Main Roads Western Australia

Quinns Quarry Access Native Vegetation Clearing Permit Supporting Documentation

April 2020

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Abbreviations

BAM Act	*Biosecurity and Agricultural Management Act 2007*
BC Act	*Biodiversity Conservation Act 2016*
BOM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
DAWE	Department of Agriculture, Water and Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DoEE	Department of the Environment and Energy [now DAWE]
DWER	Department of Water and Environmental Regulation
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
MWSSD Act	*Metropolitan Water Supply, Sewerage and Drainage Act 1909*
MS	Ministerial Statement
NVCP	Native Vegetation Clearing Permit
PEC	Priority Ecological Community
RIWI Act	*Rights in Water and Irrigation Act 1914*
TEC	Threatened Ecological Community
WoNS	Weeds of National Significance

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Appendices

1. Introduction

1.1 Proposal background

Main Roads Western Australia (Main Roads) proposes to undertake clearing of native vegetation to upgrade and realign the existing Quinn's Quarry access road located on Hester Avenue, immediately east of Mitchell Freeway, where the freeway currently terminates (Figure 1, Appendix A).

The Proposal will enable the realignment and construction of a two lane quarry access road connecting to Hester Avenue. The existing access road is required to be realigned due to the requirement for a new roundabout at Hester Avenue which has a significantly larger footprint than the existing T intersection. A native vegetation clearing permit (NVCP) (purpose) is required for the clearing of native vegetation associated with the proposed works.

1.2 Scope and purpose of this document

This document has been prepared in support of an application for a NVCP under Section 51E of Part V of the *Environmental Protection Act 1986* (EP Act), to clear up to 0.50 hectares (ha) of native vegetation within an envelope of 0.69 ha (referred to as the NVCP area).

This document includes:

- An overview of works required and description of clearing activities to be undertaken (Section 2)
- An overview of existing environment (Section 3)
- Potential impacts identified (Section 4)
- Environmental management measures to be implemented to minimise clearing impacts (Section 5)
- An assessment against the Ten Clearing Principles, as defined in Schedule 5 of the EP Act (Section 6).

The environmental assessment for this NVCP was informed by a biological survey conducted south of Hester Avenue (GHD 2019) for the upgrade of the existing Quinns Quarry access road. This biological assessment included a desktop review, with a 5 km buffer (the study area) and field survey covering 2.57 ha. The survey included a detailed vegetation and flora assessment, targeted flora survey, Level 1 fauna assessment and a Black Cockatoo habitat assessment. Relevant survey area boundaries are shown on Figure 1, Appendix A.

1.3 Location and land ownership

The NVCP area is located south of Hester Avenue, immediately east of Mitchell Freeway where the freeway currently terminates (Figure 1, Appendix A). Land ownership is a mixture of road reserve, and National Park. As Main Roads is the public authority responsible for road reserves, Main Roads partially owns the land on which the application occurs.

To facilitate the construction and operation of the Proposal, Main Roads is required to excise one parcel of land from Neerabup National Park. Main Roads is consulting and working with the Department of Biodiversity Conservation and Attractions (DBCA) Swan Coastal District to progress the excision of the required land parcels from Neerabup National Park.

2. Description of clearing activities

The following works are required to facilitate construction of the Quinns Quarry access road:

- Clearing and levelling of existing land including deconstruction of the existing access road
- Earthworks, embankments and pavement construction (including retaining walls where required)
- Site geotechnical investigations along alignment (if required)
- Installation of drainage infrastructure as required (swales, pits/pipes)
- Installation of new street lighting
- Relocation of existing services where required
- Reinstatement of fauna exclusion fencing
- Installation of pavement marking and signage
- Installation of road safety barriers as required.

Laydown areas and site offices will be located in already cleared areas.

Clearing of native vegetation will be undertaken using traditional earth moving machinery such as bulldozers. Topsoil will be striped separately and stockpiled for later reuse.

3. Existing environment

For the purposes of the desktop searches and existing environment a study area was defined, which included a 5 km buffer of the NVCP area (Figure 2, Appendix A).

3.1 Climate

The Perth Metropolitan area experiences a Mediterranean climate with cool, wet winters and warm, dry summers. Rainfall is generally received in winter (June-August), however, the area also receives periodic summer rainfall as a result of thunderstorm activity or rain-bearing depressions from tropical cyclones (Bureau of Meteorology (BoM) 2020). The closest BoM weather station with sufficient historical data is Perth weather station (site no. 009225). Average temperatures range from 7.8 °C (July) to 31.6 °C (February), with an average rainfall of 733.2 mm per annum (BoM 2020).

3.2 Land use

The NVCP area is zoned as “Primary regional roads” and “Parks and recreation” under the City of Wanneroo Town Planning Scheme No. 2 (2020).

3.3 Landform, geology and soils

The south Hester quarry access is situated on the Leederville Formation stratigraphic unit, which is comprised of interbedded sandstone and siltstone, minor conglomerate and scattered thin coal seams (Government of Western Australia (GoWA) 2020.

The Proposal covers two geological units, Guilderton and Spearwood systems, comprising of coastal sand dunes, sands and calcarenite. Soils in the NVCP area are mapped as Karrakatta yellow sand and shallow soils (GoWA 2020).

3.4 Hydrology

3.4.1 Groundwater

The NVCP area is located in the Perth Groundwater Area proclaimed under the *Rights in Water and Irrigation Act 1914* (RIWI Act) and the Perth Coastal and Gwelup Underground Water Pollution Control Area (Priority 3) proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* (MWSSD Act) (GoWA 2020).

3.4.2 Surface water

The Proposal is located within the Swan Coastal Plain Surface Water Management Area. There are no watercourses or drainage lines located within the NVCP area.

No wetlands of national or international importance (Ramsar) or geomorphic wetlands are present within the NVCP area (DAWE 2020, GoWA 2020). Five geomorphic wetlands are located within the study area (Table 3-1) (Figure 3, Appendix A).

Table 3-1 Geomorphic wetlands mapped within the study area

Name	Unique feature identifier	Category	Location relative to NVCP area
Neerabup Lake	8019	Resource Enhancement	Approximately 0.8 km from the NVCP area east boundary
Nowergup Lake	8021	Conservation	Approximately 3.5 km from NVCP area northern boundary

Name	Unique feature identifier	Category	Location relative to NVCP area
Camel Swamp	7938	Resource Enhancement	Approximately 4.7 km north east of the NVCP area boundary
Unknown	8018	Multiple Use	Approximately 2 km north east of the NVCP area boundary
Unknown	8017	Resource Enhancement	Approximately 2.5 km from NVCP area north eastern boundary

3.5 Flora and vegetation

A biological survey was conducted by GHD (2019) for the proposed upgrade of the quarry access road, which covers this proposed NVCP area. The purpose of this survey was to delineate key flora and vegetation values. The biological survey area covered 2.57 ha on the southern side of Hester Avenue. A copy of the biological survey report is provided in Appendix B.

3.5.1 Broad vegetation mapping and extents

Vegetation associations

Broad scale (1:250,000) pre-European vegetation mapping (Beard 1979) mapping indicates the NVCP area intersects two vegetation associations.

- Low woodland; Banksia (Association 949)
- Medium woodland; Tuart (Association 998).

The pre-European mapping has been adapted and digitised by Shepherd *et al.* (2002). The extent of the vegetation associations have been determined by the state-wide vegetation remaining extent calculations maintained by the DBCA (current as of March 2019 – GoWA 2019a).

As shown in Table 3-2, the current extents of all Vegetation Associations that intersect the NVCP area above 30 % of the pre-European extent at the State, IBRA bioregion, IBRA subregion and Local Government Authority (LGA) levels.

Vegetation complexes

Regional vegetation complex mapping has been completed by Heddle *at al.* (1980) with updates from Webb *et al*. (2016) based on major landform boundaries on the Swan Coastal Plain (SCP) and forested region of south-west Western Australia. The mapping indicates one vegetation complex is present within the NVCP area:

- Cottesloe Complex – Central and South: Consists of a mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *E. gomphocephala – E. marginata* (Jarrah) – *Corymbia calophylla* (Marri); closed heath on the limestone outcrops.

GoWA (2019b) has assessed the vegetation complexes mapped by Heddle *et al.* (1980) and Webb *et al*. (2016) against presumed pre-European extents within the SCP bioregion (Table 3-3) and LGA (Table 3-4). These tables show the current extent of the Cottesloe Complex within the NVCP area is above 30 % of the pre-European extents remaining within the SCP bioregion and the City of Wanneroo.

Table 3-2 Extent of vegetation associations mapped within the NVCP area (GoWA 2019a)

Pre-European Vegetation Associations	Scale	Pre–European extent (ha)	Current extent (ha)	% Remaining	% of Remaining in DBCA managed lands
949	State: WA	218,193.94	123,104.02	56.42	55.86
	IBRA bioregion: Swan Coastal Plain	209,983.26	120,287.93	57.28	56.40
	Sub-region: Perth	184,475.82	104,128.96	56.45	58.99
	LGA: City of Wanneroo	37,138.40	17,196.34	46.30	70.10
998	State: WA	51,015.33	18,492.63	36.25	48.68
	IBRA bioregion: Swan Coastal Plain	50,867.50	18,492.32	36.35	48.68
	Sub-region: Perth	50,867.50	18,492.32	36.35	48.68
	LGA: City of Wanneroo	4,635.30	2,787.40	60.13	52.75

Table 3-3 Extent of vegetation complexes on the SCP mapped within the NVCP area (GoWA 2019b)

Vegetation complex	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Remaining within DBCA managed lands (%)
Cottesloe Complex – Central and South	45,299.61	14,567.87	32.16	14.58

Table 3-4 Extent of vegetation complexes within the City of Wanneroo mapped within the NVCP area (GoWA 2019b)

Vegetation complex	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Proportion of the vegetation complex within the LGA (%)
Cottesloe Complex – Central and South	13,313.58	5,545.39	41.65	29.39

3.5.2 Vegetation types and condition

The biological survey identified one vegetation type within the NVCP area, with vegetation condition ranging from Excellent to Completely Degraded (GHD 2019). The vegetation type and condition mapped within the NVCP area is described in Table 3-5, and shown in Figure 4 and Figure 5, Appendix A. The NVCP area is predominantly located along existing transport corridors (Hester Avenue and Mitchell Freeway).

Table 3-5 Vegetation types and condition mapped within the NVCP area

Vegetation Type	Description	Area (hectares)	Condition	Area (hectares)
Banksia woodland	Low woodland of *Banksia attenuata* and *B. menziesii* with occasional *Allocasuarina fraseriana* and *Eucalyptus todtiana* over a mid to low shrubland of *Hibbertia hypericoides*, *Xanthorrhoea preissii* and *Acacia pulchella* var. *glaberrima* over open sedgeland and forbland of *Mesomelaena pseudostygia*, *Conostylis aculeata* and *Desmocladus flexuosus*.	0.50	Excellent	0.25
			Good	0.21
			Completely Degraded	0.04
Total		0.50		0.50

3.5.3 Conservation significant ecological communities

The NVCP area occurs between two known areas of Priority Ecological Community (PEC), associated with the Banksia woodlands of the Swan Coastal Plain (Figure 6, Appendix A). The flora and vegetation survey indicates that one PEC was recorded in the NVCP area. A breakdown of community type and clearing area is provided in Table 3-6 (Figure 7, Appendix A). The Banksia woodland PEC also coincides with the Banksia Woodlands of the SCP Threatened Ecological Community (TEC), listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Table 3-6 Threatened and Priority Ecological communities in the NVCP area

Community type	Status	Extent within the NVCP Area (ha)
Banksia dominated woodlands of the SCP IBRA region (PEC) (Banksia woodlands of the SCP (TEC))[1]	DBCA: P3 EPBC Act: Endangered TEC	0.50 (0.50)[1]
Total		0.50

[1] Banksia woodlands (TEC) extent is a subset of the PEC. To be representative of the Banksia Woodlands TEC, vegetation must meet key diagnostic characteristics which include minimum patch size and condition thresholds. Only vegetation in Good or better condition was considered represented of Banksia Woodlands TEC.

3.5.4 Flora diversity

The *NatureMap* database identified 291 flora taxa in the study area, representing 57 families and 164 genera previously recorded within the study area. This total comprised 238 native flora taxa and 53 naturalised (introduced) flora taxa. Dominant families recorded included Fabaceae (38 taxa), Asteraceae (22 taxa) and Proteaceae (20 taxa).

The *NatureMap* database search is provided in Appendix C.

3.5.5 Conservation significant flora

The EPBC Act Protected Matters Search Tool (PMST) and *NatureMap* databases identified the presence/potential presence of 24 conservation significant flora taxa within the study area (Appendix C), (Figure 6, Appendix A).

The biological survey identified no Threatened or Priority Flora within the NVCP area. A likelihood of occurrence assessment was conducted as part of the biological survey. This assessment took into account previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and the cryptic nature of species. The likelihood assessment concluded that no conservation significant flora are likely to occur within the survey area based on habitat requirements.

3.5.6 Weeds

The biological survey recorded 39 introduced species within the NVCP area, with three species listed as Declared Pests under the *Biosecurity and Management Act 2007.* Of these taxa, one was also identified as a Weed of National Significance (WoNS).

- *Moraea flaccida* (One-leaf Tulip) – Declared Pest
- *Echium plantagineum* (Paterson's Curse) – Declared Pest
- *Asparagus asparagoides* (Bridal Creeper) – Declared Pest and WoNS

The remaining introduced taxa are considered environmental weeds and all have been previously recorded on the Swan Coastal Plain. However, although these weeds may be likely, none have been found within the NVCP area.

3.6 Phytophthora dieback

Phytophthora cinnamomi (Dieback) is an introduced plant pathogen targeting the roots of susceptible plants, common in the south west of WA where the mean annual rainfall exceeds 400 mm (Department of the Environment 2014). It is considered that Dieback may pose a risk to the native vegetation within the NVCP area, which experiences a mean annual rainfall of 733.2 millimetres (mm). Dieback is likely to be present in the NVCP area and will be managed accordingly (see Section 4.2).

3.7 Fauna

A fauna assessment was conducted by GHD (2019) for the proposed upgrade of the quarry access road, which covers this proposed NVCP area. The purpose of this survey was to delineate key fauna habitats and black cockatoo breeding, foraging and roosting habitat. The biological survey area covered 2.57 ha on the southern side of Hester Avenue.

3.7.1 Fauna diversity

The *NatureMap* database identified 248 terrestrial fauna species previously recorded within the study area. This total comprised 142 birds, 52 reptiles, 22 mammals, 5 amphibians and 27 invertebrates. Of the 248 fauna species previously recorded, 238 are native species and 10 are

naturalised (introduced) species. The *NatureMap* fauna database search is provided in Appendix C.

3.7.2 Fauna habitat

The biological field assessment identified one fauna habitat type: *Banksia* Woodland on grey/brown sand. This habitat type consists of a dominant overstorey of Banksia (*Banksia attenuata, B. menziesii, B. sessilis),* Jarrah and Sheoak. The vegetation was generally in excellent condition and contains good structural diversity and a variety of micro-habitat types including leaf litter, fallen logs and branches, deep sandy soil and hollows. The vegetation appeared to be long unburnt. Fauna habitat mapping is shown in Figure 8, Appendix A.

3.7.3 Conservation significant fauna

The EPBC Act PMST and DBCA *NatureMap* database and GHD observations identified the presence/potential presence of 35 conservation significant fauna taxa within the study area (Appendix C). This total does not include species identified by the PMST as marine and/or migratory marine. These species have been excluded from this assessment as no marine habitat was present within or immediately adjacent to the survey area.

The biological assessment recorded two conservation significant fauna species within the NVCP area, Carnaby's Cockatoo (*Calyptorhynchus latirostris)* and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*). An additional five species were considered likely to occur
(Table 3-7). Vegetation in the NVCP area provides suitable habitat for all seven species.

3.7.4 Black cockatoos

Two conservation significant species were recorded utilising this habitat during the survey, these being the Forest Red-tailed Black Cockatoo and Carnaby's Cockatoo. The NVCP area contains suitable foraging habitat for both these species. Potential black cockatoo breeding trees with a Diameter at Breast Height (DBH) over 500 mm (as per the Black Cockatoo guidelines (DSEWPaC 2012)) were recorded by GHD (2019) within the survey area. However, no breeding, potential breeding or roosting habitat was recorded in the NVCP area (Appendix B).

Table 3-7 Fauna species potentially within NVCP area

Species	Status	Likelihood of occurrence and estimated extent of habitat within the NVCP area (ha)
Carnaby's Cockatoo (*Calyptorhynchus latirostris*)	Endangered under the EPBC Act and BC Act	Present Carnaby's Cockatoo occurs in uncleared or remnant native eucalypt woodlands, especially those that contain Salmon gum, Wandoo, Marri, Jarrah and Karri, and in shrubland or kwongan heathland dominated by Hakea, Banksia and Grevillea species. Breeding activity is restricted to eucalypt woodlands mainly in the semiarid and subhumid interior. The species has expanded its breeding range westward and south into the Jarrah- Marri forests of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain, including the Yanchep area. All native vegetation in the NVCP area (0.5 ha) would provide foraging habitat for this species. No breeding or roosting habitat was present in the NVCP area.
Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*)	Vulnerable under the EPBC Act and BC Act	Present The Forest Red-tailed Black Cockatoo inhabits the dense Jarrah, Karri, and Marri forests receiving more than 600 mm annual average rainfall but also occurs in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt (*E. staeri*), Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (DSEWPAC 2012). Habitats tend to have an understorey of Balga (*Xanthorrhoea* spp.), Kingia (*Kingia australis*), Snottygobble (*Persoonia* spp.), Parrot bush (*Banksia sessilis*), Holly-leaved mirbelia (*Mirbelia dilatata*), Bull banksia (*B. grandis*), Bullich (*Taxandria* spp.) and Sheoak (*Allocasuarina fraseriana*). They are most common in the Jarrah forest region of the northern Darling Range from Collie north to Mundaring and are very local throughout the lower south-west. They can be found on the SCP in search of food. All native vegetation in the NVCP area (0.5 ha) would provide foraging habitat for this species. No breeding or roosting habitat was present in the NVCP area.
Peregrine Falcon (*Falco peregrinus*)	Other specially protected fauna under the BC Act	The Peregrine Falcon is found on and near cliffs, gorges, timbered watercourses, riverine environments, wetlands, plains, open woodlands, and pylons and spires of buildings, though less frequently in desert regions (Morcombe 2004). They are not common but can be found almost anywhere throughout WA and in the southwest, including particularly at Fitzgerald River, Stirling Range, Porongurup National Parks, Kondinin, and Peak Charles, with many more locations north of Perth (Nevill 2013). All native vegetation in the NVCP area (0.5 ha) is suitable for this species.

Species	Status	Likelihood of occurrence and estimated extent of habitat within the NVCP area (ha)
Southern Brown Bandicoot (*Isoodon fusciventer*)	Priority 4	The Southern Brown Bandicoot prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. On the Swan Coastal Plain, Quenda are often associated with wetlands. The species often feeds in adjacent Jarrah and Wandoo forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Van Dyck and Strahan 2008). All native vegetation in the NVCP area (0.5 ha) is suitable habitat for this species.
Western Brush Wallaby (*Notamacropus Irma*)	Priority 4	The Western Brush Wallaby is found primarily in open forest or woodland, particularly favouring open, seasonally-wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in Karri forest (Van Dyck and Strahan 2008). All native vegetation in the NVCP area (0.5 ha) is suitable habitat for this species.
Black- striped Snake (*Neelaps calonotos*)	Priority 3 (DBCA)	The Black-striped Snake is a burrowing snake that is restricted to the southwest coastal regions of WA, on sand plains along the Swan Coastal Plain, from Dongara south to Mandurah (Wilson and Swan 2017). The habitat preferences of the Black-Striped Snake are not well known, however they are believed to prefer Banksia woodlands, and do not persist in small remnants of native vegetation (How and Shrine 1999). There is 0.5 ha of suitable habitat in the NVCP area for this species, this habitat includes the Banksia woodlands.
Jewelled southwest Ctenotus (Swan Coastal Plain population) (*Ctenotus gemmula)*	Priority 3 (DBCA)	Apparently disjunct populations occur on the lower west coastal plain, and south coast and adjacent interior of Western Australia. Known to occur on pale sands supporting heaths in association with banksia or mallee woodlands (Wilson and Swan 2017). There is 0.5 ha of suitable habitat in the NVCP area for this species, this habitat includes the Banksia woodland.

3.8 Conservation areas

Twenty conservation reserves are located within the study area. The NVCP area intersects the Neerabup National Park (Class A, R 27575). A total of 0.50 ha of native vegetation clearing will be required in the National Park.

There are 11 Bush Forever Sites located within the study area (GoWA 2000). Of these, Site No. 383 (Neerabup National Park, Lake Nowergup Nature Reserve and adjacent bushland) intersects the NVCP area (Figure 9, Appendix A). A total of 0.50 ha of native vegetation clearing will be required in Bush Forever Site No. 383.

3.9 Regional ecological linkages

One Regional Ecological Linkage intersects the NVCP area. Greenways linkage I.D number 6 and is part of a regionally significant contiguous bushland/wetland linkage (GoWA 2000). Greenways linkage I.D number 6 links Neerabup National Park (Bush Forever Site No. 383) to Lake Joondalup (Bush Forever Site No. 299) in the south and Yanchep and Neerabup National Parks (Bush Forever Site No. 130) in the north. The Proposal will not break or dissect this ecological linkage, clearing 0.15 ha within the linkage border (based on GIS boundary data) (WALGA 2008).

3.10 Environmentally Sensitive Areas

All of the NVCP area occurs within an Environmentally Sensitive Area (ESA), which is likely associated with the Neerabup National Park. A total of 0.50 ha of clearing is required within the ESA.

4. Potential impacts

4.1 Impact avoidance through design

The Proposal design has commenced and impacts will be minimised and avoided where possible to prevent the clearing of native vegetation. Although the design has not been finalised, significant effort has been taken to avoid impacts on the environment. The following avoidance and minimisation measures have been considered:

- The access road has been located as close as possible to existing access road to minimise footprint and impacts to adjacent vegetation.
- Where possible, works will be undertaken within previously cleared land.
- Design retains access in its current location to reduce impacts.
- Fully sealed road to eliminate potential impact of dust particles on adjacent vegetation (associated with unsealed roads).
- Implementation of typical surface water control measures along the access road including swales to prevent impacts to adjacent vegetation from surface water runoff and control 1 in 50 flooding events.
- Early consultation with utility service providers ensuring design is optimised to minimise relocation of existing services (and associated ground disturbance and clearing).
- Early consultation with the DBCA to ensure design acceptance and determine concerns in relation to minimising impacts to native vegetation and the National Park.
- Proposal design has reduced the cross section width of the access road to the minimum permissible to ensure safe and efficient movement.
- Ensuring the access road alignment uses as much of the existing road pavement as possible and ties into the existing pavement as soon as possible.
- Roundabout size is the minimum permissible to accommodate the design vehicles.
- Vertical design of the road closely matches existing topography where possible to minimise earthworks.
- Impacts could be further minimised by installation of retaining walls to reduce the earthworks batters, this will be considered during detailed design.

4.2 Potential impacts to vegetation and flora

The Proposal will involve the clearing of 0.50 ha of native vegetation, which corresponds to 0.50 ha of Banksia PEC, which also coincides with the Banksia Woodlands of the SCP TEC. The vegetation condition ranges from Completely Degraded to Excellent with the majority (0.46 ha) in Good – Excellent condition.

The Proposal is in a phytophthora dieback susceptible bioregion, with conservation significant protectable vegetation adjacent to the NVCP area. A Dieback Management Plan and project specific Construction Environmental Management Plan (CEMP) will be developed for the Proposal.

The Proposal may also result in a range of indirect impacts on adjacent vegetation including smothering from dust and the introduction and spread of weeds. These will be managed as part of the CEMP. No significant weed presence was identified in the NVCP area.

4.3 Potential impacts to conservation areas

The NVCP area is located within Neerabup National Park (Class A, R 27575). The proposed clearing will result in the removal of 0.50 ha of native vegetation from within Neerabup National Park and Bush Forever Site No. 383 (Neerabup National Park, Lake Nowergup Nature Reserve and adjacent bushland).

The Proposal may also result in indirect impacts on adjacent conservation areas including dust and the introduction and spread of weeds. These will be managed as part of the CEMP and will be subject to a targeted weed spray program, as detailed in Section 5.

4.4 Potential impacts to fauna and fauna habitat

The NVCP area contains habitat suitable for seven conservation significant fauna species:

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – Endangered under the EPBC Act and BC Act
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable under the EPBC Act and BC Act
- Peregrine Falcon (*Falco peregrinus*) – Other specially protected fauna under the BC Act
- Southern Brown Bandicoot (*Isoodon fusciventer)* – Priority 4
- Western Brush Wallaby (*Notamacropus Irma)* – Priority 4
- Black-striped Snake (*Neelaps calonotos*) – Priority 3
- Jewelled South West Ctenotus (*Ctenotus gemmula)* (Swan Coastal Plain population) – Priority 3.

Clearing of vegetation that provides suitable habitat for conservation significant species will occur. The entirety of the NVCP area provides habitat for black cockatoo species. A total of 0.50 ha of foraging habitat for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo will be cleared. No breeding or roosting habitat was identified.

All native vegetation in the NVCP area (0.50 ha) is suitable for Peregrine Falcon, Southern Brown Bandicoot, Western Brush Wallaby, Black-striped Snake and *Ctenotus gemmula* (Swan Coastal Plain population).

One Regional Ecological Linkage intersects the NVCP area (greenways linkage I.D number 6). Greenways linkage I.D number 6 links Neerabup National Park (Bush Forever Site No. 383) to Lake Joondalup (Bush Forever Site No. 299) in the south and Yanchep and Neerabup National Parks (Bush Forever Site No. 130) in the north. The Proposal will not break this ecological linkage, clearing 0.15 ha within the linkage border (based on GIS boundary data) (WALGA 2008).

The NVCP area is located adjacent to an existing road, therefore the impacts are expected to be less significant than bisecting contiguous vegetation.

Indirect impacts to fauna include injury and death through vehicle strikes and during construction, as well as secondary impacts such as dust, noise and vibration. All potential impacts will be managed under the project CEMP (See Section 5).

4.5 Land degradation, water quality and flooding

The NVCP area is located in the Perth Groundwater Area proclaimed under the RIWI Act and the Perth Coastal and Gwelup Underground Water Pollution Control Area (Priority 3 Protection Zone) proclaimed under the MWSSD Act (GoWA 2020).

Priority 3 areas are declared over land where water supply sources need to coexist with other land uses such as residential, commercial and light industrial developments. Given the scale and nature of the clearing, the construction of the road extension is unlikely to impact groundwater quality.

According to GoWA (2020) land degradation mapping, the NVCP area is mapped within an area having low risk of water erosion, flooding and salinity, and high risk of wind erosion and subsurface acidification. The Proposal is unlikely to cause subsurface acidification.

No records were returned for Acid Sulfate Soils (ASS) when searching state government databases (GoWA 2020). The Australian Soil Resources Information System (ASRIS) identified the Proposal as having extremely low risk of ASS.

5. Environmental management framework

A CEMP is currently being prepared for the Proposal. The CEMP includes:

- Vegetation clearing management:
  - Vegetation to be retained will be clearly marked with flagging on site
  - Additional areas required for construction such as laydown areas, stockpile areas and vehicle turn around, will be located in areas cleared for permanent works
- Fauna management:
  - Pre-clearance surveys will be undertaken for all areas of black cockatoo habitat proposed to be cleared within the breeding period of black cockatoos
  - Speed limits between 40-80 km p/hr will be applied throughout the construction site which will consequently reduce the risk of fauna strikes during construction.
  - Transfer of any injured fauna found on site to an appropriate fauna rescue organisation or individual. A list of local fauna rescue organisations and individuals will be maintained on site.
- Other management measures:
  - Water carts and/or surface stabilization measures (e.g. hydro mulch) will be used to minimise dust generated from cleared areas
  - Topsoil will be harvested, stockpiled and reused in accordance with Main Roads Environmental Guideline Topsoil Management.
  - Temporary drainage will be installed to capture and infiltrate surface runoff from construction areas and prevent runoff from entering adjacent native vegetation.
  - All heavy plant and machinery will be inspected at entry and exit of the work site and be confirmed to be clean and free of vegetation and soil material.
  - The Proposal is in a phytophthora dieback susceptible bioregion, with conservation significant protectable vegetation adjacent to the NVCP area. A Dieback Management Plan will be developed for the Proposal and will be utilised during the clearing of the NVCP area.
  - Weed control will be undertaken during works as part of the CEMP, specifically targeting WoNS and Declared Pests. The NVCP area will also be subject to the yearly Main Roads weed spraying program.

6. Assessment against the 10 Clearing Principles

Schedule 5 of the EP Act defines Ten Clearing Principles for native vegetation. These principles aim to ensure that all potential impacts resulting from removal of native vegetation can be assessed in an integrated way. Clearing required for construction of the Proposal has been assessed against the Ten Clearing Principles, in accordance with the DWER's *A Guide to the Assessment of Applications to Clear Native Vegetation (Department of Environment Regulation 2014*) to determine whether the application is at variance.

The assessment indicates that the Proposal is at variance with principles b and h, and likely to be at variance to principle a. An offset will be required to compensate for the residual impacts associated with the proposed clearing (see Section 7).

Table 6-1 Assessment against the Ten Clearing Principles

Principle		Assessment	Outcome
A	Native vegetation should not be cleared if it comprises a high level of biological diversity.	All native vegetation in the NVCP area is mapped as Banksia woodland. The NVCP area has a high level of biodiversity, commensurate with the surrounding region. The native vegetation was mainly in Good-Excellent condition (92.5%), and represents high biodiversity vegetation. A relatively small section is Completely Degraded (7.5%) in condition. This reflects the context of the site, between an existing road and conservation areas. One Regional Ecological Linkage intersects the NVCP area, and provides for movement of fauna through the landscape. The NVCP area intersects Regional Ecological Linkage ID 6, which links Neerabup National Park (Bush Forever Site No. 383) to Lake Joondalup (Bush Forever Site No. 299) in the south and Yanchep and Neerabup National Parks (Bush Forever Site No. 130) in the north. The NVCP area is located on an existing road, therefore the impacts are expected to be less significant than bisecting contiguous vegetation. The Proposal will not break this ecological linkage, clearing 0.15 ha within the linkage border. No State or Commonwealth Threatened or Priority flora species were recorded in the GHD (2019) biological surveys. One Bush Forever site occurs within the NVCP area, Bush Forever Site No. 383 Neerabup National Park, Lake Nowergup Nature Reserve and adjacent bushland. Up to 0.50 ha of Bush Forever Site No. 383 is within the NVCP area. The NVCP area is representative of Banksia woodlands of the Swan Coastal Plain PEC. This includes 0.50 ha of the EPBC Act listed Banksia woodlands of the Swan Coastal Plain TEC. One fauna habitat was recorded in the NVCP area, *Banksia* Woodland on grey/brown sand. The vegetation was generally in excellent condition and contains good structural diversity and a variety of micro-habitat types. The biological assessment recorded two conservation significant fauna species within the NVCP area, Carnaby's Cockatoo and Forest Re-tailed Black Cockatoo. An additional five species were considered likely to occur in the NVCP area. The Proposal will involve clearing of native vegetation in an area of high biological diversity. The Proposal is likely to be at variance to this principle.	Likely to be at variance to this principle

Principle		Assessment	Outcome
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 NVCP area contains habitat suitable for seven conservation significant fauna species including: • Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – Endangered under the EPBC Act and BC Act • Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable under the EPBC Act and BC Act • Peregrine Falcon (*Falco peregrinus*) – Other specially protected fauna under the BC Act • Southern Brown Bandicoot (*Isoodon fusciventer*) – Priority 4 • Western Brush Wallaby (*Notamacropus Irma*) – Priority 4 • Black-striped Snake (*Neelaps calonotos*) – Priority 3 • *Ctenotus gemmula* (Swan Coastal Plain population) – Priority 3. The NVCP area contains suitable foraging habitat for both Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo. A total of 0.50 ha of foraging habitat for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo will be cleared. No breeding, potential breeding or roosting habitat was recorded in the NVCP area. The NVCP area represents approximately 0.01% of available black cockatoo foraging habitat remaining within 5 km of the Proposal (approximately 4,800 ha), of which 35% (1,673 ha) is located in DBCA managed lands (GoWA 2020). It has been assumed that all native vegetation is potentially black cockatoo habitat. The Proposal lies within the modelled distribution of Carnaby's Cockatoo. Forest Red-tailed Black Cockatoo are also known to occur in the area in search of food. There are extensive, well reserved areas in the vicinity of the project that are expected to provide suitable foraging, roosting and potential breeding resources for black cockatoos. Clearing of the NVCP area will also result in the loss of: • 0.50 ha of habitat for the Peregrine Falcon • 0.50 ha of habitat for the Southern Brown Bandicoot • 0.50 ha of habitat for the Western Brush Wallaby • 0.50 ha of habitat for the Black-striped Snake • 0.50 ha of habitat for *Ctenotus gemmula* (Swan Coastal Plain population). Given the clearing of habitat for conservation significant fauna, the Proposal is considered to be at variance to this principle.	At variance to this principle

Principle		Assessment	Outcome
C	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	No EPBC Act or BC Act listed flora were recorded within the NVCP area or considered likely to occur based on habitat preferences. The Proposal is considered not at variance to this principle.	Not at variance to this 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.	No State listed TECs were recorded in the NVCP area nor will be cleared for the Proposal. The Proposal is not at variance to this principle.	Not at variance to this 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.	Broad scale (1:250,000) pre-European vegetation mapping (Beard 1979) mapping indicates the NVCP area intersects one vegetation association, Low woodland; Banksia (Association 949). The current extent of this vegetation association is above 30 % of the pre-European extent at the State, IBRA bioregion, IBRA subregion and Local Government Authority (LGA) levels. Regional vegetation complex mapping has been completed by Heddle *at al.* (1980) with updates from Webb *et al*. (2016) based on major landform boundaries within the IBRA subregion SCP and forested region of south-west Western Australia. The mapping indicates one vegetation complex is present within the NVCP area, Cottesloe Complex – Central and South. The current extent of this vegetation complex is above 30 % of the pre-European extent remaining within the SCP IBRA bioregion and the City of Wanneroo. The Proposal is not at variance to this principle.	Not at variance to this principle
F	Native vegetation should not be cleared if it is growing in, or in association with, an environment	There are no wetlands, watercourses or drainage lines located within the NVCP area. The nearest waterbody is Neerabup Lake, approximately 0.8 km from the NVCP area. One vegetation type was recorded from the NVCP area. This vegetation type doesn't grow in, or in associated with watercourses or wetlands. The Proposal is not at variance to this principle.	Not at variance to this principle.

Principle		Assessment	Outcome
	associated with a watercourse or wetland.		
G	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	According to the GoWA (2020) mapping, the NVCP area is mapped within an area having low risk of water erosion, flooding and salinity, and high risk of wind erosion and subsurface acidification. A review of ASRIS identified the Proposal as having extremely low risk of ASS. Given the small clearing area, the Proposal is unlikely to cause appreciable subsurface acidification. Clearing will be limited to the area required for construction and therefore surfaces will be sealed road or road infrastructure. Large unsealed areas prone to wind erosion will not be cleared, and therefore the impacts of wind erosion are considered insignificant. The Proposal is not likely to be at variance to this principle.	Not likely to be at variance to this 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 NVCP area is within Class A reserve, Neerabup National Park. Up to 0.50 ha of vegetation in the Neerabup National Park will be cleared. The Proposal is at variance to this principle.	At variance to this 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.	There are no wetlands, watercourses or drainage lines located within the NVCP area. The nearest waterbody is Neerabup Lake, approximately 0.8 km from the NVCP area. Surface water runoff will be managed as part of design including culverts and drainage as required. Further, the Proposal is located in an area that is not high risk of flooding and water erosion, therefore offsite impacts are considered insignificant. The NVCP area is located within the Perth Groundwater Area and the Perth Coastal and Gwelup Underground Pollution Control Area public drinking water source area (Priority 3 Protection Zone). Priority 3 areas are declared over land where water supply sources need to coexist with other land uses such as residential, commercial and light industrial developments. The construction of the road extension is unlikely to impact groundwater quality.	Not at variance to this principle.

Principle		Assessment	Outcome
		The Proposal is not at variance to this principle.	
J	Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	According to the GoWA (2020) mapping, the NVCP area is mapped within an area having low risk of water erosion and flooding. Surface water management measures will be implemented as part of design, including culverts and swales as needed. The Proposal is not at variance to this principle.	Not at variance to this principle.

7. Offsets

The principle offset for the Proposal relates to residual impacts to black cockatoo habitat. A total offset of 2.5 ha will be required for this Proposal, taking the largest result from the offset calculations (black cockatoo). It is assumed that land purchased for offset purposes will include suitable land for the other environmental factors impacted.

The financial contribution was calculated using the EPBC Offset Calculator Tool, which identified a necessary offset area 2.5 ha in size. This was then multiplied by the market valuation of unimproved (vegetated) land in the Shire of Gingin ($16,910/hectare for 10 ha price), resulting in a sum of $42,275.

The offset strategy proposed will provide adequate and commensurate offsetting of the impacted environmental values. A conservative approach has been adopted in calculating the offset requirements by using the total amount of clearing required, rather than the residual impact following landscaping and revegetation activities. This is likely to provide a slight net gain in the overall conservation outcome for environmental values being offset.

The Offset Strategy is attached as Appendix D.

8. References

Bureau of Meteorology (BOM), 2020 *Climate Data Online*, retrieved July 2019, from http://www.bom.gov.au/climate/data/.

Beard, JS 1979, *Vegetation Survey of Western Australia: the Vegetation of the Perth Area Western Australia*, map and explanatory memoir 1:250,000 series, Applecross, Vegmap Publications.

City of Wanneroo, *Town Planning Scheme No. 2 Map.* Retrieved 12/02/2020 from http://www.wanneroo.wa.gov.au/downloads/file/1977/district_planning_scheme_no_2_map

Department of the Environment and Energy (DoEE) 2018, Threat abatement plan for disease in natural ecosystems caused by *Phythophthora cinnamomii*. Government of Australia, Canberra.

Department of Agriculture, Water and the Environment, (DAWE) 2020, *Environmental Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool Results*, retrieved February 2020, from http://www.environment.gov.au/epbc/pmst/index.html.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012, EPBC Act *Referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo, Baudin's cockatoo and Forest red-tailed black cockatoo,* https://www.environment.gov.au/biodiversity/threatened/publications/epbc-act-referral-guidelines-three-threatened-black-cockatoo-species-carnabys-cockatoo accessed 12/02/2020

GHD Pty Ltd (GHD) 2019, Hester Avenue – Quarry Access Road, Biological Survey, unpublished report prepared for Main Roads Western Australia.

Government of Western Australia (GoWA) 2000, Bush Forever – Keeping the Bush in the City. Volumes 1 (Policies, Principals and Processes) & 2 (Directory of Bush Forever Sites), Perth, Government of Western Australia.

Government of Western Australia (GoWA) 2019a, *2018*, *Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full report),* Current as of March 2019, Department of Biodiversity, Conservation and Attractions, retrieved July 2019, from https://data.wa.gov.au/.

Government of Western Australia (GoWA) 2019b, *2018 South West Vegetation Complex Statistics,* Current as of March 2019, Department of Biodiversity, Conservation and Attractions, retrieved July 2019, from https://data.wa.gov.au/.

Government of Western Australia (GoWA) 2020, *Data WA*, retrieved February 2020, from https://data.wa.gov.au/.

Heddle, EM, Loneragan, OW and Havel JJ 1980, *Vegetation Complexes of the Darling System, Western Australia*, in Atlas of Natural Resources, Darling System Western Australia, Department of Conservation and Environment.

How and Shine, 1999, *Ecological traits and conservation biology of five fossorial 'sand-swimming' snake species (Simoselaps: Elapidae) in south-western Australia*. Cambridge University Press

Land Information Authority, WA (Landgate). (2016). Landgate Land Valuations of Unimproved Land, 2016-2017 – *Confidential. Unpublished report prepared for Main Road's WA. Perth, WA.

Morcombe, M 2004, *Field Guide to Australian Birds*, Queensland, Australia, Steve Parish Publishing Archer Field.

Shepherd, DP, Beeston, GR, and Hopkins, AJM 2002, *Native Vegetation in Western Australia – Extent, Type and Status*, Resource Management Technical Report 249, Perth, Department of Agriculture, Western Australia.

Van Dyke, S & Strahan, R 2008, *The Mammals of Australia*. Third Edition. New Holland Publishing, Sydney, Australia.

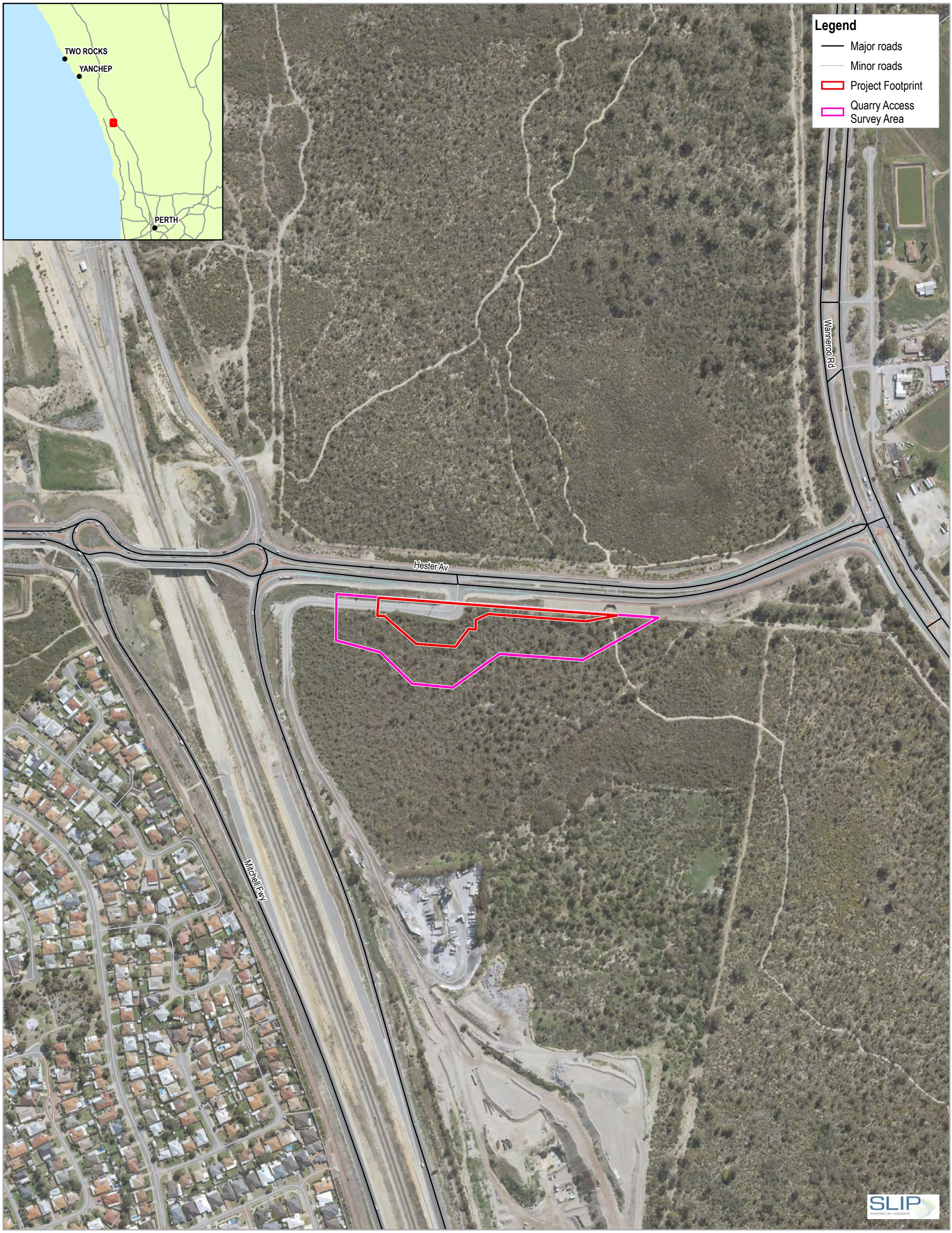
WALGA 2008, Perth Biodiversity Project, data provided by WALGA under a licence agreement, June 2008

Webb A, Kinloch J, Keighery G & Pitt G, 2016, *The extension of vegetation complex mapping to landform boundaries within the Swan Coastal Plain landform and forested region of south-west Western Australia.*

Wilson S and Swan G 2017, *A Complete Guide to Reptiles of Australia.* 4th Edition New Holland Press Sydney Australia.

Appendices

Appendix A – Figures



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Meters

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GHD

Main Roads WA
Quinns Quarry Access

NVCP and survey area boundaries

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Revision No. **0**
Date **26 Feb 2020**

FIGURE 1

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Paper Size ISO A3

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Kilometres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

Main Roads WA
Quinns Quarry Access

5 km Study Area

Project No. **12522027**
Revision No. **0**
Date **26 Feb 2020**

FIGURE 2

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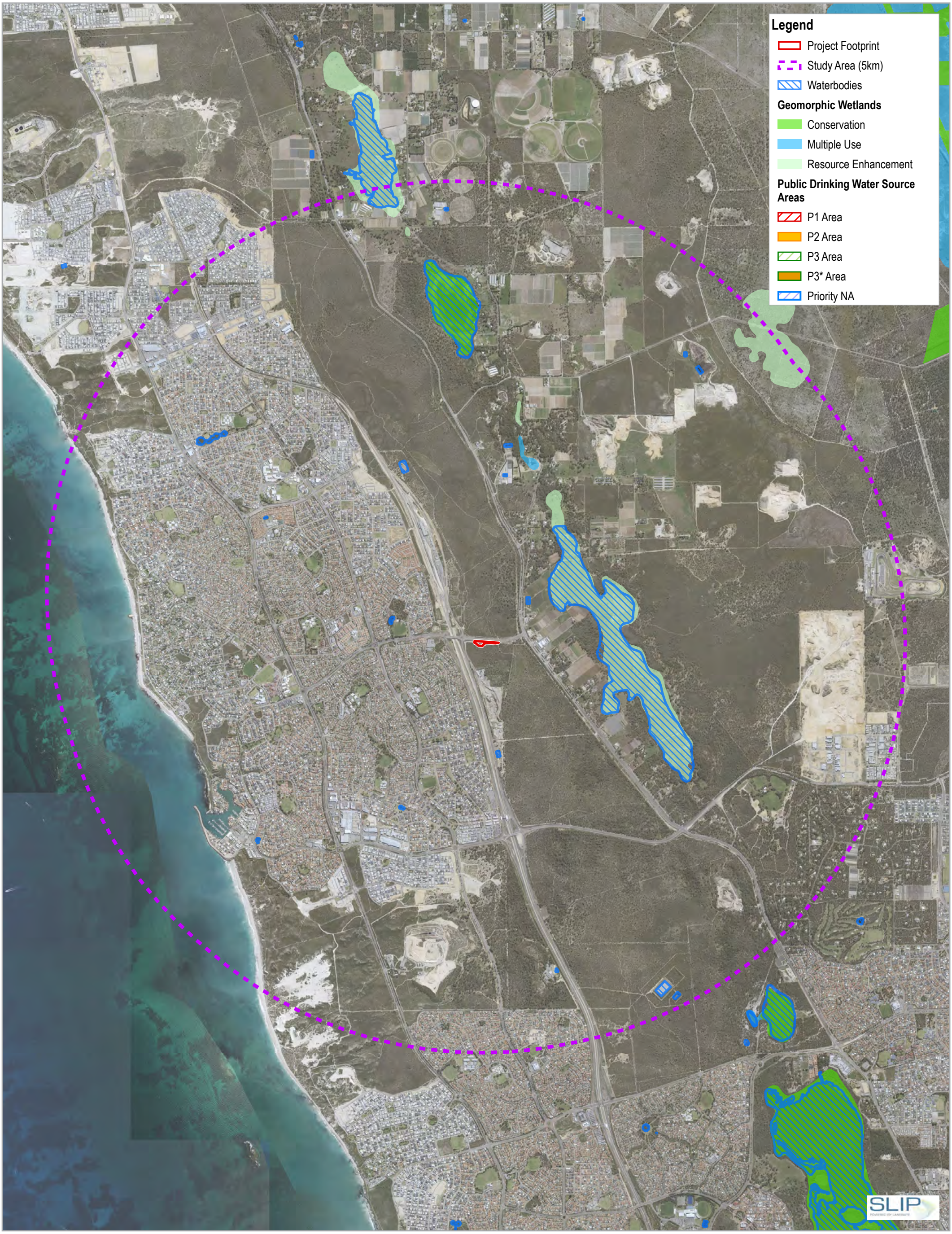

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Kilometres

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 50

GHD

Main Roads WA
Quinns Quarry Access

Hydrology constraints

Project No. **12522027**
Revision No. **0**
Date **26 Feb 2020**

FIGURE 3

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Created by: bmorgan

Paper Size ISO A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Main Roads WA
Quinns Quarry Access

Vegetation types

Project No. **12522027**
Revision No. **A**
Date **26 Feb 2020**

FIGURE 4

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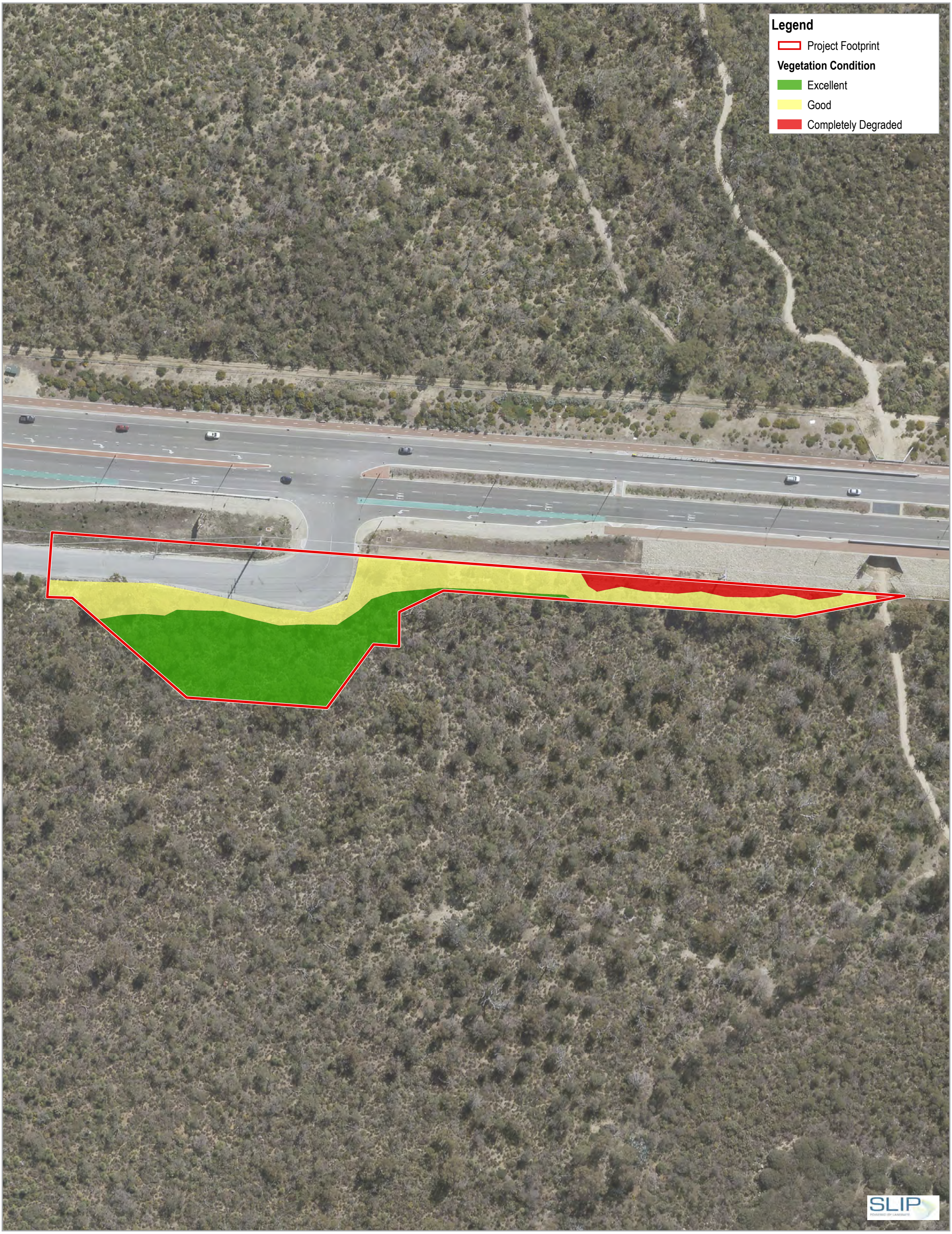

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Metres

Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 50

N

Main Roads WA
Quinns Quarry Access

Vegetation condition

Project No. **12522027**
Revision No. **0**
Date **26 Feb 2020**

FIGURE 5

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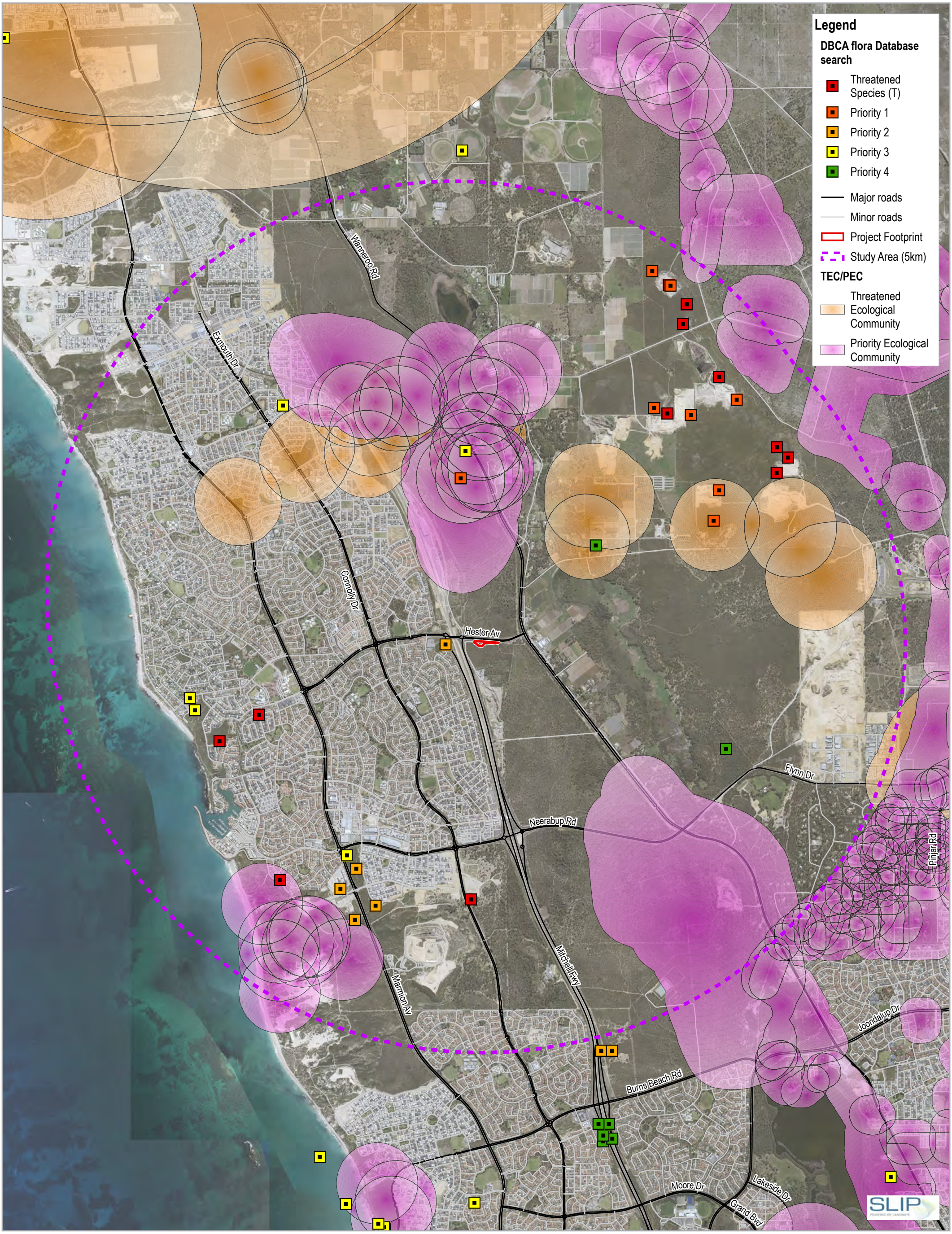

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Kilometres

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Main Roads WA
Quinns Quarry Access

Biological constraints

Project No. **12522027**
Revision No. **0**
Date **26 Feb 2020**

FIGURE 6

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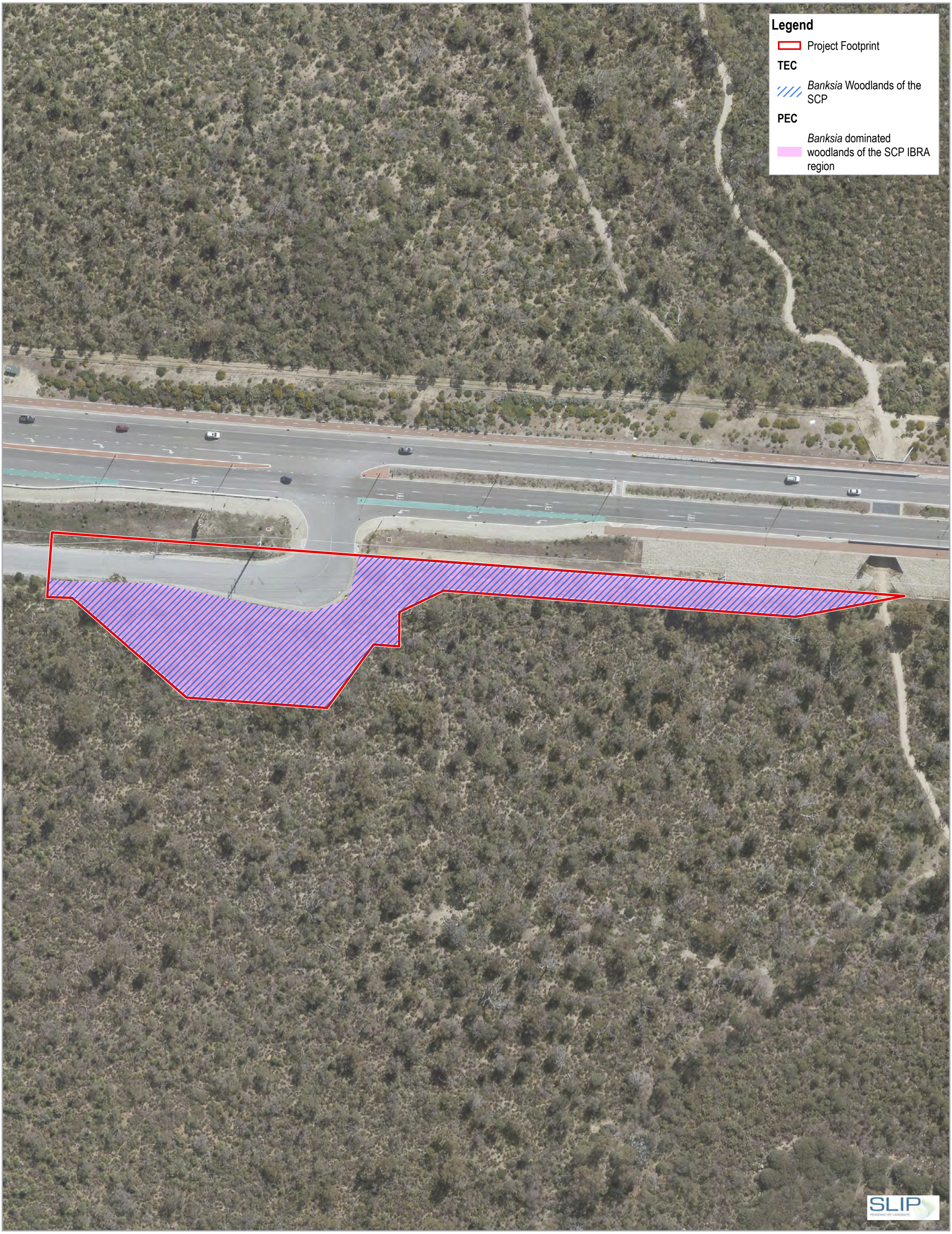

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Metres

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Grid: GDA 1994 MGA Zone 50

N

GHD

Main Roads WA
Quinns Quarry Access

Conservation significant vegetation

Project No. **12522027**
Revision No. **0**
Date **26 Feb 2020**

FIGURE 7

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Metres

Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 50

N

GHD

Main Roads WA
Quinns Quarry Access

Fauna habitats

Project No. **12522027**
Revision No. **0**
Date **26 Feb 2020**

FIGURE 8

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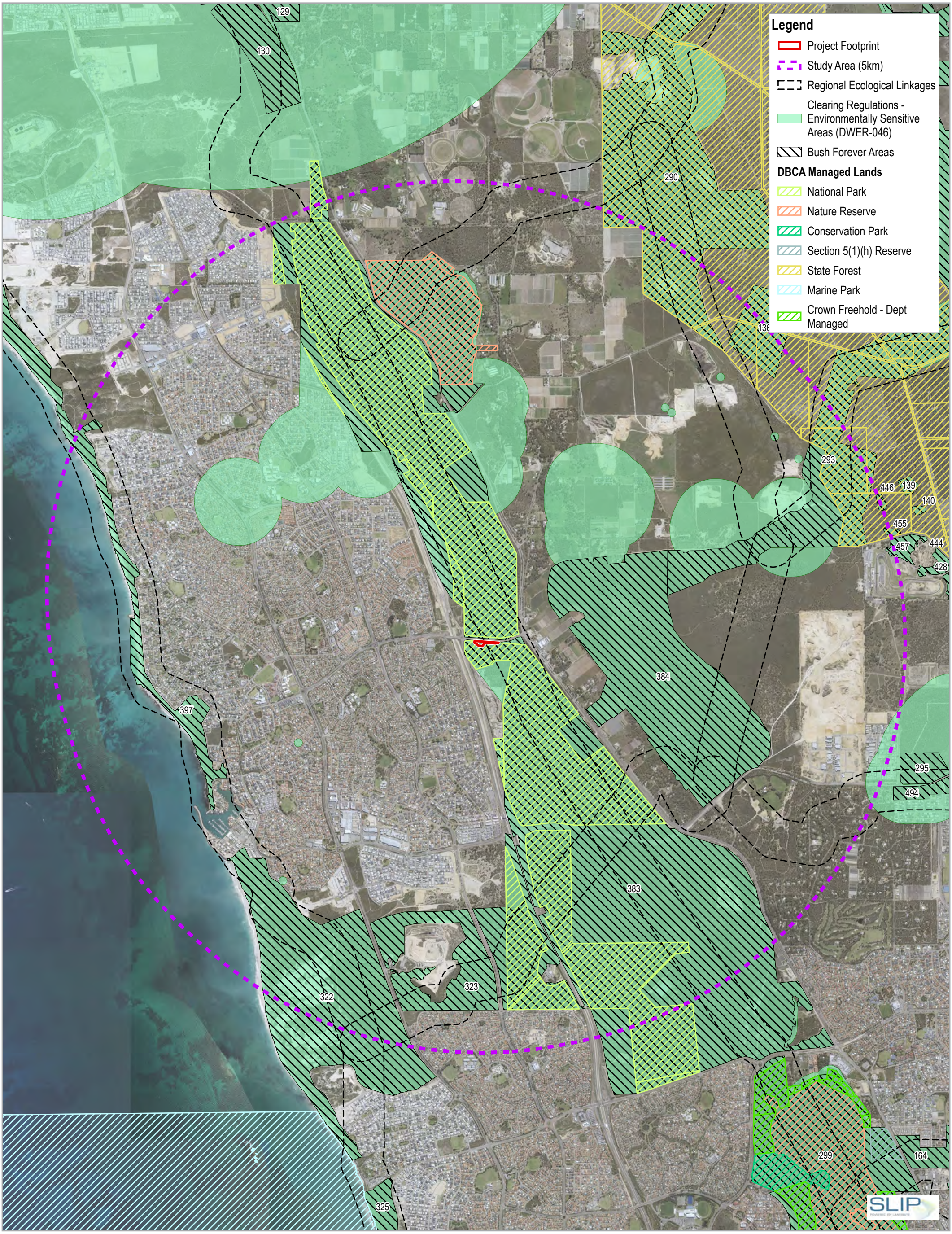

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Kilometres

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GHD

Main Roads WA
Quinns Quarry Access

Land use constraints

Project No. **12522027**
Revision No. **0**
Date **26 Feb 2020**

FIGURE 9

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Data source: GHD: Survey Area - 20200122; DBCA: Managed Lands; WALGA: Regional Ecological Linkages - 20200122; DPLH - Bush Forever Areas - 20200122; DWER: Environmentally Sensitive Areas - 20200122; Landgate: Imagery - August 2019. Created by: bmorgan

Appendix B – Survey Report

Hester Avenue - Quarry Access Biological Survey (GHD 2019)

Main Roads Western Australia

Hester Avenue - Quarry Access Road

Biological Survey

December 2019

Executive summary

Main Roads Western Australia (Main Roads) proposes to extend Mitchell Freeway north from Hester Avenue to Romeo Road, including an upgrade to Wanneroo Road from Dunstan Road to Trian Road (the Proposal). The project is located within the City of Wanneroo approximately 30 kilometres (km) north of Perth central business district and 12 km south of the coastal suburb of Yanchep.

GHD Pty Ltd (GHD) was commissioned in 2018 to undertake a biological assessment of the project including a targeted Black Cockatoo habitat assessment. In 2019, an additional area south of Hester Avenue was identified for the Proposal to allow upgrade to the existing quarry access south of Hester Avenue.

GHD was commissioned by Main Roads to undertake a biological assessment, including a targeted Black Cockatoo habitat assessment of the additional area south of Hester Avenue for the upgrade to the existing quarry access road. The purpose of the survey is to delineate key flora, vegetation and fauna values and potential sensitivity to impact to Black Cockatoo foraging and breeding habitat.

The outcome of the survey and information supplied in the biological survey and targeted fauna assessment will be used to inform corporate and statutory environmental assessment and approvals process. The results of the biological survey may also assist in the preparation of a Clearing Impact Assessment and Vegetation Management Plan.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.6 and the assumptions and qualifications contained throughout this report.

Key findings for survey area

Vegetation

One vegetation types was identified and described for the survey area, not including cleared and/or highly disturbed areas. Remnant vegetation remaining within the survey area is dominated by *Banksia* woodland with scattered *Eucalyptus marginata* (Jarrah) and *Allocasuarina fraseriana* (Sheoak) on deep sandy soils.

The condition of the intact vegetation within the survey area ranged from Excellent to Good. The vegetation immediately adjacent to the tracks and cleared areas is rated as Completely Degraded due to edge effects and weed invasion. The condition of the remnant vegetation improved the further the distance from cleared and disturbed areas, with the majority of the survey area assigned to Excellent condition.

Two conservation significant ecological communities were identified within the survey area. The conservation significant ecological communities are:

- *Banksia* Woodlands of the Swan Coastal Plain Threatened Ecological Community (TEC) listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Banksia* dominated woodlands of the Swan Coastal Plain IBRA region Priority 3 Priority Ecological Community (PEC) listed by Department of Biodiversity, Conservation and Attractions (DBCA).

Flora

One hundred and fifteen flora taxa (including subspecies and varieties) representing 44 families and 89 genera were recorded from the survey area during the field survey. This total comprised 76 native taxa and 39 introduced flora taxa. Of the 39 introduced taxa, three are listed as Declared Pests under the *Biosecurity and Management Act 2007*. One of which is also listed as a Weed of National Significance.

No Threatened or priority flora were recorded within the survey area.

Fauna

The survey area consists of one broad fauna habitat type: *Banksia* woodland on grey/brown sand. The *Banksia* woodland provides high habitat value for fauna species due to the variety of microhabitats and various resource niches available and presence of suitable habitat and foraging species for conservation significant fauna.

Within the survey area 30 vertebrate fauna species were recorded, including four mammals, 22 birds and four reptiles. Two conservation significant fauna species were recorded within the survey area during the field survey. These included:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) – listed as Endangered under the EPBC Act and *Biodiversity Conservation Act 2016* (BC Act)
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – listed as Vulnerable under the EPBC Act and BC Act

Targeted Black Cockatoo Assessment

Two species of Black Cockatoo, Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo, were recorded during the survey. Eight potential Black Cockatoo breeding trees (jarrah) were identified within the survey area (with a Diameter at Breast Height (DBH) >500 mm). Of these only one tree contained hollows. This tree contained one small hollow (<6 cm) and one large hollow (greater 10 cm). No evidence of breeding was observed.

The Banksia Woodland habitat present within the survey area provides high value foraging habitat for Black Cockatoos. Suitable foraging species present in the survey area include *Banksia attenuata, B. menziesii, B. grandis, B. sessilis, Allocasuarina fraseriana,* and *Eucalyptus marginata*. A total of 2.24 ha of foraging habitat is present in the survey area.

No suitable roosting habitat was identified within the survey area.

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Appendices

1. Introduction

1.1 Project background

Main Roads Western Australia (Main Roads) proposes to extend Mitchell Freeway north from Hester Avenue to Romeo Road, including an upgrade to Wanneroo Road from Dunstan Road to Trian Road (the Proposal). The project is located within the City of Wanneroo approximately 30 kilometres (km) north of Perth central business district and 12 km south of the coastal suburb of Yanchep.

GHD Pty Ltd (GHD) was commissioned in 2018 to undertake a biological assessment of the project including a targeted Black Cockatoo habitat assessment. In 2019, an additional area south of Hester Avenue was identified for the Proposal to allow upgrade to the existing quarry access south of Hester Avenue.

1.2 Purpose of this report

GHD was commissioned by Main Roads to undertake a biological assessment, including a targeted Black Cockatoo habitat assessment of the additional area south of Hester Avenue for the upgrade to the existing quarry access road. The purpose of the survey is to delineate key flora, vegetation and fauna values and potential sensitivity to impact to Black Cockatoo foraging and breeding habitat.

The outcome of the survey and information supplied in the biological survey and targeted fauna assessment will be used to inform corporate and statutory environmental assessment and approvals process. The results of the biological survey may also assist in the preparation of a Clearing Impact Assessment and Vegetation Management Plan.

1.3 Survey area

The survey area for the proposed upgrade of the quarry access road is located on the southern side of Hester Avenue. The survey area covers 2.57 hectares (ha).

A study area was defined for the desktop based searches and includes a 5 km buffer of the survey area.

The survey area and study area boundaries are shown on Figure 1, Appendix A.

1.4 Scope of works

The scope of works was to undertake a desktop assessment and biological survey of the survey area. The following actions were completed to fulfil the scope:

- A desktop assessment of the study area prior to the field survey to identify biological features and constraints, which may be in, or near the survey area
- A review of relevant environmental reports
- A field survey to verify/ground truth the desktop assessment findings through a combination of detailed, targeted and reconnaissance survey
- Identification and mapping of vegetation types to a scale appropriate for the bioregion and described according to the National Vegetation Information System (NVIS) structure and floristics
- Identification and mapping of Threatened and/or Priority Ecological Communities (TECs or PECs) inferred through the use of quadrats and relevés

- Assess the survey area flora species diversity, density, composition, structure and weed cover, recording the percentage of each in nominated quadrats
- Mapping of Black Cockatoo habitat and potential or known breeding trees
- A flora and fauna likelihood of occurrence assessment based on the vegetation units and fauna habitat present within the survey area
- Mapping using Geographic Information Systems (GIS) mapping software
- A concise report (this document) on the findings of the biological survey
- Raw survey data at project completion in electronic form.

1.5 Relevant legislation, conservation codes and background information

In WA some ecological communities, flora and fauna are protected under both Federal and State Government legislation. In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this biological survey is provided in Appendix B.

1.6 Report limitations and assumptions

This report has been prepared by GHD for Main Roads and may only be used and relied on by Main Roads for the purpose agreed between GHD and the Main Roads as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Main Roads arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report (including species listings). GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Main Roads and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of access tracks, operational works, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of the field survey. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This report has assessed the flora and fauna within the survey area (Figure 1, Appendix A). Should the survey area change or be refined, further assessment may be required.

2. Methodology

2.1 Desktop assessment

Prior to the commencement of the field survey, a desktop assessment was undertaken to identify relevant environmental information pertaining to the study area and to assist in survey design. This included a review of:

- The Department of the Environment and Energy (DotEE) Protected Matters Search Tool (PMST) to identify communities and species listed under the *Environment Protection and Biodiversity Act 1999* (EPBC Act) potentially occurring within the study area (DotEE 2019a) (Appendix C)
- The Department of Biodiversity, Conservation and Attractions (DBCA) Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) database to determine the potential for conservation significant communities to be present within the study area
- The DBCA NatureMap database for flora and fauna species previously recorded within the study area (DBCA 2019) (Appendix C)
- The DBCA Threatened (Declared Rare) and Priority Flora (TPFL) database and the WA Herbarium database (WAHERB) for Threatened flora listed under the *Biodiversity Conservation Act 2016* (BC Act) and listed as Priority by the DBCA, previously recorded within the study area
- Existing datasets including previous pre-European vegetation mapping of the survey area (Beard 1979; Heddle et al. 1980 and Webb et al. 2016), aerial photography, information to provide background information on the variability of the environment, likely vegetation units and fauna habitats and to identify areas that potentially contain TECs and PECs
- Review of the 2018 biological assessment report for the Mitchell Freeway Extension Hester Avenue to Romeo Road (GHD 2019).

Where the desktop data was associated with spatial locations, these have been included in Figure 2a and 2b, Appendix A.

2.2 Field survey

2.2.1 Flora and vegetation

GHD ecologist (Erin Lynch flora licence no. SL012374) completed a single season detailed and targeted vegetation and flora assessment of the survey area on 23 and 25 September 2019. The field survey was undertaken to identify and describe the dominant vegetation units, assess vegetation condition, and identify and record vascular flora taxa present at the time of survey. Searches for conservation significant or other significant ecological communities and flora taxa were also undertaken during the field survey.

The survey methodology employed by GHD was undertaken with reference to the Environmental Protection Authority (EPA) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a).

Data collection

The survey methods involved a combination of sampling quadrats, relevés and photographic reference points located in identified vegetation units and walking traverses.

Four quadrats and one relevé were described throughout the survey area. Quadrat and relevé locations are shown on Figure 3, Appendix A and the data is provided in Appendix D.

Quadrats (measuring 10 m x 10 m – area of 100 m^2) were located within each identified vegetation unit. A minimum of three quadrats were located within each identified vegetation unit. Quadrats were not established in vegetation units that had been significantly altered by clearing and weeds. Field data at each quadrat was recorded on a pro-forma data sheet and included the parameters detailed in Table 1. Relevés (unmarked area) were performed to supplement quadrat data.

Table 1 Data collected during the field survey

Aspect	Measurement
Collection attributes	Site code, personnel/recorder; date, quadrat dimensions, photograph of the quadrat.
Physical features	Aspect, slope, landform, soil attributes, ground surface cover, leaf and wood litter.
Location	Coordinates recorded in GDA94 datum using a hand-held GPS tool to accuracy approximately ± 5 m.
Vegetation condition	Vegetation condition was assessed using the condition rating scale adapted by EPA (2016a) for the South West Botanical Province.
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, exploration activities).
Flora	List of dominant flora from each structural layer. List of all species within the quadrat including average height and cover (using NVIS).

A flora inventory was compiled from taxa listed in described quadrats and relevés and from opportunistic floristic records throughout the survey area.

Vegetation units

Vegetation units were identified and boundaries delineated using a combination of aerial photography, topographical features and field data/observations. Vegetation units were described based on structure, dominant taxa and cover characteristics as defined by quadrat and relevé data and field observations. Vegetation unit descriptions follow NVIS and are consistent with NVIS Level V (Association). At Level V up to three taxa per stratum are used to describe the association (NVIS Technical Working Group 2017).

Statistical analysis

The Swan Coastal Plain bioregion (abbreviated as SWA) dataset (accessed through *NatureMap*) is derived from a database compiled and maintained over many years, combining the results of a number of floristic studies (conducted between 1990 and 1996) on plant communities of the SWA, south of Moore River. The SWA dataset includes sampling site details, the flora collected at these sampling sites and the floristic community type (FCT) assigned to these sampling sites.

PRIMER v6 (Clarke and Gorley 2006) was used to compare the GHD quadrats to existing data (where available) for FCTs described on the SWA. SWA site locations within a 5 km buffer of the survey area were located and the FCTs represented by these sites were identified. All site locations for these FCTs from the SWA dataset were extracted, along with those identified in the desktop searches (e.g. TEC and PEC searches). Representative quadrats from each FCT selected for the analysis are shown in Table 2.

The GHD quadrat data and SWA quadrat data was combined, reconciled to align nomenclature and a presence/absence matrix created of all taxa (including perennials and annuals). Taxa that were only identified to family or genus level were removed from the matrix. The dissimilarity

between quadrats was determined using the Bray-Curtis measure and the Resemblance function in PRIMER. A Cluster analysis (using Agglomerative Hierarchical Clustering technique) based on group average was undertaken using the Bray-Curtis similarity matrix and results presented as a dendrogram. In addition, a nonmetric MDS was undertaken using the Bray-Curtis similarity matrix and results presented as a two dimensional scatter plot. A factor was added to the output to define sample groups by FCT. The outputs of the PRIMER analysis were used to inform decisions on vegetation units.

It is noted that PRIMER can be limited in use for this purpose as analysis is based on all species recorded in quadrats and does not take into account dominance of species. Further interpretation of statistical results, coupled with multiple field surveys and desktop information is needed to determine whether the vegetation units are representative of a certain FCT.

The *Spinifex longifolius* grasslands and low shrublands (FCT14) was removed from the analysis as there was no *Spinifex* communities within the survey area.

Table 2 List of SWA sites used in the PRIMER analysis

Floristic Community Type Name and ID	Status	Quadrats
Woodlands over sedgelands in Holocene dune swales (FCT19b)	TEC^	19bcool 09, 19bcool14, 19bcool15, 19bxyan10
Northern Spearwood shrublands and woodlands (FCT24)	PEC*	24bold07, 24bold09, 24BOLD-1, 24bold12, 24bold13, 24bold14, 24BOLD-2, 24bold23, 24BOLD-3, 24BOLD-4, 24buck01, 24CHIDPT-1, 24cool 02, 24cool 03, 24cool 08, 24Hepb03, 24KERO-1, 24KERO-2, 24MI23, 24MTB-1, 24MTB-2, 24MTB-3, 24MTB-4, 24NAVB-3, 24NAVB-4, 24NEER-1, 24NEER-10, 24NEER-11, 24NEER-7, 24NEER-9, 24PTWALT-1, 24star01, 24star02, 24THOM-2, 24TRIG-5, 24TRIG-6, 24xbeer01
Melaleuca huegelii – Melaleuca systena shrublands on Limestone ridges (FCT26a)	TEC	26aCLIFT02, 26aCLIFT03, 26aSHE-4, 26aSHE-5, 26aSVH-1, 26aWABL-1, 26aYAN-12, 26aYAN-13, 26aYAN-15, 26aYAN-2, 26aYAN-24, 26azYAN4, 26azYAN5
Species poor mallees and shrublands on Limestone (FCT27)		27bold18, 27bold22, 27BU03, 27PAR1, 27SVH-2, 27WHILL-3, 27WHILL-4, 27wilb05, 27YALG-3, 27YALG-4, 27YALG-5, 27YALG-8
Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* woodlands (FCT28)	*	284M03, 28beel01, 28BULL-1, 28BULL-10, 28BULL-11, 28BULL-4, 28BULL-9, 28DEPOT-1, 28HARRY-1, 28HARRY-2, 28Hepb01, 28KING-1, 28KING-2, 28leda02, 28MILT-4, 28moore01, 28moore02, 28moore03, 28much01, 28much03, 28NEER-2, 28NEER-20, 28NEER-21, 28NEER-22, 28NEER-23, 28NEER-3, 28NEER-4, 28NEER-5, 28NEER-6, 28NEER-8, 28Pinn01, 28Pinn03, 28quinn02, 28sams01, 28sand01, 28SEAB-6, 28SHE-2, 28SHENT-1, 28star03, 28tokyu03, 28TRIG-3, 28TRIG-4, 28WABL-4, 28WARI-1, 28WARI-2, 28WATERRD1, 28wilb06, 28wilb07, 28wire01, 28wire02, 28WOODV-1, 28WOODV-2, 28YAN-25, 28YAN-3, 28YAN-4, 28YAN-6, 28YAN-8, 28YAN-9, 28yela01, 28yuri02
Coastal shrublands on shallow soils (FCT29a)	PEC	29aBMaid02, 29aBU01, 29aBU02, 29aBU04, 29aBURN-1, 29aBURN-2, 29aGARD02, 29aMI21, 29aNAVB-2, 29aNMaid01, 29aNMaid03, 29aPinn02, 29aPRES-1, 29arich02, 29arott02, 29aSEAB-4, 29aSEAB-5, 29aSEAB-8, 29aTRIG-2, 29awilb11
Acacia shrublands on taller dunes (FCT29b)	PEC	29bbold08, 29bbold10, 29bbold11, 29bGuild02, 29bGuild06, 29bMI01, 29bMI02, 29bMI03, 29bMI06, 29bMI07, 29bMI09, 29bMI18, 29bNPRES-1, 29bNWIL-1,

Floristic Community Type Name and ID	Status	Quadrats
		29bNWIL-3, 29bPB-2, 29bPB-3, 29bPB-4, 29bPB-5, 29bSEAB-2, 29bSEAB-3, 29bSEAB-7, 29bSW06, 29bSW07, 29bSW11, 29btokyu04, 29btokyu06, 29btokyu07, 29bTRIG-1, 29bWHILL-1, 29bWHILL-2, 29bwilb01, 29bwilb03, 29bwilb08, 29bwilb09, 29bwilb10, 29bwilb12
Quindalup *Eucalyptus gomphocephala* and/or *Agonis flexuosa* woodlands (FCT30b)	PEC**	30bLESCH-1, 30bLESCH-2, 30bLESCH-3, 30bLESCH-4, 30bLESCH-5, 30bNMaid04, 30bPEPB-1, 30bpip01, 30bPossum3, 30bPossum4
Northern *Acacia rostellifera* – *Melaleuca systena* shrublands FCTS11)		S11bold05, S11m4601, S11m4602, S11MI04, S11MI05, S11MI08, S11rott01, S11SW05, S11SW08, S11SW09, S11SW10, S11TR06, S11TR07, S11TR08
Northern *Olearia axillaris* – *Scaevola crassifolia* shrublands (FCTS13)		S13MI11, S13MI12, S13MI17, S13MI19, S13MI22, S13SW02, S13SW03, S13SW04, S13TR03, S13TR04, S13TR05, S13wilb02

^ A sub-community of the Critically Endangered Sedgelands in Holocene dune swales of the southern Swan Coastal Plain EPBC listed TEC.

* A component of the Endangered *Banksia* Woodlands of the Swan Coastal Plain EPBC listed TEC.

** Can be a component of the Endangered *Banksia* Woodlands of the Swan Coastal Plain EPBC listed TEC.

Vegetation condition

The vegetation condition was assessed and mapped in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces of Western Australia (IBRA) (devised by Keighery (1994) and adapted by EPA (2016a)). The scale recognises the intactness of vegetation and consists of six rating levels. The vegetation condition rating scale is located in Appendix B.

Surveys for conservation significant flora

Prior to the field survey, information obtained from the desktop assessments (e.g. previous surveys, aerial photography, geology, soils and topography data, EPBC Act PMST (DotEE 2019a), TPFL, NatureMap (DBCA 2019) and the WAHERB databases search results) were reviewed to determine conservation significant flora taxa potentially present within the study area. Additionally, ecological information (e.g. habitat, associated flora taxa and phenology) was sourced from FloraBase (WA Herbarium 1998–) to provide further details.

Potential habitats and locations of previous records were searched by walking transects spaced approximately 20 metres (m) apart across the survey area. Locations within the survey area with differing hydrology, fire or disturbance history to the surrounding areas were also searched where identified.

Flora identification and nomenclature

Species well known to the survey botanist were identified in the field; all other species were collected and assigned a unique collection number to facilitate tracking. All specimens collected during the field assessment were dried and processed in accordance with the requirements of the WA Herbarium. Species were identified by the use of taxonomic literature, electronic keys and online electronic databases.

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 1998–) and the EPBC Act Threatened species database provided by DotEE (2019b). Nomenclature used in this report follows that used by the WA Herbarium as reported on *FloraBase* (WA Herbarium 1998–).

2.2.2 Fauna

GHD ecologist Erin Lynch undertook a level 1 fauna survey (reconnaissance survey) in conjunction with the flora and vegetation survey. The survey area was traversed on foot over the course of the survey to identify and describe the dominant fauna habitat types present and their condition, assess habitat connectivity, and identify and record fauna species within the survey area. An assessment of the likelihood of conservation significant fauna and their habitats occurring within the survey area was also undertaken.

The survey methodology employed by GHD was undertaken in accordance with the EPA Technical Guidance – Sampling methods for terrestrial vertebrate fauna (EPA 2016b) and Technical Guidance – Terrestrial Fauna Surveys (EPA 2016c).

Opportunistic fauna searches

Opportunistic fauna searches was undertaken across the survey area. Opportunistic searches involved:

- Searching the survey area for tracks, scats, bones, diggings and feeding areas for both native and feral species
- Searching through microhabitats including turning over logs or rocks, turning over leaf litter and examining tree hollows and hollow logs
- Visual and aural surveys, which accounted for many bird species potentially utilising the survey area
- Recording GPS locations of any conservation significant fauna species observed.

Targeted Black Cockatoo habitat assessment

A Black Cockatoo habitat assessment (for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo) was undertaken for the survey area to assess the presence, quality and extent of habitat. The assessment involved visual and aural assessment of the survey area, identifying breeding habitat (presence/absence of actual and potential breeding trees), foraging habitat, roosting areas, current activity and any other signs of use by Black Cockatoos. For the purpose of this assessment, the DSEWPaC (2012) Black Cockatoo referral guidelines were used to define breeding, foraging and night roosting habitat.

Information collected during the field survey included:

- Identification and extent of suitable foraging habitat, based on the vegetation associations and presence/absence of known foraging species. During the field surveys any direct or indirect evidence of foraging by Black Cockatoos was recorded via GPS
- Record the location of suitable breeding trees - suitable breeding habitat for Black Cockatoos is defined by DSEWPaC (2012) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable Diameter at Breast Height (DBH) to develop a nest hollow. For most tree species on the Swan Coastal Plain, suitable DBH is 500 mm. On average, Carnaby's Black Cockatoos are known to nest in hollows with an entrance diameter greater than 20 - 30 cm (Johnstone and Storr 1998; Groom 2011). While the Forrest Red-tailed Black Cockatoo is known to nest in hollows with an entrance of greater than 12 cm (Johnstone and Storr 1998). Therefore, during the field survey hollows were graded into small (up to 6 cm) medium (6 to 10 cm) and large (10+ cm). The location of potential breeding trees were initially located using a handheld GPS and subsequently confirmed with a differential GPS
- Identification of night roosting habitat - suitable roosting habitat is defined by DSEWPaC (2012). Suitable roosting habitat was identified based on the presence of suitable tall trees,

evidence of roosting (feathers, twig clips etc.) and proximity of known roosting sites in the survey area

- Opportunistic observations - both visual and aural observations of Black Cockatoos within the survey area and surrounding region were noted during the survey.

Fauna species identification

Identification of fauna species was made in the field using available field guides and electronic guides (e.g. Morcombe 2014). Where identification was not possible, photographs of specimens were collected to be later identified.

Nomenclature used in this report follows that used by the WA Museum as reported on *NatureMap*. This nomenclature is deemed the most up-to-date species information for WA fauna, with the exception of birds, which follows Christidis and Boles (2008).

2.3 Limitations

2.3.1 Desktop limitations

The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. The records from the DBCA searches of Threatened fauna provide more accurate information for the general area and local occurrence. However, some collection, sighting or trapping records cannot be dated and often misrepresent the current range of Threatened species.

2.3.2 Field survey limitations

The EPA (2016a, b) states that flora and fauna survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 3.

Table 3 Survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	Nil	Adequate information is available for the survey area, this includes: • Broad scale (1:250,000) mapping by Beard (1979) and digitised by Shepherd *et al*. (2002) • Vegetation mapping by Heddle *et al.* 1980 and Webb (DBCA) (2016) • Regional biogeography (Mitchell *et al*. 2002).
Scope (what life forms were sampled etc.)	Nil	Vascular flora and terrestrial vertebrate fauna were sampled during the survey. Non-vascular flora, invertebrate and aquatic fauna were not surveyed.
Proportion of flora collected and identified (based on sampling, timing and intensity) Proportion of fauna identified, recorded and/or collected	Nil	The vegetation survey was a single season survey and was undertaken during September 2019 (Spring). Spring is considered the most optimal time to undertake vegetation surveys in the Swan Coastal Plain bioregion. The vegetation survey was a broad scale and targeted assessment, undertaken to identify and describe the dominant vegetation units and map conservation significant flora. The fauna survey (Level 1) and targeted Black Cockatoo assessment was undertaken in September 2019 in conjunction with the flora and vegetation assessment.
Flora determination	Minor	Flora determination was undertaken by GHD ecologists in the field and at the WA Herbarium. Five taxa were identified to genus level only, and one taxon could be tentatively identified to species level, due to lack of flowering and/or fruiting material required for identification. None of these species were considered to be potential conservation significant flora. The taxonomy and conservation status of the WA flora is dynamic. This report was prepared with reliance on taxonomy and conservation status current at the time of report development, but it should be noted this may change in response to ongoing research and review of the International Union for Conservation Nature criteria.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Nil	The survey area was entirely accessible and was adequately accessed by foot.
Mapping reliability	Nil	The vegetation was mapped using high-resolution ESRI aerial imagery obtained from Landgate, topographical features, previous broad scale mapping (Beard 1979) and field data. Data was recorded in the field using hand-held GPS tools (e.g. Garmin GPS and GPS enabled tablet). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin GPS units used for this survey are accurate to within ±5 metres on average. Therefore the data points consisting of coordinates recorded from the GPS may contain inaccuracies. The location of potential Black Cockatoo breeding trees were initially located using a handheld GPS and subsequently confirmed with a differential GPS.

Aspect	Constraint	Comment
Timing/weather/ season/cycle	Minor	The field survey was conducted September 2019. In the three months prior to the flora survey (June to August), Perth weather station (Bureau of Meteorology (BoM) 2019) recorded a total of 393 mm of rainfall. This rainfall total is slightly lower than the long term average for the same period (June-August; 430 mm) (BoM 2019). The weather conditions recorded during the survey were warm and dry and considered unlikely to have impacted the survey results. The survey timings were considered appropriate for the flora and fauna field surveys.
Disturbances (e.g. fire, flood, accidental human intervention)	Minor	The survey area has been subjected to historical disturbance events (e.g. clearing, tracks, fencing); however, these disturbances did not impact the survey.
Resources	Nil	Adequate resources were employed during the field survey. One staff and two person days were spent undertaking the survey using an experienced ecologist.
Access restrictions	Nil	No access problems were encountered during the survey.
Experience levels	Nil	The ecologist who executed the survey is a practitioner suitably qualified in their respective fields. Erin Lynch is an ecologist with over 12 years' experience in undertaking ecological surveys in Western Australia and has conducted biological surveys adjacent to the survey area.

3. Desktop Assessment

3.1 Regional biogeography

The survey area is situated in the South West Botanical Province of Western Australia (Beard 1990) within the Swan Coastal Plain bioregion and Perth sub-region described by IBRA (DotEE 2019c).

The Swan Coastal Plain bioregion is a low lying coastal plain, mainly covered with woodlands. The Perth sub-region is characterised by colluvial and aeolian sands, alluvial river flats and coastal limestone. Heath and/or Tuart woodlands occur on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, and Marri on Colluvial and alluvials. The region also includes a complex series of seasonal wetlands (Mitchell et al. 2002).

3.2 Landforms and soils

The survey area lies within the Spearwood Dunes. This land system is broadly described as Pleistocene and aeolian sands overlying Tamala limestone. Low dunes and swales of shallow pale grey sands over yellow sands are characteristic of the Spearwood system. Wetlands are associated with peats and carbonate sands, occasionally with clay overlaying sands.

Churchwood and McArthur (1980) identified the soils within the survey areas as consisting of the Cottesloe soil unit, described as: low hilly landscape with shallow brown sands over limestone, much exposed limestone.

The Department of Primary Industries and Regional Development (previously Department of Agriculture and Food Western Australia (DAFWA)) soil mapping indicates there is one soil subsystem within the survey area (DAFWA 2007):

- 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 *Eucalyptus gomphocephala* and *E. marginata* and a dense shrub layer.

3.3 Land use

3.3.1 Conservation reserves and estates

The survey area is located within Neerabup National Park (Class A Reserve, R27575) and Bush Forever Site 383 – Neerabup National Park, Lake Nowergup Nature Reserve and adjacent bushland (Government of Western Australia 2000).

3.3.2 Environmentally sensitive areas

The entirety of the survey areas is classified as an Environmentally Sensitive Area (ESA). The ESA mapped over the survey area is likely to be associated with the National Park and Bush Forever Site.

3.3.3 Regional Ecological linkages

One Regional Ecological Linkages transects the survey area. Greenways linkage I.D. number 6 (Tingay, Alan and Associates 1998), which forms part of a regionally significant contiguous bushland/wetland linkage (GoWA 2000). It links Neerabup National Park (Bush Forever Site 383) to Lake Joondalup (Bush Forever Site 299) in the south and Yanchep and Neerabup National Parks (Bush Forever Site 130) in the north. Hester Avenue and Neerabup Road (to the south) currently interrupt this linkage, however fauna underpasses have been constructed to reduce potential impacts to fauna and provide ecological continuity.

3.4 Vegetation and flora

3.4.1 Broad vegetation mapping and extents

Vegetation associations

Broad scale (1:250,000) pre-European vegetation mapping of the survey area has been completed by Beard (1979) at an association level. The mapping indicates the survey area intersects two vegetation associations:

- Low woodland; Banksia (association 949)
- Medium woodland; Tuart (association 998).

The pre-European mapping has been adapted and digitised by Shepherd *et al.* (2002). The extent of the vegetation associations have been determined by the state-wide vegetation remaining extent calculations maintained by the DBCA (current as of March 2019 –Government of Australia (GoWA) 2019b). As shown in Table 4, the current extents of the vegetation associations that intersect the survey area are above 30 % of their pre-European extents at the State, IBRA bioregion, IBRA subregion and Local Government Authority (LGA) levels.

Vegetation complexes

Regional vegetation complex mapping has been completed by Heddle at al. (1980) with updates from Webb et al. (2016) based on major landform boundaries within the SWA and forested region of south-west Western Australia. The mapping indicates one vegetation complex is present within the survey area:

- Cottesloe Complex - Central and South: Consists of a mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *E. gomphocephala – E. marginata* (Jarrah) – *Corymbia calophylla* (Marri); closed heath on the limestone outcrops.

GoWA (2019c) has assessed the vegetation complexes mapped by Heddle et al. (1980) and Webb et al. (2016) against presumed pre-European extents within the SWA IBRA bioregion (Table 5) and LGA levels (Table 6). These tables show the current extent of the vegetation complex within the survey area is above 30 % of their pre-European extents remaining within the SWA IBRA bioregion and the City of Wanneroo.

Swan Coastal Plain Floristic Studies

Floristic studies on the SWA include those completed by Gibson *et al.* (1994) and other unpublished data collected as part of the System 6 and Part System 1 Update program and from various sources (e.g. Weston *et al.* 1993, Griffin 1994, DEP 1996 and Keighery 1996). This data has been compiled into a dataset, referred to in this report as the SWA dataset. A search of the SWA dataset identified 10 FCTs that are known to occur within a 5 km buffer of the survey area (Table 7).

3.4.2 Conservation significant ecological communities

The EPBC Act PMST identified two EPBC Act-listed TECs potentially occurring within the study area. These TECs were also identified in a search of the DBCA TEC/PEC database along with two additional TECs and five PECs. Details of these communities are provided in Table 8. The extents of TEC and PEC buffers, where available, are presented on Figure 2a, Appendix A.

Table 4 Extents of vegetation associations mapped within the survey area (GoWA 2019b)

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Remaining within DBCA managed lands (%)
949	State: WA	218,193.94	123,104.02	56.42	55.86
	IBRA bioregion: Swan Coastal Plain	209,983.26	120,287.93	57.28	56.40
	Sub-region: Perth	184,475.82	104,128.96	56.45	58.99
	LGA: City of Wanneroo	37,138.40	17,196.34	46.30	70.10
998	State: WA	51,015.33	18,492.63	36.25	48.68
	IBRA bioregion: Swan Coastal Plain	50,867.50	18,492.32	36.35	48.68
	Sub-region: Perth	50,867.50	18,492.32	36.35	48.68
	LGA: City of Wanneroo	4,635.30	2,787.40	60.13	52.75

Table 5 Extent of vegetation complexes on the SWA mapped within the survey area (GoWA 2019c)

Vegetation complex	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Remaining within DBCA managed lands (%)
Cottesloe Complex – Central and South	45,299.61	14,567.87	32.16	14.58

Table 6 Extent of vegetation complexes within the City of Wanneroo for the survey area (GoWA 2019c)

Vegetation complex	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Proportion of the vegetation complex within the the LGA (%)
Cottesloe Complex – Central and South	13,313.58	5,545.39	41.65	29.39

Table 7 SWA dataset FCTs within the study area

FCT	Description
Seasonal wetlands	
19b	Woodlands over sedgelands in Holocene dune swales
Uplands centred on Spearwood Dunes	
24	Northern Spearwood shrublands and woodlands
26a	*Melaleuca huegelii – Melaleuca systena* shrublands on Limestone ridges
27	Species poor mallees and shrublands on Limestone
28	Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* woodlands
Uplands centred on Quindalup Dunes	
29a	Coastal shrublands on shallow soils
29b	*Acacia* shrublands on taller dunes
30b	Quindalup *Eucalyptus gomphocephala* and/or *Agonis flexuosa* woodlands
S11	Northern *Acacia rostellifera – Melaleuca systena* shrublands
S13	Northern *Olearia axillaris – Scaevola crassifolia* shrublands

Table 8 Threatened and Priority Ecological Communities identified within the study area

Community type	EPBC Act	BC Act/ DBCA	Description
Northern Spearwood shrublands and woodlands – (SCP24)*	Endangered TEC (part)	Priority 3	Heaths with scattered *Eucalyptus gomphocephala* occurring on deeper soils north from Woodman Point. Most sites occur on the Cottesloe unit of the Spearwood system. The heathlands in this group typically include *Banksia sessilis, Calothamnus quadrifidus*, and *Schoenus grandiflorus* (DBCA 2019)
Melaleuca huegelii - Melaleuca systena shrublands on limestone ridges (SCP26a)		Endangered	Species rich thickets, heaths or scrubs dominated by *Melaleuca huegelii, M. systena*, *Banksia sessilis* over *Grevillea preissii, Acacia lasiocarpa* and *Spyridium globulosum*, occurring on skeletal soil on ridge slopes and ridge tops. Broadly occurs on Spearwood Sands (Tamala Limestone) on large limestone ridges (Threatened Species Scientific Committee (TSSC) 2005)
Coastal shrublands on shallow sands, southern Swan Coastal Plain (SCP29a)		Priority 3	Mostly heaths on shallow sands over limestone close to the coast. No single dominant but important species include *Spyridium globulosum, Rhagodia baccata* and *Olearia axillaris*.
Acacia shrublands on taller dunes, southern Swan Coastal Plain (SCP29b)		Priority 3	Community is dominated by *Acacia* shrublands or mixed heaths on the larger dunes. This community stretches from Seabird to south of Mandurah.

Community type	EPBC Act	BC Act/ DBCA	Description
			No consistent dominant but species such as *Acacia rostellifera, Acacia lasiocarpa*, and *Melaleuca systena* were important
Banksia woodlands of the Swan Coastal Plain (TEC) *Banksia* dominated woodlands of the Swan Coastal Plain IBRA region (PEC)	Endangered	Priority 3	The ecological community is a woodland associated with the Swan Coastal Plain. A key diagnostic feature is a prominent tree layer of *Banksia*, with scattered eucalypts and other tree species often present among or emerging above the *Banksia* canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The ecological community is characterised by a high endemism and considerable localised variation in species composition across its range (TSSC 2016).
Tuart (*Eucalyptus gomphocephala*) woodlands and Forests of the Swan Coastal Plain (TEC) Tuart (*Eucalyptus gomphocephala*) woodlands of the Swan Coastal Plain (PEC)	Critically Endangered	Priority 3	Mostly confined to Quindalup Dunes and Spearwood Dunes from Jurien Bay to the Sabina River, with outliers along some rivers. Tuart is the key dominant canopy species however Tuart communities comprise a variety of flora and fauna assemblages. Flora commonly occurring with Tuart include *Agonis flexuosa, Banksia attenuata, B. grandis, Allocasuarina fraseriana, Xylomelum occidentale, Macrozamia riedlei, Xanthorrhoea preissii, Spyridium globulosum, Templetonia retusa* and *Diplolaena dampieri* (DBCA 2019)
Banksia attenuata woodlands over species rich dense shrublands (TEC) – (SCP20a)*	Endangered	Endangered	Occurs on the sands at the base of the Darling Scarp in the Forrestfield area and north of Perth in the Koondoola and Chittering areas. This community is very species rich (80 spp./100m^2). This community is very restricted and the richest of any *Banksia* community found on the coastal plain.

*A component of the Endangered *Banksia* woodlands of the Swan Coastal Plain EPBC listed TEC

3.4.3 Flora diversity

The *NatureMap* database identified 291 flora taxa, representing 57 families and 164 genera previously recorded within the study area. This total comprised 238 native flora taxa and 53 naturalised (introduced) flora taxa. Dominant families recorded included Fabaceae (38 taxa), Asteraceae (22 taxa) and Proteaceae (20 taxa).

The *NatureMap* database search is provided in Appendix C.

3.4.4 Conservation significant flora

The EPBC Act PMST, *NatureMap* and DBCA Threatened and Priority Flora databases identified the presence/potential presence of 24 conservation significant flora taxa within the study area (Appendix C). The desktop searches recorded:

- 12 Threatened flora taxa listed under the EPBC Act and/or WC Act
- Two Priority 1 taxon
- Two Priority 2 taxa
- Seven Priority 3 taxa
- One Priority 4 taxa.

The locations of conservation significant flora registered on the DBCA databases are mapped on Figure 2a, Appendix A.

3.5 Fauna

3.5.1 Fauna diversity

The *NatureMap* database identified 221 terrestrial vertebrate fauna species previously recorded within the study area. This total comprised of 142 birds, 52 reptiles, 22 mammals and 5 amphibians. Of the 221 fauna species previously recorded, 211 are native species and 10 are naturalised (introduced) species.

The *NatureMap* database search is provided in Appendix C.

3.5.2 Conservation significant flora

The EPBC Act PMST and DBCA *NatureMap* database and GHD observations identified the presence/ potential presence of 29 conservation significant fauna taxa within the study area (Appendix C). This total does not include species identified by the PMST as marine and/or migratory marine. These species have been excluded from this assessment as no marine habitat was present within or immediately adjacent to the survey area.

The species listed included:

- 14 species listed as Threatened under the EPBC Act and/or as Threatened under the BC Act
- Eight bird species listed as Migratory only (terrestrial and wetland) under the EPBC Act and/or as Migratory species under the BC Act
- One species listed as Other specially protected fauna under the BC Act
- Five species listed as Priority by DBCA

One additional species not identified in the desktop searches has been identified by GHD as potentially occurring within the study area:

- Jewelled Ctenotus (*Ctenotus gemmula*) – listed as Priority 3 by the DBCA.

For the purpose of assessing the species likely to be impacted by the proposed project, only those species identified or likely to occur within the survey area are discussed in the Likelihood of occurrence assessment in Section 4.2.3.

4. Survey Results

4.1 Vegetation and flora

4.1.1 Vegetation types

One vegetation type was identified across the survey area, not including cleared/highly disturbed areas. The vegetation within the survey area is dominated by *Banksia* woodland with scattered *Eucalyptus marginata* (Jarrah) and *Allocasuarina fraseriana* (Sheoak) on deep sandy soils. Areas that have been completely cleared of native vegetation such as roads and tracks, have been mapped as cleared.

The vegetation type is described in further detail in Table 9 and mapped in Figure 3, Appendix A.

4.1.2 Vegetation condition

The condition of the intact vegetation within the survey area ranged from Excellent to Good. The northern boundary of the survey area has been cleared and is situated along an existing access road (entrance to a quarry) and fenceline (along Hester Avenue road reserve). An underpass under Hester Avenue links the survey area (bushland south of Hester Avenue) to the bushland north of Hester Avenue with a cycle/walk path. The vegetation along the tracks and cleared areas is rated as Completely Degraded due to edge effects and weed invasion. The condition of the remnant vegetation improved the further the distance from cleared and disturbed areas, with the majority of the survey area assigned to Excellent condition.

The vegetation condition of the survey area is mapped on Figure 4, Appendix A.

Table 9 Vegetation type within the survey area

Vegetation Type	Vegetation association	Landform and substrate	Sample locations (quadrat/releve) and FCT alignment	Representative photographs
Banksia woodland (VT01)	Woodland of *Banksia attenuata, B. menziesii* and *B. grandis* with scattered *Eucalyptus marginata* and *Allocasuarina fraseriana* over a mid open shrubland of *Xanthorrhoea preissii, Allocasuarina humilis* and *Acacia pulchella* var. *glaberrima* over low shrubland of *Hibbertia hypericoides*, *Petrophile macrostachya* and *Leucopogon parviflorus* over open sedgeland and forbland of *Mesomelaena pseudostygia, Conostylis spp.* and weedy grasses and herbs *(*Heliophila pusilla, *Briza maxima* and **Ursinia anthemoides*)	Grey to brown sandy plains and gently undulating terrain.	Q1, Q2, Q3, Q4 and R1 FCT alignment: Spearwood *Banksia attenuata* or *Banksia attenuata* – Eucalyptus woodlands (FCT28)	 

4.1.3 Floristic analysis

The similarity between GHD quadrat data and SWA dataset for sites within a 5 km buffer from the survey area were examined using PRIMER analysis and run using two scenarios:

- All species (base quadrat data)
- Species that occur only once (singles) removed from each quadrat.

Both scenarios produced a stress value of 0.22 indicating poor/ random representation. The 'All species' scenario has been selected to demonstrate the groupings. The cluster analysis and resulting dendrogram for the 'All species' scenario is shown in Appendix D. The two dimensional MDS scatter plot for this scenario is illustrated in Plate 1. The MDS scatter plot shows GHD quadrats are grouped together. The vegetation type was mapped using a combination of statistical analysis, dominant species, landforms and field observations. The GHD quadrats showed similarities to:

- Spearwood *Banksia attenuata* or *Banksia attenuata* – *Eucalyptus* woodlands- FCT28 (this is a component of the Endangered *Banksia* woodlands of the Swan Coastal Plain TEC listed under the EPBC Act).

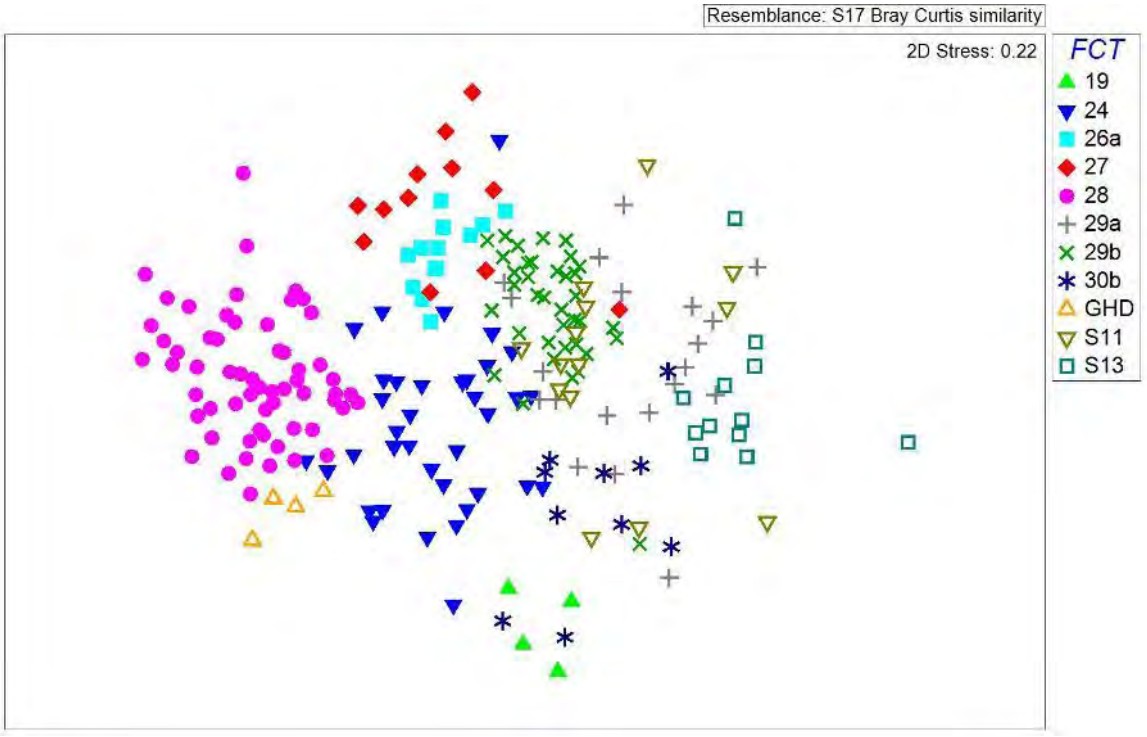

Plate 1 MDS showing broad clustering of quadrats

4.1.4 Conservation significant ecological communities

Based on the results of the desktop searches, dominant species, landform features, field observations, and coupled with the statistical analyses, two conservation significant ecological communities was identified within the survey area. The conservation significant ecological communities are:

- *Banksia* Woodlands of the Swan Coastal Plain TEC (FCT28 is a component of this TEC) listed under the EPBC Act
- *Banksia* dominated woodlands of the Swan Coastal Plain IBRA region P3 PEC listed by DBCA.

Representative photographs of the TECs and PECs recorded within the survey area are provided in Appendix D.

Banksia Woodlands of the Swan Coastal Plain (TEC)

The *Banksia* Woodlands of the Swan Coastal Plain was listed in September 2016 as an Endangered TEC under the EPBC Act. The Commonwealth TEC encompasses a number of FCTs, some of which are also listed as State TECs/PECs. *Banksia attenuata – Eucalyptus* woodlands (FCT28), which was identified within the survey area is not listed under the BC Act as a TEC or by DBCA as a PEC. However FCT 28 is considered a component of the Commonwealth TEC due to key structural features as detailed by the Threatened Species Scientific Community (TSSC) (2016). The TSSC (2016) describes the key structural features of the community as:

- A prominent tree layer of *Banksia*, with scattered eucalypts and other tree species often present among, or emerging above, the canopy
- The understorey is a species rich mix of sclerophyllous shrubs, graminoides and forbs
- High endemism and considerable localised variation in species composition across its range.

The TSSC (2016) provides guidance for determining whether the TEC is present. These criteria are listed in Appendix B. The vegetation type *Banksia* Woodland (VT01) described within the survey area is assessed as meeting the key diagnostic characteristics for the *Banksia* Woodlands of the SCP TEC. The vegetation within the survey area is considered to consist of one patch. There is 2.24 ha of *Banksia* Woodland SCP TEC in the survey area. The vegetation condition and extent occurring within the survey area is detailed in Table 10.

Table 10 Vegetation condition and extent of *Banksia* Woodland TEC within the survey area

Vegetation condition	Area (ha)
Excellent	1.86
Very Good	0.02
Good	0.36
Total Banksia Woodland	**2.24**

Banksia dominated woodlands of the SCP IBRA region (PEC)

The field assessment also confirmed the presence of the *Banksia* dominated woodlands of the SCP IBRA region PEC, listed as Priority 3 by DBCA. Similar to the TEC, this PEC is associated with VT01. This PEC differs from the TEC in that it has no minimum condition or patch size thresholds however within the survey area the location of the PEC is consistent with the TEC. There is 2.24 ha of the PEC present within the survey area.

4.1.5 Flora diversity

A total of 115 flora taxa (including subspecies and varieties) representing 44 families and 89 genera were recorded from the survey area during the field survey. This total comprised 76 native taxa and 39 introduced flora taxa.

Dominant families recorded from the survey area included:

- Fabaceae (15 taxa)
- Proteaceae (11 taxa)
- Asteraceae (10 taxa)

- Poaceae (9 taxa)

A flora taxa list is provided in Appendix D.

4.1.6 Introduced flora

Of the 39 introduced taxa recorded within the survey area, three species are listed as Declared Pests under the *Biosecurity and Management Act 2007*. One of these taxa is also identified as Weeds of National Significance (WoNS).

- **Moraea flaccida* (One-leaf Cape Tulip)– Declared Pest
- **Echium plantagineum* (Paterson's Curse) – Declared Pest
- **Asparagus asparagoides* (Bridal Creeper) – Declared Pest and WoNS

The remaining introduced taxa are considered environmental weeds and all have been previously recorded on the Swan Coastal Plain. The locations of the Declared Pests and WoNS recorded within the survey area are shown in Figure 4, Appendix A.

4.1.7 Conservation significant flora

No Threatened or Priority Flora were recorded within the survey area.

Likelihood of occurrence assessment

A likelihood of occurrence assessment was conducted post-field survey for all conservation significant flora taxa identified in the desktop assessment (Appendix D). This assessment took into account previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and the cryptic nature of species.

The likelihood of occurrence assessment for the survey area concluded that no conservation significant flora are considered likely to occur within the survey area.

4.2 Fauna

4.2.1 Fauna habitat

The survey area comprised of one fauna habitat type: *Banksia* Woodland on grey/brown sand. This habitat type consists of a dominant overstorey of *Banksia attenuata, B. menziesii, B. sessilis, Eucalyptus marginata* (jarrah) and *Allocasuarina fraseriana* (sheoak) and was generally associated with grey to brown sandy soils on low undulating plains. The vegetation was generally in excellent condition and contains good structural diversity and a variety of micro-habitat types including leaf litter, fallen logs and branches, deep sandy soil and hollows. The vegetation appeared to be long unburnt.

Two conservation significant species were recorded utilising this habitat during the survey, these being the Forest Red-tailed Black Cockatoo and Carnaby's Black Cockatoo. This habitat would be a highly utilised resource (core foraging habitat) for these species.

The *Banksia* woodland provides high habitat value for fauna species due to the variety of microhabitats and various resource niches available and presence of suitable habitat and foraging species for conservation significant fauna.

4.2.2 Fauna diversity

During the field survey 30 fauna species were recorded within the survey area, including 22 bird, four mammal and four reptile species. Three of the species recorded are introduced.

A full list of fauna recorded during the survey is provided in Appendix E.

4.2.3 Conservation significant fauna

Two conservation significant fauna species were recorded within the survey area during the field survey. These included:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) – listed as Endangered under the EPBC Act and BC Act
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – listed as Vulnerable under the EPBC Act and BC Act.

Cockatoo observations recorded during the survey are presented on Figure 5, Appendix A.

Likelihood of occurrence assessment

A likelihood of occurrence assessment was conducted for all conservation significant fauna species identified in the desktop assessment. This assessment was based on species biology, habitat requirements, the likely quality and availability of suitable habitat (based on vegetation associations present within the survey area) and records of the species in the vicinity of the survey area. The assessment is provided in Appendix E.

Of the 29 conservation significant fauna identified in the desktop searches two are identified as present (Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo) and five are considered likely to utilise the habitat present in the survey area:

- Peregrine Falcon (*Falco peregrinus*) – Other Specially Protected Fauna (BC Act)
- Quenda (*Isoodon fusciventer*) – Priority 4 (DBCA)
- Western Brush Wallaby (*Notamacropus irma*) – Priority 4 (DBCA)
- Black-striped Snake (*Neelaps calonotos)* – Priority 3 (DBCA)
- Jewelled southwest Ctenotus (Swan Coastal Plain population) (*Ctenotus gemmula*) – Priority 3 (DBCA).

4.2.4 Targeted Black Cockatoo habitat assessment

Two species of Black Cockatoo, Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo were recorded during the survey.

Carnaby's Cockatoo is endemic to the south-west of Western Australia with a wide-spread distribution. Carnaby's Cockatoo nest in hollows of live or dead eucalypts, primarily smooth-barked Salmon Gum and Wandoo (Saunders 1979, 1982) though breeding has been reported in other wheatbelt tree species and some tree species on the Swan Coastal Plain and jarrah forest (Saunders 1979, 1982; Storr 1991; Johnstone and Storr 2004). Success in breeding is dependent on the quality and proximity of feeding habitat within 12 km of nesting sites (Saunders 1977, 1986; Saunders and Ingram 1987). Along with the trees that provide nest hollows, the protection, management and increase of this feeding habitat that supports the breeding of Carnaby's Cockatoo is a critical requirement for the conservation of the species.

The Forest Red-tailed Black Cockatoo is endemic to the south-west humid and sub-humid zones of Western Australia (Mawson and Johnstone 1997). It inhabits the dense Jarrah, Karri (*E. diversicolor*) and Marri forests receiving more than 600 mm of annual average rainfall. The current distribution is north of Perth and east to Mount Helena, Christmas Tree Well, North Banister, Mt Saddleback, Rocky Gully and the upper King River (Johnstone 1997). More recently the species has been utilising and persisting on the northern portions of the Swan Coastal Plain and is now considered a regular sighting (Johnstone et al 2017). Habitats in which the Forest Red-tailed Black Cockatoo occurs at Bungendore Park and Jarrahdale, have an understorey of Bull Banksia (*Banksia grandis)*, Snottygobble (*Persoonia longifolia)*, Sheoak

(*Allocasuarina fraseriana)* and *Banksia* spp., with scattered Blackbutt (*E. patens)* and Wandoo (*E. wandoo)* (Johnstone and Kirkby 1999). The Forest Red-tailed Black Cockatoo roosts in Jarrah-Marri-Blackbutt habitat on road-sides, paddocks or forest blocks. While the Forest Red-tailed Black Cockatoo feeds on the seeds of other species, around 90 per cent of its diet is made up of the seeds from Marri and Jarrah fruits.

The results of the Black Cockatoo habitat assessment are summarised below.

Foraging habitat

The Banksia Woodland habitat present within the survey area provides high value foraging habitat for Black Cockatoos. Suitable foraging species present in the survey area include *Banksia attenuata, B. menziesii, B. grandis, B. sessilis, Allocasuarina fraseriana,* and *Eucalyptus marginata*. A total of 2.24 ha of foraging habitat is present in the survey area.

Breeding habitat

Eight potential Black Cockatoo breeding trees (jarrah) were identified within the survey area (with a DBH >500 mm). Of these only one tree contained hollows. This tree contained one small hollow (<6 cm) and one large hollow (greater 10 cm). No evidence of breeding was observed.

The location of potential breeding trees recorded in the survey area are listed in Appendix E.

Roosting habitat

No suitable roosting habitat was identified within the survey area.

5. References

Beard, JS 1979, *Vegetation Survey of Western Australia: the Vegetation of the Perth Area Western Australia*, map and explanatory memoir 1:250,000 series, Applecross, Vegmap Publications.

Bureau of Meteorology (BoM) 2019, *Climate Data Online*, retrieved November 2019, from http://www.bom.gov.au/climate/data/?ref=ftr

Churchward, HM and McArthur, WM 1980, *Landforms and Soils of the Darling System*, Western Australia, in Atlas of Natural Resources, Darling System Western Australia, Department of Conservation and Environment, Western Australia.

Clarke, KR and Gorley, RN 2006, *PRIMER v6: User Manual/Tutorial*, Plymouth, PRIMER-E

Christidis, L and Boles, WE 2008, *Systematics and Taxonomy of Australian Birds*, Melbourne, CSIRO Publishing.

Department of Agriculture and Food WA (DAFWA) 2007, *Soil-landscape mapping in South-WA*, Perth, Department of Agriculture and Food.

Department of Biodiversity, Conservation and Attractions (DBCA) 2019, *NatureMap: Mapping Western Australia's biodiversity*, Department of Parks and Wildlife, retrieved August 2019, from http://NatureMap.dpaw.wa.gov.au/default.aspx.

Department of Environment and Conservation (DEC) 2012, *Chuditch (Dasyurus geoffroii) Recovery Plan.* Wildlife Management Program No. 54. Department of Environment and Conservation, Perth, Western Australia.

Department of Environmental Protection (DEP) 1996, System 6 and Part System 1 Update Programme. Unpublished bushland plot and area records and analysis. Perth, WA.

Department of the Environment and Energy (DotEE) 2019a, *Environmental Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool Results*, retrieved August 2019, from http://www.environment.gov.au/epbc/pmst/index.html.

Department of the Environment and Energy (DotEE) 2019b, *Environment Protection and Biodiversity Act 1999 List of Threatened Species Database*, retrieved October 2019, from http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora.

Department of the Environment and Energy (DotEE) 2019c, *Interim Biogeographic Regionalisation of Australia*, Version 7, retrieved November 2019, from http://www.environment.gov.au/land/nrs/science/ibra/australias-bioregions-maps

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012, *Environment Protection and Biodiversity Act 1999 referral guidelines for three threatened black cockatoo species: Carnaby's Black Cockatoo (endangered) Calyptorhynchus latirostris, Baudin's Black Cockatoo (vulnerable) Calyptorhynchus baudinii and Forest Red-tailed Black Cockatoo (vulnerable) Calyptorhynchus banksia naso*, Australian Government Canberra.

EPA 2016a, Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment, Perth, Environmental Protection Authority.

EPA 2016b, Technical Guidance – Sampling methods for terrestrial vertebrate fauna, Perth, Environmental Protection Authority.

EPA 2016c, Technical Guidance, Terrestrial Fauna Surveys, Perth, Environmental Protection Authority.

GHD Pty Ltd (GHD) 2019, Mitchell Freeway Extension Hester Avenue to Romeo Road Biological Survey, unpublished report prepared for main Roads Western Australia.

Gibson, N, Keighery, BJ, Keighery, GJ, Burbidge, AH & Lyons, MN 1994, *A Floristic Survey of the Southern Swan Coastal Plain*, unpublished report prepared for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and The Conservation Council of Western Australia (Inc.).

Government of Western Australia (GoWA) 2000, *Bush Forever – Keeping the Bush in the City. Volumes 1 (Policies, Principals and Processes) & 2 (Directory of Bush Forever Sites)*, Perth, Government of Western Australia.

Government of Western Australia (GoWA) 2019a, *Data WA*, retrieved November 2019, from https://data.wa.gov.au/.

Government of Western Australia (GoWA) 2019b, 2018 *Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full report),* Current as of March 2019, Perth, Australia, Department of Biodiversity, Conservation and Attractions, retrieved November 2019, from https://data.wa.gov.au/.

Government of Western Australia (GoWA) 2019c, *2018 South West Vegetation Complex Statistics, Current as of March 2019*, Perth, Australia, Department of Biodiversity, Conservation and Attractions, retrieved November 2019, from https://data.wa.gov.au/.

Griffin, E.A. 1994 *Floristic Survey of Northern Sandplains between Perth and Geraldton*. Unpublished Report to the Heritage Council of WA.

Groom, C. 2011, *Plants Used by Carnaby's Black Cockatoo*. Department of Environment and Conservation, Perth.

Heddle, EM, Loneragan. OW and Havel JJ 1980, *Vegetation Complexes of the Darling System, Western Australia*, in Atlas of Natural Resources, Darling System Western Australia, Department of Conservation and Environment.

Higgins, PJ and Davies, SJJF (eds.) 1996, *Handbook of Australian, New Zealand & Antarctic birds, Volume 3:* Snipe to Pigeons, South Melbourne, Australia, Oxford University Press.

Johnstone, R.E. 1997, *Current studies on three endemic Western Australian cockatoos.* Eclectus. 3:34--35.

Johnstone, R.E. and Kirkby, T. 1999, *Food of the Forest Red-tailed Black Cockatoo Calyptorhynchus banksii naso in south-west Western Australia.* Western Australian Naturalist. 22:167-177.

Johnstone, R.E., Kirkby, T. and Sarti, K. 2017, *The distribution, status movements and diet of the Forest Red-tailed Black Cockatoo in the south-west with emphasis on the greater Perth regions, Western Australia.* Western Australian Naturalist. 30:4:1-193.

Johnstone, R. E., Storr, G. M. 2004, *'Handbook of Western Australian Birds. Volume 1*. Nonpasserines (Emu to Dollarbird).' (Western Australia Museum: Perth.)

Jones D and Goth A 2008, Mound-builders, Clayton, Australia, CSIRO Publishing.

Keighery, BJ 1994, *Bushland Plant Survey: a Guide to Plant Community Survey for the Community*, Nedlands, Wildflower Society of WA (Inc.).

Mawson, P. R., Johnstone, R. E. 1997, *Conservation status of parrots and cockatoos in Western Australia.* Eclectus 2, 4-9.

Maryan, B. Pers comm. Raw data for Level 1 Herpetofauna assessments on Pipidinny Road from 1996 to 2004.

Menkhorst, P and Knight F 2004, *A Field Guide to the Mammals of Australia, second edition*. Oxford University Press, Melbourne.

Menkhorst PW and Knight F 2010, *A Field Guide to the Mammals of Australia, Third Revised edition.* Oxford University Press. Melbourne, Australia.

Mitchell, D, Williams, K & Desmond, A 2002, *Swan Coastal Plain 2 (SWA2 — Swan Coastal Plain subregion)*, in Department of Conservation and Land Management (ed), A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002, pp 724

Morcombe, M 2004, *Field Guide to Australian Birds*, Queensland, Australia, Steve Parish Publishing Archer Field.

Nevill, S 2013, Birds of Western Australia, Perth, Australia, Simon Nevill Publications.

NVIS Technical Working Group 2017, *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 7.0*, Department of the Environment and Energy, Canberra. Prep by Bolton, M.P., deLacey, C. and Bossard, K.B. (Eds).

Pearson, D. J. 2013, *Recovery plan for five species of rock wallabies: Black-footed rock wallaby (Petrogale lateralis), Rothschild rock wallaby (Petrogale rothschildi), Short-eared rock wallaby (Petrogale brachyotis), Monjon (Petrogale burbidgei) and Nabarlek (Petrogale concinna)* 2012-2022. Department of Parks and Wildlife, Perth, WA.

Richards, J.D. 2012, *Western Barred Bandicoot Perameles bougainville, Burrowing Bettong Bettongia lesueur and Banded Hare-Wallaby Lagostrophus fasciatus National Recovery Plan*. Department of Environment and Conservation (Western Australia) and the Australian Government Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/resource/western-barred-bandicoot-perameles-bougainville-burrowing-bettong-bettongia-lesueur-and. In effect under the EPBC Act from 19-Sep-2012.

Saunders, D.A. 1977, *Effect of Agricultural Clearing on the Breeding Success of the White-tailed Black Cockatoo. Emu.* 77 (4). pp. 180-184.

Saunders, D. A. 1979, *Distribution and taxonomy of the White-tailed and Yellow-tailed Black Cockatoo Calyptorhynchus spp. Emu* 79, 215-227.

Saunders, D.A. 1982, *The breeding behaviour of the short-billed form of the White-tailed Black Cockatoo Calyptorhynchus funereus.* Ibis. 124:422--455.

Saunders, D.A. 1986, *Breeding season, nestling success and nestling growth in Carnaby's Black-Cockatoo, Calyptorhynchus funereus latirostris, over 16 years at Coomallo Creek, and a method for assessing the viability of populations in other areas.* Australian Wildlife Research 13, pp. 261-273.

Saunders, D.A. and Ingram, J.A. 1987, *Factors affecting survival of breeding populations of Carnaby's Cockatoo, Calyptorhynchus latirostris in remnants of native vegetation.* IN: Saunders, D.A., Arnold, G.W., Burbidge, A.A. and Hopkins, A.J.M, *Nature Conservation: the Role of Remnants of Native Vegetation.* Surrey Beatty and Sons, Chipping Norton, pp 249-58.

Shepherd, DP, Beeston, GR, and Hopkins, AJM 2002, *Native Vegetation in Western Australia – Extent, Type and Status*, Resource Management Technical Report 249, Perth, Department of Agriculture, Western Australia.

Storr, G.M. 1991, *Birds of the South-west Division of Western Australia.* Records of the Western Australian Museum. Suppl. 35.

Storr, GM, Smith, LA and Johnstone, RE 1999, *Lizards of Western Australia*, Volume 1: Skinks, revised edition, Perth, Western Australian Museum.

Storr GM, Smith LA and Johnstone RE 2002, *Snakes of Western Australia*. Western Australian Museum, Perth, WA.

Threatened Species Scientific Community (TSSC) 2016, *Environmental Protection and Biodiversity Conservation Act 1999 Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain Ecological Community*, Department of the Environment and Energy, Canberra. Available at: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/131-conservation-advice.pdf.

Tingay, Alan & Associates 1998, *A Strategic Plan for Perth's Greenways – Final Report*, prepared for Environment Australia, Ministry for Planning.

Van Dyke, S & Strahan, R 2008, *The Mammals of Australia*. Third Edition. New Holland Publishing, Sydney, Australia.

Webb A, Kinloch J, Keighery G & Pitt G, 2016, *The extension of vegetation complex mapping to landform boundaries within the Swan Coastal Plain landform and forested region of south-west Western Australia.*

Western Australian Herbarium 1998–, *FloraBase—the Western Australian Flora,* Department of Parks and Wildlife, retrieved September 2019, from http://florabase.dpaw.wa.gov.au/.

Weston AS, Griffin EA and Trudgen M 1993, *Flora and Vegetation Conservation Values of the Ellenbrook Estate.* Conducted for Bowman Bishaw Gorham 1993.

Wilson S and Swan G 2017, *A Complete Guide to Reptiles of Australia.* 4th Edition New Holland Press Sydney Australia

Appendices

Appendix A – Figures

Paper Size ISO A3

0 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Main Roads WA
MFEHR - 2019 Biological Survey

Project Location

Project No. **12516238**
Revision No. **A**
Date **18/11/2019**

FIGURE 1

G:\61\12516238\GIS\Maps\Working\12516238\12516238_Rev2.aprx\12516238_001_ProjectLocation_RevA
Print date: 18 Nov 2019 - 16:04

Data source: Main Roads: Survey Area - 20191114; Landgate: Roads - 20191115, Imagery - August 2019; Geoscience Australia - Islands_Mainland_Merge. Created by: bmorgan

DRAFT

Legend

DBCA flora Database search

- Threatened Species (T)
- Priority 1
- Priority 2
- Priority 3
- Priority 4

Quarry Access Survey Area

TEC/PEC

- Threatened Ecological Community
- Priority Ecological Community

Study Area

Paper Size ISO A3

0 0.5 1 1.5 2

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Main Roads WA
MFEHR - 2019 Biological Survey

Environmental Constraints

Project No. **12516238**
Revision No. **A**
Date **19/11/2019**

FIGURE 2a

G:\61\12516238\GIS\Maps\Working\12516238\12516238_Rev2.aprx\12516238_002a_EnvironmentalConstraints_RevA
Print date: 19 Nov 2019 - 09:25

Data source: GHD: Study Area - 20191115; Landgate: Imagery - August 2019; DBCA: Geomorphic Wetlands, Managed Lands - 20191115; DoP - Bush Forever Areas - 20191115; DBCA - Flora, TEC/PEC - 20180523. Created by: bmorgan

DRAFT

Legend

- Study Area
- Quarry Access Survey Area
- Bush forever area

DBCA Managed Lands

- National Park
- Nature Reserve
- Conservation Park
- Section 5(1)(h) Reserve
- State Forest
- Marine Park
- Crown Freehold - Dept Managed

Geomorphic Wetlands

- Conservation
- Multiple Use
- Resource Enhancement

Paper Size ISO A3

0 0.5 1 1.5 2

Kilometres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

GHD

Main Roads WA
MFEHR - 2019 Biological Survey

Environmental Constraints

Project No. **12516238**
Revision No. **A**
Date **19/11/2019**

FIGURE 2b

G:\61\12516238\GIS\Maps\Working\12516238\12516238_Rev2.aprx\12516238_002b_EnvironmentalConstraints_RevA
Print date: 19 Nov 2019 - 09:49

Data source: GHD: Study Area - 20191115; Landgate: Imagery - August 2019; DBCA: Geomorphic Wetlands, Managed Lands - 20191115; DoP - Bush Forever Areas - 20191115; DBCA - Flora, TEC/PEC - 20180523. Created by: bmorgan

DRAFT

Q4
R1
Q1
Q3
Q2

Legend

- Releve
- Quadrat
- Quarry Access Survey Area

Vegetation Types

- *Banksia* Woodland
- Cleared / Completely Degraded

Paper Size ISO A3

0 10 20 30 40

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Main Roads WA
MFEHR - 2019 Biological Survey

Vegetation Types

Project No. **12516238**
Revision No. **A**
Date **18/11/2019**

FIGURE 3

G:\61\12516238\GIS\Maps\Working\12516238\12516238_Rev2.aprx\12516238_003_VegTypes_RevA
Print date: 18 Nov 2019 - 16:30

Data source: GHD: Study Area - 20191115, Sample Types, Vegetation Types - 20191118; Landgate: Imagery - August 2019. Created by: bmorgan

DRAFT

Legend

Significant Weed Locations

- *Asaparagus asparagoides* (Bridal Creeper)
- *Echium plantagineum* (Paterson's Curse)
- *Moraea flaccida* (Cape Tulip)
- Quarry Access Survey Area

Vegetation Condition

- Excellent
- Very Good
- Good
- Completely Degraded

Paper Size ISO A3

0 10 20 30 40

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Main Roads WA
MFEHR - 2019 Biological Survey

Vegetation Condition

Project No. **12516238**
Revision No. **A**
Date **19/11/2019**

FIGURE 4

G:\61\12516238\GIS\Maps\Working\12516238\12516238_Rev2.aprx\12516238_004_VegCondition_RevA
Print date: 19 Nov 2019 - 11:06

Data source: GHD: Study Area - 20191115, Significant Weed Locations, Vegetation Condition - 20191118; Landgate: Imagery - August 2019. Created by: bmorgan

SLIP

DRAFT

Legend

- Black cockatoo tree (no hollows)
- Black cockatoo tree (hollows)
- Caranby activity
- Foraging Habitat
- Quarry Access Survey Area

Paper Size ISO A3

0 10 20 30 40

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

Main Roads WA
MFEHR - 2019 Biological Survey

Black Cockatoo habitat

Project No. **12516238**
Revision No. **A**
Date **4/12/2019**

FIGURE 5

G:\61\12516238\GIS\Maps\Working\12516238\12516238_Rev2.aprx\12516238_005_Black Cockatoos_RevA
Print date: 04 Dec 2019 - 13:16

Data source: GHD: Study Area - 20191115, Black Cockatoo trees, Carnaby Activity, Foraging Habitat - 20191118; Landgate: Imagery - August 2019. Created by: bmorgan

Appendix B – Relevant legislation, background information and conservation code

Relevant legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities
- Migratory species

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Federal Minister for the Environment.

The EPBC Act is administered by the Department of the Environment and Energy (DEE).

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. The Act allows the Environmental Protection Authority (EPA), to prevent, control and abate pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. Part IV of the EP Act is administered by the EPA and makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals and land use planning schemes.

The Department of Water and Environment Regulation (DWER) is responsible for administering the clearing provisions of the EP Act (Part V). Clearing of native vegetation in Western Australia requires a permit from the DWER, unless exemptions apply. Applications for clearing permits are assessed by the Department and decisions are made to grant or refuse the application in accordance with the Act. When making a decision the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

a) Native vegetation should not be cleared if it comprises a high level of biodiversity.

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

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

d) Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.

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.

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

g) 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.

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

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.

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

Exemptions for clearing include clearing that is a requirement of a written law or authorised under certain statutory processes (listed in Schedule 6 of the EP Act) and exemptions for prescribed low impact day-to-day activities (prescribed in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004); these exemptions do not apply in environmentally sensitive areas (ESAs).

State *Biodiversity and Conservation Act 2016*

The *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation and protection of biodiversity and biodiversity components, as well as the promotion of the ecologically sustainable use of biodiversity components in Western Australia. The BC Act replaces both the repealed *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929* (Sandalwood Act), as well as their associated regulations. To attain the objectives of the BC Act, principles of ecological sustainable development have been established:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
- The conservation of biodiversity and ecological integrity should be a fundamental consideration indecision-making
- Improved valuation, pricing and incentive mechanisms should be promoted.

The BC Act is administered by the Department of Biodiversity Conservation and Attractions (DBCA).

State *Biosecurity and Agriculture Management Act 2007*

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations are administered by the Department of Primary Industries and Regional Development (DPIRD) and replace the repealed *Agriculture and Related Resources Protection Act 1976.* The main purposes of the BAM Act and its regulations are to:

- Prevent new animal and plant pests (vermin and weeds) and diseases from entering WA
- Manage the impact and spread of those pests already present in the state
- Safely manage the use of agricultural and veterinary chemicals
- Increased control over the sale of agricultural products that contain violative chemical residues.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act. A Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) of the Act is in force. Declared Pests may be assigned a control category including: C1 (exclusion), C2 (eradication) and C3 (management). The category may apply to the whole of the State, LGAs, districts, individual properties or even paddocks, and all landholders are obliged to comply with the specific category of control. Categories of control are defined below.

DPIRD Categories for Declared Pests under the BAM Act

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Background information

Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the EP Act. The Table below outlines the aspects of areas declared as ESA in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005.

Aspects of ESAs

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the EPBC Act.
An area that is included on the Register of the National Estate (RNE), because of its natural values, under the *Australian Heritage Commission Act 1975* of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012).
A defined wetland and the area within 50 m of the wetland. Defined wetlands include Ramsar wetlands, conservation category wetlands and nationally important wetlands.
The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located.
The area covered by a Threatened Ecological Community.
A Bush Forever Site listed in “Bush Forever” Volumes 1 and 2 (2000), published by the Western Australia Planning Commission, except to the extent to which the site is approved to be developed by the Western Australia Planning Commission.
The areas covered by the *Environmental Protection (Gnangara Mound Crown Land) Policy 1992*.
The areas covered by the *Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002*.
The areas covered by the lakes to which the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (EPP Lakes) applies.
Protected wetlands as defined in the *Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998*.

Reserves and conservation areas

Bush Forever

Bush Forever, which was released in December 2000 and proclaimed in 2010, is a Government initiate aimed to retain and protect regionally significant bushland on the Swan Coastal Plain within the Perth Metropolitan Region. Bush Forever aims to protect more than 51,000 hectares of regionally significant bushland within 287 sites across the metropolitan portion of the Swan Coastal Plain (Government of Western Australia (GoWA) 2000). Bush Forever sites constitute ESAs as declared by a notice under Section 51B of the EP Act.

Department of Biodiversity, Conservation and Attractions managed lands and waters

DBCA manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DBCA managed lands and waters include national parks, conservation parks and reserves, marine parks and reserves, regional parks, nature reserves, State forest and timber reserves. DBCA managed conservation estate, is

vested with the Conservation Commission of Western Australia. Access to, or through, some areas of DBCA managed lands may require a permit or could be restricted due to management activities. Proposed land use changes and development proposals that abut DBCA managed lands will generally be referred to DBCA throughout the assessment process.

Wetlands

Wetlands include not only lakes with open water, but areas of seasonally, intermittently or permanently waterlogged soil.

Ramsar Listed Wetlands

The Convention of Wetlands of International Importance was signed in 1971 at the Iranian town of Ramsar. The Convention has since been referred to as the Ramsar Convention. Ramsar Listed wetlands are “sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity … because of their ecological, botanical, zoological, limnological or hydrological importance” (DEE 2019b). Once a Ramsar Listed Wetland is designated, the country agrees to manage its conservation and ensure its wise use. Under the Convention, wise use is broadly defined as “maintaining the ecological character of a wetland” (DEE 2019b).

Nationally important wetlands

Wetlands of national significance are listed under the Directory of Important Wetlands in Australia. Nationally important wetlands are wetlands which meet at least one of the following criteria (DEE 2019a):

- It is a good example of a wetland type occurring within a biogeographic region in Australia
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports one percent or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance

Geomorphic wetlands

Categorisation of wetlands has been conducted by Hill et al. (1996), delineating Swan Coastal Plain wetlands into levels of protection and management categories. Conservation Category Wetlands are wetlands that support high levels of attributes and functions. Resource Enhancement Wetlands are those that have been partly modified but still support substantial functions and attributes. Multiple Use Wetlands are classified as those wetlands with few attributes that still provide important wetland functions. Multiple Use wetlands have few important ecological attributes and functions remaining.

The Geomorphic Wetlands Swan Coastal Plain dataset displays the location, boundary, geomorphic classification (wetland type) and management category of wetlands on the Swan Coastal Plain.

Vegetation extent and status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia’s biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level

should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia's Biological Diversity (ANZECC 2000).

The extent of remnant native vegetation in WA has been assessed by Shepherd et al. (2002) and the GoWA (2018), based on broadscale vegetation association mapping by Beard (various publications). The GoWA produces Statewide Vegetation Statistics Reports that are used for a number of purposes including conservation planning, land use planning and when assessing development applications. The reports are updated at least every two years.

Vegetation condition

The vegetation condition can be assessed in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA 2016a). The scale recognises the intactness of vegetation and consists of six rating levels as outlined below.

Vegetation condition rating scale for the South West and Interzone Botanical Provinces

Condition	South West and Interzone Botanical Provinces description
Pristine	Pristine or nearly so, no obvious signs of 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 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 or shrubs.

Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State BC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

Ecological communities

Conservation significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth 1997). Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act. The BC Act provides for the Minister to list an ecological community as a TEC (section 27), or as a collapsed ecological community (section 31) statutory listing of State TECs by the Minister. The legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat, and penalties for unauthorised modification of TECs.

Possible TECs that do not meet survey criteria are added to the DBCA Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5. PECs are not listed under any formal Federal or State legislation, however, may be listed as TECs under the EPBC Act.

Conservation codes and definitions for TECs listed under the EPBC Act and/ or BC Act

Categories	**Definition**
Federal Government Conservation Categories (EPBC Act)	
Critically Endangered (CR)	An ecological community if, at that time, is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Endangered (EN)	An ecological community if, at that time: A) is not critically endangered; and B) is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Vulnerable (VU)	An ecological community if, at that time: A) is not critically endangered or endangered; and B) is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Western Australia Conservation Categories (BC Act)	
Threatened Ecological Communities	

Categories	Definition
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.
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.
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.
Collapsed ecological communities	
An ecological community is eligible for listing as a collapsed ecological community at a particular time if, at that time – (a) there is no reasonable doubt that the last occurrence of the ecological community has collapsed); or (b) the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover – (i) its species composition or structure; or (ii) its species composition and structure. Section 33 of the BC Act provides for a collapsed ecological community to be regarded as a threatened ecological community if it is discovered in a state that no longer makes it eligible for listing as a collapsed ecological community.	

Conservation categories and definitions for PECS as listed by the DBCA

Category	Description
Priority 1	Poorly known ecological communities. Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. 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 2	Poorly known ecological communities. Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. 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 threat from known threatening processes.

Category	Description
Priority 3	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 with 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 4	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 5	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.

Banksia Woodlands of the Swan Coastal Plain TEC

The Banksia Woodlands of the Swan Coastal Plain was listed in September 2016 as an Endangered TEC under the EPBC Act. The Commonwealth TEC encompasses a number of FCTs, some of which area also listed as State TECs/PECs. The TSSC (2016) provides guidance for determining whether the TEC is present. These criteria are listed below

Diagnostic characteristics and condition thresholds to determine Banksia Woodlands TEC

Diagnostics characteristics / condition thresholds	Criteria
Floristic Community Type	Location and physical environment: • Occurs in the SCP IBRA bioregion Soil and landform: • Typically occurs on well drained, low nutrient soils on sandplain landforms, particularly in deep Bassendean and Spearwood sands and occasionally on Quindalup sands. Structure:

Diagnostics characteristics / condition thresholds	Criteria
	• The community is a low woodland to forest, but may also include shrubland, open woodland or forest under some classification systems. The percentage canopy cover is more than 2% and typically less than 50%. The structure and appearance may also vary due to disturbance history. Composition: • The canopy is commonly dominated by *Banksia attenuata* and or *B. menziesii*. Other *Banksia* species that dominate include *B. prionotes or B. ilicifolia*. The patch must include at least one of these diagnostic species.
Vegetation condition[1] and minimum patch size	• Pristine – no minimum • Excellent – 0.5 ha • Very Good – 1 ha • Good – 2 ha
Surrounding context	A patch is a discrete and mostly continuous area of ecological community. A patch may include small scale (<30 m) variations, gaps and disturbances, such as tracks, that do not significantly alter the overall functionality of the ecological community. Such breaks are generally included in patch size calculations. The landscape and position of the patch including its position relative to surrounding vegetation also influences how important it is in the broader landscape.

Other significant vegetation

Vegetation may be significant for a range of reasons other than a statutory listing. The EPA (2016b) states that significant vegetation may include vegetation that includes the following:

- Restricted distribution
- Degree of historical impact from threatening processes
- Local endemism in restricted habitats
- Novel combinations of taxa
- A role as a refuge
- A role as a key habitat for Threatened species or large population representing a significant proportion of the local to regional total population of a species
- Being representative of a vegetation unit in 'pristine' condition in a highly cleared landscape, recently discovered range extensions, or isolated outliers of the main range)
- Being poorly reserved.

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

[1] As per the Keighery (1994) condition scale presented in Bush Forever (Government of Western Australia 2000).

Conservation significant flora and fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the BC Act can warrant referral to the DEE and/or the EPA.

The Federal conservation level of flora and fauna species and their significance status is assessed under the EPBC Act. The significance levels for flora and fauna used in the EPBC Act align with the International Union for Conservation of Nature (IUCN) Red List criteria, which are internationally recognised as providing best practice for assigning the conservation status of species. The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

The State conservation level of flora and fauna species and their significance status also follows the IUCN Red List criteria. Under the BC Act flora and fauna can be listed as Threatened, Extinct and as Specially Protected species.

Threatened species are those are species which have been adequately searched for and are deemed to be, in the wild, either rare, under identifiable threat of extinction, or otherwise in need of special protection, and have been gazetted as such. The assessment of the conservation status of Threatened species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria. Specially protected species meet 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 or Extinct species under the BC Act cannot also be listed as Specially Protected 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 flora or fauna.

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.

For the purposes of this assessment, all species listed under the EPBC Act, BC Act and DBCA Priority species are considered conservation significant.

Conservation categories and definitions for EPBC Act and BC Act listed flora and fauna species

Conservation category	Definition
Threatened species	
Critically Endangered (CR)	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 under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.
Endangered (EN)	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
Vulnerable (VU)	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 under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.
Extinct species	
Extinct (EX)	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).
Extinct in the Wild (EW)	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 25 of the BC Act).
Specially protected species	
Migratory (MI)	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 15 of 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

Conservation category	Definition
Species of special conservation interest (conservation dependent fauna) (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Conservation codes for DBCA listed Priority flora and fauna

Priority category	Definition
Priority 1	Poorly-known taxa 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.
Priority 2	Poorly-known taxa 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.
Priority 3	Poorly-known taxa 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.
Priority 4	Rare, Near Threatened and other taxa in need of monitoring A. Rare: Taxa 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 taxa are usually represented on conservation lands. B. Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. C. Taxa that have been removed from the list of threatened taxa during the past five years for reasons other than taxonomy.

Other significant flora

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than a statutory listing. The EPA (2016b) states that significant flora may include taxa that have:

- A keystone role in a particular habitat for threatened or Priority flora or fauna species, or large populations representing a considerable proportion of the local or regional total population of a species
- Relictual status, being representation of taxonomic or physiognomic groups that no longer occur widely in the broader landscape
- Anomalous features that indicate a potential new discovery
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- The presence of restricted subspecies, varieties, or naturally occurring hybrids
- Local endemism (a restricted distribution) or association with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems)
- Being poorly reserved

Other significant fauna

Fauna species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed (EPA 2010).

Introduced plants (weeds)

Declared Pests

Information on species considered to be Declared Pests is provided under *State Biosecurity and Agriculture Management Act 2007.*

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socio-economic and environmental values

Australian state and territory governments have identified thirty-two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

References

ANZECC 2000, *Core Environmental Indicators for Reporting on the State of Environment*, ANZECC State of the Environment Reporting Task Force.

Commonwealth of Australia 2001, *National Targets and Objectives for Biodiversity Conservation 2001–2005*, Canberra, AGPS.

DEE 2019a, *Criteria for determining nationally important wetlands*, retrieved 2019, from http://www.environment.gov.au/topics/water/water-our-environment/wetlands/australian-wetlands-database/directory-important.

DEE 2019b, *The Ramsar Convention on Wetlands*, retrieved 2019, from http://www.environment.gov.au/topics/water/water-our-environment/wetlands/ramsar-convention-wetlands.

English, V and Blyth, J 1997, *Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province*, Perth, Department of Conservation and Land Management.

EPA 2010, *Technical Guide – Terrestrial Fauna Surveys*, EPA, Perth, WA.

EPA 2016a, *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment*, EPA, Perth, WA.

EPA 2016b, *Environmental Factor Guideline - Flora and Vegetation*, EPA, Perth, WA.

GoWA 2000, *Bush Forever – Keeping the Bush in the City. Volumes 1 (Policies, Principals and Processes) & 2 (Directory of Bush Forever Sites)*, Perth, Government of Western Australia.

GoWA 2018, *Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full report)*, Current as of December 2017, Perth Western Australia, Department of Environment and Conservation, from https://www2.landgate.wa.gov.au/web/guest/downloader.

Hill, AL, Semeniuk, CA, Semeniuk, V and del Marco, A 1996, *Wetlands of the Swan Coastal Plain. Volume 2: Wetland Mapping, Classification and Evaluation – Wetland Atlas*, Prepared for the Water and Rivers Commission and the Department of Environmental Protection, Perth, Western Australia.

Shepherd, DP, Beeston, GR & Hopkins, AJM 2002, *Native Vegetation in Western Australia – Extent, Type and Status, Resource Management Technical Report 249*, Perth, Department of Agriculture.

Threatened Species Scientific Community (TSSC) 2016, *Environmental Protection and Biodiversity Conservation Act 1999 Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain Ecological Community*, Department of the Environment and Energy, Canberra. Available at: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/131-conservation-advice.pdf.

Appendix C – Desktop searches

EPBC Act PMST (5 km)

Naturemap Flora Report (5 km)

Naturemap Fauna Report (5 km)

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

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

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

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

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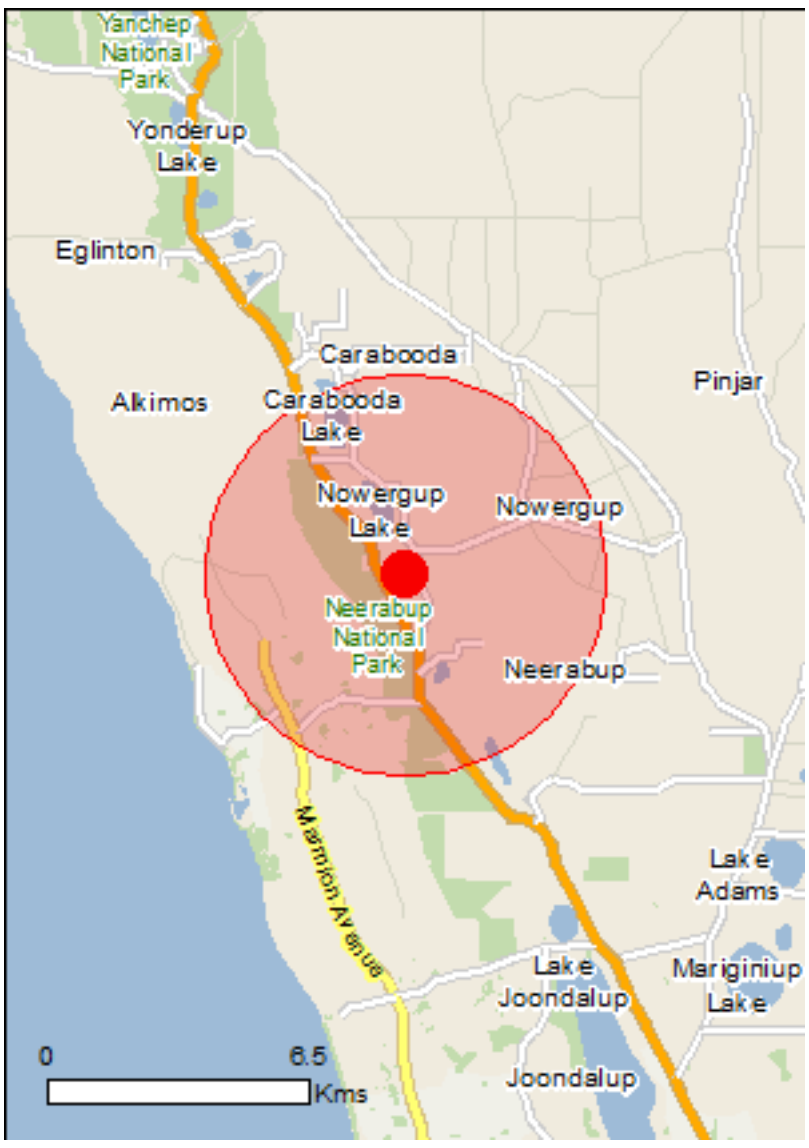

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

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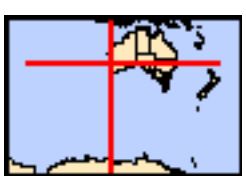

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	24
Listed Migratory Species:	13

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	20
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	34
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
[Sternula nereis nereis](#)		
Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Insects		
[Hesperocolletes douglasi](#)		
Douglas' Broad-headed Bee, Rottnest Bee [66734]	Critically Endangered	Species or species habitat may occur within area
Mammals		
[Dasyurus geoffroii](#)		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Plants		
[Andersonia gracilis](#)		
Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
[Anigozanthos viridis subsp. terraspectans](#)		
Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat may occur within area
[Diuris micrantha](#)		
Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
[Diuris purdiei](#)		
Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
[Drakaea elastica](#)		
Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
[Drakaea micrantha](#)		
Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area
[Eleocharis keigheryi](#)		
Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
[Eucalyptus argutifolia](#)		
Yanchep Mallee, Wabling Hill Mallee [24263]	Vulnerable	Species or species habitat likely to occur within area
[Lepidosperma rostratum](#)		
Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
[Marianthus paralius](#)		
[83925]	Endangered	Species or species habitat likely to occur within area
[Melaleuca sp. Wanneroo (G.J. Keighery 16705)](#)		
[89456]	Endangered	Species or species habitat known to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
[Apus pacificus](#)		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
[Ardenna carneipes](#)		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Sterna dougallii		
Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat likely to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Limosa lapponica		
Bar-tailed Godwit [844]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

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

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

Name	Threatened	Type of Presence
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Neerabup	WA
Neerabup	WA

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		

Name	Status	Type of Presence
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-31.64639 115.7375

Acknowledgements

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

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

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

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

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NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report_Flora

Created By Guest user on 20/11/2019

Kingdom Plantae
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 44' 08" E,31° 40' 18" S
Buffer 5km
Group By Family

Family	Species	Records
Aizoaceae	1	1
Amaranthaceae	3	10
Apiaceae	5	34
Araceae	1	2
Araliaceae	4	19
Arecaceae	1	1
Asparagaceae	15	53
Asteraceae	22	84
Brassicaceae	4	9
Campanulaceae	1	5
Caryophyllaceae	4	12
Casuarinaceae	2	8
Celastraceae	3	3
Centrolepidaceae	1	8
Chenopodiaceae	2	3
Colchicaceae	1	1
Crassulaceae	1	5
Cyperaceae	15	57
Dasypogonaceae	1	2
Dilleniaceae	6	23
Droseraceae	6	23
Ericaceae	11	30
Fabaceae	38	106
Fabroniaceae	1	5
Geraniaceae	4	10
Goodeniaceae	3	6
Haemodoraceae	11	35
Haloragaceae	1	3
Halymeniaceae	1	1
Hemerocallidaceae	6	20
Iridaceae	5	26
Juncaginaceae	1	1
Lamiaceae	2	4
Lauraceae	2	4
Loranthaceae	1	1
Malvaceae	1	1
Montiaceae	2	2
Myrtaceae	16	66
Orchidaceae	18	51
Orobanchaceae	2	4
Phyllanthaceae	2	15
Pittosporaceae	1	1
Poaceae	17	73
Polygalaceae	2	3
Proteaceae	20	58
Restionaceae	1	1
Rhamnaceae	3	6
Rubiaceae	1	3
Rutaceae	1	1
Santalaceae	1	1
Sapindaceae	2	2
Schizymeniaceae	1	1
Stylidiaceae	7	16
Thymelaeaceae	3	5
Violaceae	1	6
Xanthorrhoeaceae	2	17
Zamiaceae	1	7
TOTAL	**291**	**955**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Aizoaceae					
1.	17543	*Sarcozona bicarinata*		P3	
Amaranthaceae					
2.	2718	*Ptilotus drummondii (Narrowleaf Mulla Mulla)*			
3.	11260	*Ptilotus drummondii var. drummondii (Pussytail)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
4.	2742	*Ptilotus manglesii (Pom Poms, Mulamula)*			
Apiaceae					
5.	6218	*Daucus glochidiatus (Australian Carrot)*			
6.	6219	*Eryngium pinnatifidum (Blue Devils)*			
7.	15446	*Eryngium pinnatifidum subsp. pinnatifidum*			
8.	6222	*Homalosciadium homalocarpum*			
9.	6289	*Xanthosia huegelii*			
Araceae					
10.	28342	*Landoltia punctata (Thin Duckweed)*			
Araliaceae					
11.	6226	*Hydrocotyle callicarpa (Small Pennywort)*			
12.	6229	*Hydrocotyle diantha*			
13.	6232	*Hydrocotyle hispidula*			
14.	6280	*Trachymene pilosa (Native Parsnip)*			
Arecaceae					
15.	17910	*Washingtonia filifera*	Y		
Asparagaceae					
16.	1208	*Acanthocarpus preissii*			
17.	1287	*Dichopogon capillipes*			
18.	1223	*Lomandra caespitosa (Tufted Mat Rush)*			
19.	1228	*Lomandra hermaphrodita*			
20.	1231	*Lomandra maritima*			
21.	14542	*Lomandra micrantha subsp. micrantha*			
22.	1234	*Lomandra nigricans*			
23.	1239	*Lomandra preissii*			
24.	1243	*Lomandra sericea (Silky Mat Rush)*			
25.	1246	*Lomandra suaveolens*			
26.	1312	*Sowerbaea laxiflora (Purple Tassels)*			
27.	1338	*Thysanotus manglesianus (Fringed Lily)*			
28.	1339	*Thysanotus multiflorus (Many-flowered Fringe Lily)*			
29.	1343	*Thysanotus patersonii*			
30.	1351	*Thysanotus sparteus*			
Asteraceae					
31.	7851	*Asteridea pulverulenta (Common Bristle Daisy)*			
32.	7909	*Carduus pycnocephalus (Slender Thistle)*	Y		
33.	7937	*Cirsium vulgare (Spear Thistle, Scotch Thistle)*	Y		
34.	20074	*Conyza sumatrensis*	Y		
35.	7976	*Galinsoga parviflora (Potato Weed)*	Y		
36.	16311	*Gazania linearis*	Y		
37.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
38.	8106	*Millotia tenuifolia (Soft Millotia)*			
39.	42281	*Pithocarpa cordata*			
40.	8175	*Podolepis gracilis (Slender Podolepis)*			
41.	8177	*Podolepis lessonii*			
42.	8183	*Podotheca chrysantha (Yellow Podotheca)*			
43.	8195	*Quinetia urvillei*			
44.	8225	*Siloxerus humifusus (Procumbent Siloxerus)*			
45.	8230	*Sonchus asper (Rough Sowthistle)*	Y		
46.	9367	*Sonchus hydrophilus (Native Sowthistle)*			
47.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
48.	8254	*Urospermum picroides (False Hawkbit)*	Y		
49.	8255	*Ursinia anthemoides (Ursinia)*	Y		
50.	38388	*Ursinia anthemoides subsp. anthemoides*	Y		
51.	15725	*Verbesina encelioides*	Y		
52.	8282	*Waitzia suaveolens (Fragrant Waitzia)*			
Brassicaceae					
53.	11187	*Brassica barrelieri subsp. oxyrrhina (Smooth-stem Turnip)*	Y		
54.	3000	*Brassica tournefortii (Mediterranean Turnip)*	Y		
55.	3016	*Heliophila pusilla*	Y		
56.	3080	*Stenopetalum robustum*			
Campanulaceae					
57.	7389	*Wahlenbergia preissii*			
Caryophyllaceae					
58.	2889	*Cerastium glomeratum (Mouse Ear Chickweed)*	Y		
59.	16693	*Minuartia mediterranea*	Y		
60.	2910	*Silene nocturna (Mediterranean Catchfly)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
			Y		
61.	2918	*Stellaria media (Chickweed)*	Y		
Casuarinaceae					
62.	1728	*Allocasuarina fraseriana (Sheoak, Kondil)*			
63.	1732	*Allocasuarina humilis (Dwarf Sheoak)*			
Celastraceae					
64.	4733	*Stackhousia monogyna*			
65.	9070	*Stackhousia pubescens (Downy Stackhousia)*			
66.	4737	*Tripterococcus brunonis (Winged Stackhousia)*			
Centrolepidaceae					
67.	1125	*Centrolepis drummondiana*			
Chenopodiaceae					
68.	2483	*Chenopodium album (Fat Hen)*	Y		
69.	11341	*Rhagodia baccata subsp. baccata*			
Colchicaceae					
70.	12770	*Burchardia congesta*			
Crassulaceae					
71.	3137	*Crassula colorata (Dense Stonecrop)*			
Cyperaceae					
72.	43241	*Carex thecata*			
73.	910	*Isolepis cernua (Nodding Club-rush)*			
74.	917	*Isolepis marginata (Coarse Club-rush)*			
75.	925	*Lepidosperma angustatum*			
76.	42742	*Lepidosperma calcicola*			
77.	944	*Lepidosperma scabrum*			
78.	945	*Lepidosperma squamatum*			
79.	955	*Mesomelaena pseudostygia*			
80.	982	*Schoenus clandestinus*			
81.	984	*Schoenus curvifolius*			
82.	985	*Schoenus discifer*			
83.	992	*Schoenus grandiflorus (Large Flowered Bogrush)*			
84.	997	*Schoenus lanatus (Woolly Bog-rush)*			
85.	1036	*Tetraria octandra*			
86.	35581	*Tetraria sp. Chandala (G.J. Keighery 17055)*		P2	
Dasypogonaceae					
87.	1213	*Calectasia cyanea (Blue Tinsel Lily)*		T	
Dilleniaceae					
88.	5112	*Hibbertia aurea*			
89.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			
90.	45534	*Hibbertia hypericoides subsp. hypericoides*			
91.	5162	*Hibbertia racemosa (Stalked Guinea Flower)*			
92.	43280	*Hibbertia sericosepala*			
93.	11461	*Hibbertia spicata subsp. leptotheca*		P3	
Droseraceae					
94.	48751	*Drosera drummondii*			
95.	3095	*Drosera erythrorhiza (Red Ink Sundew)*			
96.	48769	*Drosera indumenta*			
97.	3106	*Drosera macrantha (Bridal Rainbow)*			
98.	3109	*Drosera menziesii (Pink Rainbow)*			
99.	3118	*Drosera pallida (Pale Rainbow)*			
Ericaceae					
100.	6311	*Andersonia heterophylla*			
101.	6314	*Andersonia lehmanniana*			
102.	6323	*Astroloma ciliatum (Candle Cranberry)*			
103.	6331	*Astroloma microcalyx (Native Cranberry)*			
104.	6334	*Astroloma pallidum (Kick Bush)*			
105.	6348	*Conostephium pendulum (Pearl Flower)*			
106.	6427	*Leucopogon parviflorus (Coast Beard-heath)*			
107.	6434	*Leucopogon polymorphus*			
108.	6436	*Leucopogon propinquus*			
109.	19460	*Leucopogon sp. Yanchep (M. Hislop 1986)*		P3	
110.	6456	*Lysinema ciliatum (Curry Flower)*			
Fabaceae					
111.	15470	*Acacia barbinervis subsp. borealis*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
112.	3237	*Acacia benthamii*		P2	
113.	3282	*Acacia cyclops (Coastal Wattle)*			
114.	3409	*Acacia lasiocarpa (Panjang)*			
115.	11611	*Acacia lasiocarpa var. lasiocarpa*			
116.	3502	*Acacia pulchella (Prickly Moses)*			
117.	15481	*Acacia pulchella var. glaberrima*			
118.	3525	*Acacia rostellifera (Summer-scented Wattle)*			
119.	3527	*Acacia saligna (Orange Wattle, Kudjong)*			
120.	30032	*Acacia saligna subsp. saligna*			
121.	3584	*Acacia truncata*			
122.	3602	*Acacia willdenowiana (Grass Wattle)*			
123.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
124.	19747	*Daviesia decurrens subsp. decurrens*			
125.	3807	*Daviesia divaricata (Marno)*			
126.	18560	*Daviesia divaricata subsp. divaricata*			
127.	3824	*Daviesia nudiflora*			
128.	3845	*Daviesia triflora*			
129.	20483	*Gastrolobium linearifolium*			
130.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
131.	3961	*Hardenbergia comptoniana (Native Wisteria)*			
132.	12859	*Hovea trisperma var. trisperma*			
133.	3992	*Isotropis cuneifolia (Granny Bonnets)*			
134.	14783	*Jacksonia calcicola*			
135.	20462	*Jacksonia gracillima*		P3	
136.	4027	*Jacksonia sericea (Waldjumi)*		P4	
137.	4029	*Jacksonia sternbergiana (Stinkwood, Kapur)*			
138.	4044	*Kennedia prostrata (Scarlet Runner)*			
139.	4066	*Lupinus cosentinii*	Y		
140.	4207	*Sphaerolobium medium*			
141.	4256	*Templetonia retusa (Cockies Tongues)*			
142.	4292	*Trifolium campestre (Hop Clover)*	Y		
143.	17763	*Trifolium campestre var. campestre (Hop Clover)*	Y		
144.	4295	*Trifolium dubium (Suckling Clover)*	Y		
145.	4297	*Trifolium glomeratum (Cluster Clover)*	Y		
146.	4309	*Trifolium scabrum (Rough Clover)*	Y		
147.	4322	*Vicia sativa (Common Vetch)*	Y		
148.	11474	*Vicia sativa subsp. nigra*	Y		
Fabroniaceae					
149.	20162	*Fabronia hampeana*		P2	
Geraniaceae					
150.	4332	*Erodium botrys (Long Storksbill)*	Y		
151.	4339	*Geranium molle (Dove's Foot Cranesbill)*	Y		
152.	4343	*Pelargonium capitatum (Rose Pelargonium)*	Y		
153.	4346	*Pelargonium littorale*			
Goodeniaceae					
154.	7580	*Lechenaultia linarioides (Yellow Leschenaultia)*			
155.	7603	*Scaevola canescens (Grey Scaevola)*			
156.	13182	*Scaevola repens var. repens*			
Haemodoraceae					
157.	1409	*Anigozanthos humilis (Catspaw)*			
158.	11434	*Anigozanthos humilis subsp. humilis*			
159.	1418	*Conostylis aculeata (Prickly Conostylis)*			
160.	11826	*Conostylis aculeata subsp. aculeata*			
161.	1425	*Conostylis bracteata*		P3	
162.	1427	*Conostylis candicans (Grey Cottonhead)*			
163.	1443	*Conostylis pauciflora (Dawesville Conostylis)*			
164.	1454	*Conostylis setigera (Bristly Cottonhead)*			
165.	11597	*Conostylis setigera subsp. setigera*			
166.	1468	*Haemodorum laxum*			
167.	1478	*Phlebocarya ciliata*			
Haloragaceae					
168.	6143	*Glischrocaryon aureum (Common Popflower)*			
Halymeniaceae					
169.	26850	*Gelinaria ulvoidea*			
Hemerocallidaceae					
170.	1276	*Caesia micrantha (Pale Grass Lily)*			
171.	1285	*Corynotheca micrantha (Sand Lily)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
172.	1259	*Dianella revoluta (Blueberry Lily)*			
173.	11636	*Dianella revoluta var. divaricata*			
174.	1260	*Stypandra glauca (Blind Grass)*			
175.	1361	*Tricoryne elatior (Yellow Autumn Lily)*			
Iridaceae					
176.	1520	*Gladiolus caryophyllaceus (Wild Gladiolus)*	Y		
177.	1537	*Orthrosanthus laxus (Morning Iris)*			
178.	11749	*Orthrosanthus laxus var. laxus (Morning Iris)*			
179.	1556	*Romulea rosea (Guildford Grass)*	Y		
180.	1558	*Sparaxis bulbifera*	Y		
Juncaginaceae					
181.	152	*Triglochin trichophora*			
Lamiaceae					
182.	16933	*Hemiandra glabra*			
183.	6839	*Hemiandra pungens (Snakebush)*			
Lauraceae					
184.	2952	*Cassytha glabella (Tangled Dodder Laurel)*			
185.	2957	*Cassytha racemosa (Dodder Laurel)*			
Loranthaceae					
186.	2401	*Nuytsia floribunda (Christmas Tree, Mudja)*			
Malvaceae					
187.	5105	*Thomasia triphylla*			
Montiaceae					
188.	2848	*Calandrinia corrigioloides (Strap Purslane)*			
189.	2856	*Calandrinia liniflora (Parakeelya)*			
Myrtaceae					
190.	34161	*Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)*		P1	
191.	5426	*Calothamnus quadrifidus (One-sided Bottlebrush, Kwowdjard)*			
192.	5429	*Calothamnus sanguineus (Silky-leaved Blood flower, Pindak)*			
193.	5458	*Calytrix flavescens (Summer Starflower)*			
194.	13091	*Eucalyptus argutifolia (Wabling Hill Mallee)*		T	
195.	5615	*Eucalyptus decipiens (Limestone Marlock, Moit)*			
196.	5649	*Eucalyptus foecunda (Narrow-leaved Red Mallee)*			
197.	5659	*Eucalyptus gomphocephala (Tuart, Duart)*			
198.	5708	*Eucalyptus marginata (Jarrah, Djara)*			
199.	20808	*Eucalyptus petiolaris*	Y		
200.	13541	*Eucalyptus petrensis*			
201.	5850	*Leptospermum laevigatum (Coast Teatree)*	Y		
202.	5887	*Melaleuca cardiophylla (Tangling Melaleuca)*			
203.	5920	*Melaleuca huegelii (Chenille Honeymyrtle)*			
204.	33022	*Melaleuca sp. Wanneroo (G.J. Keighery 16705)*		T	
205.	18598	*Melaleuca systena*			
Orchidaceae					
206.	11038	*Caladenia bicalliata*			
207.	1592	*Caladenia flava (Cowslip Orchid)*			
208.	15352	*Caladenia georgei*			
209.	1595	*Caladenia hirta (Sugar Candy Orchid)*			
210.	1599	*Caladenia latifolia (Pink Fairy Orchid)*			
211.	15361	*Caladenia longicauda subsp. calcigena*			
212.	10916	*Cyrtostylis huegelii*			
213.	19649	*Disa bracteata*	Y		
214.	1635	*Diuris longifolia (Common Donkey Orchid)*			
215.	1643	*Elythranthera brunonis (Purple Enamel Orchid)*			
216.	1646	*Eriochilus dilatatus (White Bunny Orchid)*			
217.	1653	*Leporella fimbriata (Hare Orchid)*			
218.	15419	*Microtis media subsp. media*			
219.	1672	*Prasophyllum fimbria (Fringed Leek Orchid)*			
220.		*Pterostylis aff. nana*			
221.	17267	*Pterostylis brevisepala*			
222.	12217	*Pterostylis sanguinea*			
223.	1698	*Pterostylis vittata (Banded Greenhood)*			
Orobanchaceae					
224.	7046	*Bellardia trixago (Bellardia)*	Y		
225.	7122	*Orobanche minor (Lesser Broomrape)*	Y		

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Phyllanthaceae					
226.	4675	*Phyllanthus calycinus (False Boronia)*			
227.	4691	*Poranthera microphylla (Small Poranthera)*			
Pittosporaceae					
228.	25819	*Marianthus paralius*		T	
Poaceae					
229.	184	*Aira caryophyllea (Silvery Hairgrass)*	Y		
230.	17240	*Austrostipa flavescens*			
231.	231	*Avellinia michelii*	Y		
232.	233	*Avena barbata (Bearded Oat)*	Y		
233.	244	*Briza maxima (Blowfly Grass)*	Y		
234.	245	*Briza minor (Shivery Grass)*	Y		
235.	249	*Bromus diandrus (Great Brome)*	Y		
236.	306	*Dichelachne crinita (Longhair Plumegrass)*			
237.	347	*Ehrharta calycina (Perennial Veldt Grass)*	Y		
238.	349	*Ehrharta longiflora (Annual Veldt Grass)*	Y		
239.	376	*Eragrostis curvula (African Lovegrass)*	Y		
240.	445	*Holcus setiger (Annual Fog)*	Y		
241.	467	*Lagurus ovatus (Hare's Tail Grass)*	Y		
242.	485	*Microlaena stipoides (Weeping Grass)*			
243.	573	*Poa drummondiana (Knotted Poa)*			
244.	578	*Poa porphyroclados*			
245.	724	*Vulpia myuros (Rat's Tail Fescue)*	Y		
Polygalaceae					
246.	4550	*Comesperma calymega (Blue-spike Milkwort)*			
247.	4552	*Comesperma confertum*			
Proteaceae					
248.	1800	*Banksia attenuata (Slender Banksia, Piara)*			
249.	11386	*Banksia leptophylla var. melletica*			
250.	1834	*Banksia menziesii (Firewood Banksia)*			
251.	32076	*Banksia sessilis (Parrot Bush, Pudjak)*			
252.	32077	*Banksia sessilis var. cygnorum*			
253.	1885	*Conospermum triplinervium (Tree Smokebush)*			
254.	15839	*Grevillea preissii subsp. preissii*			
255.	2119	*Grevillea vestita*			
256.	12824	*Grevillea vestita subsp. vestita*			
257.	2146	*Hakea costata (Ribbed Hakea)*			
258.	2175	*Hakea lissocarpha (Honey Bush)*			
259.	2203	*Hakea ruscifolia (Candle Hakea)*			
260.	2214	*Hakea trifurcata (Two-leaf Hakea)*			
261.	2258	*Persoonia comata*			
262.	20368	*Petrophile axillaris*			
263.	2299	*Petrophile linearis (Pixie Mops)*			
264.	2301	*Petrophile macrostachya*			
265.	2309	*Petrophile serruriae*			
266.	2316	*Stirlingia latifolia (Blueboy)*			
267.	15532	*Synaphea spinulosa subsp. spinulosa*			
Restionaceae					
268.	17663	*Desmocladus asper*			
Rhamnaceae					
269.	4802	*Cryptandra mutila*			
270.	4810	*Cryptandra scoparia*			
271.	4828	*Spyridium globulosum (Basket Bush)*			
Rubiaceae					
272.	7323	*Galium murale (Small Goosegrass)*	Y		
Rutaceae					
273.	17665	*Boronia purdieana subsp. purdieana*			
Santalaceae					
274.	2344	*Leptomeria empetriformis*			
Sapindaceae					
275.	4746	*Diplopeltis huegelii*			
276.	18541	*Diplopeltis huegelii subsp. huegelii*			
Schizymeniaceae					
277.	27144	*Platoma cyclocolpum*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Stylidiaceae					
278.	7677	*Levenhookia stipitata (Common Stylewort)*			
279.	30278	*Stylidium androsaceum*			
280.	7693	*Stylidium brunonianum (Pink Fountain Triggerplant)*			
281.	7696	*Stylidium calcaratum (Book Triggerplant)*			
282.	7745	*Stylidium junceum (Reed Triggerplant)*			
283.	13127	*Stylidium maritimum*		P3	
284.	25829	*Stylidium neurophyllum (Coastal Plain Triggerplant)*			
Thymelaeaceae					
285.	5232	*Pimelea argentea (Silvery Leaved Pimelea)*			
286.	5237	*Pimelea calcicola*		P3	
287.	5243	*Pimelea ferruginea*			
Violaceae					
288.	5216	*Hybanthus calycinus (Wild Violet)*			
Xanthorrhoeaceae					
289.	1280	*Chamaescilla corymbosa (Blue Squill)*			
290.	1256	*Xanthorrhoea preissii (Grass tree, Palga)*			
Zamiaceae					
291.	85	*Macrozamia riedlei (Zamia, Djiridji)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
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[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report_Fauna

Created By Guest user on 20/11/2019

Kingdom	Animalia
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	115° 44' 08" E,31° 40' 18" S
Buffer	5km
Group By	Species Group

Species Group	Species	Records
Amphibian	5	40
Bird	142	1413
Fish	1	1
Invertebrate	27	115
Mammal	22	113
Reptile	52	529
TOTAL	**249**	**2211**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Amphibian					
1.	25400	*Crinia insignifera (Squelching Froglet)*			
2.	25410	*Heleioporus eyrei (Moaning Frog)*			
3.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
4.	25420	*Myobatrachus gouldii (Turtle Frog)*			
5.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
Bird					
6.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
7.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
8.	24262	*Acanthiza inornata (Western Thornbill)*			
9.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
10.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
11.	25536	*Accipiter fasciatus (Brown Goshawk)*			
12.	24282	*Accipiter fasciatus subsp. fasciatus (Brown Goshawk)*			
13.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
14.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
15.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
16.	24312	*Anas gracilis (Grey Teal)*			
17.	24315	*Anas rhynchotis (Australasian Shoveler)*			
18.	24316	*Anas superciliosa (Pacific Black Duck)*			
19.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
20.	24561	*Anthochaera carunculata (Red Wattlebird)*			
21.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
22.	24285	*Aquila audax (Wedge-tailed Eagle)*			
23.	41324	*Ardea modesta (great egret, white egret)*			
24.	24340	*Ardea novaehollandiae (White-faced Heron)*			
25.	24341	*Ardea pacifica (White-necked Heron)*			
26.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
27.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
28.	24318	*Aythya australis (Hardhead)*			
29.		*Barnardius zonarius*			
30.	24319	*Biziura lobata (Musk Duck)*			
31.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
32.	25715	*Cacatua roseicapilla (Galah)*			
33.	25716	*Cacatua sanguinea (Little Corella)*			
34.	24727	*Cacatua sanguinea subsp. westralensis (Little Corella)*			
35.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
36.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
37.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
38.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
39.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
		Cockatoo)		T	
40.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		T	
41.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
42.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
43.	47909	*Cheramoeca leucosterna (White-backed Swallow)*			
44.		*Chroicocephalus novaehollandiae*			
45.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
46.	24288	*Circus approximans (Swamp Harrier)*			
47.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
48.	24613	*Colluricincla harmonica subsp. rufiventris (Grey Shrike-thrush)*			
49.	24399	*Columba livia (Domestic Pigeon)*	Y		
50.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
51.	24416	*Corvus bennetti (Little Crow)*			
52.	25592	*Corvus coronoides (Australian Raven)*			
53.	24417	*Corvus coronoides subsp. perplexus (Australian Raven)*			
54.	25701	*Coturnix ypsilophora (Brown Quail)*			
55.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
56.	25595	*Cracticus tibicen (Australian Magpie)*			
57.	24422	*Cracticus tibicen subsp. dorsalis (White-backed Magpie)*			
58.	25596	*Cracticus torquatus (Grey Butcherbird)*			
59.	24424	*Cracticus torquatus subsp. torquatus (Grey Butcherbird)*			
60.	24322	*Cygnus atratus (Black Swan)*			
61.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
62.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
63.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
64.	24470	*Dromaius novaehollandiae (Emu)*			
65.		*Egretta novaehollandiae*			
66.		*Elanus axillaris*			
67.		*Eolophus roseicapillus*			
68.	24651	*Eopsaltria australis subsp. griseogularis (Western Yellow Robin)*			
69.	24818	*Eudyptula minor subsp. novaehollandiae (Little Penguin)*			
70.	24368	*Eurostopodus argus (Spotted Nightjar)*			
71.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
72.	25623	*Falco longipennis (Australian Hobby)*			
73.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
74.	25727	*Fulica atra (Eurasian Coot)*			
75.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
76.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
77.	24763	*Gallinula tenebrosa subsp. tenebrosa (Dusky Moorhen)*			
78.	25530	*Gerygone fusca (Western Gerygone)*			
79.	24443	*Grallina cyanoleuca (Magpie-lark)*			
80.	24295	*Haliastur sphenurus (Whistling Kite)*			
81.	47965	*Hieraaetus morphnoides (Little Eagle)*			
82.	25734	*Himantopus himantopus (Black-winged Stilt)*			
83.	24491	*Hirundo neoxena (Welcome Swallow)*			
84.	24367	*Lalage tricolor (White-winged Triller)*			
85.	24511	*Larus novaehollandiae subsp. novaehollandiae (Silver Gull)*			
86.	25638	*Larus pacificus (Pacific Gull)*			
87.	25661	*Lichmera indistincta (Brown Honeyeater)*			
88.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
89.	24544	*Malurus lamberti subsp. assimilis (Variegated Fairy-wren)*			
90.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
91.	25654	*Malurus splendens (Splendid Fairy-wren)*			
92.	24552	*Malurus splendens subsp. splendens (Splendid Fairy-wren)*			
93.	24583	*Manorina flavigula (Yellow-throated Miner)*			
94.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
95.	24598	*Merops ornatus (Rainbow Bee-eater)*			
96.		*Microcarbo melanoleucos*			
97.	25693	*Microeca fascinans (Jacky Winter)*			
98.	48008	*Morus serrator (Australasian Gannet)*			
99.	24738	*Neophema elegans (Elegant Parrot)*			
100.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
101.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
102.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
103.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
104.	24624	*Pachycephala rufiventris subsp. rufiventris (Rufous Whistler)*			
105.	48591	*Pandion cristatus (Osprey, Eastern Osprey)*		IA	
106.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
107.	25682	*Pardalotus striatus (Striated Pardalote)*			
108.	24648	*Pelecanus conspicillatus (Australian Pelican)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
109.	48061	*Petrochelidon nigricans (Tree Martin)*			
110.	48066	*Petroica boodang (Scarlet Robin)*			
111.	24659	*Petroica goodenovii (Red-capped Robin)*			
112.	25697	*Phalacrocorax carbo (Great Cormorant)*			
113.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
114.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
115.	25699	*Phalacrocorax varius (Pied Cormorant)*			
116.	24409	*Phaps chalcoptera (Common Bronzewing)*			
117.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
118.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
119.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
120.	25720	*Platycercus icterotis (Western Rosella)*			
121.	24747	*Platycercus spurius (Red-capped Parrot)*			
122.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
123.	24750	*Platycercus zonarius subsp. semitorquatus (Twenty-eight Parrot)*			
124.	25703	*Podargus strigoides (Tawny Frogmouth)*			
125.	25704	*Podiceps cristatus (Great Crested Grebe)*			
126.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
127.	25722	*Polytelis anthopeplus (Regent Parrot)*			
128.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
129.	24767	*Porphyrio porphyrio subsp. bellus (Purple Swamphen)*			
130.	24716	*Puffinus pacificus (Wedge-tailed Shearwater)*		IA	
131.		*Purpureicephalus spurius*			
132.	48096	*Rhipidura albiscapa (Grey Fantail)*			
133.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
134.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
135.	30948	*Smicrornis brevirostris (Weebill)*			
136.	25597	*Strepera versicolor (Grey Currawong)*			
137.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
138.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
139.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
140.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
141.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
142.	48597	*Thalasseus bergii (Crested Tern)*		IA	
143.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
144.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
145.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
146.	25762	*Tyto alba (Barn Owl)*			
147.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

Fish

148.		*Odax cyanomelas*			

Invertebrate

149.		*Amblyomma triguttatum*			
150.		*Aname mainae*			
151.		*Araneus cyphoxis*			
152.		*Araneus senicaudatus*			
153.		*Austracantha minax*			
154.	33973	*Austrosaga spinifer (spiny katydid (Swan Coastal Plain), bush cricket (Swan Coastal Plain))*		P2	
155.		*Cormocephalus aurantiipes*			
156.		*Cormocephalus novaehollandiae*			
157.		*Cormocephalus rubriceps*			
158.		*Cormocephalus turneri*			
159.		*Idiommata blackwalli*			
160.	48935	*Idiosoma sigillatum (Swan Coastal Plain shield-backed trapdoor spider)*		P3	
161.		*Indolpium sp.*			
162.		*Latrodectus hasseltii*			
163.		*Maratus pavonis*			
164.		*Masasteron sampeyae*			
165.		*Missulena occatoria*			
166.	33988	*Pachysaga munggai (cricket)*			
167.		*Paraplectanoides crassipes*			
168.		*Raveniella arenacea*			
169.		*Raveniella cirrata*			
170.		*Raveniella peckorum*			
171.	33992	*Synemon gratiosa (Graceful Sunmoth)*		P4	
172.		*Tasmanicosa leuckartii*			
173.		*Urodacus novaehollandiae*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
174.		*Venator immansueta*			
175.		*Westrarchaea spinosa*			
Mammal					
176.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
177.	24043	*Eubalaena australis (Southern Right Whale)*		T	
178.	24041	*Felis catus (Cat)*	Y		
179.	48588	*Isoodon fusciventer (Quenda, southwestern brown bandicoot)*		P4	
180.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
181.	24051	*Megaptera novaeangliae (Humpback Whale)*		S	
182.	24223	*Mus musculus (House Mouse)*	Y		
183.	48022	*Notamacropus irma (Western Brush Wallaby)*		P4	
184.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
185.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
186.	24154	*Perameles bougainville subsp. bougainville (Western Barred Bandicoot, Marl)*		T	
187.	24155	*Perameles eremiana (Desert Bandicoot, walilya)*		X	
188.	24156	*Petaurus breviceps subsp. ariel (Sugar Glider)*			
189.	24073	*Physeter macrocephalus (Sperm Whale)*		T	
190.	24243	*Rattus fuscipes (Western Bush Rat)*			
191.	24245	*Rattus rattus (Black Rat)*	Y		
192.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
193.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
194.	25521	*Trichosurus vulpecula (Common Brushtail Possum)*			
195.	24157	*Trichosurus vulpecula subsp. arnhemensis (northern brushtail possum (Kimberley))*		T	
196.	24158	*Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)*			
197.	24040	*Vulpes vulpes (Red Fox)*	Y		
Reptile					
198.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
199.	44629	*Anilios australis*			
200.	24991	*Aprasia repens (Sand-plain Worm-lizard)*			
201.	42381	*Brachyurophis semifasciatus (Southern Shovel-nosed Snake)*			
202.	25335	*Caretta caretta (Loggerhead Turtle)*		T	
203.	43380	*Chelodina colliei (South-western Snake-necked Turtle)*			
204.	25336	*Chelonia mydas (Green Turtle)*		T	
205.	24980	*Christinus marmoratus (Marbled Gecko)*			
206.	24918	*Crenadactylus ocellatus subsp. ocellatus (Clawless Gecko)*			
207.	30893	*Cryptoblepharus buchananii*			
208.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			
209.	25027	*Ctenotus australis*			
210.	25039	*Ctenotus fallens*			
211.	25087	*Cyclodomorphus celatus (Western Slender Blue-tongue)*			
212.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
213.	24999	*Delma grayii*			
214.	25468	*Demansia psammophis (Yellow-faced Whipsnake)*			
215.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
216.	24939	*Diplodactylus polyophthalmus*			
217.	25251	*Echiopsis curta (Bardick)*			
218.	25100	*Egernia napoleonis*			
219.	25119	*Hemiergis quadrilineata*			
220.	43384	*Hydrophis platurus (Yellow-bellied Seasnake)*			
221.	25131	*Lerista distinguenda*			
222.	25133	*Lerista elegans*			
223.	25148	*Lerista lineopunctulata*			
224.	25165	*Lerista praepedita*			
225.	25005	*Lialis burtonis*			
226.	25184	*Menetia greyii*			
227.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*			
228.	25191	*Morethia lineoocellata*			
229.	25192	*Morethia obscura*			
230.	25248	*Neelaps bimaculatus (Black-naped Snake)*			
231.	25249	*Neelaps calonotos (Black-striped Snake, black-striped burrowing snake)*		P3	
232.	25252	*Notechis scutatus (Tiger Snake)*			
233.	25253	*Parasuta gouldii*			
234.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
235.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
236.	25511	*Pseudonaja affinis (Dugite)*			
237.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
238.	25258	*Pseudonaja affinis subsp. exilis (Rottnest Island Dugite)*		P4	
239.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			
240.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
241.	25518	*Strophurus spinigerus*			
242.	24943	*Strophurus spinigerus subsp. inornatus*			
243.	24942	*Strophurus spinigerus subsp. spinigerus*			
244.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
245.	25519	*Tiliqua rugosa*			
246.	25204	*Tiliqua rugosa subsp. aspera*			
247.	25207	*Tiliqua rugosa subsp. rugosa*			
248.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
249.	25526	*Varanus tristis (Racehorse Monitor)*			

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Appendix D – Flora data

Flora species list

Quadrat data

TEC/PEC analysis

Flora likelihood of occurrence

Flora taxa recorded within the survey area

Family	Taxa	Status
Aizoaceae	*Carpobrotus edulis*	*
Aizoaceae	*Carpobrotus virescens*	
Amaranthaceae	*Ptilotus polystachyus*	
Apiaceae	*Foeniculum vulgare*	
Apiaceae	*Trachymene pilosa*	
Asparagaceae	*Acanthocarpus preissii*	
Asparagaceae	*Asparagus asparagoides*	*DP
Asparagaceae	*Thysanotus arenarius*	
Asparagaceae	*Thysanotus manglesianus*	
Asteraceae	*Arctotheca calendula*	*
Asteraceae	*Conyza bonariensis*	*
Asteraceae	*Hypochaeris glabra*	*
Asteraceae	*Hypochaeris radicata*	*
Asteraceae	*Hypochaeris sp.*	*
Asteraceae	*Olearia axillaris*	
Asteraceae	*Podolepis lessonii*	
Asteraceae	*Sonchus oleraceus*	*
Asteraceae	*Ursinia anthemoides*	*
Asteraceae	*Waitzia suaveolens* var. *suaveolens*	
Boraginaceae	*Echium plantagineum*	*DP
Brassicaceae	*Brassica tournefortii*	*
Brassicaceae	*Heliophila pusilla*	*
Caprifoliaceae	*Centranthus macrosiphon*	*
Caryophyllaceae	*Petrorhagia dubia*	*
Caryophyllaceae	*Silene gallica*	*
Casuarinaceae	*Allocasuarina fraseriana*	
Casuarinaceae	*Allocasuarina humilis*	
Celastraceae	*Stackhousia monogyna*	
Chenopodiaceae	*Rhagodia baccata*	
Colchicaceae	*Burchardia congesta*	
Cyperaceae	*Ficinia nodosa*	
Cyperaceae	*Lepidosperma ?pubisquameum*	
Cyperaceae	*Lepidosperma* sp.	
Cyperaceae	*Mesomelaena pseudostygia*	
Cyperaceae	*Schoenus* sp. (sterile)	
Dilleniaceae	*Hibbertia hypericoides*	
Droseraceae	*Drosera erythrorhiza*	
Ericaceae	*Astroloma ciliatum*	
Ericaceae	*Conostephium pendulum*	
Ericaceae	*Leucopogon parviflorus*	
Ericaceae	*Leucopogon polymorphus*	
Euphorbiaceae	*Euphorbia peplus*	*
Euphorbiaceae	*Euphorbia terracina*	*

Family	Taxa	Status
Euphorbiaceae	*Phyllanthus calycinus*	
Euphorbiaceae	*Ricinus communis*	*
Fabaceae	*Acacia pulchella* var. *glaberrima*	
Fabaceae	*Acacia saligna*	
Fabaceae	*Bossiaea eriocarpa*	
Fabaceae	*Daviesia decurrens*	
Fabaceae	*Daviesia triflora*	
Fabaceae	*Gastrolobium capitatum*	
Fabaceae	*Gompholobium tomentosum*	
Fabaceae	*Hardenbergia comptoniana*	
Fabaceae	*Hovea trisperma*	
Fabaceae	*Jacksonia calcicola*	
Fabaceae	*Jacksonia sternbergiana*	
Fabaceae	*Jacksonia sternbergiana*	
Fabaceae	*Melilotus indicus*	*
Fabaceae	*Trifolium campestre*	*
Fabaceae	*Trifolium dubium*	*
Geraniaceae	*Pelargonium capitatum*	*
Goodeniaceae	*Scaevola canescens*	
Haemodoraceae	*Conostylis aculeata*	
Haemodoraceae	*Conostylis candicans* subsp. *candicans*	
Haemodoraceae	*Conostylis setigera*	
Haemodoraceae	*Haemodorum loratum*	
Hemerocallidaceae	*Dianella revoluta* var. *divaricata*	
Iridaceae	*Freesia alba x leichtlinii*	*
Iridaceae	*Gladiolus caryophyllaceus*	*
Iridaceae	*Moraea flaccida*	*DP
Iridaceae	*Orthrosanthus laxus*	
Iridaceae	*Romulea rosea*	*
Lamiaceae	*Hemiandra pungens*	
Lauraceae	*Cassytha racemosa forma racemosa*	
Asparagaceae	*Sowerbaea laxiflora*	
Malvaceae	*Malva parviflora*	*
Myrtaceae	*Calothamnus quadrifidus* subsp. *quadrifidus*	
Myrtaceae	*Eucalyptus marginata*	
Orchidaceae	*Caladenia longicauda* subsp. *calcigena*	
Orchidaceae	*Caladenia* sp.	
Orchidaceae	*Pyrorchis nigricans*	
Oxalidaceae	*Oxalis pes-caprae*	*
Papaveraceae	*Fumaria capreolata*	*
Phyllanthaceae	*Phyllanthus calycinus*	
Pittosporaceae	*Pittosporum ligustrifolium*	
Poaceae	*Avena barbata*	*
Poaceae	*Briza maxima*	*

Family	Taxa	Status
Poaceae	*Briza minor*	*
Poaceae	*Bromus diandrus*	*
Poaceae	*Bromus hordeaceus*	*
Poaceae	*Ehrharta calycina*	*
Poaceae	*Ehrharta longiflora*	*
Poaceae	*Eragrostis curvula*	*
Poaceae	*Lagurus ovatus*	*
Primulaceae	*Lysimachia arvensis*	*
Proteaceae	*Banksia attenuata*	
Proteaceae	*Banksia dallanneyi*	
Proteaceae	*Banksia grandis*	
Proteaceae	*Banksia menziesii*	
Proteaceae	*Banksia sessilis*	
Proteaceae	*Hakea costata*	
Proteaceae	*Hakea lissocarpha*	
Proteaceae	*Petrophile linearis*	
Proteaceae	*Petrophile macrostachya*	
Proteaceae	*Stirlingia latifolia*	
Proteaceae	*Synaphea spinulosa* subsp. *spinulosa*	
Restionaceae	*Desmocladus flexuosus*	
Restionaceae	*Schoenus* sp.	
Rhamnaceae	*Spyridium globulosum*	
Rubiaceae	*Opercularia vaginata*	
Santalaceae	*Santalum acuminatum*	
Stylidiaceae	*Stylidium brunonianum*	
Stylidiaceae	*Stylidium calcaratum*	
Xanthorrhoeaceae	*Xanthorrhoea preissii*	
Zamiaceae	*Macrozamia riedlei*	

Quadrat Data

Quadrat 1

Vegetation type: Banksia Woodland

Vegetation condition: Excellent

Quadrat 1 species list

Quadrat	Family	Taxa	Height	%Cover
Q1	Proteaceae	*Banksia attenuata*	5	10-30
Q1	Myrtaceae	*Eucalyptus marginata*	4.5	<10
Q1	Xanthorrhoeaceae	*Xanthorrhoea preissii*	2	<10
Q1	Casuarinaceae	*Allocasuarina humilis*	1.8	10-30

Quadrat	Family	Taxa	Height	%Cover
Q1	Fabaceae	*Acacia pulchella var. glaberrima*	1.2	<10
Q1	Cyperaceae	*Mesomelaena pseudostygia*	0.6	10-30
Q1	Asteraceae	*Podolepis lessonii*	0.15	<2 numerous
Q1	Dilleniaceae	*Hibbertia hypericoides*	0.7	<10
Q1	Proteaceae	*Petrophile macrostachya*	0.8	<2
Q1	Colchicaceae	*Burchardia congesta*	0.6	<2
Q1	Asparagaceae	*Thysanotus manglesianus*	-	<2
Q1	Restionaceae	*Desmocladus flexuosus*	0.15	<2
Q1	Poaceae	**Briza maxima*	0.2	<2 numerous
Q1	Myrtaceae	*Calothamnus quadrifidus subsp. quadrifidus*	1.1	<2
Q1	Iridaceae	**Gladiolus caryophyllaceus*	1	<2
Q1	Ericaceae	*Leucopogon parviflorus*	0.5	<2
Q1	Primulaceae	**Lysimachia arvensis*	0.05	<2 numerous
Q1	Poaceae	**Ehrharta longiflora*	1.1	<2
Q1	Asteraceae	**Ursinia anthemoides*	0.01	<2 numerous
Q1	Fabaceae	*Daviesia decurrens*	0.9	<2
Q1	Asteraceae	**Hypochaeris radicata*	-	<2 numerous
Q1	Proteaceae	*Banksia menziesii*	3	<10
Q1	Zamiaceae	*Macrozamia riedlei*	1.1	<2
Q1	Haemodoraceae	*Conostylis setigera*	0.1	<2
Q1	Geraniaceae	**Pelargonium capitatum*	0.2	<2
Q1	Cyperaceae	*Lepidosperma ?pubisquameum*	0.3	<2
Q1	Asparagaceae	*Sowerbaea laxiflora*	0.3	<2
Q1	Iridaceae	**Moraea flaccida*	0.6	<2
Q1	Apiaceae	*Trachymene pilosa*	0.05	<2
Q1	Haemodoraceae	*Conostylis aculeata*	0.1	<2
Q1	Brassicaceae	**Heliophila pusilla*	0.1	<2
Q1	Asteraceae	*Waitzia suaveolens var. suaveolens*	0.1	<2 numerous

Quadrat 2

Vegetation type: Banksia Woodland

Vegetation condition: Excellent

Quadrat 2 flora list

Quadrat	Family	Taxa	Height	%Cover
Q2	Proteaceae	*Banksia attenuata*	4.5	10-30
Q2	Casuarinaceae	*Allocasuarina fraseriana*	5	2-10
Q2	Myrtaceae	*Eucalyptus marginata*	4	<2
Q2	Xanthorrhoeaceae	*Xanthorrhoea preissii*	2	10-30
Q2	Fabaceae	*Acacia pulchella var. glaberrima*	1.8	<10

Quadrat	Family	Taxa	Height	%Cover
Q2	Dilleniaceae	*Hibbertia hypericoides*	0.8	30-70
Q2	Cyperaceae	*Mesomelaena pseudostygia*	0.7	30-70
Q2	Casuarinaceae	*Allocasuarina humilis*	1.8	10-30
Q2	Proteaceae	*Petrophile macrostachya*	1	<10
Q2	Iridaceae	**Gladiolus caryophyllaceus*	1	<2
Q2	Colchicaceae	*Burchardia congesta*	0.5	<2
Q2	Haemodoraceae	*Conostylis setigera*	0.1	<2
Q2	Restionaceae	*Desmocladus flexuosus*	0.1	2-10
Q2	Iridaceae	**Freesia alba x leichtlinii*	0.2	<2 numerous
Q2	Primulaceae	**Lysimachia arvensis*	0.1	<2 numerous
Q2	Ericaceae	*Leucopogon parviflorus*	0.1	<2
Q2	Iridaceae	**Romulea rosea*	0.2	<2
Q2	Fabaceae	*Hovea trisperma*	0.1	<2
Q2	Poaceae	**Briza maxima*	0.2	<2 numerous
Q2	Ericaceae	*Leucopogon polymorphus*	0.5	<2
Q2	Stylidiaceae	*Stylidium calcaratum*	0.05	<2
Q2	Asteraceae	*Ursinia anthemoides*	0.6	<2
Q2	Myrtaceae	*Calothamnus quadrifidus subsp. quadrifidus*	0.4	<2
Q2	Fabaceae	*Daviesia triflora*	0.4	<2
Q2	Proteaceae	*Stirlingia latifolia*	0.9	<2
Q2	Apiaceae	*Trachymene pilosa*	0.05	<2
Q2	Asparagaceae	*Thysanotus manglesianus*	-	<2
Q2	Brassicaceae	**Heliophila pusilla*	0.1	<2 numerous
Q2	Asteraceae	*Podolepis lessonii*	0.05	<2 numerous
Q2	Ericaceae	*Leucopogon parviflorus*	0.2	<2
Q2	Poaceae	**Ehrharta longiflora*	0.5	<2
Q2	Orchidaceae	*Caladenia longicauda subsp. calcigena*	0.4	<2
Q2	Fabaceae	*Jacksonia calcicola*	1	<2
Q2	Haemodoraceae	*Conostylis aculeata*	0.3	<2
Q2	Asteraceae	*Waitzia suaveolens var. suaveolens*	0.1	<2
Q2	Fabaceae	*Bossiaea eriocarpa*	0.3	<2
Q2	Fabaceae	*Gompholobium tomentosum*	0.6	<2
Q2	Poaceae	**Avena barbata*	0.4	<2

Quadrat 3

Vegetation type: Banksia Woodland

Vegetation condition: Excellent

Quadrat 3 flora list

Quadrat	Family	Taxa	Height	%Cover
Q3	Proteaceae	*Banksia attenuata*	4.5	<10
Q3	Casuarinaceae	*Allocasuarina humilis*	2.1	10-30
Q3	Casuarinaceae	*Allocasuarina fraseriana*	7	<10
Q3	Xanthorrhoeaceae	*Xanthorrhoea preissii*	2.1	10-30
Q3	Cyperaceae	*Mesomelaena pseudostygia*	0.6	30-70

Quadrat	Family	Taxa	Height	%Cover
Q3	Dilleniaceae	*Hibbertia hypericoides*	0.6	10-30
Q3	Fabaceae	*Acacia pulchella var. glaberrima*	1.3	<10
Q3	Brassicaceae	**Heliophila pusilla*	0.05	<2 numerous
Q3	Haemodoraceae	*Conostylis setigera*	0.1	<2
Q3	Primulaceae	**Lysimachia arvensis*	0.05	<2 numerous
Q3	Poaceae	**Ehrharta longiflora*	1	<10
Q3	Poaceae	**Briza maxima*	0.1	<2 numerous
Q3	Euphorbiaceae	**Euphorbia terracina*	0.1	<2 numerous
Q3	Proteaceae	*Petrophile macrostachya*	0.9	10-30
Q3	Colchicaceae	*Burchardia congesta*	0.7	<2 numerous
Q3	Asparagaceae	*Thysanotus manglesianus*	-	<2
Q3	Caryophyllaceae	**Petrorhagia dubia*	0.2	<2
Q3	Ericaceae	*Astroloma ciliatum*	0.1	<2
Q3	Droseraceae	*Drosera erythrorhiza*	-	<2
Q3	Proteaceae	*Hakea lissocarpha*	0.6	<2
Q3	Iridaceae	**Gladiolus caryophyllaceus*	0.7	<2 numerous
Q3	Caprifoliaceae	**Centranthus macrosiphon*	0.2	<2 numerous
Q3	Apiaceae	*Trachymene pilosa*	0.05	<2 numerous
Q3	Asteraceae	**Hypochaeris sp.*	-	<2 numerous
Q3	Iridaceae	**Freesia alba x leichtlinii*	0.3	<2 numerous
Q3	Ericaceae	*Conostephium pendulum*	0.4	<2
Q3	Brassicaceae	**Brassica tournefortii*	0.6	<2
Q3	Poaceae	**Ehrharta calycina*	0.5	<2
Q3	Fabaceae	*Daviesia triflora*	0.7	<2
Q3	Fabaceae	*Bossiaea eriocarpa*	0.4	<2
Q3	Cyperaceae	*Lepidosperma sp.*	0.7	<2
Q3	Caryophyllaceae	**Silene gallica*	0.15	<2

Quadrat 4

Vegetation type: Banksia Woodland

Vegetation condition: Very Good

Qudrat 4 flora list

Quadrat	Family	Taxa	Height	%Cover
Q4	Proteaceae	*Banksia attenuata*	5	<10
Q4	Casuarinaceae	*Allocasuarina fraseriana*	4.6	<10
Q4	Zamiaceae	*Macrozamia riedlei*	2.4	<10
Q4	Xanthorrhoeaceae	*Xanthorrhoea preissii*	2	30-70
Q4	Fabaceae	*Jacksonia calcicola*	1.3	10-30

Quadrat	Family	Taxa	Height	%Cover
Q4	Fabaceae	*Acacia pulchella var. glaberrima*	1.4	<10
Q4	Cyperaceae	*Mesomelaena pseudostygia*	0.9	10-30
Q4	Stylidiaceae	*Stylidium calcaratum*	0.1	<2
Q4	Dilleniaceae	*Hibbertia hypericoides*	0.8	30-70
Q4	Iridaceae	**Gladiolus caryophyllaceus*	1.3	<2
Q4	Primulaceae	**Lysimachia arvensis*	0.1	<2 numerous
Q4	Asteraceae	**Sonchus oleraceus*	0.2	<2
Q4	Poaceae	**Briza maxima*	0.3	<2 numerous
Q4	Apiaceae	*Trachymene pilosa*	0.05	<2 numerous
Q4	Colchicaceae	*Burchardia congesta*	1	<2
Q4	Asparagaceae	*Thysanotus manglesianus*	-	<2
Q4	Goodeniaceae	*Scaevola canescens*	0.2	<2
Q4	Poaceae	**Avena barbata*	0.8	<2 numerous
Q4	Iridaceae	**Freesia alba x leichtlinii*	0.3	<2 numerous
Q4	Asteraceae	*Podolepis lessonii*	0.2	<2 numerous
Q4	Haemodoraceae	*Conostylis setigera*	0.1	<2
Q4	Proteaceae	*Banksia menziesii*	4.8	<2
Q4	Haemodoraceae	*Conostylis candicans subsp. candicans*	0.3	<2
Q4	Ericaceae	*Leucopogon parviflorus*	0.5	<2
Q4	Proteaceae	*Petrophile macrostachya*	0.5	<2
Q4	Chenopodiaceae	*Rhagodia baccata*	1.3	<2
Q4	Cyperaceae	*Lepidosperma ?pubisquameum*	0.4	<2
Q4	Fabaceae	*Daviesia triflora*	0.3	<2
Q4	Euphorbiaceae	*Phyllanthus calycinus*	0.4	<2
Q4	Fabaceae	*Gompholobium tomentosum*	0.1	<2
Q4	Restionaceae	*Schoenus sp.*	0.05	<2
Q4	Restionaceae	*Desmocladus flexuosus*	0.1	<2
Q4	Asteraceae	*Waitzia suaveolens var. suaveolens*	0.1	<2
Q4	Poaceae	**Bromus diandrus*	0.3	<2

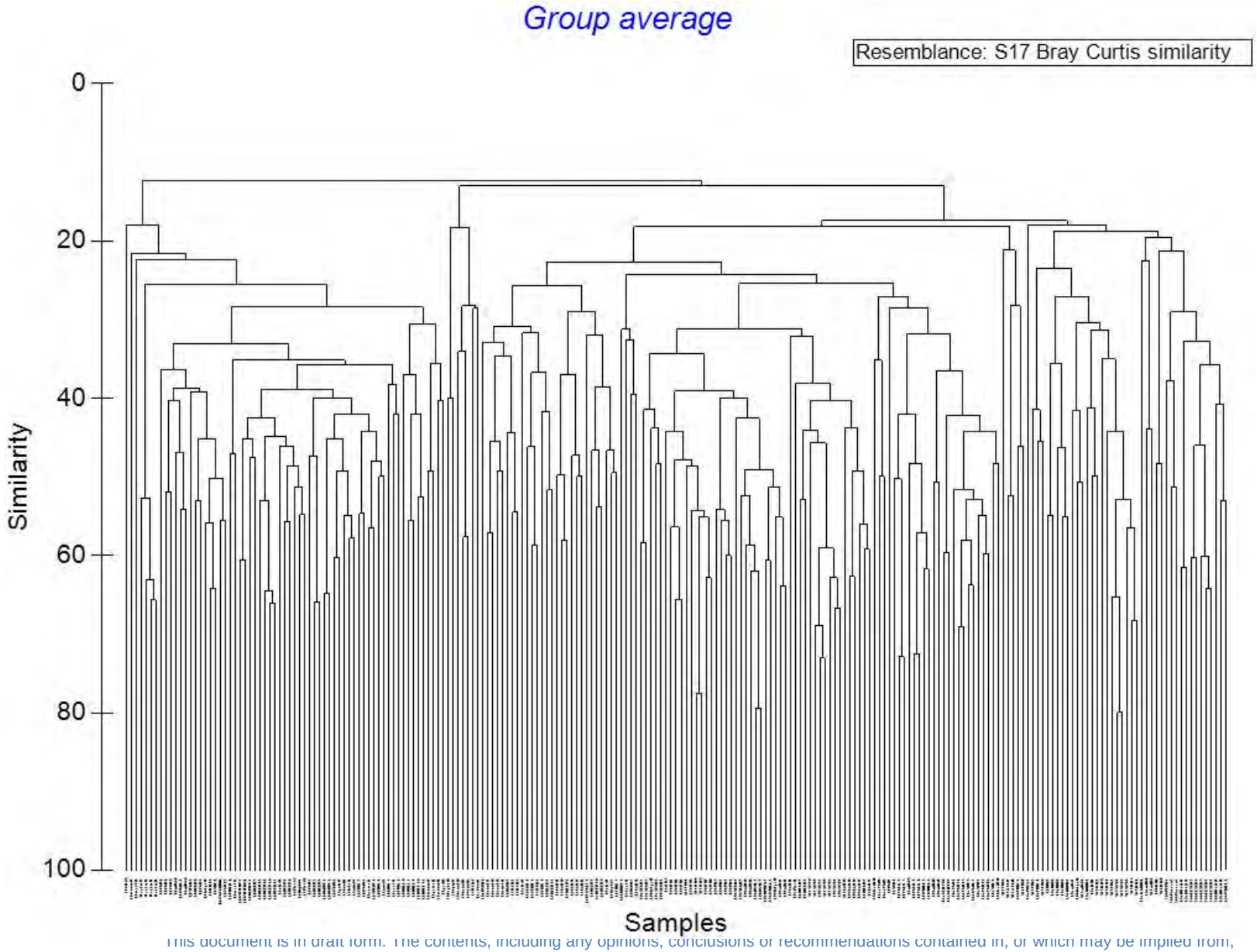
Releve 1

Vegetation type: Banksia Woodland

Vegetation condition: Good - Degraded

Releve	Family	Taxa	Height	%Cover
R1	Casuarinaceae	*Allocasuarina fraseriana*	8	30-70
R1	Myrtaceae	*Eucalyptus marginata*	9	10-30
R1	Xanthorrhoeaceae	*Xanthorrhoea preissii*	2	10-30
R1	Proteaceae	*Banksia grandis*	3.5	10-30
R1	Rhamnaceae	*Spyridium globulosum*	3	<2
R1	Proteaceae	*Hakea lissocarpha*	2.5	<2
R1	Fabaceae	*Jacksonia sternbergiana*	3.2	2-10

Releve	Family	Taxa	Height	%Cover
R1	Dilleniaceae	*Hibbertia hypericoides*	0.7	2-10
R1	Asparagaceae	**Asparagus asparagoides*	-	10-30
R1	Iridaceae	**Freesia alba x leichtlinii*	0.3	2-10
R1	Phyllanthaceae	*Phyllanthus calycinus*	0.5	10-30
R1	Poaceae	**Avena barbata*	1	<2
R1	Caprifoliaceae	**Centranthus macrosiphon*	0.2	<2 numerous
R1	Euphorbiaceae	**Euphorbia terracina*	0.2	<2 numerous
R1	Brassicaceae	**Heliophila pusilla*	0.2	2-10
R1	Poaceae	**Briza maxima*	0.2	2-10
R1	Colchicaceae	*Burchardia congesta*	0.8	10-30
R1	Asparagaceae	*Thysanotus manglesianus*	-	<2
R1	Iridaceae	**Gladiolus caryophyllaceus*	1.2	<2
R1	Primulaceae	**Lysimachia arvensis*	0.1	<2 numerous
R1	Iridaceae	*Orthrosanthus laxus*	0.3	<2
R1	Cyperaceae	*Mesomelaena pseudostygia*	0.9	2-10
R1	Fabaceae	*Acacia pulchella var. glaberrima*	1.8	<2
R1	Zamiaceae	*Macrozamia riedlei*	1.9	<2
R1	Asteraceae	**Sonchus oleraceus*	0.1	<2 numerous
R1	Asteraceae	**Ursinia anthemoides*	0.1	<2 numerous
R1	Poaceae	**Lagurus ovatus*	0.1	<2
R1	Oxalidaceae	**Oxalis pes-caprae*	0.1	<2
R1	Iridaceae	**Moraea flaccida*	0.4	<2
R1	Haemodoraceae	*Conostylis candicans subsp. candicans*	0.3	<2
R1	Chenopodiaceae	*Rhagodia baccata*	1.8	<2
R1	Proteaceae	*Banksia dallanneyi*	0.2	<2



Flora likelihood of occurrence assessment guidelines

Likelihood of occurrence	Guideline
Known	Species recorded within study area from field project results (none as this is a desktop search only).
Likely	Species previously recorded within 2 km and large areas of suitable habitat occur in the project area.
Possible	Species previously recorded within 10 km and areas of suitable habitat occur/may occur in the project area.
Unlikely	Species previously recorded within 20 km, or suitable habitat does not occur in the project area.
Highly unlikely	Species not previously recorded within 20 km, suitable habitat does not occur in the project area and/or the project area is outside the natural distribution of the species.
Other considerations	Date of known records, cryptic nature of species, anecdotal evidence from previous Broome studies/surveys

Definitions

Term	Description
Study area	A 5 km buffer around the survey area
Survey area	The potential project footprint
Cr	Critically endangered
En	Endangered
T	Threatened
Vu	Vulnerable
P1 – P4	Priority 1 – Priority 4
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
DBCA	Department of Biodiversity and Conservation Attractions 2018. WA Government, Department of Parks and Wildlife Threatened (Declared Rare) and Priority Flora List
BC Act	Biodiversity Conservation Act 2016

Flora likelihood of occurrence assessment of conservation significant flora identified in the desktop assessment as potentially occurring within the survey area.

Taxa	Common Name	Status		Source			Description and habitat requirements	Likelihood of occurrence within the survey area
		State	Federal	NM	WAHerb/ TPFL	PMST		
Acacia benthamii		P2		x			Shrub, ca 1 m high. Flowers yellow in August to September. Occurs in sand, typically on limestone breakaways.	Unlikely – the survey area was thoroughly searched and no individuals were identified.
Andersonia gracilis	Slender Andersonia	VU	EN			x	Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Flowers white-pink-purple from September to November. Occurs in white/grey sand, sandy clay, gravelly loam in winter-wet areas, near swamps.	Highly Unlikely – the closest known record is over 50 km north of the survey area. Survey area does not contain optimal habitat for this species.
Anigozanthos viridis subsp. *terraspectans*	Dwarf Green kangaroo Paw	VU	VU			x	Rhizomatous, perennial, herb, 0.05-0.85 m high. Flowers green/yellow-green, August to October. Occurs in sand, loam, clay in winter-wet areas.	Highly Unlikely - the closest known record is over 50 km north of the survey area. Survey area does not contain optimal habitat for this species.
Baeckea sp. Limestone (N. Gibson & M.N, Lyons 1425)		P1		x	x		Compact shrub 1.2 (1.6) high. Flowers pink, pale-pink to white (potentially September-December). Grey sand, yellow sand with limestone outcropping. On hills.	Unlikely – no suitable habitat present.
Calectasia cyanea	Blue Tinsel Lily	CR	CR	x			Rhizomatous, clump forming, woody perennial, herb, 0.1-0.6 m high, to 0.3 m wide. Flowers blue/purple, June to October.	Highly Unlikely – Only known from a location 10 km south of Albany with records elsewhere

Taxa	Common Name	Status		Source			Description and habitat requirements	Likelihood of occurrence within the survey area
		State	Federal	NM	WAHerb/ TPFL	PMST		
							Occurs in white, grey or yellow sand, gravel.	considered to be incorrectly identified.
Conostylis bracteata		P3		x	x		Rhizomatous, tufted or shortly proliferous perennial, grass-like or herb, 0.2-0.45 m high. Flowers yellow, August to September. Occurs in sand, limestone on consolidated sand dunes.	Unlikely - The survey area was thoroughly searched and no individuals were identified.
Diuris micrantha	Dwarf Bee-orchid	VU	VU			x	Tuberous, perennial, herb, 0.3-0.6 m high. Flowers yellow and brown in September to October. Occurs in brown loamy clay in winter-wet swamps, in shallow water.	Highly Unlikely – The closest record on the Swan Coastal Plain is over 50 km south of the survey area. The survey area does not contain optimal habitat.
Diuris purdiei	Purdie's Donkey-orchid	EN	EN			x	Tuberous, perennial, herb, 0.15-0.35 m high. Flowers yellow in September to October. Occurs in grey-black sand, moist. Winter-wet swamps.	Highly Unlikely – The nearest record on the Swan Coastal Plain is over 50 km south of the survey area. The survey area does not contain optimal habitat.
Drakaea elastica	Glossy-leafed Hammer Orchid	CR	EN			x	Tuberous, perennial, herb, 0.12-0.3 m high. Flowers red and green and yellow in October to November. Occurs white or grey sand. Low-lying situations adjoining winter-wet swamps.	Highly Unlikely - The nearest record on the Swan Coastal Plain is over 25 km north of the survey area. The survey area does not contain optimal habitat.
Drakaea micrantha	Dwarf hammer-orchid	EN	VU			x	Tuberous, perennial, herb, 0.15-0.3 m high. Flowers red and yellow, September to October. White-grey sand.	Unlikely – the closest known records are over 50 km south of the survey area.

Taxa	Common Name	Status		Source			Description and habitat requirements	Likelihood of occurrence within the survey area
		State	Federal	NM	WAHerb/ TPFL	PMST		
Eleocharis keigheryi	Keighery's Eleocharis	VU	VU			x	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Flowers green, August to November. Clay, sandy loam. Emergent in freshwater: creeks, claypans.	Unlikely – the survey area does not contain optimal habitat for this species. The closest known records are over 25 km east of the survey area.
Eucalyptus argutifolia	Wabling Hill Mallee	VU	VU		x	x	(Mallee), 1.5-4 m high, bark smooth. Flowers white, March to April. Shallow soils over limestone. Slopes or gullies of limestone ridges, outcrops.	Unlikely – no suitable habitat present.
Hibbertia spicata subsp. *leptotheca*		P3		x	x		Erect or spreading shrub, 0.2-0.5 m high. Flowers yellow, July to October. Occurs on sand near-coastal limestone ridges, outcrops and cliffs.	Unlikely – there is no suitable habitat present within the survey area.
Jacksonia gracillima		P3		x	x		Perennial tufted herb (1.5 m tall) with narrow leaves 10-40 cm long, with orange and red flowers (October). Grey sand and brown sand/sandy-loam, mid slope with exposed limestone and near damplands.	Unlikely - there is no suitable habitat present within the survey area.
Jacksonia sericea	Waldjumi	P4		x	x		Low spreading shrub, to 0.6 m high. Flowers orange, usually December or January to February. Calcareous and sandy soils.	Unlikely – suitable habitat is present throughout the survey area. During the survey a number of *Jacksonia* specimens were collected and were formally identified as *Jacksonia calcicola.*

Taxa	Common Name	Status		Source			Description and habitat requirements	Likelihood of occurrence within the survey area
		State	Federal	NM	WAHerb/ TPFL	PMST		
Lepidosperma rostratum	Beaked Lepidosperma	EN	EN			x	Rhizomatous, tufted perennial, gras-like or herb (sedge), 0.5 m high. Flowers brown. Peaty sand, clay.	Highly Unlikely – The nearest records on the Swan Coastal Plain are over 50 km from the survey area. The survey area does not contain optimal habitat for this species.
Leucopogon sp. Yanchep (M. Hislop 1986)		P3		x	x		Erect shrub, 0/15-1 m high, to 0.6 m wide. Flowers white/pink, April to June or September. Light grey-yellow sand, brown loam, limestone, laterite, granite. Coastal plain, breakaways, valley slopes, low hills.	Unlikely – no suitable habitat present.
Leucopogon maritimus		P1			x		Low spreading shrub up to 40 cm tall. Flowers white in April-May and August. Pale yellow to white-grey sand, upper slopes of coastal dunes, limestone.	Unlikely - The survey area was thoroughly searched and no individuals were identified.
Marianthus paralius		EN	EN			x	Almost prostrate, eventually scandent, woody shrub. Flowers red in September to November. White sand over limestone. Low coastal cliffs.	Unlikely – no suitable habitat present.
Melaleuca sp. Wanneroo (G.J. Keighery 16705)		EN		x	x		Erect shrub up to 3 m. Flowers yellow flowering around October to December. On fine sand to sandy loam and brown loamy sand. Limestone ridges and outcropping.	Unlikely – The survey area was thoroughly searched and no individuals were identified.

Taxa	Common Name	Status		Source			Description and habitat requirements	Likelihood of occurrence within the survey area
		State	Federal	NM	WAHerb/ TPFL	PMST		
Pimelea calcicola		P3		x	x		Erect to spreading shrub, 0.2-1 m high. Flowers pink, September to November. Sand. Coastal limestone ridges.	Unlikely – no suitable habitat present. .
Sarcozona bicarinata		P3		x	x		Shrub, ca 0.1 m high. Flowers white, August. White sand.	Unlikely – the survey area was thoroughly searched and no individuals were identified.
Stylidium maritimum		P3		x	x		Caespitose perennial, herb, 0.3-0.7 m high, leaves tufted, linear to narrowly oblanceolate. Membranous scale leaves present at base of mature leaves. Scape glandular throughout. Inflorescence paniculate. Flowers white/purple, September to November. Sand over limestone. Dune slopes and flats. Coastal heath and shrubland, open Banksia woodland.	Unlikely - the survey area was thoroughly searched and no individuals were identified. Habitat was not considered optimal for this species.
Tetraria sp. Chandala (G.J. Keighery 17055)		P2		x	x		Slender erect sedge. Flowers brown. Mound spring, edge of swamp, black peaty sand.	Highly Unlikely – The survey area does not contain optimal habitat for this species.

Appendix E – Fauna data

Fauna results

Potential Black Cockatoo tree locations

Fauna likelihood of occurrence assessment

Fauna recorded within the survey area

Family	Taxa	Common Name	Status
Birds			
Artamidae	*Cracticus torquatus*	Grey Butcherbird	
Cacatuidae	*Cacatua sanguinea*	Little Corella	
Cacatuidae	*Calyptorhynchus banksii naso*	Forest Red-tailed Black Cockatoo	Vu
Cacatuidae	*Calyptorhynchus latirostris*	Carnaby's Black Cockatoo	En
Cacatuidae	*Eolophus roseicapilla*	Galah	
Columbidae	*Phaps chalcoptera*	Common Bronzewing	
Corvidae	*Corvus coronoides perplexus*	Australian Raven	
Falconidae	*Falco cenchroides*	Nankeen Kestrel	
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	
Maluridae	*Malurus splendens*	Splendid Fairy-wren	
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	
Meliphagidae	*Lichenostomus virescens*	Singing Honeyeater	
Meliphagidae	*Phylidonyris niger*	White-cheeked Honeyeater	
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	
Petroicidae	*Petroica boodang*	Scarlet Robin	
Psittacidae	*Barnadius zonarius*	Australian Ringneck	
Psittacidae	*Neophema elegans*	Elegant Parrot	
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	*
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	
Mammals			
Canidae	*Canis domesticus*	Domestic Dog	*
Canidae	*Vulpes vulpes*	Fox	*
Leporidae	*Oryctolagus cuniculus*	Rabbit	*
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo	
Reptiles			
Scincidae	*Cryptoblephorus buchananii*	Buchanan's Snake-eyed Skink	
Scincidae	*Menetia greyii*	Common Dwarf Skink	
Scincidae	*Tiliqua rugosa*	Bobtail	
Varanidae	*gouldii gouldii*	Gould's Monitor	

Potential Black Cockatoo tree locations

Point ID	Easting	Northing	RL
TR1	380016.06	6495264.97	35.64
TR2	380212.47	6495276.59	36.30
TR3	380224.48	6495274.90	35.84
TR4	380226.25	6495273.66	35.79
TR5	380214.01	6495272.97	36.33
TR6	380230.84	6495265.92	35.75
TR7	380282.41	6495285.65	34.39
TR8	380274.40	6495289.73	34.65

Surveyed: 24/10/2019

Datum: MGAz50/AHD

Fauna likelihood of occurrence assessment guidelines

Assessment outcome	Description
Present	Species recorded during the field survey or from recent, reliable records from within or close proximity to the project area.
Likely	Species are **likely** to occur in the project area where there is suitable habitat within the survey area and there are recent records of occurrence of the species in close proximity to the project area. OR Species known distribution overlaps with the project area and there is suitable habitat within the project area.
Unlikely	Species assessed as **unlikely** include those species previously recorded within 5 km of the project area however: • There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the project area. • The suitable habitat within the project area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area. OR Those species that have a known distribution overlapping with the project area however: • There is limited habitat in the project area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). • The suitable habitat within the project area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area.
Highly unlikely	Species that are considered **highly unlikely** to occur in the project area include: • Those species that have no suitable habitat within the project area. • Those species that have become locally extinct, or are not known to have ever been present in the region of the project area.

Source information - desktop searches

NM – DBCA *NatureMap* (accessed September 2019)

PMST – DEE Protected Matters Search Tool (PMST) to identify fauna listed under the EPBC Act potentially occurring within the study area (accessed September 2019)

Fauna likelihood of occurrence assessment of conservation significant fauna identified in the desktop assessment as potentially occurring within the survey area

Species name	Status			Source		Habitat Requirements	Likelihood of occurrence Survey area
	EPBC Act	BC Act	DBCA	EPBC Act PMST	NM		
Birds							
Anous tenuirostris subsp. *melanops*	Australian Lesser Noddy	Vu	En	X		The Australian Lesser Noddy is usually found only around its breeding islands in the Houtman Abrolhos Islands in Western Australia. There are also some records north of the breeding islands, for example at the Wallabi Group of islands, in the northern Houtman Abrolhos Islands, on Barrow Island, and at Webb Island. The species usually occupies coral-limestone islands that are densely fringed with White Mangrove *Avicennia marina*. It occasionally occurs on shingle or sandy beaches (Higgins & Davies 1996). The Australian Lesser Noddy roosts mainly in mangroves, especially at night but may sometimes rest on beaches.	Highly unlikely – The survey area does not provide suitable habitat to support this species.
Ardenna pacifica	Wedge-tailed Shearwater	Mi	Mi		X	The Wedge-tailed Shearwater breeds on the east and west coasts of Australia and on off-shore islands. The species is common in the Indian Ocean, the Coral Sea and the Tasman Sea (Lindsey 1986). Areas where breeding occurs include (Lindsey 1986).	Highly unlikely – The survey area does not provide suitable habitat to support this species.
Calidris acuminata	Sharp-tailed Sandpiper	Mi	Mi	X		In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. Sometimes they occur on rocky shores (DEE 2017). They	Highly unlikely – The survey area does not provide suitable habitat to support this species.

Species name	Status			Source		Habitat Requirements	Likelihood of occurrence Survey area
	EPBC Act	BC Act	DBCA	EPBC Act PMST	NM		
						are found throughout many wetlands on the Swan Coastal Plain, in Perth lakes with wet grassed margins and receding waters, Vasse and Harvey Estuaries, and the Busselton wetlands, but are less common on the south coast until the Esperance region (Nevill 2013).	
Calidris canutus	Red Knot	En	En, IA	X	X	In Australasia the Red Knot mainly inhabits intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps, inland lakes or swamps (DotE 2016). They are found near mudflats and estuaries from Murchison to Bunbury but are then uncommon from Wilson Inlet to Esperance. In the Perth region they are mainly found in Alfred Cove and Peel Inlet (Nevill 2013).	Highly unlikely – The survey area does not provide suitable habitat to support this species.
Calidris ferruginea	Curlew Sandpiper	Cr, Mi	Cr	X		Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (Higgins & Davies 1996). Curlew Sandpipers forage on mudflats and nearby shallow water. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy shores. At high tide, they forage among low sparse emergent vegetation, such as saltmarsh, and sometimes forage in flooded paddocks or inundated saltflats. Curlew Sandpipers generally roost on bare dry shingle, shell or sand beaches,	Highly unlikely – The survey area does not provide suitable habitat to support this species.

Species name	Status			Source		Habitat Requirements	Likelihood of occurrence Survey area
	EPBC Act	BC Act	DBCA	EPBC Act PMST	NM		
						sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh (Higgins & Davies 1996).	
Calyptorhynchus banksii naso Forest Red-tailed Black Cockatoo	VU	VU		x	x	The Forest Red-tailed Black Cockatoo inhabits the dense jarrah, karri, and marri forests receiving more than 600 mm annual average rainfall but also occurs in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt (*E. staeri*), Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (DotE 2012). Habitats tend to have an understorey of balga (*Xanthorrhoea* spp.), kingia (*Kingia australis*), snottygobble (*Persoonia* spp.), parrot bush (*Banksia sessillis*), holly-leaved mirbelia (*Mirbelia dilatata*), bull banksia (*B. grandis*), bullich (*Taxandria* spp.) and sheoak (*Allocasuraina fraseriana*). They are most common in the jarrah forest region of the northern Darling Range from Collie north to Mundaring and are very local throughout the lower south-west. They can be found on the Swan Coastal Plain, mainly in search of food the exotic white cedar (*Melia azedarach*). There are also several small isolated populations in the eastern parts of its range (DotE 2012).	Known – The species was recorded during the survey
Calyptorhynchus latirostris Carnaby's Black Cockatoo	EN	EN		x	x	Carnaby's Black Cockatoo occurs in uncleared or remnant native eucalypt woodlands, especially those that contain salmon gum, wandoo, marri, jarrah and karri, and in shrubland or kwongan heathland dominated by Hakea, Dryandra, Banksia and Grevillea species. Breeding activity is restricted to eucalypt woodlands mainly in the semiarid and subhumid interior, from Kalbarri in the north, Three Springs District south to the Stirling Range, west to Cockleshell Gully and east to Manmanning. The species has expanded its breeding range westward and south into the jarrah-marri forests of the Darling Scarp and into the tuart forests of the Swan Coastal Plain, including the Yanchep	Known – The species was recorded during the survey

Species name	Status			Source		Habitat Requirements	Likelihood of occurrence Survey area
	EPBC Act	BC Act	DBCA	EPBC Act PMST	NM		
						area, Lake Clifton and near Bunbury. It nests in trees older than 120-150 years (DotEE 2018b).	
Falco peregrinus Peregrine Falcon		OS			x	The Peregrine Falcon is found on and near cliffs, gorges, timbered watercourses, riverine environments, wetlands, plains, open woodlands, and pylons and spires of buildings, though less frequently in desert regions (Morcombe 2004). They are not common but can be found almost anywhere throughout WA and in the southwest, including particularly at Fitzgerald River, Stirling Range, Porongurup National Parks, Kondinin, and Peak Charles, with many more locations north of Perth (Nevill 2013).	Likely – The species is known to occur in the local area and suitable habitat is present.
Leipoa ocellata Malleefowl	VU	VU		x		The Malleefowl generally occurs in semi-arid areas of Western Australia, in shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine Callitris woodlands, Acacia shrublands, paperbark, skheoak, Broombush Melaleuca uncinata vegetation, eucalypt woodlands, or coastal heathlands. Mostly they are found where there are sandy or gravel soils. The nest is a large mound of sand or soil and organic matter (Jones and Goth 2008; Morcombe 2004; Nevill 2013). In WA they are found from the southwest Nullarbor to Albany, north, and then west from Moore River up to Shark Bay, past Cue, across to Wiluna and east to the northern Victoria Desert south of the Blackstone Ranges (Nevill 2013).	Highly Unlikely - The survey area is outside the currently known distribution for this species.
Limosa lapponica baueri Bar-tailed Godwit	VU	VU		x		The Bar-tailed godwit (Western Alaskan) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It has also been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. It is widespread around the coast, from Eyre to Derby (TSSC 2016). They are uncommon in the south west (Nevill 2013).	Highly Unlikely - There is no suitable habitat for this species within the survey area.

Species name	Status			Source		Habitat Requirements	Likelihood of occurrence Survey area
	EPBC Act	BC Act	DBCA	EPBC Act PMST	NM		
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit	CE	VU		x		The Bar-tailed Godwit (northern Siberian) is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats (DotEE 2018a). They are uncommon in the south west, but can be sighted from Geraldton to Bunbury, at Alfred Cove, and then at a few estuaries on the south coast including Kalgan River Mouth and Oyster Harbour (Nevill 2013).	Highly Unlikely - There is no suitable habitat for this species within the survey area.
Numenius madagascariensis Eastern Curlew	CE, Mi	VU		x		The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, sometimes within the mangroves, and in coastal saltworks and sewage farms. In the south west, Eastern Curlews are recorded from Eyre, and there are scattered records from Stokes Inlet to Peel Inlet (Marchant & Higgins 1993). They are uncommon further south of Geraldton, but can be spotted in Alfred Cove, Peel Inlet and the Albany region (Nevill 2013).	Highly Unlikely - There is no suitable habitat for this species within the survey area.
Oxyura australis Blue-billed Duck			P4		x	The blue-billed duck is a small Australian almost entirely aquatic duck (Morcombe 2004). The blue-billed duck is endemic to Australia's temperate regions, ranging from the south west of WA, extending to southern Queensland, through New South Wales and Victoria, to Tasmania. The species is readily seen on freshwater lakes where deep fresh water is present (Morcombe 2004).	Highly Unlikely - There is no suitable habitat for this species within the survey area.

Species name	Status			Source		Habitat Requirements	Likelihood of occurrence Survey area
	EPBC Act	BC Act	DBCA	EPBC Act PMST	NM		
Pachyptila turtur subantarctica	Fairy Prion (southern)	Vu		X		The fairy prion (southern) breeds on Macquarie Island and a number of other subantarctic islands outside of Australia. In Australia, breeding is recorded on two rock stacks off Macquarie Island and on the nearby Bishop and Clerk Island. The subspecies digs burrows among rocks or low vegetation in which to nest. Burrows may be dug below mat forming herbs. Feeds by plucking food from the ocean surface. Some individuals may migrate towards New Zealand and southern Australia in winter	Highly unlikely The survey area is not considered to provide suitable habitat to support this species.
Rostratula australis Australian Painted Snipe	EN, Mi	EN		x		The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia, canegrass, or sometimes tea-tree (Melaleuca). It sometimes uses areas that are lined with trees, or that have some scattered fallen or washed-up timber (DotEE 2018a). In the south west it can be found around Carnarvon and wetlands north of Perth, particularly those west of Moora and Gin Gin (Nevill 2013).	Highly Unlikely - There is no suitable habitat for this species within the survey area.
Sternula nereis nereis Australian Fairy Tern	VU, Mi	VU		x		The Fairy Tern occurs along the coast of WA as far north as the Dampier Archipelago near Karratha, but mostly in the southern part of Australia including most of the coastline in the south west. It nests on sheltered sandy beaches, coastal inlets, spits and banks above the high tide line and below vegetation. It has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands, and mainland coastline (DotEE 2018a, Nevill 2013). They can also be seen in saltfields, saline or brackish lakes, and sewage ponds near the coast.	Highly Unlikely - There is no suitable habitat for this species within the survey area.

Species name	Status			Source		Habitat Requirements	Likelihood of occurrence Survey area
	EPBC Act	BC Act	DBCA	EPBC Act PMST	NM		
Actitis hypoleucos Common Sandpiper	Mi	IA		x	x	The Common Sandpiper is found along all coastlines of Australia and uses a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around often narrow and steep muddy margins or rocky shores. The species has been recorded in estuaries and deltas of streams, as well as on banks further upstream; around lakes, pools, mangroves, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. It is often found near mangroves, and sometimes in areas of mud littered with rocks or snags (DotEE 2018a). They are somewhat uncommon in the south west, but can be found on Rottnest and Penguin Islands, and along the south coast all the way to the Esperance region, including the inland lakes like Lake Warden (Nevill 2013).	Highly Unlikely - There is no suitable habitat for this species within the survey area.
Calidris melanotos Pectoral Sandpiper	Mi	IA		x		In Western Australia, the Pectoral Sandpiper is rarely recorded (DotEE 2018a). It prefers shallow fresh to saline wetlands and is found in coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands (Higgins & Davies 1996).	Highly Unlikely - There is no suitable habitat for this species within the survey area.
Motacilla cinerea Grey Wagtail	Mi	IA		x		The Grey Wagtail is an opportunistic migrant to Australia. The species typically migrates to Indonesia occasionally landing in Australia. Most records for the species are from Northern Australia and South Australia (Morcombe 2004). The non-breeding habitat only of the Grey Wagtail has a strong association with water, particularly rocky substrates along water courses but also lakes and marshes (DotEE 2018a). It can be found mainly in banks and rocks in fast-	Highly Unlikely - There is no habitat for this species within the survey area.

Species name	Status			Source		Habitat Requirements	Likelihood of occurrence Survey area
	EPBC Act	BC Act	DBCA	EPBC Act PMST	NM		
						running freshwater habitats: rivers, creeks, streams, and around waterfalls, both in forest and open country; but occurs almost anywhere during migration (Johnstone & Storr 2004).	
Pandion haliaetus Osprey	Mi	IA		x	x	Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging. They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes. They exhibit a preference for coastal cliffs and elevated islands in some parts of their range but may also occur on low sandy, muddy or rocky shores and over coral cays (DotEE 2018a). The osprey is found along all of the south west coast line except east of Cape le Grand where it becomes scarce (Nevill 2013).	Highly Unlikely - There is no suitable habitat for this species within the survey area.
Thalasseus bergii	Crested Tern	Mi	IA		X	This species occurs in coastal and offshore waters, beaches, bays, inlets, tidal rivers, salt swamps, lakes and large rivers. It is found around the coast of Australia including Tasmania. Breeding colonies are known to seek islands (Pizzey & Knight 2012).	Unlikely – The survey area does not provide suitable habitat to support this species.

Species name	Status			Source		Habitat Requirements	Likelihood of occurrence Survey area
	EPBC Act	BC Act	DBCA	EPBC Act PMST	NM		
Tringa nebularia Common Greenshank	Mi	IA		x	x	The Common Greenshank is found in a wide variety of inland wetlands and coastal habitats of varying salinity. It occurs in sheltered coastal areas typically with large mudflats and saltmarsh, mangroves or seagrass, including embayments, harbours, river estuaries, deltas and lagoons, but less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats, and artificial wetlands. They occur around most of the coast from Cape Arid in the south to Carnarvon in the north-west (DotEE 2018a), and are moderately common here given suitable habitat. They can be found in areas including Wannamal Lake, many Perth lakes, Alfred Cove, Peel Inlet, Vasse and Harvey Estuaries, and the Albany and Esperance regions (Nevill 2013).	Highly Unlikely - There is no suitable habitat for this species within the survey area.
Mammals							
Dasyurus geoffroii Chuditch, Western Quoll	VU	VU		x	x	The Chuditch inhabits eucalypt forest (especially Jarrah, E. marginata), dry woodland, mallee shrublands, heaths, and desert, particularly in the south coast of WA. They also occur at lower densities in drier woodland and mallee shrubland in the goldfields and wheatbelt, as well as in Kalbarri National Park (translocated). Chuditch require adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) to survive (DEC 2012). In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest (Van Dyck and Strahan 2008). The species can travel large distances, and for this reason requires habitats that are of a suitable size and not excessively fragmented (DEC 2012).	Unlikely - The Chuditch had disappeared from the Swan Coastal Plain in the 1930s, (Orell and Morris 1994). Scattered individuals have since been recorded but these are considered disbursal individuals from the Darling range not a sustained population.

Species name	Status			Source		Habitat Requirements	Likelihood of occurrence Survey area
	EPBC Act	BC Act	DBCA	EPBC Act PMST	NM		
Isoodon fusciventer Quenda, Southwestern Brown Bandicoot			P4		x	The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. On the Swan Coastal Plain, Quenda are often associated with wetlands. The species often feeds in adjacent Jarrah and Wandoo forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Van Dyck and Strahan 2008).	Likely – Suitable habitat present. The species is known to occur in Nowergup National Park and has previously been recorded by GHD (2018).
Notamacropus irma Western Brush Wallaby			P4		x	The Western Brush Wallaby is found primarily in open forest or woodland, particularly favouring open, seasonally-wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (Van Dyck and Strahan 2008).	Likely – Suitable habitat present. The species is known to occur in Nowergup National Park and has previously been recorded by GHD (2018).
Parameles bougainville subsp. *bougainville* Western Barred Bandicoot	EN	VU			x	The Western Barred Bandicoot is now restricted to Bernier and Dorre Islands in Shark Bay, but was reintroduced to Heirisson Prong and to Faure Island in Shark Bay, although they are presumed extinct at the former. Historically the Western Barred Bandicoot occupied a wide variety of semi-arid and arid landscapes and vegetation types, including the saltbush covered Nullarbor Plain, sand ridges with woodlands, bluebush plains, desert Acacia, dense shrublands (particularly thickets of Allocasuarina seedlings) and heath, broken by sandhills and limestone outcrops in western central Australia. On Bernier and Dorre Islands, the populations are found widely in all habitats, but are most likely found in tall scrub (Richards 2012; Van Dyck & Strahan 2008).	Highly Unlikely- The mainland sub-species of the Western Barred Bandicoot is extinct.
Reptiles							

Species name	Status			Source		Habitat Requirements	Likelihood of occurrence Survey area
	EPBC Act	BC Act	DBCA	EPBC Act PMST	NM		
Neelaps calonotos Black-striped Snake			P3		x	The Black-striped Snake is a burrowing snake that is restricted to the southwest coastal regions of WA, on sand plains along the Swan Coastal Plain, from Dongara south to Mandurah (Wilson and Swan 2017).	Likely - Suitable habitat for the Black-striped Snake is present within the survey area and there are a number of records of this species in the region.
Pseudonaja affinis subsp. *exillis* Rottnest Island Dugite			P4		x	This subspecies of Dugite occurs only of Rottnest Island.	Highly unlikely - This subspecies of dugite is restricted to Rottnest Island.
Ctenotus gemmula Jewelled southwest Ctenotus(Swan Coastal Plain population)			P3			Apparently disjunct populations occur on the lower west coastal plain, and south coast and adjacent interior of Western Australia. Known to occur on pale sands supporting heaths in association with banksia or mallee woodlands (Wilson and Swan 2017).	Likely - There is suitable habitat present for this species within the survey area. The closest known record is approximately 12 km south east of the survey area from Melaleuca Park.

Potential Black Cockatoo breeding tree locations

Tree species	Easting	Northing	Hollows
Jarrah	380016.06	6495264.97	0
Jarrah	380212.47	6495276.59	0
Jarrah	380224.48	6495274.90	0
Jarrah	380226.25	6495273.66	0
Jarrah	380214.01	6495272.97	0
Jarrah	380230.84	6495265.92	0
Jarrah	380282.41	6495285.65	0
Jarrah	380274.40	6495289.73	2 (1 small and 1 medium)

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12516238-17829/https://projectsportal.ghd.com/sites/pp18_03/mfehr2019biologicals/ProjectDocs/12516238-REP-A_Quarry Access Road Biological Survey.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date

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Appendix C – Desktop Searches

EPBC Act PMST (5 km)

NatureMap Flora Report (5 km)

NatureMap Fauna Report (5 km)

Australian Government
Department of the Environment and Energy

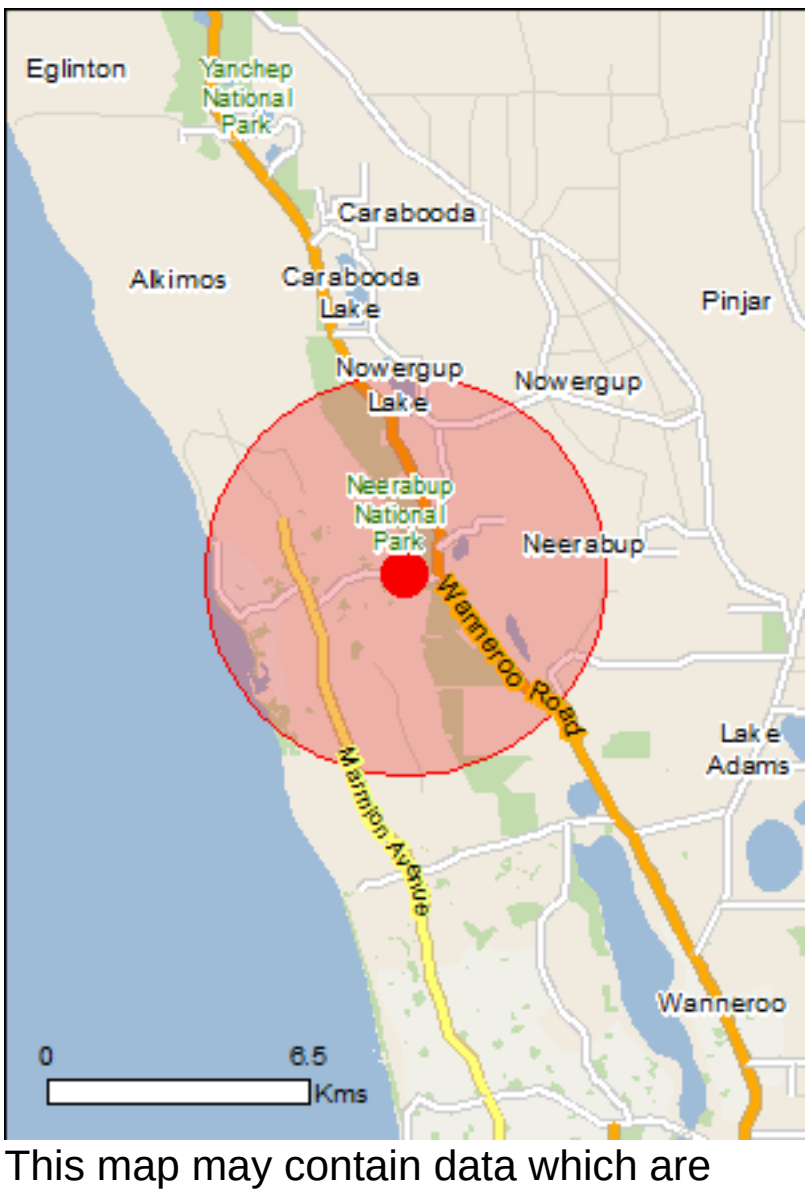
EPBC Act Protected Matters Report

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

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

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

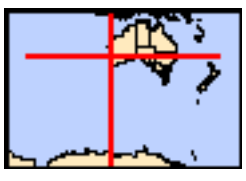
Report created: 03/02/20 16:47:11



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 5.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	47
Listed Migratory Species:	42

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	66
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	34
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community may occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thalassarche cauta cauta Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Insects		
Hesperocolletes douglasi Douglas' Broad-headed Bee, Rottnest Bee [66734]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
[Neophoca cinerea](#) Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Species or species habitat known to occur within area
Plants		
[Andersonia gracilis](#) Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
[Anigozanthos viridis subsp. terraspectans](#) Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat may occur within area
[Diuris micrantha](#) Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
[Diuris purdiei](#) Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
[Drakaea elastica](#) Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
[Drakaea micrantha](#) Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area
[Eleocharis keigheryi](#) Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
[Eucalyptus argutifolia](#) Yanchep Mallee, Wabling Hill Mallee [24263]	Vulnerable	Species or species habitat known to occur within area
[Lepidosperma rostratum](#) Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
[Marianthus paralius](#) [83925]	Endangered	Species or species habitat known to occur within area
[Melaleuca sp. Wanneroo (G.J. Keighery 16705)](#) [89456]	Endangered	Species or species habitat known to occur within area
Reptiles		
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Sharks		
[Carcharias taurus (west coast population)](#) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
[Carcharodon carcharias](#) White Shark, Great White Shark [64470]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Hydroprogne caspia Caspian Tern [808]		Foraging, feeding or related behaviour known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Foraging, feeding or related behaviour likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
[Thalassarche steadi](#) White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
[Balaena glacialis australis](#) Southern Right Whale [75529]	Endangered*	Breeding known to occur within area
[Balaenoptera edeni](#) Bryde's Whale [35]		Species or species habitat may occur within area
[Balaenoptera musculus](#) Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
[Caperea marginata](#) Pygmy Right Whale [39]		Species or species habitat may occur within area
[Carcharodon carcharias](#) White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
[Lamna nasus](#) Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
[Manta alfredi](#) Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
[Manta birostris](#) Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
[Megaptera novaeangliae](#) Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
[Orcinus orca](#) Killer Whale, Orca [46]		Species or species habitat may occur within area
[Rhincodon typus](#) Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		

Name	Threatened	Type of Presence
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
[Ardea ibis](#) Cattle Egret [59542]		Species or species habitat may occur within area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
[Calidris canutus](#) Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area
[Diomedea amsterdamensis](#) Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
[Diomedea epomophora](#) Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea exulans](#) Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Diomedea sanfordi](#) Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Haliaeetus leucogaster](#) White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
[Larus pacificus](#) Pacific Gull [811]		Foraging, feeding or related behaviour may occur within area
[Limosa lapponica](#) Bar-tailed Godwit [844]		Species or species habitat may occur within area
[Macronectes giganteus](#) Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
[Macronectes halli](#) Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
[Merops ornatus](#) Rainbow Bee-eater [670]		Species or species habitat may occur within area
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
[Pachyptila turtur](#) Fairy Prion [1066]		Species or species habitat likely to occur

Name	Threatened	Type of Presence
		within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna anaethetus Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Reptiles		
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area

Name	Status	Type of Presence
[Tursiops aduncus](#)		
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
[Tursiops truncatus s. str.](#)		
Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Neerabup	WA
Neerabup	WA

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		

Name	Status	Type of Presence
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-31.67011 115.73307

Acknowledgements

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

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

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

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

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NatureMap Fauna Species Report - Sth Hester Quarry Access

Created By Guest user on 11/02/2020

Kingdom	Animalia
Conservation Status	Conservation Taxon (T, X, IA, S, P1-P5)
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	115° 44' 07" E,31° 40' 17" S
Buffer	5km
Group By	Species Group

Species Group	Species	Records
Bird	8	154
Invertebrate	3	9
Mammal	8	35
Reptile	4	8
TOTAL	**23**	**206**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Bird					
1.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
2.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)*		T	
3.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		T	
4.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
5.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
6.	48591	*Pandion cristatus (Osprey, Eastern Osprey)*		IA	
7.	24716	*Puffinus pacificus (Wedge-tailed Shearwater)*		IA	
8.	48597	*Thalasseus bergii (Crested Tern)*		IA	
Invertebrate					
9.	33973	*Austrosaga spinifer (spiny katydid (Swan Coastal Plain), bush cricket (Swan Coastal Plain))*		P2	
10.	48935	*Idiosoma sigillatum (Swan Coastal Plain shield-backed trapdoor spider)*		P3	
11.	33992	*Synemon gratiosa (Graceful Sunmoth)*		P4	
Mammal					
12.	24043	*Eubalaena australis (Southern Right Whale)*		T	
13.	48588	*Isoodon fusciventer (Quenda, southwestern brown bandicoot)*		P4	
14.	24051	*Megaptera novaeangliae (Humpback Whale)*		S	
15.	48022	*Notamacropus irma (Western Brush Wallaby)*		P4	
16.	24154	*Perameles bougainville subsp. bougainville (Western Barred Bandicoot, Marl)*		T	
17.	24155	*Perameles eremiana (Desert Bandicoot, walilya)*		X	
18.	24073	*Physeter macrocephalus (Sperm Whale)*		T	
19.	24157	*Trichosurus vulpecula subsp. arnhemensis (northern brushtail possum (Kimberley))*		T	
Reptile					
20.	25335	*Caretta caretta (Loggerhead Turtle)*		T	
21.	25336	*Chelonia mydas (Green Turtle)*		T	
22.	25249	*Neelaps calonotos (Black-striped Snake, black-striped burrowing snake)*		P3	
23.	25258	*Pseudonaja affinis subsp. exilis (Rottnest Island Dugite)*		P4	

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

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the

Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area

calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

NatureMap CS Species Report - Sth Hester Quarry Access

Created By Guest user on 11/02/2020

Kingdom	Plantae
Conservation Status	Conservation Taxon (T, X, IA, S, P1-P5)
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	115° 44' 07" E,31° 40' 17" S
Buffer	5km
Group By	Family

Family	Species	Records
Aizoaceae	1	1
Cyperaceae	1	1
Dasypogonaceae	1	2
Dilleniaceae	1	2
Ericaceae	1	1
Fabaceae	3	5
Fabroniaceae	1	5
Haemodoraceae	1	1
Myrtaceae	3	29
Pittosporaceae	1	1
Stylidiaceae	1	2
Thymelaeaceae	1	2
TOTAL	**16**	**52**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Aizoaceae					
1.	17543	*Sarcozona bicarinata*		P3	
Cyperaceae					
2.	35581	*Tetraria sp. Chandala (G.J. Keighery 17055)*		P2	
Dasypogonaceae					
3.	1213	*Calectasia cyanea (Blue Tinsel Lily)*		T	
Dilleniaceae					
4.	11461	*Hibbertia spicata subsp. leptotheca*		P3	
Ericaceae					
5.	19460	*Leucopogon sp. Yanchep (M. Hislop 1986)*		P3	
Fabaceae					
6.	3237	*Acacia benthamii*		P2	
7.	20462	*Jacksonia gracillima*		P3	
8.	4027	*Jacksonia sericea (Waldjumi)*		P4	
Fabroniaceae					
9.	20162	*Fabronia hampeana*		P2	
Haemodoraceae					
10.	1425	*Conostylis bracteata*		P3	
Myrtaceae					
11.	34161	*Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)*		P1	
12.	13091	*Eucalyptus argutifolia (Wabling Hill Mallee)*		T	
13.	33022	*Melaleuca sp. Wanneroo (G.J. Keighery 16705)*		T	
Pittosporaceae					
14.	25819	*Marianthus paralius*		T	
Stylidiaceae					
15.	13127	*Stylidium maritimum*		P3	
Thymelaeaceae					
16.	5237	*Pimelea calcicola*		P3	

Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area

Conservation Codes
T - Rare or likely to become extinct
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NatureMap
Mapping Western Australia's biodiversity

NatureMap Fauna Species Report - Sth Hester Quarry Access

Created By Guest user on 11/02/2020

Kingdom	Animalia
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	115° 44' 07" E,31° 40' 17" S
Buffer	5km
Group By	Species Group

Area (ha)		7851.91
Taxa:	Naturalised	10
	Native	239
Endemics:		0
Families:		90
Genera:		175
Conservation Status:	-	226
	3	2
	IA	4
	T	8
	X	1
	4	5
	S	2
	2	1
MS Status:	-	248
	PN	1
Rank:	-	218
	subsp.	31

Top Ten Families

		Species	Records
1.	Scincidae	18	367
2.	Psittacidae	17	245
3.	Elapidae	13	49
4.	Anatidae	9	70
5.	Accipitridae	9	47
6.	Meliphagidae	8	158
7.	Cracticidae	6	85
8.	Acanthizidae	6	108
9.	Rallidae	6	33
10.	Diplodactylidae	5	14

Top Ten Genera

		Species	Records
1.	*Cracticus*	5	82
2.	*Cacatua*	5	26
3.	*Malurus*	5	44
4.	*Tiliqua*	4	53
5.	*Platycercus*	4	10
6.	*Phalacrocorax*	4	16
7.	*Lerista*	4	74
8.	*Cormocephalus*	4	62
9.	*Anas*	3	31
10.	*Accipiter*	3	11

[1] Endemic To Query Area

Name ID	Species	Conservation Status

Conservation Codes
T - Rare or likely to become extinct
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1 - Priority 1
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[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Statistics Report - Sth Hester Quarry Access

Created By Guest user on 11/02/2020

Kingdom	Plantae
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	115° 44' 07" E,31° 40' 17" S
Buffer	5km
Group By	Family

Area (ha)		7851.91
Taxa:	Naturalised	53
	Native	238
Endemics:		0
Families:		57
Genera:		164
Conservation Status:	-	275
	1	1
	3	7
	T	4
	2	3
	4	1
MS Status:	-	284
	PN	4
	MS	3
Rank:	-	259
	subsp.	22
	var.	10

Top Ten Families

		Species	Records
1.	Fabaceae	38	106
2.	Asteraceae	22	84
3.	Proteaceae	20	58
4.	Orchidaceae	18	51
5.	Poaceae	17	73
6.	Myrtaceae	16	67
7.	Cyperaceae	15	57
8.	Asparagaceae	15	53
9.	Ericaceae	11	30
10.	Haemodoraceae	11	35

Top Ten Genera

		Species	Records
1.	*Acacia*	12	26
2.	*Lomandra*	8	26
3.	*Eucalyptus*	7	40
4.	*Conostylis*	7	28
5.	*Stylidium*	6	14
6.	*Hibbertia*	6	23
7.	*Drosera*	6	23
8.	*Caladenia*	6	15
9.	*Trifolium*	5	17
10.	*Banksia*	5	20

[1] Endemic To Query Area

Name ID **Species** **Conservation Status**

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
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[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix D – Offset Proposal

Main Roads Western Australia

Quinns Quarry Access

Offset Proposal

April 2020

Executive summary

Main Roads Western Australia (Main Roads) proposes to undertake clearing of native vegetation to upgrade and realign the existing Quinns Quarry access road located on Hester Avenue, immediately east of Mitchell Freeway, where the freeway currently terminates (Figure 1, Appendix A).

The Proposal will enable the realignment and construction of a two lane quarry access road connecting to Hester Avenue. The existing access road is required to be realigned due to the requirement for a new roundabout at Hester Avenue which has a significantly larger footprint than the existing T intersection. A Native Vegetation Clearing Permit (NVCP) (purpose) is required for the clearing of native vegetation associated with the proposed works.

Aspect	Comments
Proposal Details	Main Roads proposes to undertake clearing in association with the upgrade and realignment of the Quinns Quarry access road (Figure 1, Appendix A).
Proposal Requirement	Main Roads proposes to undertake 0.5 ha clearing of native vegetation in association with upgrade of the access road to the quarry.
Measures to avoid, reduce, mitigate and manage Proposal impacts	All strategies to avoid and mitigate environmental impacts have been explored and implemented, including the following: • The access road has been located as close as possible to existing access road to minimise footprint and impacts to adjacent vegetation. • Where possible, works will be undertaken within previously cleared land. • Design retains access in its current location to reduce impacts. • Fully sealed road to eliminate potential impact of dust particles on adjacent vegetation (associated with unsealed roads). • Implementation of typical surface water control measures along the access road including swales to prevent impacts to adjacent vegetation from surface water runoff and control 1 in 50 flooding events. • Early consultation with utility service providers ensuring design is optimised to minimise relocation of existing services (and associated ground disturbance and clearing). • Early consultation with the DBCA to ensure design acceptance and determine concerns in relation to minimising impacts to native vegetation and the National Park. • Project design has reduced the cross section width of the access road to the minimum permissible to ensure safe and efficient movement. • Ensuring the access road alignment uses as much of the existing road pavement as possible and ties into the existing pavement as soon as possible. • Roundabout size is the minimum permissible to accommodate the design vehicles.

Aspect	Comments
	• Vertical design of the road closely matches existing topography where possible to minimise earthworks. • Impacts could be further minimised by installation of retaining walls to reduce the earthworks batters, this will be considered during detailed design.
Related Documents	A biological survey was conducted by GHD (2019), which covers the proposed NVCP area. A Supporting Documentation report for the clearing permit application was completed in February 2020 and outlines the mitigation measures applied to the Proposal as well as an assessment against the EP Act Ten Clearing Principles (GHD 2020).
Clearing Impacts	Clearing impacts will include the loss of: • Up to 0.5 ha of native vegetation • 0.46 ha of vegetation in Good or better condition • 0.5 ha of class A Neerabup National park • 0.5 ha of Bush Forever Site 383 (overlapping with Neerabup National Park). • 0.5 ha of *Banksia* woodlands of the Swan Coastal Plain PEC. This includes 0.5 ha of the EPBC Act listed *Banksia* woodlands of the Swan Coastal Plain TEC. • 0.5 ha of foraging habitat for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo. • 0.5 ha of habitat for the Peregrine Falcon • 0.5 ha of habitat for the Southern Brown Bandicoot • 0.5 ha of habitat for the Western Brush Wallaby • Up to 0.5 ha of habitat for the Black-striped Snake.
Offset Type	Financial contribution to the Department of Water and Environment Regulation (DWER) to mitigate significant residual impacts associated with the Proposal activities. The financial contribution was calculated using the EPBC Offset Calculator Tool, which identified a necessary offset area 2.5 ha in size. This was then multiplied by the market valuation of unimproved (vegetated) land in the Shire of Gingin ($16,910/hectare for 10 ha price), resulting in a sum of $42,275.
Offset Purpose	A NVCP Supporting Documentation report was completed for the proposal and identified residual impacts remaining, after the application of the mitigation hierarchy (GHD 2020). The purpose of this document is to outline the offset proposed for the Proposal in accordance with the WA Environmental Offsets Guidelines, as a response to the residual impacts remaining.
Offset Proposal	It is assumed that a 2.5 ha rural freehold property will be acquired by DWER on the northern Swan Coastal Plain. The value of un-improved (vegetated) rural land in the Shire of Gingin is estimated by the Valuer-General at $16,910/hectare (for the 10 hectare price), which for 2.5 ha equates to sum of $42,275.

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Appendices

1. Introduction

1.1 Proposal background

Main Roads Western Australia (Main Roads) proposes to undertake clearing of native vegetation to upgrade and realign the existing Quinns Quarry access road located on Hester Avenue, immediately east of Mitchell Freeway where the freeway currently terminates (Figure 1, Appendix A).

The Proposal will involve the re-alignment of an existing access road to the quarry and construction of an approximately 100 m two lane quarry access road, connecting to Hester Avenue. The existing access road is required to be realigned due to the requirement for a new roundabout at Hester Avenue which has a significantly larger footprint than the existing T intersection. An NVCP (purpose) is required for clearing of native vegetation associated with the proposed works.

1.2 Purpose

The purpose of this document is to outline the offset proposed for the native vegetation clearing permit in accordance with the WA Environmental Offsets Guidelines (Government of Western Australia (GoWA) 2011), as a response to the residual impacts remaining after the application of the mitigation hierarchy (detailed in the Native Vegetation Clearing Permit (NVCP) supporting documentation (GHD 2020).

1.3 Proposal location

The NVCP area is located on Hester Avenue, immediately east of Mitchell Freeway where the freeway currently terminates (Figure 1, Appendix A). The NVCP area is 0.50 hectares (ha) of native vegetation within an envelope of 0.69 ha.

1.4 Clearing principles likely to be at variance

Schedule 5 of the *Environmental Protection Act 1986* (EP Act) defines Ten Clearing Principles for native vegetation. These principles aim to ensure that all potential impacts resulting from removal of native vegetation can be assessed in an integrated way. Clearing required for construction of the Proposal has been assessed against the Ten Clearing Principles, with each principle being assessed in accordance with the Department of Environment Regulation (DWER) *Guide to the Assessment of Applications to Clear Native Vegetation* (DWER 2014) to determine whether the application is at variance to the principles. The assessment indicates that the Proposal is at variance with principles b and h, and likely to be at variance with principle a (Table 1).

Table 1 Principles at variance

Principle		Assessment	Outcome
A	Native vegetation should not be cleared if it comprises a high level of biological diversity.	All native vegetation in the NVCP area is mapped as Banksia woodland. The NVCP area has a high level of biodiversity, commensurate with the surrounding region. The native vegetation was mainly in Good-Excellent condition (92.5%), and represents high biodiversity vegetation. A relatively small section is Completely Degraded (7.5%) in condition. This reflects the context of the site, between an existing road and conservation areas. One Regional Ecological Linkage intersects the NVCP area, and provides for movement of fauna through the landscape. The NVCP area intersects Regional Ecological Linkage ID 6, which links Neerabup National Park (Bush Forever Site No. 383) to Lake Joondalup (Bush Forever Site No. 299) in the south and Yanchep and Neerabup National Parks (Bush Forever Site No. 130) in the north. The NVCP area is located on an existing road, therefore the impacts are expected to be less significant than bisecting contiguous vegetation. The Proposal will not break this ecological linkage, clearing 0.15 ha within the linkage border. No State or Commonwealth Threatened or Priority flora species were recorded in the GHD (2019) biological surveys. One Bush Forever site occurs within the NVCP area, Bush Forever Site No. 383 Neerabup National Park, Lake Nowergup Nature Reserve and adjacent bushland. Up to 0.50 ha of Bush Forever Site No. 383 is within the NVCP area. The NVCP area is representative of Banksia woodlands of the Swan Coastal Plain PEC. This includes 0.50 ha of the EPBC Act listed Banksia woodlands of the Swan Coastal Plain TEC. One fauna habitat was recorded in the NVCP area, *Banksia* Woodland on grey/brown sand. The vegetation was generally in excellent condition and contains good structural diversity and a variety of micro-habitat types. The biological assessment recorded two conservation significant fauna species within the NVCP area, Carnaby's Cockatoo and Forest Re-tailed Black Cockatoo. An additional five species were considered likely to occur in the NVCP area. The Proposal will involve clearing of native vegetation in an area of high biological diversity. The Proposal is likely to be at variance to this principle.	Likely to be at variance to this principle

Principle		Assessment	Outcome
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 NVCP area contains habitat suitable for seven conservation significant fauna species including: • Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – Endangered under the EPBC Act and BC Act • Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable under the EPBC Act and BC Act • Peregrine Falcon (*Falco peregrinus*) – Other specially protected fauna under the BC Act • Southern Brown Bandicoot (*Isoodon fusciventer*) – Priority 4 • Western Brush Wallaby (*Notamacropus Irma*) – Priority 4 • Black-striped Snake (*Neelaps calonotos*) – Priority 3 • *Ctenotus gemmula* (Swan Coastal Plain population) – Priority 3. The NVCP area contains suitable foraging habitat for both Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo. A total of 0.50 ha of foraging habitat for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo will be cleared. No breeding, potential breeding or roosting habitat was recorded in the NVCP area. The NVCP area represents approximately 0.01% of available black cockatoo foraging habitat remaining within 5 km of the Proposal (approximately 4,800 ha), of which 35% (1,673 ha) is located in DBCA managed lands (GoWA 2020). It has been assumed that all native vegetation is potentially Black Cockatoo habitat. The Proposal lies within the modelled distribution of Carnaby's Cockatoo. Forest Red-tailed Black Cockatoos are also known to occur in the area in search of food. There are extensive, well reserved areas in the vicinity of the project that are expected to provide suitable foraging, roosting and potential breeding resources for black cockatoos. Clearing of the NVCP area will also result in the loss of: • 0.50 ha of habitat for the Peregrine Falcon • 0.50 ha of habitat for the Southern Brown Bandicoot • 0.50 ha of habitat for the Western Brush Wallaby • 0.50 ha of habitat for the Black-striped Snake • 0.50 ha of habitat for Ctenotus gemmula (Swan Coastal Plain population). Given the clearing of habitat for conservation significant fauna, the Proposal is considered to be at variance to this principle.	At variance to this principle

Principle		Assessment	Outcome
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 NVCP area is within Class A reserve, Neerabup National Park. Up to 0.50 ha of vegetation in the Neerabup National Park will be cleared. The Proposal is at variance to this principle.	At variance to this principle.

1.5 Residual impacts associated with specific clearing principles

The residual impacts associated with the Proposal include the loss of 0.5 ha of native vegetation. The vegetation was mainly in Good – Excellent (92.5%) and Completely Degraded (7.5%) condition. This reflects the context of the site, between an existing road and conservation areas. A total of 0.46 ha of native vegetation is in Good or better condition and represents high biodiversity vegetation.

Clearing impacts will include the loss of:

- 0.46 ha of native vegetation in Good or better condition
- 0.5 ha of Class A Neerabup National Park
- 0.5 ha of Bush Forever Site 383 (this overlaps with Neerabup National Park)
- 0.5 ha of *Banksia* woodlands of the Swan Coastal Plain PEC. This is includes the EPBC Act listed Banksia woodlands of the Swan Coastal Plain TEC.
- Up to 0.5 ha of habitat for conservation significant fauna, specifically:
  - 0.5 ha of foraging habitat for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo, and one potential breeding tree.
  - 0.5 ha of habitat for the Peregrine Falcon
  - 0.5 ha of habitat for the Southern Brown Bandicoot
  - 0.5 ha of habitat for the Western Brush Wallaby
  - Up to 0.5 ha of habitat for the Black-striped Snake
  - 0.5 ha of habitat for *Ctenotus gemmula* (Swan Coastal Plain population).

2. Offset Proposal requirements

2.1 Summary of offsets proposed

The principle offset for the Proposal relates to residual impacts to black cockatoo habitat. The offsets calculation has determined that 2.5 ha of land is required to offset this residual impact.

For the purposes of providing a financial offset for this Proposal, it is assumed that a 2.5 ha rural freehold property will be acquired on the northern Swan Coastal Plain. The value of un-improved (vegetated) rural land in the Shire of Gingin is estimated by the Valuer-General at $16,910/hectare (ten hectare price), which for 2.5 ha equates to sum of $42,275. A summary of the offset proposed is provided in Table 2.

Table 2 Summary of residual impacts, offset type, size of offset and percentage of residual impact offset

Residual Impact		Details	Temporary clearing revegetation (Y/N)	Offset Type (Other)	Residual impact (ha)	Offset size (ha)	% of residual impact offset
1	Loss of high biodiversity vegetation	• 0.46 ha of native vegetation in Good or better condition • 0.5 ha of Class A Neerabup National Park • 0.5 ha of Bush Forever Site 383 • 0.5 ha of PEC	N	Financial Contribution to a fund established by DWER	0.5 ha	2.2 ha	101
2	Loss of habitat necessary for the maintenance of indigenous fauna	• 0.5 ha of foraging habitat for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo • 0.5 ha of habitat for the Peregrine Falcon • 0.5 ha of habitat for the Southern Brown Bandicoot • 0.5 ha of habitat for the Western Brush Wallaby • Up to 0.5 ha of habitat for the Black-striped Snake • 0.5 ha of habitat for *Ctenotus gemmula* (Swan Coastal Plain population).	N	Financial Contribution to a fund established by DWER	0.5 ha	2.5 ha	106.35
3	Clearing of vegetation associated with a conservation reserve	• 0.5 ha of Class A Neerabup National Park • 0.5 ha of Bush Forever Site 383 (this overlaps with Neerabup National Park)	N	Financial Contribution to a fund established by DWER	0.5 ha	2.1 ha	101

2.2 Justification for the Offset Proposal

The EPBC Offset Calculator Tool was used to evaluate Proposal impacts for biodiversity clearing principles with significant residual impacts, in accordance with the requirements of the WA Environmental Offsets Guidelines (GoWA 2014). The calculations for Principles a, b and h are provided in Appendix B. Copies of the EPBC Offset Calculator Tool worksheets for the residual impacts to Clearing Principles a, b and h for the Proposal are included in Appendix C.

2.3 Calculation of financial contribution

A total offset of 2.5 ha will be required for this Proposal, taking the largest result from the offset calculations (black cockatoo). It is assumed that land purchased for offset purposes will include suitable land for the other environmental factors impacted.

The financial contribution was calculated using the EPBC Offset Calculator Tool to determine the area of the offset required in hectares (2.5 ha total) multiplied by the market valuation of the unimproved (vegetated) land $16,910 for a land parcel size of 10 ha within the Shire of Gingin obtained from the Valuer-General (Landgate 2016).

The market valuation of the vegetated land was based on the valuation obtained from the Valuer-General (on a $/ha basis) for unimproved (vegetated) land within the Local Government Area (LGA) (Landgate 2016). As the Valuer-General's market valuation ($/ha) of vegetated land differs according to the size of the land parcel, the valuation of the closest 'standard parcels' of land (i.e. 10, 50, 100, 200 or 500 ha) was used to determine the market valuation of the offset area.

2.4 Offset Condition Milestones

Condition Milestone 1 – Main Roads shall provide documentary evidence to the CEO of DWER that funding of $42,275 has been transferred to the Department.

Timeframe for Completion – Prior to undertaking any clearing for the works authorised under the Proposal clearing permit.

3. Application of Environmental Offset Policy Principles

The WA Environmental Offsets Policy (GoWA 2011) states that environmental offsets are to be used as a last resort, and details six principles to be applied in the assessment and decision making with respect to offsets.

The application of the environmental offset policy principles to the Offset Proposal is provided in Table 3.

Table 3 Application of the WA Environmental Offset Policy Principles to the Offset Proposal

Principle No.	Principle	Comment
1.	Environmental offsets will only be considered after avoidance and mitigation options have been pursued.	All strategies to avoid and mitigate environmental impacts have been explored and implemented, including the following: • The access road has been located as close as possible to existing access road to minimise footprint and impacts to adjacent vegetation. • The majority of the works will be undertaken within previously cleared land. • Design retains access in its current location to reduce impacts. • Fully sealed road to eliminate potential impact of dust particles on adjacent vegetation (associated with unsealed roads). • Implementation of typical surface water control measures along the access road including swales to prevent impacts to adjacent vegetation from surface water runoff and control 1 in 50 flooding events. • Early consultation with utility service providers ensuring design is optimised to minimise relocation of existing services (and associated ground disturbance and clearing). • Early consultation with the DBCA to ensure design acceptance and determine concerns in relation to minimising impacts to native vegetation and the National Park. • Project design has reduced the cross section width of the access road to the minimum permissible to ensure safe and efficient movement. • Ensuring the access road alignment uses as much of the existing road pavement as possible and ties into the existing pavement as soon as possible. • Roundabout size is the minimum permissible to accommodate the design vehicles. • Vertical design of the road closely matches existing topography where possible to minimise earthworks.

Principle No.	Principle	Comment
		• Impacts could be further minimised by installation of retaining walls to reduce the earthworks batters, this will be considered during detailed design.
2	Environmental offsets are not appropriate for all proposals.	Environmental offsets are considered an appropriate form of mitigation for biological impacts including the clearing of native vegetation.
3	Environmental Offsets will be cost effective, as well as relevant and proportionate to the significance of the environmental value being impacted.	Main Roads believes that the proposed offset represents a cost-effective solution that is relevant and proportionate to the environmental value being impacted by the Proposal. The area to be purchased with the financial contribution will consist of environmental values that are equal or of higher value than the vegetation proposed to be cleared within the Proposal area.
4	Environmental offsets will be based on sound environmental information and knowledge.	The selection and management of land to be purchased will be based on sound environmental information and knowledge.
5	Environmental offsets will be applied within a framework of adaptive management.	The offset land acquired will be added to the conservation estate and will be managed within an adaptive management framework utilising the State's environmental knowledge and understanding.
6	Environmental offsets will be focussed on longer term strategic outcomes.	The proposed offset will contribute to the Offset Fund established by DWER under the EP Act for the acquisition of offset sites. Land to be purchased will be added to the conservation estate.

4. References

Department of Environment Regulation 2014, A Guide to the Assessment of Applications to Clear Native Vegetation. Government of Western Australia, Perth.

GHD 2019, Hester Avenue – Quarry Access Road Biological Survey, December 2019

GHD 2020, Quinns Quarry Access NVCP Supporting Documentation, March 2020

Government of Western Australia (GoWA) 2011, WA Environmental Offset Policy (September 2011). Perth, WA. Available online: http://www.epa.wa.gov.au/EPADocLib/WAEnvOffsetsPolicy-270911.pdf

Keighery, BJ 1994, Bushland Plant Survey: A Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc). Nedlands, WA.

Land Information Authority, WA (Landgate) 2016, Landgate Land Valuations of Unimproved Land, 2016-2017 – *Confidential. Unpublished report prepared for Main Road's WA. Perth, WA.

Appendices

Appendix A – Figures

Figure 1 Proposal Location

Paper Size ISO A3

0 10 20 30 40

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Main Roads WA
Quinns Quarry Access

Proposal Location

Project No. **12522027**
Revision No. **0**
Date **26 Feb 2020**

FIGURE 1

G:\61\12522027\GIS\Maps\Working\Sth Hester Ave.aprx\12522027_001_ProposalLocation_RevA
Print date: 26 Feb 2020 - 14:42

Data source: GHD: Project Footprint - 20200122, Survey Area (South Hester Ave) - 20200205; Landgate: Roads - 20200122, Imagery - August 2019. Created by: bmorgan

Appendix B – Offset Calculation Values

Values that were input into the EPBC Calculator Tool – Residual Impact to Clearing Principle a

Attribute	Value	Justification
Area of community/habitat impacted	0.5 ha	Total amount of Class A Neerabup National Park to be cleared, assuming that the National Park represents high biodiversity vegetation.
Vegetation/Habitat quality of the impacted area	7	An overall quality score was obtained by weighting the vegetation condition across the Proposal area: • Pristine: score 10 – 0% of PEC area • Excellent: score 9 – 50% of PEC area • Excellent – Very Good: score 8 – 0% of PEC area • Very Good: score 7 – 0% of PEC area • Very Good – Good: score 6 – 0% of PEC area • Good: score 5 – 43% of PEC area • Good – Degraded: score 4 – 0% of PEC area • Degraded: score 3 – 0% of PEC area • Degraded – Completely Degraded: score 2 – 0% of PEC area • Completely Degraded: score 1 – 7% of PEC area. The majority of PEC impacted is in Good or better condition, a weighted score of 6.7 was identified. This was rounded up to 7.
Start quality Vegetation/habitat Quality of the offset area (takes into account the regional context and stocking rate)	9	Rating for Excellent condition vegetation based on Keighery (1994). It is assumed that land purchase with funds provided under s51i (2b) of the EP Act would be in Excellent or Pristine condition (Keighery 1994).
Future Quality without Offset	9	Unlikely to change over a period of one year prior to purchase.
Future Quality with Offset	9	Acquisition only therefore no change is expected in future quality
Time Horizon over which loss is averted (security of land tenure)	20 years	Land purchased with financial contributions will be added to the conservation estate so long term protection is afforded. Twenty years is the maximum value that can be input.
Time until ecological benefit	1 year	Short time-frame required for land to be purchased and placed into the conservation estate.
Risk of loss without offset	30%	Moderate risk of loss.
Risk of loss with offset	10%	Minimal risk. Offset placed into secure tenure managed by the State (i.e. conservation estate). Ten percent allows for ongoing management of the offset site.
Confidence in result	90%	High degree of confidence. Financial contributions are used to purchase land that is added to the conservation estate through a State guaranteed scheme.
Hectares of offset required	2.2 ha	
Percentage of impact offset	101.00 %	

Values that were input into the EPBC Offset Calculator Tool – Residual Impact to Clearing Principle b – Black Cockatoos

Attribute	Value	Justification
Area of community/habitat impacted	0.5 ha	0.5 ha of foraging habitat for Carnaby's and Forest Red-tailed Black Cockatoos was applied to this factor. Black cockatoos has the highest combined conservation significance. It is assumed that black cockatoo habitat is also representative of habitat for other conservation significant species.
Vegetation/Habitat quality of the impacted area	6	An overall quality score was obtained by weighing the habitat quality across the Proposal area, taking into account site condition, site context and species stocking rate. **Site condition** • Pristine: score 10 – 0% of cockatoo area • Excellent: score 9 – 50% of cockatoo area • Excellent – Very Good: score 8 – 0% of cockatoo area • Very Good: score 7 – 0% of cockatoo area • Very Good – Good: score 6 – 0% of cockatoo area • Good: score 5 –43% of cockatoo area • Good – Degraded: score 4 – 0% of cockatoo area • Degraded: score 3 – 0% of cockatoo area • Degraded – Completely Degraded: score 2 – 0% of cockatoo area • Completely Degraded: score 1 – 7% of cockatoo area. A weighted score of 6.7 was identified. **Site context** A moderate score was applied to reflect the location of the Proposal adjacent to an existing road and within a conservation areas. The Proposal area is subject to threatening processes to habitat associated with informal access and weed invasion along the interface with the disturbed areas. The Proposal is anticipated to be relatively resistant to Dieback spread and expression due to the presence of well drained, calcareous soils. The Proposal area represents approximately 0.01% of available Carnaby's Cockatoo habitat remaining within 5 km of the Proposal area (estimated to be 4,800 ha), of which 1,673 (35%) ha is located in Bush Forever sites and/or DBCA managed lands. The Proposal lies within the modelled distribution of the species distribution. A score of 7 has been applied to reflect this context. **Stocking rate** A moderate score is provided as the Proposal area is known to support foraging and occupation by the species, but has an absence of actual breeding and roosting evidence. The Proposal is expected to play a minor role in sustaining the overall species population

Attribute	Value	Justification
		viability as the species forages and migrates across the Swan Coastal Plain each year. The score reflects the presence of 0.5 ha of foraging habitat and no potential breeding trees. A score of 4 has been applied. An average score of 5.9 was obtained, this has been rounded to 6.
Start quality Vegetation/habitat Quality of the offset area (takes into account the regional context and stocking rate)	9	Rating for Excellent condition vegetation based on Keighery (1994). It is assumed that land purchase with funds provided under s51i (2b) of the EP Act would be in Excellent or Pristine condition (Keighery 1994).
Future Quality without Offset	9	Unlikely to change over a period of one year prior to purchase.
Future Quality with Offset	9	Acquisition only therefore no change is expected in future quality
Time Horizon over which loss is averted (security of land tenure)	20 years	Land purchased with financial contributions will be added to the conservation estate so long term protection is afforded. Twenty years is the maximum value that can be input.
Time until ecological benefit	1 year	Short time-frame required for land to be purchased and placed into the conservation estate.
Risk of loss without offset	30%	Moderate risk of loss.
Risk of loss with offset	10%	Minimal risk. Offset placed into secure tenure managed by the State (i.e. conservation estate). Ten percent allows for ongoing management of the offset site.
Confidence in result	90%	High degree of confidence. Financial contributions are used to purchase land that is added to the conservation estate through a State guaranteed scheme.
Hectares of offset required	2.5 ha	
Percentage of impact offset	106.35 %	

Values that were Input into the EPBC Offset Calculator Tool – Residual Impact to Clearing Principle h

Attribute	Value	Justification
Area of community/habitat impacted	0.5 ha	0.5 ha of vegetation in Bush Forever site 383 and Neerabup National Park
Vegetation/Habitat quality of the impacted area	7	An overall quality score was obtained by weighting the vegetation condition across the Proposal area: • Pristine: score 10 – 0% of conservation area • Excellent: score 9 – 50% of conservation area • Excellent – Very Good: score 8 – 0% of conservation area • Very Good: score 7 – 36.5% of conservation area • Very Good – Good: score 6 – 2% of conservation area • Good: score 5 – 43% of conservation area • Good – Degraded: score 4 – 0% of conservation area • Degraded: score 3 – 12% of conservation area • Degraded – Completely Degraded: score 2 – 0.5% of conservation area • Completely Degraded: score 1 – 7% of conservation area. A weighted score of 6.7 was identified, this has been rounded up to 7.
Start quality Vegetation/habitat Quality of the offset area (takes into account the regional context and stocking rate)	9	Rating for Excellent condition vegetation based on Keighery (1994). It is assumed that land purchase with funds provided under s51i (2b) of the EP Act would be in Excellent or Pristine condition (Keighery 1994).
Future Quality without Offset	9	Unlikely to change over a period of one year prior to purchase.
Future Quality with Offset	9	Acquisition only therefore no change is expected in future quality
Time Horizon over which loss is averted (security of land tenure)	20 years	Land purchased with financial contributions will be added to the conservation estate so long term protection is afforded. Twenty years is the maximum value that can be input.
Time until ecological benefit	1 year	Short time-frame required for land to be purchased and placed into the conservation estate.
Risk of loss without offset	30%	Moderate risk of loss.
Risk of loss with offset	10%	Minimal risk. Offset placed into secure tenure managed by the State (i.e. conservation estate). Ten percent allows for ongoing management of the offset site.
Confidence in result	90%	High degree of confidence. Financial contributions are used to purchase land that is added to the conservation estate through a State guaranteed scheme.
Hectares of offset required	2.2 ha	
Percentage of impact offset	101.00 %	

Appendix C – EPBC Act Offset Guides

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Biodiversity
EPBC Act status	Other
Annual probability of extinction Based on IUCN category definitions	**0.0%**

Other annual probability of extinction	Information source

Key to Cell Colours

- User input required
- Drop-down list
- Calculated output
- Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	Yes		**Area**	0.5	Hectares	
			Quality	**7**	Scale 0-10	
			Total quantum of impact	0.35	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	Yes	0.35	Adjusted hectares		**Risk-related time horizon (max. 20 years)**	20	**Start area (hectares)**	2.2	**Risk of loss (%) without offset**	30%	**Risk of loss (%) with offset**	10%	0.44	90%	0.40	0.40	0.36	101.83%	Yes	
									Future area without offset (adjusted hectares)	1.5	**Future area with offset (adjusted hectares)**	2.0								
					Time until ecological benefit	1	**Start quality (scale of 0-10)**	**9**	**Future quality without offset (scale of 0-10)**	**9**	**Future quality with offset (scale of 0-10)**	**9**	0.00		0.00	0.00				
Threatened species habitat																				
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Black Cockatoo
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	**1.2%**

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes		**Area**	0.5	Hectares	
			Quality	**6**	Scale 0-10	
			Total quantum of impact	0.30	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																				
Area of community	No				**Risk-related time horizon (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**									
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0								
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**									
Threatened species habitat																				
Area of habitat	Yes	0.30	Adjusted hectares		**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	2.5	**Risk of loss (%) without offset**	30%	**Risk of loss (%) with offset**	10%	0.50	90%	0.45	0.35	0.32	106.35%	Yes	
									Future area without offset (adjusted hectares)	1.8	**Future area with offset (adjusted hectares)**	2.3								
					Time until ecological benefit	1	**Start quality (scale of 0-10)**	9	**Future quality without offset (scale of 0-10)**	9	**Future quality with offset (scale of 0-10)**	9	0.00	90%	0.00	0.00				
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**	**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Threatened species																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	National Park
EPBC Act status	Other
Annual probability of extinction Based on IUCN category definitions	**0.0%**

Other annual probability of extinction	Information source

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	Yes		**Area**	0.5	Hectares	
			Quality	**7**	Scale 0-10	
			Total quantum of impact	0.35	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)		% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
Ecological Communities																					
Area of community	Yes	0.35	Adjusted hectares		**Risk-related time horizon (max. 20 years)**	20	**Start area (hectares)**	2.2	**Risk of loss (%) without offset**	30%	**Risk of loss (%) with offset**	10%	0.44	90%	0.40	0.40	0.36	101.83%	Yes		
									Future area without offset (adjusted hectares)	1.5	**Future area with offset (adjusted hectares)**	2.0									
					Time until ecological benefit	1	**Start quality (scale of 0-10)**	**9**	**Future quality without offset (scale of 0-10)**	**9**	**Future quality with offset (scale of 0-10)**	**9**	0.00	90%	0.00	0.00					
Threatened species habitat																					
Area of habitat	No				**Time over which loss is averted (max. 20 years)**		**Start area (hectares)**		**Risk of loss (%) without offset**		**Risk of loss (%) with offset**										
									Future area without offset (adjusted hectares)	0.0	**Future area with offset (adjusted hectares)**	0.0									
					Time until ecological benefit		**Start quality (scale of 0-10)**		**Future quality without offset (scale of 0-10)**		**Future quality with offset (scale of 0-10)**										
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**		**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**	**Adjusted gain**	**Net present value**		**% of impact offset**	**Minimum (90%) direct offset requirement met?**	**Cost ($ total)**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No																				
Condition of habitat Change in habitat condition, but no change in extent	No																				
Threatened species																					
Birth rate e.g. Change in nest success	No																				
Mortality rate e.g Change in number of road kills per year	No																				
Number of individuals e.g. Individual plants/animals	No																				

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12522027-90043/https://projectsportal.ghd.com/sites/pp18_04/nowergupdepotaccessr/ProjectDocs/12522027-REP_Quinns Quarry Access Offset Proposal.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	R Lupton	J Tindiglia		J Tindiglia		28/02/2020

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12522027-56183/https://projectsportal.ghd.com/sites/pp18_04/nowergupdepotaccessr/ProjectDocs/12522027_Quinns_Quarry Access Native Vegetation Clearing Permit Supporting Documentation.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	R Lupton	J Tindiglia		J Tindiglia		28/02/2020

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