Nicholson Road Wetlands Management Plan

Biologic Environmental Survey & Hyd2O

Report to the City of Gosnells

May 2021

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EXECUTIVE SUMMARY

The City of Gosnells (the City) commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake field assessment studies to inform the preparation of a Wetland Management Plan (the Plan) for the Nicholson Road Wetlands Reserve (the Study Area). The Plan is to provide key directions for management and improvement of the Study Area, which is located approximately 16 kilometres (km) southeast of Perth city, upon the Swan Coastal Plain Interim Biogeographic Regionalisation for Australia (IBRA) subregion. The Plan is a requirement of the West Canning Vale Outline Development Plan: Development Contribution Plan Report, to ensure the protection and enhancement of the conservation area.

The Study Area is a 9.3-hectare (ha) site under management of the City. It consists of several Conservation Category Wetlands (CCWs) and Multiple Use Wetlands (MUWs). The core remnant bushland/wetland covers approximately 5.6 ha. Parts of the reserve have undergone historical clearing in the last ten years for the installation of drainage infrastructure including several drainage basins (swales).

Flora and Vegetation

A two-phase detailed flora and vegetation survey was carried out by Biologic botanists on 29-30 September and 17-18 November 2020. A total of 243 vascular flora taxa were recorded in the Study Area, including conservation significant flora taxa: *Schoenus benthamii* (P3) (one individual from one point location) and *Jacksonia sericea* (P4) (81 individuals from 30 point locations – all previously planted). Two taxa previously confirmed from the Study Area pre-survey, *Diuris purdiei* (T) and *Tripterococcus* sp. Brachylobus (A.S. George 14234) (P4), are still considered possible to occur in the Study Area post-survey. A total of five vegetation types and four mapping units ("Cleared", "Parkland Cleared", "Drain" and "Swales") were recorded and mapped within the Study Area. Floristic data analysis with regional data determined that the *Banksia* woodland (BaEmBi) located in the southern section of the Study Area was considered to be analogous with SCP21a which is encompassed within the '*Banksia* woodlands of the Swan Coastal Plain', a priority 3 state-listed Priority Ecological Community and Endangered federally-listed Threatened Ecological Community. Three *Melaleuca* woodland vegetation types (MP Kg, Mp Ll and Mp PefHa) represent that of the Conservation Category Wetlands "Damplands". Vegetation condition ranged from excellent to completely degraded. A total of 52 introduced plant taxa were found, including Declared Pests **Gomphocarpus fruticosus* and **Echium plantagineum*. Weed cover was highest along tracks, swales, drains and edges of the Study Area.

Fauna

A two-phase detailed terrestrial vertebrate fauna survey was carried out by Biologic zoologists from 25-29 June 2020 and 16-23 November 2020, including the use of systematic trapping, acoustic and ultrasonic recordings, camera traps, bird censuses, and targeted on-ground searches. Forty-eight fauna taxa were recorded, of which three were of conservation significance; Carnaby's cockatoo *Calyptorhynchus latirostris* (EPBC and BC Act Endangered), forest red-tailed black cockatoo *Calyptorhynchus banksii naso* (EPBC and BC Act Vulnerable), and quenda *Isoodon fusciventer* (DBCA

Priority 4). Seven broad fauna habitats were identified based on the vegetation mapping, aerial photography, and various other site parameters. Four trees considered appropriate diameter at breast height (DBH, 500 mm) for consideration as breeding habitat for black cockatoo were identified; however, none were observed to have hollows and as such, do not currently represent black cockatoo breeding trees. Nine species of introduced fauna were recorded; of greatest concern is the presence of red foxes *Vulpes vulpes* and cats *Felis catus*.

Drainage Infrastructure

A drainage infrastructure assessment was conducted by hydrologists from Hyd2o on 29 June 2020 in order to identify, locate and assess the quality of existing stormwater infrastructure. Overall, the wetland drainage system appeared functional; however, there were several areas found to have erosion issues and debris which may impact upon on future water drainage. Surface water quality monitoring of incoming stormwater revealed that whilst most parameters fell within the acceptable ranges for wetland ecosystems, the values for NOx-N, copper and zinc exceeded the set trigger values.

Management and Recommendations

The majority of the remnant vegetation within the Study Area is intact native vegetation in excellent condition, this in itself is considered significant vegetation and local natural area and should be protected at its entirety. The threats to the Study Area are consistent with those typical for highly fragmented urban landscapes such as those found upon the Swan Coastal Plain. Small reserve size and surrounding human activity has resulted in high weed density on paths and edges, dumping of rubbish and debris, and hydrological issues. The majority of the Study Area is infested with *Phytophthora cinnamomi* which has the potential to significantly affect the health and persistence of remnant bushland on site. Several areas are recommended for revegetation works to help maintain vegetation in good or better condition, outcompete weeds, and improve the hydrological biofiltering function of the drainage basins.

It is recommended that strategies to improve and maintain the biodiversity values and hydrological function of the Nicholson Road Wetlands Reserve should focus on the key threatening processes of:

- Weeds and invasive flora
- Feral fauna
- Inappropriate access
- Vandalism
- Diseases and pathogens
- Fire
- Hydrological changes

A total of twenty-three management recommendations are suggested for the Nicholson Road Wetlands Reserve and are described in Section 5 of the Plan. The recommendations are prioritised with high priority actions to be considered for the next 12 months.

Threat / Section	Proposed Management Action	Priority (H, M, L)
Weeds and invasive flora		
5.5	Annual weed control	H
5.3	Revegetation – dryland and wetland areas	H
	Gauge interest for a Friends of Nicholson Road Wetlands group for volunteering	L
Feral fauna		
5.7	Feral fauna control – potential annual targeted trapping for red fox and cat.	H
	Investigate feasibility of installing a fauna underpass	L
Inappropriate access and vandalism		
5.8	Fencing along Kinsale Parkway	M
	Construction of dual-use pathway off Merrion Ramble	M
	Construction of concrete footpath alongside Nicholson Road	M
5.2	Placing of signage in revegetation areas and for 'No Dumping'	M
5.9.1	Removal of rubbish and debris throughout Study Area	M
Diseases and pathogens		
5.6	Phosphite application to all susceptible host plants	H
5.6	Installation of Phytophthora signage at entrance points to the reserve and vegetated areas	M
5.6	Attach wire brushes to hygiene signage	L
Fire		
5.8	Re-clearing and application of crushed limestone along northern firebreak	H
	Maintenance of existing firebreaks	H
Hydrological changes		
5.9	Make changes to mapping of hydrological infrastructure as per Plate 3.12 (remove piped inlet which does not exist).	L
5.9.2	Replace headwall at location 74	M
5.9.1	Manual litter removal at locations 1, 15, 21, 35, 56 and 58	H
5.9.3	Erosion control – instate rockpitching at locations 48, 73 and 74	M
5.9.3	Erosion control – extend or realign existing rockpitching at locations 71 and 82	M
5.9.3	Remove sediment and organic matter at locations 15, 35, 41, 53, 56, 58, 67 and 81	H
5.9.4	Surface water monitoring at the outlets of the compensating basins to assess their performance in enhancing surface water quality	M
5.9	Ongoing assessment of drainage infrastructure every 3 years	M

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1 INTRODUCTION

1.1 Background

The City of Gosnells (the "City") commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake field assessment studies to inform the preparation of a Wetland Management Plan (the "Plan") for the Nicholson Road Wetlands Reserve (the Study Area). The Plan is to provide key directions for management and improvement of the Study Area, which is located approximately 16 kilometres (km) southeast of Perth city, upon the Swan Coastal Plain IBRA subregion. The Plan is a requirement of the West Canning Vale Outline Development Plan: Development Contribution Plan Report (DCPR) to ensure the protection and enhancement of the conservation area (City of Gosnells, 2017).

The Study Area is a 9.3-hectare (ha) site under management of the City. It consists of several Conservation Category Wetlands (CCWs) and Multiple Use Wetlands (MUWs). Parts of the reserve have undergone historical clearing in the last ten years for the installation of drainage infrastructure including several drainage basins (swales).

1.2 Purpose and Objectives

1.2.1 Management Objectives

This management plan has been prepared to fulfill a requirement of the DCPR to write a Wetland Management Plan to ensure the protection and enhancement of the conservation area. This overall goal should be supported by the City as part of negotiations to implement this Plan.

The overarching management objective is to:

Actively manage for conservation the core area of remnant bushland/wetland area containing intact and undisturbed vegetation and landforms (5.6 ha), and improve the adjoining previously cleared, revegetated and landscaped areas (3.7 ha) by carrying out additional works to support the core area's conservation values.

First efforts should be made to protect and manage the portion of the Study Area in best condition. This portion (core area) of the Study Area consists of undisturbed and uncleared remnant bushland in excellent to very good condition. Historically, the Swan Coastal Plain bioregion has been heavily cleared (approximately 60 %) thus strengthening the needed support for the protection and enhancement of small remnants such as this for ongoing environmental, biophysical and cultural health and functionality (DoEE, 2016a). This portion supports a number of important environmental, biophysical and cultural factors including one vegetation community of conservation significance, multiple Conservation Category Wetlands and Multiple Use Wetlands, a link within a Regional Ecological Link, habitat for conservation significant flora taxa, conservation significant fauna and supporting habitat, a functioning wetland system, and an important recreational and aesthetic natural area for the surrounding urban community.

Management objectives stemming from the key objective above are presented in Table 1.1.

Table 1.1: Management objectives for the Nicholson Road Wetlands Study Area

Environmental Factor	Management Objectives
Flora and Vegetation	• Complete a two-phase Detailed flora and vegetation survey to support the management plan

	• Identification of the significant values present within the Study Area in relation to:
	  • vegetation type mapping, including the mapping of any significant vegetation.
	  • confirmed locations of conservation significant flora taxa.
	  • confirmed locations of flora taxa of "other" significance.
	  • confirmed locations of weeds, particularly significant environmental weeds.
	  • weed mapping, including mapping of dominant weeds within weed suites.
	  • vegetation condition mapping, including key areas of high localised disturbances

	• Outline the present and potential level and extent of impacts of threat sources to flora and vegetation within the Study Area.
	• Outline potential strategies for the management of threats to flora, including introduced species, vandalism and inappropriate access, fire, and disease.
	• Outline potential strategies for the maintenance of the core habitat values and condition for flora and vegetation, particularly those of conservation significance

	• Within the previously cleared, revegetated and landscaped areas:
	  • Provide regeneration and revegetation strategies that focus on increasing native vegetation diversity and cover of localized natives found in adjacent vegetation types and landforms identified during the accompanying flora survey.
	  • Provide weed control and assisted regeneration strategies.
	  • Provide targets and/or evaluation measures to retain or increase condition within these areas through revegetation and weed control strategies

Dieback	• Provide a detailed summary of the dieback assessment completed by Dieback Treatment Services (Dieback Treatment Services, 2020)
	• Provide management actions in the interest of preserving the integrity of native vegetation across the whole site, particularly within the core area
	• Provide management actions in the interest of preventing spread of the pathogen to surrounding areas, particularly neighboring remnant bushlands
Vertebrate fauna	• Identification of both the native species inventory and assemblage present, and the potential species expected to occur, through a systematic and comprehensive two season field-survey.

	• Identification of the significant values present within the Study Area in relation to:
	  • conservation significant fauna confirmed and with the potential to occur,
	  • the potential breeding of these species within the Study Area,
	  • habitat and microhabitat features of value, and
	  • significant ecological linkages.

	• Outline the present and potential level and extent of impacts of threats sources to vertebrate fauna within the Study Area.
	• Outline potential strategies for the management of threats to vertebrate fauna, including introduced species, vandalism and inappropriate access, fire, and disease.

	• Outline a potential strategy for the maintenance of core habitat values for vertebrate fauna, particularly those of conservation significance, including:
	  • core habitat (e.g., broad habitat types) and
	  • microhabitat features (e.g., significant trees, water resources).

Drainage infrastructure	• Identification of the existing location of drainage swales and other drainage infrastructure within the Study Area
	• Identification of the drainage flow paths through the Study Area.
	• Identification of potential repairs, maintenance, additions, or replacement of infrastructure present to maintain the hydrological integrity of the Study Area.
	• Outline a potential strategy for monitoring of drainage infrastructure within the Study Area to ensure that groundwater and surface water are managed to maintain water quality and quantity.

1.2.2 Survey Objectives

In June 2020, the City commissioned Biologic and Hyd2o to undertake the following field assessments within the Study Area and present the results within this Plan:

- Detailed and targeted flora and vegetation survey and weed assessment;
- Detailed vertebrate fauna survey; and
- Drainage Infrastructure Assessment.

The overarching objective of the flora and vegetation and fauna assessments was to:

Document the environmental values of the Study Area as it relates to flora and vegetation, weeds, and terrestrial vertebrate fauna.

The overarching objective of the Drainage Infrastructure Assessment was to:

To identify, locate, and assess the quality of existing stormwater infrastructure.

397450

397950

6448656

6448156

Parnell Wy

Ranford Rd

Ballycastle Loop

Nicholson Rd

Clontarf Tce

Merrion Rmbl

Tramore Tarn

Legend

- Study Area
- City of Gosnells
- Swan Coastal Plain Bioregion

IBRA Subregion

- Northern Jarrah Forest
- Perth

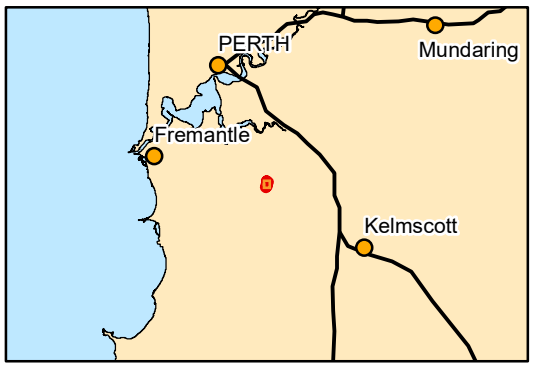
0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 05/02/2021

N

biologic Environmental Survey

Scale: 1:3,000



CITY OF GOSNELLS

Nicholson Rd Biological Survey and Management Plan

Figure 1.1: Location of the Study Area

2 FLORA AND FAUNA SURVEY METHODS

2.1 Compliance

This assessment was carried out in a manner consistent with documents developed by the EPA and the DAWE, formerly the Department of the Environment (DoE), Department of the Environment and Energy (DoEE) and Department of Sustainability, Water, Population, and Communities (DSEWPaC), as outlined below in Table 2.1.

Table 2.1: Guidelines, technical guidelines and procedures for the field survey

Survey component	Guidance documents
General / EIA	EPA (2020a) *Statement of environmental principles, factors and objectives*
	DoE (2013) *Significant impact guidelines*
	EPA (2018) *Environmental Factor Guideline: Inland Waters*
Detailed and targeted flora survey	EPA (2016c) *Technical guidance: Flora and vegetation surveys for environmental impact assessment*
	EPA (2016a) *Environmental factor guideline: flora and vegetation*
	DoEE (2016a) *Banksia woodlands of the Swan Coastal Plain*
	DoE (2014) *Draft Survey guidelines for Australia's threatened orchids*
Basic terrestrial vertebrate fauna survey	EPA (2016b) *Environmental factor guideline: Terrestrial fauna*
	EPA (2020b) *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment*
	DEWHA (2010) *Survey guidelines for Australia's threatened birds*
	DSEWPaC (2011b) *Survey guidelines for Australia's threatened mammals*
	DSEWPaC (2011c) *Survey guidelines for Australia's threatened reptiles*
Black cockatoo habitat (breeding, roosting, foraging) assessment	DoEE (2017a) *Revised draft referral guideline for three threatened black cockatoo species: Carnaby's cockatoo, Baudin's cockatoo and the Forest red-tailed black cockatoo*
	DSEWPaC (2012b) *EPBC Act Referral Guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) Calyptorhynchus latirostris, Baudin's cockatoo (vulnerable) Calyptorhynchus baudinii, Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso*

2.2 Background to Protection of Flora and Fauna

Within Western Australia, native flora and fauna are protected under the *Biodiversity Conservation Act 2016* (BC Act) and at a national level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any action that has the potential to impact native fauna needs to be approved by relevant state and/or federal departments in accordance with the WA *Environmental Protection Act 1986* (EP Act) and the federal EPBC Act.

Some species of flora and fauna that are determined to be at risk of extinction or decline are afforded extra protection under these Acts. For the purposes of this report, these species are deemed to be of conservation significance. A summary of applicable legislation and status codes is provided in Table 2.2. The EPBC Act identifies Threatened Ecological Communities (TECs) as ecological

communities at risk of extinction. The BC Act provides for the statutory listing of TECs by the WA Minister for Environment (the Minister). The Minister has endorsed 69 ecological communities as Threatened under Critically Endangered (20 communities), Endangered (17 communities), Vulnerable (28 communities) and Presumed Totally Destroyed (four communities).

For some species and ecological communities, there is insufficient information to determine their status. These species are generally considered by the Environmental Protection Authority (EPA) and the Department of Biodiversity, Conservation and Attraction's (DBCA) as being of conservation significance for all development related approvals and are listed on a 'Priority List' that is regularly reviewed and maintained by the DBCA (Table 2.2). TECs that do not meet the criteria for statutory listing by the Minister for Environment are added to DBCA's 'Priority Ecological Communities' (PECs) lists under Priorities 1, 2, 3, and 4 (Near Threatened).

Table 2.2 Definitions and terms for fauna, flora and communities of conservation significance

Agreement, Act or List	Status Codes
Federal	
***Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)** The Department of Agriculture, Water and the Environment (DAWE)[1] lists Threatened flora and fauna, which are determined by the Threatened Species Scientific Committee (TSSC) per criteria set out in the Act. The Act lists flora and fauna that are considered to be of conservation significance under one of eight categories (listed under 'Status Codes'). Migratory bird species are those listed under international agreements and protected under the EPBC Act as a Matter of National Environmental Significance (MNES). Relevant international agreements include the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA), and Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA). Threatened Ecological Communities (TECs) are those that are at risk of extinction.	• Extinct (EX) • Extinct in the Wild (EW) • Critically Endangered (CR) • Endangered (EN) • Vulnerable (VU) • Conservation Dependent (CD) • Migratory (MI) • Marine (MA) • Critically Endangered (CR) • Endangered (EN) • Vulnerable (VU)
State	
***Biodiversity Conservation Act 2016* (BC Act)** At a state level, native flora and fauna and TECs are protected under the BC Act. Species in need of conservation are given a ranking ranging from Critically Endangered to Vulnerable. TECs are given a ranking ranging from Vulnerable to Presumed Totally Destroyed. Migratory bird species are those listed under the Bonn Convention and/or CAMBA, JAMBA and ROKAMBA agreements.	Species • Extinct (EX) • Extinct in the Wild (EW) • Critically Endangered (CR) • Endangered (EN) • Vulnerable (VU) • Migratory (MI) • Conservation Dependent Fauna (CD) • Other specially protected species (OS) TECs • Presumed Totally Destroyed (PD) • Critically Endangered (CR) • Endangered (EN) • Vulnerable (VU)
DBCA Priority List DBCA produces a list of Priority species and ecological communities that have not been assigned statutory protection under the BC Act. This system gives a ranking from Priority 1 to Priority 4.	• Priority 1 (Poorly-known species/ ecological communities) (P1) • Priority 2 (Poorly-known species/ ecological communities) (P2) • Priority 3 (Poorly-known species/ ecological communities) (P3) • Priority 4 (Rare, Near Threatened, and other species/ecological communities in need of monitoring) (P4) • Priority 5 (Conservation dependent ecological communities) (P5)

[1] Previously referred to as Department of Environment and Energy (DoEE)

2.3 Desktop Assessment

2.3.1 Database Searches

Database searches were undertaken to generate a list of vascular flora and vertebrate fauna taxa previously recorded within, and near, the Study Area, including introduced species and taxa of conservation significance. The database searches also identified ecological communities/ vegetation types of conservation significance that occur, or may occur, within, and near, the Study Area. Seven database searches were conducted around a central coordinate (-32.0936, 115.9169), with varying buffers as deemed appropriate (Table 2.3).

Table 2.3: Details of database searches conducted.

Purpose	Provider	Database	Parameters
Flora and Vegetation			
To identify potential communities and species listed under the Commonwealth EPBC Act within the Study Area	Department of Agriculture, Water and the Environment (DAWE)	Protected Matters Search Tool (PMST) (DAWE, 2020)	5 km radius
To identify flora species and ecological communities previously recorded within the Study Area and vicinity, in particular those of conservation significance	Department of Biodiversity, Conservation and Attractions' (DBCA)	DBCA's NatureMap (DBCA, 2020a)	5 km radius
		FloraBase (WAH, 1998-)	5 km radius
		DBCA's Species & Communities Branch threatened and priority flora databases (DBCA, 2020f)	5 km radius
	Atlas of Living Australia (ALA)	Species occurrence search (ALA, 2020)	5 km radius
To identify declared pest plants within the Study Area	Department of Primary Industries and Regional Development (DPIRD)	Western Australian Organism List (WAOL) (DPIRD, 2020)	Search of the City of Gosnells
Fauna			
Identify potential species listed under the Commonwealth EPBC Act within the Study Area	DAWE	Protected Matters Search Tool (PMST) (DAWE, 2020)	5 km radius
To identify fauna species previously recorded within the Study Area and its vicinity, in particular those of conservation significance	DBCA	NatureMap (DBCA, 2020a)	5 km radius
		DBCA's Species & Communities Branch threatened and priority fauna databases (DBCA, 2020d)	5 km radius
	Atlas of Living Australia (ALA)	Species occurrence search (ALA, 2020)	5 km radius
	Birdllife Western Australia	Birdlife black cockatoo roost database (BirdLife Australia, 2020)	12 km radius

2.3.2 Literature Review

A review of available literature relevant to the Study Area was undertaken, utilising publicly available searches, reports provided by the City and the Index of Biodiversity Surveys for Assessment (IBSA) portal (Table 2.4). The literature review covered 41 reports related to flora and vegetation surveys and fauna surveys.

Table 2.4: Literature sources used for the review.

Report Title	Reference	Survey Type	Flora	Fauna	Distance from Study Area (km)
Rare Flora Search and Vegetation Survey Campbell Estate	Weston (2004)	Detailed floristic survey	X		Overlaps
Strategic Ecological Assessment of Natural Areas Stage 2: Field Assessment and Natural Area Summary	Ecoscape (2007)	Flora and Vegetation survey	X		Overlaps - 43 reserves throughout City of Gosnells
Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale	Bowman Bishaw Gorham (2001)	Management Plan (Desktop assessment only)	X	X	Overlaps
Lot 9604 Clontarf Terrace, Canning Vale Wetland and Conservation Area Management Plan	ENV (2013b)	Management Plan (Desktop assessment only)	X	X	Overlaps
Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan	ENV (2005a)	Management Plan (Desktop assessment only)	X	X	Overlaps
City of Gosnells Local Natural Areas Vegetation Condition Assessment 2016	Syrinx (2016)	Vegetation Condition Assessment	X		Overlaps – 22 Local Natural Areas assessed
Bushland Management Plan – Gosnells Golf Course, Bush Forever Site 467	Ironbark Environmental (2010)	Management Plan	X		0.6 km E
Clifton Park Cricket Nets Expansion, Flora and Vegetation	Ecoscape (2019)	Detailed Flora and Vegetation Survey	X		0.9 km W
Shreeve Road Reserve Wetland Management Plan	Natural Area (2012)	Management Plan	X	X	2.2 km NE
Ken Hurst Park Strategic Management Plan 2014-2019	Waters (2014)	Management Plan	X	X	2.6 km NW
Fauna survey of the Jandakot airport: 2002	Bamford *et al.* (2003)	Detailed vertebrate fauna survey		X	3 km W
Jandakot Airport Fauna Survey	ENV (2009)	Detailed vertebrate fauna survey		X	3 km W
Jandakot Airport Conservation Areas: Carnaby's Black-Cockatoo Habitat Survey 2011	Western Wildlife (2011a)	Black cockatoo habitat survey		X	3 km W
Jandakot Airport Conservation Areas: Quenda Survey 2011	Western Wildlife (2011b)	Targeted vertebrate fauna survey		X	3 km W
Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011	Western Wildlife (2011c)	Targeted vertebrate fauna survey		X	3 km W
Flora and Vegetation Review, Lot 9103 Warton Road, Piara Waters	Focused Vision (2020)	Reconnaissance Flora and Vegetation Survey	X		3.1 km S
Vertebrate fauna of Ken Hurst Park, City of Melville	Dell and Cooper (1992)	Detailed fauna survey		X	3.2 NW
Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management Plan	ERM Mitchell McCotter (1999)	Basic vertebrate fauna survey, and Management Plan		X	3.5 km NW
Roe Highway Stage 7 Review of Fauna Investigations	Bamford Consulting (2003)	Desktop review		X	3.5 km NW
Review of Carnaby's Cockatoo, *Calyptorhynchus latirostris* within the Proposed Roe Highway Stage 7 Area Jandakot	Johnstone and Johnstone (2004)	Desktop review		X	3.5 km NW
Precinct 3 - Environmental review, Southern River	ENV (2006)	Detailed Flora and Vegetation; Detailed	X	X	3.7 km SE

Report Title	Reference	Survey Type	Flora	Fauna	Distance from Study Area (km)
		Vertebrate Fauna Survey; Environmental Review			
Targeted flora survey - Southern River road duplication	360 Environmental (2014b)	Threatened & Priority survey	X		3.7 km SE
City of Armadale Skeet Road Reconnaissance Flora Survey	Natural Area (2019)	Reconnaissance Flora and Vegetation Survey, Basic Fauna Survey	X	X	3.7 km SE
Vegetation and Declared Rare and Priority Flora Assessment Garden Street Extension	Woodman (2004)	Detailed Flora and Vegetation Survey	X		3.8 km E
Level 2 Flora and Vegetation Survey of Proposed Sand Mining Area at Lot 467, Warton Road	Morgan (2011)	Detailed Flora and Vegetation Survey	X		3.8 km SW
Targeted conservation significant flora survey – Garden Street extension	360 Environmental (2014a)	Targeted search	X		3.8 km E
Black cockatoo assessment - Garden Street extension	Terrestrial Ecosystems (2014)	Black Cockatoo Assessment		X	3.8 km E
Garden Street Road Reserve Environmental Assessment	Natural Area (2016b)	Detailed Flora and Vegetation Survey; Detailed Vertebrate Fauna Survey	X	X	3.8 km E
Fauna Management Plan Holmes Street Bushland North	Natural Area (2016a)	Detailed vertebrate fauna survey; Fauna Management Plan		X	3.8 km E
Garden Street, Southern River - Targeted conservation significant species survey	PGV (2016)	Targeted search	X	X	3.8 km E
Garden Street Extension Targeted Wetland Vegetation Assessment.	PGV (2018)	Targeted TEC search	X		3.8 km E
Australasian bittern survey	Terrestrial Ecosystems (2016)	Targeted Fauna Survey		X	3.8 km E
Ecological Assessment of Sutherlands Park Bushland, City of Gosnells	ENV (2010)	Ecological Assessment	X	X	4 km E
Lot 131 Jandakot Road, Banjup – Flora and Vegetation Survey	360 Environmental (2015a)	Detailed Flora and Vegetation Survey	X		4.2 km SW
Flora, Vegetation and Fauna Assessment, Keane Road	ENV (2013a)	Detailed Flora and Vegetation Survey, Basic Fauna Survey	X		4.8 km S
Flora, vegetation and fauna assessment proposed Verde Drive extension	Focused Vision (2019)	Detailed Flora and Vegetation Survey, and Basic Fauna Survey	X	X	5.9 km SW
Botanical Assessment of Lots 101 and 200 Anstey Road, Forrestdale	Bennett Environmental Consulting (2013)	Detailed Flora and Vegetation Survey	X		6 km S
Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment	Focused Vision (2016)	Reconnaissance Flora and Vegetation Survey, Basic Fauna Survey	X	X	6.1 km SW
Cockburn Central East Local Structure Plan (CCE LSP) Area, Targeted *Caladenia huegelii* Survey	Focused Vision (2018)	Targeted Flora Survey	X		6.1 km SW
Vertebrate Fauna Survey for the Roe Highway Extension Project	Phoenix (2011)	Detailed vertebrate fauna survey		X	8.7 km W
City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey	Golder Associates (2016)	Reconnaissance Flora and Vegetation Survey, Basic Fauna Survey	X	X	8.7 km SW

2.4 Survey Timing and Weather

2.4.1 Flora Survey

Phase one of the flora survey was completed over two days on 29 and 30 of September 2020, while phase two was completed over two days on 17 and 18 of November (Figure 2.1). The flora team spent approximately 100 person hours on site undertaking the assessment over both phases. Maximum temperatures experienced in phase one (20.1 °C & 21.1 °C,) were consistent with the long-term averages for the area (20.2 °C), however phase two (22.1 °C & 24.0 °C) experienced slightly cooler temperatures (26.4 °C) (Jandakot Aero; BoM, 2020)).

Although the month of May received slightly above average rainfall, the rainfall in the six months leading up to the phase one survey was below average, in particular in the winter months (June – August) which received 149.5 mm below average collectively (Figure 2.1). This may have caused a "flush" of early flowering and fruiting of flora taxa, particularly in annuals and ephemeral taxa, in response to the below average rainfall in winter. Below average rainfall was received for August and September, while the month of November received well above average rainfall (81.4 mm compared to the LTA of 28.3 mm – the highest rainfall received for November at this weather station on record) (Jandakot Aero; BoM, 2020).

2.4.2 Fauna Survey

The fauna survey was completed over two field survey periods; from 25 – 29 June 2020 and 16 – 23 November 2020 (Figure 2.1). Phase one comprised of a targeted Winter survey, deploying acoustic recorders to target amphibian species, and undertaking bird censuses and targeted searches. The field team spent approximately 16 person hours on site undertaking the assessment. A total of 41.4 mm of rainfall fell during the survey period (BoM, 2020). This may have reduced the number of mammalian, reptile, and avian species observed; however, the conditions were suitable for the recording of winter-calling amphibians. Maximum temperatures observed (between 18.4 – 21.3 °C) was consistent with the long-term average for the area (19.2 °C; BoM, 2020).

Phase two was undertaken during Spring and comprised a full Detailed vertebrate fauna survey consisting of systematic trapping, acoustic and ultrasonic recorders, camera traps, bird censuses, and targeted searches. The field team spent approximately 76 person hours on site undertaking the assessment. As discussed above, the month of November received well above average rainfall (81.4 mm compared to the LTA of 28.3 mm); however, no rain fell over the course of the survey, providing ideal conditions to assess the likelihood of occurrence for fauna or determine the fauna habitats present. The maximum temperature experienced (34.7 °C) was considerably higher than the LTA for the area (26.4 °C; BoM, 2020); however, this was experienced on the final day of survey and did not influence the trapping success rate. Maximum temperatures throughout the remainder of the survey ranged between 23.1 to 27.9 °C (BoM, 2020).

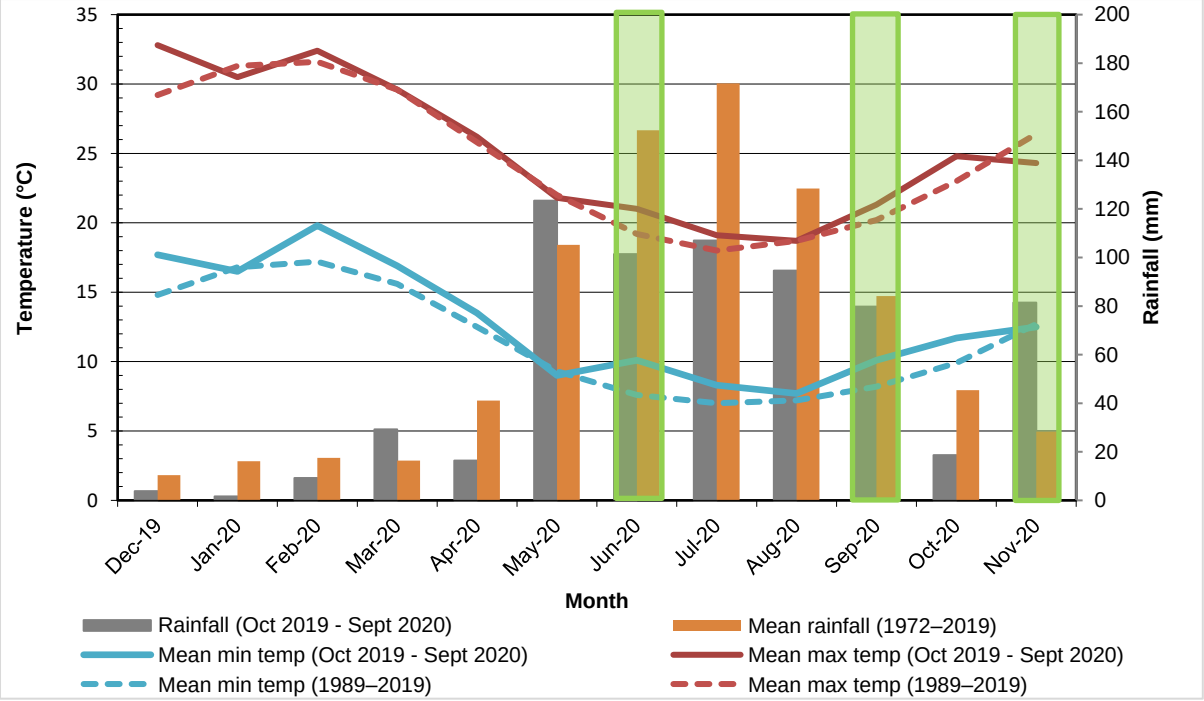


Figure 2.1: Monthly recorded and LTA climatic data for Jandakot Aero (BoM, 2021). Green boxes indicate timing months of surveys

2.5 Survey Team and Licensing

2.5.1 Flora Survey Team and Licensing

The flora field surveys were completed by botanists with extensive experience with flora and vegetation in the region. The following personnel were involved in the field component of the project, with phase attendance and licenses listed. Licensing consists of both flora collecting permit numbers pursuant to the BC Act (Regulation 61) and, if applicable, *Permit to Take Declared Rare Flora* for identification purposes licence numbers, issued under the BC Act, Section 40, listed respectively:

- Samuel Coultas (Senior Botanist – Field Team Lead) – phase one and two, FB2000017-2 and TFL 60-1819;
- Joel Chick (Senior Botanist) – phase one and two, FB62000273 and TFL 38-2021
- Heather Edwards (Botanist) – phase one and two, FB62000281
- Clinton van den Bergh (Principal Botanist) – phase one, FB62000105 and TFL 59-1819
- Clare Whyte (Botanist) – phase one, FB62000274
- Emily Eakin-Busher (Botanist) – phase two, FB62000160 and TFL 53-1920

2.5.2 Fauna Survey Team and Licensing

The fauna sampling for this survey was conducted under a DBCA Regulation 27 “Fauna Taking (Biological Assessment) License” (BA27000294) issued to Chris Knuckey.

The assessment was undertaken by zoologists with extensive experience with fauna in the region. The following personnel were involved in the field component of the project:

- Claire Brooks (Senior Zoologist – Field Team Lead) – phase one and two;

- Chris Knuckey (Senior Zoologist) – phase two;
- Ryan Ellis (Senior Zoologist) – phase two;
- Aidan Williams (Zoologist) – phase one;
- Amy Hutchison (Zoologist) – phase one; and
- Ashleigh Jenkins (Zoologist) – phase two.

2.6 Flora and Vegetation Field Survey

2.6.1 Detailed Survey

A single season two phase (sampling of the site over two phases within the one season, for example two site visits in Spring) detailed flora and vegetation survey was completed by Biologic botanists. The survey involved the establishment and sampling of ten quadrats (10 m × 10 m) and one relevé within representative vegetation types and/or units (Figure 2.2). The quadrats were established and sampled during phase one, while the quadrats were re-scored during phase two to identify any late flowering flora species, with emphasis on late flowering annuals, ephemerals and perennial natives. The sampling design and intensity was developed with consideration given to the following:

- landform and habitat – scale, heterogeneity, rarity;
- vegetation structure, diversity and seasonality;
- potential for significant ecological communities to occur, based on habitat analysis; and
- information from previous biological surveys conducted in the vicinity of the Study Area.

Due to the small size of the Study Area, the sampling of three quadrats per vegetation type as recommended by the EPA (2016a) was not achievable; however at least one quadrat per vegetation unit was sampled. Any opportunistic flora taxa seen were also recorded to supplement the survey work. The following information was recorded at each quadrat and relevé:

- unique quadrat number (or relevé number);
- date of survey;
- personnel;
- GPS coordinate of the north-west corner unless specified otherwise;
- site photograph;
- soil characteristics (texture and colour);
- vegetation condition (based on EPA (2016a) (Appendix A; Table 3.14); and
- disturbance (if present).

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GNR-01

GNR-05

GNR-02

GNR-03

GNR-09

GNR-04

GNR-08

GNR-07

GNR-10

GNR-06

Ranford Rd

Nicholson Rd

Legend

- Study Area
- Quadrat
- Traverse

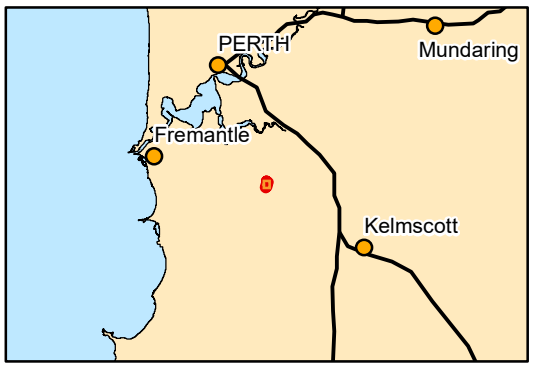
0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 05/02/2021

N

biologic Environmental Survey

Scale: 1:3,000



CITY OF GOSNELLS

Nicholson Rd Biological Survey and Management Plan

Figure 2.2: Flora sampling intensity and traverses

2.6.2 Targeted Searches for Taxa of Conservation Significance

Prior to the survey, a list of conservation significant flora known to, with the likelihood to, or potential to occur within the Study Area was compiled. Field personnel familiarised themselves with photographs, reference samples and descriptions of these taxa before conducting the survey. Once on the ground, personnel actively searched for conservation significant species while traversing the Study Area.

Targeted searching was undertaken for flora of conservation significance, as identified during the desktop assessment. Taxa that were confirmed or considered highly likely, likely or possible to occur within the Study Area were targeted. The meandering targeted searches while traversing the Study Area focussed on habitat considered likely to support conservation significant flora.

If a conservation significant taxon was identified, a GPS coordinate of the individual was taken when occurring in isolation, or a central GPS coordinate was taken for a small population (central coordinate with an approximate 20 m radius). Information collected at each location comprised:

- Number of individuals, for a small population;
- Condition and reproductive status of the plants in each population;
- Photographs and description of vegetation habitat;
- Broad information on vegetation type and condition;
- Coordinates of either each plant (if few) or the extent of the population (if many) using a GPS. A differential GPS (Trimble Catalyst antenna) was used to record the locations of threatened and priority flora to ensure accurate coordinates are provided.

Threatened and Priority Flora Report Forms will be provided to the Parks and Wildlife Division (Parks and Wildlife) of DBCA, as required under the flora collecting permits. Conservation significant flora specimens will be vouchered with the Western Australian Herbarium (WAH), where required and appropriate.

2.6.3 Weed Assessment

While completing the detailed flora assessment and the targeted searches, any significant environmental weeds, including Weeds of National Significance (WoNS) and Declared Pests (DPs) listed under Section 12 and Section 22 of the Biosecurity and Agriculture Management (BAM) Act, located in the Study Area had their locations noted and searches with a minimum 20 m radius from the given specimen were conducted to document the number of individual plants and map the spatial extent of the infestation.

Prominent weeds were mapped to guide future weed control, for example large isolated non-native woody plants, or where individual specimens are noted in specific locations which could be controlled before spreading further. In addition to the point locations, weed suite mapping was undertaken by grouping each weed species by their control method (i.e. annual and perennial grasses, herbaceous weeds, woody weeds, or bulbous weeds).

2.6.4 Vegetation Mapping

Vegetation types were also mapped at a 1:5,000 to 1:1,000 scale to a minimum NVIS Level V (NVIS Technical Working Group, 2017), which is the current nationally adopted classification system for vegetation descriptions,. Site photographs were also taken to support the vegetation type mapping. The floristic data collected from the quadrats was statistically analysed using R version 4.0.0 (R Core Team, 2018) and appropriate similarity analysis techniques. Quadrat groupings into vegetation types based on statistical analysis was then used for comparison against regional data. The proposed statistical methodology is sufficient to meet EPA expectations and is detailed further below.

2.6.5 Floristic Data Analysis

2.6.5.1 Data Transformation and Reconciliation

The observed taxa in the quadrats were recorded on a cover abundance basis, with an estimate of the foliage cover of each species made at each quadrat. To allow for any disparity in cover and the potential for ambiguities in determining cover between observers, the cover values were reduced to cover codes, based on an adapted Braun-Blanquet method (1 = <1 %; 2 = 1–5 %; 3 = 6–25 %; 4 = 26–50 %; 5 = 51–75 %; and 6 = >75 %). The flora species list was reconciled to amalgamate selected taxa, for example, varieties of the same species. Tentative genus identifications (i.e., ?Genus species) were removed from the analysis if confirmed specimens of the same genus had already been recorded.

2.6.5.2 Species Accumulation Curve

Species accumulation curves were plotted using Sobs, Chao 1, Jacknife 1, Bootstrap and Michealis-Menton in Primer v7 to determine the adequacy of the survey. When a curve approaches an asymptote it suggests that sampling effort has been sufficient to adequately collect the species comprising the floral assemblage at the locations sampled (Thompson & Withers, 2003). The value at which the curve asymptotes can also be used as an approximate measure of the total size of the species complement at that location (Thompson *et al.*, 2003).

2.6.5.3 Hierarchical Clustering

Cluster analyses were carried out using R version 4.0.0 (R Core Team, 2018). Cover code and presence absence values for the flora in each quadrat were compiled in R and a resemblance matrix was created. In order to compare the floristic data collected from this survey and with data from regional surveys (Gibson *et al.*, 1994; Keighery *et al.*, 2012), presence absence dendrograms were created.

Similarity testing was undertaken using the Bray-Curtis coefficient. Quadrats were also analysed individually against the regional floristic datasets (Gibson *et al.*, 1994; Keighery *et al.*, 2012) (referred to as single site insertion), to determine which floristic communities the quadrats most closely resembled.

2.6.6 Vegetation Condition

Vegetation condition was defined within the Study Area using the vegetation condition scale in EPA (2016a), which has been adapted from Keighery (1994) (Appendix A). The vegetation condition was determined based on the level of disturbance observed in an area. Condition was recorded at each quadrat and relevé, while additional notes were taken while traversing the Study Area to broadly map

vegetation condition boundaries. The vegetation condition mapping was then digitised using GIS software.

2.6.7 Conservation Significant Ecological Communities

Data and observations from the field survey were used to identify and confirm the presence of conservation significant ecological communities within the Study Area and whether it met condition and patch size thresholds outlined by the approved conservation advice for these communities. The quadrat data was analysed against state data for that community (Gibson *et al.*, 1994; Keighery *et al.*, 2012) where applicable, consistent with methods used in key regional surveys. Any TEC/PEC boundaries were then mapped within the Study Area at a scale of 1:5,000.

2.6.8 Specimen Identifications

Plant taxa that could not be identified during the field survey were collected, assigned a unique number for tracking purposes, and pressed for subsequent identification. Identifications were carried out by Biologics taxonomists Dr Rachel Meissner and Sam Coultas, utilising the Western Australian Herbarium's (WAH) reference collection, taxonomic keys and reference material. Photographs of some plant taxa (namely members of the Orchidaceae family) were taken and compared later to images available on FloraBase. All taxa were checked against Florabase© (version 2.9.42; WAH, 1998-) to ensure their currency and validity. Any additional flora taxa, including potential threatened and priority species, range extensions and potential new taxa have been verified and vouchered (if appropriate) at the WAH.

2.6.9 Likelihood assessment of occurrence

Conservation significant flora species recorded from the desktop assessment were assessed for their likelihood of occurrence in the Study Area using a decision matrix (Table 2.5).

Table 2.5: Flora species likelihood of occurrence decision matrix

		Habitat categories (within the Study Area)			
		Core/ critical habitat present	**Suitable habitat present/ within known distribution**	**Marginal habitat present/ adjacent to known distribution**	**No suitable habitat present/ outside of known distribution**
Species Records / Occurrence Categories	**Recorded in the Study Area**	Confirmed	Confirmed	Confirmed	Confirmed
	Recorded within <2 km	Highly Likely	Likely	Possible	Possible
	Recorded within 2-5 km	Likely	Possible	Possible	Unlikely
	Recorded within 5-20 km	Possible	Possible	Unlikely	Unlikely
	Recorded >20 km	Possible	Unlikely	Unlikely	Highly Unlikely
	Species considered locally/ regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

2.7 Fauna Field Survey

2.7.1 Habitat Assessments

Habitat assessments were undertaken in the field to characterise and define habitats and their significance to vertebrate fauna. Habitat assessments were undertaken at ten locations across the Study Area, including at all sampling sites (Figure 2.4).

Habitat assessments were conducted using methodology and terminology modified from the *Australian Soil and Land Survey Field Handbook* (National Committee on Soil and Terrain, 2009). The characteristics recorded during the habitat assessments were:

- site information, photo and location;
- landform: slope, relative inclination of slope, morphological type and landform type;
- vegetation: leaf litter %, wood litter, hollow bearing trees, broad floristic formation, vegetation structure (tall, mid and low), and dominant species;
- land surface: micro relief, sheet erosion, rill erosion, gully erosion, gully depth, abundance and size of coarse fragments, rock outcropping, water bodies, comments on nests, burrows, roosts and diggings;
- soil: texture, colour;
- substrate: bare ground, rock size, rock type, rock outcropping; and
- disturbance: time since last fire, evidence of weeds, grazing, or human disturbances.

2.7.2 Systematic Trapping Sites

A total of three systematic trapping sites were established and sampled during the phase two field survey, with sites representing most fauna habitats present within the Study Area (Figure 2.3, Figure 2.4, Table 2.6). The sites were setup to sample the most common and significant habitats, while ensuring adequate coverage across the entire Study Area. Each trapping site was open for seven consecutive nights for a total of 1,092 trap nights and were checked daily within three hours of sunrise. Each site comprised the following:

- Pit traps – Ten pit traps comprising five 20 Litre buckets and five PVC pipes (16 centimetres [cm] diameter and 50 cm deep) were installed at each site. Traps were installed approximately 10–20 metres [m] apart along a single transect with a 5 m long by 0.3 m high aluminium drift fence bisecting each pit trap. Traps were placed in locations deemed most likely to catch fauna (i.e., areas with dense ground cover, litter, rocks etc.) and most representative of broad fauna habitats occurring within the Study Area. Styrofoam trays were placed within all pits to provide refuge for any captured fauna from exposure to environmental conditions (i.e., heat and wind) and predators.
- Funnel traps – Two funnel traps were placed at either end of the drift fence bisecting each pit trap. A total of 20 funnel traps were deployed at each systematic trapping site.

- Elliott traps – Twenty medium (Type B) Elliott style box traps were placed at each site. Traps were placed along two parallel transects adjacent to pit traps and positioned approximately 10–20 m apart. Each trap was positioned in habitat niches likely to be attractive to small non-volant mammals and reptiles (i.e., areas of cover and shade).
- Cage Traps – Two cage traps (20 x 20 x 56 cm) were located at each site, with one placed at each end of the trap site transect.

Shade covers were used over funnel, cage and Elliot traps to reduce the likelihood of exposure-related trap death. Elliot and cage traps were baited with a universal bait mix comprising oats, peanut butter and sardines, and rebaited every 2–3 days.

Figure 2.3 Layout of traps at a systematic sampling site

2.7.3 Avifauna Sampling

A twenty-minute avifauna census was undertaken daily during both the phase one and two surveys. Additional 5–10-minute opportunistic avifauna sampling was undertaken at selected habitat assessment sites. All avifauna, either directly observed or known to be present via calls or other signs (e.g., nests, tracks) were recorded. Each avifauna census was conducted between 6:30 am and 11:00 am whilst undertaking trap clearing activities. The order of site visitation was staggered to reduce bias due to timing of arrival at sites and the recorders were rotated where possible to reduce observers' bias (Lindenmayer *et al.*, 2009). A total of 9 person hours were spent undertaking avifauna sampling throughout the course of both survey phases (Figure 2.4).

2.7.4 Ultrasonic Bat Recording

SongMeter (SM; Wildlife Acoustics Inc.) ultrasonic bat recorders were deployed at three locations within the Study Area during the phase one and phase two surveys (VNIC-02 and VNIC-05 during phase one, and VNIC-02 and VNIC-04 during phase two) (Table 2.6, Figure 2.4). Locations were representative of the habitats occurring with the Study Area and focused primarily on suitable habitat for prospective foraging and/or roosting habitats and features most likely to be utilised by bats, such as large trees near waterbodies. Recorders were deployed between four and six nights at each location for a total of 19 recording nights (Table 2.6). The audio settings used for all the SM units followed the manufacturer's recommendations contained in the user manual (Wildlife Acoustics, 2011, 2017). Selectable filters and triggers were also set using the manufacturer's recommendations. Bat calls were analysed by Robert Bullen of Bat Call WA.

2.7.5 Acoustic Recording

SongMeter (SM; Wildlife Acoustics Inc.) acoustic recorders were deployed at six locations during both phases of the field survey where suitable habitat was present for frog species i.e., water bodies (Table 2.6, Figure 2.4). SongMeters were deployed between four and five nights for a total of 27 recording nights (Table 2.6). The audio settings used for all the SM units followed the manufacturer's recommendations contained in the user manual (Wildlife Acoustics, 2011, 2017). Acoustic recordings were analysed for frog and nocturnal bird species by Claire Brooks using Kaleidoscope Pro (Wildlife Acoustics, 2020).

2.7.6 Camera traps

Targeted sampling using camera traps was conducted to survey for larger and/or cryptic species and introduced mammalian species, and to verify the presence of conservation significant vertebrate species identified during the desktop assessment (i.e. quenda *Isoodon fusciventer*, and western brush wallaby *Notamacropus irma*), as recommended for many medium-sized mammals such as these (DSEWPaC, 2011b; EPA, 2020b). The locations chosen were considered prospective for detecting fauna, including at fallen branches and water features. Camera traps were baited with a universal bait mix, a mixture of oats, sardines and peanut butter. A total of 15 individual camera traps were deployed at three sites within the Study Area during phase two for between 5 and 6 nights per site (Table 2.6, Figure 2.4). This resulted in a total of 80 camera trap nights over the course of the survey.

Each camera was set to record 5 continuous seconds of video footage when triggered during their deployment. An example of a camera trap deployment in shown below in Plate 2.1.

Plate 2.1 Example of camera trap deployment during phase two of the current survey

Table 2.6: Survey effort by vertebrate sampling sites

Site	Site type	Pits (nights)	Funnels (nights)	Elliot (nights)	Cages (nights)	Total trap nights	Bird census (person hrs)	SongMeter (ultrasonic) (nights)	SongMeter (acoustic) (nights)	Targeted searches (person hrs)	Camera traps (nights)
Phase One											
VNIC-01	SongMeter (acoustic)	-	-	-	-			-	4	-	-
VNIC-02	SongMeter (ultrasonic)	-	-	-	-		1	4		-	-
VNIC-03	SongMeter (acoustic)	-	-	-	-			-	4	-	-
VNIC-04	SongMeter (acoustic)	-	-	-	-		1	-	4	-	-
VNIC-05	SongMeter (ultrasonic)	-	-	-	-			4		-	-
Phase One total		**0**	**0**	**0**	**0**	**0**	**2**	**8**	**12**	**0**	**0**
Phase Two											
VNIC-01	Systematic, SongMeter (acoustic), Camera traps	70	140	140	14		2.5	-	5	1	25
VNIC-02	Systematic, SongMeter (ultrasonic), Camera traps	70	140	140	14			5	-	1	25
VNIC-03	SongMeter (acoustic)	-	-	-	-			-	5		
VNIC-04	Systematic, SongMeter (ultrasonic)	70	140	140	14		2.5	6	-	1	
VNIC-05	SongMeter (acoustic), Camera traps	-	-	-	-			-	5		30
Phase Two total		**210**	**420**	**420**	**42**	**1092**	**5**	**11**	**15**	**3**	**80**
Survey total		**210**	**420**	**420**	**42**	**1092**	**7**	**19**	**27**	**3**	**80**

2.7.7 Black Cockatoo Breeding Assessment

Breeding habitat for black cockatoos is defined 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" (DoEE, 2017a) (Table 2.7). For most tree species, suitable DBH is 500 mm, while for salmon gum and wandoo, suitable DBH is 300 mm (DoEE, 2017a; DSEWPaC, 2012b). Breeding habitat for all three black cockatoo species generally consists of woodland or forest; however, breeding is also known to occur in former woodland or forest now comprising of isolated or small patches of trees (DoEE, 2017a; DSEWPaC, 2012b).

Table 2.7: Known breeding trees for black cockatoo species

Species[1]	DBH (mm)
Corymbia calophylla (marri) *Eucalyptus marginata* (jarrah) *Eucalyptus rudis* (flooded gum) *Eucalyptus camaldulensis* (river gum) *Eucalyptus diversicolor* (karri) *Eucalyptus gomphocephala* (tuart) *Eucalyptus patens* (Swan River blackbutt) *Eucalyptus megacarpa* (bullich) *Eucalyptus accedens* (powderbark wandoo)	500
Eucalyptus salmonophloia (salmon gum) *Eucalyptus wandoo* (wandoo)	300

[1] List excludes species for which Study Area occurs outside the known distribution of the species, as provided in Florabase (WAH, 1998-)

The location and attributes of all potential black cockatoo habitat trees (as defined by DAWE) were recorded within the Study Area during the field survey (Figure 2.4). Attributes recorded included tree species (where discernible), approximate height, DBH, condition (i.e., living or dead), presence of hollows, and dimensions of hollows (where discernible).

2.7.8 Targeted Searches

Targeted searches were undertaken throughout the Study Area within habitats considered likely to support species of conservation significance. Targeted searches comprised searching for occurrence of conservation significant species (i.e., direct observation and/or secondary evidence such as tracks, scats, and nests) and habitats and/or habitat features of significance (i.e., dens, caves, and water features) likely to be utilised by particular species.

2.7.9 Opportunistic Records

At all times while surveying, all records pertaining to species not previously recorded during the survey, rare species, species of conservation significance or other fauna of interest were documented. These records include those from primary (i.e., direct observation of species) or secondary (e.g., burrows, scratching's, diggings, and scats) evidence. Efforts were made to target likely microhabitats by turning rocks, logs and anthropogenic debris where present.

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Nicholson Rd

Ranford Rd

VNIC-05
BNIC-02
VNIC-04
VNIC-04
VNIC-07
VNIC-04
TNIC-02
TNIC-01
VNIC-06
VNIC-08
VNIC-03
VNIC-02
VNIC-02
VNIC-02
VNIC-09
BNIC-03
TNIC-04
BNIC-01
TNIC-03
VNIC-10
VNIC-01
VNIC-01

Legend

- Study Area
- GPS Track

Sampling Method

- Acoustic recorder
- Bat detector
- Bird Census
- Black cockatoo breeding tree
- Black cockatoo habitat assessment
- Camera
- Foraging
- Habitat Assessment
- Trapping

0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 03/02/2021

N

biologic Environmental Survey

Scale: 1:3,000

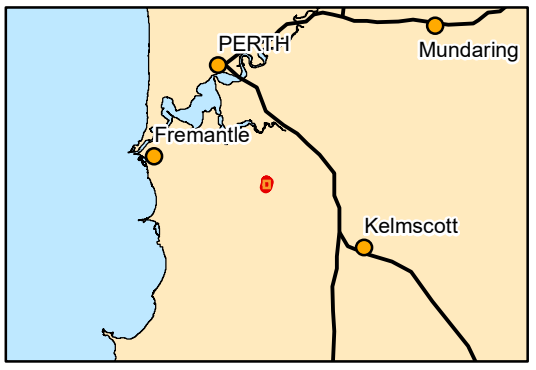

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Figure 2.4: Fauna sampling intensity and traverses

2.7.10 Taxonomy and Nomenclature

The latest checklist of mammal, reptile and amphibian names published by the WAM (2020) was used as a guide to the current taxonomy and nomenclature of these groups. For birds, the current checklist of Australian birds maintained by Birdlife Australia (based on Christidis & Boles, 2008) was used in conjunction with the WAM (2020) species list. While compiling a list of fauna potentially occurring in the Study Area, all records were checked to ensure the latest taxonomy, using recent papers and lists, was used.

2.7.11 Data Analysis

To estimate the adequacy and effectiveness of sampling during the survey, the cumulative number of species encountered from systematic sampling (i.e. trapping sites) was plotted against survey effort in terms of cumulative individuals or trap days/night to develop a species accumulation curve for the survey, following (EPA, 2020b). The species accumulation curve assists in estimating total species richness and the proportion of species caught during the survey, with well-sampled species assemblages showing a distinct plateau following the initial rapid increase in the plotted data of species recorded, while under-sampled assemblages continuing to show a continual or slowly decreasing rise in species diversity. When a curve approaches a plateau, it suggests that sampling effort has been sufficient to adequately collect the majority of species comprising the faunal assemblage at the locations sampled (Thompson & Withers, 2003). The value at which the curve asymptotes can also be used as an approximate measure of the total size of the species diversity at the sampled location (Thompson *et al.*, 2003).

Species accumulation curves were created for each faunal group (mammals, birds and herpetofauna). Accumulation curves and estimators were run using EstimateS v9.1.0 (Colwell, 2013) and included the estimated number of species based on observed data recorded (S(est), formerly Sobs Mao Tau) and species richness estimators Chao 1, Chao 2 and Jacknife 1 to predict the total number of species that could potentially be recorded using the same techniques.

Species accumulation curves and richness estimators for this survey were calculated using avifauna census data for birds and systematic trapping data for mammals, reptiles and amphibians at systematic trapping sites only. It should be noted that additional species were recorded from other techniques (i.e., opportunistic and targeted sampling methods) which are not included in the analysis as the survey effort and data are not statistically valid (i.e., not standardized or comparable).

2.7.12 Fauna Habitat Mapping and Significance

Fauna habitat mapping was completed using the vegetation mapping from the concurrent survey, the drainage infrastructure assessment, vertebrate fauna habitat assessments conducted during the field surveys, as well as high-resolution aerial imagery, vegetation, topographical, land system and drainage mapping. Habitats were delineated and mapped across the Study Area at a scale of approximately 1:20,000.

2.7.13 Likelihood of Vertebrate Fauna Occurrence

Species of conservation significance identified by the desktop assessment were assessed for their likelihood of occurrence within the Study Area using a decision matrix which considers the suitability of habitat within the Study Area and the proximity of previous records (Table 2.8). Based on this decision matrix, each species was assigned to one of six categories of likelihood of occurrence: confirmed, highly likely, likely, possible, unlikely, or highly unlikely.

The decision matrix is intended to be an indicative guide only, and the way in which it is interpreted may vary between species, depending on a given species' habitat preferences and ability to disperse, as well as the reliability and availability of contextual information. For example, considering species which have been previously recorded close to the Study Area, a species with a limited dispersal capability will have a reduced likelihood of occurring in the Study Area compared with a species with greater dispersal capability. It is also recognised that a lack of records in the vicinity of the Study Area may indicate limited sampling effort rather than species' absence, and that previous records may include historic or presumed erroneous information which may misrepresent a species' current distribution. Where the determination of a species' likelihood of occurrence within the Study Area deviates from the decision matrix, detailed justification for any variation will be presented.

Table 2.8: Fauna species likelihood of occurrence decision matrix

		Habitat suitability of Study Area			
		Core breeding habitat present	**Foraging and dispersal habitat present**	**Marginally suitable habitat[2] present**	**No suitable habitat present**
Species records[1]	**Recorded in Study Area**	Confirmed	Confirmed	Confirmed	Confirmed
	Recorded within 2 km of Study Area	Highly Likely	Likely	Possible	Possible
	Recorded within 2-5 km of Study Area	Likely	Possible	Possible	Unlikely
	Recorded within 5-20 km of Study Area	Possible	Possible	Unlikely	Unlikely
	Recorded >20 km of Study Area	Possible	Unlikely	Unlikely	Highly Unlikely
	Species considered locally/regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

[1]Only records within the previous 50 years are considered.
[2]Marginally suitable habitat is habitat which is possibly used by a species for roosting or nesting, or during foraging and dispersal activities, but is unlikely to be depended upon; for example, it may be of low quality or only sporadically present.

2.8 Drainage Infrastructure Assessment

A desktop assessment was conducted to gain an understanding of the site, locate existing drainage infrastructure, and identify drainage flow paths through the wetland. This included analysis of the City of Gosnells (2020b) aerial imagery over the site and further shapefiles provided by the City. The existing Urban Water Management Plans (ENV, 2005b) were reviewed to gain familiarity with the intended function of the drainage system.

Hyd2o conducted the field assessment on 29 June 2020; at the time of the site visit it was raining which allowed field staff to capture and observe the wetland in wet conditions. The Bureau of Meteorology recorded 12.2 mm of rainfall at the Jandakot Aero Station on 29 June 2020, with an additional 19 mm recorded in the preceding 48 hrs (BoM, 2020). The assessment was undertaken by Suzanne Smart, Principal Environmental Hydrologist and Sean O'Sullivan, Engineering Hydrologist, who are suitably qualified to undertake this level of assessment.

The purpose of the field visit was to identify, locate and assess the quality of existing stormwater infrastructure. To achieve this aim, stormwater infrastructure was identified, a photograph was taken, and a GPS reading was recorded. The site was traversed methodically to capture infrastructure both known (from the desktop assessment) and unknown to exist. Note that photographs of all side-entry pits were not undertaken, they were all assessed for condition (and were deemed reasonable), however photographing each presents a safety issue for the field team standing on the road.

2.9 Potential Limitations and Constraints

The EPA outlines several potential limitations to flora and vegetation, and fauna surveys (EPA, 2016c, 2020b). These aspects are assessed and discussed in Table 2.9 below. The sampling techniques used during the biological surveys were not constrained by any significant limitations.

There are no specific guidelines that govern hydrological/ drainage assessments, however it was noted that it was raining at the time of their site visit which allowed field staff to capture and observe the wetland in wet conditions. Photographs of side-entry pits were not undertaken for every pit; they were all assessed for condition (and were deemed reasonable), however photographing each pit presented a safety issue for the field team standing on the road.

Table 2.9: Flora and fauna survey limitations and constraints

Potential limitation or constraint	Limitation to current survey	Applicability to this survey
Availability of data and information	No	**Flora and Vegetation –** Flora and vegetation of the Swan Coastal Plain is well understood with a significant amount of flora and vegetation assessments having been undertaken in the local area and surrounding region. These surveys were reviewed to assist in the development of the survey and the preparation of the report. The WAH, DBCA, DAWE and ALA database searches provided additional sources of recent information. **Fauna -** Numerous fauna surveys have been completed within the City of Gosnells. These surveys were reviewed to assist in the development of the survey and the preparation of the report. A significant amount of black cockatoo survey work has been undertaken in the wider local area and the surrounding region, including annual black cockatoo monitoring for the past decade, and these survey results were available for review. The Birdlife, DBCA, and DAWE database searches provided additional sources of recent information.

Potential limitation or constraint	Limitation to current survey	Applicability to this survey
Competency /experience of the survey team, including experience in the bioregion surveyed	No	**Flora and Vegetation –** The flora and vegetation survey was supervised by botanist(s) with >5 years survey experience in the Swan Coastal Plain (Samuel Coultas, Clinton van den Bergh, Joel Chick met this requirement). **Fauna -** The zoologists who undertook the survey have extensive survey experience within the region. DoEE (2017a) advises that black cockatoo breeding surveys should be done by a suitably qualified person with at least three years' experience in surveys of black cockatoo habitat. Claire Brooks has the required experience and has completed numerous black cockatoo habitat assessments on the Swan Coastal Plain.
Scope (floral/ faunal groups sampled and whether any constraints affect this)	No	**Flora and Vegetation –** The survey was completed in line with the scope of a detailed flora and vegetation survey (EPA, 2016c). The survey was conducted over two phases, one at the beginning of spring (September) and one at the end of spring (November). This enabled the team to record both early and late flowering perennials, as well as to capture any annual or ephemeral taxa. The resulting flora species list was therefore as comprehensive and representative as possible. **Fauna -** The survey was completed in line with the scope of a Detailed survey (EPA, 2020b). The survey used a comprehensive survey design over two survey phases. This allowed quantitative data on species, assemblages, and habitats in the Study Area to be compiled to inform the management plan.
Timing, weather and season	Yes (minor for Flora and Vegetation)	**Flora and Vegetation –** The field survey was conducted over two phases, early and late spring, which is the recommended optimal survey period for flora in south west Western Australia (EPA, 2016c). However, the months of winter received well below average rainfall collectively (149.5 mm less than what is expected). Considering many of the conservation significant flora taxa which occur in close proximity to the Study Area are ephemeral taxa (e.g., *Diuris purdiei* (T)) this is considered a minor limitation to the survey. **Fauna -** The field survey was conducted in both Winter and late Spring which is the recommended optimal survey period for the faunal groups sampled (amphibians, birds, mammals, reptiles) (EPA, 2020b). The survey timing fell within the recommended timing for two of the targeted black cockatoo species (March to September for Baudin's cockatoo, and year-round for forest red-tailed black cockatoo) (DoEE, 2017a). Although the timing was outside of that recommended for Carnaby's cockatoo (January to July; DoEE, 2017a); targeted searches were undertaken for secondary evidence of the species presence (i.e. foraging evidence) and to evaluate the potential suitability of the habitat.
Disturbance that may have affected results, e.g. fire, flood	No	**Flora and Vegetation, and Fauna –** No on-ground disturbance affected the field survey in any way. Weeds, clearing, and rubbish were the main environmental disturbances recorded during the survey; however, as the Study Area occurs within a semi-urban environment, the disturbances were not considered to constrain the survey. The disturbances have been present for a long period of time.
Proportion of flora and fauna identified, recorded, or collected	No	**Flora and Vegetation –** A small number of taxa (5.3 % or 13 taxa) observed and collected from the field were difficult to confidently identify to species or infraspecies level. This was mainly due to the specimens lacking suitable flowering and fruiting material for confident taxonomic identification. None of the taxa that have been identified to genus level are considered to be analogous with conservation significant taxa, therefore this is not considered to have constrained the survey. **Fauna -** All observed fauna were identified at the point of observation. All fauna captured on motion camera, and ultrasonic and acoustic recorders were identified post-survey with no limitations on identification.

Potential limitation or constraint	Limitation to current survey	Applicability to this survey
Adequacy of the survey intensity and proportion of survey achieved	No	**Flora and Vegetation –** A two phase detailed flora and vegetation survey with targeted searching was undertaken across the Study Area with all vegetation types surveyed and all areas traversed extensively. **Fauna -** A two-phase Detailed vertebrate fauna survey was undertaken across the Study Area. This level of survey is the required intensity to identify most of the fauna inventory present and any potential threats present. The entire Study Area was traversed on foot, with all tasks achieved within the allotted field time.
Access problems	No	**Flora and Vegetation, and Fauna –** The entire Study Area was traversed on foot; thus remoteness or access was not considered a limitation.
Problems with data and analysis, including sampling biases	No	**Flora and Vegetation, and Fauna –** No issues with data or analysis were experienced.

3 BIOPHYSICAL ENVIRONMENT

3.1 Climate

The climate of the Swan Coastal Plain subregion is typically cool, wet winters and warm, dry summers (Beard, 1990). The Bureau of Meteorology's (BoM) nearby weather station, Jandakot Airport BOM Station (number 9172) has documented the long-term average temperature and rainfall near the Study Area (BoM, 2020). The highest average daily temperature of 31.6 °C occurs in February and the lowest average daily temperature of 7 °C occurs in July (BoM, 2020; length of record 1989-2020) (Figure 3.1). The monthly rainfall average is lowest in December (10.4 mm) and highest during July (171.7 mm), averaging 816 mm annually (BoM, 2020; length of record 1972-2020) (Figure 3.1).

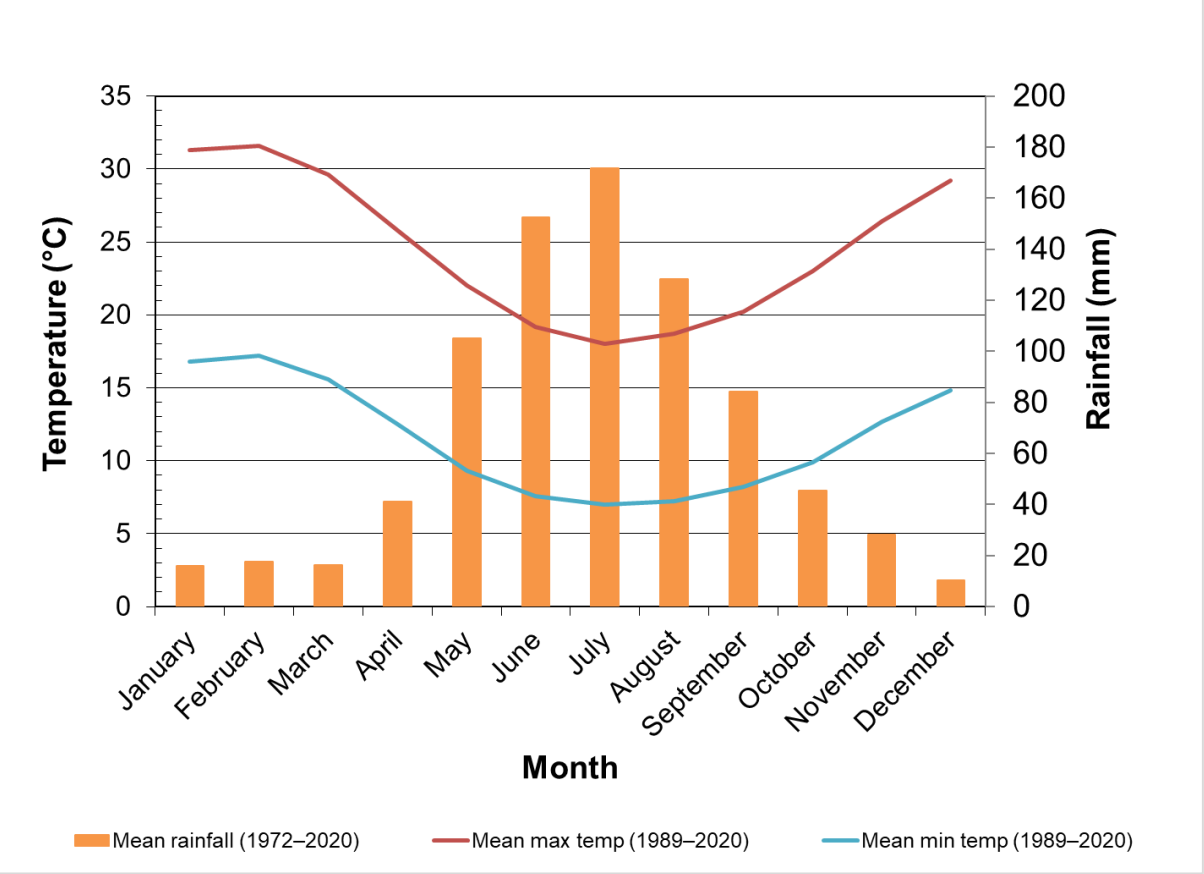

Figure 3.1: Long-term climatic averages (LTA) for monthly rainfall and temperature in the vicinity of the Study Area (station no. 9172; BoM, 2020).

3.2 Bioregion

The Study Area is within the Swan Coastal Plain (SCP) Interim Biogeographic Regionalisation for Australia (IBRA) bioregion (Thackway & Cresswell, 1995). The SCP bioregion is characterised as a low lying coastal plain, mainly covered with woodlands (Mitchell *et al.*, 2002). It is dominated by banksia (*Banksia* spp.) or tuart (*Eucalyptus gomphocephala*) on sandy soils, *Casuarina obesa* on outwash plains, and paperbark (*Melaleuca* spp.) in swampy areas, while the plain rises to duricrusted Mesozoic sediments dominated by jarrah (*Eucalyptus marginata*) woodland in the east (Mitchell *et al.*, 2002). Within the SCP bioregion, the Study Area occurs within the Perth subregion (Figure 1.1).

The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone. Heath and/or tuart woodlands occur on limestone, banksia and jarrah woodlands on Quaternary marine dunes, and marri (*Corymbia calophylla*) on colluvial and alluvial soils (Mitchell *et al.*, 2002). Th Perth subregion includes a complex series of seasonal wetlands.

The Swan Coastal Plain bioregion is part of the South West Botanical Province which has a very high degree of species diversity. Within the bioregion there are areas of relatively high ecosystem or species diversity, particularly on the eastern side of the coastal plain. The bioregion supports several Threatened Ecological Communities (TEC), as well as a large number of rare and threatened species (Mitchell *et al.*, 2002).

3.3 Landform, soils and topography

3.3.1 Landform, soils and topography

The terrain of the SCP includes sand, limestone, and fluvial deposits that form a coastal strip between the Darling Scarp and the Indian Ocean. The SCP extends from near Geraldton in the north to Dunsborough in the south. It is bounded by the Darling Fault to the east, in the north by a fault extending from north-west from Bullsbrook and by the Collie-Naturaliste scarp in the south (McArthur & Bettenay, 1974).

The SCP is formed from the deposition of sediments, from either fluviatile or aeolian activity. The pattern of deposition of these sediments forms a series of geomorphic entities which are subparallel to the coastline (McArthur & Bettenay, 1974). The Ridge Hill Shelf, a series of laterite covered spurs, is the most easterly feature of the plain and forms the foothills of the Darling Scarp. The relatively flat Pinjarra Plain stretches approximately 13 km from the foot of the Ridge Hill Shelf where it terminates in a series of coastal sand dunes in the west. There are three generations of dunes commencing with the Bassendean System in the east, followed by the Spearwood System and the Quindalup System which fringes the coastline (McArthur & Bettenay, 1974). The Study Area is located on the Bassendean dune system.

The Atlas of Australian Soils (Northcote *et al.*, 1968) was compiled by CSIRO (Commonwealth Scientific and Industrial Research Organisation) in the 1960s to provide a consistent national description of Australia's soils. It comprises of a series of ten maps and associated explanatory notes and is published at a scale of 1:2,000,000, but the original compilation was at scales from 1:250,000 to 1:500,000. The Study Area is located within one broad soil landscape unit, Cb38 (Northcote *et al.*, 1968). This unit consists of sandy dunes with intervening sandy and clayey swamp flats. Chief soils are leached sands with periodic subsurface waterlogging (Northcote *et al.*, 1968).

The Quaternary sedimentary units that underlie the SCP have been formally named as geological formations. The Study Area is located within the Bassendean Sand, which is present over much of the central Perth region. It is pale grey to white and includes fine to coarse, but is predominantly medium grained (Davidson, 1995). It comprises moderately sorted, sub-rounded to rounded quartz sand, and commonly exhibits fining upward textures. The Bassendean Sand unconformably overlies the Cretaceous and Tertiary strata, and inter-fingers to the east with the Guildford Formation. To the west,

it is unconformably overlain by the Tamala Limestone (Davidson, 1995). The depositional mechanism for this unit is unclear, but it was likely deposited in a variety of fluvial, estuarine, and shallow-marine environments (Davidson, 1995).

At a finer scale (1:500,00) the Study Area (GSWA, 2016) is mapped as:

- Coolyena Group (K-CY-xk-s): Chalk, greensand, glauconitic sandstone, siltstone, marl; characteristically glauconitic. Occurs centrally across 100% (or 9.3 ha) of the Study Area.

Hydrology

On the Swan Coastal Plain, surface run-off and groundwater discharge contribute to the flows within the rivers and their tributaries. The major rivers and some tributaries are perennial, having greater flows in winter than in summer, but some rivers and tributaries are also fed by drainage corridors all year round (DPaW, 2016). A major component of the summer flows is from groundwater discharge (Davidson, 1995). The wetlands, such as lakes and swamps, have formed along the boundaries of the dune systems, though some wetlands occur within the dune systems (Davidson, 1995; McArthur & Bettenay, 1974). Many of these wetlands are dependent on groundwater.

3.3.2 Wetlands

Twenty per cent (by area) of wetlands across the Swan Coastal Plain retain high ecological values, making them the highest priority for conservation (conservation management category). However, approximately 72 per cent of wetlands have been degraded to the extent that they are not a priority for conservation (multiple use management category) (DBCA, 2018a). The wetlands on the Swan Coastal Plain have been evaluated and assigned a management category (Table 3.1).

Table 3.1: Wetlands of the Swan Coastal Plan Management Categories (DBCA, 2018b)

Management category	General description	Management objectives
Conservation	Wetlands which support a high level of attributes and functions.	**Highest priority wetlands** Objective is to preserve and protect the existing conservation values of the wetlands through various mechanisms including: • reservation in national parks, crown reserves and State owned land • protection under Environmental Protection Policies • wetland covenanting by landowners. No development or clearing is considered appropriate. These are the most valuable wetlands and any activity that may lead to further loss or degradation is inappropriate.
Resource enhancement	Wetlands which may have been partially modified but still support substantial ecological attributes and functions	**Priority wetlands** Ultimate objective is to manage, restore and protect towards improving their conservation value. These wetlands have the potential to be restored to Conservation category. This can be achieved by restoring wetland function, structure and biodiversity. Protection is recommended through a number of mechanisms.
Multiple use	Wetlands with few remaining important attributes and functions	Use, development and management should be considered in the context of ecologically sustainable development and best management practice catchment planning through landcare.

The Geomorphic Wetlands dataset describes the wetlands of the Swan Coastal Plain in relation to two main aspects, physical classification and environmental evaluation (DBCA, 2019). This dataset has been recognised and endorsed by the Government of Western Australia (DBCA, 2019).

The Study Area lies partially within various geomorphic wetlands units as seen in Table 3.2 and Figure 3.2.

Table 3.2: Geomorphic wetlands located within the Study Area

Unique Feature Identifier	Category	Description	Landform
14524	Conservation	Dampland	Basin
14517	Conservation	Dampland	Basin
14519	Conservation	Dampland	Basin
14523	Multiple Use	Dampland	Basin
13191	Multiple Use	Dampland	Basin
15209	Multiple Use	Dampland	Basin
13192	Multiple Use	Dampland	Basin
14484	Multiple Use	Dampland	Basin
13190	Multiple Use	Dampland	Basin

3.3.3 Groundwater

A review of the Perth Groundwater Map indicates that groundwater depth averages approximately 35 m across the Study Area (Table 3.3) (DoW, 2019). The natural surface contours provided in the Perth Groundwater Map(DoW, 2019) within the Study Area range from 24 to 25.8 m. However, the water table is inferred to be at between 22 m Australian Height Datum (AHD) and 23 m AHD (DoW, 2019).

Table 3.3: Groundwater information within the Study Area (DoW, 2019)

Location	Depth from ground level to		Natural Surface (mAHD)	Water table (mAHD)	Base of aquifer (mAHD)
	Watertable (m)	Base of aquifer (m)			
Northern study area	2	34	24	22	-10
Central study area	2	35	25	23	-10
Southern study area	2.8	35.8	25.8	23	-10
Average	2.3	34.9	24.9	22.7	-10

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Nicholson Rd

13194

14519

14523

Ranford Rd

Parnell Wy

Ballycastle Loop

13191

15209

14517

13192

13190

14484

14524

Merrion Rmbl

Tramore Tam

Clontarf Tce

Legend

Study Area

Wetland Classification

Conservation Category

Resource Enhancement Category

Multiple Use Category

0 100 200 300 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 29/03/2021

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Scale: 1:7,000

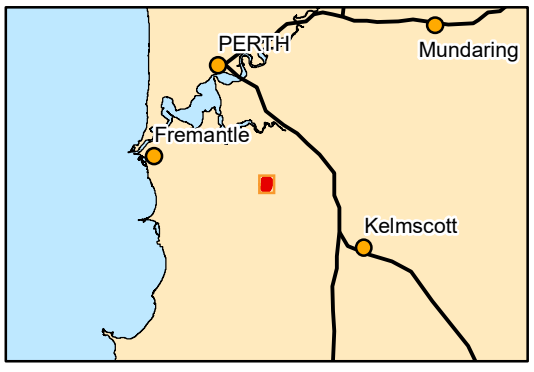

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Figure 3.2: Hydrology of the Study Area

3.4 Vegetation Complexes

The vegetation complexes of the Swan Coastal Plain are those defined by Heddle *et al.* (1980) at the scale of 1:250,000. The Study Area lies wholly within the Southern River vegetation complex (System 6 code #42). This is described as open woodland of *Corymbia calophylla* (marri) – *Eucalyptus marginata* (jarrah) – *Banksia* species with fringing woodland of *Eucalyptus rudis* (flooded gum) – *Melaleuca rhaphiophylla* (swamp paperbark) along creek beds (DBCA, 2020h).

The Government of Western Australia reports annually on the statistics of the pre-European and current extent for the vegetation complexes of the south-west of Western Australia. The updated statistics provide details on the progress towards achieving a conservation reserve system that is comprehensive, adequate and representative (CAR Reserve) and the statistics for each local government area (LGA; City of Gosnells). This vegetation complex extends across eighteen LGAs. The City of Gosnells contains 8.23 % of the Southern River vegetation complex extent (Table 3.4). The Study Area sits close (<20 m) from the border of the Bassendean-Central and South complex.

Table 3.4: Pre-European and current extent of vegetation complexes occurring in the Study Area

Vegetation Complex & Code	Scale	Pre-European Extent (ha)	Current Extent remaining (ha / %)	Current Extent remaining on DBCA lands (%)
Southern River Complex (#42)	LGA	4,836	554 / 11.5	0
	Bioregion	58,781	10,832 / 18.4	1.6

Source: Government of Western Australia (2019).

3.5 Bioregional Significance and Conservation Areas

Under the Convention of Biological Diversity, Australia has worked towards a target of 17 % of the continent to be protected as part of the National Reserve System (NRSTG). In building the NRS, Priority is given to under to under-represented bioregions that have less than 10 % of their remaining are protected in reserves (NRSTG, 2009). The SCP is adequately represented with approximately 10.01-15% of the subregional area protected in reserves.

In order to conserve the biodiversity of this area, regionally significant bushland is identified and protected under the Government of Western Australia's strategic plan for the conservation of bushland, "Bush Forever" (Government of Western Australia, 2000). The Study Area does not overlap any current Bush Forever sites but there is several Bush Forever sites within 2 km, as listed in Table 3.5.

Although the Study Area is surrounded by a developing urban environment, it is intersected by a Regional Ecological Link (Link ID "45") in the southern section, with a second Regional Ecological Link immediately to the south of the Study area (Link ID "48") (Figure 3.7). These linkages are defined as a series of continuous and non-continuous patches of native vegetation which, by virtue of their proximity to each other, act as stepping stones of habitat which facilitate the maintenance of ecological processes and the movement of organisms within, and across, a landscape (Del Marco, 2004; Molloy *et al.*, 2009).

The Study Area therefore has high potential to provide dispersal opportunities for fauna between nearby areas such as the Jandakot Regional Park.

Table 3.5: Bush Forever sites within 2km of the Study Area

Site No.	Site name	Location	Landform Element	Potential fauna values	Site Significance
389	Acourt Road Bushland, Banjup	0.5 km south west of Study Area	Vegetated wetland Vegetated uplands	• Significant mammal species: quenda	• Inferred to contain: 21c Low lying *Banksia attenuata* woodlands or shrublands, 22 *B. ilicifolia* woodlands and 23a Central *B. attenuata* and *B. menziesii* woodlands (Government of Western Australia, 2000b), encompassed within the Banksia WL SCP (WA P3, EPBC T-EN) (TSSC, 2016). • Adjacent bushland to the north, south east and west; Part of Greenway 92 and part of a regionally fragmented bushland/wetland linkage.
472	Canning Vale Prison Bushland	300 m south east of Study Area	Bassendean Dunes Vegetated wetland Vegetated uplands	• Significant mammal species: quenda	• Inferred to contain: 23a Central *Banksia attenuata* and *B. menziesii* woodlands (Government of Western Australia, 2000b), encompassed within the Banksia WL SCP (WA P3, EPBC T-EN) (TSSC, 2016). • Adjacent bushland to the north, east and west; part of a regionally significant fragmented bushland/wetland linkage.
467	Gosnells Golf Course Bushland, Canning Vale	700 m east of Study Area	Bassendean Dunes Vegetated wetland Vegetated uplands	• Significant mammal species: quenda	• Inferred to contain: 23a Central *Banksia attenuata* and *B. menziesii* woodlands (Government of Western Australia, 2000b), encompassed within the Banksia WL SCP (WA P3, EPBC T-EN) (TSSC, 2016).
388	Jandakot Airport, Jandakot	2.5 km west	Bassendean Dunes Vegetated wetland Vegetated uplands	• Significant populations of splendid fairy-wren, grey shrike-thrush. • Significant bird species: category 1 (1), category 3 (9) and category 4 (7) • Significant mammal species: honey possum, quenda and western brush wallaby. • Significant reptile species: skink lizards *(Lerista lineata* and *Acritoscincus trilineatus*) and black-headed snake (*Parasuta gouldii)*	• Inferred to contain: 21c low-lying *Banksia attenuata* woodlands or shrublands, 22 *B. ilicifolia* woodlands and 23a Central *Banksia attenuate* and *B. menziesii* woodlands (Government of Western Australia, 2000b), encompassed within the Banksia WL SCP (WA P3, EPBC T-EN) (TSSC, 2016). • Adjacent bushland to the north, east, south and west; part of greenway 92; part of fragmented potential bushland/wetland linkage.
245	Ken Hurst Park, Leeming	2 km west	Bassendean Dunes, Vegetated wetland, Vegetated uplands	• Significant mammal species: quenda and western brush wallaby. • Significant bird species category 1 (1), category 3 (3), and category 4 (4).	• Adjacent bushland to the north and south, part of Greenway 92 and part of a regionally significant fragmented bushland/wetland linkage. • Inferred to contain: 23a Central *Banksia attenuate* and *B. menziesii* woodlands present (Government of Western Australia, 2000b), encompassed within the Banksia WL SCP (WA P3, EPBC T-EN) (TSSC, 2016).
125	Holmes Street Bushland, Southern River/Huntingdale	2.5 km east	Bassendean Dunes Vegetated wetland Vegetated uplands	• Significant mammal species: quenda • Significant bird species: category 1 (1), category 3 (11) and category 4 (2)	• Bennett Brook Wetland Groups (91.6 ha conservation) • Part of regionally significant fragmented bushland/wetland linkage • Inferred to contain SCP23a Central *Banksia attenuata* and *B. menziesii* woodlands (Government of Western Australia, 2000b), encompassed within the Banksia WL SCP (WA P3, EPBC T-EN) (TSSC, 2016).
253	Harrisdale Swamp and Adjacent Bushland, Forrestdale	1.4 km south east	Bassendean Dunes	• Significant mammal species: quenda	• Inferred to contain: SCP23a Central *Banksia attenuata* and *B. menziesii* woodlands (Government of Western Australia, 2000b), encompassed within the Banksia WL SCP (WA P3, EPBC T-EN) (TSSC, 2016). • Adjacent bushland to the south, east and west; part of Greenway 91 and part of regionally significant fragmented bushland/wetland linkage,

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6447512

Nicholson Rd

Ranford Rd

Parnell Wy

Ballycastle Loop

Merrion Rmbl

Tramore Tarn

Clontarf Tce

467

389

472

472

Legend

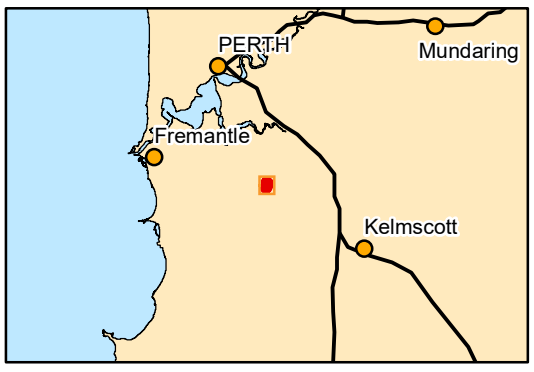
- Study Area
- Bush Forever Sites
- Jandakot Regional Park

Regional Ecological Linkages

- 45
- 48

0 100 200 300 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 09/02/2021



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Scale: 1:7,000

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Figure 3.3: Conservation areas in the vicinity of the Study Area

3.5.1 Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region (WA (P3), EPBC (T-EN))

The Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region (WA (P3), EPBC (T-EN)) (Banksia WL SCP) TEC is restricted to areas in, and immediately adjacent to, the SCP bioregion. These woodlands are the most prominent type of vegetation around Perth and once formed an almost continuous band with a median patch size estimated at 146 hectares. They are now heavily fragmented (divided from around 132 into over 12,000 patches), with a median patch size estimated at 1.6 hectares. Since the 19th century, the region has been heavily cleared (approximately 60 %) for agriculture, housing and associated infrastructure. Small patch sizes make communities more vulnerable to disturbances such as invasion by weeds or feral animals, while separation between patches disrupt ecological processes that support the health of the community (e.g. dispersal). This reaffirms that the protection and potential regeneration of the remaining patches of the ecological community are paramount, as they provide important wildlife corridors and refuges in a highly fragmented landscape (DoEE, 2016a).

The Banksia WL SCP has a prominent tree layer of Banksia, with scattered Eucalypts and other tree species often present. The understorey is a mix of sclerophyllous shrubs, grasses, rushes, sedges and herbs and is characterised by high diversity and endemism. The TEC mainly occurs on deep Bassendean and Spearwood sands or occasionally on Quindalup sands, and also occurs where there are shallow sands over more complex stratigraphic sequences of foothills (Ridge Hill Shelf), Whicher Scarp and Gingin/Dandaragan Scarp (adapted from TSSC, 2016).

Regional vegetation mapping at various scales has been produced for the SCP and each of these encompass vegetation units supporting Banksia woodlands. Forty-nine of the vegetation system associations mapped by Beard (1981) contain some component of the Banksia woodlands ecological community, of which fourteen system associations contain the key *Banksia* species as a major component of the vegetation (TSSC, 2016). Vegetation complexes mapped by Heddle *et al.* (1980) have been stratified according to whether they are strongly or moderately associated with Banksia woodlands. The Southern River vegetation complex covers the Study Area and is considered to be moderately associated with the Banksia WL SCP ecological community. Fourteen Floristic Community Types (FCTs) as defined by Gibson *et al.* (1994) are listed as sub-communities under the federally listed TEC, of which eight are also listed as separate TECs/ PECs at a state level.

The intact remnant vegetation (core area) in the Study Area has broadly been inferably mapped at a regional scale by the DBCA as Banksia WL SCP (DBCA, 2020c).

3.6 Introduced Taxa

3.6.1 Weeds of National Significance

The Commonwealth of Australia, in collaboration with the states and territories, has identified 32 WoNS based on an assessment process that prioritises these weeds according to their invasiveness, potential for spread and environmental, social and economic impacts. A list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

Landowners and land managers at all levels are responsible for managing WoNS. State and territory governments are responsible for legislation, regulation and administration of weeds. The WoNS were selected as they require coordination among all levels of government, organisations and individuals with weed management responsibilities.

3.6.2 Declared Pests

To protect Western Australian agriculture DPIRD regulates harmful plants under the BAM Act. Plants that are prevented entry into the state or have control or keeping requirements within the state are known as declared pests. The main purposes of the BAM Act and its regulations related to DPs are to prevent new plant pests from entering Western Australia, manage the impact and spread of those pests already present in the state and safely manage the use of agricultural chemicals.

The BAM Act has categorised the weeds of Western Australia into four main classifications:

- Declared Pests (under Section 22 of the Act);
- Permitted (under Section 11 of the Act);
- Prohibited (under Section 12 of the Act); and
- Permitted requiring a permit (Section 73, BAM Regulations 2013).

Under the BAM Act all DPs listed under Section 22 (not including pests listed under Section 12 of the BAM Act; Prohibited Pests) are placed in one of three control categories:

- Category 1 (C1) – Exclusion: if in the opinion of the Minister introduction of the declared pest into an area or part of an area for which it is declared should be prevented;
- Category 2 (C2) – Eradication: if in the opinion of the Minister eradication of the declared pest from an area or part of an areas for which is declared is feasible; and
- Category 3 (C3) – Management: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is not feasible but that it is necessary to:
    - Alleviate the harmful impact of the declared pest in the area; or
    - Reduce the number or distribution of the declared pest in the area; or
    - Prevent or contain the spread of the declared pest in the area.

Prohibited pests listed under Section 12 of the BAM Act are assigned separate control categories and include:

- Category 1 (C1) – Exclusion: if in the opinion of the Minister introduction of the prohibited organism into the State or a part of the State should be prevented; and

- Category 2 (C2) – Eradication: if in the opinion of the Minister eradication of the prohibited organism from the State or a part of the State is feasible.

3.6.3 Weed Prioritisation

In 2008 the former Department of Environment and Conservation (DEC) (now the DBCA) developed and implemented an integrated approach to weed management on lands managed for conservation in WA by the then DEC, the Weed Prioritisation Process. It was updated in 2013 and further revised in 2016. DBCA prioritised weeds in each region, based on their:

- Invasiveness;
- Ecological impact
- Potential and current distribution; and
- Feasibility of control.

The resulting priorities focus on weeds considered to be high impact, rapidly invasive and still at a population size that can feasibly be eradicated or contained to a manageable size. This means that weed species that are already widespread may not be ranked as a high priority.

3.7 Flora and Vegetation

3.7.1 Desktop Assessment Results

3.7.1.1 Flora of Conservation Significance

The results and outcomes of the flora and vegetation reports identified from the literature review are presented in Appendix B.

One conservation significant flora taxon, *Eleocharis keigheryi* (T), was identified from the literature review but not the database searches. This has been included in the overall conservation significant flora desktop assessment results likelihood of occurrence table (Appendix C). All other conservation significant flora taxa identified in the literature review were also present in one or more of the databases searches.

A total of 39 conservation significant flora taxa were identified from the database searches (within 5 km of the survey are) (Figure 3.4). Of the 39 taxa:

- 16 are listed as Threatened (EPBC Act and BC Act); and
- 23 are Priority (DBCA) flora taxa (two P1, three P2, ten P3 and eight P4).

Taxa identified from the desktop assessment (combined total of 40 taxa) were then assessed and ranked on the likelihood of occurring within the Study Area (Appendix C). It should be noted that many of the closest records of these taxa have since been cleared due to urbanisation. Likelihoods have been adjusted accordingly where applicable to account for nearest present records. Two taxa have been previously recorded from the Study Area pre-survey, however the *Diuris purdiei* (T) record is noted as an extinct location (Table 3.6, Figure 3.4). Four taxa were considered likely while 17 were considered possible (Table 3.6) The remaining 17 taxa were considered unlikely or highly unlikely to occur (Appendix C).

Table 3.6: Conservation significant flora desktop assessment results likelihood of occurrence

Taxon	Description (WAH, 1998-)	Location[2]	Reference
Confirmed			
Diuris purdiei (T)	Tuberous, perennial, herb, 0.15-0.35 m high. Fl. yellow, Sep to Oct. Grey-black sand, moist. Winter-wet swamps.	Within Study Area (this is now an extinct population - cleared)	DBCA (2020f)
Tripterococcus sp. Brachylobus (A.S. George 14234) (P4)	Erect, perennial, herb, to 0.8 m high. Fl. green. Grey sand or clay. Plains, winter damp flats.	Within Study Area	
Likely			
Caladenia huegelii (T)	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green & cream & red, Sep to Oct. Grey or brown sand, clay loam.	0.1 km N (this is now an extinct population - cleared)	DBCA (2020f)
Byblis gigantea (P3)	Small, branched perennial, herb (or sub-shrub), to 0.45 m high. Fl. pink-purple/white, Sep to Dec or Jan. Sandy-peat swamps. Seasonally wet areas.	0.1 km W (this is now an extinct population - cleared)	
Jacksonia gracillima (P3)	Prostrate, spreading or scrambling, spindly shrub, to 1.5 m high. Fl. pink/orange, Oct and Nov. Grey/brown sandy loam. Winter damp flats, gentle lower slopes of dunes.	0.4 km ENE	
Stylidium paludicola (P3)	Reed-like perennial, herb, 0.35-1 m high. Inflorescence racemose. Fl. pink, Oct to Dec. Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland.	0.6 km E	
Possible			
Austrostipa jacobsiana (T)	Clumping, perennial grass, to 0.6(flower spike to 1.1) m high. Fl. green. Grey sandy clay. Plains, damplands, winter wet flats.	3.9 km ESE	DBCA (2020f)
Diuris drummondii (T)	Tuberous, perennial, herb, 0.5-1.05 m high. Fl. yellow, Nov to Dec or Jan. Low-lying depressions, swamps.	3.5 km NW	
Drakaea elastica (T)	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red & green & yellow, Oct to Nov. White or grey sand. Low-lying situations adjoining winter-wet swamps.	2 km N (this is now an extinct population - cleared)	
Drakaea micrantha (T)	Tuberous, perennial, herb, 0.15-0.3 m high. Fl. red & yellow, Sep to Oct. White-grey sand.	2 km N (this is now an extinct population - cleared)	
Eremophila glabra subsp. *chlorella* (T)	Prostrate & spreading or sprawling shrub, 0.2-1 m high. Fl. green-yellow, Jul to Nov. Sandy clay. Winter-wet depressions.	3 km N	
Synaphea sp. Fairbridge Farm (D. Papenfus 696) (T)	Dense, clumped shrub, to 0.3 m high, to 0.4 m wide. Fl. yellow, Oct. Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.	3.5 km NW	
Levenhookia preissii (P1)	Annual (ephemeral), herb, 0.03-0.17 m high. Fl. pink-red, Sep to Dec or Jan. Grey or black, peaty sand. Swamps.	3.3 km WNW	
Stenanthemum sublineare (P2)	Erect shrub, to 0.1 m high. Fl. green, Oct to Dec. Littered white sand. Coastal plain.	3.8 km ENE	
Schoenus benthamii (P3)	Tufted perennial, grass-like or herb (sedge), 0.15-0.45 m high. Fl. brown, Oct to Nov. White, grey sand, sandy clay. Winter-wet flats, swamps.	2.7 km ENE	
Schoenus capillifolius (P3)	Semi-aquatic tufted annual, grass-like or herb (sedge), 0.05 m high. Fl. green, Oct to Nov. Brown mud. Claypans.	1.8 km E	
Schoenus pennisetis (P3)	Tufted annual, grass-like or herb (sedge), 0.05-0.15 m high. Fl. purple-black, Aug to Sep. Grey or peaty sand, sandy clay. Swamps, winter-wet depressions.	4.6 km SSE	
Stylidium aceratum (P3)	Fibrous rooted annual, herb, 0.05-0.09 m high, leaves spathulate. Fl. pink/white, Oct to Nov. Sandy soils. Swamp heathland.	4.6 km SSE	
Styphelia filifolia (P3)	Erect, well branched shrub, to 0.5 cm high. Fl. white. Brown/yellow sand. Midslopes, sandplains.	2.2 km NW	
Aponogeton hexatepalus (P4)	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl. green-white, Jul to Oct. Mud. Freshwater: ponds, rivers, claypans.	1.8 km E	
Ornduffia submersa (P4)	Perennial aquatic, floating herb, 0.03-0.2 m high. Fl. white/cream/yellow. Brown/white clay or sandy loam. Ephemeral winter wetland, clay flats, open depression.	5.2 km SE	
Stylidium longitubum (P4)	Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. pink, Oct to Dec. Sandy clay, clay. Seasonal wetlands.	4.6 km SSE	
Verticordia lindleyi subsp. *lindleyi* (P4)	Erect shrub, 0.2-0.75 m high. Fl. pink, May or Nov to Dec or Jan. Sand, sandy clay. Winter-wet depressions.	4 km SE	

[2] Distance from Study Area boundary

396894 397894

6449516 6449516

6448516 6448516

6447516 6447516

Nicholson Rd

Ranford Rd

Legend

Study Area

Species records

T - CR

Caladenia huegelii

T - EN

Diuris purdiei

P3

Byblis gigantea

Jacksonia gracillima

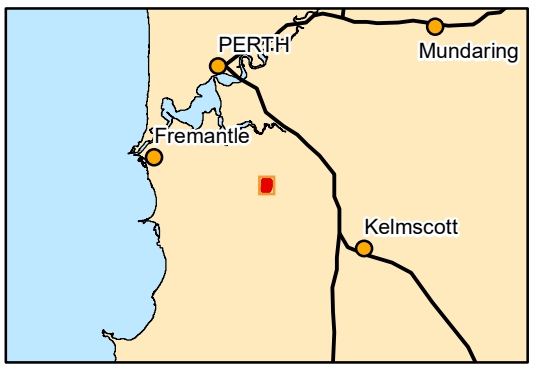
Stylidium paludicola

P4

Tripterococcus sp. Brachylobus (A.S. George 14234)

0 100 200 300 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 03/02/2021



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Scale: 1:7,000

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Figure 3.4: Conservation significant flora database results

3.7.1.2 Vegetation of Conservation Significance

Searches of the DAWE database with regard to matters of national environmental significance as listed under the EPBC Act (DAWE, 2020) and the Threatened and Priority Ecological Communities database (DBCA, 2020c) revealed 12 ecological communities of conservation significance within the database search radius of 5 km (Figure 3.5; Table 3.7). This search has included communities that seemingly occur outside of the 5 km radius but were still picked up by the searches. Of these communities, one was determined as occurring within the Study Area (Banksia WL SCP) which is are listed as Endangered under the EPBC act.

All conservation significant communities identified by the literature were also identified by the database searches (Appendix B)

Table 3.7: Conservation significant ecological communities desktop assessment results

Ecological Community/Wetland	Status			Nearest Inferred Occurrence
	DBCA	BC Act	EPBC Act	
Banksia WL SCP Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region	P3	-	EN	Within Study Area
SCP08 Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson et al. (1994)) **(Component of Clay Pans SCP (EPBC T-CR)**	T	VU	CR	4.6 km NE
SCP10a Shrublands on dry clay flats (floristic community type 10a as originally described in Gibson et al. (1994)) **(Component of Clay Pans SCP (EPBC T-CR)**	T	EN	CR	
Muchea Limestone Shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain	T	EN	EN	4.7 km SE
SCP21c Low lying *Banksia attenuata* woodlands or shrublands of the Swan Coastal Plain (floristic community type 21c as originally described in in Gibson et al. (1994)) **(Component of Banksia WL SCP (WA P3, EPBC T-EN)**	P3	-	EN	5.6 km SE
SCP3a *Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain (floristic community type 21c as originally described in in Gibson et al. (1994))	T	CR	EN	7.4 km NE
SCP07 Herb rich saline shrublands in clay pans (floristic community type 7 as originally described in Gibson et al. (1994)) **(Component of Clay Pans SCP (EPBC T-CR)**	T	VU	CR	9.3 km NE
SCP20b *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (floristic community type 20b as originally described in Gibson et al. (1994)) **(Component of Banksia WL SCP (WA P3, EPBC T-EN))**	T	EN	EN	10.1 km NE
SCP3b *Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils of the Swan Coastal Plain (floristic community type 21c as originally described in in Gibson et al. (1994))	T	VU	-	10.3 km ENE

Ecological Community/Wetland	Status			Nearest Inferred Occurrence
	DBCA	BC Act	EPBC Act	
SCP20c Shrublands and woodlands of the eastern side of the Swan Coastal Plain (floristic community type 20c as originally described in in Gibson et al. (1994)) **(Component of Banksia WL SCP (WA P3, EPBC T-EN)**	T	CR	EN	10.4 km NE
SCP20a *Banksia attenuata* woodlands over species rich dense shrublands (floristic community type 20a as originally described in Gibson et al. (1994)) **(Component of Banksia WL SCP (WA P3, EPBC T-EN)**	T	EN	EN	10.6 km NE
Central Granite Shrublands (Com 5, Markey) Central Northern Darling Scarp Granite Shrubland Community	P4	-	-	10.6 km E

397172

398172

6448836

6447836

Nicholson Rd

Ranford Rd

Legend

Study Area

Vegetation records

Banksia WL SCP (P3 WA, EN EPBC)

0 100 200 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 03/02/2021

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Scale: 1:5,000

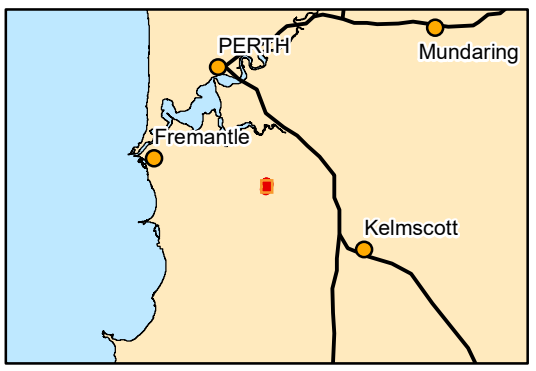

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Figure 3.5: Conservation significant vegetation database results

3.7.1.3 Vegetation of other significance

The EPA (2016c) advises that vegetation may be of significance for reasons other than a listing as a TEC or a PEC. This may include, although is not limited to, scarcity, novel combination of species, role as a refuge, restricted distribution and vegetation extent being below a threshold level (EPA, 2016c). The Study Area overlaps three Damplands (Unique Feature Identifier 14524, 14571 and 14519; basins, seasonal inundation) (Figure 3.3), which are all classified as Conservation Category Wetlands (DBCA, 2019; PGV, 2014), supporting high levels of attributes and functions.

3.7.1.4 Introduced Flora Taxa

The NatureMap (DBCA, 2020f), Protected Matters (DAWE, 2020), ALA (ALA, 2020) and The Western Australian Organism List (WAOL) (DPIRD, 2020) database searches identified a list of 154 introduced taxa that may potentially occur within the Study Area. The list of introduced taxa known to occur or potentially occur within the Study Area (Appendix D) was reviewed to identify WoNS and DPs.

Weeds of National Significance and Declared Pests

Of the list of introduced taxa identified during the desktop assessment as occurring in or near the Study Area, 40 are listed as WoNS (Appendix D). Thirty of the 40 WoNS were identified from the WAOL database search for the entire City of Gosnells LGA and occur or may potentially occur within the City's boundaries. The remaining 10 WoNS were identified from the EPBC Protected Matters Search Tool and occur or may potentially occur within a 5 km buffer of the Study Area. The 40 taxa include numerous *Opuntia* and *Cylindropuntia* species that are grouped together in the WoNS listing. The desktop assessment identified 49 DPs (including numerous cacti species that are all listed as DPs), previously recorded or potentially located within the City of Gosnells.

3.7.2 Flora and Vegetation Field Results

3.7.2.1 Flora Composition

A total of 243 vascular flora taxa from 54 families and 151 genera were recorded from the Study Area during the field survey (Appendix E). The total number of vascular flora taxa recorded comprised 191 native taxa and 52 introduced taxa. Species by site data is provided in (Appendix F).

The dominant families equate to 29.6 % of the total taxa recorded and comprised Fabaceae (28), Myrtaceae (23) and Cyperaceae (21). Of the 54 families recorded, 24 were represented by one taxon, which equates to 9.8 % of the total taxa recorded. The dominant genera make up 9.7 % of the total taxa recorded and comprised *Lomandra* (8), *Acacia* (7) and *Stylidium* (7). Of the 151 genera recorded, 104 were represented by only one taxon, which equates to 66.8 % of the total taxa recorded.

A small number of taxa (5.3 % or 13 taxa) observed and collected from the field were difficult to confidently identify to species or infraspecies level. This was mainly due to the specimens lacking suitable flowering and fruiting material for confident taxonomic identification. Of these taxa, one was tentatively identified to species level (*Acacia ?applanata*), while twelve have only been identified to genus level (Appendix E). None of the taxa that have been identified to genus level are considered to be analogous with conservation significant taxa.

3.7.2.2 Survey Adequacy

During phase one, a total of 10 quadrats were established during the current survey. The reconciled list of confirmed native flora taxa comprised 128 different species, not including singleton and opportunistic records. Total observed native flora taxa increases to 193 with these inclusions. Using the observed taxa value (128), richness estimators indicated that the survey was approximately 70 % (Michaelis-Menten) to 87 % (Bootstrap) adequate (Table 3.8).

Table 3.8: Expected native species richness for the Study Area

Treatment	Results	Richness Estimates (based on Sobs)	Richness Estimates (based on 193)
Chao 1	159	80 %	121 %
Jacknife 1	168	76 %	115 %
Bootstrap	148	87 %	131 %
Michaelis-Menten	182	70 %	106 %
Sobs	128	-	-

NB: percentage values have been rounded to the nearest whole number.

The species accumulation curve for the Study Area shows that few new species were recorded after the first couple of sites, with the Chao1 and MM curves plateauing and the remainder slightly climbing (Figure 3.6). However, due to the diverse range of landforms and vegetation types (for example wetlands and sandplains/dunes), unique and new taxa were recorded in most sites across the Study Area. Greater survey effort could have resulted in more taxa being recorded but given the small size of the Study Area (9.3 ha, not all of which was intact vegetation), the sampling intensity is considered to be adequate.

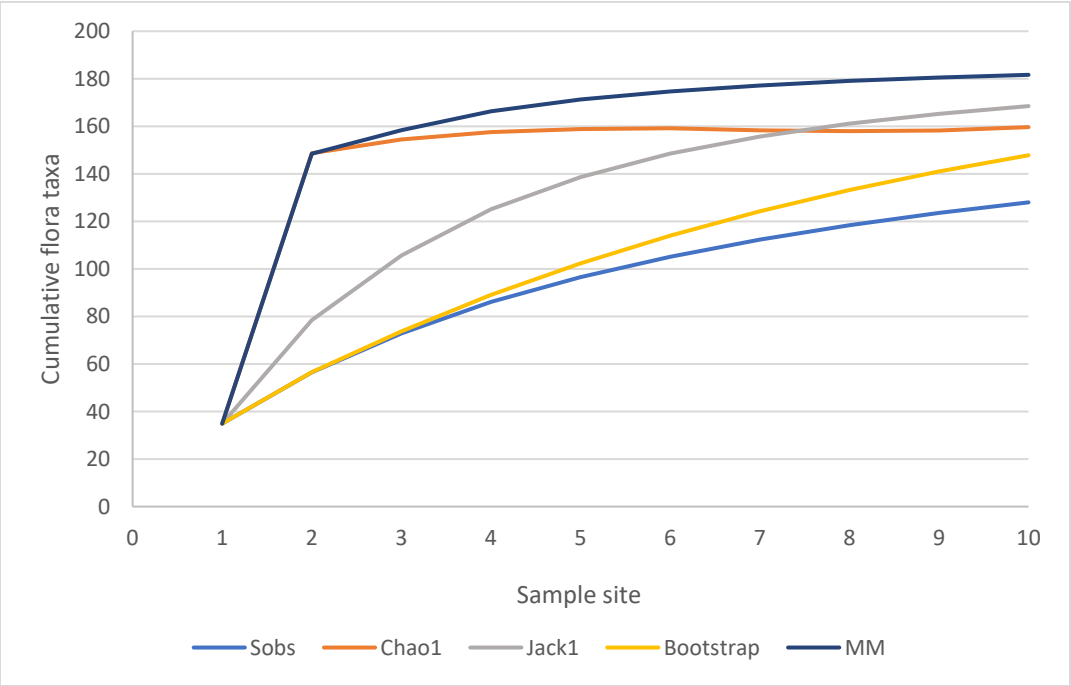


Figure 3.6 Species accumulation curve for the Study Area

3.7.2.3 Flora of Conservation Significance

Two conservation significant flora taxa were recorded in the Study Area by this survey (Figure 3.7; Appendix G):

- *Schoenus benthamii* (P3) – One individual from one point location
- *Jacksonia sericea* (P4) – 80 individuals from 29 point locations. One additional plant from one location was located outside of the Study Area (<5 m). All individuals have been planted.

Both of these taxa have been confirmed by Michael Hislop from the Western Australian Herbarium (Accession number 8732).

The two taxa previously confirmed from the Study Area pre-survey, *Diuris purdiei* (T) and *Tripterococcus* sp. Brachylobus (A.S. George 14234) (P4), were not located by this survey (see section 3.7.2.4).

Schoenus benthamii (P3)

Schoenus benthamii is a tufted perennial, grass like herb (sedge) (0.15 to 0.45 m) (Plate 3.1) occurring sporadically from Victoria plains to Albany (approximately 527 km) in the Jarrah Forest and Swan Coastal Plain bioregions (Hislop & Puente-Lelièvre, 2017; WAH, 1998-). It grows on white -grey sand and sandy clay soils of the coastal plain, usually in winter-wet flats and/or swamps and produces flowers from October through to November. There are currently 19 FloraBase and 27 NatureMap records for *S. benthamii* (DPaW, 2018; WAH, 1998-) with limited contextual information, suggesting this is an often under-recorded and overlooked taxon.

The one individual from one location in the Study Area was recorded and collected as a supplementary taxon to quadrat GNR-04 and occurred on seasonally inundated white/grey to black sand on the boundary of a wetland and dampland. It is possible that additional individuals occur in the immediate vicinity of this location due to its inconspicuous nature.

Plate 3.1: *Schoenus benthamii* (P3) specimen collected from the field, approximately 0.2 m in height (Biologic photos)

Jacksonia sericea (P4)

Jacksonia sericea is a low, spreading shrub (to 0.6 m) (Plate 3.2) restricted to calcareous and sandy soil habitats of the Perth subregion within the South-west Botanical Province from Joondalup to Mandurah (approximately 98 km) (WAH, 1998-). It has terete, non-spiny stems with absent leaves/phylloclades and stipules (Keybase, 2020), flowering from December to February. There are currently 58 FloraBase and 88 NatureMap records for this taxon (DPaW, 2018; WAH, 1998-).

Individuals recorded during this survey were confined to the previously cleared and revegetated areas in the far south of the Study Area along Tranmore Turn and Kinsale Parkway, with past landscaping and revegetation indicating that 265 individuals were planted previously at this location (APACE Natural Design; ENV, 2013b). No individuals of this taxon were located within the undisturbed and intact vegetation suggesting that all 81 individuals located by this survey have been previously planted. The reduction in numbers of this taxon located by this survey compared to the number of individuals planted is likely a result of natural senescence and thinning with age.

Plate 3.2: *Jacksonia sericea* (P4) observed in the field (Biologic photos)

397450

397950

Ranford Rd

Nicholson Rd

6448656

6448156

Legend

Study Area

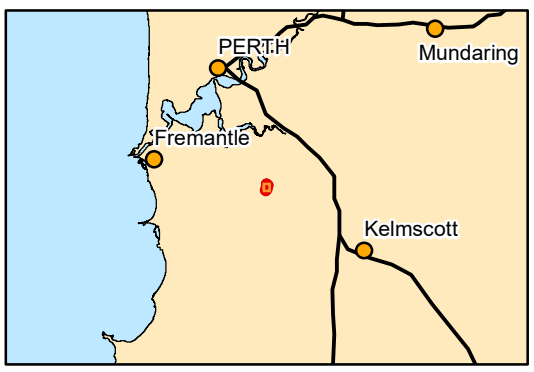
Species recorded

Schoenus benthamii (P3)

Jacksonia sericea (P4)

0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 03/02/2021



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Scale: 1:3,000

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Figure 3.7: Conservation significant flora recorded in the Study Area

3.7.2.4 Review of Conservation Significant Flora Likelihood of Occurrence

The results of the post-survey likelihood of occurrence for conservation significant flora considered is presented in Table 3.9. All taxa considered unlikely or highly unlikely pre-survey, unless upgraded, are presented in Appendix C.

The two taxa previously confirmed from the Study Area pre-survey, *Diuris purdiei* (T) and *Tripterococcus* sp. Brachylobus (A.S. George 14234) (P4), were not located by this survey.

The previous location of *Diuris purdiei* (T) is a known extinct record location (DBCA, 2020f), with aerial imagery suggesting this location has since been cleared for road and road verge associated with Nicholson Road (Figure 3.4). Intensive searches in both phases during this survey, and many other previous surveys, have not resulted in the location of this taxon in the Study Area since the population became extinct (see section 3.7.1.1). However, this taxon is a known fire-respondent flowering species and could still be present as a dormant tuber within the Study Area (DEC, undated). Additionally, suitable habitat for this taxon (inundated wetlands and damplands with grey/black sand) was present in the Study Area. It is therefore considered possible to occur in the Study Area post-survey.

The previous location of *Tripterococcus* sp. Brachylobus (A.S. George 14234) (P4), occurring on the edge of the limestone footpath in the southern portion of the Study Area, is over 30 years old (DBCA, 2020f). No individuals have since been located in the Study Area from 1990 onwards, while Weston (2004) located individuals of this taxon 10 m north of the northern Study Area boundary, of which have since been cleared (Figure 3.4). Based on this information, it could be considered unlikely that *T*. sp. Brachylobus (A.S. George 14234) occurs within the Study Area post-survey. However, this taxon, much like *Diuris purdiei* (T) (above), is a known fire-responder and hence could still occur in the Study Area post-disturbance (WAH, 1998-). The likelihood of occurrence of this taxon post-survey has therefore been reviewed as possible.

Of the 21 taxa considered likely (four) and possible (17), only one taxon was confirmed post survey; *Schoenus benthamii* (P3) (see section above). The remaining 20 taxa are now considered unlikely to occur within the Study Area post-survey. Although suitable habitat requirements for these taxa occur within the Study Area, the portion of the Study Area providing in-tact undisturbed native vegetation is small and could therefore be intensively searched during both phases of the survey. Previous survey work completed in the Study Area has not identified the presence of these taxa either (see section 3.7.1.1). Furthermore, with the exception of taxa within genera *Drakaea*, *Levenhookia*, *Schoenus* and *Stylidium*, these taxa are relatively conspicuous perennial taxa suggesting that if individuals were present, they would have been identified (WAH, 1998-).

One taxon, *Jacksonia sericea* (P4), considered unlikely pre-survey was confirmed by this survey (see section above). However, all of these individuals are considered to be planted as they occurred in disturbed and revegetated areas. This compliments the pre-survey likelihood (unlikely) as generally this taxon occurs on calcareous soils, none of which occurs in the Study Area.

All remaining taxa considered unlikely or highly unlikely pre-survey were either downgraded or remained so post-survey due to distances from the Study Area and marginal or unsuitable habitat observed.

Table 3.9: Post-survey likelihood of occurrence for conservation significant flora

Taxon	Post-survey likelihood	Reason for change in likelihood
Pre-survey likelihood – Confirmed		
Diuris purdiei (T)	Possible	Previously confirmed location extinct (cleared), Study Area intensively surveyed, known fire-responder
Tripterococcus sp. Brachylobus (A.S. George 14234) (P4)	Possible	Not found at previously confirmed location, Study Area intensively surveyed, known disturbance and fire-responder
Pre-survey likelihood – Likely		
Caladenia huegelii (T)	Unlikely	Limited suitable habitat observed within Study Area, Study Area intensively surveyed
Byblis gigantea (P3)	Unlikely	
Jacksonia gracillima (P3)	Unlikely	
Stylidium paludicola (P3)	Unlikely	
Pre-survey likelihood – Possible		
Schoenus benthamii (P3)	Confirmed	One individual from one location recorded within the Study Area
Austrostipa jacobsiana (T)	Unlikely	Limited suitable habitat observed within Study Area, Study Area intensively surveyed
Diuris drummondii (T)	Unlikely	
Drakaea elastica (T)	Unlikely	
Drakaea micrantha (T)	Unlikely	
Eremophila glabra subsp. *chlorella* (T)	Unlikely	
Synaphea sp. Fairbridge Farm (D. Papenfus 696) (T)	Unlikely	
Levenhookia preissii (P1)	Unlikely	
Stenanthemum sublineare (P2)	Unlikely	
Schoenus capillifolius (P3)	Unlikely	
Schoenus pennisetis (P3)	Unlikely	
Stylidium aceratum (P3)	Unlikely	
Styphelia filifolia (P3)	Unlikely	
Aponogeton hexatepalus (P4)	Unlikely	
Ornduffia submersa (P4)	Unlikely	
Stylidium longitubum (P4)	Unlikely	
Verticordia lindleyi subsp. *lindleyi* (P4)	Unlikely	
Pre-survey likelihood - Unlikely		
Jacksonia sericea (P4)	Confirmed	81 individuals from 30 locations recorded within the Study Area (planted)

3.7.2.5 Flora of Other Significance

The EPA (2016c) advises that flora species, subspecies, varieties, hybrids and ecotypes may be considered significant for reasons other than listing as a Threatened or Priority Flora taxa. This may include, but is not limited to, range extensions, keystone species, relic status, local endemism and anomalous features. Based on these features, three taxa recorded from the Study Area during the current assessment were considered to be flora of "other" significance (Appendix E):

- *Chaetanthus leptocarpoides.*- represents a significant range extension northwest of approximately 66 km, being the first record in the Perth area and only the fifth on the Swan Coastal Plain (generally recorded from wet areas along the south coast) (DPaW, 2018; WAH, 1998-). A small patch of individuals was recorded opportunistically in close proximity to GNR-01 on grey-white sand on sandy damplands

- *Goodenia pulchella* subsp. Coastal Plain B (L.W. Sage 2336) – represents a new location for this taxon, filling a slight locality hole (8 km to nearest record) as there are few records (eight) in the Perth area (DPaW, 2018; WAH, 1998-). One specimen was collected opportunistically, while numerous individuals were observed scattered across the Study Area
- *Schoenus sublateralis* - represents a new location for this taxon (first location within the City of Gosnells), filling a slight locality hole (17.3 km to nearest record) as there are only two records in the Perth area (DPaW, 2018; WAH, 1998-). One individual was recorded within quadrat GNR06

None of these taxa are considered to be conservation significant. *Chaetanthus leptocarpoides* and *Schoenus sublateralis* have been confirmed by Michael Hislop from the Western Australian Herbarium (Accession number 8732).

3.7.2.6 Introduced Flora

A total of 52 introduced flora taxa were recorded from the Study Area by this survey (Appendix E; Figure 3.8). The most frequently encountered introduced taxon with regard to floristic sites was **Gladiolus caryophyllaceus* which was recorded from all but one site, however numbers and cover were considerably low (<10 plants and ≤0.2% cover). The most dominant introduced taxon with regard to cover was **Ehrharta calycina* which was recorded from 15 point locations (six floristic sites, nine opportunistic) with counts of up to 100 plants at each location (Appendix H). These taxa, along with other commonly encountered introduced taxa including **Avena barbata, *Acacia longifolia* subsp. *longifolia*, **Fumaria capreolata*, **Briza maxima* and **Hypochaeris glabra* dominated the disturbed portions of the Study Area (track edges, fencelines, partially cleared areas and areas adjacent to urban infrastructure) but were also spread throughout the rest of the Study Area (Figure 3.8). Although none of the species recorded were listed as WoNS, two weeds, **Echium plantagineum* and **Gomphocarpus fruticosus,* are considered DPs under the BAM Act.

Additionally, eighteen recorded weed species had both a high ecological impact and rapid invasiveness as rated by DBCAs weed prioritisation process (DBCA, 2013). Four of these, **Cynodon dactylon*, **Ehrharta calycina*, **Acacia longifolia* subsp. *longifolia*, and **Acacia iteaphylla*, are on the high priority list for the Swan NRM region. These species have the potential to spread rapidly and significantly alter the structure and function of remnant bushland within the Study Area.

There were two small infestations of *Typha orientalis*; one alongside Merrion Ramble and the other in the swale alongside the path/ firebreak between the central and southern portions of the survey area. *Typha orientalis* was considered an introduced weed until recent investigations by Keighery and McCabe (2015) determined that it was present very soon after European settlement of the Perth area. The species is now considered to be native in the south-west; however, it has increased and become weedy in many wetlands across the Swan Coastal Plain.

Echium plantagineum

Echium plantagineum*, commonly known as Paterson's curse, is a serious environmental weed and can form dense monocultures outcompeting native understorey plants (WAH, 1998-).Echium plantagineum* is an annual or sometimes biennial herb growing up to 1 m tall (WAH, 1998-). It produces

large amounts of seed and can germinate at any time of year given the right conditions. Seeds can persist in the soil seedbank for more than seven years (CSIRO, 2021). It has been rated by the DBCA as having a high ecological impact and moderate invasiveness in the Swan region (DBCA, 2013). Weeds with high ecological impact have the potential to cause acute disruption to ecological processes, dominate and/or significantly alter vegetation structure, composition and function of ecosystems (DBCA, 2013). Twenty-five individuals from two point locations were recorded by this survey, both of which were alongside the track/ firebreak between Nicholson Road and Merrion Ramble. These individuals were flowering and had not yet penetrated into nearby native vegetation.

Plate 3.3:*_Echium plantagineum_, a Declared Pest, individuals located within the Study Area (Biologic Photos)

Gomphocarpus fruticosus

**Gomphocarpus fruticosus*, commonly known as Narrowleaf cottonbush, is a serious environmental weed capable of forming dense thickets and can easily move into undisturbed native vegetation (WAH, 1998-). Its seeds are long-lived and are dispersed easily via wind or water. Plants can also reproduce vegetatively through resprouting and sending out root suckers (Brown & Brooks, 2002). It has been rated by the DBCA as having a high ecological impact and rapid invasiveness in the Swan region (DBCA, 2013). Weeds with high ecological impact have the potential to cause acute disruption to ecological processes, dominate and/or significantly alter vegetation structure, composition and function of ecosystems (DBCA, 2013). Seven individuals from two point locations were recorded by this survey, both of which were on the edge of native vegetation nearby the northern section of Merrion Ramble. These plants were immature and did not bear flowers or fruits.

Plate 3.4: ****Gomphocarpus fruticosus***, a Declared Pest, individuals located within the Study Area (Biologic Photos)**

397560

398060

6448641

6448141

Parnell Wy

Ranford Rd

Nicholson Rd

Merrion Rmbl

Tramore Tarn

Introduced Flora Observed

Herbaceous weeds

- **Arctotheca calendula*
- **Callitriche stagnalis*
- **Cerastium glomeratum*
- **Crassula glomerata*
- **Cyperus involucratus*
- **Dittrichia graveolens*
- **Echium plantagineum*
- **Erigeron bonariensis*
- **Erodium cicutarium*
- **Hypochaeris glabra*
- **Juncus microcephalus*
- **Lactuca serriola*
- **Lotus angustissimus*
- **Lupinus cosentinii*
- **Lysimachia arvensis*
- **Lythrum hyssopifolia*
- **Medicago polymorpha*
- **Nephrolepis cordifolia*
- **Oenothera drummondii* subsp. *drummondii*
- **Oenothera stricta* subsp. *stricta*
- **Orobanche minor*
- **Pelargonium capitatum*
- **Raphanus raphanistrum*
- **Senecio vulgaris*
- **Solanum nigrum*
- **Sonchus oleraceus*
- **Ursinia anthemoides*
- **Vicia sativa*
- **Wahlenbergia capensis*

Woody weeds

- **Acacia iteaphylla*
- **Acacia longifolia* subsp. *longifolia*
- **Callistemon citrinus*
- **Eucalyptus* sp.
- Gomphocarpus fruticosus
- **Vitis vinifera*

Grassy weed

- **Aira cupaniana*
- **Avena barbata*
- **Briza maxima*
- **Briza minor*
- **Bromus diandrus*
- **Cynodon dactylon*
- **Ehrharta calycina*
- **Ehrharta longiflora*
- **Eragrostis curvula*
- **Hordeum leporinum*
- **Lolium multiflorum*
- **Pentameris airoides*
- **Poa annua*

Bulbous weed

- **Fumaria capreolata*
- **Fumaria* sp.
- **Gladiolus caryophyllaceus*
- **Romulea rosea*

Legend

Study Area

Significant Taxon

**Echium plantagineum* (Declared Pest)

**Gomphocarpus fruticosus* (Declared Pest)

0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 09/04/2021

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Scale: 1:3,000

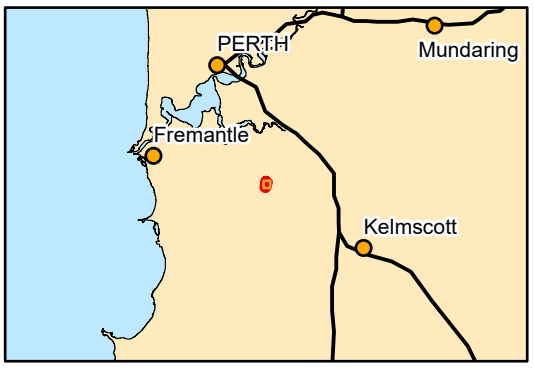

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Figure 3.8: Introduced flora recorded in the Study Area

3.7.2.7 Weed suites

The most common weeds recorded within the survey area were categorised into four weed suites based on their biology. These were, herbaceous weeds (31 taxa), grass weeds (14 taxa), woody weeds (4 taxa), and bulbous weeds (3 taxa). The most prominent and/or significant weeds within in each suite are presented in Table 3.10.

Herbaceous weeds were the most common weed suite in terms of species (31 taxa) and were distributed mostly along edges and tracks with particularly high density beside the track running between Nicholson Rd and Merrion Ramble. Grass weeds however, had higher cover within quadrats in both phase one and 2, and were more common within remnant bushland of good or higher condition. Three bulbous weeds were recorded, **Gladiolus caryophyllaceus*, **Fumaria capreolata* and **Romulea rosea*, and these were mainly recorded within quadrat sites. Larger woody weeds were found in the southern half of the Study Area in vegetation of good to excellent condition.

Two aquatic weeds, **Callitriche stagnalis*, (recorded on the north side of the main track running through the Study Area), and **Juncus microcephalus* (approximately 20 m in west of Merrion Ramble) occurred in the Study Area. The remainder of introduced flora recorded was terrestrial and not associated with permanent inundation.

Weed suite cover (for grass, herbaceous and bulbous weeds) and location (for woody weeds) mapping was then produced (Appendix H) utilising opportunistic and site data recorded in the field. Cover mapping has been broken down into cover categories, consisting of high (>60% cover), medium (5-60% cover) and low (<5% cover).

Table 3.10: Weed Suites containing prominent/significant weed taxa located within the Study Area

Weed suite	Dominant weed taxa	Locations	Ecological Impact	Invasiveness
Grass Weeds	**Avena barbata*	GNR-05, GNR-08, thirteen opportunistic	High	Rapid
	**Briza maxima*	GNR-02, GNR-03, GNR-08, five opportunistic	Unknown	Rapid
	**Briza minor*	GNR-02, GNR-07, GNR-08, two opportunistic	Unknown	Rapid
	**Bromus diandrus*	Four opportunistic	High	Rapid
	**Cynodon dactylon*	Four opportunistic	High	Rapid
	**Pentameris airoides*	GNR-01, GNR-02, GNR-03, GNR-05	Unknown	Rapid
	**Ehrharta calycina*	GNR-01, GNR-03, GNR-05, GNR-06, GNR-07, GNR-08, nine opportunistic	High	Rapid
	**Eragrostis curvula*	Six opportunistic	High	Rapid
Woody weeds	**Acacia longifolia* subsp. *longifolia*	Ten opportunistic	High	Rapid
	**Acacia iteaphylla*	Two opportunistic	High	Rapid

Weed suite	Dominant weed taxa	Locations	Ecological Impact	Invasiveness
	**Gomphocarpus fruticosus*	Two opportunistic	High	Rapid
Bulbous weeds	**Gladiolus caryophyllaceus*	GNR-01, GNR-02, GNR-03, GNR-05, GNR-06, GNR-07, GNR-08, GNR-09, GNR-10, one opportunistic	High	Rapid
	**Fumaria capreolata*	GNR-05, GNR-08, eight opportunistic	High	Rapid
Herbaceous weeds	**Hypochaeris glabra*	GNR-01, GNR-02, GNR-03, GNR-05, GNR-06, GNR-07, GNR-08, GNR-09	High	Rapid
	**Pelargonium capitatum*	Six opportunistic	High	Rapid
	**Raphanus raphanistrum*	Six opportunistic	Unknown	Moderate
	**Sonchus oleraceus*	GNR-02, GNR-06, GNR-08, three opportunistic	Unknown	Rapid
	**Echium plantagineum*	Two opportunistic	High	Moderate
	**Lactuca serriola*	GNR-08, two opportunistic	High	Rapid

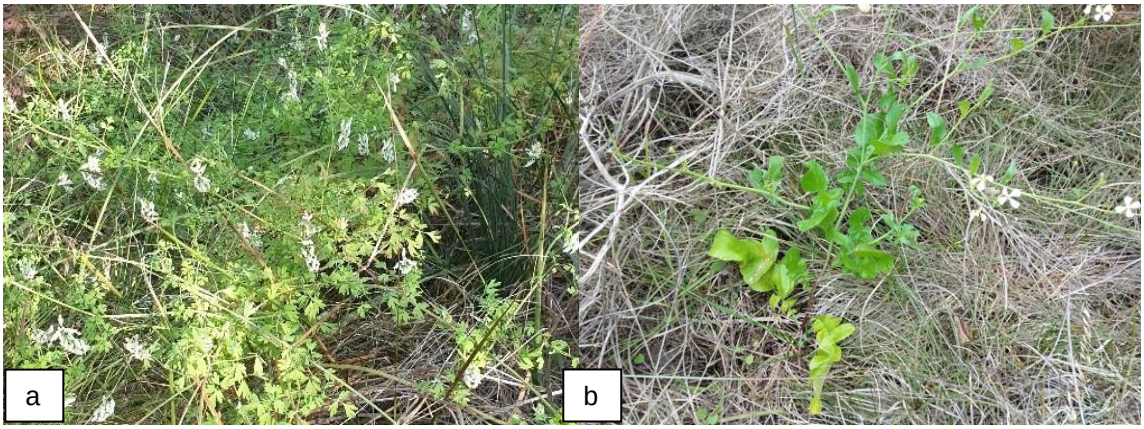

Plate 3.5: Prominent/significant bulbous/ herbaceous weeds a) ****Fumaria capreolata* and b) ****Raphanus raphanistrum*** (Biologic photos)**

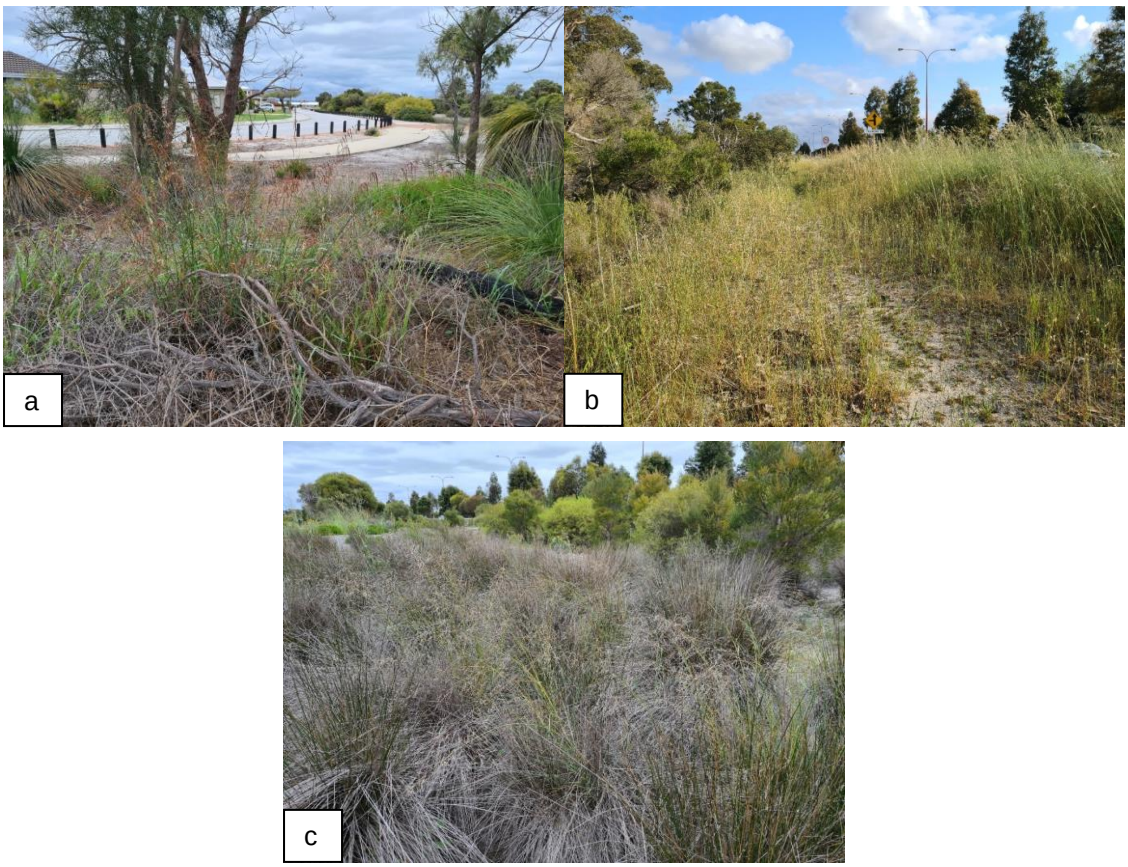

Plate 3.6: Prominent/significant grass weeds a) ****Ehrharta calycina* b) ****Avena barbata*** c) ****Eragrostis curvula*** in wetland vegetation (Biologic photos)**

Plate 3.7: Prominent/significant woody weed ****Acacia longifolia* **subsp. ***longifolia*** **(Biologic photos)**

Plate 3.8: Prominent/significant bulbous weed ****Gladiolus caryophyllaceus* **(Florabase photo) (WAH, 1998-)

3.7.2.8 Vegetation Types

Three broad floristic formations (BFFs), supporting five vegetation types, were recorded within the Study Area:

- *Banksia* low open woodland – containing one vegetation type
- *Melaleuca* low open woodland – containing three vegetation types
- *Melaleuca* low woodland – containing one vegetation type

The BFF covering the greatest proportion of the Study Area was *Melaleuca* low open woodland (35%).

Five vegetation types were mapped and described within the Study Area (Table 3.11; Figure 3.9). The dominant vegetation type in the Study Area was Mp PefHa, covering 23% of the Study Area.

Four mapping units, “Cleared”, “Swales” “Drains” and “Parkland Cleared”, were mapped in the Study Area additional to the vegetation types. The Swales unit covers a large portion of the Study Area (23 %) and includes areas considered to be man-made altered vegetation and landforms (which does not represent natural intact vegetation and landforms) including revegetated and rehabilitated areas. Drains (5 %) are man-made altered wetland landforms which have not been revegetated in any way. Cleared (2 %) represents bare areas with no vegetation present (tracks, cleared firebreaks, roads, road-verge and footpaths) while Parkland Cleared (10 %) represents bare areas with mainly exclusive introduced taxa cover.

Table 3.11: Vegetation Type Descriptions

Code and Description	Broad Floristic Formation	Sample Sites	Study Area Extent (ha / %)	Condition	Photo
BaEmBi (full code: BaEmBi Kg HaXp DbPcSp) Low *Banksia attenuata* woodland, with occasional low scattered *Eucalyptus marginata* and *Banksia ilicifolia* trees, over tall open *Kunzea glabrescens* shrubland over *Hypocalymma angustifolium* and *Xanthorrhoea preissii* low shrubland over *Dasypogon bromeliifolius*, *Phlebocarya ciliata* and *Schoenus pedicellatus* mixed shrubland and sedgeland on white/grey and brown loamy sand on sand plains	*Banksia* low open woodland	GNR-06, GNR-10	1.4 / 15	Excellent (mostly), Very Good	
MpAfEm (full code: MpAfEm Xp JfHaApp DbElPoo) Low open *Melaleuca preissiana* woodland, with occasional low scattered *Allocasuarina fraseriana* and *Eucalyptus marginata* trees, over tall *Xanthorrhoea preissii* shrubland over mid open *Jacksonia furcellata*, *Hypocalymma angustifolium* and *Acacia pulchella* var. *pulchella* shrubland over low *Dasypogon bromeliifolius*, *Euchilopsis linearis* and *Patersonia occidentalis* var. *occidentalis* shrubland on white/grey loamy sand on sandplains	*Melaleuca* low open woodland	GNR-01, GNR-02	0.8 / 9	Excellent (mostly), Very Good	

Code and Description	Broad Floristic Formation	Sample Sites	Study Area Extent (ha / %)	Condition	Photo
MP Kg (full code: MP Kg HaXp Ll DbElMg) Low *Melaleuca preissiana* woodland over tall scattered *Kunzea glabrescens* shrubs over mid open *Hypocalymma angustifolium* and *Xanthorrhoea preissii* open shrubland over mid *Lepidosperma longitudinale* sedgeland over low open *Dasypogon bromeliifolius*, *Euchilopsis linearis* and *Mesomelaena graciliceps* mixed sedgeland and shrubland on black/grey loamy sand on sandy damplands	*Melaleuca* low woodland	GNR-07, GNR-08	1 / 10	Excellent (mostly), Very Good	
Mp Ll (full code: Mp Xp LlLpLsp) Low open *Melaleuca preissiana* woodland over tall open *Xanthorrhoea preissii* shrubland over mid *Lepidosperma longitudinale*, *Lepidosperma pubisquameum* and *Lomandra* sp. mixed sedgeland and shrubland on black sandy clay loam on damplands and wetlands	*Melaleuca* low open woodland	GNR-04	0.3 / 3	Excellent (mostly), Very Good	

Code and Description	Broad Floristic Formation	Sample Sites	Study Area Extent (ha / %)	Condition	Photo
Mp PefHa (full code: Mp Xp PefHa MtDbSe) Low open *Melaleuca preissiana* woodland over tall *Xanthorrhoea preissii* shrubland over mid open *Pericalymma ellipticum* var. *floridum* and *Hypocalymma angustifolium* shrubland over mid to low *Mesomelaena tetragona*, *Dasypogon bromeliifolius* and *Schoenus efoliatus* sedgeland mixed shrubland and sedgeland on white/grey loamy sand on sandy damplands	*Melaleuca* low open woodland	GNR-03, GNR-05	2.1 / 23	Excellent (mostly), Very Good, Good	

Code and Description	Broad Floristic Formation	Sample Sites	Study Area Extent (ha / %)	Condition	Photo
Swales Altered/disturbed areas which have been revegetated and landscaped	-	-	2.1 / 23	Good	 

Code and Description	Broad Floristic Formation	Sample Sites	Study Area Extent (ha / %)	Condition	Photo
Drains Altered/disturbed wetlands which have not been revegetated	-	-	0.5 / 5	Good	

Code and Description	Broad Floristic Formation	Sample Sites	Study Area Extent (ha / %)	Condition	Photo
Parkland Cleared Cleared/disturbed areas with no intact native vegetation layers (e.g. overgrown firebreaks)	-	-	0.9 / 10	Completely Degraded	 
Cleared Cleared areas with no vegetation (e.g., roads)	-	-	0.2 / 2	Cleared	-
TOTAL			**9.3 / 100**		

397450

397950

6448656

6448156

Nicholson Rd

Parnell Wy

Ranford Rd

Ballycastle Loop

Clontarf Tce

Merrion Rmbl

Tramore Tarn

Legend

- Study Area

Vegetation Type

- BaEmBi (1.44 ha)
- Drain (0.51 ha)
- MP Kg (0.96 ha)
- Mp Ll (0.30 ha)
- Mp PefHa (2.10 ha)
- MpAfEm (0.80 ha)
- Parkland Cleared (0.89 ha)
- Swale (2.11 ha)
- Cleared (0.17 ha)

0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 29/03/2021

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Scale: 1:3,000

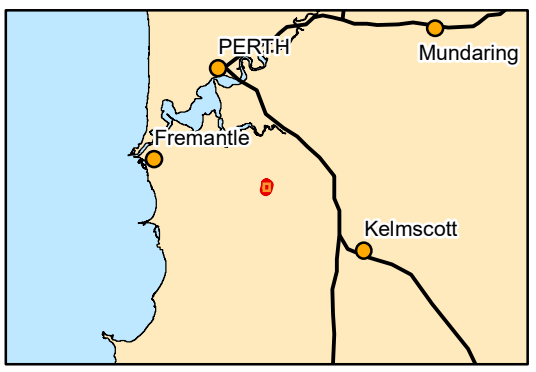

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Figure 3.9: Vegetation types in the Study Area

3.7.2.9 Floristic Community Type Analysis

The floristic data collected from the Study Area was statistically analysed against the regional floristic dataset for the SCP (Gibson *et al.*, 1994; Keighery *et al.*, 2012). The resultant hierarchical clustering output indicated that the five vegetation types utilised in the analysis grouped moderately to strongly with different floristic community types (FCTs) as shown in Table 3.12.

Table 3.12: Determination of floristic community types

Veg Type	Quadrats	FCT	Super-group	Description	Regional sites	Significance (state)	Significance (EPBC)
BaEmBi	GNR-06, GNR-10	SCP21a	3	Central *Banksia attenuata* - *Eucalyptus marginata* woodlands of the Swan Coastal Plain	FL-4, gosn04, gosn13	Yes Encompassed within the Banksia WL SCP (P3)	Yes Encompassed within the Banksia WL SCP (T - EN)
MP Kg	GNR07, GNR-08	SCP05	2	Mixed shrub damplands of the Swan Coastal Plain	Perth02	No	No
Mp Ll	GNR-04	SCP12	2	*Melaleuca teretifolia* and/or *Astartea* aff. *fascicularis* shrublands	FL-10, gosn05	No	No
Mp PefHa	GNR-03, GNR-05, GNR-09	SCP04	2	*Melaleuca preissiana* damplands of the Swan Coastal Plain	Perth02, gosn01, gosn03, FL-1, FL-9	No	No
MpAfEm	GNR-01, GNR02						

3.7.2.10 Vegetation of Conservation Significance

Based on the review of floristic data, review of the floristic community type analysis (see above) and cross checking with relevant conservation advice, listing advice and community lists (DBCA, 2020b, 2020g), only vegetation type BaEmBi is considered vegetation of conservation significance; Banksia woodlands of the Swan Coastal Plain IBRA Region (WA (P3), EPBC (T-EN)).

Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region (WA (P3), EPBC (T-EN))

The desktop assessment identified one conservation significant ecological community inferred to be occurring within the Study Area; Banksia WL SCP. Floristic analysis determined that vegetation types BaEmBi mapped by this survey grouped closely with SCP21a (Gibson *et al.*, 1994), which is encompassed within Banksia WL SCP community (Table 3.12). This vegetation type was then assessed against criteria and thresholds under the relevant federal conservation advice (TSSC, 2016) in order to confirm presence or absence of this community within the Study Area. The results of this assessment are presented in Table 3.13.

Based on floristic analysis and diagnostic criteria assessments, vegetation type BaEmBi represents that of SCP21a Central *Banksia attenuata* - *Eucalyptus marginata* woodlands of the Swan Coastal Plain, encompassed within the Banksia WL SCP ecological community (WA (P3), EPBC (T-EN)). Typical vegetation representing this community is displayed in Plate 3.9.

Presence of the Banksia WL SCP consists of one patch in the Study Area (1.4 ha) (Figure 3.10). This patch is dissected by an old overgrown track or firebreak in the centre (up to 5 m wide) and a thin section of revegetated bush in the southeast (up to 8m wide), none of which affects the surrounding patch contiguity.

Plate 3.9: Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region (WA (P3), EPBC (T-EN)) within the Study Area (Biologic Photos)

Table 3.13: Banksia WL SCP assessment of vegetation types BaEmBi, adapted from (TSSC, 2016)

Key diagnostic characteristic/ threshold	Field results	Does it meet the criteria?
Location and physical environment	Study Area is located in the Swan Coastal Plain IBRA bioregion	Yes
Soils and landform	Study Area is located within the Bassendean sands. Vegetation types BaEmBi occurred on a well-drained sandplain/sandy low rise with white/grey coloured sand	Yes
Structure	Structure of vegetation type BaEmBi was a low woodland with an upper sclerophyllous layer of low trees dominated by *Banksia attenuata*. Occasional *Eucalyptus marginata*, *Banksia ilicifolia,* and *Banksia menziesii* were observed throughout this vegetation type*, while Eucalyptus todtiana, Nuytsia floribunda* and *Corymbia calophylla* were also noted to occur sporadically in this vegetation type. Species rich understorey consisting of: • a layer of sclerophyllous shrubs of various heights • an herbaceous ground layer of rushes, sedges, and perennial and ephemeral herbs (including grasses)	Yes
Composition	Structure of vegetation type BaEmBi was a low woodland with an upper sclerophyllous layer of low trees dominated by *Banksia attenuata*. Occasional *Eucalyptus marginata*, *Banksia ilicifolia,* and *Banksia menziesii* were observed throughout this vegetation type*, while Eucalyptus todtiana, Nuytsia floribunda* and *Corymbia calophylla* were also noted to occur sporadically in this vegetation type The understorey had a high diversity of shrub and herb species • Total of 60 flora taxa, including 56 native and 4 introduced taxa from detailed floristic sites (not including taxa recorded opportunistically • Grouped with regional sites confirmed to be SCP21a Central Banksia attenuata - Eucalyptus marginata woodlands of the Swan Coastal Plain • 26 species recorded are considered characteristic of the *Banksia* woodland TEC: • *Bossiaea eriocarpa, Caladenia flava, Dasypogon bromeliifolius, Hypolaena exsulca, Kunzea glabrescens, Lomandra hermaphrodita, Lyginia imberbis, Patersonia occidentalis, Petrophile linearis, Philotheca spicata, Phlebocarya ciliata, Stylidium brunonianum, Trachymene Pilosa, Xanthorrhoea preissii, Xanthosia huegelii*	Yes
Contra-indicators	No contra-indicators found within vegetation type BaEmBi	Yes
Condition/ Patch size thresholds		
Indicative condition measures/thresholds	Vegetation types BaEmBi were mostly in excellent condition, except for a small area in the southeast adjacent to roads considered very good • High native plant species diversity • All detailed floristic sites below 1% weed cover	Yes
Minimum patch size	Patch size is 1.4 ha within the Study Area. The patch inside the Study Area includes Excellent and Very Good vegetation as the condition changes are part of a continuous patch	Yes

Key diagnostic characteristic/ threshold	Field results	Does it meet the criteria?
Further considerations		
Sampling protocols	All detailed floristic sites in the Study Area were 10 x 10 m (100 m^2), and were surveyed twice as part of a two-phase detailed survey (surveyed over two days in early Spring and two days in late Spring) Targeted searches for conservation significant taxa, as well as additional opportunistic taxa to the Study Area, were conducted in both phases of the survey; This resulted in thorough coverage of the *Banksia* woodland area. Landscape variables were recorded in phase one including: landform, aspect, slope, rock type, outcropping, soil type, soil colour, disturbances, and ground cover of rock, bare soil, leaf litter and perennial vegetation	Yes
Survey timing	Surveys were undertaken in spring with two sampling periods • phase one – 29 and 30 September (early spring) • phase two – 17 and 18 November (late spring) No recently disturbed areas e.g. fire	Yes
Patch definition	The patch consists of one contiguous portion of vegetation, with two small divisions (<8m wide)	Yes
Buffer zone	There is no distinct buffer around the vegetation within the Study Area. However this is not necessary for the protection and distinction of this vegetation	Yes
Floristic Community Types with relationships to the Banksia Woodlands ecological community	**Supergroup 3 – Uplands centred on Bassendean Dunes and Dandaragan Plateau** • 21a Central *Banksia attenuata – Eucalyptus marginata* woodlands	Yes

397450

397950

6448656

6448156

Parnell Wy

Ranford Rd

Ballycastle Loop

Nicholson Rd

Clontarf Tce

Merrion Rmbl

Tramore Tarn

Legend

Study Area

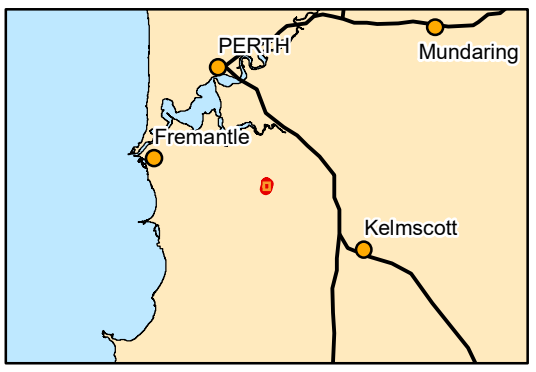
Conservation Significant Vegetation

Banksia WL SCP (P3 WA, T-EN EPBC)

Conservation Category Wetland (Dampland)

0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 29/03/2021



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Scale: 1:3,000

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Figure 3.10: Conservation significant vegetation in the Study Area

3.7.2.11 Vegetation of Other Significance

Local and Regional Significance

One vegetation type, BaEmBi, matches and represents that of a state listed PEC and a federally listed TEC (Banksia WL SCP) of which is considered to be regionally significant.

Historically, the SCP bioregion has been heavily cleared (approximately 60%). Small remnant patch sizes make communities more vulnerable to disturbances such as invasion by weeds or feral animals, while separation between patches disrupt ecological processes that support the health of the community (DoEE, 2016a). As the majority of the remnant vegetation within the Study Area is intact native vegetation in excellent condition, this itself has the potential to be considered locally significant vegetation.

Wetlands and Damplands

Floristic analysis determined that all vegetation types, excluding the Banksia woodland (BaEmBi), mapped by this survey grouped with SCP04, SCP05 and SCP12 (Table 3.12), all of which were associated with, and represent vegetation associated with dampland and wetland landforms. However, vegetation type MpAfEm was noted as containing more dryland flora taxa and occurred on non-dampland landforms and will not be considered as part of this collection. For the purpose of this report, this vegetation (MP Kg, Mp LlL and Mp PefHa) is collectively known as “Damplands” (Figure 3.10) and closely matches that of the DBCA mapped Damplands (Figure 3.3), three of which (14524, 14517 and 14519) are classified as a Conservation Category Wetlands (DBCA, 2019; PGV, 2014). Vegetation type Mp Ll was noted as being inundated (<10 cm) with surface water at the time of phase one survey, while larger pools of surface water were observed during both phases within the revegetated swales and drains strewn through the Study Area (see section 3.11).

3.7.2.12 Vegetation Condition

The condition of the vegetation within the Study Area ranged from completely degraded to excellent (Table 3.14; Figure 3.11), with cleared areas with no vegetation (e.g., tracks) mapped as “cleared”. The revegetated swale areas and drain areas, which covered a large portion (28%) of the Study Area, are considered to be in good condition as they do not represent natural unaltered vegetation and/or landforms. Weed cover in the swale areas were generally low, but native species cover in these areas varied depending on quality of revegetation. The main disturbances observed in the Study Area were associated with surrounding urban development and included weeds, roads, tracks/ firebreaks, and rubbish. These disturbances were mainly restricted to the edges of the Study Area where edge effects from roads and housing were more evident. Current and historical paths, tracks and firebreaks running laterally through the Study Area also provided disturbances of similar nature to the edges and were mapped as completely degraded. The majority (50%) of the vegetation was in excellent condition.

Table 3.14: Vegetation condition extent in the Study Area

Condition	Study Area extent (ha / %)	Comment
Excellent	4.7 / 50	Located within the larger areas of remnant bushland where vegetation has remained more or less intact. Low weed cover (<1%).
Very Good	0.8 / 9	Located closer to areas affected by urban development (furthest northern and southern portions). More noticeable weed presence (1-5%).
Good	2.7 / 29	Areas in good condition was entirely made up of altered vegetation and/or landforms (“Swales” and “Drains”). Generally located on the eastern edges of the remnant vegetation and a thin stretch connecting the northern and central blocks. Weed covers were generally low to moderate (5-10%).
Completely Degraded	0.9 / 10	No intact vegetation structure present. Mostly introduced grass and herb cover. Consisted of mapping unit ‘Parkland cleared’.
Cleared	0.2 / 2	Tracks, paths, firebreaks and roads.
TOTAL	9.3 / 100	-

397450

397950

6448656

6448156

Parnell Wy

Ranford Rd

Ballycastle Loop

Nicholson Rd

Clontarf Tce

Merrion Rmbl

Tramore Tarn

Legend

Study Area

Vegetation Condition

- Excellent (4.68 ha)
- Very Good (0.81 ha)
- Good (2.73 ha)
- Completely Degraded (0.89 ha)
- Cleared (0.17 ha)

0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 08/07/2021

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biologic Environmental Survey

Scale: 1:3,000

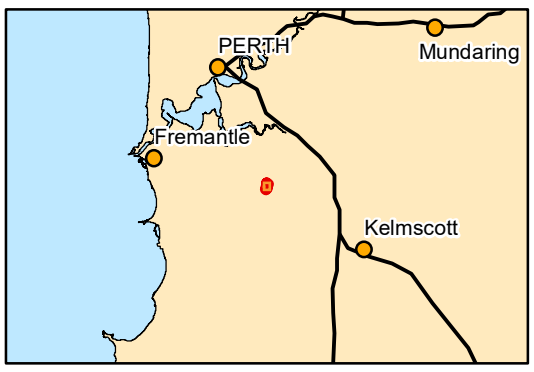

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Figure 3.11: Vegetation condition in the Study Area

3.8 Dieback

A dieback assessment was previously completed within the Study Area by Dieback Treatment Services (Dieback Treatment Services, 2020). The assessment was conducted on the 25th of March 2020 by two DBCA registered disease interpreters. It was found that no previous dieback mapping or assessments had been done within the reserve up until this assessment.

The site was traversed by foot using a transect survey approach with a distance of 50m between transect lines, where evidence points for category allocations were recorded and used to create a Phytophthora Occurrence Map for the reserve. Areas were mapped as either Infested, Uninfested, Uninterpretable or Excluded. Soil and plant tissue samples were obtained from host plant deaths suspected of being caused by dieback and were processed at the DBCA managed Vegetation Health Services laboratory.

Some of the key findings from this assessment were:

- The entire 9.3-ha was found the be infested with *Phytophthora* apart from a 0.9 ha area which was classified as excluded and comprised of a revegetated drain. Although excluded it is likely that this area is also infested with dieback and should be treated as such.
- Three soil and plant tissue samples were taken from all areas suspected of being infested with Phytophthora and all samples returned a confirmation for Phytophthora as being present.
- The central section of reserve is a Melaleuca dampland and was originally classed as uninterpretable due to a low number of dieback hosts present, however the presence of dead *Xanthorrhoea preissii* and *X. brunonis* in conjunction with obvious infestations to the east and south plus the positive confirmation from all three samples taken, leads to believe this area is also infested.
- The southern and eastern ends of the site show a more recent introduction (estimated to be in the last 20 years) of dieback and still possess many host plants in good health.
- Dieback indicator species deaths were seen and recorded all over the site, with the main indicator species being *Adenanthos cygnorum, Banksia ilicifolia, Banksia attenuata, Banksia nivea, Banksia menziesii, Dasypogon* species*, Eucalyptus marginata, Eucalyptus todtiana, Patersonia occidentalis,* and *Xanthorrhoea preissii*.

3.9 Fauna

3.9.1 Desktop Assessment Results

A desktop assessment, comprising database searches and a literature review, was undertaken prior to the field survey. The purpose of the desktop assessment was to identify vertebrate fauna potentially occurring in the Study Area, with a focus on species of conservation significance. The literature review and database searches identified a total of 267 species of vertebrate fauna, which have previously been recorded and/or have the potential to occur within the Study Area. This comprised 26 mammals (including 17 native and 9 non-native), 191 birds (including 184 native and seven non-native), 38 reptiles (including 37 native and one non-native), and 12 amphibians (Appendix M).

Of the 267 species of vertebrate fauna identified by the desktop assessment, 45 species are of conservation significance, comprising six mammals, 37 birds and two reptiles (Table 3.15). This includes one species which have previously been recorded within the Study Area, the quenda *Isoodon fusciventer* (DBCA P4) from an opportunistic record in 2011 (DBCA, 2020d). Of the conservation significant species considered to potentially occur, 38 species are listed as Threatened, Conservation Dependent or Specially Protected under the EPBC Act and/or BC Act, 27 species are listed as Migratory under the EPBC Act and/or BC Act (and may also be classified under other categories under these acts), and eight species are listed as Priority by the DBCA.

Significant roost sites exist for Carnaby's cockatoo in the Greater Perth-Peel region (Peck *et al.*, 2019), while forest red-tailed black cockatoos have been recorded breeding in the Perth region over recent years. Database searches did not record any roost sites within the Study Area boundary; however, there are 14 confirmed white-tailed black cockatoo (Carnaby's and/ or Baudin's black cockatoo) roosts, 15 forest-red tailed black cockatoo roosts, and 15 joint roost sites within 12 km of the Study Area (44 total; BirdLife Australia, 2020). The nearest roosts to the Study Area are GOSCNVR001, located 1.3 km east, and GOSCNVR002 located 1.7 km east at the Gosnells Golf Course (both joint roosts; BirdLife Australia, 2020) (Figure 3.13). These sites have not been in use since 2015; however, black cockatoos will not use roosts consistently between years (Peck *et al.*, 2019).

Breeding habitat is defined in the referral guidelines as species of trees 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 species of trees, suitable DBH is 500 mm (DoEE, 2017a; DSEWPaC, 2012b). Modelled distributions show the Study Area lies within the breeding range for Carnaby's cockatoo, within forest red-tailed black cockatoo distribution and within the known foraging areas for Baudin's cockatoo (DoEE, 2017a). There is evidence of black cockatoo breeding in the region of the Study Area, with two forest red-tailed black cockatoo natural hollow nests (Cockburn, 2020; anecdotal report of breeding in Kenwick) and one artificial hollow nest at Murdoch University, most recently used in 2013 (BirdLife Australia, 2020).

Table 3.15: Species of conservation significance identified during the desktop assessment and their conservation status

Name		Conservation Status				Database Searches				Literature Review																					
Scientific Name	Common name	EPBC Act	BC Act	DBCA	IUCN	NatureMap (5 km)	EPBC (5km)	DBCA (5km)	ALA (5km)	ENV, Australia. (2010). Ecological assessment of Sutherlands park bushland.	CMPS&F. (1993). Public environmental review: Southern River bridge project for Gosnells City Council.	ENV, Australia (2013). Flora, vegetation and fauna assessment, Keane Road.	ENV, Australia (2006). Precinct 3 - Environmental review, Southern River.	Focused Vision, Consulting (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension.	Garden Street, Southern River - Targeted conservation significant species survey. (PGV, 2016)	Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale (Bowman Bishaw	Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan (ENV, 2005)	Jandakot Airport Fauna Survey (ENV, 2009)	Jandakot Airport Conservation Areas: Carnaby' s Black-Cockatoo Habitat Survey 2011. (Western Wildlife, 2011a)	Jandakot Airport Conservation Areas: Quenda Survey 2011. (Western Wildlife, 2011b)	Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011 (Western Wildlife, 2011c)	Fauna survey of the Jandakot airport 2002 (Bamford et al., 2003)	Vertebrate fauna of Ken Hurst Park, City of Melville. (Dell and Cooper, 1992)	Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management	City of Armadale Skeet Road Reconnaissance Flora Survey (Natural Area, 2019)	Garden Street Road Reserve Environmental Assessment (Natural Area, 216b)	Fauna Management Plan Holmes Street Bushland North (Natural Area, 216a)	Black cockatoo assessment - Garden Street extension (Terrestrial Ecosystems, 216)	Australasian bittern survey (Terrestrial Ecosystems, 216)	Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment (Focused	Vertebrate Fauna Survey for the Roe Highway Extension Project (Phoenix, 2011)	City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey (Golder Associates, 2016)
MAMMALS																															
MACROPODIDAE																															
Notamacropus irma	Western brush wallaby			P4		•		•										•			•	•	•							
Setonix brachyurus	Quokka	VU	VU				•																								
MYRMECOBIIDAE																															
Myrmecobius fasciatus	Numbat	EN	EN			•		•																							
PERAMELIDAE																															
Isoodon fusciventer	Quenda, southern brown bandicoot			P4				•	•		•	•	•	•				•		•		•	•			•	•	•		•	•	
PSEUDOCHEIRIDAE																															
Pseudocheirus occidentalis	Western ringtail possum, ngwayir	CR	CR				•																								
VESPERTILIONIDAE																															
Falsistrellus mackenziei	Western false pipistrelle			P4																		•									
BIRDS																															
ACCIPITRIDAE																															
Elanus scriptus	Letter-winged kite			P4	NT			•	•																						
Pandion haliaetus	Osprey	MI	MI				•		•																						
ANATIDAE																															
Oxyura australis	Blue-billed duck			P4	NT	•		•	•																						
APODIDAE																															
Apus pacificus	Fork-tailed Swift	MI	MI				•		•																						
ARDEIDAE																															
Botaurus poiciloptilus	Australasian bittern	EN	EN				•	•	•																						
CACATUIDAE																															
Calyptorhynchus banksii naso	Forest red-tailed black cockatoo	VU	VU				•	•	•	•			•	•														•		•	•	
Calyptorhynchus baudinii	Baudin's cockatoo	EN	EN				•		•																						•
Calyptorhynchus latirostris	Carnaby's cockatoo	EN	EN			•	•	•	•				•	•				•				•	•			•	•			•	•	
CHARADRIIDAE																															
Charadrius dubius	Little ringed plover	MI	MI					•	•																						

Name		Conservation Status				Database Searches				Literature Review																					
Scientific Name	Common name	EPBC Act	BC Act	DBCA	IUCN	NatureMap (5 km)	EPBC (5km)	DBCA (5km)	ALA (5km)	ENV, Australia. (2010). Ecological assessment of Sutherlands park bushland.	CMPS&F. (1993). Public environmental review: Southern River bridge project for Gosnells City Council.	ENV, Australia (2013). Flora, vegetation and fauna assessment, Keane Road.	ENV, Australia (2006). Precinct 3 - Environmental review, Southern River.	Focused Vision, Consulting (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension.	Garden Street, Southern River - Targeted conservation significant species survey. (PGV, 2016)	Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale (Bowman Bishaw	Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan (ENV, 2005)	Jandakot Airport Fauna Survey (ENV, 2009)	Jandakot Airport Conservation Areas: Carnaby' s Black-Cockatoo Habitat Survey 2011. (Western Wildlife, 2011a)	Jandakot Airport Conservation Areas: Quenda Survey 2011. (Western Wildlife, 2011b)	Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011 (Western Wildlife, 2011c)	Fauna survey of the Jandakot airport 2002 (Bamford et al., 2003)	Vertebrate fauna of Ken Hurst Park, City of Melville. (Dell and Cooper, 1992)	Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management	City of Armadale Skeet Road Reconnaissance Flora Survey (Natural Area, 2019)	Garden Street Road Reserve Environmental Assessment (Natural Area, 216b)	Fauna Management Plan Holmes Street Bushland North (Natural Area, 216a)	Black cockatoo assessment - Garden Street extension (Terrestrial Ecosystems, 216)	Australasian bittern survey (Terrestrial Ecosystems, 216)	Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment (Focused	Vertebrate Fauna Survey for the Roe Highway Extension Project (Phoenix, 2011)	City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey (Golder Associates, 2016)
Charadrius leschenaultii	Greater sand plover	VU/ MI	VU/ MI					•	•																						
Pluvialis fulva	Pacific golden plover	MI	MI					•	•																						
Pluvialis squatarola	Grey plover	MI	MI					•	•																						
FALCONIDAE																															
Falco peregrinus	Peregrine falcon		OS			•		•	•														•								
GLAREOLIDAE																															
Glareola maldivarum	Oriental pratincole	MI	MI					•	•																						
LARIDAE																															
Thalasseus bergii	Crested tern	MI	MI					•	•																						
Hydroprogne caspia	Caspian tern	MI	MI						•																						
Gelochelidon nilotica	Gull-billed tern	MI	MI						•																						
MEGAPODIIDAE																															
Leipoa ocellata	Malleefowl	VU	VU				•																								
MOTACILLIDAE																															
Motacilla cinerea	Grey wagtail	MI	MI				•		•																						
ROSTRATULIDAE																															
Rostratula australis	Australian painted snipe	EN	EN		EN		•																								
SCOLOPACIDAE																															
Calidris acuminata	Sharp-tailed sandpiper	MI	MI				•	•	•																						
Calidris canutus	Red knot	EN/ MI	EN/ MI		NT			•	•																						
Calidris ferruginea	Curlew sandpiper	CR/ MI	CR/ MI		NT		•	•	•																						
Calidris melanotos	Pectoral sandpiper	MI	MI				•	•	•																						
Calidris ruficollis	Red-necked stint	MI	MI		NT			•	•																						
Calidris subminuta	Long-toed stint	MI	MI					•	•																						
Calidris tenuirostris	Great knot	CR/ MI	MI		EN			•	•																						
Limosa lapponica	Bar-tailed godwit	MI	MI					•	•																						
Limosa limosa	Black-tailed godwit	MI	MI		NT			•	•																						
Numenius madagascariensis	Eastern curlew	CR/ MI	CR/ MI		EN		•																								
Philomachus pugnax	Ruff	MI	MI					•	•																						

Name		Conservation Status				Database Searches				Literature Review																					
Scientific Name	Common name	EPBC Act	BC Act	DBCA	IUCN	NatureMap (5 km)	EPBC (5km)	DBCA (5km)	ALA (5km)	ENV, Australia. (2010). Ecological assessment of Sutherlands park bushland.	CMPS&F. (1993). Public environmental review: Southern River bridge project for Gosnells City Council.	ENV, Australia (2013). Flora, vegetation and fauna assessment, Keane Road.	ENV, Australia (2006). Precinct 3 - Environmental review, Southern River.	Focused Vision, Consulting (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension.	Garden Street, Southern River - Targeted conservation significant species survey. (PGV, 2016)	Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale (Bowman Bishaw	Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan (ENV, 2005)	Jandakot Airport Fauna Survey (ENV, 2009)	Jandakot Airport Conservation Areas: Carnaby' s Black-Cockatoo Habitat Survey 2011. (Western Wildlife, 2011a)	Jandakot Airport Conservation Areas: Quenda Survey 2011. (Western Wildlife, 2011b)	Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011 (Western Wildlife, 2011c)	Fauna survey of the Jandakot airport 2002 (Bamford et al., 2003)	Vertebrate fauna of Ken Hurst Park, City of Melville. (Dell and Cooper, 1992)	Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management	City of Armadale Skeet Road Reconnaissance Flora Survey (Natural Area, 2019)	Garden Street Road Reserve Environmental Assessment (Natural Area, 216b)	Fauna Management Plan Holmes Street Bushland North (Natural Area, 216a)	Black cockatoo assessment - Garden Street extension (Terrestrial Ecosystems, 216)	Australasian bittern survey (Terrestrial Ecosystems, 216)	Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment (Focused	Vertebrate Fauna Survey for the Roe Highway Extension Project (Phoenix, 2011)	City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey (Golder Associates, 2016)
Tringa brevipes	Grey-tailed tattler	MI	MI	P4					•																						
Tringa glareola	Wood sandpiper	MI	MI					•	•																						
Tringa hypoleucos	Common sandpiper	MI	MI				•																								
Tringa nebularia	Common greenshank	MI	MI				•	•	•																						
Tringa stagnatilis	Marsh sandpiper	MI	MI					•	•																						
THRESKIORNITHIDAE																															
Plegadis falcinellus	Glossy ibis	MI	MI			•		•	•																						
REPTILES																															
ELAPIDAE																															
Neelaps calonotos	Black-striped snake			P3		•		•														•									
SCINCIDAE																															
Lerista lineata	Lined skink			P3	EN	•		•	•													•	•							•	

393112

398112

6453018

6448018

6443018

Garden St

Nicholson Rd

Ranford Rd

Warton Rd

Bird

- Curlew sandpiper - CR
- Great knot - CR
- Australasian bittern - EN
- Red knot - EN
- Greater sand plover - VU
- Common greenshank - IA
- Crested tern - IA
- Glossy ibis - IA
- Peregrine falcon - OS
- Grey plover - IA
- Marsh sandpiper - IA
- Oriental pratincole - IA
- Pacific golden plover - IA
- Ruff (reeve) - IA
- Wood sandpiper - IA
- Llittle ringed plover - IA
- Pectoral sandpiper - IA

Mammal

- Numbat, walpurti - EN
- Quenda, southwestern brown bandicoot - P4
- Western brush wallaby - P4

Reptile

- Perth slider - P3

Legend

- Study Area

0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 04/02/2021

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biologic Environmental Survey

Scale: 1:35,000

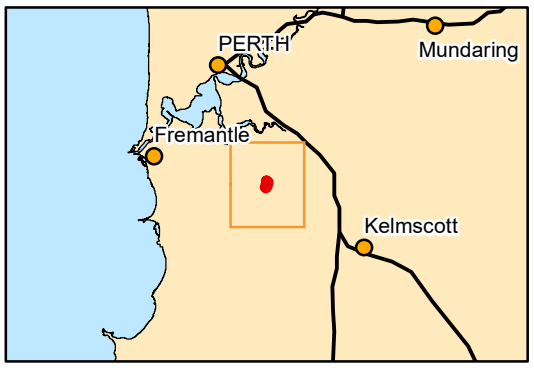

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Figure 3.12: Vertebrate fauna of conservation significance identified in the desktop assessment (excluding black cockatoos)

393002

398002

6453034

6448034

6443034

Roe Hwy

Garden St

Nicholson Rd

Ranford Rd

Warton Rd

Legend

Study Area

Species records (DBCA, 2020)

Carnaby's cockatoo

Roosts (Birdlife, 2020)

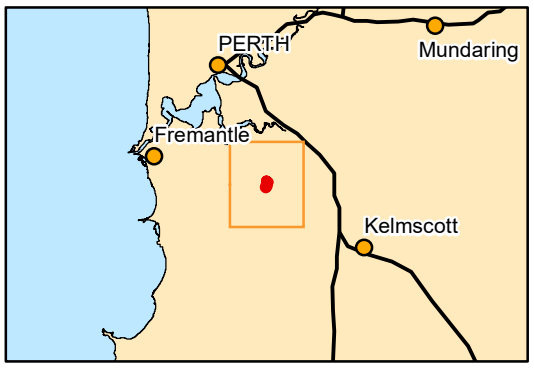
Forest red-tailed rockatoo

White-tailed cockatoo

Joint Forest red-tailed and White-tailed cockatoo

0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 04/02/2021



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biologic Environmental Survey

Scale: 1:35,000

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Figure 3.13: Previous records of black cockatoos in the vicinity of the Study Area

3.9.2 Fauna Habitats

Following the detailed field survey, fauna habitat mapping was completed across the Study Area from a combination of detailed fauna habitat assessments (Appendix K), the results of the concurrent flora and vegetation survey, the drainage infrastructure assessment, and high-quality aerial imagery. Seven broad fauna habitat types were identified, including areas considered 'Cleared' (Table 3.16, Figure 3.14), as follows:

- Banksia Woodland;
- Melaleuca and Jarrah Woodland;
- Melaleuca Grassland;
- Parkland;
- Wetland;
- Drain; and
- Cleared.

The habitats of greatest significance within the Study Area are the "woodland' habitat types, in particular the Banksia Woodland, occupying 1.44 ha (15.50 % of the Study Area). Banksia woodlands are considered crucial for the ongoing viability of foraging resources for black cockatoo on the Swan Coastal Plain, particularly Carnaby's cockatoo (DoEE, 2017a), as supported by the foraging evidence recorded in this habitat type during the field survey. This habitat type also has the potential to support other conservation significant species such as quenda (DBCA Priority 4, recorded in this habitat type during the current survey), western brush wallaby, likely as foraging or dispersal habitat, as well as reptile species such as Perth slider *Lerista lineata* and the black-striped snake *Neelaps calonotos*. There was 600.6 ha of Banksia Woodland TEC remaining in the City of Gosnells in 2015 (TSSC, 2016); as such the habitat patch present in the Study Area represents 0.24 % of that remaining within the local area.

The Melaleuca and Jarrah Woodland (0.8 ha; 8.63 %) is also considered of high value for vertebrate fauna; however, the habitat was subject to areas of bare open ground and areas of dense rubbish from human visitation. The quenda was also recorded from this habitat type from trap records during the current survey (see Section 3.9.5.1, Figure 3.18). It may also potentially support black cockatoos for foraging and night roosting. These habitats are not restricted to the Study Area, and have some connectivity extending outside of the Study Area in the broader vicinity through the Regional Ecological Linkage to the Jandakot Regional Park. The regional park is also mapped as containing "Woodland of *Melaleuca preissiana*" (Bamford *et al.*, 2003).

The Melaleuca Grassland (3.37 ha; 36.30 %) habitat has the potential to support some conservation significant fauna species. Due to the dense understorey of *Xanthorrhoea* sp. and *Lepidosperma* sp., the habitat is suitable for foraging and dispersal for quenda (recorded in this habitat type during the current survey). The conservation significant species with the potential to use this habitat type are unlikely to be solely reliant on the Study Area itself and the habitats are not restricted to the Study Area. Habitat similar to this appears present in the adjacent Jandakot Regional Park, where it is noted that western brush wallabies utilise the "dense vegetation in low-lying areas" (Bamford *et al.*, 2003).

There are three Conservation Category Wetlands mapped within the Study Area, in the northern, central, and southern portions (Figure 3.2, Section 3.3.2) (DBCA, 2019). However, for the purposes of the significance and utilisation by vertebrate fauna, the basins and swales with native vegetation present (Section 3.11, Figure 3.21- Figure 3.23) are considered “Wetland” or “Dampland” habitat within the Study Area. These areas have been mapped as 2.11 ha (22.70 %). These areas are located immediately adjacent to the “Conservation Category Wetlands” and were inundated with water during the phase one field survey. The Wetland areas were dry during the phase two spring field survey. This habitat is considered to be of most value to vertebrate fauna following rainfall where the wetland would hold water, potentially supporting waterbirds and frogs. Quenda are known to prefer the dense vegetation surrounding waterways, providing protection and foraging opportunities (Lohr *et al.*, 2018).

The Parkland habitat (0.89 ha, 9.58 %) present along the road verges and firebreaks is not considered of high significance to vertebrate fauna and has limited potential to support species of conservation significance. It consists of scattered mosaic of immature *Melaleuca, Allocasuarina,* jarrah and some introduced trees over an introduced grassland, as well as some disturbed areas with no intact native vegetation layers (e.g., overgrown firebreaks). Road verge habitats are known to provide a wide range of ecological services, including biodiversity provision, regulating services, and cultural services (e.g. aesthetic benefits) (Phillips *et al.*, 2020). However, the lack of an understorey within the Parkland habitat is unlikely to support foraging or burrowing activities for ground-dwelling species such as quenda and lacks protection from predators or human interaction for dispersal (Paull *et al.*, 2013). A lower stratum growth form of herbaceous plants, tussocky or tufted grasses, or an absence of a lower stratum are considered unsuitable for bandicoots (Paull *et al.*, 2013)

The remainder of the survey area comprises of Cleared/completely degraded areas (0.17 ha; 1.82 %), including roads, carpark and infrastructure, and Drains (0.51 ha, 5.49 %). These habitats are primarily devoid of vegetation, and as such are considered of little to no value as fauna habitat. Although when inundated the Drain areas may support the Wetland in supporting conservation significant water birds such as the blue-billed duck, and glossy ibis, there is a lack of vegetation both within the habitat and on the fringes to encourage fauna usage.

Table 3.16: Broad fauna habitats occurring within the Study Area

Habitat type	Vegetation Associations	Description of key habitat characteristics	Conservation significant species likely to support	Area (ha) and % of Study Area	Photo
Banksia Woodland	BaEmBi	Banksia Woodland Threatened Ecological Communities (TEC) are Endangered under the EPBC Act (TSSC, 2016). The number of *Banksia* woodland patches on the Swan Coastal Plain has increased from 132 to over 12,000, with the number of patches under 5 ha increasing by several orders of magnitude from 39 to over 9000 (Ramalho *et al.*, 2014). There was 600.6 ha of Banksia Woodland TEC remaining in the City of Gosnells in 2015 (TSSC, 2016). The habitat present in the Study Area is characterised by an upper storey of *Banksia attenuata* and occasional jarrah *Eucalyptus marginata*, and a dense middle and lower storey of *Xanthorrhoea preissii* and *Kunzea sp*. The habitat also provides microhabitat features such as fallen branches.	This broad fauna habitat type has potential to support conservation significant species. • Carnaby's cockatoo utilise the habitat for foraging habitat due to the presence of Banksia species (*B. attenuata*), and potentially as night roosting. • The habitat is described as core habitat for species such as quenda (due to a dense understorey including *Xanthorrhoea*). • Western brush wallaby may utilise the habitat for foraging or dispersal. • The habitat is described as core habitat for reptile species such as the Perth slider and black-striped snake, which are restricted to Banksia Woodlands.	1.44 ha 15.5 %	
Melaleuca Grassland	MP Kg Mp Ll Mp PefHa	This habitat type consists of a dense shrubland of *Xanthorrhoea preissii* and *Lepidosperma sp*., with an open mosaic of *Melaleuca preissiana* and occasional *Allocasuarina fraseriana.*	This broad fauna habitat type has potential to support conservation significant species. • Black cockatoo species may utilize the habitat for foraging (primarily jarrah), and night roosting. Breeding is unlikely due to the lack of suitable hollows. • The habitat is also highly suitable for foraging and dispersal for quenda (dense understory including *Xanthorrhoea*). • Western brush wallaby may utilise the habitat for foraging or dispersal. • Peregrine falcon may use the habitat for foraging.	3.37 ha 36.29 %	

Habitat type	Vegetation Associations	Description of key habitat characteristics	Conservation significant species likely to support	Area (ha) and % of Study Area	Photo
Melaleuca and Jarrah Woodland	MpAfEm	Mixed woodland of *Melaleuca preissiana* and jarrah *Eucalyptus marginata* over a moderately dense understorey of *Xanthorrhoea preissii* and *Jacksonia furcellata*. The habitat included some significant microhabitat features such as large logs and *Xanthorrhoea* stumps. The habitat was subject to some areas of bare open ground and areas of dense rubbish from human visitation.	This broad fauna habitat type has potential to support conservation significant species. • All three black cockatoo species may utilize the habitat for foraging (primarily jarrah), and night roosting. Breeding is unlikely due to the lack of suitable hollows. • The habitat is also highly suitable for foraging and dispersal for quenda (dense understory including *Xanthorrhoea*). • Western brush wallaby may utilise the habitat for foraging or dispersal. • Peregrine falcon may use the habitat for foraging	0.80 ha 8.63 %	
Wetland	Swale	The Wetland habitat is considered to occur in the swales and basins present with native vegetation. The areas lack dense vegetation surrounding the perimeter of the water bodies, but macrophyte flora is present. The Wetland area is not a permanent water resource and is only seasonally inundated.	This broad fauna habitat type has potential to support conservation significant species and is of significance when inundated. • There is a lack of dense and connecting patches of understorey to support species such as quenda; however, the species may use the habitat for additional foraging opportunities. • When inundated, the Wetland areas may support conservation signficant water birds such as the blue-billed duck, and glossy ibis • When inundated, the Wetland may provide essential water resources for black cockatoo species (Red-tailed and Carnaby's).	2.11 ha 22.70 %	

Habitat type	Vegetation Associations	Description of key habitat characteristics	Conservation significant species likely to support	Area (ha) and % of Study Area	Photo
Parkland	Parkland (Cleared)	The Parkland habitat primarily consists of verge and footpath habitat, comprised of lawn or grassy area with scattered immature *Melaleuca* sp. and eucalypt species, or planted shrubs. There is a lack of dense and connecting patches of understorey, and in general is considered very open and lacking in protection.	This broad fauna habitat type has limited potential to support conservation significant species. • There is a lack of dense and connecting patches of understorey to support species such as quenda; although the species may use the habitat for dispersal opportunities, these would be considered uncommon.	0.89 ha 9.59 %	
Drain	Drain	The Drain areas are altered/disturbed wetlands which have not been revegetated.	This broad fauna habitat type is not considered to be of high value to vertebrate fauna. • When inundated, the Drain areas may support the Wetland in supporting conservation significant water birds such as the blue-billed duck, and glossy ibis. However, there is a lack of vegetation both within the habitat and on the fringes to encourage fauna.	0.51 ha 5.49 %	
Cleared/track	Cleared	Areas cleared of vegetation. Disturbances also include tracks and rubbish/litter.	This broad fauna habitat type is not considered to be of value to vertebrate fauna.	0.17 ha 1.82 %	
Total area				9.28 ha	

397450

397950

6448656

6448156

Parnell Wy

Ranford Rd

Ballycastle Loop

Nicholson Rd

Clontarf Tce

Merrion Rmbl

Tramore Tarn

Legend

Study Area

Fauna Habitat

- Drain (0.51 ha)
- Banksia Woodland (1.44 ha)
- Melaleuca Grassland (3.37 ha)
- Melaleuca and Jarrah Woodland (0.80 ha)
- Parkland (0.89 ha)
- Wetland (2.11 ha)
- Cleared (0.17 ha)

0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 29/03/2021

N

biologic Environmental Survey

Scale: 1:3,000

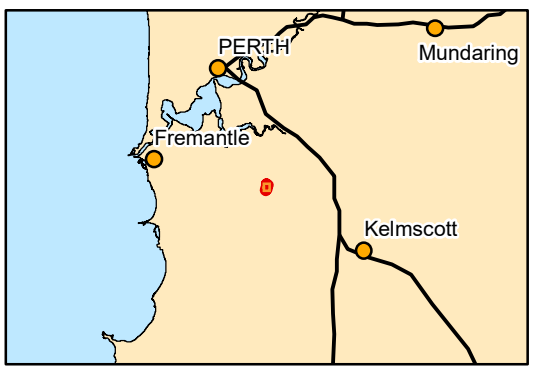

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Figure 3.14: Broad fauna habitats occurring within the Study Area

3.9.3 Fauna Recorded

A total of 48 vertebrate fauna species, comprising nine mammal species (four native and five introduced), 26 bird species (22 natives and four introduced), nine reptile species, and four amphibian species were recorded from the Study Area during the current survey (Table 3.17). This comprises approximately 17.9 % of the total number of species identified in the desktop assessment (n = 267) (see Section 3.9.1).

All the species recorded during the current survey have previously been recorded within the surrounding area as identified in the desktop assessment. The total species diversity recorded during the current survey is comparable to other Detailed vertebrate fauna surveys in the immediate vicinity of similar survey effort (Bamford *et al.*, 2003); however, the bird inventory is lower in comparison (*n* = 46 to Bamford *et al.* (2003)). Although the current survey comprised two phases, phase one was undertaken over two single field days, and consisted of targeted sampling methods for winter-calling amphibians and conservation significant species only, which are less likely to record non-target species. In addition, phase one was undertaken over a smaller area than Phase 2; as such, fewer habitat types with a reduced carrying capacity for species were sampled.

Table 3.17: Fauna recorded during the current survey

Species	Common name	Conservation Status				Survey detection method										Number of records	Season(s) recorded		Habitat types likely to utilise in study area					
		EPBC Act	BC Act	DBCA	IUCN	Pitfall trap	Cage Trap	Elliot Trap	Funnel trap	Camera trap	Ultrasonic recorder	Acoustic recorder	Bird census	Active foraging	Opportunistic		Winter (June)	Spring (Nov)	Banksia Woodland	Melaleuca Grassland	Wetland	Melaleuca and Jarrah Woodland	Parkland (cleared)	Drain
MAMMALS																								
Austronomus australis	White-striped free-tailed bat										9					9		X	X	X	X	X	X	
Chalinolobus gouldii	Gould's wattled bat										17					17	X	X	X	X	X	X	X	
Vespadelus regulus	Southern forest bat										5					5		X	X	X	X	X	X	
*Canis familiaris**	Dog														1	1		X	X	X		X	X	
*Felis catus**	Cat														1	1		X	X	X		X	X	
Isoodon fusciventer	Quenda			P4		3	11	42		208			1		4	269	X	X	X	X	X	X	X	
*Mus musculus**	House mouse					4		8		13			1			26		X	X	X	X	X	X	X
*Rattus rattus**	Black rat									1						1		X	X	X	X	X	X	X
*Vulpes vulpes**	Red fox									2					1	3		X	X	X		X	X	
BIRDS																								
Acanthorhynchus superciliosus	Western spinebill												1			1		X	X	X		X	X	
Anas superciliosa	Pacific black duck														1	1	X				X			X
Anthochaera carunculata	Red wattlebird												2		1	3	X	X	X	X		X	X	
Cacatua pastinator	Western long-billed corella														1	1		X	X	X		X	X	
Cacatua roseicapilla	Galah					1							3		1	5	X	X	X	X		X	X	
Cacatua sanguinea	Little corella												1			1		X	X	X		X	X	
Calyptorhynchus banksii naso	Forest red-tailed black cockatoo	VU	VU										2			2		X	X			X		
Calyptorhynchus latirostris	Carnaby's cockatoo	EN	EN												5	5		X	X			X		
*Columba livia**	Domestic pigeon (rock dove)												1			1		X	X	X		X	X	
Coracina novaehollandiae	Black-faced cuckoo-shrike												1		1	2	X	X	X	X		X	X	
Corvus coronoides	Australian raven												11		1	12	X	X	X	X		X	X	
Cracticus tibicen	Australian magpie												1			1		X	X	X		X	X	
Gavicalis virescens	Singing honeyeater												9		1	10	X	X	X	X		X	X	
Lichmera indistincta	Brown honeyeater												7		1	8	X	X	X	X		X	X	
Merops ornatus	Rainbow bee-eater												1			1		X	X	X		X		
Petrochelidon nigricans	Tree martin														1	1		X	X	X		X	X	
Phaps chalcoptera	Common bronzewing														1	1		X	X	X		X	X	
Phylidonyris niger	White-cheeked honeyeater												1			1	X		X	X		X	X	
Phylidonyris novaehollandiae	New holland honeyeater														1	1	X	X	X	X		X	X	
Platycercus zonarius	Australian ringneck												4		1	5		X	X	X		X	X	
Rhipidura leucophrys	Willie wagtail												2		1	3	X	X	X	X		X	X	
*Spilopelia chinensis**	Spotted turtle dove												4		1	5	X	X	X	X		X	X	
*Spilopelia senegalensis**	Laughing turtle dove														2	2	X	X	X	X		X	X	
Threskiornis moluccus	Australian white ibis												8		1	9		X	X	X		X	X	
*Trichoglossus moluccanus**	Rainbow lorikeet												2			2	X	X	X	X		X	X	

Species	Common name	Conservation Status				Survey detection method										Number of records	Season(s) recorded		Habitat types likely to utilise in study area					
		EPBC Act	BC Act	DBCA	IUCN	Pitfall trap	Cage Trap	Elliot Trap	Funnel trap	Camera trap	Ultrasonic recorder	Acoustic recorder	Bird census	Active foraging	Opportunistic		Winter (June)	Spring (Nov)	Banksia Woodland	Melaleuca Grassland	Wetland	Melaleuca and Jarrah Woodland	Parkland (cleared)	Drain
Zosterops lateralis	Silvereye												14		3	17	X	X	X	X		X	X	
REPTILES																								
Acritoscincus trilineatus	A skink								4					1		5		X	X	X		X		
Cryptoblepharus buchananii	A skink					3				5				2	1	11		X	X	X		X		
Ctenotus australis	A skink					1								1	1	3		X	X	X		X		
Lerista elegans	A skink					1										1		X	X	X		X		
Lialis burtonis	Burton's legless lizard					1			2							3		X	X	X		X		
Morethia obscura	A skink					1			2							3		X	X	X		X		
Pogona minor	Western bearded dragon														2	2		X	X	X		X		
Pseudonaja affinis	Dugite								2							2		X	X	X		X		
Tiliqua rugosa	Bobtail					1	2	1		2				1		7		X	X	X		X		
AMPHIBIANS																								
Crinia georgiana	Quacking frog					1										1		X	X	X	X			X
Crinia insignifera	Squelching froglet					15			4			3			2	24	X	X	X	X	X			X
Heleioporus eyrei	Moaning frog					65		1	13							79		X	X	X	X	X		X
Limnodynastes dorsalis	Western banjo frog					2										2		X		X	X			X

*denotes introduced species

3.9.4 Fauna Species Richness

3.9.4.1 Sampling Adequacy

The results below represent this survey accumulation curves for each taxa, due to differences in survey methods and statistical analysis between previous surveys, statistical comparisons between previous surveys were not possible. The results below are based on systematic sampling results (i.e., pit trapping and avifauna census results) only and do not include opportunistic sightings or other non-standardised sampling methods (e.g., ultrasonic bat recordings and motion cameras). Therefore, captures are not consistent and not enough data available to statistically compare in accumulation curves. Contextual comparisons between previous surveys have been made in Section 3.9.1.

While results of species accumulation curves can often show a reduced capture of species richness, this is generally attributed to the exclusion of species recorded from opportunistic or other sampling methods. Furthermore, many species may not have been recorded during the survey due to a number of factors which are likely to influence a species occurrence, abundance and/or activity levels, including temporal changes in habitats (i.e. degradation from fire and/or introduced species over time) and species (i.e. population fluctuations), climatic influences such as rainfall and/or temperature (i.e. climate change) and species detectability (i.e. some species naturally occur in low abundance or have fluctuating populations influenced by other factors such as rainfall). For example, some taxa such as amphibians are recorded in low abundance due to captures being dependent on climatic events such as rainfall.

3.9.4.2 Mammals

The species accumulation curve for mammals produced a rapidly increasing line, indicating that an asymptote had been reached by night three (Figure 3.15). Richness estimators indicated that 100% of species had been recorded. A total of two species were recorded as expected based on the results obtained. While mammal numbers were low, these results are likely to reflect the fact that species richness for mammals is typically lower than that for birds and herpetofauna. Due to richness estimates only incorporating results recorded from standardised sampling methods for mammals (i.e., systematic trapping methods), several species recorded from other methods (i.e., opportunistic records) within habitats trapped are not included. These include, but are not limited to, cat (*Felis catus*), red fox (*Vulpes* vulpes), dog (*Canus familiaris),* black rat (*Rattus rattus*) and numerous bat species (Appendix L). Contextual comparisons of total mammal species recorded from all sampling methods with previous surveys have been discussed in Section 3.9.1.

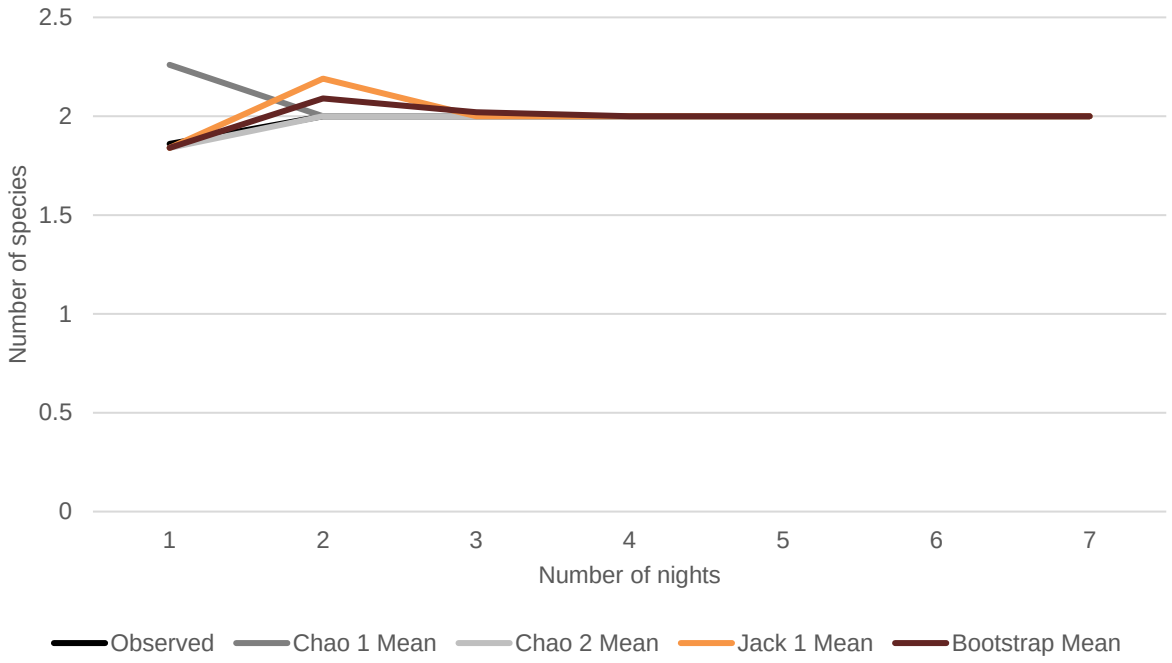


Figure 3.15: Species accumulation curve for mammals trapped at systematic sampling sites

3.9.4.3 Avifauna

Analysis of the avifauna data set from the survey produced a steadily increasing line over the 7-day sampling period, indicating that an asymptote had not been reached; however, the curve was starting to gradually flatten towards a point plateau (Figure 3.16). Richness estimators indicated that the survey recorded 74% (Jacknife 1), 78% (Chao 1), 81% (Chao 2) and 86% (Bootstrap) of possible species occurring. A total of 20 species were recorded and it was indicated that between 23 and 27 species would be expected based on the results obtained. These results indicate that additional survey effort may increase the species richness, although the avifauna censuses were effective in identifying and recording the majority of the bird assemblage present at these sites. As richness estimates do not include species recorded from methods other than avifauna census' at systematic trapping sites (i.e., motion camera and opportunistic records), estimates do not include all species recorded during the survey from other sampling methods. These include, but are not limited to, records of Carnaby's cockatoo (*Calyptorhynchus latirostris*), and Pacific black duck (*Anas superciliosa*) (Appendix L). Contextual comparisons of total avifauna species recorded from all sampling methods with previous surveys have been discussed in Section 3.9.1.

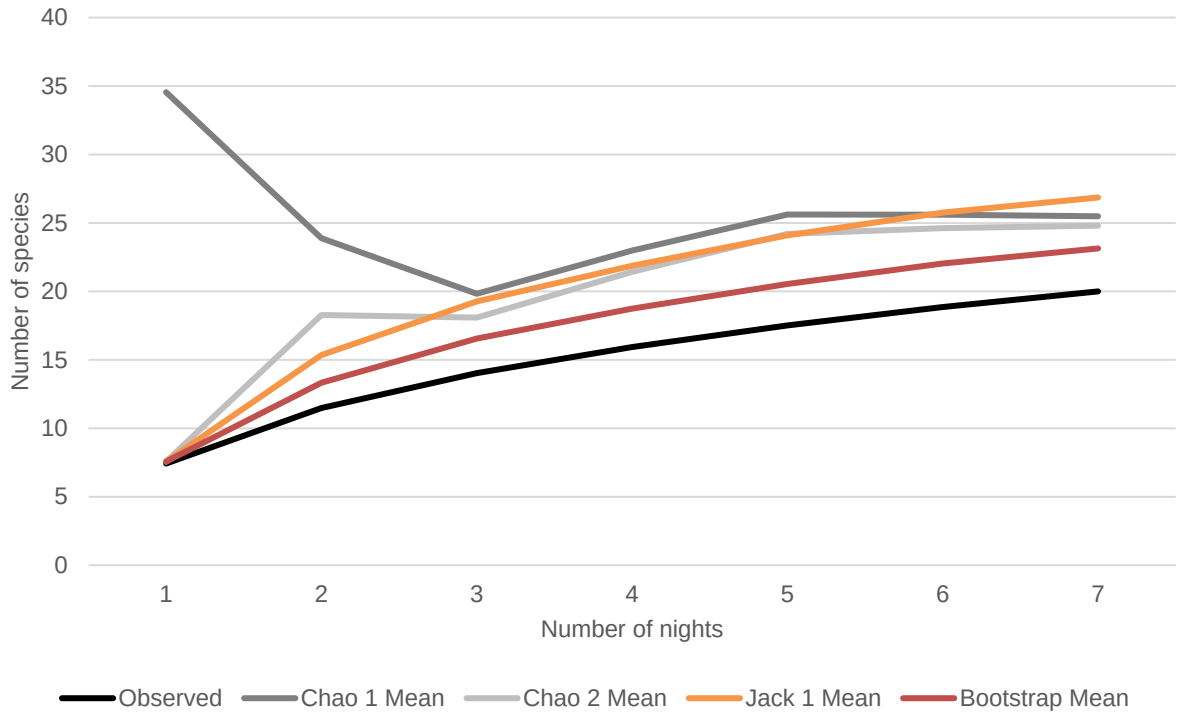


Figure 3.16: Species accumulation curve for birds recorded during avifauna census at systematic sampling sites

3.9.4.4 Herpetofauna

Analysis of the herpetofauna data set from the survey produced a steadily increasing line over the 7 day sampling period, indicating that an asymptote had not been reached; however, was close to reaching a point of plateau (Figure 3.17). Richness estimators indicated that between 82% (Jacknife 1), 94% (Chao 1), 96% (Chao 2) and 89% (Bootstrap) of species had been recorded. A total of 12 species were recorded and it was indicated that 13 and 15 species would be expected based on the results obtained. These results indicate that while additional survey effort may increase the species richness, the systematic trapping effort applied was effective in identifying and recording most of the herpetofauna assemblage present. Due to richness estimates only incorporating results recorded from standardised sampling methods for herpetofauna (i.e., systematic trapping methods), estimates do not include all species recorded during the survey which weren't recorded from trapping sites. These include, but are not limited to, records of the western bearded dragon (*Pogona minor*) (Appendix L). Contextual comparisons of total herpetofauna species recorded from all sampling methods with previous surveys have been discussed in Section 3.9.1.

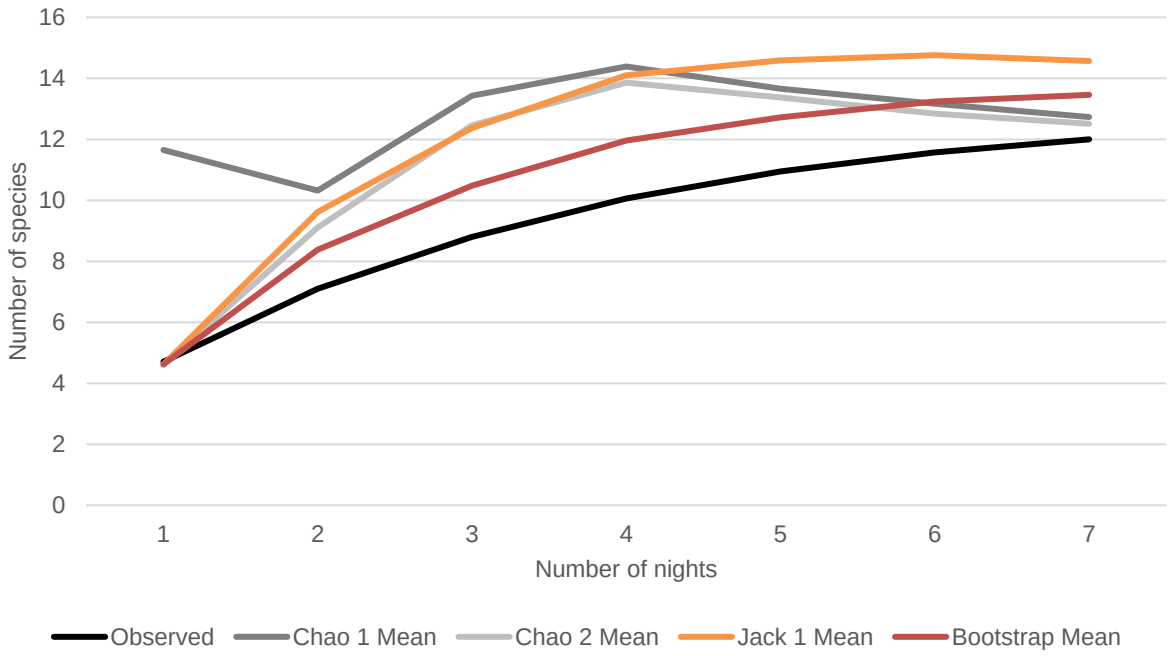


Figure 3.17: Species accumulation curve for herpetofauna trapped at systematic sampling sites

3.9.5 Conservation significant species

A total of 45 species of conservation significance were identified from the desktop assessment (see Section 3.9.1), comprising six mammals, 37 birds and two reptiles (Table 3.15). One of these species have previously been recorded within the Study Area, the quenda, which was also recorded during the current field survey. An additional two species of conservation significance, Carnaby's cockatoo and the forest red-tailed black cockatoo were also recorded during the current survey (Table 3.17, Figure 3.18).

In total, based on distribution, previous records and the habitats present within the Study Area, three species of conservation significance are confirmed within the Study Area, one is considered Likely to occur, seven species were deemed Possible to occur, and the remaining 34 species are Unlikely or Highly Unlikely to occur. These species, and the justification for their likelihood of occurrence, are detailed in Appendix P. In addition to those confirmed during the current survey, the conservation significant species most likely to occur in the Study Area is the Perth slider *Lerista lineata,* considered Likely to occur. Consideration for some species as Unlikely or Highly Unlikely to occur within the Study Area is generally based on the absence of suitable habitat for the species and/or the Study Area occurring outside the known distribution for the species (Appendix P).

3.9.5.1 Species Confirmed within Study Area

Two species considered Matters of Environmental Significance (MNES) were recorded in the Study Area during the current surveys; Carnaby's cockatoo *Calyptorhynchus latirostris* (EPBC and BC Act Endangered) and forest red-tailed black cockatoo *Calyptorhynchus banksii naso* (EPBC and BC Act Vulnerable). In addition, one other species of conservation significance was confirmed as occurring

within the Study Area, the quenda (southern brown bandicoot) *Isoodon fusciventer* (DBCA Priority 4). The locations of these records are provided in Appendix N.

Carnaby's cockatoo

Carnaby's cockatoo *Calyptorhynchus latirostris* is classified as Endangered under the EPBC and BC Act. The species is considered common within the local vicinity, with 810 previous records and an additional 76 "*Calyptorhynchus sp. "white-tailed black cockatoo*" records within 5 km of the Study Area, (105 records; ALA, 2020; 786 records, DBCA, 2020d). These records are concentrated in the bushland at Harrisdale Swamp 1.7 km south-east, a small patch of bushland along Ranford Road 2.5 km north-west, and at Balannup Lake Nature Reserve, 4 km south-east (DBCA, 2020d).

Carnaby's cockatoo was recorded during the current survey from secondary evidence within the Banksia Woodland habitat, through five instances of chewed *Banksia attenuata* cones (Plate 3.10, Figure 3.18). *Banksia* species are considered a primary food resource for Carnaby's cockatoo (DoEE, 2017a; Johnstone *et al.*, 2011). Some secondary food resources were present within the Study Area, including sheoak, grasstree, and jarrah. (Groom, 2011). Overall, the habitat types providing potential foraging resources for the species are the Banksia Woodland (1.44 ha, 15.50 %) and Melaleuca and Jarrah Woodland (0.80 ha, 8.63 %).

As discussed in Section 3.9.1, there are fourteen white-tailed black cockatoo roosts and fifteen joint roosts (with forest red-tailed black cockatoo) within 12 km of the Study Area (BirdLife Australia, 2020). No evidence of black cockatoo roosting activity was recorded during the field survey (e.g., clipped leaves and branches or droppings under suitable trees). The survey timing fell outside that recommended for Carnaby's cockatoo, where it is likely that most birds have migrated to the Wheatbelt for breeding, and so recent evidence of roosting for this species is unlikely. However, based on the habitat mapping conducted and the presence of recognised roosting species (i.e jarrah; DoEE, 2017a; Johnstone *et al.*, 2011), potential night roosting habitat was identified in the Study Area across the Melaleuca and Jarrah Woodland and Banksia Woodland (total of 2.2 ha, 24 % of the Study Area) (Figure 3.14). However, the quality of roosting habitat is considered sub-optimal, and more preferred habitat is present in surrounding areas.

Black cockatoos will forage up to 12 km from breeding hollows during the breeding season and rely on a proximity of foraging resources to breeding hollows and roosts (DoEE, 2017a). Given the location of occupied roosts within this distance, the foraging habitat present is considered of significance for the species. However, the Study Area itself is unlikely to provide significant potential breeding habitat for black cockatoo; of the four trees of appropriate DBH to potentially support breeding, none were found to currently have hollows (see section 3.9.7).

Plate 3.10: Carnaby's cockatoo foraging evidence on banksia cone

Forest red-tailed black cockatoo

The forest red-tailed black cockatoo *Calyptorhynchus banksii naso* is classified as Vulnerable under the EPBC and BC Act. The species is regularly sighted within the immediate vicinity, with 77 previous records of the species from within 5 km of the Study Area (67 records; ALA, 2020; 10 records; DBCA, 2020d). The nearest record of the species is located approximately 1.29 km north-west from 2008; however, more contemporary records are also present in the immediate vicinity, with a record 2.23 km north, north-west from 2017 (DBCA, 2020d). During the current survey, the species was recorded on two separate days by a group of two individuals and three individuals flying over the Study Area (Figure 3.18, Appendix M).

The habitat types providing foraging resources for the species are the Melaleuca and Eucalypt Woodland (0.80 ha, 8.63 %) and Banksia Woodland (1.44 ha, 15.50 %), due to the presence of known foraging resources for the species through the presence of jarrah (*Eucalyptus marginata*). Jarrah and marri make up over 90 % of the diet of the forest red-tailed black cockatoo (Johnstone & Storr, 1998); however, no foraging evidence was recorded during either survey phase.

As discussed in Section 3.9.1, there are fifteen forest red-tailed black cockatoo and fifteen joint (with white-tailed black cockatoo) roosts within 12 km of the Study Area (BirdLife Australia, 2020). No evidence of black cockatoo roosting activity was recorded during the field survey (e.g., clipped leaves and branches or droppings under suitable trees). Based on the habitat mapping conducted and the

presence of recognised roosting species (i.e jarrah; DoEE, 2017a; Johnstone *et al.*, 2011), potential night roosting habitat was identified in the Study Area across the Melaleuca and Jarrah Woodland and Banksia Woodland (Figure 3.19). In total, these habitats represent 24.13 % (2.24 ha) of the Study Area.

There are confirmed and anecdotal records of the species breeding within the vicinity, with two forest red-tailed black cockatoo natural hollow nests (Cockburn, 2020; anecdotal report of breeding in Kenwick) and one artificial hollow nest at Murdoch University, most recently in 2013 (BirdLife Australia, 2020). Black cockatoos will forage up to 12 km from breeding hollows during the breeding season and rely on a proximity of foraging resources to breeding hollows and roosts (DoEE, 2017a). However, the Study Area itself is unlikely to provide significant potential breeding habitat for black cockatoo; of the four trees of appropriate DBH to potentially support breeding, none were found to currently have hollows (see section 3.9.7).

Quenda, southern brown bandicoot *Isoodon fusciventer*

The quenda (*Isoodon fusciventer*) is classified as Priority 4 by the DBCA. The species is distributed coastal margins in Western Australia ranging from Yanchep to Cape Le Grand and inland to Wyalkatchem and Hyden (Pentland, 1999). The habitat for the species is described as jarrah forest and swamp habitats, in dense vegetation around wetland fringes and heathland (Cooper, 1998; Woinarski *et al.*, 2014b). The species prefers dense, low shrubland to forage underneath (Woinarski *et al.*, 2014b), and low grass trees with leaves that touch the ground to provide protection from predators (Lohr *et al.*, 2018). The dense vegetation surrounding waterways also provides protection and foraging opportunities. Their presence is often identified by distinctively shaped foraging pits dug searching for invertebrates, tubers, and fungi, and can range in size from “nose-pokes” in leaf litter to well-excavated holes (Lohr *et al.*, 2018).

The species is considered common in the local vicinity and has been recorded 205 times from primary (direct observations during both day and night) and secondary evidence within 5 km of the Study Area (11 records; ALA, 2020; 194 records; DBCA, 2020d). The species has been previously recorded from the Study Area in 2011 from an opportunistic night sighting (DBCA, 2020d). Quenda were recorded in 13 of the reviewed previous fauna survey reports. The City of Gosnells accounted for 3.3 % of the total quenda sightings made during the Perth quenda community survey in 2012 (Howard *et al.*, 2014), and as such the local area is significant for these populations.

Quenda were recorded 57 times (11 in cage traps, and 46 in Elliott traps) through direct captures and from 208 instances on camera traps during phase two of the field survey (Figure 3.18, Appendix M). The individuals recorded ranged from adult (including females with pouch young) to sub-adult and juvenile (Appendix M).

The species was also recorded via direct observation (opportunistic day sightings) during the phase one survey. Thomas (1990) states that a high density of quenda is approximately one individual per hectare. Other Perth studies have found as high densities of quenda as 1.24 - 1.45 individuals / hectare at Ellenbrook Reserve (Pentland, 1999) and 2.8 animals/ hectare at the Perth airport (Everard & Bamford, 2014). Based on the estimated minimum number of unique captured individuals (n = 30), the

estimated population size when average population density at each trap site is generalised across the Study Area is 31 individuals. This estimate is given as a minimum due to limitations in marking of recaptured individuals; potential unique individuals were determined based on the presence of a marker, and morphometrics such as gender, pes length, and weight. The estimated minimum population gives an approximate density of 3.3 animals / hectare across the 9.3-hectare site. This gives an approximate density of 3.3 animals / hectare across the 9.3-hectare site. As such, the density of animals' present represents a very high-density population with the Perth urban environment, and the population present should be considered of high local significance.

In consideration of the habitats present and the spread of records throughout the Study Area, all fauna habitats, excluding the Cleared and Drain areas, are likely to provide suitable habitat for quenda in some respect (8.60 ha, 92.70 %). Everard and Bamford (2014) suggest that dampland heaths support the greatest density of quenda, followed by woodland areas of marri and *Banksia* (40 – 60 % of maximum density) and grassland areas (10 – 20 % of maximum density). However, comparable numbers of quenda were recorded across the Banksia Woodland, Melaleuca and Jarrah Woodland, and Melaleuca Grassland during the current field survey. The Parkland habitat is considered of low value, and likely provides limited dispersal opportunities only. The habitat types supporting the species in the Study Area are also present within the Jandakot Regional Park in the immediate vicinity of the Study Area (Bamford *et al.*, 2003), providing additional core habitat linked by a Regional Ecological Linkage.

Plate 3.11: Evidence of quenda in the Study Area. Photos show a) juvenile quenda trapped and b) pouch young with an individual trapped during the phase two survey.

397450

397950

6448656

6448156

Parnell Wy

Ranford Rd

Ballycastle Loop

Nicholson Rd

Clontarf Tce

Merrion Rmbl

Tramore Tarn

Legend

Study Area

Common Name - Observation Method

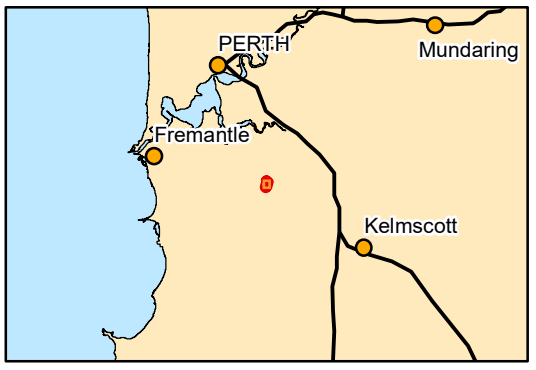
- Carnaby's cockatoo - Opportunistic
- Forest red-tailed black cockatoo - Bird Census
- Quenda - Cage Trap
- Quenda - Camera
- Quenda - Elliot Trap
- Quenda - Opportunistic

Fauna Habitat

- Drain
- Banksia Woodland
- Melaleuca Grassland
- Melaleuca and Jarrah Woodland
- Parkland
- Wetland
- Cleared

0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 29/03/2021



N

biologic Environmental Survey

Scale: 1:3,000

CITY OF GOSNELLS

Nicholson Rd Biological Survey and Management Plan

Figure 3.18: Conservation significant fauna recorded in the Study Area

3.9.5.2 Species Likely to Occur

In addition to the species described above (see Section 3.9.5.1), two other species of conservation significance were considered Likely to occur in the Study Area.

Perth Slider *Lerista lineata*

The Perth Slider *Lerista lineata* (DBCA Priority 3) is a fossorial skink largely restricted to the Swan Coastal Plain (Maryan *et al.*, 2015). However, Australian squamate fauna has not been re-assessed for more than 25 years (Tingley *et al.*, 2019), and the species listing as Endangered by the IUCN (Gaikhorst *et al.*, 2017) suggests that its listing may be upgraded. The species distribution follows a narrow strip located approximately 20–25 km inland from the coast, with the majority of *L. lineata* records from the southern suburbs of the Perth metropolitan area on the Bassendean and Spearwood Dune Systems. It is estimated that suitable habitat for the species has declined by 86% since European settlement (Maryan *et al.*, 2015). This habitat includes the TEC Banksia Woodlands of the Swan Coastal Plain (TSSC, 2016).

There are five records of the species within 5 km of the Study Area (DBCA, 2020d), with previous records at the Jandakot airport, Ken Hurst Park, and within the vicinity of Roe Highway (Bamford *et al.*, 2003; Dell & Cooper, 1992; Phoenix, 2011). Based on the availability of suitable habitat in the Banksia Woodland, the proximity and number of nearby records, and the distribution of the species, the Perth Slider is considered Likely to occur in the Study Area.

3.9.5.3 Species Possibly Occurring

In addition to the species described above (see Section 3.9.5.1 and 3.9.5.2), five other species of conservation significance were considered Possible to occur in the Study Area.

Baudin's cockatoo *Calyptorhynchus baudinii*

Baudin's cockatoo (*Calyptorhynchus baudinii*) is classified as Endangered under the EPBC and BC Act. The species is distributed through the south western humid and sub-humid zones, from the northern Darling Range and adjacent far east of the Swan Coastal Plain (south of the Swan River), south to Bunbury and east to Albany (Johnstone & Storr, 1998). Baudin's cockatoos nest in tree hollows in the deep southwest of Western Australia, with primary nesting trees being karri, marri, and wandoo (*Eucalyptus wandoo*) (Johnstone & Kirkby, 2008).

The Study Area lies within the foraging distribution of the species. The species was previously recorded by five individuals calling by Golder Associates (2016) at Station Street in the City of Gosnells, approximately 8.7 km southwest of the Study Area. An additional 96 records of Baudin's cockatoo are recorded within 5 km by ALA (2020). Baudin's cockatoo has very similar morphological characteristics to Carnaby's cockatoo, and many early accounts of white-tailed black cockatoos did not distinguish between the two species (Chapman, 2007). In addition, the two species commonly occur together in mixed flocks (Peck *et al.*, 2019), and therefore correct identification of white-tailed black cockatoos is difficult, and it is likely that most of the Baudin's cockatoo records in proximity to the Study Area are incorrect.

No foraging (i.e., chewed jarrah nuts) or roosting evidence (e.g., clipped leaves and branches or droppings under suitable trees) was recorded during the field survey. Based on the habitat mapping conducted and the presence of recognised roosting species (i.e jarrah; DoEE, 2017a; Johnstone *et al.*, 2011), potential night roosting habitat was identified in the Study Area across the Melaleuca and Jarrah Woodland (0.80 ha, 8.63 %) and Banksia Woodland (1.44 ha, 15.50 %). These habitat types also offer some suitable foraging habitat in light of the jarrah present, which forms a majority of the species diet (Johnstone & Kirkby, 2008).The species does not breed in the Perth region; as such the Study Area provides potential foraging and roosting habitat only.

In light of these factors, the distribution and proximity of recent records, and presence of some suitable habitat, the species is considered Possible to occur.

Peregrine Falcon *Falco peregrinus*

The peregrine falcon is classified as Other Specially Protected Fauna (OS) under the BC Act. The species typically nests on rocky ledges occurring on tall, vertical cliff faces or occasionally within tall trees occurring along major drainage lines and has occasionally been recorded nesting in human made structures providing high vantage points, such as radio-towers (Olsen & Olsen, 1989). There are 22 records of the species within 5 km of the Study Area (13 records, ALA, 2020; eight records, DBCA, 2020d; one record, Dell & Cooper, 1992), with the nearest record from 1981 approximately 1.75 km north (DBCA, 2020d). Dell and Cooper (1992) recorded peregrine falcon at Ken Hurst Park, 3.5 km north-west of the Study Area in 1992. The species has also been recorded at numerous reserves and lakes in the City of Melville (e.g. 5 km NW at PJ Hanley Park, 5.6 km NW at Harry Baker Park, 6.5 km NNW at Bull Creek Park, 7.4 km NW at George Welby Park) (Waters, 2019). There is a concentration of records (>15) approximately eight kilometres west at the Beeliar Regional Park (DBCA, 2020a).

Although the Study Area does not contain breeding habitat, peregrine falcon are known to breed within the Perth region such as a tree hollow in Whiteman Park (Bamford *et al.*, 2003), and so there is the possibility that the species breed in the general region of the Study Area. Peregrine falcon may use the available habitats of the Study Area for foraging, and in consideration of records present within the vicinity of the Study Area, the peregrine falcon is considered Possible to occur irregularly while foraging.

Fork-tailed Swift *Apus pacificus*

The fork-tailed swift *Apus pacificus* is classified as Migratory under the EPBC and BC Act. It is a wide ranging but sparsely distributed species that occurs in a wide range of dry and/or open habitats (Johnstone & Storr, 1998). The species does not breed in Australia, migrating from breeding grounds in the northern Hemisphere. The species usually arrives in Australia in October, where it remains in various parts of the continent to as long as April. During its occurrence in Australia, the species is almost exclusively aerial, feeding and possibly also roosting aerially (DoE, 2018). The species is often observed during foraging or migration, with flocks ranging from 10 to 1,000 individuals (DoE, 2018).

The fork-tailed swift was not recorded during the current survey, and the nearest record is a historical one located approximately 1.6 km south-west of the Study Area (ALA, 2020); however, the species is considered Possible to occur. The species is likely to occur as an infrequent visitor and may forage in the airspace above all habitats occurring within the Study Area. The species is unlikely to land or nest within the Study Area due to its almost exclusively aerial behaviour within Australia (DoE, 2018).

Glossy Ibis *Plegadis falcinellus*

The glossy ibis *Plegadis falcinellus* is classified as Migratory under the EPBC and BC Act. The preferred habitat is described as freshwater wetlands, irrigated areas, margins of dams, floodplains, brackish and saline wetlands, tidal mudflats, pastures, lawns and public gardens (Johnstone *et al.*, 2013). There are seventeen records of the species within 5 km of the Study Area (ten records, ALA, 2020; seven records, DBCA, 2020d) (Figure 3.12). The nearest contemporary record to the Study Area is 1.6 km NWW in the Jandakot Regional Park as recently as 2019 (ALA, 2020); other records are located approximately 2.2 km SE at Harrisdale Swamp from 1991 (DBCA, 2020d). The species has also been recorded at some reserves and lakes in the City of Melville (e.g. Blue Gum Lake Reserve and Booragoon Lake approximately eight kilometres north-west) (Waters, 2019).

Based on the presence of potentially suitable habitat present within the Study Area (Wetland), and contemporary records of the species in the near proximity, glossy ibis are considered Possible to occur, and are most likely present when the ephemeral wetland is inundated during winter.

Western Brush Wallaby *Notamacropus irma*

The western brush wallaby *Notamacropus irma* (DBCA Priority 4) inhabits a wide-range of habitats including low *Banksia* woodlands, jarrah/marri woodlands and moist *Melaleuca* lowlands, favouring open, grassy areas (Wann & Bell, 1997; Woinarski *et al.*, 2014a). The species abundance is noted to have significantly declined until widespread fox control was implemented in state forests and conservation estates (Woinarski *et al.*, 2014a). There are 35 records of the species within 5 km of the Study Area (DBCA, 2020d). Although the nearest records are approximately 1.7 km south-south-east from 1997 at Harrisdale Swamp and 1.6 km south from 2005 (both deceased individuals) (DBCA, 2020a), the largest concentration of records (n = 33) is located in the Jandakot Regional Park and Ken Hurst Reserve. These records were made during multiple surveys in the area; detailed fauna surveys by Bamford *et al.* (2003) and ENV (2009) at Jandakot airport, a targeted western brush wallaby survey by Western Wildlife (2011c) at Jandakot airport, and a detailed survey in Ken Hurst Reserve in 1992

(Dell & Cooper, 1992). The population density of brush wallabies at Jandakot airport was found to be consistent with that of the resident population in Whiteman Park, with most individuals in dense vegetation in low-lying areas, and as such was considered locally significant (Bamford *et al.*, 2003). Bamford *et al.* (2003) states that as the species is sedentary, small populations could be vulnerable to local extinction.

In consideration of the potentially suitable habitat present in the Study Area (in particular the *Banksia* Woodland and Melaleuca Grassland), the linkage to bushland at Jandakot Regional Park, and contemporary records of the species in the near proximity, western brush wallaby are considered Possible to occur. The presence of introduced predators such as red foxes, may potentially discourage the species from occurring other than in low densities. The small total area of the Study Area may also be too small to sustain a population other than for dispersal or foraging; in isolation other remnant bushland in the area such as Ken Hurst Reserve also appear to provide insufficient habitat to sustain a population (Dell & Cooper, 1992).

Blue-billed Duck *Oxyura australis*

The blue-billed duck *Oxyura australis* is classified as Priority 4 by the DBCA. It is endemic to south-eastern and south-western Australia (Marchant & Higgins, 1990). The habitat preferences of the species are mainly deep freshwater swamps and lakes, and occasionally salt lakes and estuaries freshened by flood waters (Johnstone & Storr, 1998). There are 74 records of the species within 5 km of the Study Area (37 records, ALA, 2020; 37 records, DBCA, 2020d); approximately 1.35 km north from 1981 (DBCA, 2020d), approximately 1.6 km southwest in Jandakot Regional Park from as recent as 2018 (ALA, 2020), and approximately 4 km SSE from as recent as 2000 at Harrisdale Swamp (DBCA, 2020d).

The Wetland habitat type provides potentially suitable for the species during periods of inundation for foraging. In consideration of the habitat present and records located within proximity of the Study Area, the blue-billed duck is considered possible to occur on a seasonal basis.

Black-striped Snake *Neelaps calonotos*

The black-striped snake *Neelaps calonotos* (DBCA Priority 3) is restricted to coastal areas in the south west of Western Australia around Perth between Port Kennedy and the Dongara region (Gaikhorst *et al.*, 2018). The species inhabits sand dunes and sand plains vegetated with heaths, *Banksia* and Eucalypt woodlands (ALA, 2019). They are found in the upper soil layer beneath leaf litter and dense foliage of shrubs and grasses, and can shelter in abandoned ants nests and beneath logs and stumps, and interior of decaying trees (Bush *et al.*, 1995). There is a single record of the species within 5 km of the Study Area (Figure 3.12); an opportunistic day sighting located 2.2 km north-west of the Study from 2011 at Jandakot airport (Bamford *et al.*, 2003; DBCA, 2020d). An additional contemporary record in the area is located 8.3 km south at Lake Jandakot in 2018 (DBCA, 2020a).

Based on the presence of potentially suitable habitat present within the Study Area (*Banksia* Woodland), and a contemporary record of the species in the near proximity, the black-striped snake is considered Possible to occur. However, the overall area of core habitat present (1.44 ha, 15.50 %) is considered small and unlikely to support more than a few resident individuals or dispersal.

3.9.6 Introduced fauna species

Rabbits, red foxes, and feral cats are listed under the EPBC Act as key threatening processes to the conservation of biodiversity in Australia. A total of 17 introduced fauna species have the potential to occur within the Study Area, based on the results of the desktop assessment, comprising nine mammals, seven birds and one reptile. Nine feral vertebrate species were recorded from the current survey (53 % of those with the potential to occur), as described below. The locations and types of observations of introduced vertebrate fauna are given in Appendix O.

Mammalian species

Five introduced mammalian species were recorded during the current field survey; red fox *Vulpes vulpes*, domestic dog *Canis familiaris*, cat *Felis catus*, black rat *Rattus rattus*, and house mouse *Mus musculus*.

The red fox is a Declared Pest under the BAM Act 2007. The species was recorded via various survey methods during the field survey, including scats, camera traps, and a potential old den. These records were concentrated within the central section of the Study Area around VNIC-02. Although the potential den recorded at VNIC-02 was considered old (due to the presence of some cobwebs and a lack of recent footprints), its presence suggests a potential persistent presence of the introduced species in the Study Area. The den was deliberately caved in by the field team during the current survey. The risk of predation by foxes is likely to be higher around breeding dens, with foxes concentrating their efforts around den sites during the breeding season and regularly visiting dens during other times of year (Carter *et al.*, 2012). The phase two field survey recorded a potential bandicoot predation by red fox on an individual trapped within a cage trap. Bandicoots have been generally found in lower population densities with foxes (Carter *et al.*, 2012); the persistent presence of the introduced species may pose a threat to the size of the population of quenda present.

The quenda predation recorded may also be attributed to a domestic dog *Canis familiaris*. Dog tracks were recorded in the vicinity of VNIC-03 during the phase two field survey, and dogs were observed walking in the Study Area with their owners.

A deceased cat *Felis catus* was recorded at VNIC-01 during the phase two survey. Cats are a recognised as a significant predation threat to native fauna in Western Australia (Algar & Burrows, 2004), and use food resources in proportion to their availability (Doherty *et al.*, 2015a). The cat recorded was a pet individual due to the presence of a collar with the carcass.

Two introduced rodent species were recorded during the phase two field survey; black rat *Rattus rattus* and house mouse *Mus musculus*. These species were recorded on camera trap; in addition, the house mouse was trapped in pitfall and Elliott traps throughout the Study Area (Table 3.18). These rodent species are known competitors and predators for small native fauna, including quenda, and can introduce disease, parasites, or attract predators (Bettink, 2011).

Avian species

Four introduced avian species were recorded during the current field survey; rock dove *Columba livia* (naturalised exotic), laughing turtle dove *Spilopelia senegalensis* (naturalised exotic), spotted turtle dove *Spilopelia chinensis* (naturalised exotic), and rainbow lorikeet *Trichoglossus moluccanus*. Turtle-doves do not appear to compete with native bird species for nest sites or food (DEC, 2007).

The rainbow lorikeet was established in Perth in 1968 and is a Declared Pest under the BAM Act 2007. The species is a known aggressive nest and feeding competitor with other avian species, in particular black cockatoo (DoEE, 2017a), and arboreal mammals. However, there is a lack of hollows present in the Study Area to facilitate the breeding of the species.

Table 3.18: Introduced fauna recorded during the current survey.

Species	Survey detection method	Number of records	Season(s) recorded	Breeding Activity	Photo
MAMMALS					
Red fox *Vulpes vulpes*	Opportunistic • VNIC-02 - scat • VNIC-02 – potential den Systematic • VNIC-05 – camera trap	3	Spring (phase two, November)	A potential den was observed at site VNIC-02 during the phase two field survey.	
Dog *Canis familiaris*	Opportunistic • VNIC-03 - tracks observed. • Dogs observed with owners within Study Area	2	Spring (phase two, November)	None observed. Highly unlikely within Study Area	No photo available
Cat *Felis catus*	Opportunistic • VNIC-01 - skull and collar of individual observed	1	Spring (phase two, November)	None observed. Highly unlikely within Study Area	No photo available
Black rat *Rattus rattus*	Systematic • VNIC-01 - Camera trap	1	Spring (phase two, November)	None observed. Likely to occur within Study Area	

Species	Survey detection method	Number of records	Season(s) recorded	Breeding Activity	Photo
House mouse *Mus musculus*	Systematic • VNIC-05 - Camera trap • VNIC-02 and VNIC-04 - Pitfall trap • VNIC-02 and VNIC-04 - Elliot trap	26	Spring (phase two, November)	None observed. Likely to occur within Study Area.	
BIRDS					
Rock pigeon *Columba livia*	Systematic • VNIC-04 – Bird census	1	Spring (phase two, November)	None observed. Breeding is unlikely – species is known to nest along cliff faces or “artificial cliffs” along apartments buildings and ledges.	No photo available
Laughing turtle dove *Spilopelia senegalensis*	Systematic • VNIC-01, VNIC02, VNIC-04 – Bird census	9	Winter (phase one, June) and Spring (phase two, November)	None observed. Possible to occur - species build a frail platform nest of twigs and rootlets concealed in trees or shrubs.	No photo available
Spotted turtle dove *Spilopelia chinensis*	Systematic • VNIC-04 – Bird census	2	Winter (phase one, June) and Spring (phase two, November)	None observed. Possible to occur - species build a frail platform nest of twigs and rootlets concealed in trees or shrubs.	No photo available
Rainbow lorikeet *Trichoglossus moluccanus*	Systematic • VNIC-01, VNIC02, VNIC-04 – Bird census	17	Winter (phase one, June) and Spring (phase two, November)	None observed – Breeding is unlikely to occur as no hollows present within Study Area	No photo available

3.9.7 Native fauna breeding activity

Quenda breeding activity

As discussed in Section 3.9.5.1, the density of quenda present in the Study Area represents a very high-density population within the Perth urban environment, and the population present should be considered of high local significance. There is a high degree of successful breeding within the Study Area with both juvenile/sub-adults individuals present as well as five unique adult female bandicoots with pouch young recorded. In such a high density population, as space and resources become more limited, populations may self-regulate with males adapting to larger home range overlaps, or a higher rate of dispersal of younger males from the population into other areas may be observed (Pentland, 1999).

Small mammals have been shown to show large variations in population densities above and below carrying capacity, fluctuating with the current environmental conditions (Krebs & Myers, 1974). Quenda populations have been shown fluctuations in population size and density attributed to changes in breeding activity, which in turn leads to a change in carrying capacity and numbers of bandicoots present (Pentland, 1999). Pentland (1999) stated that it was not determined if quenda populations at high-density affects the number and size of litters produced; however, these high-density populations do show a high degree of dispersal. As such, if the Study Area is at carrying capacity, quendas are likely to disperse to other remnant bushland or regional parks in the vicinity, such as the Jandakot Regional Park, particularly of juveniles or less-aggressive individuals. In addition, breeding rates in subsequent years, or the survival and age at which young mature may decline in response to the carrying capacity of the environment, and the population size within the Study Area may experience a decline. Overall, the habitat present within the Study Area is valued by the population for residency, in addition to dispersal opportunities to the surrounds.

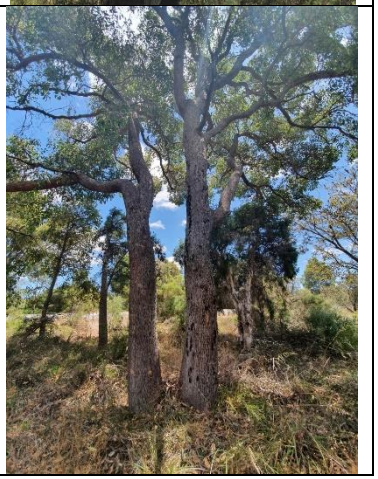
Potential black cockatoo breeding habitat

The Study Area contains four trees suitable as potential breeding trees for black cockatoos in the future (trees recorded with greater than 500 mm DBH). Four trees within the Study Area were of a suitable DBH and species to support potential black cockatoo breeding in the future, with the most common species being jarrah (*Eucalyptus marginata*) (n = 2). A summary of potential breeding trees within the Study Area are shown in Table 3.19 and Figure 3.19.

Although the trees present in the Study Area did not currently have hollows present, the importance of veteran and stag trees are recognized in their potential to develop hollows in the future, as it can take more than 200 years for a tree to develop suitable hollows (DoEE, 2017a; Johnstone *et al.*, 2011). As discussed in Section 3.9.1, there is evidence of black cockatoo breeding in the region of the Study Area, with two forest red-tailed black cockatoo natural hollow nests (Cockburn, 2020; anecdotal report of breeding in Kenwick) and one artificial hollow nest at Murdoch University, most recently in 2013 (BirdLife Australia, 2020).

Table 3.19: Potential breeding trees suitable for black cockatoo present within the Study Area

Tree ID	Species	DBH (cm)	Height (m)	Status	Latitude	Longitude	Comments	Photo
TNIC-01	Jarrah (*Eucalyptus marginata*)	53	6	Live	-32.0918	115.9185	No hollows present	
TNIC-02	Stag (Dead)	51	6	Dead	-32.0918	115.9184	No hollows present	

Tree ID	Species	DBH (cm)	Height (m)	Status	Latitude	Longitude	Comments	Photo
TNIC-03	Jarrah (*Eucalyptus marginata*)	53	6	Live	-32.0969	115.9166	No hollows present	
TNIC-04	Marri (*Corymbia calophylla*)	50	7	Live	-32.0967	115.9162	No hollows present	

397450

397950

6448656

6448156

VNIC-02

VNIC-01

VNIC-04

VNIC-03

Parnell Wy

Ranford Rd

Ballycastle Loop

Nicholson Rd

Clontarf Tce

Merrion Rmbl

Tramore Tarn

Legend

Study Area

Potential Breeding Trees

- Jarrah (*Eucalyptus marginata*)
- Marri (*Corymbia calophylla*)
- Stag (Dead)

Fauna Habitat

- Drain
- Banksia Woodland
- Melaleuca Grassland
- Melaleuca and Jarrah Woodland
- Parkland
- Wetland
- Cleared

0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 29/03/2021

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biologic Environmental Survey

Scale: 1:3,000

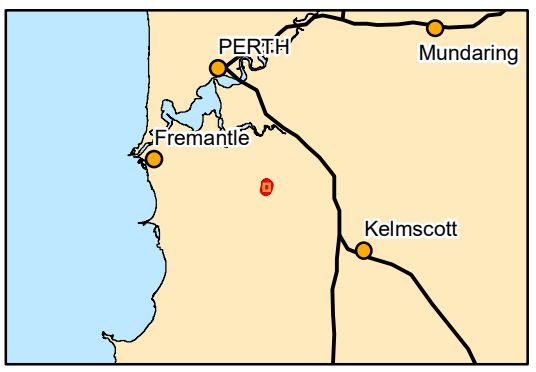

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Figure 3.19: Black cockatoo potential breeding trees within the Study Area

3.10 Heritage

3.10.1 Aboriginal heritage

The *Aboriginal Heritage Act (*AHA*) 1972* affords automatic protection to places and objects important to Aboriginal people. The Act emphasises the importance of Aboriginal tradition, culture and heritage to contemporary Aboriginal people and their culture, rather than merely matters of archaeological, anthropological or other scientific interest (DPIH, 2020). The AHA is soon to be replaced by the *Aboriginal Cultural Heritage Bill 2020.* A Register of Aboriginal Sites is maintained by the WA Department of Indigenous Affairs, which contains all reported possible sites within the meaning of the AHA, including:

- Registered Sites – being places assessed as meeting the criteria for Section 5 of the AHA.
- Lodged Places - being places that are yet to be formally assessed against the criteria of Section 5.
- Stored Data – being places assessed to which section 5 of the AHA does not apply.

No targeted field survey for potential heritage values was undertaken during the current field assessments. A desktop review of the Department of Planning, Lands, and Heritage (DPIH) Aboriginal Heritage Places dataset found that there are no known Registered or Lodged Sites within the Study Area (DPIH, 2019). Twenty-four sites were identified within five kilometres of the Study Area, as summarized below in Table 3.20, and shown on Figure 3.20. Of these, only five have been assessed as Registered Sites under the AHA; Kelso Road 2.1 km west, Acourt Road 2.1 km west, Lukin Swamp 2.7 km south-west-west, Murdoch Road in Canning Vale, 4.4 km north-east, and South-East Corridor 09, 5 km south-east (DPIH, 2019).

Seventeen sites are registered as artefacts/scatter, two as mythological, and five as a combination of categories including camps and arch deposits. The nearest Aboriginal Heritage Place to the Study Area is the Gosnells Golf Club, located 1.8 km east; however, it is yet to be formally assessed as a Registered Sites (Table 3.20, Figure 3.20).

Table 3.20 Summary of Aboriginal Heritage Places within 5 km of the Study Area DPIH (2019).

Name	Heritage type	Site Assessment	Distance from Study Area
Acourt Road	Artefacts / Scatter	Registered Site	2.1 km west
Agincourt, Willetton	Artefacts / Scatter	Stored Data / Not a Site	5.0 km north-west
Baile Road, Canning Vale	Artefacts / Scatter	Stored Data / Not a Site	2.5 km north
Banjup: Calsil.	Artefacts / Scatter, Camp	Stored Data / Not a Site	4.8 km south-west
Bannister Road	Artefacts / Scatter	Lodged	3.4 km north-west
Beasley Road	Artefacts / Scatter	Stored Data / Not a Site	4.2 km north-west
Collins Road, Willetton	Artefacts / Scatter	Lodged	4.5 km north-north-west
Gosnells Golf Club	Mythological	Lodged	1.8 km east
Johnston Road NE	Artefacts / Scatter	Lodged	3.3 km north
Johnston Road SW	Artefacts / Scatter	Stored Data / Not a Site	3.3 km north

Name	Heritage type	Site Assessment	Distance from Study Area
Kelso Road	Artefacts / Scatter	Registered Site	2.1 km west
Lukin Swamp.	Artefacts / Scatter, Camp	Registered Site	2.7 km south-west-west
Mclean Road, Canning Vale	Artefacts / Scatter	Stored Data / Not a Site	3.2 km north-east
Murdoch Road, Canning Vale	Artefacts / Scatter	Registered Site	4.4 km north-east
Nicholson Road Waugal Site.	Mythological	Stored Data / Not a Site	3.9 km north-east
Nicol Road/Baile Road	Artefacts / Scatter	Lodged	3.7 km north
Partridge Way, Thornlie	Artefacts / Scatter	Stored Data / Not a Site	4.8 km north-east
Readymix Sandpit 1	Artefacts / Scatter	Stored Data / Not a Site	5.0 km south-west
Riley Road, Canning Vale	Artefacts / Scatter	Stored Data / Not a Site	3.5 km north-west
Roe Highway Fieldsite 02	Artefacts / Scatter	Lodged	3.8 km north-west
South-East Corridor 09	Artefacts / Scatter, Camp	Registered Site	5.0 km south-east
Vulcan Road.	Artefacts / Scatter, Arch Deposit	Stored Data / Not a Site	4.4 km north
Warton Road, Banjup	Artefacts / Scatter	Lodged	2.8 km south
Willeri Drive/Nicol Road.	Artefacts / Scatter, Camp	Stored Data / Not a Site	4.8 km north-north-west

3.10.2 European heritage

The *Heritage Act* (HA) *2018* recognises the importance of, and promotes understanding and appreciation of, Western Australia's cultural heritage; and provides for the identification and documentation of places of cultural heritage significance and for the conservation, use, development and adaptation of such places.

The State Register of Heritage Places recognises a place's value and importance to Western Australia, and includes buildings, structures, gardens, cemeteries, landscapes and archaeological sites within Western Australia (DPIH, 2021). A desktop review of the State Register found that there are no known Registered Heritage Places within five kilometres of the Study Area (DPIH, 2021).

393697 397697 401697

6451834 6451834

6447834 6447834

6443834 6443834

WILLERI DRIVE/NICOL ROAD.
VULCAN ROAD.
Roe Hwy
PARTRIDGE WAY, THORNLIE
COLLINS ROAD, WILLETON
BEASLEY ROAD
AGINCOURT, WILLETTON
NICOL ROAD/BAILE ROAD
MURDOCH ROAD, CANNING VALE
Nicholson Road Waugal Site.
Roe Highway Fieldsite 02
RILEY ROAD, CANNING VALE
JOHNSTON ROAD SW
JOHNSTON ROAD NE
BANNISTER ROAD
McLEAN ROAD, CANNING VALE
BAILE ROAD, CANNING VALE
Garden St
KELSO ROAD
Nicholson Rd
Ranford Rd
GOSNELLS GOLF CLUB
ACOURT ROAD
LUKIN SWAMP
Warton Rd
WARTON ROAD, BANJUP
READYMIX SANDPIT 1
BANJUP: CALSIL.
SOUTH-EAST CORRIDOR 09

Legend

Study Area

Aboriginal Heritage Site

- Artefacts/Scatter, Arch Deposit
- Artefacts/Scatter, Camp
- Artefacts/Scatter
- Mythological

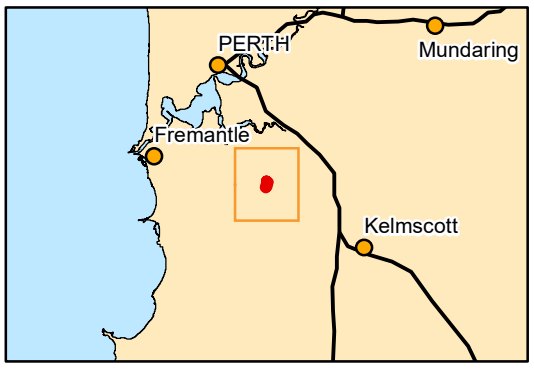
0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 04/02/2021

N

biologic Environmental Survey

Scale: 1:30,000



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Nicholson Rd Biological Survey and Management Plan

Figure 3.20: Aboriginal and European heritage sites in the Study Area

3.11 Drainage Infrastructure Assessment

3.11.1 Drainage Infrastructure Assessment Outcomes

All logged locations of drainage infrastructure within the Study Area are shown on Figure 3.21, Figure 3.22 and Figure 3.23, with the associated field assessment catalogue contained in Appendix Q.

Overall, the wetland drainage system appears functional and vegetation in good health; however, there was a common presence of rubbish at most locations and throughout the wetland which could potentially hinder drainage performance and wetland health. Manual litter collection is recommended to improve the overall performance of the drainage system and improve the aesthetic and conservation values of the wetlands. Frequency and extent of litter collection should be considered within the scope of the City of Gosnells maintenance team or suitable private contractor Consistent with the Stormwater Management Manual for Western Australia (DoE, 2005), assessment of drainage function should be undertaken annually to determine any changes to this overall evaluation of the system. Locations and infrastructure requiring attention have been flagged within the field catalogue and recommendations as to the actions to be taken are also provided in Sections 5.9 and 5.9.3. It should be noted that flagging has been done in the interest of drainage performance rather than environmental factors. Such locations/ infrastructure have also been indicated on Figure 3.21, Figure 3.22 and Figure 3.23 (labelled with 'AR' for attention required).

The assessment found that the stormwater infrastructure network displayed on the City of Gosnells Intramaps in regard to the wetland reserve is accurate, with the exception of the mapping of a piped inlet in the northern section of the reserve which does not exist (Plate 3.12).

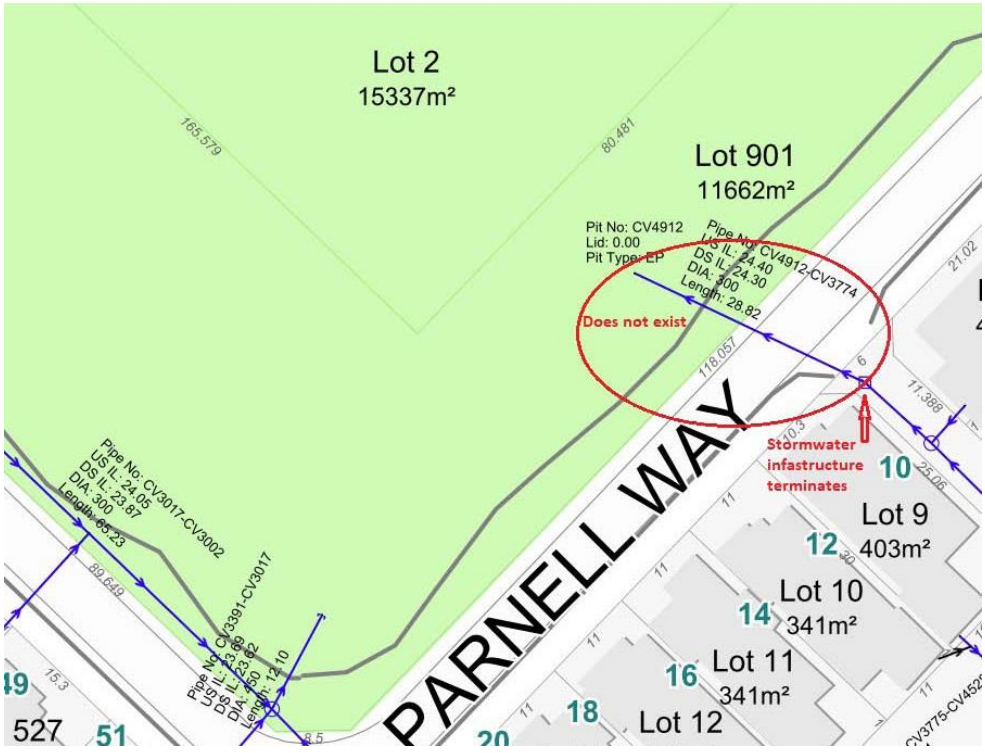

Plate 3.12 Absent drainage infrastructure identified from the Study Area

3.11.2 Surface Water Quality Monitoring Summary

As detailed in the overarching Campbell Estate Urban Water Management Plan (ENV, 2005b) the drainage system across the Study Area consists of a series of dry vegetated compensating basins and swales that provide natural filtration and nutrient stripping. Discharge from this system is via swales towards the northern overflow discharge point.

Surface water quality monitoring was conducted at the site by Emerge in May 2020. Five monitoring locations were selected by the City of Gosnells to assess surface water quality at the wetland reserve and presented in the *Nicholson Rd Stormwater Quality Report* (Emerge, 2020*)*. All five locations represented samples of incoming stormwater with the exception of SW01 (C19) and were collected in response to a significant rainfall event.

During the monitoring period, there was only one rainfall event (25 May 2020) that generated stormwater at three out of the five monitoring locations to sample (SW02, SW04 and SW05).

Detailed surface quality results are contained in the Emerge (2020) report. A summary of results is provided in Table 3.21 below with comparison against ANZECC and ARMCANZ (2000) trigger values for wetland ecosystems in South-western Australia and the protection of freshwater species.

- Measured pH and EC at all sites fell within ANZECC trigger values for wetland ecosystems.
- TN, TP, and PO_4-P at all sites fell within ANZECC trigger values for wetland ecosystems, while NH_3-N at all sites fell within the ANZECC trigger value for the 9 5% protection of freshwater species.
- All sites exceeded the NOx-N ANZECC trigger value for wetland ecosystems (0.1 mg/L) with a range of 0.14 mg/L – 0.25 mg/L. This suggests that anthropocentric sources of nitrogen are higher than typical ANZECC values however, TN values remain within the guideline values which suggests that overall nitrogen input to the system is within an acceptable range. Future monitoring should consider any further exceedances of this trigger value.

All sites returned readings for metals within the ANZECC trigger values for the 95 % protection of freshwater species with the exception of Copper and Zinc, with reported ranges of 0.006 mg/L – 0.007 mg/L and 0.084 mg/L – 0.12 mg/L, respectively (Table 3.21).

Table 3.21: Surface water parameters (those which fall outside of acceptable values are in orange)

Parameter	ANZECC Guidelines (ANZECC & ARMCANZ, 2000)	Southern River Catchment SCWQIP Targets (Swan River Trust, 2009)	SW02 (25/05/2020)	SW04 (25/05/2020)	SW05 (25/05/2020)
EC (mS/cm)	0.30 – 1.50[1]	-	0.355	0.039	0.316
pH	7.0 – 8.5[1]	-	7.18	7.63	7.28
DO (saturated) (%)	90-120		64.4	51.5	70.1

Parameter	ANZECC Guidelines (ANZECC & ARMCANZ, 2000)	Southern River Catchment SCWQIP Targets (Swan River Trust, 2009)	SW02 (25/05/2020)	SW04 (25/05/2020)	SW05 (25/05/2020)
TN (mg/L)	1.5[1]	0.75	0.5	1.0	0.7
NO_x-N (mg/L)	0.1[1]	-	0.14	0.25	0.18
NH_3-N (mg/L)	1.47[2]	-	0.19	0.29	0.15
TP (mg/L)	0.06[1]	0.075	0.04	0.05	0.03
PO_4-P (mg/L)	0.03[1]	-	<0.01	0.01	<0.01
Copper (mg/L)	0.0014[2]	-	0.006	0.007	0.005
Zinc (mg/L)	0.008[2]	-	0.12	0.084	0.085

1. ANZECC (2000) guidelines default trigger values for wetland ecosystems in South-west Australia

2. Trigger values for 95th percentile protection of freshwater species.

The measured nutrient levels reflect urban catchment runoff of relatively good quality within the Southern River Catchment, given that readings of TN and TP at all sites fall within targets of the Swan Canning Water Quality Improvement Plan (SCWQIP) (Swan River Trust, 2009) with the exception of TN at SW04 (1.0 mg/L). This value at SW04 still falls under a modelled winter median (1.32 mg/L) for the Southern River Catchment for 1997 to 2006. The presence of Copper and Zinc levels above ANZECC guidelines is consistent with urban road runoff, given that these contaminants can be attributed to by motorized vehicle pollutants (fuel, oil, tires, breaks and engine wear) and particularly in areas where traffic becomes stationary (DoW, 2009).

As mentioned, the monitored surface water sampling sites are inflow points for stormwater in the designed drainage system and as such represent stormwater prior to it being treated in the vegetated basins. As such, it is not possible to relate surface water quality results to the system and infrastructure performance. Given that it would be expected that surface water would only be present at outlet SW01 (C19) in a major rainfall event, it is recommended that samples also be taken at the outlets of the compensating basins to assess system performance in relation to surface water quality. This is consistent with the UWMP (ENV, 2005b). Although the runoff entering the wetland is already of generally good quality, it is expected that after biofiltration through the stormwater infrastructure the water quality within the wetland would improve further. Ongoing maintenance of vegetation and biofiltration media by the City of Gosnells is recommended to ensure the system remains in good functioning condition.

397776 397876 397976

6449059 6448959 6448859 6448759

SEP25 SEP23 SEP24 SEP22 SEP21 SEP20 SEP19

AR C19 AR C16 AR C17 AR C18

BUP6 BUP7 BUP8

B6E3 B6E2 B6E1

SWL8 SWL7 SWL9

C15

Ranford Rd

Nicholson Rd

Ballycastle Loop

Parnell Wy

Legend

- Study Area
- Swale
- Basin

Logging locations

- Basin Edges
- Bubble Up Pits
- Culverts
- Side Entry Pits
- Swales

0 10 20 30 40 50 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 29/03/2021

N

biologic Environmental Survey

Scale: 1:1,000

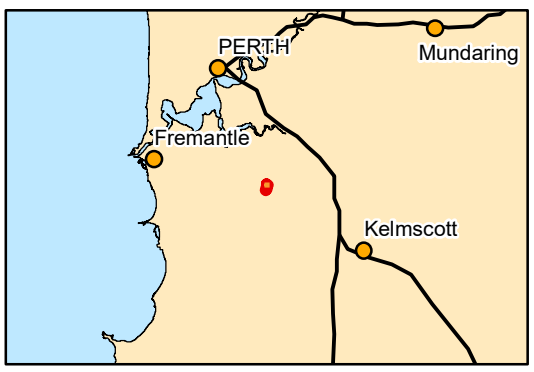

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Figure 3.21: Drainage infrastructure and surface water runoff within the Study Area (northern section)

397712 397812 397912

6448781 6448681 6448581 6448481

SEP19 AR C18 BUP8 SEP12 SWL6 SEP13 AR B4E3 B4E2 BUP3 AR B4E1 SWL5 C10 SEP14 AR BUP4 C11 SEP15 AR C12 SEP16 AR C13 BUP5 B5E1 C14 B5E2 SWL4 C9 M2 AR M3

Parnell Wy Nicholson Rd Ballycastle Loop Merrion Rmbl

Legend

- Study Area
- Swale
- Basin

Logging locations

- Basin Edges
- Bubble Up Pits
- Culverts
- Manholes
- Side Entry Pits
- Swales

0 10 20 30 40 50 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 29/03/2021

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Scale: 1:1,000

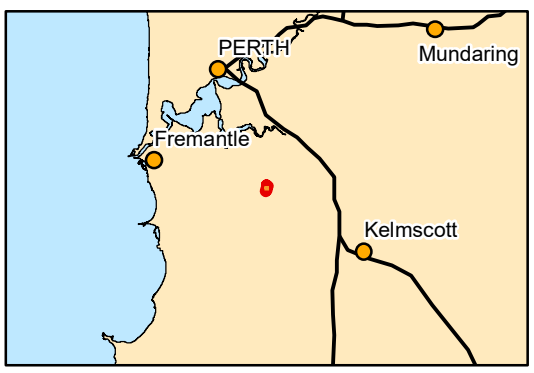

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Figure 3.22: Drainage infrastructure and surface water runoff within the Study Area (central section)

397634 397734 397834

6448500 6448400 6448300 6448200

AR C13 SEP16 BUP5 B5E1 C14 B5E2 SEP17 SEP18 B5E3 SEP8 SEP9 SEP9B SEP10 SEP11 SEP2 BUP2 B1E3 B1E4 B1E2 C1 B1E5 B1E1 SEP1 BUP1 AR B2E4 C3 B2E5 C2 AR SEP3 B2E3 B2E1 B2E2 AR C9 M2 SWL4 SWL3 SWL2 SWL1 AR C8 SEP6 SEP7 M1 C7 C6 C5 B3E2 SEP5 SEP4 AR B3E1 C4

Nicholson Rd

Tramore Tam

Merrion Rmbl

Clontarf Tce

Legend

- Study Area
- Swale
- Basin

Logging locations

- Basin Edges
- Bubble Up Pits
- Culverts
- Manholes
- Side Entry Pits
- Swales

0 10 20 30 40 50 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 29/03/2021

N

biologic Environmental Survey

Scale: 1:1,000

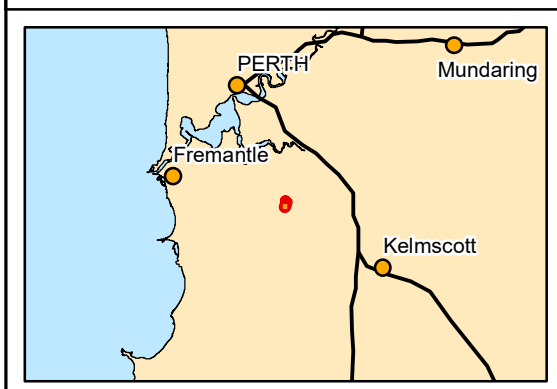

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Figure 3.23: Drainage infrastructure and surface water runoff within the Study Area (southern section)

4 THREATENING PROCESSES

This section discusses and provides an overview of the key threatening process occurring within or with the potential to occur in the Study Area. To help conserve the ecological and hydrological values of the Study Area the following threatening process are to be managed by the City's Natural Areas and Parks teams and any adjacent landowners. All these parties are responsible for the on-ground management of the processes mentioned below.

4.1 Weeds and Invasive Flora

Weeds and invasive species are one of the major threats to the conservation of biological diversity across nearly all biogeographical regions on earth (Adair & Groves, 1998). Environmental weeds and invasive flora may be defined as those introduced plants which have become naturalised and have invaded natural ecosystems (Adair & Groves, 1998). Weeds and invasive species within natural areas can cause a decline in native species richness and diversity, ecosystem diversity and flora genetic diversity (Adair & Groves, 1998). They do this by impacting environmental values through:

- Competing with native species for space, nutrients and sunlight
- Producing large amounts of seed and rapidly spread through disturbed areas
- Contributing to soil disturbance, loss of native plant cover and changed/altered burning patterns
- Reduced habitat for native animals (Australian Weeds Committee, 2015).

Introduced species were observed throughout the Study Area but were most dominant in previously disturbed and/or modified sections (see sections 3.7.2.6 and 3.7.2.7). These sections included the boundary of the Study Area, adjoining pathways and walkways, previous fire access tracks and along the Nicholson Road verge side. It is recommended that these invasive species be controlled through an integrated weed management strategy (see Section 5), to preserve the conservation and ecological values of the Study Area.

4.2 Feral Fauna

Rabbits, foxes and feral cats are listed under the EPBC Act as key threatening processes to the conservation of biodiversity in Australia. Introduced species pose a range of potential impact sources to native fauna species in Perth and the surrounds. A total of 17 introduced fauna species have the potential to occur within the Study Area, based on the results of the desktop assessment, comprising nine mammals, seven birds and one reptile (Section 3.9.6). Nine feral vertebrate species were recorded from the current field survey (53 % of those with the potential to occur).

These animals can have significant impacts on native species including:

Predation on native fauna species

The most critical impact caused by the presence of introduced species is the predation of native fauna. Native fauna in fragmented or disturbed environments are likely to be exposed to higher levels of fox predation from the predators preferences for human-modified environments including roads (Hradsky *et*

al., 2017). In 2012, predation accounted for 30 % (*n* = 113) of reported quenda deaths, with the vast majority (98 %) of reported predated events from introduced mammal species (cats, dogs, or foxes) (Howard *et al.*, 2014). Predation by foxes is a significant factor in the decline in abundance of western brush wallaby (Woinarski *et al.*, 2014a), and the species has increased in abundance where foxes have been controlled. Native fauna form a large proportion of a cat's diet (Doherty *et al.*, 2015a). On average, a pet cat will predate on 32 mammals, 38 birds and 40 reptiles a year (Legge *et al.*, 2020). Although adult quenda may be less susceptible to cat predation, juvenile quendas are particularly at risk from predation due to their smaller size (DEC, 1998). In some areas of Perth, the local decline in populations of blue wrens has been attributed to domestic cats (Banks & Hughes, 2012; BirdLife Australia, 2017).

Competition with native fauna for food and shelter

A number of the introduced fauna recorded or with the potential to occur within the Study Area are likely to compete with native fauna for resources. Rainbow lorikeets are a known aggressive nest and feeding competitor with other avian species, in particular black cockatoo (DoEE, 2017a), other parrot species (Olsen *et al.*, 2006) and arboreal mammals. Feral European honeybees (*Apis mellifera*) are also known to compete with native fauna species for tree habitat (DoEE, 2017a). Although not recorded during the current survey, feral bees are likely to occur. Black rats are thought to compete with other ground-dwelling mammals such as bush rats and bandicoots due to the overlap in diet and habitat (Banks & Hughes, 2012).

Habitat loss, degradation, and fragmentation

Introduced grazing species can have a significant impact on the environment. European rabbit (*Oryctolagus cuniculus*) grazes on native vegetation, including threatened plants, and competes with native animals for food and habitat (DSEWPaC, 2011a). The species may also impact on revegetation efforts via eating seedlings and seeds and grazing closer to the ground than other species (DSEWPaC, 2011a). Rabbits will also preferentially graze on native vegetation over weeds and exotic plants, as such increasing the abundance of weeds (Parker *et al.*, 2006). The species was not recorded during the current field surveys but were recorded 1.7 km west in the Jandakot Regional Park in 2019 (DBCA, 2020e), and as such is considered possible to occur in the Study Area.

Spreading diseases

A number of the introduced fauna recorded or with the potential to occur within the Study are known to be vectors of disease. For example, 38 % of cats in Australia are known to carry the *Toxoplasma gondii* infection, known to be fatal to infected wildlife such as quenda (BirdLife Australia, 2017). Cats are known to occur within the Study Area. Introduced rodent species such as those recorded in the Study Area (black rat *Rattus rattus* and house mouse *Mus musculus*) can introduce disease and parasites, including helminths, bacteria, protozoa and viruses. (Banks & Hughes, 2012; Bettink, 2011).

4.3 Inappropriate Access

Inappropriate access can cause a number of negative impacts within natural areas, and is caused through the unauthorised access by vehicles, motor bikes, bicycles and foot traffic from humans as examples. The effects of inappropriate access can include:

- damage to understorey vegetation (Scheltema *et al.*, 1995) and loss of plant cover and biomass (Newsome *et al.*, 2002);
- changing understorey plant composition (Hamberg *et al.*, 2008) including loss of sensitive species, and establishment of weeds (Newsome *et al.*, 2002);
- the creation of tracks, which can act as a conduit for spreading weeds (Del Marco, 2004);
- reduction in the height of vegetation (Newsome *et al.*, 2002);
- soil compaction (Newsome *et al.*, 2002);
- soil erosion (Scheltema *et al.*, 1995) (Newsome *et al.*, 2002); and
- reduction in insect abundance and distribution (Dixon *et al.*, 1995).

As well as environmental impacts, inappropriate access can also have social impacts that can lead to issues such as rubbish dumping, green waste dumping and the establishment of bush cubbies and campsites as well as leading to an increase in antisocial behaviour. Historical access can be seen throughout the Study Area through the occurrence of old vehicle tracks, trampled vegetation from foot traffic, bike jumps and tracks and presence of cubbies.

4.4 Diseases and Pathogens

Plant diseases and pathogens have a potential to negatively affect biodiversity within natural areas by causing deaths and decline in native vegetation populations. A major threat to the biodiversity of south-west of Western Australia is dieback, caused by the pathogen *Phytophthora cinnamomi* (Dieback Treatment Services, 2020). Dieback is also listed as a threatening process under the EPBC Act. This introduced water mould kills up to 40 % of all native plant species in an area spanning from Kalbarri to Cape Arid east of Esperance in areas that receive 400 mm or more of rainfall a year (Dieback Treatment Services, 2020). It is spread by spore movement through soil disturbance, plant material and/or water movement (Dieback Treatment Services, 2020). Loss and degradation of habitat by secondary impacts such as introduction of dieback caused by *Phytophthora cinnamomi* (and other plant diseases) are a listed threat to black cockatoo species (DSEWPaC, 2012a; EPA, 2019). Dieback can alter the structural and floristic composition of quenda habitat and food resources (Brown & Main, 2010; Environment Australia, 2001). The entirety of the Study Area is infested with dieback (Section 3.8). Dieback is particularly deadly to plants within the following families (Woodman, 2010):

- Proteaceae (*Banksia, Grevillea*, *Hakea* etc);
- Ericaceae (*Conostephium*, *Leucopogon*, *Styphelia* etc);
- Myrtaceae (*Eremaea*, *Eucalyptus, Calothamnus* etc); and
- Xanthorrhoeaceae (*Xanthorrhoea*).

Plants from these families are used as key indicator species in looking for dieback infections within natural areas. Appropriate management recommendations to minimise the impact of this threat are described in Section 5.6.

4.5 Vandalism

Vandalism could be defined as the destruction or damage of infrastructure and environmental values within a natural area. Vandalism can include damage to/or from:

- Rubbish dumping;
- Green waste dumping;
- Graffiti;
- Illegal vegetation clearing or removal of dead wood/logs;
- Tampering/destroying native species;
- Damage to infrastructure such as fencing, signage, bollards, gates, and benches etc.; and
- Creation of bike jumps/tracks.

All the threats mentioned above have the potential to not only cause an increase in the spread of weeds and diseases, but it can also diminish the visual aspect and aesthetics of the Study Area. This could have negative social impacts on residents living near or around the Study Area. Vandalism also has the potential to increase fuel loads within natural areas leading to an increased fire risk. The removal of dead wood in the form of fallen branches and logs removes important microhabitat features for fauna such as small reptiles.

4.6 Fire

Increased or decreased fire frequency can have a multitude of effects on biodiversity and ecological processes. Ramalho *et al.* (2014) found that Banksia Woodland remnants in the Perth metropolitan region are burnt more frequently in areas with a higher incidence of human activities. The region experiences many hundreds of unplanned bushfires ignited by human activities and lightning (Whitford *et al.*, 2015). Change in fire frequency can also be associated with (City of Rockingham, 2017):

- Reduced rain fall
- Higher global temperatures
- Urban development
- Arson events

Fire is a naturally occurring phenomena across the south west of Western Australia and is vital to the regeneration of ecosystem function (Doherty *et al.*, 2015b). However, the frequency and intensity of fires is key to maintaining and enhancing ecosystem function (Driscoll *et al.*, 2010). Hot, intense fires in late spring and summer may be detrimental to the regenerative capacity of the natural environment, while cool, fires in autumn prior to winter rains allows the natural environment to regenerate and improve ecosystem function (Driscoll *et al.*, 2010). Naturally occurring fires also plays a role in the germination and flowering/ seed set of many native flora species, including threatened and priority listed species.

Some of the threats to biodiversity in natural environments by changes in fire frequencies include reduced reproduction rates of native species, increased recruitment of weeds and changes to vegetation structure. Fire is listed as a threatening process for conservation significant fauna such as black cockatoos as a significant factor in the fall of hollow, mature, and stag trees (Parnaby *et al.*, 2010), and can impact the survival of local populations through removal of foraging habitat (Johnstone *et al.*, 2011). As with other small Australian mammals, bandicoot numbers have been recorded as increasing in the years proceeding fire events, attributed to the gradual increase in vegetation density preferred by the species (Brown & Main, 2010). In New South Wales, recently burned habitats (0-20 years) appear to be less favoured by the species (Claridge & Barry, 2000), and fire events have been known to cause the local extinction of a population of southern brown bandicoots in the eastern states (Brown & Main, 2010). For potentially occurring conservation significant reptile species, fire can be a significant threat. *Lerista lineata* relies on dense litter ground cover and other debris for shelter (Maryan & Gaikhorst, 2016). Although there is some evidence that the species is able to survive and disperse into recently burned areas (Carati, Unpublished), the long-term viability of populations in fire-affected areas is unclear, as the event may increase exposure to predation (Gaikhorst *et al.*, 2017). There are also social and economic impacts from fire, including the threat to human lives, homes and businesses surrounding natural areas.

Management of fire hazards within the Study Area and surrounding natural areas requires co-operation and consistency with the requirements and processes of the City's Bushfire Risk Management Plan (City of Gosnells, 2020a).

4.7 Hydrological Changes

Reduction in groundwater levels, due to an increase in abstraction coupled with a decrease in annual rainfall, has been identified as a long term threat to ecosystems on the Swan Coastal Plain (City of Rockingham, 2017). Hydrological changes within natural ecosystems can have a huge effect on plant survival and decreases and even increases in ground water level can lead to plant deaths and changes in vegetation structure and composition. Hydrological changes in natural areas can occur due to:

- Increased development surrounding natural areas;
- Increased/decreased rainfall;
- Ground water extraction;
- Climate change;
- Loss of vegetation;
- Introduction of invasive plants and animals;
- Pollution; and
- Salinity and inundation (DBCA, 2018b).

With the presence of three Conservation-Category Wetlands present in the Study Area (DBCA, 2019), as well as several large swales and drains providing habitat and water resources for a number of species, the impact of any hydrological changes could be significant within the Study Area, and have the potential to affect species assemblages and densities.

A portion of the Study Area is at high to moderate risk of having acid sulfate soils occurring within 3 m of natural soil surface (Class 1); the remainder of the Study Area is at low to moderate risk (Class 2) (DWER, 2020). Changes to saturated soils within the watertable such as excavation, compaction or dredging, have the potential to expose these soils to oxygen thereby releasing deleterious metals and nutrients into wetlands and drainage systems (DER, 2015).

4.8 Climate change

Climate change poses significant risks to economies, communities and the natural environment (DoEE, 2015). Human induced activities such as the burning of fossil fuels has spurred on climate change at a rapid rate, leaving ecosystems and species unable to adapt and evolve fast enough to the changing environment (Hardy, 2003). Australia has already seen an increase of 0.9°C in average temperatures since the 1950's (DoEE, 2015), and Western Australia is experiencing a trend of increasing temperatures and declining rainfall (DoEE, 2016b). Other changes being observed over the 20th century include increases in global average air and ocean temperature, widespread melting of snow and ice leading to rising global sea levels (DoEE, 2015).

Scientists predict that as the unique biodiversity and ecosystems in south-western Australia are particularly sensitive to changes in temperature and rainfall, the capacity of these natural systems to adapt to climate change is limited (DoEE, 2015). There for it is everyone's responsibility to help mitigate the effects of climate change. Local governments are on the frontline in dealing with the impacts of climate change and have an essential role to play in ensuring that particular local issues are considered in the overall adaption response (DoEE, 2015). Local governments such as the City are well positioned to inform state and federal governments about the on-ground needs of local and regional communities and to respond to local changes (DoEE, 2015).

Mitigating the impacts of climate change undoubtedly requires a global response, however it is recognised that healthy ecosystems are likely to be more resilient in the face of climate change (DoEE, 2017b). The best recommended actions for the City to take in mitigating the effects of climate change is to start building resistance within natural areas. This means creating healthy, functioning and resilient environments by managing threats to habitat such as weeds and feral animals, managing water resources, and revegetating degraded areas with healthy genetically diverse species (DoEE, 2017b). Installing green initiatives within urban setting such as green spaces and increased trees to reduce urban heat are great ways for Councils to decrease their climate footprint.

5 RECOMMENDATIONS AND IMPLEMENTATION

5.1 Protected areas

Historically, the SCP bioregion has been heavily cleared (approximately 60%). Small remnant patch sizes make communities more vulnerable to disturbances such as invasion by weeds or feral animals, while separation between patches disrupt ecological processes that support the health of the community (DoEE, 2016a). As the majority of the remnant vegetation within the Study Area is intact native vegetation in excellent condition, this itself is considered significant vegetation and local natural area and should be protected at its entirety.

More specifically, three significant areas located within the Study Area are in need of protecting. The first to be considered as a protected area is the Federally listed Banksia woodlands of the Swan Coastal Plain IBRA Region TEC (WA (P3), EPBC (T-EN)) or vegetation type BaEmBi (Figure 3.9). This is a priority area for protection and holds a high conservation value. It is considered crucial for the persistence of the threatened black cockatoo species, providing important foraging resources and some small patches of breeding habitat (TSSC, 2016). The community also provides core habitat for the skink species *Lerista lineata* (TSSC, 2016). The other two sections of priority are the Conservation Category Wetlands (Damplands) located in the middle and northern sections of the Study Area (Figure 3.10). All the recommendations and implementations mentioned in the sections below all contribute to the protection, maintenance and rehabilitation of these areas and the surrounding vegetation.

5.2 Signage

Signage is a great way to engage local communities with natural areas. Signs can provide educational information, warnings for potential hazards (e.g., feral animal control), and factors to look out for such as local wildlife. There are currently already warning signs for vehicles about the presence of bandicoots within the reserve (Plate 5.1), however there is a potential for strong community engagement with educational signage. Educational signs could include information on:

- The reserves regional conservation significance;
- The presence of a threatened ecological community (Banksia woodland TEC);
- The presence and significance of CCW wetlands;
- The significance of the reserve for wildlife populations including bandicoots, reptiles, and frogs;
- Periods of feral animal control;
- The presence of priority listed flora;
- The hydrological value this reserve provides within urban environments;
- Advice against littering, vandalism, and entry into vegetated areas; and
- The significance of ecological linkages within urban environments, and how to create “stepping stones” for wildlife and insects through residents planting native vegetation within their own gardens.

These signs could be placed along the limestone track through the middle of the reserve or along the soon to be constructed footpath on Nicholson Road.

Informational signage could be useful in areas undergoing revegetation as this will help to keep the local community informed with the City's plans for the reserve. Signs denoting revegetation areas will also help to prevent public access and trampling to increase the survival rate of plants, including phrases such as "revegetation in progress" or "revegetation area, please do not disturb". The location of these signs should be placed along the heavily revegetated section on Ballycastle Loop and in any new revegetation areas easily visible to residents. It is also suggested that "No Dumping" signs be placed along the northern boundary of the reserve adjacent to the shopping centres to help address the issues of rubbish and green waste dumping onto the firebreak. Signage should be erected during periods of annual feral animal control, advising the community of the presence of traps, and that all pets should remain on a lead in the reserve.

Plate 5.1: Wildlife signage located around the reserve (Biologic Photos)

5.3 Revegetation

Revegetation of the Study Area is recommended to improve and maintain the biodiversity values of the wetland areas and *Banksia* woodland. The aim of revegetation is to establish native plant cover and reduce competition from invasive weeds, thereby providing a buffer for adjacent vegetation of good or better condition. Adjacent vegetation types were used as reference ecosystems with recommended species being those that occur naturally in these vegetation types. Recommended species are presented in Table 5.2, Table 5.3, Table 5.4, Table 5.5 and Table 5.6 below. It should be noted that these represent an ideal species list but will depend on availability. In addition, some of the species listed may have complex dormancy, seed viability, or seed collection issues (Stevens *et al.*, 2016).

Plant numbers have been calculated based on recommended planting densities outlined in the City's revegetation guidelines (City of Gosnells, 2020c) (Table 5.1). For areas that already have some vegetation but require additional filling in (Infill), planting densities have been halved. The planting

densities for herbs, sedges and rushes were higher relative to large shrubs. In order to best replicate the reference ecosystems being used for revegetation, density of the dominant species were increased relative to less common species. The total number of plants required allows for a 20 % mortality rate. Consideration was given to ensuring the revegetation maintained existing firebreaks and formal access tracks.

Table 5.1: Recommended planting densities of tubestock (based on City of Gosnells, 2020c)

Lifeform	Dryland areas		Wetland areas	
	Bare (per m^2)	Infill (per m^2)	Bare (per m^2)	Infill (per m^2)
Herbs, shrubs, sedges and rushes (combined)	4 plants	2 plants	5 plants	2.5 plants
Trees	0.1 tree	0.05 trees	0.1 tree	0.05 trees

Dieback resistant species

Due to the presence of *Phytophthora* dieback throughout the entire Study Area, information on whether species are susceptible or resistant to *Phytophthora* has been included in the planting lists (DEC, 2012; Hardy & McComb, 2020). Response of native species to this pathogen can vary and affected areas do not always show obvious signs of *Phytophthora* being present. There were several individuals of susceptible species found within the reference vegetation communities including *Dasypogon bromeliifolius*, *Xanthorrhoea preissii*, *Banksia attenuata*, and *Patersonia occidentalis* subsp. *occidentalis*, that were alive and persisting. Due to the presence of *Phytophthora* Dieback, the suggested planting density of resistant species has been increased whilst the density of susceptible species has been decreased, in order to maximise survival rates of seedlings planted.

Seed provenance

Collecting seed of local provenance to ensure local adaptation is a widely accepted restoration practise; however in landscapes which are largely fragmented, collection of seed from too close may put plant populations at an elevated risk of genetic in-breeding (SERA, 2018). City of Gosnells guidelines require that plants be propagated from the same vegetation complex and nearby Natural Area (City of Gosnells, 2020c). Locally collected seed should be from large, healthy populations, and preferably with collections made from multiple areas to increase the genetic diversity being introduced into the Study Area. Restoration programs are increasingly looking at sourcing seed from hotter/ drier areas within a species range to account for increased temperatures and decreased rainfall as a result of climate change (Prober *et al.*, 2015). This may be something that the city may wish to investigate further.

5.3.1 Dryland revegetation

The recommended areas for dryland revegetation include any old tracks running through the remnant bushland, bare areas within existing revegetation, and degraded areas alongside the main firebreak. Vegetation mapped as damplands still fits within the dryland revegetation category, while the remaining vegetation type is considered to be wetland. Dryland areas proposed for revegetation (0.74 ha total) and their reference ecosystem are as follows (Figure 5.1):

- *Banksia attenuata* woodland (BaEmB) (Area D1 – 0.03 ha)
- *Melaleuca preissiana* woodland over *Kunzea glabrescens* (MP Kg) (Area D2 – 0.19 ha)
- *Melaleuca preissiana* woodland over *Xanthorrhoea preissii* (Mp PefHa) (Area D3 – 0.24 ha)
- *Melaleuca preissiana* / *Allocasuarina fraseriana* / *Eucalyptus marginata* woodland (MpAfEm) (Area D4 – 0.28 ha)

Area D1 is an old narrow track which runs through the Banksia woodland in the southern section of the Study Area. The track is approximately 3 m wide and is connected to degraded sections on either side of the Study Area, thereby creating an opportunity for weed spread throughout the Banksia woodland (a PEC/TEC). It covers a total area of 0.03 ha and is bare except for scattered weeds. 1230 plants are recommended for revegetation Area D1 (Table 5.2).

Table 5.2: Revegetation species for *Banksia attenuata* woodland (Area D1)

Lifeform	Species name	Dieback response	Planting densities per m^2	Plant numbers
Herbs	*Conostylis juncea*	Unknown	0.3	90
	Dasypogon bromeliifolius	Susceptible	0.1	30
	Lomandra caespitosa	Unknown	0.2	60
	Patersonia occidentalis var. *occidentalis*	Susceptible	0.1	30
	Phlebocarya ciliata	Resistant	0.5	150
	Stylidium brunonianum	Resistant	0.3	90
	Tricoryne elatior	Resistant	0.3	90
	Xanthosia huegelii	Resistant	0.3	90
Sedges and rushes	*Hypolaena exsulca*	Unknown	0.1	30
	Lepidosperma pubisquameum	Unknown	0.1	30
	Mesomelaena graciliceps	Unknown	0.3	90
	Schoenus pedicellatus	Unknown	0.2	60
	Schoenus sublateralis	Unknown	0.2	60
Shrubs	*Bossiaea eriocarpa*	Susceptible	0.1	30
	Dampiera linearis	Resistant	0.3	90
	Hibbertia vaginata	Unknown	0.2	60
	Hypocalymma angustifolium	Resistant	0.2	60
	Kunzea glabrescens	Unknown	0.1	30
	Xanthorrhoea preissii	Susceptible	0.1	30
Combined density for understorey = 4				
Tree	*Banksia attenuata*	Susceptible	0.1	30
Combined density for trees = 0.1				
Total number of plants required = 1230				

Area D2 consists of degraded areas either side of limestone footpath between Nicholson Rd and Merrion Ramble. This area is heavily infested by weeds, including the Declared Pest **Echium plantagineum*. It has been indicated by the City of Gosnells that this track will be formalised and potentially widened, presenting an opportunity for revegetation and weed control both during and following track upgrades.

However, weed control may also be necessary prior to upgrades. It covers a total area of 0.19 ha. The revegetation along this path is to consist of low ground cover species only; additional species from other vegetation units in the Study Area were added to increase the diversity and visual amenity. 7600 plants are recommended to revegetate Area D2 (Table 5.3).

Table 5.3: Revegetation species for *Melaleuca preissiana* woodland over *Kunzea glabrescens* (Area D2)

Lifeform	Species name	Dieback response	Planting densities per m^2	Plant numbers
Grasses	*Amphipogon amphipogonoides*	Susceptible	0.1	190
	Austrostipa compressa	Unknown	0.2	380
Herbs	*Anigozanthos manglesii* subsp. *manglesii*	Unknown	0.3	570
	Comesperma calymega	Resistant	0.3	570
	Conostylis juncea	Unknown	0.3	570
	Dasypogon bromeliifolius	Susceptible	0.1	190
	Stylidium brunonianum	Resistant	0.3	570
	Thysanotus manglesianus	Unknown	0.2	380
	Xanthosia huegelii	Resistant	0.3	570
Sedges and rushes	*Hypolaena exsulca*	Unknown	0.2	380
	Mesomelaena graciliceps	Unknown	0.3	570
	Schoenus pedicellatus	Resistant	0.3	570
Shrubs	*Aotus procumbens*	Unknown	0.3	570
	Gastrolobium linearifolium	Unknown	0.2	380
	Hibbertia hypericoides	Unknown	0.3	570
	Lechenaultia expansa	Unknown	0.3	570
Combined density for understorey = 4				
Total number of plants required = 7600				

Area D3 consists of three areas; 1) an old track heading into *Melaleuca preissiana* woodland in the mid-section of the Study Area; 2) a straight section of thin vegetation between the road verge of Nicholson Road and the central portion of the Study Area; and 3) a section of dense planted cultivar of *Grevillea* sp. alongside Ballycastle Loop. These areas are mainly bare except for scattered weeds and cover a total of 0.24 ha. The section of *Grevillea* has been categorised as bare on the assumption that the City will remove and re-plant with native flora species as part of the recommended revegetation works. 9840 plants are recommended to revegetate Area D3 (Table 5.4).

Table 5.4: Revegetation species for *Melaleuca preissiana* woodland over *Xanthorrhoea preissii* (Area D3 – 0.24 ha)

Lifeform	Species name	Dieback response	Planting densities per m^2	Plant numbers
Herbs	*Conostylis juncea*	Unknown	0.2	480
	Dasypogon bromeliifolius	Susceptible	0.05	120
	Patersonia occidentalis var. *occidentalis*	Susceptible	0.05	120

Lifeform	Species name	Dieback response	Planting densities per m²	Plant numbers
	Phlebocarya ciliata	Resistant	0.3	720
	Thysanotus multiflorus	Susceptible	0.05	120
	Xanthosia huegelii	Resistant	0.2	480
Sedges and rushes	*Hypolaena exsulca*	Unknown	0.2	480
	Lepidosperma longitudinale	Unknown	0.3	720
	Lepidosperma pubisquameum	Unknown	0.2	480
	Lyginia barbata	Resistant	0.2	480
	Mesomelaena graciliceps	Unknown	0.2	480
	Mesomelaena tetragona	Resistant	0.25	600
	Schoenus efoliatus	Unknown	0.2	480
Shrubs	*Acacia pulchella* var. *pulchella*	Resistant	0.2	480
	Acacia stenoptera	Susceptible	0.05	120
	Boronia dichotoma	Unknown	0.2	480
	Euchilopsis linearis	Unknown	0.2	480
	Hypocalymma angustifolium	Resistant	0.2	480
	Jacksonia furcellata	Susceptible	0.05	120
	Lechenaultia expansa	Unknown	0.2	480
	Melaleuca seriata	Unknown	0.2	480
	Pericalymma ellipticum var. *floridum*	Susceptible	0.05	120
	Philotheca spicata	Unknown	0.2	480
	Xanthorrhoea preissii	Susceptible	0.05	120
Combined density for understorey = 4				
Trees	*Melaleuca preissiana*	Resistant	0.1	240
Combined density for trees = 0.1				
Total number of plants required = 9840				

Area D4 (0.28 ha) consists of bare areas at the northernmost portion of the Study Area. This includes an old firebreak/ track crossing through vegetation type MpAfEm and an area which has had minimal revegetation and is predominantly bare. There are weeds present as well as a few isolated native shrubs. 11,480 plants are recommended to revegetate Area D4 (Table 5.5).

Table 5.5: Revegetation species for *Melaleuca preissiana* / *Allocasuarina fraseriana* / *Eucalyptus marginata* woodland (Area D4 – 0.28 ha)

Lifeform	Species name	Dieback response	Planting densities per m²	Plant numbers
Herbs	*Anigozanthos manglesii* subsp. *manglesii*	Resistant	0.2	560
	Conostylis juncea	Unknown	0.15	420
	Dasypogon bromeliifolius	Susceptible	0.05	140
	Laxmannia ramosa subsp. *ramosa*	Unknown	0.2	560
	Lomandra caespitosa	Unknown	0.1	280
	Lomandra preissii	Resistant	0.2	560

Lifeform	Species name	Dieback response	Planting densities per m^2	Plant numbers
	Patersonia occidentalis var. *occidentalis*	Susceptible	0.05	140
	Phlebocarya ciliata	Resistant	0.3	840
	Thysanotus manglesianus	Unknown	0.15	420
	Xanthosia huegelii	Resistant	0.25	700
Sedges and rushes	*Desmocladus fasciculatus*	Unknown	0.15	420
	Hypolaena exsulca	Unknown	0.15	420
	Lepidosperma pubisquameum	Unknown	0.15	420
	Lyginia barbata	Resistant	0.2	560
	Mesomelaena graciliceps	Resistant	0.2	560
	Schoenus rigens	Resistant	0.25	700
Shrubs	*Acacia pulchella* var. *pulchella*	Resistant	0.15	420
	Adenanthos obovatus	Susceptible	0.05	140
	Bossiaea eriocarpa	Susceptible	0.05	140
	Euchilopsis linearis	Unknown	0.15	420
	Gompholobium tomentosum	Resistant	0.25	700
	Hemiandra pungens	Resistant	0.2	560
	Hypocalymma angustifolium	Resistant	0.15	420
	Jacksonia furcellata	Susceptible	0.05	140
	Lechenaultia expansa	Unknown	0.15	420
	Xanthorrhoea preissii	Susceptible	0.05	140
Combined density for understorey = 4				
Trees	*Allocasuarina fraseriana*	Resistant	0.02	56
	Eucalyptus marginata	Susceptible	0.02	56
	Melaleuca preissiana	Susceptible	0.06	168
Combined density for trees = 0.1				
Total number of plants required = 11,480				

5.3.2 Wetland revegetation

Wetland swale areas in the middle portion of the Study Area are in need of additional revegetation in order to increase vegetation cover, outcompete weeds, and improve the biofiltering function of the wetlands. In particular, they require revegetation to a higher sedge density such as that found in wetland revegetation on the southern end of the Study Area. Wetland areas proposed for revegetation and their reference ecosystem are as follows (Figure 5.1):

- *Melaleuca preissiana* woodland over *Lepidosperma longitudinale* sedgeland (Mp Ll) (Area W1 – 1.42 ha)

Suggested species were chosen from surrounding vegetation types to the Study Area and were ranked according to their ability to tolerate inundation and thus to which planting region they belong. Species which can grow in shallow water or saturated soil are suggested for the lowest parts of the swales (Basin), species which can tolerate a degree of seasonal inundation are recommended for the slopes of the swales (Bank), and species which generally grow in lower parts of the landscape are suggested for floodplain

surrounding the swales (Flats) (Figure 5.2). 36,210 plants are recommended to revegetate the wetland areas W1 (Table 5.6).

397450

397950

6448656

6448156

Parnell Wy

Ranford Rd

Ballycastle Loop

Nicholson Rd

Clontarf Tce

Merrion Rmbl

Tramore Tarn

Legend

- Study Area

Revegetation Areas

- BaEmBi - D1 (0.03 ha)
- MP Kg - D2 (0.19 ha)
- Mp LI - W1 (1.42 ha)
- Mp PefHa - D3 (0.24 ha)
- MpAfEm - D4 (0.07 ha)
- MpAfEm - D4 (0.21 ha)

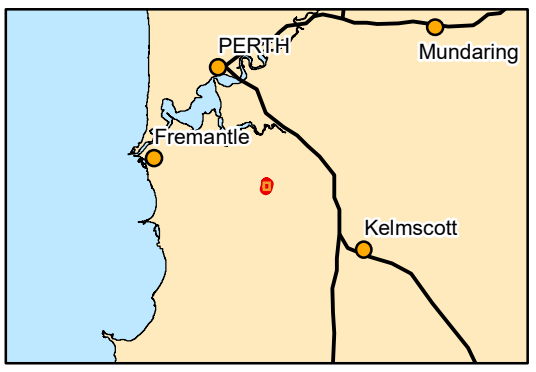
0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 29/03/2021

N

biologic Environmental Survey

Scale: 1:3,000



CITY OF GOSNELLS

Nicholson Rd Biological Survey and Management Plan

Figure 5.1: Recommended revegetation areas

Figure 5.2: Cross-section of wetland swales with different planting regions

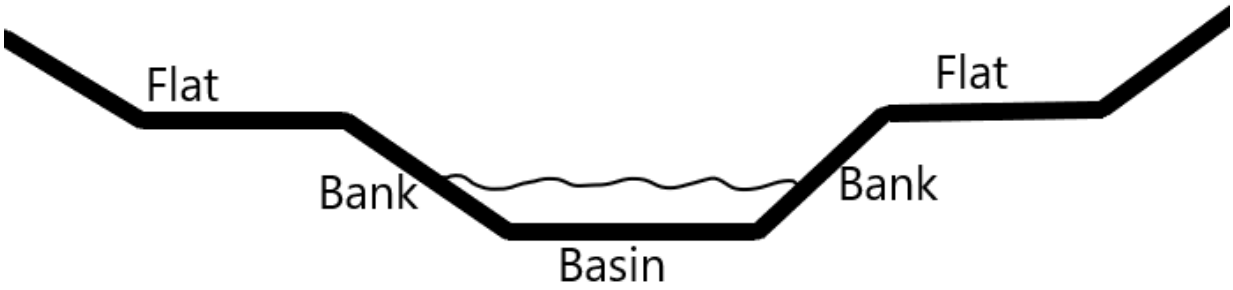


Table 5.6: Revegetation species for wetland revegetation (Area W1 – 1.42 ha)

Lifeform	Species name	Dieback response	Planting region	Planting densities per m^2	Plant numbers
Herbs	*Centella asiatica*	Unknown	Bank, Basin	0.2	2840
	Lobelia anceps	Unknown	Bank	0.05	710
	Siloxerus humifusus	Unknown	Flat	0.05	710
Sedges and rushes	*Baumea juncea*	Unknown	Basin	0.25	3550
	Bolboschoenus caldwellii	Unknown	Basin	0.25	3550
	Cyathochaeta avenacea	Resistant	Flat	0.1	1420
	Hypolaena exsulca	Unknown	Bank, Flat	0.05	710
	Isolepis marginata	Unknown	Basin, Bank	0.1	1420
	Juncus kraussii	Unknown	Basin, Bank	0.25	3550
	Lepidosperma longitudinale	Unknown	Bank, Flat	0.25	3550
	Lepidosperma striatum	Unknown	Bank	0.05	710
	Mesomelaena graciliceps	Resistant	Bank, Flat	0.1	1420
	Schoenus rigens	Resistant	Bank, Basin	0.1	1420
Shrubs	*Aotus procumbens*	Unknown	Flats	0.05	710
	Astartea affinis	Unknown	Basin, Bank, Flat	0.2	2840
	Boronia dichotoma	Unknown	Flat	0.05	710
	Euchilopsis linearis	Unknown	Flat	0.05	710
	Eutaxia virgata	Unknown	Flat	0.05	710
	Gompholobium aristatum	Unknown	Bank, Flat	0.05	710
	Hypocalymma angustifolium	Resistant	Bank, Flat	0.1	1420
	Melaleuca seriata	Unknown	Flat	0.05	710
	Pericalymma ellipticum var. *floridum*	Susceptible	Flat, Bank, Basin	0.1	1420
Combined density for understorey = 2.5					
Trees	*Melaleuca preissiana*	Resistant	Bank, Flat	0.05	710

Lifeform	Species name	Dieback response	Planting region	Planting densities per m^2	Plant numbers
					Combined density for trees = 0.1
					Total number of plants required = 36,210

An overall summary of planting density and plants required for revegetation across all areas (Dryland and Wetland) is provided below in Table 5.7. In total, 66,360 plants are recommended for revegetation.

Table 5.7 Summary of revegetation requirements across all areas (Dryland and Wetland)

Revegetation Area	Area (ha)	Planting Density per m^2	Total plants
Dryland			
D1 (bare)	0.03	4 for understorey / 0.1 for trees	1200 understorey / 30 trees
D2 (bare)	0.19	4 for understorey	7600 understorey
D3 (bare)	0.24	4 for understorey / 0.1 for trees	9600 understorey / 240 trees
D4 (bare)	0.28	4 for understorey / 0.1 for trees	11,200 understorey / 280 trees
Subtotal	**0.74**		**30,150**
Wetland			
W1 (infill)	1.42	2.5 for understorey / 0.05 for trees	35,500 for understorey / 710 for trees
Subtotal	**0.74**		**36,210**
Total	**2.16**		**66,360**

5.4 Linkage

Maintaining and creating ecological linkages is one of the most effective strategies for allowing for species and population dispersal. Howard *et al.* (2014) reported that 44 % of reported mortality events of southern brown bandicoot in Perth and Peel regions in 2012 were caused by vehicle strike and was the most common cause of death. ENV (2005a) recommended a fauna linkage corridor between the northern and central wetlands of the Study Area along Nicholson Road, to facilitate the movement of terrestrial fauna across the site. This area (site D3 as described above in Section 5.3) is still in need of revegetation (see Table 3.16); quenda are less likely to disperse along such areas as an absence of a lower vegetation stratum is considered unsuitable habitat.

Consideration should be given to the construction of a fauna underpass to facilitate the movement of populations and individuals between the Study Area and the Jandakot Regional Park. Several sources report that quenda are one of the most likely species in Perth to utilise fauna underpasses (Chambers & Bencini, 2015; ecologia, 1995; Harris *et al.*, 2010); Harris *et al.* (2010) found that bandicoots begin to use underpasses immediately, and utilise them up to 200 times per year. Reptiles, birds, and other mammals (e.g. kangaroos, possums) are also known to utilise such linkages in Perth (Chambers & Bencini, 2015).

5.5 Weed control treatments

Effective weed management requires a strategic and targeted approach with a detailed understanding of the site parameters, vegetation condition, and biology and control methods for the significant weed species present. Resources should be prioritised to weeds with the highest ecological impact and the potential to invade and impact bushland in good or higher condition. In general, annual herbs and grasses, are often not serious bushland weeds (Brown & Brooks, 2002). The highest priority weeds for targeted control within the Study Area are, in order of priority:

- **Gomphocarpus fruticosus* (DP)
- **Echium plantagineum* (DP)
- Woody weeds **Acacia longifolia* subsp. *longifolia* and **Acacia iteaphylla*
- Perennial grasses **Ehrharta calycina*, **Eragrostis curvula*

The control methods for these, and other weed species, are presented in Appendix R. This information represents the ideal method and timing of weed control for each individual species. However, it is not always realistic or efficient to target each individual species, and therefore weed control treatments have been summarised and combined to capture as many species within each weed suite as possible (Table 5.8). As weed cover and restoration works improve the condition of the Study Area, the City may wish to target certain individual species that are still posing a problem.

Table 5.8: Weed control annual schedule

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DEGRADED & BUSHLAND AREAS Weed suite: **Herbaceous** Target species: **Erigeron bonariensis*, **Raphanus raphanistrum*. Method: 1.5-2% glyphosate foliar spraying. **Raphanus raphanistrum* can be hand pulled.												
DEGRADED & BUSHLAND AREAS Weed suite: **Woody** Target species: *Acacia longifolia* subsp. *longifolia*, *Acacia iteaphylla* Method: Hand pull seedlings. Fell mature plants. Monitor site for recruitment from seedbank.												
DEGRADED & BUSHLAND AREAS Weed suite: **Herbaceous** Target species: **Echium plantagineum* Method: Grubbing and cutting for young plants, removing 20 to 40 mm of taproot. Spot spray in late autumn/winter when most seed has germinated for the year with 0.5 g/10 L chlorsulfuron + wetting agent.												
DEGRADED AREAS Weed suite: **Grasses, Herbaceous, Bulbous** Target species: Grasses - **Eragrostis curvula*, **Cynodon dactylon*, **Bromus diandrus*, **Ehrharta calycina*, **Avena barbata*. Herbs - **Lactuca serriola* (prior to elongation of flowering stems), **Pelargonium capitatum*, **Arctotheca calendula*. Bulbs – **Fumaria capreolata* Method: 1% glyphosate foliar spraying												
BUSHLAND AREAS Weed suite: **Herbaceous, Bulbous** Target species: Herbs - **Hypochaeris glabra*, **Lactuca serriola* (prior to elongation of flowering stems), **Pelargonium capitatum*, **Sonchus oleraceus*. Bulbs - **Fumaria capreolata, *Gladiolus caryophyllaceus* Method: 1% glyphosate (biactive form) foliar spraying												
BUSHLAND AREAS Weed suite: **Grasses** Target species: **Ehrharta calycina*, **Ehrharta longiflora*, **Eragrostis curvula*, **Avena barbata*, **Briza minor*, **Briza maxima*, **Cynodon dactylon*, **Pentameris airoides* Method: Fusilade or Quizalofop 1% foliar spraying												
DEGRADED & BUSHLAND AREAS Weed suite: **Woody** Target species: **Gomphocarpus fruticosus* Method: Hand pull small plants prior to fruiting, ensuring to remove as much root material as possible. For larger plants foliar spray with 1.5% glyphosate or cut and paint using 50% glyphosate.												

Locations of **Gomphocarpus fruticosus*, **Echium plantagineum*, **Acacia longifolia* subsp. *longifolia* and **Acacia iteaphylla* are currently small and isolated, and therefore is recommended that these are removed manually as soon as possible in accordance with methods set out in Appendix R (weed locations are found in Appendix H). **Gomphocarpus fruticosus* individuals were at the time of survey immature and small; it is recommended to reassess these individuals and to manually remove them before flowering/fruiting if possible. If the individuals are too large or are fruiting, it is advised to schedule weed control as per Table 5.8. Degraded vegetation units as displayed in Figure 3.9 have the highest weed cover within the Study Area. It is recommended that weed control for these areas is undertaken immediately prior to revegetation (or as close as practicable), to reduce replacement by other weed species. Herbicide use should be avoided where possible to reduce off-target effects. Locations with only small numbers of individuals may be suitable to manual methods as per Appendix R. Weed suite density (high >60%, medium 60-5%, low<5%) was mapped across the Study Area and provided an overview of which areas were most affected by weeds and thus are a priority for weed control (Appendix I).

Local landcare and community groups such as the Armadale Gosnells Landcare Group should be utilised in weed management, particularly for manual weed control. There is also potential to establish a new Friends of Nicholson Road Wetlands group. Field herbaria with targeted weeds and any similar native species should be made and distributed to volunteers and staff involved in weed control. It is recommended that chemical (herbicide) control is carried out by suitably trained local government employees or a licensed contractor.

Regular monitoring of weed control outcomes will ensure success and protection of natural ecosystems within the Study Area. It is suggested to monitor the site quarterly for weeds and for re-application of herbicide when necessary.

5.6 Dieback management/mapping

The dieback assessment conducted by Dieback Treatment Services (2020) (see Section 3.8 for a summary of the report's findings) provided a range of dieback management recommendations. These recommendations were made in the interest of preserving the integrity of native vegetation across the whole site and include:

- Initiating a program for phosphite delivery to any/all surviving susceptible host plants in the reserve, with a priority placed on the Banksia woodland vegetation located on the southern and eastern sides of the reserve. This should be reapplied every three years to maintain maximal protection.
- Install Phytophthora hygiene signage at entrance points to the reserve and vegetated areas informing users of the infested state of the whole reserve and the requirements for hygienic entry and exit from the reserve.
- Restrict vehicle access to designated paths, and only in dry soil conditions.
- Consider using dieback resistant native plants in future re-vegetation efforts.

Due to the whole site being mapped as infested, it is recommended that no future dieback mapping of the reserve is required (Dieback Treatment Services, 2020).

5.7 Feral animal control

Feral animal control is recommended in consideration of the presence of Declared Pests, in particular red fox with the presence of a potential old den. A likely predation event by red fox on a bandicoot was recorded during phase two of the field survey (Section 3.9.6).

The key management objectives for feral animal control are:

1. Ensuring that feral animal control methods are suitable for use in close proximity to urban environments.

Effective fox treatments such as baiting are unsuitable for use in close proximity to residents and domestic animals (Sharp & Saunders, 2005b). Shooting is a humane method of destroying foxes but is not suitable where dense cover is available for foxes, such as the Melaleuca Grassland or Banksia Woodland in the Study Area, or in the vicinity of human habitation (Sharp & Saunders, 2005b). The Standard Operating Procedure for foxes (Sharp & Saunders, 2005b) lists both soft-leg traps and cage trapping as a humane control of foxes appropriate for use in urban environments. Although cage trapping is not as effective for broad-scale control, it can be useful for the small-scale control of nuisance animals, as is likely present in the Study Area. The potential fox den was deliberately caved in by the field team during the current survey.

For cats, the Standard Operating Procedure (Sharp & Saunders, 2005a, 2005b) lists cage trapping as a humane control method appropriate for use in urban environments. Cage trapping where domestic cats are present, or where populations have already been reduced and individual cats need to be targeted, is

deemed a suitable control method. Any microchipped or collared animals should be surrendered to the local ranger or vet for return to their owner.

It is recommended that during any periods of feral animal control, warning signs be installed at all entry points and throughout the Study Area; in addition, correspondence to neighbouring properties should be undertaken prior to feral animal control. All feral animal trapping should be undertaken by a feral animal consultant team with extensive knowledge in the Standard Operating Procedures, relevant federal and State Legislation, and be licenced to undertake such activities.

2. Optimise the use of limited resources by undertaking monitoring to prioritise areas of high feral animal activity.

Regular annual targeted surveying and control programs should be implemented for species of high priority; red foxes and cats. To maximise the effectiveness of the program, concurrent annual surveys and trapping for both species are recommended during late Winter or early Spring outside of school holidays to minimise inference with captured animals and trap damage. This timing coincides with when foxes are less mobile as they are rearing young and their food demands are high (DPIRD, 2018). Den location is an important consideration in efforts to control foxes and protect native prey (Carter *et al.*, 2012). Should the potential den present in the Study Area be found to be active, fumigation using carbon monoxide is a consideration (Sharp & Saunders, 2005b).

5.8 Infrastructure upgrades

Fencing within the Study Area is in relatively good condition, however the shade cloth fence located long Kinsale Parkway on the southern section of the Study Area has the potential to be upgraded. The previous purpose of the shade cloth was to prevent rubbish and material blowing into the reserve from the houses being built along Kinsale Parkway, however now that majority of the building is complete this shade cloth is no longer required (Plate 5.2). The shade cloth is also damaged in locations and has become unattached, with plants beginning to push through. It is recommended that it either be removed or replaced with standard quality fencing or bollards to prevent unauthorised access. It is also recommended that the fence at the end of Kinsale Parkway and Tranmore Turn, be repaired, replaced, or removed.

Plate 5.2 Example of shade cloth fencing in the Study Area.

The City currently has plans to undergo construction of a concrete footpath in the road reserve from Tranmore Turn to Ranford Road to connect existing pathways. This path will run all the way down the Nicholson Road side of the reserve. The City also has plans to formalise the access track off Merrion Ramble to a formal dual use path/firebreak/maintenance track. The plans need to allow a 4 m width for the future pathway and 2 culverts; this means revegetation must be limited within this area to low ground covering species only. It is also recommended that the firebreak/maintenance track located at the northern end of the reserve undergo a clearance of dead wood and vegetation as it is currently quite overgrown. This path has the potential to be formalised with crushed limestone to make maintenance and access easier, with consideration to budgets and time.

5.9 Drainage infrastructure upgrades

The drainage infrastructure assessment by Hyd2o found that overall, the drainage system was functional. Consistent with the *Stormwater Management Manual for Western Australia* (DoE, 2005) assessment of drainage function should be undertaken annually to determine any changes to the system (Section 3.11, Figure 3.21, Figure 3.22, Figure 3.23).

5.9.1 Manual litter collection

Manual litter collection is recommended to improve the overall performance of the drainage system and improve the aesthetic and conservation values of the wetlands. Manual litter collection is required at Locations 1 (bubble up pit) (Figure 3.23), 15 and 21 (side entry pits) (Figure 3.23), and 35, 56, and 58 (culverts) (Figure 3.22, Figure 3.23). Frequency and extent of litter collection should be considered within the scope of the City of Gosnells maintenance team or suitable private contractor.

5.9.2 Physical infrastructure

Location 74 requires a replacement of the headwall as exposed piping was noted (Figure 3.21). Works should be commissioned with the City's engineering specifications for culverts and associated headwalls.

The City has indicated that they will be installing two culverts at either end of the main track running between Merrion Ramble and Nicholson Road, to assist with stormwater runoff and erosion.

5.9.3 Erosion control

Erosion was identified at Locations 48, 71, 73, 74 and 82. Erosion was typically identified as scour type erosion, with sediment likely being transported and deposited into drainage systems. For Location 48, 73, and 74, rock-pitching should be installed alongside the footpath to prevent and minimise gully erosion. In all other locations mentioned above, existing rock-pitching should be extended or realigned to cover a wider area where erosion is observed.

Sedimentation and build-up of organic matter was noted at Locations 15, 35, 41, 53, 56, 58, 67, and 81. Sediment and organic matter should be removed at these locations annually prior to winter without altering the design invert level of drainage infrastructure. The pipe at culvert 19 (Location 81) is partially blocked and needs clearing and ongoing inspection. All sediment and organic matter should be removed via suitable machinery by qualified personnel during dry conditions rather than flushing the sediment through the drainage system. Offsite disposal of sediment and organic matter should be undertaken to ensure it does not re-enter the drainage system.

5.9.4 Water Quality monitoring

The surface water points sampled by Hyd2o are the inflow points for stormwater in the designed drainage system, and as such represent stormwater prior to it being treated in the vegetated basins. As such, it is not possible to relate the surface water quality results to system and infrastructure performance. Given that it would be expected that surface water would only be present at outlet SW01 (C19) in a major rainfall event, it is recommended that samples be taken also at the outlets of the compensating basins to assess system performance in relation to surface water quality. This is consistent with the UWMP (ENV, 2005b).

It should be noted that generally the stormwater entering the system is of reasonable quality (based on a single monitoring event), and it is expected that after biofiltration through the stormwater infrastructure water quality would improve. Ongoing maintenance of vegetation and biofiltration media should continue by the City.

5.10 Implementation

Table 5.9 provides a summary of recommended management actions, including indicative costings, timings, and priorities (High, Medium and Low).

The costings include both labour and materials unless specified otherwise. However, there is the potential to use internal City staff for many of the actions, which will significantly reduce the overall cost. Costings will also depend on the contractors and quotes chosen.

Table 5.9: Summary of implementation in the Study Area

Threat / Issue	No.	Proposed Management Action	Cost (inc. GST)*	Responsible Team	Indicative Timing	Priority (H, M, L)
4.1 Weeds and Invasive Flora	1	Annual weed control: 1. Forming a weed herbarium for the Study Area 2. Application of weed controls 3. Quarterly monitoring of weeds on-site	21 days x ~$80/hr (including materials) = **$13,440** (for 1.3 only)	External weed contractor and/or City operational staff	Annually, throughout the year as per section 5.5	H
	2	Local provenance seed collecting. Revegetation (dryland and wetland areas) in order of priority: 1. D1 (0.03 ha) 2. D2 (dependant on construction of path, see Action no. 7) (0.19 ha) 3. D3 (0.24 ha) 4. W1 (1.42 ha) 5. D4 (0.28 ha) Note: weed control to be undertaken immediately prior to revegetation.	Seed & cutting collection 5 days x $800/day Seed cleaning 3 days x $85/hr Seed bank fee $400/year 66,360 plants at ~$2/seedling Planting 6 days x 3 people at ~$60/hr **$147,800**	External revegetation contractor, volunteers and/or City operational staff	May-June for dryland areas, Aug-Oct for wetland areas. Revegetation is likely to take two (or more) consecutive years, depending on seed collection and revegetation success	H
	3	Gauge interest for developing a Friends of Nicholson Road Wetlands group for volunteering activities	TBD	City operational staff	TBD	L
4.2 Feral Fauna	4	Feral fauna control: annual cage trapping or soft leg-trapping of red fox and cats present within the Study Area	7 days x 2 people at $100/hour = **$7,000**	External feral animal control consultant	Annually, Winter or early Spring	H
	5	Investigate the feasibility of installing a fauna underpass	TBD	TBD	TBD	L
4.3 Inappropriate Access & 4.5 Vandalism	6	Repairing or replacing of fencing using the City's standard specifications for conservation fencing (post and rail): 1. Fencing along the entire length of Kinsale Parkway (replacing existing shade cloth fencing and repairing fencing at southern cul-de-sac end) Approximately 202 m of fence line in total.	Approx. 202 m x $60/m (materials + labour) = **$12,120**	External contractor	Can be done anytime, once	M
	7	Construction of dual use pathway/ emergency access track off Merrion Ramble. (approximately 133 m x 4 m)	2 days x 2 people at $150/hr + materials ($40/m^2) = **$26,080**	External contractor	Can be done anytime, once	M

Threat / Issue	No.	Proposed Management Action	Cost (inc. GST)*	Responsible Team	Indicative Timing	Priority (H, M, L)
	8	Construction of concrete footpath alongside Nicholson Road from Ranford Road to Tranmore Turn (approximately 845 m x 2.5 m)	$40/m^2 (labour included) = **$84,500**	External contractor		M
	9	Placing of informational "Revegetation in progress" signs along Ballycastle Loop and main limestone firebreak track, and a "No Dumping" sign on the northern boundary	3 signs ~$200 each + 4hrs installation at $100/hr = **$1,000**	External contractor	Can be done anytime, once	M
	10	Removal of rubbish and debris throughout the Study Area	1 day x 3 people at ~$80/hr each quarter = **$7,680**	External contractor and/or City operational staff	Quarterly ongoing	M
4.4 Diseases and Pathogens	11	Phosphite application to all susceptible host plants	2 days x 2 people at ~$80/hr (materials included) = **$2,559 (every three years)**	External dieback contractor	3 yearly ongoing	H
	12	Installation of Phytophthora hygiene signage at entrance points to the reserve and vegetated areas	2 signs ~$200 each + 2.5hrs installation at ~$100/hr = **$650**	External contractor	Can be done anytime, once	M
	13	Attach wire brushes to hygiene signage (for brushing boots)	TBD	City operational staff	Can be done anytime, once	L
4.6 Fire	14	Firebreak at northern edge of Study Area adjacent to shopping centre requires re-clearing and limestoning (approximately 235 m x 4 m)	**$17,530** (as per quote)	External contractor	ASAP, once	H
	15	Regular maintenance of firebreaks (limestone firebreaks will make maintenance quicker) - Pruning vegetation - Weed control (as per Action no. 1)	1 day x 1 person at ~$80/hr = **$2,560**	External contractor and/or City operational staff	Quarterly	H
4.7 Hydrological Changes	16	Make changes to mapping of hydrological infrastructure as per Plate 3.12 (remove piped inlet which does not exist).	n/a	City Engineering staff	Can be done anytime, once	L
	17	Replace headwall at location 74	2 days x 2 people at ~$150/hr + materials ~$1500 = **$6,300**	External contractor		M

Threat / Issue	No.	Proposed Management Action	Cost (inc. GST)*	Responsible Team	Indicative Timing	Priority (H, M, L)
	18	Manual litter removal at locations 1, 15, 21, 35, 56 and 58	1 day x 2 people at ~$80/hr = **$1,280**	External contractor and/or City operational staff	Annually prior to opening rains	H
	19	Erosion control – instate rockpitching at locations 48, 73 and 74	1 day x 2 people at ~$100/hr + materials ~$1500 = **$3,100**	External contractor	Prior to first flush event, once	M
	20	Erosion control – extend or realign existing rockpitching at locations 71 and 82	1 day x 2 people at ~$100/hr + materials ~$1000 = **$2,600**	External contractor	Prior to first flush event, once	M
	21	Remove sediment and organic matter at locations 15, 35, 41, 53, 56, 58, 67 and 81	1 day x 2 people at ~$80/hr = **$1,280**	External contractor and/or City operational staff	Annually, summer (dry conditions)	H
	22	Surface water monitoring at the outlets of the compensating basins to assess their performance in enhancing surface water quality (with particular reference to NOx-N, TN, copper and zinc)	0.5 days x 1 person at ~$100/hr + testing of 5 water samples at ~$196/sample = **$1,380**	External contractor	After first flush event (late Autumn to Winter), once	M
	23	Ongoing assessment of drainage infrastructure	1 day x 2 people at ~$100/hr = **$1,600 (every 3 years)**	External contractor	Every three years (preferably after significant rainfall)	M
4.8 Climate Change	n/a	No actions required	n/a	n/a	n/a	n/a
					Total cost in first year (i.e. ALL recommendations) = $263,786	
					Total cost in second year (revegetation costs split across 1st and 2nd years) = $107,993	
					Total annual cost ongoing = $34,093	

*Day = 8 hours. Total cost in bold represents the one-off or annual cost, unless otherwise specified.

5.10.1 Management Performance Indicators

Following implementation of the suggested management actions outlined in Section 5.10, it is suggested to assess their performance against the current state of the Study Area as recorded during the field surveys. Indicators of success may include such factors as improvement in condition and extent of native vegetation across the site, and the continued presence, number of individuals, and extent within the Study Area of conservation significant fauna. The potential management performance indicators address the main environmental factors of the site (flora and vegetation, fauna, and wetlands and hydrology) and threats to the integrity of the Study Area (e.g., weeds, introduced fauna, disease, and fire). These indicators are outlined below in Table 5.10.

Table 5.10: Potential management performance indicators for the Study Area

Factor	Monitoring Indicators
Environmental Values	
Native Flora	Number of native species recorded in the Study Area remains comparable or increases compared to the Detailed survey.
	Continued presence, number of individuals, and extent within the Study Area of conservation significant flora.
	Continued presence and extent within the Study Area of conservation significant vegetation (i.e., Banksia Woodland TEC).
	Improvement in extent of each vegetation condition category across higher value categories.
	Extent of potential habitat linkages within the Study Area for dispersal of significant flora and fauna species.
	Number and density of planted flora in revegetation areas following planting supports self-sustaining regeneration.
Native Fauna	Number of native species recorded remains comparable or increases compared to Detailed survey.
	Continued presence, number of individuals, and extent within the Study Area of conservation significant fauna.
	Continued presence of core habitat (Banksia Woodland) and resources (i.e., Wetland) for conservation significant species.
	Continued presence of potentially significant cockatoo trees (i.e., trees over 500 mm DBH).
Wetlands and Hydrology	Seasonal water levels in wetlands during seasonal inundation remains comparable or improves comparable to that observed during the Detailed survey.
	Absence of contaminants in the wetland areas.
Threats	
Introduced fauna	Reduction in number of feral animal species recorded in the Study Area compared to the Detailed field survey.
	Reduction in number of predation events recorded by feral predators (i.e., red fox, cat)
	Number of occasions habitat features are occupied by feral animals (i.e., future hollows occupied by species such as rainbow lorikeet or feral bees).
Fire	Number, extent, cause, and timing, and location of all fires within 2 km of the Study Area comparable to previous five years
	Maintenance of the presence of a fire access tracks and footpath within the Study Area.
	Extent and quantity of fire fuel load within the Study Area remains comparable to that observed during the Detailed survey.
Weeds	Reduction in inventory of weed species within areas of natural bushland in the Study Area compared to the Detailed field survey.
	Reduction in the location, extent and density of specified weeds or groups of weeds within areas of natural bushland compared to the Detailed field survey.
	The number of species, extent, and density of weeds in the revegetation areas.
	Reduction in the number, location, and timing of rubbish and garden waste material observed.
	Reduction or comparable numbers and lengths of informal tracks present in the Study Area.
Disease	Reduction in location and extent of Phytophthora infestations within the Study Area compared to the Detailed field survey.
	Maintenance of hygiene protocols for weed or feral fauna control, revegetation, or Friends Group activities.
	Absence of toxoplasmosis from native fauna within the Study Area.

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7 APPENDICES

Appendix A – Vegetation condition rating scale

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

Appendix B – Flora literature review

Study Details	Methods	Results	Significant Findings	Limitations
Weston (2004) **Client:** Bowman Bishaw Gorham **Type:** Detailed floristic survey **Location:** Nicholson Rd wetlands / Campbell Estate **Timing:** October & November 2004	• Desktop assessment • Four detailed floristic sites (quadrats) • Targeted searching	• 230 taxa from 49 families • Three vegetation units • Condition ranged from 'Excellent' to 'Degraded'. • 34 introduced weed taxa	• Three Priority flora taxa: ○ *Byblis gigantea* (P3) ○ *Jacksonia gracilis* (P3) • *Tripterococcus* sp. Brachylobus (A.S. George 14234)	• Survey was late in the year No stands of recently burnt vegetation (important for *Diuris purdiei*)
Ecoscape (2007) **Client:** City of Gosnells **Type:** Strategic ecological assessment **Location:** 43 reserves throughout City of Gosnells **Timing:** October to December 2006	• Detailed floristic sites • Targeted searching	• 146 taxa • Vegetation units not in report • Condition ranged from Excellent to Completely Degraded	• One Threatened and two Priority flora taxa: ○ *Eleocharis keigheryi* (T) ○ *Acacia benthamii* (P2) ○ *Jacksonia sericea* (P4) • One TEC/PEC: ○ SCP7 'Herb-rich saline shrublands in claypans' (VU (WA) and CR (EPBC)) and SCP8 'Herb-rich shrublands in claypans' (VU (WA) and CR (EPBC)) • Eight Declared Pests recorded: ○ *Asparagus asparagoides (also WoNS) ○ *Cuscuta campestris ○ *Echium plantagineum ○ *Gomphocarpus fruticosus ○ *Moraea flaccida ○ *Opuntia sp. (also WoNS) ○ *Rubus sp. (also WoNS) • *Zantedeschia aethiopica	• Lower rainfall than normal Timing too late for some species
Syrinx (2016) **Client:** City of Gosnells **Type:** Vegetation Condition survey **Location:** Nicholson Wetlands **Timing:** September 2016	• series of parallel transects set 20m apart noting the condition of vegetation within each 40m 2	• Ranged from completely degraded- Very Good. Most was Very Good.	• Nil	Some disturbances such as fire in 2015, weeds, children playing in bushland etc
Ironbark Environmental and Regen4 Environmental Services **Client:** City of Gosnells **Type:** Management Plan **Location:** Gosnells golf course including Bush Forever site 467 **Timing:** 2010	• Desktop review • 'Walked through' each vegetation community • Targeted search	• 110 native species • 4 vegetation communities • Pristine (26%)- Completely Degraded (28%)	• One Priority flora taxon ○ *Cyathochaeta teretifolia* (P3) • Vegetation likely representing Banksia WL SCP (P3 (WA), T-EN (EPBC))	Flora survey results section is limited

Study Details	Methods	Results	Significant Findings	Limitations
Ecoscape (2019) **Client:** City of Canning **Type:** Detailed Flora and Vegetation Survey **Location:** Clifton Park, Canning Vale ~ 900 m west **Timing:** September and November 2018	• Two detailed floristic sites (quadrats) • Opportunistic observations • Targeted searching	• 68 flora taxa • Vegetation condition 'Very Good' • 15 introduced weed species	• Nil	No substantial limitations
Natural Area (2012) **Client:** City of Gosnells **Type:** Management Plan **Location:** Shreeve Road Reserve Wetland ~2.2 km ENE **Timing:** December 2012, February 2012,	• Not discussed in detail	• 78 species from 29 families • 7 vegetation communities • Excellent to completely degraded. Majority very good method	• None reported on	Not ideal time to survey flora, however estimated that 85% of species were present
Waters 2014 **Client:** City of Melville **Type:** Management Plan **Location:** Ken Hurst Park ~2.6Km NW **Timing:** Ongoing surveys/ varies	• 29 reference sites for long-term monitoring of plants and animals • 4 flora reference sites quadrats established by CALM in 1994	• 8 vegetation sub-associations • 246 native plant species • Degraded to very good vegetation condition. 63% very good 34% good	• One Threatened flora taxon • *Caladenia huegelii* (T)	Nil
Focused Vision (2020) **Client:** Coterra Environment **Type:** Reconnaissance Flora and Vegetation Survey **Location:** Lot 9103 Warton Road, Piara Waters ~ 3.1 km south **Timing:** March 2020	• Desktop assessment • Five relevé sites • Targeted searching	• 57 flora taxa • Six vegetation units • Vegetation condition ranged from 'Good' to 'Completely Degraded' • Six introduced flora species	• One possible Priority flora species: ○ *Jacksonia* ? *gracillima* (P3) • Two vegetation units represent Banksia WL SCP (P3 (WA), T-EN (EPBC))	Poor survey timing for targeted significant flora

Study Details	Methods	Results	Significant Findings	Limitations
ENV (2006) **Client:** City of Gosnells **Type:** Detailed floristic survey **Location:** Precinct 3, Southern River (3.7 km southeast) **Timing:** Sept & Oct 2006	• Detailed floristic sites (using LGBPG template) • Targeted searching	• 227 taxa from 50 families and 146 genera • 32 vegetation units • Condition ranged from 'Excellent' to 'Completely Degraded'. • 41 introduced flora taxa	• Two Priority flora taxa: ○ *Aponogeton hexatepalus* (P4) ○ *Verticordia lindleyi* subsp. *lindleyi* (P4) • Three TEC/PECs: ○ SCP21c Low lying *Banksia attenuata* woodlands or shrublands (P3 (WA) and EN (EPBC)) ○ SCP3a *Corymbia calophylla – Kingia australis* Woodlands on heavy soils (EN (EPBC)) ○ Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain (EN (WA) and EN (EPBC)) • Four Declared Pests: ○ **Asparagus asparagoides* (also WoNS) ○ **Echium plantagineum* ○ **Moraea flaccida* • **Zantedeschia aethiopica*	No substantial limitations
360 Environmental (2014b) **Client:** City of Gosnells **Type:** Threatened & Priority survey **Location:** Southern River Road Duplication (~3.7 km southeast) **Timing:** July and Sept 2014	• Targeted searching	• Condition reported as Excellent	• One Priority flora taxon: • *Jacksonia gracillima* (P3)	No substantial limitations
Natural Area (2019) **Client:** City of Armadale **Type:** Reconnaissance Flora and Vegetation Survey **Location:** Skeet Road, Harrisdale ~ 3.7 km southeast **Timing:** July 2019	• Desktop assessment • Relevé sites	• 79 flora taxa • Three vegetation types • Vegetation condition ranged from 'Very Good' to 'Completely Degraded'	• One Priority flora species recorded: • *Jacksonia gracillima* (P3)	Survey completed mid-winter, which is not optimal timing
Woodman (2004) **Client:** City of Gosnells **Type:** Detailed floristic survey **Location:** Garden St (~3.8 km east) **Timing:** October 2003	• Detailed floristic survey along road reserve + 5m either side • Targeted searching	• 114 taxa • Six vegetation units • Condition ranged from Excellent to Good, with localised disturbance	• Nil	Survey timing too late to identify *Caladenia huegelii*

Study Details	Methods	Results	Significant Findings	Limitations
Morgan (2011) **Client:** RPS Environmental **Type:** Detailed floristic survey **Location:** Lot 467 Warton Rd (3.8 km southwest) **Timing:** October 2010	• Six detailed floristic sites (quadrats), two relevés • Targeted searching	• 193 taxa • Six vegetation units • Condition ranged from Excellent to Completely Degraded	• One TEC/PEC: • SCP22 '*Banksia ilicifolia* woodlands' (P3 (WA))	No substantial limitations
360 Environmental (2014a) **Client:** City of Gosnells **Type:** Targeted search **Location:** Garden St (~3.8 km east) **Timing:** August and September 2014	• Targeted searching	• Condition of remnant vegetation reported as Excellent apart from localised disturbance, roadside verges and parkland	• One Priority flora taxon: • *Jacksonia gracillima* (P3)	No substantial limitations
Natural Area (2016b) **Client:** City of Gosnells **Type:** **Location:** Garden St Road Reserve (~3.8 km east) **Timing:** October 2015	• Six detailed floristic sites (quadrats) using LGBPG template • Targeted searching	• 85 taxa • Seven vegetation units • Condition ranged from Excellent to Degraded	• One Priority flora taxon: • *Jacksonia gracillima* (P3)	No substantial limitations
PGV (2016) **Client:** City of Gosnells **Type:** Targeted search **Location:** Garden St (3.8 km east) **Timing:** September 2016	• Desktop assessment • Targeted searching	• Eight Orchidaceae species identified	• Nil	• No substantial limitations
PGV (2018) **Client:** City of Gosnells **Type:** Targeted TEC search **Location:** Garden St (~3.8 km east) **Timing:** Nov, Dec 2017 & Jan 2018	• Desktop assessment • 5 detailed floristic sites (quadrats)	• 57 flora taxa • Vegetation condition 'Excellent' in all quadrats • Six introduced flora taxa	○ Concluded that study area did not meet the definition for 'Clay Pans of the Swan Coastal Plain' (including SCP07, SCP08, SCP09, SCP10a) (CR (EPBC))	• No substantial limitations
ENV (2010b) **Client:** City of Gosnells **Type:** **Location:** Sutherlands Park Bushland (~4 km east) **Timing:** October 2009	• 7 detailed floristic sites (quadrats) using LGBPG template • Targeted searching	• 97 taxa from 79 genera and 29 families • Seven vegetation units • Condition ranged from Excellent to Completely Degraded	• One TEC/PEC: ○ SCP21c Low lying *Banksia attenuata* woodlands or shrublands (P3 (WA) and EN (EPBC))	• Below average rainfall prior to survey

Study Details	Methods	Results	Significant Findings	Limitations
360 Environmental (2015b) **Client:** Perron Developments **Type:** Detailed floristic survey **Location:** Lot 131 Jandakot Road, Banjup (4.2 km southwest) **Timing:** Sept & Oct 2014	• 10 detailed floristic sites (quadrats), three relevés • Targeted searching	• 98 taxa from 76 genera and 33 families • Six vegetation units • Condition ranged from Excellent to Completely Degraded	• One Threatened flora taxa: ○ *Caladenia huegelii* (T) • One Declared Pest: • **Zantedeschia aethiopica*	• No substantial limitations

ENV (2013a)
Client: Water Corporation
Type: Detailed floristic survey
Location: Keane Rd Forrestdale (4.8 km south)
Timing: October 2012
	• Desktop assessment
	• Six detailed floristic sites (quadrats)
	• Four relevé sites
	• Targeted searching
		• 94 taxa from 30 families and 76 genera
		• Four vegetation units
		• Vegetation condition ranged from 'Excellent' to 'Completely Degraded'
		• 15 introduced flora taxa
			• One Priority flora taxon:
			  ○ *Jacksonia gracillima* (P3)
			• Two TEC/PECs:
			  ○ SCP21c Low lying *Banksia attenuata* woodlands or shrublands (P3 (WA), EN (EPBC))
			  ○ Either Herb-rich shrublands in claypans (VU (WA), CR (EPBC)) or Shrublands on dry clay flats (EN (WA), CR (EPBC))
			• Two Declared Pests:
			  • **Zantedeschia aethiopica*
			• **Moraea flaccida*
				• No substantial limitations

Focused Vision Consulting (2019)
Client: City of Cockburn
Type: Detailed floristic survey
Location: Extension to Verde Drive, Jandakot (5.9 km southwest)
Timing:
	• Desktop assessment
	• Detailed floristic sites (quadrats)
	• Relevés
	• Targeted searching
		• 77 taxa from 38 families and 66 genera
		• Two vegetation units
		• Vegetation condition ranged from 'Good' to 'Completely Degraded'
		• 44 introduced flora taxa
			• Four Declared Pests:
			  ○ **Asparagus asparagoides* (also WoNS)
			  ○ **Echium plantagineum*
			  ○ **Gomphocarpus fruticosus*
			  ○ **Zantedeschia aethiopica*
				• No substantial limitations

Bennett Environmental Consulting (2013)
Client: Coterra Environment
Type: Detailed floristic survey
Location: Lots 101 and 200 Anstey Road, Forrestdale (~6 km south)
Timing: May & October 2013
	• Desktop assessment
	• Eight detailed floristic sites (quadrats)
	• Targeted searching
		• 117 taxa from 42 families and 93 genera
		• Six vegetation units
		• Vegetation condition ranged from 'Excellent' to 'Degraded'
		• 37 introduced flora taxa
			• One Priority flora taxon:
			  ○ *Jacksonia gracillima* (P3)
			• Three Declared Pests:
			  ○ **Gomphocarpus fruticosus*
			  ○ **Zantedeschia aethiopica*
			• **Moraea flaccida*
				• No substantial limitations

Study Details	Methods	Results	Significant Findings	Limitations

Focused Vision (2016)
Client: City of Cockburn
Type: Reconnaissance Flora and Vegetation Survey
Location: Cockburn Central East Local Structure Plan ~ 6.1 km southwest
Timing: September 2016
	• Desktop assessment
	• Five detailed floristic sites (quadrats)
	• Relevé sites
	• Opportunistic observations
		• 107 flora taxa from 44 families and 90 genera
		• Eight vegetation communities (five intact, three degraded)
		• Vegetation condition ranged from 'Very Good' to 'Completely Degraded'
		• 45 introduced weed species
			• Four flora species listed as Declared Pests:
			  ○ **Asparagus asparagoides* (also WoNS)
			  ○ **Echium plantagineum*
			  ○ **Gomphocarpus fruticosus*
			• **Zantedeschia aethiopica*
				• No substantial limitations

Focused Vision (2018) **Client:** City of Cockburn **Type:** Targeted Flora Survey **Location:** Cockburn Central East Local Structure Plan ~ 6.1 km southwest **Timing:** September 2017	• Targeted searching	• Nil	• No *Caladenia huegelii* plants were recorded	• No substantial limitations
Golder Associates (2016) **Client:** City of Gosnells **Type:** Reconnaissance flora and vegetation survey **Location:** Station Street (5.3 km SSW) **Timing:** September and October 2016	• Desktop assessment • Traversing transects • Targeted searches	• 34 flora taxa • One vegetation association • Vegetation condition was 'Completely Degraded' • 29 introduced weed species	• No Threatened or Priority flora species / ecological communities recorded	• No substantial limitations

Appendix C – Conservation significant flora likelihood of occurrence assessment

Family	Taxon	Conservation status			Habit and Habitat	Habitat within Study Area	Study Area within Known Distribution	Distance from Study Area to Nearest Record	Likelihood of Occurrence Pre-Survey	Likelihood of Occurrence Post-Survey
		DBCA	BC Act	EPBC Act						
Cyperaceae	*Schoenus benthamii*	P3			Tufted perennial, grass-like or herb (sedge), 0.15-0.45 m high. Fl. brown, Oct to Nov. White, grey sand, sandy clay. Winter-wet flats, swamps.	Yes	Yes	2.7 km ENE	Possible	Confirmed
Fabaceae	*Jacksonia sericea*	P4			Low spreading shrub, to 0.6 m high. Fl. orange, usually Dec or Jan to Feb. Calcareous & sandy soils.	Possible	Yes	5.1 km SSE	Unlikely	Confirmed
Orchidaceae	*Diuris purdiei*	T	EN	EN	Tuberous, perennial, herb, 0.15-0.35 m high. Fl. yellow, Sep to Oct. Grey-black sand, moist. Winter-wet swamps.	Yes	Yes	Within (extinct population)	Confirmed	Possible
Celastraceae	*Tripterococcus* sp. Brachylobus (A.S. George 14234)	P4			Erect, perennial, herb, to 0.8 m high. Fl. green. Grey sand or clay. Plains, winter damp flats.	Yes	Yes	Within	Confirmed	Possible
Orchidaceae	*Caladenia huegelii*	T	CR	EN	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green & cream & red, Sep to Oct. Grey or brown sand, clay loam.	Yes	Yes	0.1 km N	Likely	Unlikely
Byblidaceae	*Byblis gigantea*	P3			Small, branched perennial, herb (or sub-shrub), to 0.45 m high. Fl. pink-purple/white, Sep to Dec or Jan. Sandy-peat swamps. Seasonally wet areas.	Yes	Yes	0.1 km W	Likely	Unlikely
Fabaceae	*Jacksonia gracillima*	P3			Prostrate, spreading or scrambling, spindly shrub, to 1.5 m high. Fl. pink/orange, Oct and Nov. Grey/brown sandy loam. Winter damp flats, gentle lower slopes of dunes.	Yes	Yes	0.4 km ENE	Likely	Unlikely
Stylidiaceae	*Stylidium paludicola*	P3			Reed-like perennial, herb, 0.35-1 m high. Inflorescence racemose. Fl. pink, Oct to Dec. Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland.	Yes	Yes	0.6 km E	Likely	Unlikely

Family	Taxon	Conservation status			Habit and Habitat	Habitat within Study Area	Study Area within Known Distribution	Distance from Study Area to Nearest Record	Likelihood of Occurrence Pre-Survey	Likelihood of Occurrence Post-Survey
		DBCA	BC Act	EPBC Act						
Poaceae	*Austrostipa jacobsiana*	T	CR	CR	Clumping, perennial grass, to 0.6(flower spike to 1.1) m high. Fl. green. Grey sandy clay. Plains, damplands, winter wet flats.	Possible	Adjacent	3.9 km ESE	Possible	Unlikely
Orchidaceae	*Diuris drummondii*	T	VU	VU	Tuberous, perennial, herb, 0.5-1.05 m high. Fl. yellow, Nov to Dec or Jan. Low-lying depressions, swamps.	Possible	Yes	3.5 km NW	Possible	Unlikely
Orchidaceae	*Drakaea elastica*	T	CR	EN	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red & green & yellow, Oct to Nov. White or grey sand. Low-lying situations adjoining winter-wet swamps.	Possible	Yes	2 km N	Possible	Unlikely
Orchidaceae	*Drakaea micrantha*	T	EN	VU	Tuberous, perennial, herb, 0.15-0.3 m high. Fl. red & yellow, Sep to Oct. White-grey sand.	Possible	Adjacent	2 km N	Possible	Unlikely
Scrophulariaceae	*Eremophila glabra* subsp. *chlorella*	T	EN	EN	Prostrate & spreading or sprawling shrub, 0.2-1 m high. Fl. green-yellow, Jul to Nov. Sandy clay. Winter-wet depressions.	Possible	Adjacent	3 km N	Possible	Unlikely
Proteaceae	*Synaphea* sp. Fairbridge Farm (D. Papenfus 696)	T	CR	CR	Dense, clumped shrub, to 0.3 m high, to 0.4 m wide. Fl. yellow, Oct. Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.	Possible	Yes	3.5 km NW	Possible	Unlikely
Stylidiaceae	*Levenhookia preissii*	P1			Annual (ephemeral), herb, 0.03-0.17 m high. Fl. pink-red, Sep to Dec or Jan. Grey or black, peaty sand. Swamps.	Possible	Yes	3.3 km WNW	Possible	Unlikely
Rhamnaceae	*Stenanthemum sublineare*	P2			Erect shrub, to 0.1 m high. Fl. green, Oct to Dec. Littered white sand. Coastal plain.	Yes	Yes	3.8 km ENE	Possible	Unlikely
Cyperaceae	*Schoenus capillifolius*	P3			Semi-aquatic tufted annual, grass-like or herb (sedge), 0.05 m high. Fl. green, Oct to Nov. Brown mud. Claypans.	Yes	Yes	1.8 km E	Possible	Unlikely

Family	Taxon	Conservation status			Habit and Habitat	Habitat within Study Area	Study Area within Known Distribution	Distance from Study Area to Nearest Record	Likelihood of Occurrence Pre-Survey	Likelihood of Occurrence Post-Survey
		DBCA	BC Act	EPBC Act						
Cyperaceae	*Schoenus pennisetis*	P3			Tufted annual, grass-like or herb (sedge), 0.05-0.15 m high. Fl. purple-black, Aug to Sep. Grey or peaty sand, sandy clay. Swamps, winter-wet depressions.	Yes	Yes	4.6 km SSE	Possible	Unlikely
Stylidiaceae	*Stylidium aceratum*	P3			Fibrous rooted annual, herb, 0.05-0.09 m high, leaves spathulate. Fl. pink/white, Oct to Nov. Sandy soils. Swamp heathland.	Yes	Yes	4.6 km SSE	Possible	Unlikely
Ericaceae	*Styphelia filifolia*	P3			Erect, well branched shrub, to 0.5 cm high. Fl. white. Brown/yellow sand. Midslopes, sandplains.	Possible	Yes	2.2 km NW	Possible	Unlikely
Aponogetonaceae	*Aponogeton hexatepalus*	P4			Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl. green-white, Jul to Oct. Mud. Freshwater: ponds, rivers, claypans.	Possible	Yes	1.8 km E	Possible	Unlikely
Menyanthaceae	*Ornduffia submersa*	P4			Aquatic, floating herb. Fl. cream/white/yellow. Grey/brown clay. Ephemeral creeks, wetlands, open depressions.	Possible	Yes	5.2 km SE	Possible	Unlikely
Stylidiaceae	*Stylidium longitubum*	P4			Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. pink, Oct to Dec. Sandy clay, clay. Seasonal wetlands.	Yes	Yes	4.6 km SSE	Possible	Unlikely
Myrtaceae	*Verticordia lindleyi* subsp. *lindleyi*	P4			Erect shrub, 0.2-0.75 m high. Fl. pink, May or Nov to Dec or Jan. Sand, sandy clay. Winter-wet depressions.	Yes	Yes	4 km SE	Possible	Unlikely
Ericaceae	*Andersonia gracilis*	T	VU	EN	Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Fl. white-pink-purple, Sep to Nov. White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Possible	Adjacent	8.2 km NE	Unlikely	Unlikely

Family	Taxon	Conservation status			Habit and Habitat	Habitat within Study Area	Study Area within Known Distribution	Distance from Study Area to Nearest Record	Likelihood of Occurrence Pre-Survey	Likelihood of Occurrence Post-Survey
		DBCA	BC Act	EPBC Act						
Orchidaceae	*Diuris micrantha*	T	VU	VU	Tuberous, perennial, herb, 0.3-0.6 m high. Fl. yellow & brown, Sep to Oct. Brown loamy clay. Winter-wet swamps, in shallow water.	No	No	13.8 km SW	Unlikely	Unlikely
Cyperaceae	*Eleocharis keigheryi*	T	VU	VU	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Fl. green, Aug to Nov. Clay, sandy loam. Emergent in freshwater: creeks, claypans.	Possible	Yes	7.9 km ENE	Unlikely	Unlikely
Proteaceae	*Grevillea thelemanniana*	T	CR	CR	Spreading, lignotuberous shrub, 0.3-1.5 m high. Fl. pink-red, May to Nov. Sand, sandy clay. Winter-wet low-lying flats.	Possible	No	8.3 km NE	Unlikely	Unlikely
Cyperaceae	*Lepidosperma rostratum*	T	EN	EN	Rhizomatous, tufted perennial, grass-like or herb (sedge), 0.5 m high. Fl. brown. Peaty sand, clay.	Possible	Yes	7.3 km SSE	Unlikely	Unlikely
Araliaceae	*Hydrocotyle striata*	P1			Prostrate, spreading, annual herb, 0.05-0.1 m high. Fl. cream. Black peaty sand, brown sandy loam. Winter wet creekline, springs.	Possible	Adjacent	7.4 km NW	Unlikely	Unlikely
Cyperaceae	*Cyathochaeta teretifolia*	P3			Rhizomatous, clumped, robust perennial, grass-like or herb (sedge), to 2 m high, to 1.0 m wide. Fl. brown. Grey sand, sandy clay. Swamps, creek edges.	Possible	Yes	6.6 km SW	Unlikely	Unlikely
Asparagaceae	*Thysanotus glaucus*	P4			Erect, tuberous, perennial herb, to 0.3 m high. Fl. purple. Grey sand. Plains, flats.	Possible	Yes	6.3 km SE	Unlikely	Unlikely
Proteaceae	*Grevillea curviloba*	T	EN	EN	Prostrate to erect shrub, 0.1-2.5 m high. Fl. white-cream, Aug to Oct. Grey sand, sandy loam. Winter-wet heath.	Possible	No	18.6 km NNE	Unlikely	Highly Unlikely

Family	Taxon	Conservation status			Habit and Habitat	Habitat within Study Area	Study Area within Known Distribution	Distance from Study Area to Nearest Record	Likelihood of Occurrence Pre-Survey	Likelihood of Occurrence Post-Survey
		DBCA	BC Act	EPBC Act						
Proteaceae	*Synaphea* sp. Serpentine (G.R. Brand 103)	T	CR	CR	Erect, compact shrub, 0.3-0.6 m high. Fl. yellow. Brown/grey loamy sand/clay. Coastal plain, winter wet areas, flats.	No	Adjacent	12.6 km SE	Unlikely	Highly Unlikely
Fabaceae	*Acacia benthamii*	P2			Shrub, ca 1 m high. Fl. yellow, Aug to Sep. Sand. Typically on limestone breakaways.	No	Yes	1.9 km NE	Unlikely	Highly Unlikely
Asparagaceae	*Thysanotus* sp. Badgingarra (E.A. Griffin 2511)	P2			Perennial, herb (with tuberous roots), ca 0.35 m high. Fl. blue, Dec. Grey sand with lateritic gravel.	Possible	Yes	5 km N	Unlikely	Highly Unlikely
Apiaceae	*Platysace ramosissima*	P3			Perennial, herb, to 0.3 m high. Fl. white-cream, Oct to Nov. Sandy soils.	Possible	Yes	14 km NNE	Unlikely	Highly Unlikely
Sapindaceae	*Dodonaea hackettiana*	P4			Erect shrub or tree, 1-5 m high. Fl. yellow-green/red, mainly Jul to Oct. Sand. Outcropping limestone.	No	Yes	2.6 km NW	Unlikely	Highly Unlikely
Myrtaceae	*Eucalyptus* x *balanites*	T	CR	EN	(Mallee), to 5 m high, bark rough, flaky. Fl. white, Oct to Dec or Jan to Feb. Sandy soils with lateritic gravel.	No	No	12.7 km SE	Highly Unlikely	Highly Unlikely
Orchidaceae	*Thelymitra dedmaniarum*	T	CR	EN	Tuberous, perennial, herb, to 0.8 m high. Fl. yellow, Nov to Dec or Jan. Granite.	No	No	33.8 km NNE	Highly Unlikely	Highly Unlikely

Appendix D – Introduced flora desktop assessment

Family	Taxon	Source				Declared Pest	Wood of National Significance	Ecological	Invasiveness
		NatureMap	ALA	EPBC	WAOL				
Aizoaceae	*Aizoon pubescens*	●	●			No	No	Not Assessed	Not Assessed
	Carpobrotus edulis		●			No	No	Unknown	Rapid
Alismataceae	*Sagittaria platyphylla*			●	●	Yes	Yes	Not Assessed	Not Assessed
Apocynaceae	*Calotropis procera*				●	Yes	No	Not Assessed	Not Assessed
	Cryptostegia madagascariensis				●	Yes	No	Not Assessed	Not Assessed
Araceae	*Pistia stratiotes*				●	Yes	No	Not Assessed	Not Assessed
	Zantedeschia aethiopica				●	Yes	No	High	Moderate
Araliaceae	*Hydrocotyle ranunculoides*		●		●	No	No	Not Assessed	Not Assessed
Asparagaceae	*Asparagus aethiopicus*			●		No	Yes	High	Rapid
	Asparagus asparagoides			●	●	Yes	Yes	High	Rapid
	Asparagus plumosus			●		No	Yes	High	Unknown
	Lachenalia aloides	●	●			No	No	High	Slow
Asphodelaceae	*Asphodelus fistulosus*	●	●			No	No	Low	Unknown
	Trachyandra divaricata		●			No	No	Unknown	Rapid
Asteraceae	*Arctotheca calendula*		●			No	No	Medium	Moderate
	Centaurea melitensis	●	●			No	No	Medium	Rapid
	Chondrilla juncea	●	●		●	Yes	No	Not Assessed	Not Assessed
	Chrysanthemoides monilifera			●		No	No	Not Assessed	Not Assessed
	Chrysanthemoides monilifera subsp. *monilifera*			●		No	Yes	Not Assessed	Not Assessed
	Cotula coronopifolia	●	●			No	No	Unknown	Rapid
	Crepis foetida		●			No	No	Not Assessed	Not Assessed
	Crepis foetida subsp. *foetida*	●				No	No	Not Assessed	Not Assessed
	Hypochaeris glabra	●	●			No	No	Medium	Rapid
	Hypochaeris radicata		●			No	No	Medium	Rapid
	Lactuca serriola		●			No	No	Low	Rapid
	Leontodon rhagadioloides	●	●			No	No	Not Assessed	Not Assessed
	Leontodon saxatilis	●	●			No	No	Medium	Rapid
	Onopordum acaulon				●	Yes	No	Not Assessed	Not Assessed
	Silybum marianum				●	Yes	No	Unknown	Moderate
	Solidago canadensis		●			No	No	Not Assessed	Not Assessed
	Solidago chilensis	●	●			No	No	Not Assessed	Not Assessed
	Sonchus oleraceus		●			No	No	Medium	Rapid
	Urospermum picroides		●			No	No	High	Rapid

Family	Taxon	Source				Declared Pest	Wood of National Significance	Ecological	Invasiveness
		NatureMap	ALA	EPBC	WAOL				
	Ursinia anthemoides		●			No	No	Unknown	Rapid
	Xanthium spinosum				●	Yes	No	Not Assessed	Not Assessed
	Xanthium strumarium				●	Yes	No	Not Assessed	Not Assessed
Basellaceae	*Anredera cordifolia*			●		No	Yes	High	Rapid
Bignoniaceae	*Jacaranda mimosifolia*		●			No	No	Not Assessed	Not Assessed
Boraginaceae	*Echium plantagineum*				1	Yes	No	Low	Moderate
Brassicaceae	*Brassica tournefortii*		●			No	No	Unknown	Rapid
	Cardamine hirsuta		●			No	No	Low	Slow
Cactaceae	*Austrocylindropuntia cylindrica*				●	Yes	Yes	Not Assessed	Not Assessed
	Austrocylindropuntia subulata				●	Yes	Yes	Not Assessed	Not Assessed
	Cylindropuntia fulgida				●	Yes	Yes	Not Assessed	Not Assessed
	Cylindropuntia imbricata				●	Yes	Yes	Not Assessed	Not Assessed
	Cylindropuntia kleiniae				●	Yes	Yes	Not Assessed	Not Assessed
	Cylindropuntia pallida				●	Yes	Yes	Not Assessed	Not Assessed
	Cylindropuntia tunicata				●	Yes	Yes	Not Assessed	Not Assessed
	Opuntia elata				●	Yes	Yes	Not Assessed	Not Assessed
	Opuntia elatior				●	Yes	Yes	Not Assessed	Not Assessed
	Opuntia engelmannii				●	Yes	Yes	Not Assessed	Not Assessed
	Opuntia ficus-indica				●	Yes	Yes	Not Assessed	Not Assessed
	Opuntia microdasys				●	Yes	Yes	Not Assessed	Not Assessed
	Opuntia monacantha				●	Yes	Yes	Low	Slow
	Opuntia polyacantha				●	Yes	Yes	Not Assessed	Not Assessed
	Opuntia puberula				●	Yes	Yes	Not Assessed	Not Assessed
	Opuntia stricta				●	Yes	Yes	Low	Slow
	Opuntia tomentosa				●	Yes	Yes	Not Assessed	Not Assessed
Campanulaceae	*Grammatotheca bergiana*		●			No	No	Not Assessed	Not Assessed
	Grammatotheca bergiana var. *bergiana*	●				No	No	Not Assessed	Not Assessed
	Wahlenbergia capensis		●			No	No	Unknown	Rapid
Caryophyllaceae	*Minuartia mediterranea*	●	●			No	No	Unknown	Rapid
	Petrorhagia dubia		●			No	No	Unknown	Rapid
	Polycarpon tetraphyllum	●	●			No	No	Unknown	Unknown
	Sagina apetala	●	●			No	No	Unknown	Unknown
	Silene gallica		●			No	No	Unknown	Rapid
	Spergula arvensis	●	●			No	No	Unknown	Unknown

Family	Taxon	Source				Declared Pest	Wood of National Significance	Ecological	Invasiveness
		NatureMap	ALA	EPBC	WAOL				
Chenopodiaceae	*Atriplex prostrata*	●	●			No	No	Unknown	Rapid
Crassulaceae	*Crassula alata*	●	●			No	No	Not Assessed	Not Assessed
Euphorbiaceae	*Jatropha gossypiifolia*				●	Yes	Yes	Not Assessed	Not Assessed
Fabaceae	*Acacia iteaphylla*		●			No	No	Unknown	Rapid
	Acacia longifolia		●			No	No	Unknown	Moderate
	Alhagi maurorum				●	Yes	No	Not Assessed	Not Assessed
	Genista linifolia			●		No	Yes	Unknown	Rapid
	Genista monspessulana			●		No	Yes	Unknown	Rapid
	Genista sp. X *Genista monspessulana*			●		No	Yes	Not Assessed	Not Assessed
	Lotus angustissimus	●	●			No	No	Unknown	Rapid
	Lotus subbiflorus		●			No	No	Unknown	Rapid
	Lupinus angustifolius		●			No	No	Medium	Unknown
	Medicago minima	●	●			No	No	Not Assessed	Not Assessed
	Parkinsonia aculeata				●	Yes	Yes	Not Assessed	Not Assessed
	Prosopis glandulosa x *velutina*				●	Yes	Yes	Not Assessed	Not Assessed
	Senna alata				●	Yes	No	Not Assessed	Not Assessed
	Senna obtusifolia				●	Yes	No	Not Assessed	Not Assessed
	Trifolium angustifolium		●			No	No	Not Assessed	Not Assessed
	Trifolium angustifolium var. *angustifolium*	●				No	No	Unknown	Unknown
	Ulex europaeus				●	Yes	Yes	High	Moderate
Gentianaceae	*Centaurium erythraea*		●			No	No	Unknown	Rapid
Geraniaceae	*Geranium molle*	●	●			No	No	Unknown	Unknown
	Pelargonium capitatum		●			No	No	High	Rapid
Hydrocharitaceae	*Limnobium laevigatum*		●			No	No	Not Assessed	Not Assessed
Iridaceae	*Gladiolus caryophyllaceus*	●	●			No	No	Not Assessed	Not Assessed
	Iris unguicularis		●			No	No	Not Assessed	Not Assessed
	Moraea flaccida		●		●	Yes	No	High	Moderate
	Moraea miniata				●	Yes	No	Not Assessed	Not Assessed
	Romulea rosea		●			No	No	Not Assessed	Not Assessed
	Watsonia versfeldii	●	●			No	No	High	Moderate
Juncaceae	*Juncus articulatus*	●	●			No	No	Unknown	Unknown
	Juncus capitatus		●			No	No	Low	Rapid
Lamiaceae	*Lavandula stoechas*	●	●			No	No	Low	Moderate

Family	Taxon	Source				Declared Pest	Wood of National Significance	Ecological	Invasiveness
		NatureMap	ALA	EPBC	WAOL				
Malvaceae	*Brachychiton acerifolius*		●			No	No	Not Assessed	Not Assessed
Myrtaceae	*Callistemon citrinus*		●			No	No	Not Assessed	Not Assessed
	Leptospermum laevigatum	●	●			No	No	High	Moderate
Oleaceae	*Olea europaea*			●		No	No	Not Assessed	Not Assessed
Onagraceae	*Oenothera drummondii*		●			No	No	Low	Unknown
Onagraceae	*Oenothera mollissima*	●	●			No	No	Low	Slow
Orchidaceae	*Disa bracteata*		●			No	No	Unknown	Rapid
Orobanchaceae	*Bellardia viscosa*	●	●			No	No	Not Assessed	Not Assessed
Oxalidaceae	*Oxalis corniculata*		●			No	No	Not Assessed	Not Assessed
Papaveraceae	*Fumaria capreolata*		●			No	No	Medium	Unknown
Pinaceae	*Pinus radiata*			●		No	No	High	Rapid
Plantaginaceae	*Veronica arvensis*	●	●			No	No	Low	Slow
Poaceae	*Aira caryophyllea*		●			No	No	Unknown	Rapid
	Aira praecox		●			No	No	Unknown	Unknown
	Avena barbata		●			No	No	High	Rapid
	Avena fatua		●			No	No	High	Rapid
	Briza maxima	●	●			No	No	Unknown	Rapid
	Briza minor		●			No	No	Unknown	Rapid
	Cenchrus ciliaris			●		No	No	Not Assessed	Not Assessed
	Cenchrus setaceus		●			No	No	Not Assessed	Not Assessed
	Ehrharta calycina		●			No	No	Unknown	Moderate
	Ehrharta longiflora		●			No	No	Unknown	Rapid
	Eragrostis curvula		●			No	No	High	Rapid
	Glyceria declinata	●	●			No	No	Medium	Rapid
	Holcus lanatus	●	●			No	No	Medium	Unknown
	Hyparrhenia hirta	●	●			No	No	High	Rapid
	Pentameris airoides		●			No	No	Unknown	Unknown
	Polypogon monspeliensis	●	●			No	No	Medium	Unknown
	Setaria parviflora	●	●			No	No	Low	Moderate
	Urochloa mutica			●		No	No	Not Assessed	Not Assessed
	Vulpia bromoides		●			No	No	Unknown	Rapid
	Vulpia myuros		●			No	No	Not Assessed	Not Assessed
Primulaceae	*Lysimachia arvensis*		●			No	No	Not Assessed	Not Assessed
Rhamnaceae	*Ziziphus mauritiana*				●	Yes	No	Not Assessed	Not Assessed
Rosaceae	*Eriobotrya japonica*	●	●			No	No	Low	Slow

Family	Taxon	Source				Declared Pest	Wood of National Significance	Ecological	Invasiveness
		NatureMap	ALA	EPBC	WAOL				
	Rubus anglocandicans				●	Yes	Yes	High	Moderate
	Rubus fruticosus aggregate			●		No	No	Not Assessed	Not Assessed
	Rubus laudatus				●	Yes	Yes	High	Moderate
	Rubus rugosus				●	Yes	Yes	Not Assessed	Not Assessed
	Rubus ulmifolius				●	Yes	Yes	High	Moderate
Rubiaceae	*Galium aparine*				●	Yes	No	Not Assessed	Not Assessed
	Galium murale		●			No	No	Low	Unknown
	Galium spurium				●	Yes	No	Not Assessed	Not Assessed
Salicaceae	*Salix* spp.			●		No	Yes	Not Assessed	Not Assessed
Salviniaceae	*Salvinia molesta*			●		No	Yes	Not Assessed	Not Assessed
Sapindaceae	*Cardiospermum grandiflorum*	●	●			No	No	Not Assessed	Not Assessed
Solanaceae	*Lycium ferocissimum*			●		No	Yes	High	Moderate
	Nicotiana glauca		●			No	No	Medium	Rapid
	Solanum elaeagnifolium				●	Yes	Yes	Not Assessed	Not Assessed
	Solanum linnaeanum				●	Yes	No	Medium	Moderate
	Solanum nigrum		●			No	No	Unknown	Moderate
Tamaricaceae	*Tamarix aphylla*			●	●	Yes	Yes	Not Assessed	Not Assessed
Verbenaceae	*Lantana camara*			●	●	Yes	Yes	Not Assessed	Not Assessed
Zygophyllaceae	*Tribulus terrestris*	●	●			No	No	Not Assessed	Not Assessed

Appendix E – Flora Composition

36 Lomariopsidaceae

* *Nephrolepis cordifolia*

80 Lauraceae

Cassytha flava
Cassytha racemosa

109 Colchicaceae

Burchardia congesta

115 Orchidaceae

Caladenia flava subsp. *flava*
Caladenia paludosa
Diuris sp.
Elythranthera brunonis
Eriochilus scaber
Microtis media subsp. *media*
Microtis sp.
Prasophyllum parvifolium
Pterostylis crispula
Pterostylis recurva
Pterostylis vittata
Pyrorchis nigricans
Thelymitra crinita
Thelymitra macrophylla
Thelymitra sp.

124 Iridaceae

* *Gladiolus caryophyllaceus*
Patersonia occidentalis var. *occidentalis*
* *Romulea rosea*

126 Xanthorrhoeaceae

Xanthorrhoea preissii

128 Asparagaceae

Chamaescilla corymbosa var. *corymbosa*
Laxmannia ramosa subsp. *ramosa*
Laxmannia squarrosa
Lomandra caespitosa
Lomandra hermaphrodita
Lomandra nigricans
Lomandra odora
Lomandra preissii
Lomandra sericea
Lomandra sonderi
Lomandra sp. Indet
Thysanotus manglesianus
Thysanotus multiflorus
Thysanotus sparteus
Thysanotus tenellus
Thysanotus triandrus

130 Hemerocallidaceae

Dianella revoluta var. *divaricata*
Tricoryne elatior

138 Haemodoraceae

Anigozanthos manglesii subsp. *manglesii*
Anigozanthos viridis subsp. *viridis*
Conostylis candicans

Conostylis juncea
Haemodorum sparsiflorum
Phlebocarya ciliata
Phlebocarya filifolia

147 Dasypogonaceae

Dasypogon bromeliifolius

148 Typhaceae

Typha orientalis

155 Juncaceae

Juncus kraussii
* *Juncus microcephalus*
Juncus pallidus

156 Cyperaceae

Baumea arthrophylla
Baumea juncea
Bolboschoenus caldwellii
Chaetospora curvifolia
Chaetospora subbulbosa
Cyathochaeta avenacea
* *Cyperus involucratus*
Evandra pauciflora
Isolepis marginata
Isolepis sp.
Lepidosperma longitudinale
Lepidosperma pubisquameum
Lepidosperma striatum
Mesomelaena graciliceps
Mesomelaena stygia
Mesomelaena tetragona
Schoenus benthamii (P3)
Schoenus efoliatus
Schoenus pedicellatus
Schoenus rigens
Schoenus sublateralis

157 Anarthriaceae

Lyginia barbata
Lyginia imberbis

159 Restionaceae

Chaetanthus leptocarpoides
Cytogonidium leptocarpoides
Desmocladus fasciculatus
Desmocladus flexuosus
Dielsia stenostachya
Hypolaena exsulca
Leptocarpus decipiens
Leptocarpus scariosus
Lepyrodia glauca
Loxocarya cinerea

163 Poaceae

* *Aira cupaniana*
Amphipogon amphipogonoides
Austrostipa compressa
Austrostipa elegantissima
* *Avena barbata*
* *Briza maxima*

* *Briza minor*
* *Bromus diandrus*
* *Cynodon dactylon*
* *Ehrharta calycina*
* *Ehrharta longiflora*
* *Eragrostis curvula*
* *Hordeum leporinum*
* *Lolium multiflorum*
* *Pentameris airoides*
* *Poa annua*

Rytidosperma setaceum

166 Papaveraceae

* *Fumaria capreolata*
* *Fumaria* sp.

175 Proteaceae

Adenanthos cygnorum subsp. *cygnorum*
Adenanthos obovatus
Banksia attenuata
Banksia ilicifolia
Banksia littoralis
Banksia menziesii
Banksia nivea
Grevillea sp.
Hakea prostrata
Hakea varia
Petrophile linearis

181 Dilleniaceae

Hibbertia hypericoides
Hibbertia sp.
Hibbertia stellaris
Hibbertia subvaginata
Hibbertia vaginata

192 Crassulaceae

Crassula colorata var. *colorata*
* *Crassula glomerata*

196 Haloragaceae

Gonocarpus ?pithyoides
Gonocarpus pithyoides

197 Vitaceae

* *Vitis vinifera*

201 Fabaceae

Acacia ?applanata
* *Acacia iteaphylla*
* *Acacia longifolia* subsp. *longifolia*

Acacia pulchella var. *glaberrima*
Acacia pulchella var. *pulchella*
Acacia saligna
Acacia stenoptera
Aotus gracillima
Aotus procumbens
Bossiaea eriocarpa
Daviesia angulata
Daviesia physodes
Euchilopsis linearis
Eutaxia virgata

Gastrolobium linearifolium
Gompholobium aristatum
Gompholobium capitatum
Gompholobium tomentosum
Hovea trisperma
Jacksonia furcellata
Jacksonia sericea (P4)
Jacksonia sternbergiana
Latrobea tenella
* *Lotus angustissimus*
* *Lupinus cosentinii*
* *Medicago polymorpha*
* *Vicia sativa*
Viminaria juncea

203 Polygalaceae

Comesperma calymega

217 Casuarinaceae

Allocasuarina fraseriana
Allocasuarina humilis
Casuarina obesa

229 Celastraceae

Tripterococcus brunonis

242 Euphorbiaceae

* *Euphorbia helioscopia*
Monotaxis occidentalis

247 Phyllanthaceae

Poranthera microphylla

274 Geraniaceae

* *Erodium cicutarium*
* *Pelargonium capitatum*

278 Lythraceae

* *Lythrum hyssopifolia*

279 Onagraceae

* *Oenothera drummondii* subsp. *drummondii*
* *Oenothera stricta* subsp. *stricta*

281 Myrtaceae

Astartea affinis
Callistemon citrinus
Calothamnus lateralis var. *lateralis*
Calothamnus rupestris
Calytrix fraseri
Calytrix sp.
Chamelaucium uncinatum
Corymbia calophylla
Eucalyptus camaldulensis
Eucalyptus marginata
Eucalyptus sp.
Eucalyptus todtiana
Hypocalymma angustifolium
Kunzea glabrescens
Melaleuca huegelii subsp. *huegelii*

Melaleuca parviceps
Melaleuca preissiana
Melaleuca seriata
Melaleuca teretifolia
Melaleuca thymoides
Pericalymma ellipticum var. *floridum*
Regelia ciliata
Verticordia densiflora var. *cespitosa*

300 Rutaceae

Boronia dichotoma
Philotheca spicata

311 Thymelaeaceae

Pimelea imbricata var. *piligera*

332 Brassicaceae

* *Raphanus raphanistrum*

339 Loranthaceae

Nuytsia floribunda

346 Droseraceae

Drosera erythrorhiza
Drosera gigantea
Drosera menziesii
Drosera micrantha
Drosera sp.
Drosera stolonifera

355 Caryophyllaceae

* *Cerastium glomeratum*

392 Primulaceae

* *Lysimachia arvensis*

403 Ericaceae

Brachyloma preissii
Conostephium preissii
Leucopogon tenuis

411 Loganiaceae

Phyllangium divergens
Phyllangium paradoxum

413 Apocynaceae

* *Gomphocarpus fruticosus*

415 Boraginaceae

* *Echium plantagineum*

417 Solanaceae

* *Solanum nigrum*

427 Plantaginaceae

* *Callitriche stagnalis*

432 Lamiaceae

Hemiandra pungens

435 Orobanchaceae

* *Orobanche minor*

450 Campanulaceae

Lobelia anceps
Lobelia tenuior
* *Wahlenbergia capensis*

452 Stylidiaceae

Levenhookia stipitata
Stylidium brunonianum
Stylidium calcaratum
Stylidium divaricatum
Stylidium guttatum
Stylidium piliferum
Stylidium repens
Stylidium schoenoides

457 Menyanthaceae

Ornduffia albiflora

458 Goodeniaceae

Dampiera linearis
Goodenia micrantha
Goodenia pulchella subsp. Coastal Plain B (L.W. Sage 2336)
Lechenaultia expansa

460 Asteraceae

* *Arctotheca calendula*
* *Dittrichia graveolens*
* *Erigeron bonariensis*
Hyalosperma cotula
* *Hypochaeris glabra*
* *Lactuca serriola*
Podotheca angustifolia
Podotheca gnaphalioides
* *Senecio vulgaris*
Siloxerus humifusus
* *Sonchus oleraceus*
* *Ursinia anthemoides*

472 Araliaceae

Trachymene pilosa

474 Apiaceae

Centella asiatica
Xanthosia huegelii

Appendix F – Species by site data

Nicholson Road Wetlands **Site GNR-01**

Date	29/09/2020
Described by	JC & SC
Type	Q 10m x 10m
Location	MGA Zone 50 397895 mE; 6448963 mN 115.9179 E -32.091020 S
Veg Condition	Very Good
Soil	Sandy Loam
Rock Type	None
Fire Age	5-10 yrs
Habitat	Drainage Area/ Floodplain
Vegetation	Low open *Melaleuca preissiana* woodland over tall *Xanthorrhoea preissii* shrubland over mid open *Jacksonia furcellata* and *Hypocalymma angustifolium* shrubland over low mixed *Dasypogon bromeliifolius, Lyginia barbata* and *Patersonia occidentalis* shrubland and sedgeland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia pulchella var. *pulchella*	0.1		0.5		
Adenanthos obovatus	0.1		0.3		
Anigozanthos manglesii subsp. *manglesii*	0.5		1		
Bossiaea eriocarpa	0.1		0.3		
Cassytha racemosa	2			GNR01-03	
Chamaescilla corymbosa var. *corymbosa*	0.1		0.3	GGS12-01	
Comesperma calymega	0.1		0.4	GNR01-09	
Conostylis juncea	0.1		0.2		
Crassula colorata var. *colorata*	0.1		0.1	GNR07-01	
Cytogonidium leptocarpoides	0.1		0.4	GNR01-04	
Dasypogon bromeliifolius	16		0.4		
Desmocladus fasciculatus	0.1		0.2		
Ehrharta calycina	0.1		0.6		
Euchilopsis linearis	1		0.5	GNR01-02	
Gladiolus caryophyllaceus	0.2		0.9		
Gompholobium aristatum	0.1		0.2	GNR01-06	
Gompholobium tomentosum	0.1		0.6		
Gonocarpus pithyoides	8		0.2		
Hemiandra pungens	4		0.3		
Hyalosperma cotula	0.1		0.1	GNR01-05	
Hypocalymma angustifolium	12		0.6		
Hypochaeris glabra	0.1		0.1		
Hypolaena exsulca	0.1		0.3		
Jacksonia furcellata	3		1.8	GNR01-01	
Laxmannia ramosa subsp. *ramosa*	0.1		0.1	GNR01-07	
Lechenaultia expansa	0.1		0.3	GNR01-17	
Lepidosperma pubisquameum	0.1		0.6	GNR01-08	
Leucopogon tenuis	0.5		0.4	GNR01-16	
Lomandra caespitosa	0.1		0.3	GNR01-10	
Lomandra preissii	0.1		0.4		
Lyginia barbata	12		0.6		
Melaleuca preissiana	8		3.5		
Mesomelaena graciliceps	0.1		0.5		
Patersonia occidentalis var. *occidentalis*	2		0.6		
Pentameris airoides	0.1		0.1		
Philotheca spicata	0.1		0.5		
Phlebocarya ciliata	8		0.4		
Pimelea imbricata var. *piligera*	0.1		0.5		
Podotheca angustifolia	0.1		1	GNR01-12	
Pterostylis vittata	0.1		0.2		
Schoenus rigens	0.1		0.4	GNR01-13	

Siloxerus humifusus	0.1	0.1	GNR01-15
Stylidium brunonianum	0.1	0.3	
Stylidium calcaratum	0.1	0.1	
Stylidium repens	0.1	0.1	
Trachymene pilosa	0.1	0.1	
Ursinia anthemoides	2	0.3	
Xanthorrhoea preissii	12	2	

Phase 1

Phase 2

Nicholson Road Wetlands **Site GNR-02**

Date	29/09/2020
Described by	JC & SC
Type	Q 10m x 10m
Location	MGA Zone 50 397966 mE; 6448899 mN 115.9187 E -32.091604 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	None
Fire Age	5-10 yrs
Habitat	Sand Plain
Vegetation	Low *Melaleuca preissiana*, *Allocasuarina fraseriana* and *Eucalyptus marginata* woodland over tall *Xanthorrhoea preissii* shrubland over mid *Jacksonia furcellata* and *Acacia pulchella* var. *pulchella* shrubland over low *Euchilopsis linearis*, *Patersonia occidentalis* and *Phlebocarya ciliata* mixed shrubland and sedgeland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia ?applanata	0.1		0.3	GNR02-16	
Acacia pulchella var. *pulchella*	2.5		1		
Adenanthos obovatus	0.4		1		
Allocasuarina fraseriana	8		8		
Anigozanthos manglesii subsp. *manglesii*	0.25		0.6		
Aotus procumbens	0.1		0.2	GNR02-10	
Banksia attenuata	3		5.7		
Boronia dichotoma	0.1		0.5		
Bossiaea eriocarpa	0.1		0.2		
Briza maxima	0.1		0.1		
Briza minor	0.1		0.1		
Caladenia flava subsp. *flava*	0.1		0.2		
Calytrix sp.	0.1		0.5	GNR02-04	
Chaetospora curvifolia	0.1		0.3		
Chamaescilla corymbosa var. *corymbosa*	0.1		0.5	GGS12-01	
Comesperma calymega	0.1		0.4	GNR01-09	
Conostylis juncea	4		0.3		
Dasypogon bromeliifolius	4		0.6		
Desmocladus fasciculatus	0.1		0.1		
Eucalyptus marginata	2		3.8		
Euchilopsis linearis	1.3		0.4	GNR01-02	
Gladiolus caryophyllaceus	0.1		1		
Gompholobium tomentosum	0.3		0.3		
Gonocarpus pithyoides	0.1		0.3	SCOPP02	
Hemiandra pungens	0.2		0.2		
Hibbertia subvaginata	0.2		0.4		
Hovea trisperma	0.1		0.3		
Hyalosperma cotula	0.1		0.1	GNR01-05	
Hypocalymma angustifolium	0.5		0.4		
Hypochaeris glabra	0.1		0.2		
Hypolaena exsulca	0.1		0.3		
Jacksonia furcellata	1		0.8	GNR01-01	
Laxmannia ramosa subsp. *ramosa*	0.3		0.3	GNR01-07	
Lechenaultia expansa	0.1		0.2		
Lepidosperma pubisquameum	1		0.5	GNR01-08	
Leucopogon tenuis	0.1		0.4	GNR01-16	
Levenhookia stipitata	0.1		0.1		
Lomandra preissii	0.1		0.5	GNR02-05	
Lomandra sonderi	0.1		0.3		
Lyginia barbata	1		0.5		
Lysimachia arvensis	0.1		0.1		

Melaleuca preissiana	5.5	10	
Monotaxis occidentalis	0.3	0.2	GNR02-03
Patersonia occidentalis var. *occidentalis*	2	0.4	
Pentameris airoides	0.1	0.2	
Phlebocarya ciliata	12	0.4	
Phlebocarya filifolia	0.1	0.3	GNR02-13
Podotheca angustifolia	0.1	0.1	GNR01-12
Rytidosperma setaceum	0.1	0.4	GNR02-15
Schoenus efoliatus	1	0.5	GNR02-01
Schoenus rigens	0.1	0.6	
Schoenus rigens	1.5	0.6	GNR01-13
Sonchus oleraceus	0.1	0.3	
Stylidium brunonianum	0.1	0.3	
Stylidium calcaratum	0.1	0.1	
Stylidium repens	0.1	0.1	
Thysanotus manglesianus	0.1	0	
Trachymene pilosa	0.1	0.1	
Tricoryne elatior	0.1	0.4	
Ursinia anthemoides	0.1	0.1	
Xanthorrhoea preissii	16	1.8	
Xanthosia huegelii	0.1	0.1	GNR02-02

Phase 1

Phase 2

Nicholson Road Wetlands **Site GNR-03**

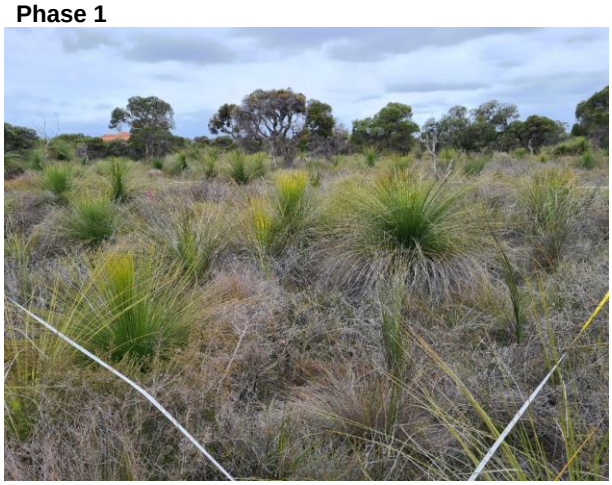
Date	29/09/2020
Described by	JC & SC
Type	Q 10m x 10m
Location	MGA Zone 50 397818 mE; 6448593 mN 115.9171 E -32.094355 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	None
Fire Age	>10 yrs
Habitat	Drainage Area/ Floodplain
Vegetation	Low open *Melaleuca preissiana* woodland over tall *Xanthorrhoea preissii* shrubland over mid open *Pericalymma ellipticum* shrubland over low open *Hypocalymma angustifolium* shrubland over low *Dasypogon bromeliifolius*, *Schoenus efoliatus* and *Phlebocarya ciliata* mixed shrubland and sedgeland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia pulchella var. *pulchella*	1.6		0.6		
Acacia stenoptera	0.1		0.3		
Adenanthos obovatus	0.4		1.6		
Austrostipa compressa	0.1		0.2	GNR09-11	
Banksia nivea	0.1		0.3		
Boronia dichotoma	0.1		0.7	SCKGOPP02	
Briza maxima	0.1		0.3		
Cassytha racemosa	2		0	GNR01-03	
Conostylis juncea	0.1		0.3		
Cytogonidium leptocarpoides	0.1		0.5		
Dasypogon bromeliifolius	10		0.6		
Desmocladus fasciculatus	0.1		0.2		
Drosera stolonifera	0.1		0.1	GNR03-01	
Ehrharta calycina	0.1		0.6		
Euchilopsis linearis	2		0.4	GNR01-02	
Gladiolus caryophyllaceus	0.1		1.1		
Hypocalymma angustifolium	10		0.8		
Hypochaeris glabra	0.1		0.2		
Hypolaena exsulca	0.1		0.3		
Jacksonia furcellata	0.5		1.6	GNR01-01	
Lechenaultia expansa	0.1		0.2		
Lepidosperma pubisquameum	0.1		0.6		
Lomandra sp. indet	0.5		0.5	GNR03-03	
Lyginia barbata	4		0.6		
Melaleuca seriata	0.5		1.1	GNR03-04	
Mesomelaena stygia	0.1		0.3		
Patersonia occidentalis var. *occidentalis*	0.2		0.3		
Pentameris airoides	0.1		0.1		
Pericalymma ellipticum var. *floridum* .	12		1.2		
Philotheca spicata	0.1		0.6		
Phlebocarya ciliata	10		0.3		
Pimelea imbricata var. *piligera*	0.2		0.6	GNR03-02	
Schoenus efoliatus	8		0.6	GNR02-01	
Schoenus rigens	1		0.8	GNR01-13	
Stylidium brunonianum	0.1		0.3		
Stylidium guttatum	0.1		0.1	SCEEBopp03	
Thelymitra sp.	0.1		0.1		
Thysanotus tenellus	0.1		0.4	GNR06-01	
Trachymene pilosa	0.1		0.1		
Tricoryne elatior	0.1		0.3	GOG02-07	
Ursinia anthemoides	0.1		0.2		

Wahlenbergia capensis	0.1	0.3
Xanthorrhoea preissii	18	2.1

Phase 1



Phase 2

Nicholson Road Wetlands **Site GNR-04**

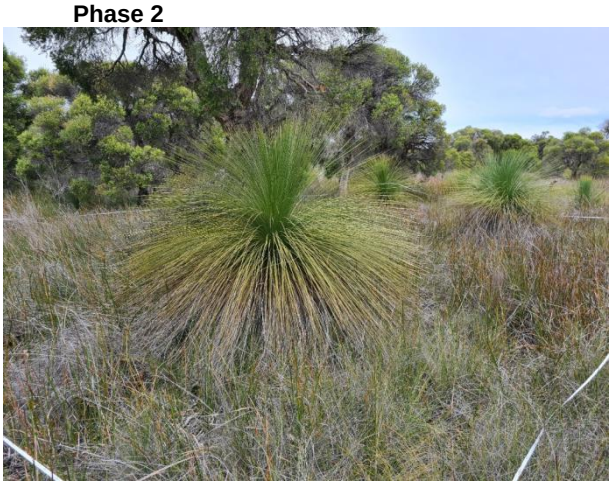
Date	29/09/2020
Described by	JC & SC
Type	Q 10m x 10m
Location	MGA Zone 50 397867 mE; 6448529 mN 115.9176 E -32.094936 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	None
Fire Age	5-10 yrs
Habitat	Wetland
Vegetation	Low open *Melaleuca preissiana* woodland over tall open *Xanthorrhoea preissii* shrubland over tall *Lepidosperma longitudinale*, *Lepidosperma striatum* and *Lepidosperma pubisquameum* sedgeland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia longifolia subsp. *longifolia*	0.2		1.2		
Acacia pulchella var. *pulchella*	0.2		1		
Astartea affinis	0.1		1		
Calothamnus lateralis var. *lateralis*	0.7		1	GGS06-02	
Cyathochaeta avenacea	0.1		1.1	GNR04-05	
Dasypogon bromeliifolius	0.1		0.2		
Hypocalymma angustifolium	0.1		0.4		
Isolepis sp.	0.1		0.1	GNR04-10	
Lepidosperma longitudinale	75		1.3	GNR04-02	
Lepidosperma pubisquameum	2		1	GNR04-01	
Lepidosperma striatum	1		0.9	GNR04-04	
Lomandra caespitosa	0.1		0.3		
Lomandra sp. indet	13		0.6	GNR04-03	
Lyginia barbata	0.1		0.6		
Melaleuca preissiana	14		7		
Pericalymma ellipticum var. *floridum*	0.2		1.2		
Solanum nigrum	0.1		0.1		
Xanthorrhoea preissii	8		2.1		

Phase 1

Phase 2



Nicholson Road Wetlands **Site GNR-05**

Date	29/09/2020
Described by	JC & SC
Type	Q 10m x 10m
Location	MGA Zone 50 397940 mE; 6448958 mN 115.9184 E -32.091074 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	None
Fire Age	>10 yrs
Habitat	Sand Plain
Vegetation	Mid to tall open *Xanthorrhoea preissii* shrubland over low open *Eutaxia virgata* and *Acacia pulchella* var. *pulchella* shrubland over mid *Mesomelaena tetragona* and *Dasypogon bromeliifolius* sedgeland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia pulchella var. *pulchella*	10		1.2		
Amphipogon amphipogonoides	0.1		0.5	GNR05-03	
Anigozanthos manglesii subsp. *manglesii*	0.1		0.5		
Astartea affinis	0.1		0.5		
Avena barbata	0.1		0.6		
Boronia dichotoma	0.1		0.3	SCKGOPP02	
Caladenia flava subsp. *flava*	0.1		0.2		
Cerastium glomeratum	0.1		0.1	GNR05-04	
Conostylis juncea	0.2		0.3		
Cytogonidium leptocarpoides	0.5		0.4	GNR01-04	
Dasypogon bromeliifolius	6		0.6		
Daviesia angulata	0.1		0.6	GNR05-02	
Daviesia physodes	0.1		0.4	GNR05-10	
Ehrharta calycina	0.1		0.5		
Euchilopsis linearis	0.1		0.3		
Eutaxia virgata	12		0.7	GGS08-05	
Fumaria capreolata	0.1		0.4	GNR05-01	
Gladiolus caryophyllaceus	0.1		0.6		
Gompholobium tomentosum	0.1		0.3		
Hyalosperma cotula	0.1		0.1	GNR01-05	
Hypochaeris glabra	0.1		0.2		
Hypolaena exsulca	0.1		0.4	GNR01-11	
Lepidosperma pubisquameum	0.1		0.6		
Leucopogon tenuis	0.1		0.6	GNR01-16	
Lyginia barbata	0.1		0.6		
Melaleuca preissiana	0.5		1.2		
Mesomelaena tetragona	35		0.7		
Patersonia occidentalis var. *occidentalis*	0.1		0.3		
Pentameris airoides	0.1		0.2		
Pericalymma ellipticum var. *floridum*	1		1		
Phlebocarya ciliata	0.2		0.2		
Pimelea imbricata var. *piligera*	0.1		0.6	GNR03-02	
Schoenus efoliatus	1		0.3	GNR02-01	
Schoenus pedicellatus	0.1		0.7		
Siloxerus humifusus	0.1		0.1	GNR01-15	
Stylidium brunonianum	0.1		0.3		
Stylidium calcaratum	0.1		0.1		
Stylidium guttatum	0.1		0.1	SCEEBopp03	
Thysanotus multiflorus	0.2		0.3		
Thysanotus sparteus	0.1		0.6		
Trachymene pilosa	0.1		0.1		
Ursinia anthemoides	0.1		0.2		

Xanthorrhoea preissii	8	2	
Xanthosia huegelii	0.2	0.2	GNR02-02

Phase 1

Phase 2

Nicholson Road Wetlands **Site GNR-06**

Date	30/09/2020
Described by	CW, HE & SC
Type	Q 10m x 10m
Location	MGA Zone 50 397758 mE; 6448286 mN 115.9164 E -32.097115 S
Veg Condition	Excellent
Soil	Loamy Sand
Rock Type	None
Fire Age	>10 yrs
Habitat	Sand Plain
Vegetation	Low *Banksia attenuata* woodland over tall *Kunzea glabrescens* shrubland over *Xanthorrhoea preissii*, *Acacia pulchella* var. *pulchella* mid open shrubland, over *Dasypogon bromeliifolius* low shrubland and sedgeland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia longifolia subsp. *longifolia*	0.1		0.4		
Acacia pulchella var. *pulchella*	2		1.8		
Banksia attenuata	38		9		
Bossiaea eriocarpa	0.1		0.4		
Caladenia flava subsp. *flava*	0.1		0.1		
Chamaescilla corymbosa var. *corymbosa*	0.1		0.1	GGS12-01	
Conostephium preissii	0.1		0.7	GNR06-03	
Conostylis juncea	0.1		0.15		
Dampiera linearis	0.1		0.1		
Dasypogon bromeliifolius	17		0.6		
Diuris sp.	0.1		0.4		
Drosera sp.	0.1		0		
Ehrharta calycina	0.1		0.4		
Gladiolus caryophyllaceus	0.1		0.4		
Hibbertia subvaginata	0.1		0.4		
Hovea trisperma	0.1		0.5		
Hypocalymma angustifolium	0.3		0.6		
Hypochaeris glabra	0.1		0.1		
Kunzea glabrescens	18		7		
Lomandra caespitosa	0.1		0.3	GNR10-07	
Lomandra hermaphrodita	0.1		0.25		
Lomandra nigricans	0.1		0.35	GNR06-04	
Lomandra odora	0.1		0.15	GNR06-05	
Lomandra sonderi	0.1		0.6		
Loxocarya cinerea	0.1		0.1	GNR06-07	
Mesomelaena graciliceps	0.1		0.5	GNR06-06	
Microtis media subsp. *media*	0.1		0.4		
Patersonia occidentalis var. *occidentalis*	0.1		0.4		
Phlebocarya ciliata	0.1		0.3		
Prasophyllum parvifolium	0.1		0.4		
Pterostylis crispula	0.1		0.2		
Pterostylis vittata	0.1		0.4		
Pyrorchis nigricans	0.1		0.1		
Schoenus pedicellatus	2		0.4	GNR06-01	
Schoenus sublateralis	0.1		0.15	GNR06-02	
Sonchus oleraceus	0.1		0.1		
Stylidium brunonianum	0.1		0.5		
Thysanotus tenellus	0.1		0.3	GNR06-01	
Trachymene pilosa	0.1		0.15		
Tricoryne elatior	0.1		0.3	GOG02-07	
Xanthorrhoea preissii	4		1.4		
Xanthosia huegelii	0.1		0.1	CVCWopp.04	

Phase 1

Phase 2

Nicholson Road Wetlands **Site GNR-07**

Date	30/09/2020
Described by	HE & SC
Type	Q 10m x 10m
Location	MGA Zone 50 397760 mE; 6448401 mN 115.9164 E -32.096076 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	None
Fire Age	>10 yrs
Habitat	Sand Plain
Vegetation	Low open *Melaleuca preissiana* woodland over mid *Hypocalymma angustifolium* and *Xanthorrhoea preissii* shrubland over a low open *Dasypogon bromeliifolius*, *Mesomelaena graciliceps* and *Euchilopsis linearis* mixed sedgeland and shrubland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia pulchella var. *pulchella*	0.4		0.7		
Adenanthos obovatus	0.5		1		
Aira cupaniana	0.5		0.15		
Austrostipa compressa	0.1		0.8	GNR07-02	
Boronia dichotoma	0.2		0.5	SCKGOPP02	
Briza minor	0.1		0.2		
Caladenia flava subsp. *flava*	0.1		0.25		
Cassytha racemosa	8		0.5	GNR01-03	
Comesperma calymega	0.1		0.4		
Crassula colorata var. *colorata*	0.3		0.1	GNR07-01	
Dasypogon bromeliifolius	15		0.4		
Drosera sp.	1		0.1		
Ehrharta calycina	0.1		0.8		
Euchilopsis linearis	8		0.6	GNR01-02	
Gladiolus caryophyllaceus	0.1		0.1		
Hypocalymma angustifolium	35		0.6		
Hypochaeris glabra	0.1		0.1		
Hypolaena exsulca	0.5		0.3	GNR07-09	
Latrobea tenella	0.1		1	GNR07-06	
Leucopogon tenuis	0.1		1	GNR07-01	
Melaleuca preissiana	7		3.5		
Mesomelaena graciliceps	10		0.3	GNR06-06	
Microtis media subsp. *media*	0.1		0.4		
Pericalymma ellipticum var. *floridum*	5		1		
Philotheca spicata	0.1		1.1		
Phyllangium divergens	0.1		0.1	GNR07-08	
Phyllangium paradoxum	0.1		0.1	GNR07-07	
Podotheca gnaphalioides	0.1		0.3	GNR07-03	
Poranthera microphylla	0.5		0.1	GNR07-02	
Stylidium brunonianum	0.1		0.4		
Thysanotus manglesianus	1		0.6	GNR07-04	
Trachymene pilosa	0.1		0.1		
Ursinia anthemoides	0.1		0.5		
Wahlenbergia capensis	0.1		0.1		
Xanthorrhoea preissii	15		1		
Xanthosia huegelii	0.1		0.2		

Phase 1

Phase 2

Nicholson Road Wetlands **Site GNR-08**

Date	30/09/2020
Described by	CW, HE & SC
Type	Q 10m x 10m
Location	MGA Zone 50 397752 mE; 6448429 mN 115.9164 E -32.095826 S
Veg Condition	Very Good
Soil	Sandy Loam
Rock Type	None
Fire Age	>10 yrs
Habitat	Drainage Area/ Floodplain
Vegetation	*Melaleuca preissiana* woodland over mid open *Kunzea glabrescens* and *Xanthorrhoea preissii* shrubland over mid *Lepidosperma longitudinale* sedgeland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia pulchella var. *pulchella*	0.2		0.5		
Adenanthos obovatus	0.1		0.4		
Aotus gracillima	0.1		1	GNR08-01	
Astartea affinis	0.1		1.2	GNR08-02	
Avena barbata	0.1		0.4		
Boronia dichotoma	0.1		0.6	SCKGOPP02	
Briza maxima	0.1		0.3		
Briza minor	0.1		0.3		
Cassytha flava	0.1				
Cassytha racemosa	0.5			GNR01-03	
Dasypogon bromeliifolius	5		0.4		
Drosera sp.	0.1		0.2		
Ehrharta calycina	3		1		
Erigeron bonariensis	0.1		0.4		
Eriochilus scaber	0.1		0.1		
Fumaria sp.	0.1		0.2		
Gladiolus caryophyllaceus	0.1		0.6		
Hypocalymma angustifolium	0.1		1.3		
Hypochaeris glabra	3		0.1		
Hypolaena exsulca	0.1		0.4	GNR07-09	
Kunzea glabrescens	1		2.5		
Lactuca serriola	0.1		0.4		
Lepidosperma longitudinale	80		1.3	GNR04-02	
Melaleuca preissiana	15		8		
Mesomelaena graciliceps	7		0.3	GNR06-06	
Phyllangium paradoxum	0.1		0.1		
Poranthera microphylla	0.1		0.1		
Pterostylis vittata	0.1		0.2		
Pyrorchis nigricans	0.1		0.1		
Solanum nigrum	0.1		0.1		
Sonchus oleraceus	0.1		0.3		
Trachymene pilosa	0.1		0.1		
Xanthorrhoea preissii	5		0.6		
Xanthosia huegelii	0.1		0.1	GNR08-03	

Phase 1

Phase 2

Nicholson Road Wetlands **Site GNR-09**

Date	30/09/2020
Described by	HE & SC
Type	Q 10m x 10m
Location	MGA Zone 50 397812 mE; 6448522 mN 115.9170 E -32.094994 S
Veg Condition	Excellent
Soil	Sandy Loam
Rock Type	None
Fire Age	>10 yrs
Habitat	Sand Plain
Vegetation	Low open *Melaleuca preissiana* woodland over mid *Hypocalymma angustifolium* and *Xanthorrhoea preissii* shrubland over mid *Mesomelaena tetragona*, *Dasypogon bromeliifolius* and *Schoenus pedicellatus* sedgeland

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia longifolia subsp. *longifolia*	0.1		0.3		
Acacia pulchella var. *pulchella*	0.5		0.9		
Acacia stenoptera	0.1		0.8		
Aira cupaniana	0.1		0.2		
Austrostipa compressa	0.1		0.6		
Boronia dichotoma	0.1		0.5		
Cassytha flava	0.1			GNR09-04	
Cassytha racemosa	4			GNR01-03	
Chaetospora curvifolia	0.1		0.4	GNR09-03	
Conostylis juncea	0.1		0.2		
Dampiera linearis	0.1		0.2		
Dasypogon bromeliifolius	4		0.7		
Desmocladus flexuosus	0.1		0.2		
Drosera menziesii	0.1		0.2		
Drosera stolonifera	0.1		0.1	GNR09-01	
Erigeron bonariensis	0.1		0.3		
Gladiolus caryophyllaceus	0.1		1		
Hibbertia hypericoides	0.3		0.3		
Hibbertia sp.	0.1		0.4	GNR09-10	
Hypocalymma angustifolium	20		1.3		
Hypochaeris glabra	0.1		0.1		
Hypolaena exsulca	0.1		0.4		
Lechenaultia expansa	0.1		0.3	GNR09-05	
Lepidosperma longitudinale	0.5		0.7		
Leucopogon tenuis	0.1		0.5		
Lobelia anceps	0.1		0.2		
Lyginia barbata	6		0.7		
Melaleuca preissiana	6		5		
Mesomelaena graciliceps	0.1		0.3		
Mesomelaena tetragona	16		0.7		
Microtis media subsp. *media*	0.1		0.3		
Pericalymma ellipticum var. *floridum*	0.5		1.2		
Philotheca spicata	0.1		0.7		
Phlebocarya ciliata	0.1		0.2		
Phyllangium paradoxum	0.1		0.1		
Schoenus pedicellatus	15		0.6	GNR06-01	
Siloxerus humifusus	0.1		0.1		
Stylidium brunonianum	0.1		0.3		
Thysanotus multiflorus	0.1		0.4		
Thysanotus sparteus	0.1		0.5		
Trachymene pilosa	0.1		0.4		
Xanthorrhoea preissii	6		1.5		
Xanthosia huegelii	0.1		0.1		

Phase 1

Phase 2

Nicholson Road Wetlands **Site GNR-10**

Date	30/09/2020
Described by	CW & CvdB
Type	Q 10m x 10m
Location	MGA Zone 50 397822 mE; 6448340 mN 115.9171 E -32.096632 S
Veg Condition	Excellent
Soil	Loamy Sand
Rock Type	None
Fire Age	>10 yrs
Habitat	Sand Plain
Vegetation	Low open *Banksia attenuata* and *Banksia ilicifolia* woodland over *Hypocalymma angustifolium* and *Xanthorrhoea preissii* low shrubland over *Dasypogon bromeliifolius*, *Phlebocarya ciliata*, *Lomandra sericea* and mixed shrubland and sedgeland.

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia longifolia subsp. *longifolia*	0.5		1.7		
Acacia pulchella var. *glaberrima*	0.1		1.8	GNR10-12	
Austrostipa compressa	0.1		0.3	GNR07-02	
Banksia attenuata	8		5		
Banksia ilicifolia	0.5		4		
Bossiaea eriocarpa	0.1		0.3		
Calytrix sp.	0.1		0.4		
Cassytha racemosa	0.1		0.3	GNR01-03	
Dampiera linearis	0.1		0.3		
Dasypogon bromeliifolius	35		0.6		
Eucalyptus marginata	0.5		1.6		
Euchilopsis linearis	1		0.4	GNR01-02	
Gladiolus caryophyllaceus	0.1		0.6		
Hibbertia subvaginata	1		0.4		
Hibbertia vaginata	0.1		0.4	GNR10-03	
Hypocalymma angustifolium	7		0.7		
Hypolaena exsulca	1		0.4	GNR10-08	
Kunzea glabrescens	0.2		1.8		
Lepidosperma pubisquameum	0.1		0.8	GNR10-06	
Lomandra caespitosa	0.5		0.4	GNR10-07	
Lomandra sericea	1		0.5	GNR10-09	
Lyginia imberbis	0.1		0.5	GNR10-14	
Melaleuca seriata	0.1		0.4		
Mesomelaena graciliceps	0.5		0.4	GNR10-10	
Monotaxis occidentalis	0.1		0.1	GNR10-01	
Patersonia occidentalis var. *occidentalis*	0.5		0.5		
Petrophile linearis	0.1		0.4		
Philotheca spicata	0.1		0.6		
Phlebocarya ciliata	35		0.4	CVCWOPP02	
Schoenus pedicellatus	2		0.7	GNR10-05	
Schoenus sublateralis	0.5		0.1	GNR10-02	
Stylidium brunonianum	0.1		0.6		
Thysanotus triandrus	0.1		0.4		
Tricoryne elatior	0.1		0.4	GOG02-07	
Xanthorrhoea preissii	7		0.7		

Phase 1

Phase 2

Nicholson Road Wetlands **Site** **Opp**

Date
Described by
Type
Location
Veg Condition
Soil
Rock Type
Fire Age
Habitat
Vegetation
Notes

SPECIES LIST

Name	Cover	C Class	Height	Specimen	Notes
Acacia iteaphylla					
Acacia iteaphylla					
Acacia longifolia subsp. *longifolia*					
Acacia longifolia subsp. *longifolia*					
Acacia longifolia subsp. *longifolia*					
Acacia longifolia subsp. *longifolia*					
Acacia longifolia subsp. *longifolia*					
Acacia longifolia subsp. *longifolia*					
Acacia longifolia subsp. *longifolia*					
Acacia longifolia subsp. *longifolia*					
Acacia longifolia subsp. *longifolia*					
Acacia saligna					
Acacia stenoptera				CWopp03	
Adenanthos cygnorum subsp. *cygnorum*					
Allocasuarina humilis					
Amphipogon amphipogonoides				CWopp09	
Anigozanthos viridis subsp. *viridis*				Cvopp.04	
Arctotheca calendula					
Arctotheca calendula					
Arctotheca calendula					
Arctotheca calendula					
Austrostipa elegantissima					
Avena barbata					
Avena barbata					
Avena barbata					
Avena barbata					
Avena barbata					
Avena barbata					
Avena barbata					
Avena barbata					
Avena barbata					
Avena barbata					
Avena barbata					
Avena barbata					
Banksia ilicifolia					
Banksia littoralis					
Banksia menziesii					
Banksia menziesii					
Banksia menziesii					
Baumea arthrophylla				SCOPP06	
Baumea juncea				SCHEopp04	
Baumea juncea				SCHEopp12	
Baumea juncea				SCOPP05	
Bolboschoenus caldwellii				SCJCopp04	
Boronia dichotoma				CvCWopp03	
Brachyloma preissii				HEopp01	
Briza maxima					

Briza maxima	
Briza maxima	
Briza maxima	
Briza maxima	
Briza minor	
Briza minor	
Bromus diandrus	
Bromus diandrus	
Bromus diandrus	
Bromus diandrus	
Burchardia congesta	
Burchardia congesta	
Caladenia flava subsp. *flava*	
Caladenia paludosa	
Callistemon citrinus	
Callitriche stagnalis	
Calothamnus rupestris	CWopp04
Calytrix fraseri	GNR02-14
Casuarina obesa	
Centella asiatica	SCHEopp08
Chaetanthus sp.	SCHEopp05
Chaetospora subbulbosa	GNR01-14
Chamaescilla corymbosa var. *corymbosa*	
Chamelaucium uncinatum	
Conostylis candicans	
Conostylis candicans	
Conostylis juncea	CvCWopp06
Corymbia calophylla	
Crassula glomerata	SCHEopp02
Cynodon dactylon	
Cynodon dactylon	
Cynodon dactylon	
Cynodon dactylon	
Cyperus involucratus	
Desmocladus fasciculatus	
Dianella revoluta var. *divaricata*	
Dielsia stenostachya	CWopp15
Drosera erythrorhiza	
Drosera gigantea	CvCWopp01
Drosera menziesii	
Drosera micrantha	SCHEopp14
Echium plantagineum	
Echium plantagineum	
Ehrharta calycina	
Ehrharta calycina	
Ehrharta calycina	
Ehrharta calycina	
Ehrharta calycina	
Ehrharta calycina	
Ehrharta calycina	
Ehrharta calycina	
Ehrharta calycina	
Ehrharta longiflora	
Elythranthera brunonis	
Eragrostis curvula	
Eragrostis curvula	
Eragrostis curvula	
Eragrostis curvula	
Eragrostis curvula	
Eragrostis curvula	
Erigeron bonariensis	
Erigeron bonariensis	
Erodium cicutarium	
Erodium cicutarium	
Eucalyptus camaldulensis	
Eucalyptus sp.	
Eucalyptus todtiana	

Euphorbia helioscopia		
Euphorbia helioscopia		
Evandra pauciflora	SCHEopp01	Cyperus curly base
Fumaria capreolata		
Fumaria capreolata		
Fumaria capreolata		
Fumaria capreolata		
Fumaria capreolata		
Fumaria capreolata		
Fumaria capreolata		
Fumaria capreolata		
Gastrolobium linearifolium	SCOPP10	
Gladiolus caryophyllaceus		
Gomphocarpus fruticosus		
Gomphocarpus fruticosus		
Gompholobium capitatum		
Gompholobium tomentosum	CWopp10	
Gonocarpus ?pithyoides	CWopp14	
Goodenia micrantha	SCJCopp10	
Goodenia pulchella subsp. Coastal Plain B (L.W. Sage 2336)	SCJCopp01	
Grevillea sp.		
Haemodorum sparsiflorum	SCJCopp02	
Hakea prostrata		
Hakea varia	GGS08-09	
Hibbertia stellaris	SCOPP01	
Hordeum leporinum		
Hordeum leporinum		
Hovea trisperma	CvCWopp05	
Isolepis marginata	SCOPP04	
Jacksonia furcellata		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)	SCOPP09	
Jacksonia sericea (P4)	CWopp06	
Jacksonia sericea (P4)	CWopp11	
Jacksonia sericea (P4)	SCHEopp13	
Jacksonia sericea (P4)	SCHEopp13	
Jacksonia sericea (P4)		
Jacksonia sericea (P4)	SCOPP09	
Jacksonia sericea (P4)	SCOPP09	
Jacksonia sericea (P4)	SCOPP09	
Jacksonia sericea (P4)		
Jacksonia sericea (P4)	SCOPP09	
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)		
Jacksonia sericea (P4)	SCOPP09	
Jacksonia sternbergiana		
Juncus kraussii		
Juncus microcephalus	SCJCopp06	
Juncus pallidus		
Lactuca serriola		
Lactuca serriola		

Laxmannia squarrosa	CWopp13
Laxmannia squarrosa	
Lepidosperma longitudinale	
Leptocarpus decipiens	JCopp01
Leptocarpus scariosus	SCOPP02
Lepyrodia glauca	GGS08-03
Lobelia anceps	SCJCopp05
Lobelia tenuior	SCOPP03
Lolium multiflorum	
Lomandra hermaphrodita	
Lomandra preissii	CVopp.01
Lotus angustissimus	
Lupinus cosentinii	
Lupinus cosentinii	
Lysimachia arvensis	
Lysimachia arvensis	
Lythrum hyssopifolia	SCHEopp07
Medicago polymorpha	SCHEopp03
Melaleuca huegelii subsp. *huegelii*	
Melaleuca huegelii subsp. *huegelii*	SCOPP07
Melaleuca huegelii subsp. *huegelii*	
Melaleuca parviceps	CWopp12
Melaleuca preissiana	
Melaleuca seriata	SCOPP08
Melaleuca teretifolia	SCGSopp02
Melaleuca thymoides	GGS12-04
Melaleuca thymoides	CWopp01
Mesomelaena stygia	
Microtis media subsp. *media*	
Microtis sp.	
Nephrolepis cordifolia	
Nuytsia floribunda	
Nuytsia floribunda	
Nuytsia floribunda	
Nuytsia floribunda	
Oenothera drummondii subsp. *drummondii*	
Oenothera stricta subsp. *stricta*	
Ornduffia albiflora	CVopp.03
Orobanche minor	
Orobanche minor	
Pelargonium capitatum	
Pelargonium capitatum	
Pelargonium capitatum	
Pelargonium capitatum	
Pelargonium capitatum	
Pelargonium capitatum	
Phlebocarya ciliata	CvCWopp02
Poa annua	
Pterostylis recurva	
Raphanus raphanistrum	
Raphanus raphanistrum	
Raphanus raphanistrum	
Raphanus raphanistrum	CWopp07
Raphanus raphanistrum	
Raphanus raphanistrum	
Regelia ciliata	CWopp02
Regelia ciliata	
Romulea rosea	
Schoenus benthamii (P3)	GNR04-SUPP
Schoenus pedicellatus	
Senecio vulgaris	
Solanum nigrum	
Solanum nigrum	
Solanum nigrum	
Solanum nigrum	
Sonchus oleraceus	
Sonchus oleraceus	

Sonchus oleraceus	
Stylidium divaricatum	SCJCopp03
Stylidium piliferum	CvCWopp07
Stylidium schoenoides	
Stylidium schoenoides	
Thelymitra crinita	
Thelymitra crinita	
Thelymitra macrophylla	
Thysanotus manglesianus	
Tripterococcus brunonis	CVopp.02
Tripterococcus brunonis	SCHEopp11
Typha orientalis	
Typha orientalis	
Verticordia densiflora var. *cespitosa*	SCOPP01
Vicia sativa	
Viminaria juncea	HEJCopp05
Vitis vinifera	
Wahlenbergia capensis	
Xanthosia huegelii	CvCWopp04

Appendix G – Conservation significant flora locations

Family	Taxon	Count	Latitude	Longitude
Fabaceae	*Jacksonia sericea* (P4)	2	-32.0968564	115.9174192
Fabaceae	*Jacksonia sericea* (P4)	1	-32.0974873	115.9163269
Fabaceae	*Jacksonia sericea* (P4)	6	-32.0974464	115.9158782
Fabaceae	*Jacksonia sericea* (P4)	2	-32.0975209	115.9159075
Fabaceae	*Jacksonia sericea* (P4)	3	-32.097721	115.91645
Fabaceae	*Jacksonia sericea* (P4)	4	-32.0976119	115.916654
Fabaceae	*Jacksonia sericea* (P4)	6	-32.097485	115.9168229
Fabaceae	*Jacksonia sericea* (P4)	7	-32.097356	115.916988
Fabaceae	*Jacksonia sericea* (P4)	1	-32.096916	115.9174821
Fabaceae	*Jacksonia sericea* (P4)	1	-32.0971647	115.9171986
Fabaceae	*Jacksonia sericea* (P4)	1	-32.0972492	115.9169551
Fabaceae	*Jacksonia sericea* (P4)	1	-32.0973208	115.9158493
Fabaceae	*Jacksonia sericea* (P4)	1	-32.097871	115.916304
Fabaceae	*Jacksonia sericea* (P4)	3	-32.097274	115.917082
Fabaceae	*Jacksonia sericea* (P4)	2	-32.09747051	115.9159496
Fabaceae	*Jacksonia sericea* (P4)	2	-32.09748423	115.9158642
Fabaceae	*Jacksonia sericea* (P4)	3	-32.0974865	115.9162487
Fabaceae	*Jacksonia sericea* (P4)	3	-32.09722259	115.9171194
Fabaceae	*Jacksonia sericea* (P4)	2	-32.09748519	115.9159141
Fabaceae	*Jacksonia sericea* (P4)	6	-32.09755535	115.9159352
Fabaceae	*Jacksonia sericea* (P4)	1	-32.09766759	115.9160438
Fabaceae	*Jacksonia sericea* (P4)	7	-32.09769033	115.9160769
Fabaceae	*Jacksonia sericea* (P4)	2	-32.09781096	115.9162548
Fabaceae	*Jacksonia sericea* (P4)	3	-32.097678	115.916602
Fabaceae	*Jacksonia sericea* (P4)	4	-32.0977272	115.9166315
Fabaceae	*Jacksonia sericea* (P4)	1	-32.09738441	115.9169371
Fabaceae	*Jacksonia sericea* (P4)	1	-32.0972937	115.9158699
Fabaceae	*Jacksonia sericea* (P4)	1	-32.09746535	115.9164473
Fabaceae	*Jacksonia sericea* (P4)	2	-32.0970616	115.9173118
Fabaceae	*Jacksonia sericea* (P4)	2	-32.097022	115.917367
Fabaceae	*Jacksonia sericea* (P4)	2	-32.0968564	115.9174192
Cyperaceae	*Schoenus benthamii* (P3)	1	-32.0949	115.9177

Appendix H – Introduced flora locations

Taxon	Latitude	Longitude	Site ID	No. of Individuals
Acacia iteaphylla	-32.096498	115.9169227	No Site	1
Acacia iteaphylla	-32.0972065	115.9163419	No Site	1
Acacia longifolia subsp. *longifolia*	-32.0949271	115.9176386	GNR-04	1
Acacia longifolia subsp. *longifolia*	-32.0971052	115.9164006	GNR-06	1
Acacia longifolia subsp. *longifolia*	-32.0955314	115.9179103	GNR-09	2
Acacia longifolia subsp. *longifolia*	-32.0966647	115.9171667	GNR-10	1
Acacia longifolia subsp. *longifolia*	-32.0941787	115.9178548	No Site	1
Acacia longifolia subsp. *longifolia*	-32.0970269	115.9169119	No Site	1
Acacia longifolia subsp. *longifolia*	-32.0958414	115.9164437	No Site	1
Acacia longifolia subsp. *longifolia*	-32.0961607	115.9163924	No Site	1
Acacia longifolia subsp. *longifolia*	-32.0971514	115.9162648	No Site	2
Acacia longifolia subsp. *longifolia*	-32.0976988	115.9164761	No Site	1
Acacia longifolia subsp. *longifolia*	-32.0968202	115.9166668	No Site	3
Acacia longifolia subsp. *longifolia*	-32.0954115	115.9169216	No Site	6
Acacia longifolia subsp. *longifolia*	-32.0967825	115.9167479	No Site	1
Acacia longifolia subsp. *longifolia*	-32.0973875	115.9160196	No Site	1
Aira cupaniana	-32.0961607	115.916519	GNR-07	20
Aira cupaniana	-32.0950758	115.9170793	GNR-09	10
Arctotheca calendula	-32.0954463	115.9168013	No Site	5
Arctotheca calendula	-32.0902209	115.9177518	No Site	30
Arctotheca calendula	-32.0906162	115.9181658	No Site	10
Arctotheca calendula	-32.0951146	115.9179096	No Site	10
Avena barbata	-32.0904511	115.9191874	GNR-05	15
Avena barbata	-32.0958189	115.9163534	GNR-08	20
Avena barbata	-32.0952825	115.9163739	No Site	100
Avena barbata	-32.0902218	115.9177508	No Site	100
Avena barbata	-32.091047	115.918676	No Site	100
Avena barbata	-32.0930859	115.9169613	No Site	50
Avena barbata	-32.0954023	115.9166116	No Site	50
Avena barbata	-32.0958871	115.9170901	No Site	100
Avena barbata	-32.0955368	115.9162841	No Site	38
Avena barbata	-32.0962882	115.9161827	No Site	200
Avena barbata	-32.09673	115.916071	No Site	100
Avena barbata	-32.095948	115.9163036	No Site	50
Avena barbata	-32.0972652	115.9158758	No Site	100
Avena barbata	-32.0968895	115.9164328	No Site	50
Briza maxima	-32.091641	115.9187393	GNR-02	10
Briza maxima	-32.0944277	115.9171411	GNR-03	10
Briza maxima	-32.0958256	115.916402	GNR-08	20
Briza maxima	-32.0967267	115.9161073	No Site	100
Briza maxima	-32.0917926	115.9188851	No Site	30
Briza maxima	-32.0955862	115.9168882	No Site	20
Briza maxima	-32.09699784	115.9169603	No Site	50
Briza maxima	-32.0965335	115.9165455	No Site	5
Briza minor	-32.0916364	115.9187241	GNR-02	10

Taxon	Latitude	Longitude	Site ID	No. of Individuals
Briza minor	-32.0961372	115.9165107	GNR-07	5
Briza minor	-32.0958256	115.916402	GNR-08	5
Briza minor	-32.0954228	115.9167953	No Site	50
Briza minor	-32.09632867	115.9172603	No Site	50
Bromus diandrus	-32.0902222	115.9177497	No Site	28
Bromus diandrus	-32.0931875	115.916931	No Site	100
Bromus diandrus	-32.0953551	115.9163783	No Site	20
Bromus diandrus	-32.0955092	115.9163116	No Site	30
Callistemon citrinus	-32.0962542	115.9174628	No Site	1
Callitriche stagnalis	-32.0953432	115.9163905	No Site	30
Cerastium glomeratum	-32.0910473	115.9184633	GNR-05	5
Crassula glomerata	-32.0954541	115.9166818	No Site	100
Cynodon dactylon	-32.0937371	115.9171375	No Site	10
Cynodon dactylon	-32.0957186	115.9170786	No Site	10
Cynodon dactylon	-32.095372	115.9176382	No Site	20
Cynodon dactylon	-32.0952485	115.9176917	No Site	38
Cyperus involucratus	-32.0956868	115.9172639	No Site	20
Dittrichia graveolens	-32.0951121	115.9177511	No Site	5
Echium plantagineum	-32.0955569	115.9167987	No Site	15
Echium plantagineum	-32.095647	115.9169793	No Site	10
Ehrharta calycina	-32.09102015	115.9179719	GNR-01	10
Ehrharta calycina	-32.0943353	115.917118	GNR-03	1
Ehrharta calycina	-32.0911746	115.9185309	GNR-05	20
Ehrharta calycina	-32.0971209	115.9164047	GNR-06	1
Ehrharta calycina	-32.0961708	115.9164835	GNR-07	5
Ehrharta calycina	-32.0958114	115.9163582	GNR-08	15
Ehrharta calycina	-32.0972609	115.9158633	No Site	100
Ehrharta calycina	-32.0970257	115.9167623	No Site	60
Ehrharta calycina	-32.0931386	115.91698	No Site	20
Ehrharta calycina	-32.095282	115.91773	No Site	20
Ehrharta calycina	-32.0955709	115.9162766	No Site	20
Ehrharta calycina	-32.0958731	115.9170056	No Site	20
Ehrharta calycina	-32.0902436	115.9177694	No Site	20
Ehrharta calycina	-32.0948626	115.9171147	No Site	15
Ehrharta calycina	-32.0955944	115.9168683	No Site	100
Ehrharta longiflora	-32.097017	115.9169072	No Site	20
Eragrostis curvula	-32.0914818	115.9176942	No Site	20
Eragrostis curvula	-32.0953835	115.9163873	No Site	10
Eragrostis curvula	-32.0954336	115.9163215	No Site	10
Eragrostis curvula	-32.0914858	115.9176164	No Site	10
Eragrostis curvula	-32.0944148	115.9175799	No Site	30
Eragrostis curvula	-32.0973841	115.9160301	No Site	20
Erigeron bonariensis	-32.0956984	115.9164112	GNR-08	1
Erigeron bonariensis	-32.0950044	115.9171515	GNR-09	2
Erigeron bonariensis	-32.0953077	115.9163755	No Site	20

Taxon	Latitude	Longitude	Site ID	No. of Individuals
Erigeron bonariensis	-32.0903809	115.9178583	No Site	10
Erodium cicutarium	-32.0954616	115.9166999	No Site	5
Erodium cicutarium	-32.095467	115.916347	No Site	5
Eucalyptus sp.	-32.0920838	115.9172756	No Site	1
Euphorbia helioscopia	-32.0955224	115.9168109	No Site	5
Euphorbia helioscopia	-32.0953347	115.9163941	No Site	20
Fumaria capreolata	-32.0911602	115.9185902	GNR-05	5
Fumaria capreolata	-32.0954163	115.9169266	No Site	10
Fumaria capreolata	-32.0954339	115.9167625	No Site	30
Fumaria capreolata	-32.0957561	115.9162581	No Site	20
Fumaria capreolata	-32.0959343	115.9162332	No Site	20
Fumaria capreolata	-32.0955744	115.9170791	No Site	20
Fumaria capreolata	-32.0957358	115.9171001	No Site	100
Fumaria capreolata	-32.0902302	115.9177475	No Site	20
Fumaria capreolata	-32.0956236	115.9164543	No Site	5
Fumaria sp.	-32.0957422	115.9164369	GNR-08	5
Gladiolus caryophyllaceus	-32.0910145	115.917991	GNR-01	6
Gladiolus caryophyllaceus	-32.09160426	115.9187185	GNR-02	2
Gladiolus caryophyllaceus	-32.0944281	115.9171046	GNR-03	3
Gladiolus caryophyllaceus	-32.0910785	115.9185105	GNR-05	8
Gladiolus caryophyllaceus	-32.0970647	115.9163635	GNR-06	5
Gladiolus caryophyllaceus	-32.09610888	115.9165004	GNR-07	5
Gladiolus caryophyllaceus	-32.0958298	115.91639	GNR-08	2
Gladiolus caryophyllaceus	-32.095038	115.9171314	GNR-09	1
Gladiolus caryophyllaceus	-32.0966917	115.9171504	GNR-10	3
Gladiolus caryophyllaceus	-32.0968994	115.9163549	No Site	10
Gomphocarpus fruticosus	-32.0947962	115.9180624	No Site	1
Gomphocarpus fruticosus	-32.0950052	115.9179576	No Site	6
Hordeum leporinum	-32.0902265	115.9177568	No Site	30
Hordeum leporinum	-32.095881	115.917046	No Site	100
Hypochaeris glabra	-32.0910132	115.9180135	GNR-01	10
Hypochaeris glabra	-32.0916016	115.9187195	GNR-02	23
Hypochaeris glabra	-32.0943456	115.9171125	GNR-03	2
Hypochaeris glabra	-32.0910751	115.9184807	GNR-05	10
Hypochaeris glabra	-32.0971148	115.9164492	GNR-06	5
Hypochaeris glabra	-32.0884264	115.9188967	GNR-07	50
Hypochaeris glabra	-32.0958119	115.9163564	GNR-08	50
Hypochaeris glabra	-32.0950059	115.9170583	GNR-09	10
Juncus microcephalus	-32.09518402	115.9176315	No Site	1
Lactuca serriola	-32.0957315	115.9163995	GNR-08	1
Lactuca serriola	-32.0953348	115.9163942	No Site	20
Lactuca serriola	-32.0953461	115.9165581	No Site	20
Lolium multiflorum	-32.096603	115.917626	No Site	15
Lotus angustissimus	-32.0953387	115.9163844	No Site	30
Lupinus cosentinii	-32.0902124	115.9177362	No Site	10

Taxon	Latitude	Longitude	Site ID	No. of Individuals
Lupinus cosentinii	-32.0955585	115.9168336	No Site	5
Lysimachia arvensis	-32.0916364	115.9187241	GNR-02	20
Lysimachia arvensis	-32.091047	115.918676	No Site	20
Lysimachia arvensis	-32.0953354	115.9163858	No Site	30
Lythrum hyssopifolia	-32.09519269	115.9176303	No Site	100
Medicago polymorpha	-32.0955091	115.9167113	No Site	3
Nephrolepis cordifolia	-32.0953851	115.917559	No Site	1
Oenothera drummondii subsp. *drummondii*	-32.0953408	115.9163795	No Site	10
Oenothera stricta subsp. *stricta*	-32.0953706	115.916378	No Site	5
Orobanche minor	-32.094778	115.9178923	No Site	5
Orobanche minor	-32.0954437	115.9167674	No Site	5
Pelargonium capitatum	-32.0968925	115.9167054	No Site	5
Pelargonium capitatum	-32.096455	115.917558	No Site	1
Pelargonium capitatum	-32.091305	115.919	No Site	5
Pelargonium capitatum	-32.0954439	115.9175842	No Site	5
Pelargonium capitatum	-32.09133867	115.9179473	No Site	1
Pelargonium capitatum	-32.0916116	115.9180222	No Site	5
Pentameris airoides	-32.0910158	115.9180122	GNR-01	10
Pentameris airoides	-32.0916016	115.9187195	GNR-02	10
Pentameris airoides	-32.0944512	115.9171275	GNR-03	3
Pentameris airoides	-32.0910832	115.9184632	GNR-05	10
Poa annua	-32.0914863	115.9177038	No Site	20
Raphanus raphanistrum	-32.0954531	115.916774	No Site	30
Raphanus raphanistrum	-32.0955886	115.9168722	No Site	20
Raphanus raphanistrum	-32.0956467	115.9169858	No Site	100
Raphanus raphanistrum	-32.0960917	115.9161406	No Site	10
Raphanus raphanistrum	-32.0964864	115.9176062	No Site	1
Raphanus raphanistrum	-32.0902143	115.9177504	No Site	40
Romulea rosea	-32.094448	115.917642	No Site	5
Senecio vulgaris	-32.095384	115.916347	No Site	20
Solanum nigrum	-32.0955628	115.9178649	GNR-04	2
Solanum nigrum	-32.0957703	115.9163349	GNR-08	3
Solanum nigrum	-32.0945095	115.9178384	No Site	3
Solanum nigrum	-32.0956593	115.9170021	No Site	2
Solanum nigrum	-32.0950348	115.9179488	No Site	5
Solanum nigrum	-32.0941843	115.9178654	No Site	2
Sonchus oleraceus	-32.0916364	115.9187241	GNR-02	1
Sonchus oleraceus	-32.0970817	115.9163367	GNR-06	2
Sonchus oleraceus	-32.0957284	115.9164204	GNR-08	2
Sonchus oleraceus	-32.0902252	115.9177564	No Site	50
Sonchus oleraceus	-32.0969633	115.9167543	No Site	20
Sonchus oleraceus	-32.0958125	115.9162642	No Site	10
Typha orientalis (no longer considered introduced)	-32.0951949	115.9176935	No Site	20
Typha orientalis (no longer considered introduced)	-32.095355	115.9165754	No Site	10
Ursinia anthemoides	-32.0910327	115.9179986	GNR-01	10

Taxon	Latitude	Longitude	Site ID	No. of Individuals
Ursinia anthemoides	-32.0916016	115.9187195	GNR-02	10
Ursinia anthemoides	-32.0944306	115.9171636	GNR-03	5
Ursinia anthemoides	-32.0911153	115.9185495	GNR-05	10
Ursinia anthemoides	-32.0871032	115.9188967	GNR-07	3
Vicia sativa	-32.0938747	115.9176226	No Site	1
Vitis vinifera	-32.0950229	115.9179857	No Site	5
Wahlenbergia capensis	-32.0943441	115.9171137	GNR-03	2
Wahlenbergia capensis	-32.09615902	115.9165148	GNR-07	10
Wahlenbergia capensis	-32.0956516	115.916983	No Site	2

Appendix I – Weed suite mapping

397450

397950

6448656

6448156

Ranford Rd

Parnell Wy

Ballycastle Loop

Nicholson Rd

Clontarf Tce

Merrion Rmbl

Tramore Tarn

Legend

Study Area

Bulbous Weed Cover

Medium (8.88 ha)

Low (0.23 ha)

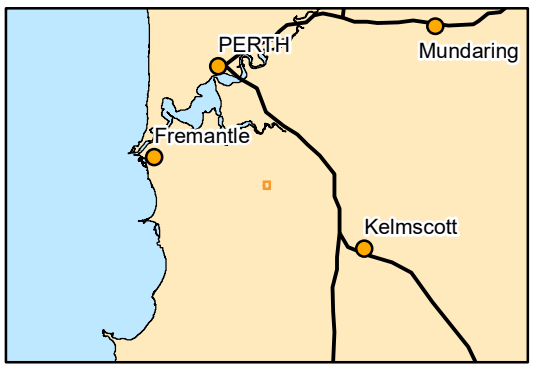
0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 09/02/2021

N

biologic Environmental Survey

Scale: 1:3,000



CITY OF GOSNELLS

Nicholson Rd Biological Survey and Management Plan

Introduced flora cover - Bulbous Weeds

397450

397950

6448656

6448156

Parnell Wy

Ranford Rd

Ballycastle Loop

Nicholson Rd

Clontarf Tce

Merrion Rmbl

Tramore Tarn

Legend

Study Area

Grassy Weed Cover

High (0.46 ha)

Medium (3.13 ha)

Low (5.53 ha)

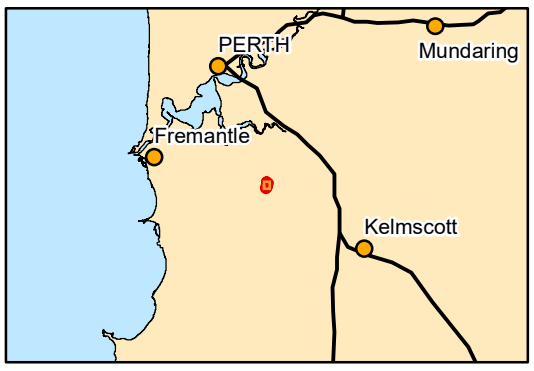
0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 09/02/2021

N

biologic Environmental Survey

Scale: 1:3,000



CITY OF GOSNELLS

Nicholson Rd Biological Survey and Management Plan

Introduced flora cover - Grassy Weeds

397450

397950

6448656

6448156

Parnell Wy

Ranford Rd

Ballycastle Loop

Nicholson Rd

Clontarf Tce

Merrion Rmbl

Tramore Tarn

Legend

Study Area

Herbaceous Weed Cover

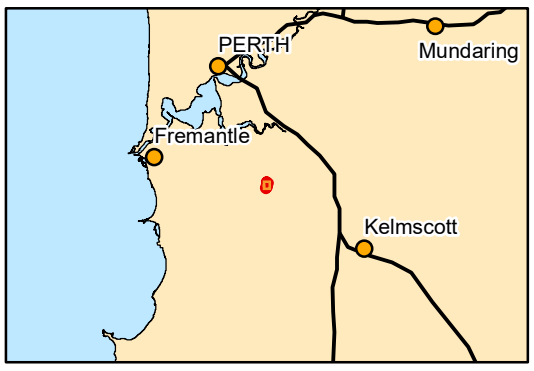
High (1.42 ha)

Medium (2.63 ha)

Low (5.07 ha)

0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 09/02/2021



N

biologic Environmental Survey

Scale: 1:3,000

CITY OF GOSNELLS

Nicholson Rd Biological Survey and Management Plan

Introduced flora cover - Herbaceous Weeds

397450

397950

6448656

6448156

Parnell Wy

Ranford Rd

Ballycastle Loop

Nicholson Rd

Clontarf Tce

Merrion Rmbl

Tramore Tarn

Legend

Study Area

Species recorded

- **Acacia iteaphylla*
- **Acacia longifolia* subsp. *longifolia*
- **Eucalyptus* sp.
- *Eucalyptus camaldulensis*
- *Grevillea* sp.
- *Melaleuca huegelii* subsp. *huegelii*

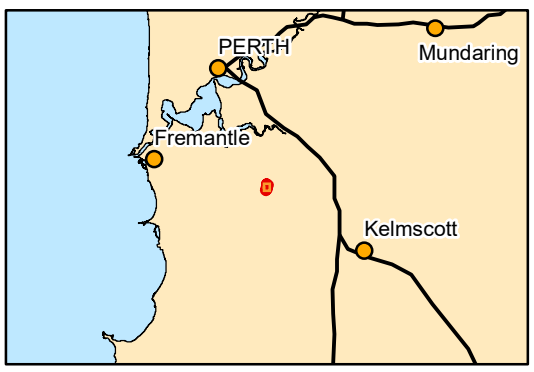
0 50 100 150 Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 09/02/2021

N

biologic Environmental Survey

Scale: 1:3,000



CITY OF GOSNELLS

Nicholson Rd Biological Survey and Management Plan

Introduced flora - Woody Weeds

Appendix J – Locations of vertebrate fauna sampling sites

Site	Start Date	End Date	Method	Habitat	Latitude	Longitude
VNIC-01	25/06/2020	29/06/2020	Acoustic recorder	Banksia Woodland	-32.0970	115.9163
VNIC-01	18/11/2020	23/11/2020	Acoustic recorder	Banksia Woodland	-32.0971	115.9164
VNIC-03	25/06/2020	29/06/2020	Acoustic recorder	Melaleuca Grassland	-32.0942	115.9176
VNIC-03	18/11/2020	23/11/2020	Acoustic recorder	Melaleuca Grassland	-32.0942	115.9174
VNIC-04	25/06/2020	29/06/2020	Acoustic recorder	Melaleuca and Jarrah Woodland	-32.0915	115.9185
VNIC-05	17/11/2020	23/11/2020	Acoustic recorder	Melaleuca and Jarrah Woodland	-32.0912	115.9180
VNIC-02	25/06/2020	29/06/2020	Bat detector	Melaleuca Grassland	-32.0948	115.9174
VNIC-02	18/11/2020	23/11/2020	Bat detector	Melaleuca Grassland	-32.0948	115.9174
VNIC-04	17/11/2020	23/11/2020	Bat detector	Melaleuca Grassland	-32.0915	115.9186
VNIC-05	25/06/2020	29/06/2020	Bat detector	Melaleuca and Jarrah Woodland	-32.0912	115.9180
VNIC-01	25/06/2020	25/06/2020	Bird Census	Banksia Woodland	-32.0971	115.9164
VNIC-01	16/11/2020	23/11/2020	Bird Census	Banksia Woodland	-32.0977	115.9165
VNIC-02	25/06/2020	25/06/2020	Bird Census	Melaleuca Grassland	-32.0950	115.9171
VNIC-04	25/06/2020	25/06/2020	Bird Census	Melaleuca and Jarrah Woodland	-32.0915	115.9185
VNIC-04	16/11/2020	23/11/2020	Bird Census	Melaleuca and Jarrah Woodland	-32.0916	115.9189
BNIC-01	18/11/2020	18/11/2020	Black cockatoo habitat assessment	Banksia Woodland	-32.0967	115.9163
BNIC-02	18/11/2020	18/11/2020	Black cockatoo habitat assessment	Melaleuca and Jarrah Woodland	-32.0915	115.9180
BNIC-03	18/11/2020	18/11/2020	Black cockatoo habitat assessment	Melaleuca Grassland	-32.0955	115.9171
VNIC-01	18/11/2020	23/11/2020	Camera	Banksia Woodland	-32.0971	115.9164
VNIC-02	18/11/2020	23/11/2020	Camera	Melaleuca Grassland	-32.0950	115.9171
VNIC-05	17/11/2020	23/11/2020	Camera	Melaleuca and Jarrah Woodland	-32.0912	115.9180
VNIC-01	22/11/2020	22/11/2020	Foraging	Banksia Woodland	-32.0977	115.9165
VNIC-02	22/11/2020	22/11/2020	Foraging	Melaleuca Grassland	-32.0955	115.9172
VNIC-04	22/11/2020	22/11/2020	Foraging	Melaleuca and Jarrah Woodland	-32.0916	115.9189
VNIC-01	25/06/2020	25/06/2020	Habitat Assessment	Banksia woodland	-32.0971	115.9164
VNIC-02	25/06/2020	25/06/2020	Habitat Assessment	Melaleuca Grassland	-32.0950	115.9171
VNIC-03	25/06/2020	25/06/2020	Habitat Assessment	Melaleuca Grassland	-32.0942	115.9176
VNIC-04	25/06/2020	25/06/2020	Habitat Assessment	Melaleuca and Jarrah Woodland	-32.0915	115.9185
VNIC-05	25/06/2020	25/06/2020	Habitat Assessment	Melaleuca and Jarrah Woodland	-32.0912	115.9180

Site	Start Date	End Date	Method	Habitat	Latitude	Longitude
VNIC-06	18/11/2020	18/11/2020	Habitat Assessment	Wetland	-32.0923	115.9174
VNIC-07	18/11/2020	18/11/2020	Habitat Assessment	Cleared	-32.0917	115.9194
VNIC-08	18/11/2020	18/11/2020	Habitat Assessment	Parkland	-32.0935	115.9172
VNIC-09	18/11/2020	18/11/2020	Habitat Assessment	Parkland	-32.0952	115.9179
VNIC-10	18/11/2020	18/11/2020	Habitat Assessment	Wetland	-32.0969	115.9173
VNIC-01	16/11/2020	23/11/2020	Trapping	Banksia Woodland	-32.0977	115.9165
VNIC-02	16/11/2020	23/11/2020	Trapping	Melaleuca Grassland	-32.0955	115.9172
VNIC-04	16/11/2020	23/11/2020	Trapping	Melaleuca and Jarrah Woodland	-32.0916	115.9189

Appendix K – Vertebrate fauna habitat assessments

Site ID	Latitude	Longitude	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping / Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows <10cm	Hollows > 10cm	Water present	Disturbances	Last Fire
VNIC-01	-32.0971	115.9164	27/11/2020	Banksia woodland	Wetland	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Negligible	Evenly Spread	*Banksia attenuata, Xanthorrhoea sp.*, *Allocasuarina* sp., *Acacia* sp., various grasses	Nil	Very High	None	None	Prone to Pooling	Rubbish/ Litter, Weed Invasion	Old (6+ yr)
VNIC-02	-32.0950	115.9171	10/12/2020	Melaleuca Grassland	Wetland	Flat	Flat	Clay Loam	Scarce	Negligible	Negligible	Evenly Spread	Scattered Eucalypts, scattered *Melaleuca* ,dense low *Acacia*, dense *Xanthorrhoea* sp.	Nil	Very High	None	None	Prone to Pooling	Road/ Access Track	Old (6+ yr)
VNIC-03	-32.0942	115.9176	23/11/2020	Melaleuca Grassland	low melaleuca grassland	Flat	Flat	Sandy Loam	Many Small Patches	Negligible	Negligible	Many Large Patches	Scattered Eucalypts, scattered *Melaleuca* ,dense low *Acacia*, dense *Xanthorrhoea* sp. and sedges	Nil	Very High	None	None	Prone to Pooling	Road/ Access Track, Rubbish/ Litter, Weed Invasion	Old (6+ yr)
VNIC-04	-32.0915	115.9185	23/11/2020	Melaleuca and Jarrah Woodland	Wetland	Flat	Flat	Sandy Loam	Few Small Patches	Negligible	Negligible	Few Large Patches	Scattered Eucalypts, *Allocasuarina* sp., *Melaleuca* sp. upperstory, *Xanthorrhoea sp.* Middlestory and dense various grasses understory	Nil	Very High	None	None	Prone to Pooling	Road/ Access Track, bike track	Old (6+ yr)
VNIC-05	-32.0912	115.9180	23/11/2020	Melaleuca and Jarrah Woodland	Wetland	Flat	Flat	Sandy Loam	Many Large Patches	Negligible	Negligible	Few Small Patches	Scattered Eucalypts, scattered *Melaleuca* sp., middlestory of *Xanthorrhoea* sp., understorey of various grasses and sedges	Nil	Very High	None	None	Prone to Pooling	Frequent Fire, Road/ Access Track, Rubbish/ Litter	Recent (0 to 2 yr)
VNIC-06	-32.0923	115.9174	18/11/2020	Wetland	Minor Drainage Line	West	Low	Sand	Many Large Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Young scattered *Melaleuca* sp., *Grevillea* sp., *Xanthorrhoea* sp., and various grasses	Nil	Very High	None	None	Prone to Pooling	Weed invasion	Old (6+ yr)
VNIC-07	-32.0917	115.9194	18/11/2020	Cleared	Minor Drainage Line	Flat	Flat	Sand	Few Large Patches	Minor Outcropping	Small Rocks (11-20cm)	Scarce	Scattered Eucalypts, various grasses and shrubs	Moderate	Moderate	None	None	Prone to Pooling	Road/Access Track, Rubbish/Litter, Weed Invasion	Old (6+ yr)
VNIC-08	-32.0935	115.9172	18/11/2020	Parkland	Drainage Area/ Floodplain	South	Low	Sand	Few Large Patches	Limited Outcropping	Gravel (1-4cm)	Scarce	Scattered *Melaleuca* sp., understory of reeds.	Moderate	Very High	None	None	Prone to Pooling	Road/Access Track, Rubbish/Litter, Weed Invasion	Old (6+ yr)
VNIC-09	-32.0952	115.9179	18/11/2020	Parkland	Sand Plain	West	Low	Sand	None Discernible	Negligible	Negligible	Few Small Patches	Scattered *Melaleuca* sp., *Xanthorrhoea* sp., various grasses and low shrubs	Nil	Moderate	None	None	Scarce	Road/Access Track, Rubbish/Litter, Weed Invasion	Old (6+ yr)
VNIC-10	-32.0969	115.9173	18/11/2020	Wetland	Drainage Area/ Floodplain	West	Low	Sand	Few Large Patches	Minor Outcropping	Small Rocks (11-20cm)	Few Small Patches	Scattered *Banksia* sp., lower story reeds, sedges and shrubs	Low	High	None	None	Prone to Pooling	Weed invasion	Old (6+ yr)

Appendix L – Summary of fauna species recorded during the current survey and previous surveys in the vicinity of the Study Area

Source	Mammals (native)	Mammals (introduced)	Birds	Reptiles	Amphibians	Total
Literature Sources						
ENV (2010). Ecological assessment of Sutherlands park bushland. Unpublished report prepared for City of Gosnells.	0	1	7	0	0	**8**
CMPS&F (1993). Public environmental review: Southern River bridge project for Gosnells City Council. Unpublished report prepared for Gosnells City Council.	2	0	9	2	0	**13**
ENV (2013a). Flora, vegetation and fauna assessment, Keane Road. Unpublished report prepared for Water Corporation	1	1	23	0	0	**25**
ENV (2006). Precinct 3 - Environmental review, Southern River. Unpublished report prepared for the City of Gosnells.	2	4	64	7	6	**83**
Focused Vision (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension. Unpublished report prepared for the City of Cockburn.	1	3	25	1	0	**30**
PGV (2016). Garden Street, Southern River - Targeted conservation significant species survey.	0	0	0	0	0	**0**
Bowman Bishaw Gorham (2001). Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale	0	0	0	0	0	**0**
ENV (2005a) Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan	0	0	0	0	0	**0**
ENV (2009). Jandakot Airport Fauna Survey	6	6	46	6	4	**68**
Western Wildlife (2011a)Jandakot Airport Conservation Areas: Carnaby's Black-Cockatoo Habitat Survey 2011.	0	0	0	0	0	**0**
Western Wildlife (2011b)Jandakot Airport Conservation Areas: Quenda Survey 2011.	1	0	0	0	0	**1**
Western Wildlife (2011c). Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011	1	0	0	0	0	**1**
Bamford *et al.* (2003) Fauna survey of the Jandakot airport 2002.	12	6	62	12	3	**95**
Dell and Cooper (1992). Vertebrate fauna of Ken Hurst Park, City of Melville.	3	5	37	8	4	**57**
ERM Mitchell McCotter (1999). Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management Plan.	0	0	0	0	0	**0**
Natural Area (2019) City of Armadale Skeet Road Reconnaissance Flora Survey	0	0	0	0	0	**0**
Natural Area (2016b) Garden Street Road Reserve Environmental Assessment.	1	5	27	0	2	**35**
Natural Area (2016a). Fauna Management Plan Holmes Street Bushland North	1	5	27	0	2	**35**
Terrestrial Ecosystems (2014). Black cockatoo assessment - Garden Street extension	1	1	1	0	0	**3**

Source	Mammals (native)	Mammals (introduced)	Birds	Reptiles	Amphibians	Total
Terrestrial Ecosystems (2016). Australasian bittern survey.	0	0	0	0	0	**0**
Focused Vision (2016). Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment.	1	3	25	1	0	**30**
Phoenix (2011). Vertebrate Fauna Survey for the Roe Highway Extension Project.	7	7	67	12	8	**101**
Golder Associates (2016). City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey.	0	0	1	0	0	**1**
Current survey	**4**	**5**	**26**	**9**	**4**	**48**

Appendix M – Vertebrate fauna desktop assessment, including database searches and literature review

Scientific Name	Common Name	Conservation Status				Database searches					Literature Review																							Current Survey
		EPBC	BC	DBCA	IUCN	NatureMap (5 km)	EPBC (5km)	DBCA (5km)	ALA (5 km)	Birdlife (12km)	ENV, Australia. (2010). Ecological assessment of Sutherlands park bushland.	CMPS&F. (1993). Public environmental review: Southern River bridge project for Gosnells City Council.	ENV, Australia (2013). Flora, vegetation and fauna assessment, Keane Road	ENV, Australia (2006). Precinct 3 - Environmental review, Southern River.	Focused Vision, Consulting (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension.	Garden Street, Southern River - Targeted conservation significant species survey. (PGV, 2016)	Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale (Bowman Bishaw Gorham, 2002)	Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan (ENV, 2005)	Jandakot Airport Fauna Survey (ENV, 2009)	Jandakot Airport Conservation Areas: Carnaby' s Black-Cockatoo Habitat Survey 2011. (Western Wildlife, 2011a)	Jandakot Airport Conservation Areas: Quenda Survey 2011. (Western Wildlife, 2011b)	Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011 (Western Wildlife, 2011c)	Fauna survey of the Jandakot airport 2002 (Bamford et al., 2003)	Vertebrate fauna of Ken Hurst Park, City of Melville. (Dell and Cooper, 1992)	Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management Plan. (ERM Mitchell McCotter, 1999)	City of Armadale Skeet Road Reconnaissance Flora Survey (Natural Area, 2019)	Garden Street Road Reserve Environmental Assessment (Natural Area, 216b)	Fauna Management Plan Holmes Street Bushland North (Natural Area, 216a)	Black cockatoo assessment - Garden Street extension (Terrestrial Ecosystems, 216)	Australasian bittern survey (Terrestrial Ecosystems, 216)	Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment (Focused Vision, 216)	Vertebrate Fauna Survey for the Roe Highway Extension Project (Phoenix, 2011)	City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey (Golder Associates, 216)	
MAMMALS																																		
BOVIDAE																																		
Bubalus bubalis	**Water Buffalo*						•																											
CANIDAE																																		
Canis familiaris	**Dog*						•								•								•			•	•			•			•	
Vulpes vulpes	**Red Fox*						•							•	•				•				•	•			•	•			•	•		•	
FELIDAE																																		
Felis catus	**Cat*						•							•					•				•	•			•	•				•		•	
LEPORIDAE																																		
Oryctolagus cuniculus	**Rabbit*						•		•		•		•	•	•					•				•	•			•	•	•		•	•			
MACROPODIDAE																																		
Macropus fuliginosus	*Western Grey Kangaroo*													•					•				•	•										
Notamacropus irma	*Western Brush Wallaby*			P4		•		•											•			•	•	•										
Setonix brachyurus	*Quokka*	VU	VU				•																											
MOLOSSIDAE																																		
Austronomus australis	*White-striped Freetail-bat*																		•				•									•		•	
Ozimops kitcheneri	*South-western Free-tailed Bat*																															•		
MURIDAE																																		
Mus musculus	**House Mouse*						•		•					•					•				•	•			•	•				•		•	
Rattus norvegicus	**Brown Rat*						•																											
Rattus rattus	**Black Rat*						•		•										•				•									•		•	
MYRMECOBIIDAE																																		
Myrmecobius fasciatus	*Numbat*	EN	EN			•		•																										
PERAMELIDAE																																		

Scientific Name	Common Name	Conservation Status				Database searches					Literature Review																							Current Survey
		EPBC	BC	DBCA	IUCN	NatureMap (5 km)	EPBC (5km)	DBCA (5km)	ALA (5 km)	Birdlife (12km)	ENV, Australia. (2010). Ecological assessment of Sutherlands park bushland.	CMPS&F. (1993). Public environmental review: Southern River bridge project for Gosnells City Council.	ENV, Australia (2013). Flora, vegetation and fauna assessment, Keane Road	ENV, Australia (2006). Precinct 3 - Environmental review, Southern River.	Focused Vision, Consulting (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension.	Garden Street, Southern River - Targeted conservation significant species survey. (PGV, 2016)	Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale (Bowman Bishaw Gorham, 2002)	Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan (ENV, 2005)	Jandakot Airport Fauna Survey (ENV, 2009)	Jandakot Airport Conservation Areas: Carnaby' s Black-Cockatoo Habitat Survey 2011. (Western Wildlife, 2011a)	Jandakot Airport Conservation Areas: Quenda Survey 2011. (Western Wildlife, 2011b)	Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011 (Western Wildlife, 2011c)	Fauna survey of the Jandakot airport 2002 (Bamford et al., 2003)	Vertebrate fauna of Ken Hurst Park, City of Melville. (Dell and Cooper, 1992)	Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management Plan. (ERM Mitchell McCotter, 1999)	City of Armadale Skeet Road Reconnaissance Flora Survey (Natural Area, 2019)	Garden Street Road Reserve Environmental Assessment (Natural Area, 216b)	Fauna Management Plan Holmes Street Bushland North (Natural Area, 216a)	Black cockatoo assessment - Garden Street extension (Terrestrial Ecosystems, 216)	Australasian bittern survey (Terrestrial Ecosystems, 216)	Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment (Focused Vision, 216)	Vertebrate Fauna Survey for the Roe Highway Extension Project (Phoenix, 2011)	City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey (Golder Associates, 216)	
Isoodon fusciventer	*Southern Brown Bandicoot*			P4				•	•			•	•	•	•				•		•		•	•			•	•	•		•	•		•
PHALANGERIDAE																																		
Trichosurus vulpecula	*Common Brushtail Possum*											•																				•		
PSEUDOCHEIRIDAE																																		
Pseudocheirus occidentalis	*Western Ringtail Possum, ngwayir*	CR	CR				•																											
SCIURIDAE																																		
Funambulus pennanti	**Indian Palm Squirrel*						•																											
TARSIPEDIDAE																																		
Tarsipes rostratus	*Honey Possum*																						•											
VESPERTILIONIDAE																																		
Chalinolobus gouldii	*Gould's Wattled Bat*																		•				•										•	•
Chalinolobus morio	*Chocolate Wattled Bat*																						•											
Falsistrellus mackenziei	*Western False Pipistrelle*			P4																														
Nyctophilus geoffroyi	*Lesser Long-eared Bat*																						•										•	
Nyctophilus gouldi	*Gould's Long-eared Bat*																						•											
Nyctophilus major	*Greater Long-eared Bat*																						•											
Vespadelus regulus	*Southern Forest Bat*																		•				•										•	•
ACANTHIZIDAE																																		
Acanthiza apicalis	*Inland Thornbill*								•					•									•										•	
Acanthiza chrysorrhoa	*Yellow-rumped Thornbill*								•					•					•				•	•			•	•					•	
Acanthiza inornata	*Western Thornbill*								•														•										•	
Calamanthus campestris	*Rufous Fieldwren*								•																									
Gerygone fusca	*Western Gerygone*								•				•	•	•				•				•								•	•		

Scientific Name	Common Name	Conservation Status				Database searches					Literature Review																						Current Survey
		EPBC	BC	DBCA	IUCN	NatureMap (5 km)	EPBC (5km)	DBCA (5km)	ALA (5 km)	Birdlife (12km)	ENV, Australia. (2010). Ecological assessment of Sutherlands park bushland.	CMPS&F. (1993). Public environmental review: Southern River bridge project for Gosnells City Council.	ENV, Australia (2013). Flora, vegetation and fauna assessment, Keane Road	ENV, Australia (2006). Precinct 3 - Environmental review, Southern River.	Focused Vision, Consulting (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension.	Garden Street, Southern River - Targeted conservation significant species survey. (PGV, 2016)	Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale (Bowman Bishaw Gorham, 2002)	Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan (ENV, 2005)	Jandakot Airport Fauna Survey (ENV, 2009)	Jandakot Airport Conservation Areas: Carnaby' s Black-Cockatoo Habitat Survey 2011. (Western Wildlife, 2011a)	Jandakot Airport Conservation Areas: Quenda Survey 2011. (Western Wildlife, 2011b)	Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011 (Western Wildlife, 2011c)	Fauna survey of the Jandakot airport 2002 (Bamford et al., 2003)	Vertebrate fauna of Ken Hurst Park, City of Melville. (Dell and Cooper, 1992)	Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management Plan. (ERM Mitchell McCotter, 1999)	City of Armadale Skeet Road Reconnaissance Flora Survey (Natural Area, 2019)	Garden Street Road Reserve Environmental Assessment (Natural Area, 216b)	Fauna Management Plan Holmes Street Bushland North (Natural Area, 216a)	Black cockatoo assessment - Garden Street extension (Terrestrial Ecosystems, 216)	Australasian bittern survey (Terrestrial Ecosystems, 216)	Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment (Focused Vision, 216)	Vertebrate Fauna Survey for the Roe Highway Extension Project (Phoenix, 2011)	City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey (Golder Associates, 216)	
Sericornis frontalis	*White-browed Scrubwren*								•					•																	•		
Smicrornis brevirostris	*Weebill*								•														•									•		
ACCIPITRIDAE																																		
Accipiter cirrocephalus	*Collared Sparrowhawk*								•			•							•				•											
Accipiter fasciatus	*Brown Goshawk*								•					•									•	•			•	•				•		
Aquila audax	*Wedge-tailed Eagle*								•					•									•									•		
Circus approximans	*Swamp Harrier*								•																							•		
Circus assimilis	*Spotted Harrier*								•																									
Elanus axillaris	*Black-shouldered Kite*								•				•	•					•													•		
Elanus scriptus	*Letter-winged Kite*			P4	NT			•	•																									
Haliastur sphenurus	*Whistling Kite*								•				•																			•		
Hieraaetus morphnoides	*Little Eagle*								•										•				•											
Milvus migrans	*Black Kite*								•																									
Pandion haliaetus	*Osprey, Eastern Osprey*	MI	MI				•		•																									
ACROCEPHALIDAE																																		
Acrocephalus australis	*Australian Reed Warbler*								•																									
AEGOTHELIDAE																																		
Aegotheles cristatus	*Australian Owlet-nightjar*																															•		
ALCEDINIDAE																																		
Dacelo novaeguineae	*Laughing Kookaburra*								•			•		•	•								•								•	•		
Todiramphus sanctus	*Sacred Kingfisher*								•					•										•								•		
ANATIDAE																																		
Anas castanea	*Chestnut Teal*								•																									
Anas gracilis	*Grey Teal*								•					•																		•		

Scientific Name	Common Name	Conservation Status				Database searches					Literature Review																							Current Survey
		EPBC	BC	DBCA	IUCN	NatureMap (5 km)	EPBC (5km)	DBCA (5km)	ALA (5 km)	Birdlife (12km)	ENV, Australia. (2010). Ecological assessment of Sutherlands park bushland.	CMPS&F. (1993). Public environmental review: Southern River bridge project for Gosnells City Council.	ENV, Australia (2013). Flora, vegetation and fauna assessment, Keane Road	ENV, Australia (2006). Precinct 3 - Environmental review, Southern River.	Focused Vision, Consulting (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension.	Garden Street, Southern River - Targeted conservation significant species survey. (PGV, 2016)	Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale (Bowman Bishaw Gorham, 2002)	Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan (ENV, 2005)	Jandakot Airport Fauna Survey (ENV, 2009)	Jandakot Airport Conservation Areas: Carnaby' s Black-Cockatoo Habitat Survey 2011. (Western Wildlife, 2011a)	Jandakot Airport Conservation Areas: Quenda Survey 2011. (Western Wildlife, 2011b)	Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011 (Western Wildlife, 2011c)	Fauna survey of the Jandakot airport 2002 (Bamford et al., 2003)	Vertebrate fauna of Ken Hurst Park, City of Melville. (Dell and Cooper, 1992)	Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management Plan. (ERM Mitchell McCotter, 1999)	City of Armadale Skeet Road Reconnaissance Flora Survey (Natural Area, 2019)	Garden Street Road Reserve Environmental Assessment (Natural Area, 216b)	Fauna Management Plan Holmes Street Bushland North (Natural Area, 216a)	Black cockatoo assessment - Garden Street extension (Terrestrial Ecosystems, 216)	Australasian bittern survey (Terrestrial Ecosystems, 216)	Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment (Focused Vision, 216)	Vertebrate Fauna Survey for the Roe Highway Extension Project (Phoenix, 2011)	City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey (Golder Associates, 216)	
Anas platyrhynchos	**Mallard*						•		•					•																				
Anas rhynchotis	*Australasian Shoveler*								•																									
Anas superciliosa	*Pacific Black Duck*								•		•		•	•					•													•		•
Aythya australis	*Hardhead*								•																									
Biziura lobata	*Musk Duck*								•																									
Chenonetta jubata	*Australian Wood Duck*								•					•																				
Cygnus atratus	*Black Swan*								•																									
Cygnus olor	**Mute Swan*								•																									
Dendrocygna arcuata	*Wandering Whistling Duck*								•																									
Malacorhynchus membranaceus	*Pink-eared Duck*								•																									
Oxyura australis	*Blue-billed Duck*			P4	NT	•		•	•																									
Stictonetta naevosa	*Freckled Duck*								•																									
Tadorna tadornoides	*Australian Shelduck*								•					•																•	•			•	
ANHINGIDAE																																		
Anhinga novaehollandiae	*Australasian Darter*								•																									
APODIDAE																																		
Apus pacificus	*Fork-tailed Swift*	MI	MI				•		•																									
ARDEIDAE																																		
Ardea ibis	*Cattle Egret*						•		•																									
Ardea intermedia	*Intermediate Egret*								•																									
Ardea modesta	*Eastern Great Egret*						•		•																								•	
Ardea novaehollandiae	*White-faced Heron*													•																		•		
Ardea pacifica	*White-necked Heron*								•					•																				
Botaurus poiciloptilus	*Australasian Bittern*	EN	EN				•	•	•																									

Scientific Name	Common Name	Conservation Status				Database searches					Literature Review																						Current Survey
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Ixobrychus flavicollis	*Black Bittern*								•																								
Nycticorax caledonicus	*Rufous Night Heron*								•																		•						
Nycticorax nycticorax	*Nankeen Night Heron*																											•					
ARTAMIDAE																																	
Artamus cinereus	*Black-faced Woodswallow*								•					•									•	•			•	•					
Artamus cyanopterus	*Dusky Woodswallow*								•																						•		
Cracticus nigrogularis	*Pied Butcherbird*								•																								
Gymnorhina tibicen	*Australian Magpie*								•		•	•		•	•				•				•	•			•	•			•	•	•
Cracticus torquatus	*Grey Butcherbird*								•					•	•				•				•	•			•	•			•	•	
BURHINIDAE																																	
Burhinus grallarius	*Bush Stone-curlew*								•																								
CACATUIDAE																																	
Cacatua pastinator	*Western Long-billed Corella*								•										•				•										•
Cacatua roseicapilla	*Galah*											•	•	•	•				•				•				•	•			•	•	•
Cacatua sanguinea	*Little Corella*								•					•																		•	•
Cacatua tenuirostris	*Eastern Long-billed Corella*								•																								
Calyptorhynchus banksii	*Red-tailed Black Cockatoo*																		•														
Calyptorhynchus banksii naso	*Forest Red-tailed Black Cockatoo*	VU	VU				•	•	•		•			•	•														•		•	•	•
Calyptorhynchus baudinii	*Baudin's Cockatoo*	EN	EN				•		•																							•	
Calyptorhynchus latirostris	*Carnaby's Cockatoo*	EN	EN			•	•	•	•					•	•				•				•	•			•	•			•	•	•
CAMPEPHAGIDAE																																	
Coracina novaehollandiae	*Black-faced Cuckoo-shrike*								•		•			•	•				•				•	•			•	•			•	•	•
Lalage tricolor	*White-winged Triller*								•				•	•									•										

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CAPRIMULGIDAE																																		
Eurostopodus argus	*Spotted Nightjar*								•																									
CHARADRIIDAE																																		
Charadrius dubius	*Little Ringed Plover*	MI	MI					•	•																									
Charadrius leschenaultii	*Greater Sand Plover*	VU/ MI	VU/ MI					•	•																									
Charadrius melanops	*Black-fronted Dotterel*													•																				
Charadrius ruficapillus	*Red-capped Plover*								•																									
Erythrogonys cinctus	*Red-kneed Dotterel*								•																									
Pluvialis fulva	*Pacific Golden Plover*	MI	MI					•	•																									
Pluvialis squatarola	*Grey Plover*	MI	MI					•	•																									
Vanellus miles	*Masked Lapwing*								•																									
Vanellus tricolor	*Banded Lapwing*								•										•				•											
CLIMACTERIDAE																																		
Climacteris rufa	*Rufous Treecreeper*								•																									
COLUMBIDAE																																		
Columba livia	**Domestic Pigeon*						•		•					•										•							•		•	
Ocyphaps lophotes	*Crested Pigeon*								•				•	•					•								•	•				•		
Phaps chalcoptera	*Common Bronzewing*								•				•	•					•				•	•										•
Phaps elegans	*Brush Bronzewing*								•																									
Streptopelia chinensis	**Spotted Turtle-Dove*						•							•					•				•								•		•	
Streptopelia senegalensis	**Laughing Turtle-Dove*						•						•	•					•				•	•			•	•				•		•
CORVIDAE																																		
Corvus coronoides	*Australian Raven*								•		•		•	•	•				•				•	•			•	•			•	•		•
CRACTICIDAE																																		

Scientific Name	Common Name	Conservation Status				Database searches					Literature Review																								Current Survey
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Strepera versicolor	*Grey Currawong*								•																										
CUCULIDAE																																			
Cacomantis flabelliformis	*Fan-tailed Cuckoo*								•										•																
Cacomantis pallidus	*Pallid Cuckoo*								•														•												
Chrysococcyx basalis	*Horsfield's Bronze Cuckoo*								•					•					•				•												
Chrysococcyx lucidus	*Shining Bronze Cuckoo*								•					•	•				•					•							•	•			
DICAEIDAE																																			
Dicaeum hirundinaceum	*Mistletoebird*								•			•											•												
ESTRILDIDAE																																			
Lonchura castaneothorax	*Chestnut-breasted Mannikin*								•																										
Stagonopleura oculata	*Red-eared Firetail*								•																										
Taeniopygia guttata	*Zebra Finch*								•																										
FALCONIDAE																																			
Falco berigora	*Brown Falcon*								•														•												
Falco cenchroides	*Australian Kestrel*								•				•	•	•				•				•	•							•	•			
Falco longipennis	*Australian Hobby*								•										•													•			
Falco peregrinus	*Peregrine Falcon*		OS			•		•	•															•											
GLAREOLIDAE																																			
Glareola maldivarum	*Oriental Pratincole*	MI	MI					•	•																										
HIRUNDINIDAE																																			
Hirundo neoxena	*Welcome Swallow*								•					•									•	•								•			
Petrochelidon ariel	*Fairy Martin*								•																										
Petrochelidon nigricans	*Tree Martin*								•					•					•				•	•								•		•	
LARIDAE																																			

Scientific Name	Common Name	Conservation Status				Database searches					Literature Review																										Current Survey
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Larus novaehollandiae	*Silver Gull*																							•												
Thalasseus bergii	*Crested Tern*	MI	MI					•	•																											
Hydroprogne caspia	*Caspian Tern*	MI	MI						•																											
Gelochelidon nilotica	*Gull-billed Tern*	MI	MI						•																											
Cladorhynchus leucocephalus	*Banded Stilt*								•																											
LOCUSTELLIDAE																																				
Megalurus gramineus	*Little Grassbird*								•																											
MALURIDAE																																				
Malurus splendens	*Splendid Fairy-wren*								•				•	•	•				•				•	•			•	•			•	•				
Stipiturus malachurus	*Southern Emu-wren*								•																											
MEGAPODIIDAE																																				
Leipoa ocellata	*Malleefowl*	VU	VU				•																													
Acanthorhynchus superciliosus	*Western Spinebill*								•					•					•				•	•								•		•	
Anthochaera carunculata	*Red Wattlebird*								•			•		•	•				•				•	•			•	•			•	•		•	
Anthochaera lunulata	*Western Little Wattlebird*								•					•					•				•									•			
Epthianura albifrons	*White-fronted Chat*								•																											
Gavicalis virescens	*Singing Honeyeater*								•					•	•				•				•	•			•	•			•	•		•	
Glyciphila melanops	*Tawny-crowned Honeyeater*								•														•													
Lichmera indistincta	*Brown Honeyeater*								•				•	•	•				•				•	•			•	•			•	•		•	
Manorina flavigula	*Yellow-throated Miner*								•																											
Phylidonyris nigra	*White-cheeked Honeyeater*												•	•					•				•	•			•	•				•		•	
Phylidonyris novaehollandiae	*New Holland Honeyeater*								•				•	•	•				•				•				•	•			•	•		•	
MEROPIDAE																																				

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Merops ornatus	*Rainbow Bee-eater*						•		•					•							•	•			•	•				•		•
MONARCHIDAE																																	
Grallina cyanoleuca	*Magpie-lark*								•				•	•					•				•	•			•	•				•	
Myiagra inquieta	*Restless Flycatcher*								•																								
MOTACILLIDAE																																	
Anthus australis	*Australian Pipit*																						•										
Motacilla cinerea	*Grey Wagtail*	MI	MI				•																										
NEOSITTIDAE																																	
Daphoenositta chrysoptera	*Varied Sittella*								•														•									•	
PACHYCEPHALIDAE																																	
Colluricincla harmonica	*Grey Shrike-thrush*								•				•	•					•				•	•								•	
Pachycephala occidentalis	*Western Golden Whistler*								•										•				•										
Pachycephala rufiventris	*Rufous Whistler*								•		•		•	•	•				•				•	•							•	•	
PARDALOTIDAE																																	
Pardalotus punctatus	*Spotted Pardalote*								•																							•	
Pardalotus striatus	*Striated Pardalote*								•					•					•				•	•								•	
PELECANIDAE																																	
Pelecanus conspicillatus	*Australian Pelican*								•														•										
PETROICIDAE																																	
Eopsaltria georgiana	*White-breasted Robin*												•																				
Melanodryas cucullata	*Hooded Robin*								•														•										
Microeca fascinans	*Jacky Winter*								•																								
Petroica boondang	*Scarlet Robin*																						•										
Petroica goodenovii	*Red-capped Robin*								•					•																				

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PHAETHONTIDAE																																					
Phalacrocorax carbo	*Great Cormorant*								•																												
Phalacrocorax melanoleucos	*Little Pied Cormorant*								•					•																							
Phalacrocorax sulcirostris	*Little Black Cormorant*								•																												
Phalacrocorax varius	*Pied Cormorant*								•																												
PHASIANIDAE																																					
Coturnix pectoralis	*Stubble Quail*								•					•										•													
Coturnix ypsilophora	*Brown Quail*								•											•																	
PODARGIDAE																																					
Podargus strigoides	*Tawny Frogmouth*								•				•											•													
PODICIPEDIDAE																																					
Podiceps cristatus	*Great Crested Grebe*								•																												
Poliocephalus poliocephalus	*Hoary-headed Grebe*								•																												
Tachybaptus novaehollandiae	*Australasian Grebe*								•					•																							
PROCELLARIIDAE																																					
Puffinus assimilis	*Little Shearwater*								•																												
PSITTACIDAE																																					
Glossopsitta concinna	*Musk Lorikeet*								•																												
Melopsittacus undulatus	*Budgerigar*								•																												
Neophema elegans	*Elegant Parrot*								•																											•	
Platycercus icterotis	*Western Rosella*								•																												
Platycercus spurius	*Red-capped Parrot*													•	•					•				•	•							•	•			
Platycercus zonarius	*Australian Ringneck*								•					•	•					•				•	•							•	•			•

Scientific Name	Common Name	Conservation Status				Database searches					Literature Review																											Current Survey
		EPBC	BC	DBCA	IUCN	NatureMap (5 km)	EPBC (5km)	DBCA (5km)	ALA (5 km)	Birdlife (12km)	ENV, Australia. (2010). Ecological assessment of Sutherlands park bushland.	CMPS&F. (1993). Public environmental review: Southern River bridge project for Gosnells City Council.	ENV, Australia (2013). Flora, vegetation and fauna assessment, Keane Road	ENV, Australia (2006). Precinct 3 - Environmental review, Southern River.	Focused Vision, Consulting (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension.	Garden Street, Southern River - Targeted conservation significant species survey. (PGV, 2016)	Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale (Bowman Bishaw Gorham, 2002)	Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan (ENV, 2005)	Jandakot Airport Fauna Survey (ENV, 2009)	Jandakot Airport Conservation Areas: Carnaby' s Black-Cockatoo Habitat Survey 2011. (Western Wildlife, 2011a)	Jandakot Airport Conservation Areas: Quenda Survey 2011. (Western Wildlife, 2011b)	Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011 (Western Wildlife, 2011c)	Fauna survey of the Jandakot airport 2002 (Bamford et al., 2003)	Vertebrate fauna of Ken Hurst Park, City of Melville. (Dell and Cooper, 1992)	Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management Plan. (ERM Mitchell McCotter, 1999)	City of Armadale Skeet Road Reconnaissance Flora Survey (Natural Area, 2019)	Garden Street Road Reserve Environmental Assessment (Natural Area, 216b)	Fauna Management Plan Holmes Street Bushland North (Natural Area, 216a)	Black cockatoo assessment - Garden Street extension (Terrestrial Ecosystems, 216)	Australasian bittern survey (Terrestrial Ecosystems, 216)	Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment (Focused Vision, 216)	Vertebrate Fauna Survey for the Roe Highway Extension Project (Phoenix, 2011)	City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey (Golder Associates, 216)	
Platycercus zonarius zonarius	*Port Lincoln Parrot*											•																									
Polytelis anthopeplus	*Regent Parrot*								•			•																									
Trichoglossus moluccanus	**Rainbow Lorikeet*								•				•	•	•				•				•	•			•	•			•	•		•			
RALLIDAE																																					
Fulica atra	*Eurasian Coot*								•																										•		
Gallinula tenebrosa	*Dusky Moorhen*								•																										•		
Gallirallus philippensis	*Buff-banded Rail*								•																												
Porphyrio porphyrio	*Purple Swamphen*								•																										•		
Porzana fluminea	*Australian Spotted Crake*								•																												
Porzana pusilla	*Baillon's Crake*								•																												
Porzana tabuensis	*Spotless Crake*								•																												
Tribonyx ventralis	*Black-tailed Native-hen*								•																										•		
RECURVIROSTRIDAE																																					
Himantopus himantopus	*Black-winged Stilt*								•					•																							
RHIPIDURIDAE																																					
Rhipidura albiscapa	*Grey Fantail*								•			•	•	•	•								•	•							•	•				
Rhipidura leucophrys	*Willie Wagtail*								•		•		•	•	•				•				•	•			•	•			•	•		•		
ROSTRATULIDAE																																					
Rostratula australis	*Australian Painted Snipe*	EN	EN		EN		•																														
SCOLOPACIDAE																																					
Calidris acuminata	*Sharp-tailed Sandpiper*	MI	MI				•	•	•																												
Calidris canutus	*Red Knot*	EN/ MI	EN/ MI		NT			•	•																												
Calidris ferruginea	*Curlew Sandpiper*	CR/ MI	CR/ MI		NT		•	•	•																												

Scientific Name	Common Name	Conservation Status				Database searches					Literature Review																								Current Survey
		EPBC	BC	DBCA	IUCN	NatureMap (5 km)	EPBC (5km)	DBCA (5km)	ALA (5 km)	Birdlife (12km)	ENV, Australia. (2010). Ecological assessment of Sutherlands park bushland.	CMPS&F. (1993). Public environmental review: Southern River bridge project for Gosnells City Council.	ENV, Australia (2013). Flora, vegetation and fauna assessment, Keane Road	ENV, Australia (2006). Precinct 3 - Environmental review, Southern River.	Focused Vision, Consulting (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension.	Garden Street, Southern River - Targeted conservation significant species survey. (PGV, 2016)	Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale (Bowman Bishaw Gorham, 2002)	Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan (ENV, 2005)	Jandakot Airport Fauna Survey (ENV, 2009)	Jandakot Airport Conservation Areas: Carnaby' s Black-Cockatoo Habitat Survey 2011. (Western Wildlife, 2011a)	Jandakot Airport Conservation Areas: Quenda Survey 2011. (Western Wildlife, 2011b)	Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011 (Western Wildlife, 2011c)	Fauna survey of the Jandakot airport 2002 (Bamford et al., 2003)	Vertebrate fauna of Ken Hurst Park, City of Melville. (Dell and Cooper, 1992)	Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management Plan. (ERM Mitchell McCotter, 1999)	City of Armadale Skeet Road Reconnaissance Flora Survey (Natural Area, 2019)	Garden Street Road Reserve Environmental Assessment (Natural Area, 216b)	Fauna Management Plan Holmes Street Bushland North (Natural Area, 216a)	Black cockatoo assessment - Garden Street extension (Terrestrial Ecosystems, 216)	Australasian bittern survey (Terrestrial Ecosystems, 216)	Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment (Focused Vision, 216)	Vertebrate Fauna Survey for the Roe Highway Extension Project (Phoenix, 2011)	City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey (Golder Associates, 216)	
Calidris melanotos	*Pectoral Sandpiper*	MI	MI				•	•	•																									
Calidris ruficollis	*Red-necked Stint*	MI	MI		NT			•	•																									
Calidris subminuta	*Long-toed Stint*	MI	MI					•	•																									
Calidris tenuirostris	*Great Knot*	CR/ MI	MI		EN			•	•																									
Limosa lapponica	*Bar-tailed Godwit*	MI	MI					•	•																									
Limosa limosa	*Black-tailed Godwit*	MI	MI		NT			•	•																									
Numenius madagascariensis	*Eastern Curlew*	CR/ MI	CR/ 5		EN		•																											
Philomachus pugnax	*Ruff*	MI	MI					•	•																									
Tringa brevipes	*Grey-tailed Tattler*	MI	MI	P4	NT				•																									
Tringa glareola	*Wood Sandpiper*	MI	MI					•	•																									
Tringa hypoleucos	*Common Sandpiper*	MI	MI				•																											
Tringa nebularia	*Common Greenshank*	MI	MI				•	•	•																									
Tringa stagnatilis	*Marsh Sandpiper*	MI	MI					•	•																									
STRIGIDAE																																		
Ninox boobook	*Boobook Owl*								•															•								•		
THRESKIORNITHIDAE																																		
Platalea flavipes	*Yellow-billed Spoonbill*								•					•													•	•				•		
Platalea regia	*Royal Spoonbill*								•																									
Plegadis falcinellus	*Glossy Ibis*	MI	MI			•		•	•																									
Threskiornis molucca	*Australian White Ibis*								•					•	•				•				•	•							•	•		•
Threskiornis spinicollis	*Straw-necked Ibis*								•					•	•				•				•				•	•			•	•		
TURNICIDAE																																		
Turnix varia	*Painted Button-quail*																							•	•									
ZOSTEROPIDAE																																		

Scientific Name	Common Name	Conservation Status				Database searches					Literature Review																								Current Survey
		EPBC	BC	DBCA	IUCN	NatureMap (5 km)	EPBC (5km)	DBCA (5km)	ALA (5 km)	Birdlife (12km)	ENV, Australia. (2010). Ecological assessment of Sutherlands park bushland.	CMPS&F. (1993). Public environmental review: Southern River bridge project for Gosnells City Council.	ENV, Australia (2013). Flora, vegetation and fauna assessment, Keane Road	ENV, Australia (2006). Precinct 3 - Environmental review, Southern River.	Focused Vision, Consulting (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension.	Garden Street, Southern River - Targeted conservation significant species survey. (PGV, 2016)	Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale (Bowman Bishaw Gorham, 2002)	Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan (ENV, 2005)	Jandakot Airport Fauna Survey (ENV, 2009)	Jandakot Airport Conservation Areas: Carnaby' s Black-Cockatoo Habitat Survey 2011. (Western Wildlife, 2011a)	Jandakot Airport Conservation Areas: Quenda Survey 2011. (Western Wildlife, 2011b)	Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011 (Western Wildlife, 2011c)	Fauna survey of the Jandakot airport 2002 (Bamford et al., 2003)	Vertebrate fauna of Ken Hurst Park, City of Melville. (Dell and Cooper, 1992)	Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management Plan. (ERM Mitchell McCotter, 1999)	City of Armadale Skeet Road Reconnaissance Flora Survey (Natural Area, 2019)	Garden Street Road Reserve Environmental Assessment (Natural Area, 216b)	Fauna Management Plan Holmes Street Bushland North (Natural Area, 216a)	Black cockatoo assessment - Garden Street extension (Terrestrial Ecosystems, 216)	Australasian bittern survey (Terrestrial Ecosystems, 216)	Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment (Focused Vision, 216)	Vertebrate Fauna Survey for the Roe Highway Extension Project (Phoenix, 2011)	City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey (Golder Associates, 216)	
Zosterops lateralis	*Silvereye*								•			•		•	•				•				•	•						•	•		•
REPTILES																																			
AGAMIDAE																																			
Ctenophorus adelaidensis	*Western Heath Dragon*								•															•	•										
Pogona minor									•					•					•					•	•							•		•
CHELUIDAE																																			
Chelodina oblonga	*Northern Snake-necked Turtle*								•					•																					
DIPLODACTYLIDAE																																			
Christinus marmoratus	*Marbled Gecko*								•		•																						•		
ELAPIDAE																																			
Brachyurophis semifasciatus									•																										
Demansia psammophis	*Yellow-faced Whipsnake*																		•				•												
Elapognathus coronatus	*Crowned Snake*													•																					
Neelaps bimaculatus	*Black-naped Snake*																							•											
Neelaps calonotos	*Black-striped Snake*			P3		•		•																•											
Notechis scutatus	*Tiger Snake*											•		•																			•		
Parasuta gouldii																								•	•										
Parasuta nigriceps									•																										
Pseudonaja affinis	*Dugite*											•	•	•					•					•	•								•		•
GEKKONIDAE																																			
Hemidactylus frenatus	**Asian House Gecko*						•																												
PYGOPODIDAE																																			
Aprasia repens									•																•								•		
Delma fraseri									•					•					•					•	•								•		•

Scientific Name	Common Name	Conservation Status				Database searches					Literature Review																							Current Survey
		EPBC	BC	DBCA	IUCN	NatureMap (5 km)	EPBC (5km)	DBCA (5km)	ALA (5 km)	Birdlife (12km)	ENV, Australia. (2010). Ecological assessment of Sutherlands park bushland.	CMPS&F. (1993). Public environmental review: Southern River bridge project for Gosnells City Council.	ENV, Australia (2013). Flora, vegetation and fauna assessment, Keane Road	ENV, Australia (2006). Precinct 3 - Environmental review, Southern River.	Focused Vision, Consulting (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension.	Garden Street, Southern River - Targeted conservation significant species survey. (PGV, 2016)	Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale (Bowman Bishaw Gorham, 2002)	Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan (ENV, 2005)	Jandakot Airport Fauna Survey (ENV, 2009)	Jandakot Airport Conservation Areas: Carnaby' s Black-Cockatoo Habitat Survey 2011. (Western Wildlife, 2011a)	Jandakot Airport Conservation Areas: Quenda Survey 2011. (Western Wildlife, 2011b)	Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011 (Western Wildlife, 2011c)	Fauna survey of the Jandakot airport 2002 (Bamford et al., 2003)	Vertebrate fauna of Ken Hurst Park, City of Melville. (Dell and Cooper, 1992)	Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management Plan. (ERM Mitchell McCotter, 1999)	City of Armadale Skeet Road Reconnaissance Flora Survey (Natural Area, 2019)	Garden Street Road Reserve Environmental Assessment (Natural Area, 216b)	Fauna Management Plan Holmes Street Bushland North (Natural Area, 216a)	Black cockatoo assessment - Garden Street extension (Terrestrial Ecosystems, 216)	Australasian bittern survey (Terrestrial Ecosystems, 216)	Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment (Focused Vision, 216)	Vertebrate Fauna Survey for the Roe Highway Extension Project (Phoenix, 2011)	City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey (Golder Associates, 216)	
Delma grayii									•															•	•									
Lialis burtonis									•					•										•	•							•		•
Pletholax gracilis	*Keeled Legless Lizard*								•					•										•										
Pygopus lepidopodus	*Common Scaly Foot*								•										•					•									•		
SCINCIDAE																																		
Acritoscincus trilineatus									•			•		•					•					•	•								•		•
Cryptoblepharus buchananii									•										•														•		•
Cryptoblepharus plagiocephalus														•										•	•									
Ctenotus australis									•					•										•	•								•		•
Ctenotus fallens																																	•		
Ctenotus impar									•																										
Egernia napoleonis									•															•									•		
Hemiergis quadrilineata																			•					•									•		
Lerista distinguenda														•																					
Lerista elegans									•										•					•	•								•		•
Lerista lineata	*Lined Skink*			P3	EN	•		•	•															•	•								•		
Menetia greyii									•			•		•					•					•	•								•		
Morethia lineoocellata																																	•		
Morethia obscura																																	•		•
Tiliqua occipitalis	*Western Bluetongue*								•															•	•										
Tiliqua rugosa									•					•	•				•					•	•							•	•		•
TYPHLOPIDAE																																			
Anilios australis									•															•											
VARANIDAE																																			

Scientific Name	Common Name	Conservation Status				Database searches					Literature Review																							Current Survey
		EPBC	BC	DBCA	IUCN	NatureMap (5 km)	EPBC (5km)	DBCA (5km)	ALA (5 km)	Birdlife (12km)	ENV, Australia. (2010). Ecological assessment of Sutherlands park bushland.	CMPS&F. (1993). Public environmental review: Southern River bridge project for Gosnells City Council.	ENV, Australia (2013). Flora, vegetation and fauna assessment, Keane Road	ENV, Australia (2006). Precinct 3 - Environmental review, Southern River.	Focused Vision, Consulting (2019). Flora, vegetation and fauna assessment proposed Verde Drive extension.	Garden Street, Southern River - Targeted conservation significant species survey. (PGV, 2016)	Wetland Assessment Report – Two dampland wetlands within Campbell Estate, Canning Vale (Bowman Bishaw Gorham, 2002)	Campbell Estate West Canning Vale Wetland and Conservation Area Management Plan (ENV, 2005)	Jandakot Airport Fauna Survey (ENV, 2009)	Jandakot Airport Conservation Areas: Carnaby' s Black-Cockatoo Habitat Survey 2011. (Western Wildlife, 2011a)	Jandakot Airport Conservation Areas: Quenda Survey 2011. (Western Wildlife, 2011b)	Jandakot Airport Conservation Areas: Western Brush Wallaby Survey 2011 (Western Wildlife, 2011c)	Fauna survey of the Jandakot airport 2002 (Bamford et al., 2003)	Vertebrate fauna of Ken Hurst Park, City of Melville. (Dell and Cooper, 1992)	Roe Highway Stages 5-7, Kenwick Link to Kwinana Freeway – Environmental Assessment and Management Plan. (ERM Mitchell McCotter, 1999)	City of Armadale Skeet Road Reconnaissance Flora Survey (Natural Area, 2019)	Garden Street Road Reserve Environmental Assessment (Natural Area, 216b)	Fauna Management Plan Holmes Street Bushland North (Natural Area, 216a)	Black cockatoo assessment - Garden Street extension (Terrestrial Ecosystems, 216)	Australasian bittern survey (Terrestrial Ecosystems, 216)	Cockburn Central East Local Structure Plan (CCE LSP) Area, Level 1 Flora and Fauna Assessment (Focused Vision, 216)	Vertebrate Fauna Survey for the Roe Highway Extension Project (Phoenix, 2011)	City of Gosnells - Station Street Bridge Project: Flora and Fauna Survey (Golder Associates, 216)	
Varanus gouldii	*Sand Monitor*													•									•											
AMPHIBIANS																																		
PELODRYADIDAE																																		
Litoria adelaidensis	*Slender Tree Frog*								•					•					•														•		
Litoria moorei	*Motorbike Frog*								•					•																		•		
LIMNODYNASTIDAE																																		
Heleioporus eyrei	*Moaning Frog*								•					•									•	•			•	•				•		•
Heleioporus psammophilus	*Sand Frog*																		•															
Limnodynastes dorsalis	*Western Banjo Frog*								•					•					•				•	•			•	•				•		•
MYOBATRACHIDAE																																		
Crinia georgiana	*Quacking Frog*								•										•														•		•
Crinia glauerti	*Clicking Frog*								•					•																		•		
Crinia insignifera	*Squelching Froglet*								•					•																		•		•
Crinia pseudinsignifera	Bleating Froglet																																	
Geocrinia leai	*Ticking Frog*								•																									
Myobatrachus gouldii	*Turtle Frog*								•														•	•								•		
Pseudophryne guentheri	*Crawling Toadlet*																							•										

Appendix N – Conservation significant species recorded during the vertebrate fauna survey.

Common Name (Scientific Name)	Site	Location		Habitat	Record Type	Total no. Records
		Latitude	Longitude			
Carnaby's cockatoo *Calyptorhynchus latirostris*	OPP	-32.0969	115.9169	Banksia Woodland	Chewed banksia cone	
Carnaby's cockatoo *Calyptorhynchus latirostris*	OPP	-32.0971	115.9168	Banksia Woodland	Chewed banksia cone	
Carnaby's cockatoo *Calyptorhynchus latirostris*	OPP	-32.0970	115.9166	Banksia Woodland	Chewed banksia cone	
Carnaby's cockatoo *Calyptorhynchus latirostris*	OPP	-32.0897	115.9174	Banksia Woodland	Chewed banksia cone	
Carnaby's cockatoo *Calyptorhynchus latirostris*	OPP	-32.0967	115.9163	Banksia Woodland	Chewed banksia cone	
Forest red-tailed black cockatoo *Calyptorhynchus banksii naso*	VNIC-04	-32.0907	115.9179	Melaleuca and Jarrah Woodland	Observed (flyover)	1 (2 individuals)
Forest red-tailed black cockatoo *Calyptorhynchus banksii naso*	VNIC-02	-32.0953	115.9172	Melaleuca Grassland	Observed (flyover)	1 (3 individuals)
Quenda Isoodon fusciventer	OPP	-32.0961	115.9169	Melaleuca Grassland	Opportunistic	4
Quenda Isoodon fusciventer	OPP	-32.0957	115.9171	Melaleuca Grassland	Opportunistic	
Quenda *Isoodon fusciventer*	OPP	-32.0946	115.9177	Melaleuca Grassland	Opportunistic	
Quenda *Isoodon fusciventer*	OPP	-32.0944	115.9177	Melaleuca Grassland	Opportunistic	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0977	115.9171	Banksia Woodland	Pitfall Trap	169
Quenda *Isoodon fusciventer*	VNIC-01	-32.0976	115.9165	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0975	115.9170	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0974	115.9164	Banksia Woodland	Camera	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0973	115.9165	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0972	115.9167	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0972	115.9166	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0971	115.9167	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0970	115.9168	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0970	115.9169	Banksia Woodland	Camera	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0968	115.9162	Banksia Woodland	Camera	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0967	115.9166	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0965	115.9166	Banksia Woodland	Camera	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0964	115.9166	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0962	115.9166	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0961	115.9166	Banksia Woodland	Bird Census	

Common Name (Scientific Name)	Site	Location		Habitat	Record Type	Total no. Records
		Latitude	Longitude			
Quenda *Isoodon fusciventer*	VNIC-01	-32.0961	115.9166	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0961	115.9166	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0961	115.9166	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0959	115.9167	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0959	115.9166	Banksia Woodland	Camera	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0959	115.9167	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0959	115.9167	Banksia Woodland	Cage Trap	
Quenda *Isoodon fusciventer*	VNIC-01	-32.0958	115.9168	Banksia Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0956	115.9171	Banksia Woodland	Cage Trap	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0955	115.9171	Melaleuca Grassland	Cage Trap	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0950	115.9176	Melaleuca Grassland	Camera	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0947	115.9171	Melaleuca Grassland	Camera	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0946	115.9171	Melaleuca Grassland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0943	115.9169	Melaleuca Grassland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0940	115.9169	Melaleuca Grassland	Camera	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0940	115.9168	Melaleuca Grassland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0940	115.9169	Melaleuca Grassland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0939	115.9169	Melaleuca Grassland	Cage Trap	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0939	115.9169	Melaleuca Grassland	Cage Trap	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0939	115.9169	Melaleuca Grassland	Cage Trap	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0939	115.9169	Melaleuca Grassland	Cage Trap	
Quenda *Isoodon fusciventer*	VNIC-02	-32.0907	115.9179	Melaleuca Grassland	Cage Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0917	115.9190	Melaleuca Grassland	Elliot Trap	26
Quenda *Isoodon fusciventer*	VNIC-04	-32.0917	115.9189	Melaleuca and Jarrah Woodland	Cage Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0917	115.9189	Melaleuca and Jarrah Woodland	Cage Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0917	115.9188	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0916	115.9188	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0916	115.9190	Melaleuca and Jarrah Woodland	Elliot Trap	

Common Name (Scientific Name)	Site	Location		Habitat	Record Type	Total no. Records
		Latitude	Longitude			
Quenda *Isoodon fusciventer*	VNIC-04	-32.0916	115.9187	Melaleuca and Jarrah Woodland	Cage Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0916	115.9186	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0915	115.9183	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0915	115.9184	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0914	115.9184	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0912	115.9183	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0912	115.9183	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0912	115.9181	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0912	115.9181	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0911	115.9183	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0911	115.9181	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0911	115.9179	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0910	115.9179	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0909	115.9178	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0909	115.9179	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0909	115.9178	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0907	115.9179	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0907	115.9179	Melaleuca and Jarrah Woodland	Pitfall Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0907	115.9180	Melaleuca and Jarrah Woodland	Elliot Trap	
Quenda *Isoodon fusciventer*	VNIC-04	-32.0907	115.9179	Melaleuca and Jarrah Woodland	Pitfall Trap	
Quenda *Isoodon fusciventer*	VNIC-05	-32.0915	115.9187	Melaleuca and Jarrah Woodland	Elliot Trap	44
Quenda *Isoodon fusciventer*	VNIC-05	-32.0912	115.9184	Melaleuca Grassland	Camera	
Quenda *Isoodon fusciventer*	VNIC-05	-32.0912	115.9180	Melaleuca Grassland	Camera	
Quenda *Isoodon fusciventer*	VNIC-05	-32.0909	115.9185	Melaleuca Grassland	Camera	

Appendix O – Introduced vertebrate fauna recorded during the current field survey

Latitude	Longitude	Date	Observation method	Site	Species name	Common name	Abundance
-32.09415	115.91758	19/11/2020	Opportunistic	No site	*Canis familiaris*	Dog	1
-32.09073	115.91795	23/11/2020	Bird Census	VNIC-04	*Columba livia*	Domestic pigeon (rock dove)	1
-32.09728	115.91657	19/11/2020	Opportunistic	VNIC-01	*Felis catus*	Cat	1
-32.09468	115.91715	17/11/2020	Elliot Trap	VNIC-02	*Mus musculus*	House mouse	1
-32.09532	115.9171	18/11/2020	Elliot Trap	VNIC-02	*Mus musculus*	House mouse	1
-32.09095	115.91792	18/11/2020	Pitfall Trap	VNIC-04	*Mus musculus*	House mouse	1
-32.09118	115.91827	20/11/2020	Elliot Trap	VNIC-04	*Mus musculus*	House mouse	1
-32.09544	115.91717	19/11/2020	Elliot Trap	VNIC-02	*Mus musculus*	House mouse	1
-32.09508	115.9172	19/11/2020	Elliot Trap	VNIC-02	*Mus musculus*	House mouse	1
-32.09508	115.91718	19/11/2020	Pitfall Trap	VNIC-02	*Mus musculus*	House mouse	1
-32.09154	115.91856	19/11/2020	Elliot Trap	VNIC-04	*Mus musculus*	House mouse	1
-32.09115	115.91835	19/11/2020	Elliot Trap	VNIC-04	*Mus musculus*	House mouse	1
-32.09533	115.91714	20/11/2020	Elliot Trap	VNIC-02	*Mus musculus*	House mouse	1
-32.09467	115.91714	21/11/2020	Pitfall Trap	VNIC-02	*Mus musculus*	House mouse	1
-32.09547	115.91714	21/11/2020	Elliot Trap	VNIC-02	*Mus musculus*	House mouse	1
-32.09415	115.91699	22/11/2020	Pitfall Trap	VNIC-02	*Mus musculus*	House mouse	1
-32.09117	115.918	18/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1
-32.09124	115.91844	17/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1
-32.09124	115.91844	18/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1
-32.09124	115.91844	20/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1
-32.09124	115.91844	21/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1
-32.09124	115.91844	22/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1
-32.09124	115.91844	23/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1
-32.0915	115.91868	17/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1
-32.0915	115.91868	19/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1
-32.0915	115.91868	20/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1
-32.0915	115.91868	21/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1
-32.0915	115.91868	22/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1
-32.0915	115.91868	23/11/2020	Camera	VNIC-05	*Mus musculus*	House mouse	1

Latitude	Longitude	Date	Observation method	Site	Species name	Common name	Abundance
-32.09587	115.91664	22/11/2020	Camera	VNIC-01	*Rattus rattus*	Black rat	1
-32.09496	115.91727	25/06/2020	Opportunistic	no site	*Spilopelia chinensis*	Spotted turtle dove	1
-32.09072	115.91781	18/11/2020	Opportunistic	VNIC-04	*Spilopelia chinensis*	Spotted turtle dove	1
-32.09555	115.91712	25/06/2020	Opportunistic	no site	*Spilopelia senegalensis*	Laughing turtle dove	1
-32.09516	115.91778	18/11/2020	Bird Census	VNIC-02	*Spilopelia senegalensis*	Laughing turtle dove	2
-32.09509	115.91718	19/11/2020	Bird Census	VNIC-02	*Spilopelia senegalensis*	Laughing turtle dove	1
-32.09187	115.91873	20/11/2020	Bird Census	VNIC-04	*Spilopelia senegalensis*	Laughing turtle dove	1
-32.09561	115.91703	20/11/2020	Bird Census	VNIC-02	*Spilopelia senegalensis*	Laughing turtle dove	1
-32.09589	115.91667	21/11/2020	Bird Census	VNIC-01	*Spilopelia senegalensis*	Laughing turtle dove	1
-32.09549	115.91715	21/11/2020	Bird Census	VNIC-02	*Spilopelia senegalensis*	Laughing turtle dove	1
-32.09545	115.91721	22/11/2020	Bird Census	VNIC-02	*Spilopelia senegalensis*	Laughing turtle dove	1
-32.09593	115.91663	22/11/2020	Bird Census	VNIC-01	*Spilopelia senegalensis*	Laughing turtle dove	1
-32.09119	115.91813	25/06/2020	Opportunistic	no site	*Trichoglossus moluccanus*	Rainbow lorikeet	2
-32.09061	115.91784	17/11/2020	Opportunistic	VNIC-04	*Trichoglossus moluccanus*	Rainbow lorikeet	2
-32.09579	115.91684	18/11/2020	Bird Census	VNIC-01	*Trichoglossus moluccanus*	Rainbow lorikeet	2
-32.0951	115.91718	19/11/2020	Bird Census	VNIC-02	*Trichoglossus moluccanus*	Rainbow lorikeet	2
-32.09588	115.91674	19/11/2020	Bird Census	VNIC-01	*Trichoglossus moluccanus*	Rainbow lorikeet	2
-32.09159	115.91859	20/11/2020	Bird Census	VNIC-04	*Trichoglossus moluccanus*	Rainbow lorikeet	1
-32.09545	115.91716	20/11/2020	Bird Census	VNIC-02	*Trichoglossus moluccanus*	Rainbow lorikeet	1
-32.09585	115.91671	20/11/2020	Bird Census	VNIC-01	*Trichoglossus moluccanus*	Rainbow lorikeet	2
-32.09167	115.91896	21/11/2020	Bird Census	VNIC-04	*Trichoglossus moluccanus*	Rainbow lorikeet	1
-32.09511	115.91719	21/11/2020	Bird Census	VNIC-02	*Trichoglossus moluccanus*	Rainbow lorikeet	1
-32.09545	115.91721	22/11/2020	Bird Census	VNIC-02	*Trichoglossus moluccanus*	Rainbow lorikeet	1
-32.09122	115.91826	22/11/2020	Bird Census	VNIC-04	*Trichoglossus moluccanus*	Rainbow lorikeet	1
-32.09597	115.91662	22/11/2020	Bird Census	VNIC-01	*Trichoglossus moluccanus*	Rainbow lorikeet	3
-32.0912	115.91812	22/11/2020	Bird Census	VNIC-04	*Trichoglossus moluccanus*	Rainbow lorikeet	1
-32.09611	115.91661	23/11/2020	Bird Census	VNIC-01	*Trichoglossus moluccanus*	Rainbow lorikeet	1
-32.09466	115.9172	23/11/2020	Bird Census	VNIC-02	*Trichoglossus moluccanus*	Rainbow lorikeet	1
-32.09099	115.91798	23/11/2020	Opportunistic	no site	*Trichoglossus moluccanus*	Rainbow lorikeet	2

Latitude	Longitude	Date	Observation method	Site	Species name	Common name	Abundance
-32.09561	115.91703	20/11/2020	Opportunistic (old den)	VNIC-02	*Vulpes vulpes*	Red fox	1
-32.09117	115.918	17/11/2020	Camera	VNIC-05	*Vulpes vulpes*	Red fox	1
-32.09092	115.91853	17/11/2020	Camera	VNIC-05	*Vulpes vulpes*	Red fox	1

Appendix P – Conservation significant species likelihood assessment

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution (DoEE, 2018)	Distance to Nearest Record - Year	Potential Habitat Within Study Area	Recorded Within Study Area	Post-Survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
MAMMALS									
MACROPODIDAE									
Western brush wallaby (*Notamacropus irma*)	-		P4	The species inhabits a wide-range of habitats including low Banksia woodlands, Jarrah/Marri woodlands and moist *Melaleuca* lowlands, favours open, grassy areas (Wann & Bell, 1997; Woinarski *et al.*, 2014a).	Yes	~ 1.76 km SSE (1997), Harrisdale Swamp (DBCA, 2020a) 33 contemporary (2017) records ~ 3 – 3.5 km W, Jandakot Regional Park (DBCA, 2020a)	Yes (Banksia Woodland, Melaleuca Grassland, Melaleuca Woodland)	No	**Possible** -presence of likely habitat (foraging, dispersal) - numerous contemporary records within 5 km -however, total area present may not support resident population
Quokka (*Setonix brachyurus*)	VU	VU		Habitat varies but prefer *Acacia* and *Melaleuca* thickets. In Jarrah Forest associated with tea-tree, *Taxandria linearifolia* (de Tores, 2008).	Yes	~ 9.5 km west (1966), Beeliar Regional Park (DBCA, 2020a) ~ 14.4 km SE (2010), Wungong Regional Park (DBCA, 2020a)	No	No	**Unlikely** -lack of suitable habitat -lack of contemporary records in proximity -mainland population is restricted to known populations
MYRMECOBIIDAE									
Numbat *(Myrmecobius fasciatus)*	EN	EN		Eucalypts forests and woodland, notably wandoo and jarrah woodland (van Dyck & Strahan, 2008). Known from few localised populations (Friend & Page, 2015)	No	~ 2.16 km NNE (1981) (DBCA, 2020a)	No	No	**Highly Unlikely** -outside extant distribution -lack of suitable habitat -no contemporary records in proximity
PERAMELIDAE									
Quenda, southern brown bandicoot (*Isoodon fusciventer*)	-		P4	Jarrah Forest and swamp habitats, preferring dense vegetation around wetland fringes and heathland (Cooper, 1998; Woinarski *et al.*, 2014a).	Yes	Within Study Area (2014) (DBCA, 2020a) 194 records within 5 km	Yes (Banksia Woodland, Melaleuca Grassland, Melaleuca Woodland, Wetland)	Yes (current survey)	**Confirmed**
PSEUDOCHEIRIDAE									
Western ringtail possum, ngwayir *(Pseudocheirus occidentalis)*	CR	CR		Coastal *Agonis flexuosa* forest or eucalypt woodland or forest with a Midstorey of *Agonis flexuosa* (Burbidge & de Tores, 1998; Jones *et al.*, 1994)	No (outside currently known distribution)	~ 28 km SE (1991) (DBCA, 2020a) ~ 60 km SW (2017) (DBCA, 2020a)	No	No	**Highly Unlikely** -outside extant distribution -lack of suitable habitat -no contemporary records in proximity
VESPERTILIONIDAE									

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution (DoEE, 2018)	Distance to Nearest Record - Year	Potential Habitat Within Study Area	Recorded Within Study Area	Post-Survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Western false pipistrelle *(Falsistrellus mackenziei)*			P4	Jarrah, Marri, Tuart and Karri forests with high rainfall. Has also found in Banksia woodlands on the Swan Coastal Plain (Armstrong *et al.*, 2017).	No (Armstrong *et al.*, 2017)	~ 8.8 km SW – Harry Waring Reserve (1993) (DBCA, 2020a) ~ 10 km east – Gosnells Quarry (2017) (Bamford Consulting, 2017) 13.3 km SE (2013) (DBCA, 2020a)	Marginal (Banksia Woodland)	No	**Unlikely** -outside extant distribution -lack of contemporary records in proximity -species generally found in tall, mature eucalypt forest
BIRDS									
ACCIPITRIDAE									
Letter-winged kite (*Elanus scriptus*)			P4	Habitats for this species include grasslands with trees and tree-lined watercourses (Pizzey & Knight, 2007).	Yes	~ 1.35 km N (1977) (DBCA, 2020a) ~1.75 km SW, Jandakot National Park (no year) (ALA, 2020)	Yes (Melaleuca Grassland)	No	**Unlikely** -marginal habitat present - records in proximity are not contemporary
Osprey (*Pandion haliaetus)*	MI	MI		Occurs mainly in sheltered seas around islands, tidal creeks, estuaries and saltwork ponds, also large river pools (Johnstone *et al.*, 2013)	Yes	~ 1.75 km NW (1977) (ALA, 2020)	Marginal	No	**Unlikely** -lack of contemporary records in proximity -marginal habitat outside normal foraging regions
ANATIDAE									
Blue-billed duck (*Oxyura australis*)			P4	Mainly deep freshwater swamps and lakes; occasionally salt lakes and estuaries freshened by flood waters (Johnstone & Storr, 1998).	Yes	~ 1.35 km N (1981), (DBCA, 2020a) 1.9 km SSE (1991), Harrisdale Swamp ~ 4 km SSE (2000), (DBCA, 2020a) 37 records ~ 1.6 km SW (Jandakot National Park) (ALA, 2020)	Marginal (Wetland)	No	**Possible** -marginal habitat present -contemporary record within 5 km
APODIDAE									
Fork-tailed swift (*Apus pacificus*)	MI	MI		Aerial species, which forages high above the tree canopy and rarely lower (Johnstone & Storr, 1998).	Yes	~ 1.6 km SW, Jandakot Regional Park (historical) (ALA, 2020)	Yes (aerial)	No	**Possible** -suitable habitat present -contemporary record within 5 km
ARDEIDAE									
Australasian bittern (*Botaurus poiciloptilus*)	EN	EN		Beds of tall dense *Typha*, *Baumea* and sedges in freshwater swamps (Johnstone & Storr, 1998).	Yes	~ 1.35 km N (1981) (DBCA, 2020a) ~ 1.75 km SW (no year), Jandakot National Park (ALA, 2020)	Marginal (Wetland – lack of dense reeds and sedges)	No	**Unlikely** -marginal habitat present - records in proximity are not contemporary
CACATUIDAE									

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution (DoEE, 2018)	Distance to Nearest Record - Year	Potential Habitat Within Study Area	Recorded Within Study Area	Post-Survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*)	VU	VU		Eucalypts forests. Attracted to seeding Marri, Jarrah, Blackbutt, Karri and Sheoak (Johnstone & Storr, 1998).	Yes	~ 1.29 km NW (2008) (DBCA, 2020a) ~2.23 km NNW (2017) (DBCA, 2020a)	Yes (Melaleuca Woodland)	Yes (current survey)	**Confirmed**
Baudin's cockatoo (*Calyptorhynchus baudinii*)	EN	EN		Species forages primarily in Eucalypt forest, feeding on Marri nuts, flowers, nectar and seeds (Johnstone & Storr, 1998). Nesting trees are Karri, Marri, and Wandoo (Johnstone & Kirkby, 2008).	Yes	~ 1.75 km SW (no year), Jandakot National Park (ALA, 2020) 76 “white-tailed” black cockatoo records within 5 km (potentially either Baudin’s or Carnaby’s cockatoo)	Yes (Melaleuca Woodland)	No	**Possible** -presence of potential foraging habitat - Confirmed and potential presence of records within proximity
Carnaby's cockatoo (*Calyptorhynchus latirostris*)	EN	EN		Proteaceous scrubs and heaths and adjacent eucalypt woodlands and forests (Johnstone & Storr, 1998).	Yes	~ 770 m W (2004) (DBCA, 2020a) 707 records within 5 km	Yes (Banksia Woodland, Melaleuca Grassland, Melaleuca Woodland)	Yes (current survey)	**Confirmed**
CHARADRIIDAE									
Little ringed plover *(Charadrius dubius)*	MI	MI		Bare or sparsely vegetated sandy and pebbly shores of shallow standing freshwater pools, lakes or slow-flowing rivers. Also found in artificial habitats including gravel pits, sewage works, industrial wastelands and rubbish tips (Geering *et al.*, 2007).	No	~ 1.35 km N (1981) (DBCA, 2020a)	Marginal (Wetland)	No	**Unlikely** -outside extant distribution -marginal/uncommon habitat presence - records in proximity are not contemporary
Greater sand plover (Charadrius leschenaultia)	VU/ MI	VU/ MI		Inhabits sheltered sandy, shelly or muddy beaches, large intertidal mudflats, sandbanks, salt-marshes, estuaries, coral reefs, rocky islands, tidal lagoons and dunes near the coast (BirdLife International, 2020).	No	~ 1.35 km N (1979) (DBCA, 2020a)	No	No	**Unlikely** -outside extant distribution -marginal/uncommon habitat presence - records in proximity are not contemporary
Pacific golden plover (*Pluvialis fulva*)	MI	MI		Found in estuaries, mudflats, saltmarshes, mangroves, rocky reefs and seaweed stranded on ocean shores (Pizzey & Knight, 2007).	No	~ 1.35 km N (1981) (DBCA, 2020a)	No	No	**Unlikely** -outside extant distribution -marginal/uncommon habitat presence - records in proximity are not contemporary
Grey plover (*Pluvialis squatarola*)	MI	MI		Inhabits intertidal mudflats, saltmarshes, sandflats and beaches, tidal reefs, estuaries and is rarely found inland. (Garnett *et al.*, 2011; Pizzey & Knight, 2007).	No	~ 1.35 km N (1980) (DBCA, 2020a)	No	No	**Unlikely** -outside extant distribution -marginal/uncommon habitat presence - records in proximity are not contemporary
FALCONIDAE									

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution (DoEE, 2018)	Distance to Nearest Record - Year	Potential Habitat Within Study Area	Recorded Within Study Area	Post-Survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Peregrine falcon *(Falco peregrinus)*		OS		The species occurs along coastal cliffs, rivers and ranges as well as wooded watercourses and lakes nesting on cliffs, granite outcrops, quarries and in the wheatbelt, old Raven and Whistling Kite nests (Johnstone & Storr, 1998).	Yes	~ 1.35 km N (1981) (DBCA, 2020a) 13 records ~ 1.75 km SW, Jandakot Regional Park and Ken Hurst Park (ALA, 2020; Dell & Cooper, 1992) >15 records ~ 8km west at Beeliar Regional Park (DBCA, 2020a)	Marginal (foraging)	No	**Possible** -potentially suitable foraging habitat -presence of numerous contemporary records within 10 km of Study Area
GLAREOLIDAE									
Oriental pratincole (*Glareola maldivarum*)	MI	MI		Prefers open plains, floodplains or short grasslands, often with extensive bare areas. They often occur near terrestrial wetlands (such as billabongs, lakes or creeks), and artificial wetlands (such as reservoirs, saltworks and sewage farms) (Johnstone & Storr, 1998).	No	~ 1.35 km N (1981) (DBCA, 2020a)	Marginal (Wetland)	No	**Unlikely** -outside extant distribution -marginal/uncommon habitat presence - records in proximity are not contemporary
LARIDAE									
Crested tern (*Thalasseus bergii)*	MI	MI		Favours sheltered seas, also estuaries and saltwork ponds. Rarely crosses the coastline and inland records generally involve birds driven by a storm or cyclone (Johnstone & Storr, 1998).	No	~ 1.35 km N (1981) (DBCA, 2020a)	No	No	**Highly Unlikely** -outside extant distribution -lack of suitable habitat -lack of contemporary records in proximity
Caspian tern (*Hydroprogne caspia*)	MI	MI		Mainly sheltered seas, estuaries and tidal creeks; occasionally near-coastal salt lakes (including saltwork ponds) and brackish pools in lower courses of rivers; rarely fresh water (Johnstone & Storr, 1998).	No	~ 1.75 km SW (no year), Jandakot National Park (ALA, 2020)	No	No	**Highly Unlikely** -outside extant distribution -lack of suitable habitat -lack of contemporary records in proximity
Gull-billed tern (*Gelochelidon macrotarsa*)	MI	MI		Shallow sheltered seas close to land, estuaries, tidal creeks; and inundated samphire flats, flooded salt lakes, claypans and watercourses in the interior (Johnstone & Storr, 1998).	Yes	~ 1.75 km SW (no year), Jandakot National Park (ALA, 2020)	No	No	**Highly Unlikely** -outside extant distribution -lack of suitable habitat -lack of contemporary records in proximity
MEGAPODIIDAE									
Malleefowl (*Leipoa ocellata*)	VU	VU		Inhabits semi-arid shrublands and low woodlands dominated by mallee eucalypts and/or *Acacia*s with sandy loam soils (Benshemesh, 2007).	Yes	~ 23 km SE (2004) (DBCA, 2020a)	No	No	**Highly Unlikely** -lack of suitable habitat -lack of contemporary records in proximity
MOTACILLIDAE									
Grey wagtail (*Motacilla cinerea*)	MI	MI		A rare vagrant to Western Australia where it has been recorded within various habitats with open waterbodies (Johnstone & Storr, 2004).	Yes	~ 300km S (DBCA, 2020a)	Yes	No	**Highly Unlikely** -lack of contemporary records in proximity
ROSTRATULIDAE									

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution (DoEE, 2018)	Distance to Nearest Record - Year	Potential Habitat Within Study Area	Recorded Within Study Area	Post-Survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Australian painted snipe (*Rostratula australis)*	EN	EN		Generally, occupies shallow terrestrial freshwater wetlands (i.e. temporary and permanent lakes, swamps and claypans) with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire (Johnstone & Storr, 1998).	Yes	~8.35 km SW (2012), Beeliar Regional Park (DBCA, 2020a)	Marginal (Wetland)	No	**Unlikely** -presence of >5 records within 10 km at Beeliar Regional Park -some marginal habitat present
SCOLOPACIDAE									
Sharp-tailed sandpiper (*Calidris acuminata)*	MI	MI		Coastal and inland areas saline and freshwater but prefers non-tidal fresh or brackish wetlands (Geering *et al.*, 2007)	Yes	~ 1.35 km N (1981) (DBCA, 2020a)	Marginal (Wetland)	No	**Unlikely** -marginal habitat present - records in proximity are not contemporary
Red knot (*Calidris canutus*)	EN/ MI	EN/ MI		Found in mudflats and sandflats in estuaries, on sheltered coasts, near coastal saltlakes, and saltworks ponds (Johnstone & Storr, 1998)	No	~ 1.35 km N (1980) (DBCA, 2020a)	No	No	**Unlikely** -outside extant distribution -lack of suitable habitat - records in proximity are not contemporary
Curlew sandpiper *(Calidris ferruginea)*	CR/ MI	CR/ MI		Inhabits intertidal mudflats in sheltered coastal areas (i.e. estuaries, bays, inlets and lagoons) (Geering *et al.*, 2007). This rare species generally roosts on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands (Geering *et al.*, 2007).	No	~ 1.35 km N (1981) (DBCA, 2020a)	No	No	**Unlikely** -outside extant distribution -lack of suitable habitat - records in proximity are not contemporary
Pectoral sandpiper (*Calidris melanotos*)	MI	MI		Coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (Johnstone & Storr, 2004; Johnstone *et al.*, 2013). It prefers wetlands with open fringing mudflats and low, emergent or fringing vegetation (Geering *et al.*, 2007).	Yes	~ 1.35 km N(1979) (DBCA, 2020a)	No	No	**Unlikely** -outside extant distribution -lack of suitable habitat - records in proximity are not contemporary
Red-necked stint (*Calidris ruficollis*)	MI	MI		Lives in permanent or ephemeral wetlands of varying salinity, and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In Western Australia they prefer freshwater to marine environments. The species usually forages in shallow water at the edge of wetlands and roost or loaf on tidal mudflats, near low saltmarsh, and around inland swamps (Johnstone & Storr, 1998).	No	~ 1.35 km N (1981) (DBCA, 2020a)	Marginal (Wetland)	No	**Unlikely** -outside extant distribution -marginal habitat present - records in proximity are not contemporary
Long-toed stint (*Calidris subminuta*)	MI	MI		They prefer shallow freshwater or brackish wetlands but are also fond of muddy shorelines, growths of short grasses, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire. The Long-toed Stint also frequents permanent wetlands and forages on wet mud or in shallow water, often among short grass, weeds and other vegetation on islets or around the edges of wetlands. They roost or loaf in sparse vegetation at the edges of wetlands and on damp mud near shallow water. It also roosts in small depressions in the mud (Johnstone & Storr, 1998).	No	~ 1.35 km N (1981) (DBCA, 2020a)	Marginal (Wetland)	No	**Unlikely** -outside extant distribution -marginal habitat present - records in proximity are not contemporary
Great knot *(Calidris tenuirostris)*	MI	MI		Breeds in the subarctic on montane tundra. Non-breeding birds migrate to harbours, bays, inlets, estuaries and lagoons with large intertidal sand and mud flats (Garnett *et al.*, 2011).	No	~ 1.35 km N(1980) (DBCA, 2020a)	No	No	**Unlikely** -outside extant distribution -lack of suitable habitat - records in proximity are not contemporary
Bar-tailed godwit *(Limosa lapponica)*	MI	MI		Found mainly in coastal habitats like estuaries, tidal mudflats, shallow river margins, sewage ponds, brackish or saline inland lakes, airfields and flooded pastures (Pizzey & Knight, 2007).	No	~ 1.35 km N (1980) (DBCA, 2020a)	No	No	**Unlikely** -outside extant distribution -lack of suitable habitat - records in proximity are not contemporary

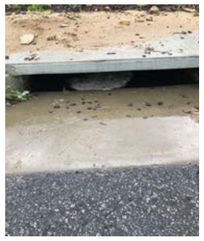
Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution (DoEE, 2018)	Distance to Nearest Record - Year	Potential Habitat Within Study Area	Recorded Within Study Area	Post-Survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Black-tailed godwit (*Limosa limosa*)	MI	MI		Found mainly in coastal habitats like estuaries, tidal mudflats, sandspits, shallow river margins, sewage ponds. Inland habitats include large shallow fresh or brackish waters (Pizzey & Knight, 2007).	No	~ 1.35 km N(1979) (DBCA, 2020a)	No	No	**Unlikely** -outside extant distribution -lack of suitable habitat - records in proximity are not contemporary
Eastern curlew *(Numenius madagascariensis)*	CR/ MI	CR/ MI		Mainly tidal mudflats, also reef flats, sandy beaches and rarely near-coastal lakes including saltwork ponds (Johnstone & Storr, 1998).	Yes	~13.2 km NW (2002) (DBCA, 2020a)	No	No	**Unlikely** -lack of suitable habitat - lack of records in proximity
Ruff *(Philomachus pugnax)*	MI	MI		Mainly fresh, brackish and saline wetlands with exposed mudflats. Found near lakes, swamps, pools, lagoons, tidal rivers and floodlands. Sometimes observed in sheltered coastal areas, including harbours and estuaries (DoEE, 2019).	No	~ 1.35 km N (1980) (DBCA, 2020a)	No	No	**Unlikely** -outside extant distribution -lack of suitable habitat - records in proximity are not contemporary
Grey-tailed tattler (*Tringa brevipes*)	MI	MI	P4	Found mainly in tidal mudflats, estuaries; shores and reefs of islands and coastal swamps and commercial salt fields (Pizzey & Knight, 2007).	No	~ 1.75 km SW (no year), Jandakot National Park (ALA, 2020)	No	No	**Unlikely** -outside extant distribution -lack of suitable habitat - records in proximity are not contemporary
Wood sandpiper (*Tringa glareola)*	MI	MI		Freshwater wetlands and occasional brackish intertidal mudflats (Geering *et al.*, 2007).	No	~ 1.35 km N (1981) (DBCA, 2020a)	Marginal (Wetland)	No	**Unlikely** -outside extant distribution -marginal habitat present - records in proximity are not contemporary
Common sandpiper (*Actitis hypoleucos*)	MI	MI		Estuaries and deltas of streams, as well as banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans (Johnstone & Storr, 1998).	No	~ 1.75 km SW (no year), Jandakot National Park (ALA, 2020)	Marginal (Wetland)	No	**Unlikely** -outside extant distribution -marginal habitat present - records in proximity are not contemporary
Common greenshank *(Tringa nebularia)*	MI	MI		Species occurs as a non-breeding summer Migrant which occurs throughout the region. Occurs mainly in Tidal mudflats, mangrove creeks, flooded samphire flats, beaches, river pools, and saltwork and sewage ponds (Johnstone *et al.*, 2013).	Yes	~ 1.35 km N (1981) (DBCA, 2020a)	No	No	**Unlikely** -outside extant distribution -lack of suitable habitat - records in proximity are not contemporary
Marsh sandpiper (*Tringa stagnatilis*)	MI	MI		Lives in permanent or ephemeral wetlands of varying salinity, and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In Western Australia they prefer freshwater to marine environments. The species usually forages in shallow water at the edge of wetlands and roost or loaf on tidal mudflats, near low saltmarsh, and around inland swamps (Johnstone & Storr, 1998).	No	~ 1.35 km N (1981) (DBCA, 2020a)	Marginal (Wetland)	No	**Unlikely** -outside extant distribution -marginal habitat present - records in proximity are not contemporary
THRESKIORNITHIDAE									
Glossy ibis *(Plegadis falcinellus)*	MI	MI		Freshwater wetlands, irrigated areas, margins of dams, floodplains, brackish and saline wetlands, tidal mudflats, pastures, lawns and public gardens (Johnstone *et al.*, 2013).	Yes	~ 1.35 km N (1981) (DBCA, 2020a) ~ 1.6 km NWW (2019), Jandakot Regional Park (ALA, 2020) ~ 2.19 km SE (1991), Harrisdale Swamp (DBCA, 2020a)	Yes (Wetland)	No	**Possible** -presence of foraging habitat -contemporary record in proximity

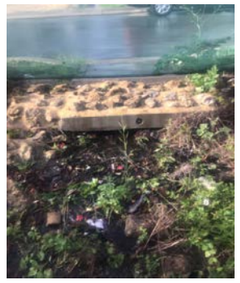
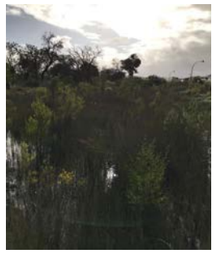
Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution (DoEE, 2018)	Distance to Nearest Record - Year	Potential Habitat Within Study Area	Recorded Within Study Area	Post-Survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
REPTILES									
ELAPIDAE									
Black-striped snake (*Neelaps calonotos*)	-		P3	Found in dunes and sand plains with heath and eucalypt/banksia woodlands, along the sandy coastal strip from Mandurah to Lancelin (Wilson & Swan, 2014). In the upper soil layer beneath leaf litter and dense foliage of shrubs and grasses, and shelters in abandoned ants nests and beneath logs and stumps, and interior of decaying trees (Bush *et al.*, 1995)	Yes	~ 2.25 km NW (2011) (DBCA, 2020a)	Marginal (Banksia Woodland)	No	**Possible** -presence of potentially suitable habitat -contemporary record in proximity
SCINCIDAE									
Perth slider *Lerista lineata*			P3	Found in loose soil or sand, particularly in coastal heaths and low shrublands (Cogger, 2014).	Yes	~ 3.44 km WSW (1992), Ken Hurst Reserve (DBCA, 2020a) ~4.94 km (2016), Rose Shanks Reserve (DBCA, 2020a)	Yes (Banksia Woodland)	No	**Likely** -presence of suitable habitat -contemporary record in proximity

Appendix Q – Drainage infrastructure assessment catalogue

Nicholson Rd Wetland Reserve Drainage Infastructure Assesment Catalogue
Date: 29/06/20

Location #	Type	ID	Easting (MGA Zone 50)	Northing (MGA Zone 50)	Comments	Photo	Action Required
1	Bubble up pit	Bubble up pit 1 (BUP1)	397726	6448226	No erosion, good condition, full of water and flowing after rainfall, bubble up pit dimensions: 120mm length & 120mm width, rock pitching dimesions: 440mm length & 330mm width, rubbish present	 	Clear debris/rubbish
2	Basin Edge	Basin 1 Edge 1 (B1E1)	397731	6448230	Basin highly vegetated		N/a
3	Culvert	Culvert 1 (C1)	397731	6448244	diamater: 300mm, concrete, winged headwall, headwall height: 700 mm, balance for CH2		N/a
4	Culvert	Culvert 2 (C2)	397763	6448244	concrete, winged headwall, good condition, balance for CH1		N/a
5	Basin Edge	Basin 1 Edge 2 (B1E2)	397730	6448255	No standing water, high vegetation, some weeds, no evident erosion, moderate rubbish, basin approx. depth: 1.2m		N/a
6	Basin Edge	Basin 1 Edge 3 (B1E3)	397720	6448260	Refer B1E2		N/a
7	Basin Edge	Basin 1 Edge 4 (B1E4)	397702	6448256	Adjacent to Nicholson Rd		N/a
8	Bubble up pit	Bubble up pit 2 (BUP2)	397710	6448248	Within basin 1, good condition, full of water		N/a

9	Basin Edge	Basin 1 Edge 5 (B1E5)	397707	6448240	Adjacent to Tranmore Turn	  	N/a
10	Side Entry Pit	Side Entry Pit 1 (SEP1)	397718	6448225	Full of water, on Tranmore Turn		N/a
11	Side Entry Pit	Side Entry Pit 2 (SEP2)	397694	6448249	Partially filled, on Nicholson Rd		N/a
12	Basin Edge	Basin 2 Edge 1 (B2E1)	397760	6448230	Highly vegetated, wet, standing water, sedges at base		N/a
13	Basin Edge	Basin 2 Edge 2 (B2E2)	397777	6448229	Adjacent to Kinsale Parkway	 	N/a
14	Basin Edge	Basin 2 Edge 3 (B2E3)	397791	6448239			N/a

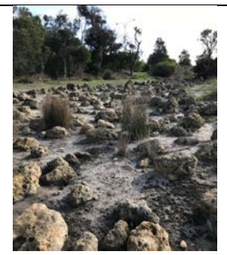
15	Side Entry Pit	Side Entry Pit 3 (SEP3)	397800	6448247	Direct connection to wetland via orifice, blocked up with rubbish and vegetation, low erosion, weedy, rock pitching dimensions: 310mm width & 480mm length		Clear debris
16	Culvert	Culvert 3 (C3)	397799	6448256	Within basin 2, concrete, 300mm diameter, 700mm winged headwall height, no erosion, clear		N/a
17	Basin Edge	Basin 2 Edge 4 (B2E4)	397792	6448258			N/a
18	Basin Edge	Basin 2 Edge 5 (B2E5)	397783	6448256			N/a
19	Culvert	Culvert 4 (C4)	397829	6448287	Balance to CH3, within basin 3, concrete, 300mm diamater, 700mm winged headwall height, vegetation mostly sedges with some mallaluca, water present aprrox. 12 cm depth		N/a
20	Basin Edge	Basin 3 Edge 1 (B3E1)	397841	6448294	Approx. 1m depth	 	N/a
21	Side Entry Pit	Side Entry Pit 4 (SEP4)	397850	6448299	direct connection to wetland from road (no culvert), no flow, weedy, no erosion, rubbish, rock pitching dimensions: 270mm width & 440mm length		Clear pollutants and weeds

22	Side Entry Pit	Side Entry Pit 5 (SEP5)	397878	6448326	Direct connection to wetland from road (no culvert), standing water, rubbish and weeds, no erosion, rock pitching submerged, rock pitching dimensions: 280mm width & 390mm length		
23	Basin Edge	Basin 3 Edge 2 (B3E2)	397880	6448343			N/a
24	Culvert	Culvert 5 (C5)	397876	6448343	Within Basin 3, 300mm diamater, winged headwall, 700mm headwall height, concrete, good condition		N/a
25	Culvert	Culvert 6 (C6)	397871	6448350	Balance to CH5, concrete, winged headwall		N/a
26	Culvert	Culvert 7 (C7)	397869	6448358	Heavily vegetated, 375mm diameter, 700mm winged headwall height, dry, overflow for southern section of wetland		N/a
27	Side Entry Pit	Side Entry Pit 6 (SEP6)	397872	6448364	Partly draining		N/a

28	Side Entry Pit	Side Entry Pit 7 (SEP7)	397876	6448367	Side entry pit across the road from SEP6		N/a
29	Manhole	Manhole 1 (M1)	397871	6448363	Connected to CH7		N/a
30	Side Entry Pit	Side Entry Pit 8 (SEP8)	397732	6448440	Partially filled, on Nicholson Rd		N/a
31	Side Entry Pit	Side Entry Pit 9A (SEP9A)	397725	6448402	Partially filled, on Nicholson Rd		N/a
32	Side Entry Pit	Side Entry Pit 9 (SEP9B)	397715	6448359	Partially filled, on Nicholson Rd		N/a
33	Side Entry Pit	Side Entry Pit 10 (SEP10)	397712	6448327	Partially filled, on Nicholson Rd		N/a
34	Side Entry Pit	Side Entry Pit 10 (SEP11)	397704	6448291	Partially filled, on Nicholson Rd		N/a
35	Culvert	Culvert 8 (C8)	397841	6448428	Opens into steep sided channel coevered with metal grate, 550mm channel length, 120mm channel width, 600mm culvert diameter, 370 mm water depth, fair condition, end highly blocked with organic matter and rubbish, headwall present	 	Clear organic matter and rubbish
36	Swale	Swale 1 (SWL1)	397839	6448440	Fed by CH8, rock pitching, 0.5m swale depth, 2m swale width, mulched, some natural vegetation		N/a

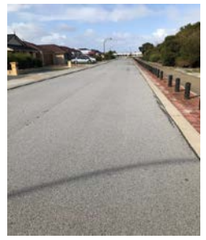
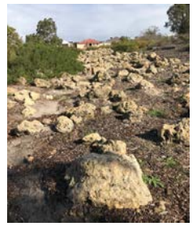
37	Swale	Swale 2 (SWL2)	397838	6448456	Transition to swale with no hard stuctures		N/a
38	Swale	Swale 3 (SWL3)	397849	6448472	Swale with no hard structures, moves futher in to wetland		N/a
39	Swale	Swale 4 (SWL4)	397863	6448483	Continuation of SWL3		N/a
40	Manhole	Manhole 2 (M2)	397901	6448508	Permeable lid, 300mm culvert enters, 300mm culvert departs		N/a
41	Culvert	Culvert 9 (CH9)	397897	6448510	Mostly blocked by organic matter and debris, 300mm diamater, concrete, headwall in fair condition	 	Clear organic matter, ongoing inspection

42	Manhole	Manhole 3 (M3)	397943	6448527	Across the road on lot, fed by 2 subsoil draiange pipes		N/a
43	Culvert	Culvert 10 (C10)	397921	6448551	375 mm diameter, concrete, feeds Basin 4, rock spall dimensions: 160mm width & 150 mm length, winged headwall		N/a
44	Basin Edge	Basin 4 Edge 1 (B4E1)	397890	6448584	Base mostly clear of vegetation, some sedges, unclear edges, approx. 1 m depth		N/a
45	Swale	Swale 5 (SWL5)	397901	6448563	2m depth, 30 cm wide, connects basin 4 and wetland		N/a
46	Bubble up pit	Bubble up pit 3 (BUP3)	397879	6448611	Fair condition, rock pitching dimensionsL 2.7m width & 2.7m lenth, no erosion evident, partly filled, within basin 4		Ongoing inspection
47	Basin Edge	Basin 4 Edge 2 (B4E2)	397863	644618	Eastern side of basin, more sedges present		N/a

48	Basin Edge	Basin 4 Edge 3 (B4E3)	397846	6448670	Signs of erosion caused by flow from footpath		Introduce rock pitching
49	Swale	Swale 6 (SWL6)	397819	6448706	Connects to Basin 4, shallow with rock spall		N/a
50	Side Entry Pit	Side Entry Pit 12 (SEP12)	397795	6448742			N/a
51	Side Entry Pit	Side Entry Pit 13 (SEP13)	397785	6448693			N/a
52	Side Entry Pit	Side Entry Pit 14 (SEP14)	397768	8448607	Another side entry pit across the road		N/a
53	Culvert	Culvert 11 (C11)	397768	6448602	300mm diameter, concrete in fair condition, vegetated near entry, some rubbish, winged headwall	 	Ongoing inspection

54	Bubble up pit	Bubble up pit 4 (BUP4)	397772	6448603	Good condition, some rocks at base not concreted, partly filled		N/a
55	Side Entry Pit	Side entry pit 15 (SEP15)	397757	6448557			N/a
56	Culvert	Culvert 12 (C12)	397759	6448557	300mm diameter, not flowing, concrete, no erosion, full of leaf litter and rubbish, 2m offset to SEP15, winged headwall		Clear clutter and rubbish
57	Side entry pit	Side entry pit 16 (SEP16)	397748	6448510			N/a
58	Culvert	Culvert 13 (C13)	397750	6448510	300 mm diamater, fair condition, concrete, rock pitching full of sand, 2m offset to SEP16, winged headwall		Clear debris from rock pitching

59	Bubble up pit	Bubble up pit 5 (BUP5)	397751	6448507	Partly filled, rock pitching random, no erosion evident, rubbish and weeds present		N/a
60	Basin Edge	Basin 5 Edge 1 (B5E1)	397750	6448492	Basin full of sedges and young malleluca, some water present, basin depth approx. 1m		N/a
61	Basin Edge	Basin 5 Edge 2 (B5E2)	397764	6448489			N/a
62	Basin Edge	Basin 5 Edge 3 (B5E3)	397777	6448473			N/a
63	Culvert	Culvert 14 (C14)	397751	6448485	300mm culvert, inlet for basin 5, concrete, winged headwall present		N/a

64	Dual side Entry Pit	Side Entry pit 17 (SEP17) & Side entry pit 18 (SEP18)	397740	6448477			N/a
65	Culvert	Culvert 15 (C15)	398024	6448896	Culvert within steep sided rock pitched basin, basin 2m deep, culvert diamater 375mm, connected to SWL7		N/a
66	Swale	SWL7	397982	6448856	Rock spall, flush kerbing adjacent, photo taken looking upstream	 	N/a
67	Culvert	Culvert 16 (C16)	397954	6448820	425mm diameter, sediment build up, rock pithcing not present/random, inlet for basin 6, winged headwall		Clear sediment build up
68	Basin	Basin 6 Edge 1 (B6E1)	397953	6448842	Depth aprox. 1m, sandy base, some standing water		N/a

69	Basin	Basin 6 Edge 2 (B6E2)	397858	6448902			N/a
70	Basin	Basin 6 Edge 3 (B6E3)	397873	6448932		 	N/a
71	Culvert	Culvert 17 (C17)	397824	6448846	Condition fair to poor, 300mm diameter, rock pitching dimensions: 170mm width & 140mm length, evidence of erosion/scour, inline with two side entry pits on adjacent road, connects to SWL8, winged headwall		Ongoing inspection, rearrange rock pitching
72	Swale	Swale 8 (SWL8)	397842	6448877	Swale width to the extent of the corridor, approx. 1.2m depth, runs parallel to Nicholson Rd		N/a
73	Swale	Swale 9 (SWL9)	397838	6448827	Erosion scour present due to inflow from sidewalk		Introduce rock pitching

74	Culvert	Culvert 18 (C18)	397811	6448790	325mm diamater, PVC pipe, no rock pitching, no headwall, condition poor	 	Introduce rock pitching and form flow path, consider concrete replacement with headwall
75	Side Entry Pit	Side Entry Pit 19 (SEP19)	397805	6448791	Another side entry pit across Nicholson road, both align with C18		N/a
76	Side Entry Pit	Side Entry Pit 20 (SEP20)	397817	6448847	Another side entry pit across Nicholson road, both align with C17		N/a
77	Side Entry Pit	Side Entry Pit 21 (SEP21)	397834	6448932	Aligns with two side entry pits across the road, manhole also present across Nicholson road		N/a
78	Side Entry Pit	Side Entry Pit 22 (SEP22)	397841	6448968	Another side entry pit across Nicholson road		N/a
79	Dual side Entry Pit	Side Entry Pit 23 (SEP23) & Side Entry Pit 24 (SEP24)	397848	6448995	2 side entry pits adjacent Nicholson Rd		N/a

80	Dual side Entry Pit	Side Entry Pit 25 (SEP25) & Side Entry Pit (SEP26)	397859	6449057	2 side entry pits adjacent Nicholson Rd		N/a
81	Culvert	Culvert 19 (C19)	397968	6448964	Wetland outflow, 400mm diamater, concrete, no headwall, partially blocked, drop of 1m from footpath		Clear pipe and ongoing inspection
82	Bubble up pit	Bubble up pit 6 (BUP6)	397850	6448928	1m of rock pitching downstream, some erosion	 	Rearrange rock pitching to prevent scour
83	Bubble up pit	Bubble up pit 7 (BUP7)	397836	6448831	Good condition, some debris in rock pitching		N/a
84	Bubble up pit	Bubble up pit 8 (BUP8)	397825	6448789	Good condition		N/a

Appendix R – Weed control treatments

NOTE: Information in this Appendix is compiled and adapted from the following sources: (Brown & Brooks, 2002; Brown & Bettink, 2021; CABI, 2021; Csurches & Edwards, 1998; DPI, 2021; DPIRD, 2021; Simon & Alfonso, 2021)

Control Method Category	Weed Taxon	Ecological Impact	Invasiveness	Manual method	Herbicide - type and method	Treatment timing	Additional information	Seedbank persistence
Bulbous weeds	**Gladiolus caryophyllaceus*	H	R	Not recommended	Wipe individual leaves with glyphosate 10 % or spray dense infestations in degraded areas with 1% glyphosate just on flowering at corm exhaustion.	Jul-Sept	Annually renewed corm, some dormancy between fire. Reproduction primarily via seed, occasionally offsets. Generally survives fire. Fire can bring corms out of dormancy and stimulate prolific flowering.	1-5 years
	**Romulea rosea*	U	R	Not recommended	Spot spray metsulfuron methyl 0.2 g/15 L + Pulse® or 2.5-5 g/ha + Pulse® . Apply just on flowering at corm exhaustion.	Jul-Aug	Annually renewed corm. Generally survives fire.	1-5 years
Grass weeds	**Aira cupaniana*	U	U	Hand weed small infestations prior to seed set	Spray with grass selective herbicide such as Fusilade® Forte in winter 4-6 weeks after opening rains, at the three to five leaf stage.	Jun-Aug	Annual. Winter-growing.	Unknown
	**Avena barbata*	H	R	In small infestations hand removal may be feasible.	Spray at 3-5 leaf stage with Fusilade® Forte at 16 ml/10 L + wetting agent or for generic fluazifop-p (212g/L active ingredient) 10mL/10L or 0.5L/ha + wetting agent. Repeat over the following 2 years. Aim to prevent seed production.	July-October	Annual. Can increase fire frequencies. Self-pollinated. Buried seed often remains dormant. Herbicide resistance has been recorded.	0.5-6 years
	**Briza maxima*	U	R	Hand pull plants	Spray at 3-5 leaf stage with Fusilade® Forte at 16 ml/10 L or 800 ml/ha (based on 500 L water/ha) + wetting agent or for generic fluazifop-p (212g/L active ingredient) 10ml/10L or 500ml/ha + wetting agent. Repeat treatment for 2 - 3 years.	Jul-Aug	Annual. Fire promotes germination of soil-stored seed.	Up to 3 years
	**Briza minor*	U	R	Hand pull plants	Spray at 3-5 leaf stage with Fusilade® Forte at 16 ml/10 L or 800 ml/ha (based on 500 L water/ha) + wetting agent or for generic fluazifop-p (212g/L active ingredient) 10ml/10L or 500ml/ha + wetting agent. Repeat treatment for 2 - 3 years.	Jul-Sept	Annual. Fire promotes germination of soil-stored seed.	3 years
	**Bromus diandrus*	H	R	Hand pull plants	In degraded areas use 1% glyphosate on seedlings, young plants or when flowering. Alternatively spray plants at 3-5 leaf stage with Fusilade® Forte at 16 ml/10 L or 800 ml/ha (based on 500 L water/ha) + wetting agent or for generic fluazifop-p (212g/L active ingredient) 10ml/10L or 500ml/ha + wetting agent.	Jun-Aug	Annual. Most seed will germinate with first substantial rain in autumn/early winter.	days to 2 years
	**Cynodon dactylon*	H	R	Small infestations may be dug out, ensuring removal of all rhizomes and stolons, however it is difficult to eradicate without herbicides.	Spray Fusilade® Forte at 13 ml/L + wetting agent or for generic fluazifop-p (212g/L active ingredient) 8mL/L + wetting agent when plants are small and beginning new growth, or 1% glyphosate in late spring/summer and autumn when rhizomes are actively growing. In sensitive areas try painting runners or crowns with 50% glyphosate. Follow-up is nearly always required. Treatment is particularly effective after fire.	Nov-Feb	Perennial. Survives most fire, reshoots from rhizomes.	3-4 years
	**Ehrharta calycina*	H	R	For small infestations, cut out plants ensuring crown removal. Do not slash.	Spray with Fusilade® Forte 13 ml/L or 6.5 L/ha + wetting agent on actively growing and unstressed plants. For generic fluazifop-p (212g/L active ingredient) 8ml/L or 4L/ha +wetting agent. Follow-up in subsequent years. Use unplanned fires to spray regrowth and seedlings within 4-6 weeks of germination.	Nov-Feb	Perennial. Fire promotes resprouts, seed production and germination. Intense fires can reduce seedbank. Established plants resprout vigorously from the base of the tussock following drought stress.	Up to 5 years
	**Ehrharta longiflora*	M	R	Hand remove small infestations	Spray with Fusilade Forte® 30 ml/10 L or 1.6 L/ha (based on 500 L water/ha) + wetting agent or for generic fluazifop-p (212g/L active ingredient) 18ml/10L or 1L/ha + wetting agent before flowering stem emerges, or at 3-5 leaf stage. Secondary seedling flush often occurs, repeat treatment if necessary.	Aug-Oct	Annual. Has staggered germination.	4-6 years
	**Eragrostis curvula*	H	R	Plants can be chipped out before they flower. When chipping out the plant, ensure that the entire tussock crown is removed to prevent regrowth. Do not slash or plough, as this can promote seed spread and reinfestation.	Herbicides can be used as part of integrated management, but foliar application should only be conducted when the plant is green and actively growing.	Dec-May. Residual herbicides are best applied Jul-Dec.	Perennial. Fire response. Often only top-killed by fire, rapidly resprouts.	Up to 5 years
	**Hordeum leporinum*	H	U	Hand pull plants	Spray with Fusilade® Forte 16 ml/10 L or 800 mL/ha (based on 500 L water/ha) + wetting agent or for generic fluazifop-p (212g/L active ingredient) 10ml/10L or 500ml/ha + wetting agent 4-6 weeks after opening rains.	Jun-Aug	Annual. Known to have herbicide resistance.	2 years
	**Lolium multiflorum*	H	R	Hand pull	Spray with grass selective herbicide such as Fusilade® Forte in winter 4-6 weeks after opening rains. For larger plants up to flowering, increase rates of grass selective herbicide 3 to 4 fold. Spray 10 ml/10 L glyphosate when plants are vegetative up to when seed heads are emerging.	Jun-Oct	Annual. Herbicide resistance has been well documented. NB. Information presented is for related species **Lolium rigidum*.	2-4 years
	**Pentameris airoides*	U	R	Cut out small plants, avoiding excess soil disturbance.	Try low rates of glyphosate otherwise grass-selective herbicide when actively growing.	Jul-Sept	Annual or perennial.	

Control Method Category	Weed Taxon	Ecological Impact	Invasiveness	Manual method	Herbicide - type and method	Treatment timing	Additional information	Seedbank persistence
	**Poa annua*	L	R	Light infestations can be hand weeded	Susceptible to many herbicides, however some grass-selective herbicides such as fluazifop (Fusilade® Forte) can give poor control.	Jun-Oct	Annual. Can flower and establish at any time of the year. Seed has generally high viability and staggered germination.	4-6 years
Herbaceous weeds	**Arctotheca calendula*	H	R	Chip out small infestations, ensuring root is severed well below ground level to prevent re-sprouting from the crown.	For large infestations apply Lontrel® 6 ml/10 L (300 ml/ha) in early growth stages. Glyphosate at 0.2% will provide some selective control if the plants are young or at the budding stage, otherwise spot spraying glyphosate at 10 ml/L will control capeweed at all growth stages. A combination of chemical and physical control with follow up treatment provides optimal control.	Jun-Nov	Reproduction. Seed, stolons. Biotypes have evolved resistance to Group D/22 (Bipyridiliums) and Group L herbicides. Can go on to produce seed under defoliation.	Up to 8 years
	**Callitriche stagnalis*	U	R	No recommendations exist for this or related species	No recommendations exist for this or related species		Reproduces via seeds and stem fragments.	Unknown
	**Crassula glomerata*	U	R	No recommendations exist for this or related species	No recommendations exist for this or related species			Unknown
	**Cerastrium glomeratum*	U	R	No recommendations exist for this or related species	No recommendations exist for this or related species			Unknown
	**Cyperus involucratus*	U	S	Hand remove small/isolated infestations ensuring removal of all rhizomes.	Try 1% glyphosate + Pulse®	May-Aug	Reproduction is via primarily tubers and rhizome, occasionally seed. NB. Information presented is for related species **Cyperus congestus* and **Cyperus eragrostis*.	Low seed viability
	**Dittrichia graveolens*	M	R	Hand remove isolated plants before flowering. Slash close to ground otherwise plants can resprout.	Any treatment should be applied twice, early and then late summer. Apply glyphosate at 1% when plants are small, or up to flowering. Clean equipment, clothing and shoes, etc. to prevent spread of seed.	Nov-Dec	Can cause dermatitis and skin irritation in people.	Up to 3 years
	**Echium plantagineum* (DPP)	H	M	Grubbing and cutting are suitable for young plants as long as 20 to 40 mm of taproot is removed. Slashing or mowing can cause out of season flowering and seed production.	Spot spray in late autumn/winter when most seed has germinated for the year with 0.5 g/10 L chlorsulfuron + wetting agent, this will also help prevent further germination. Glyphosate at 75 ml -100 ml/15 L or metsulfuron methyl 5 g/ 100 L applied at early flowering will control existing plants.	May-Aug	Smoke stimulates seedling emergence. Most germination is after substantial rains in autumn/winter. Herbicide resistance to Group B/2 herbicides has been recorded in WA.	Up to 6 years
	**Erigeron bonariensis*	L	M	Rosettes are readily destroyed by tillage. Does not compete well under high plant density or cover. Requires disturbance to establish and persist. Establish desirable vegetation.	Normally susceptible to a wide range of the standard herbicides for control of broad-leaved weeds, including 2,4-D, dicamba, atrazine, simazine, paraquat and glyphosate. However, it has developed resistance to paraquat and to triazines, and sometimes shows dual resistance to both. Level of resistance is lower in the early vegetative stage.	April to Jul (rosette stage)	It has developed resistance to many herbicides in a large number of countries. Germinates in autumn and persists as a basal rosette over winter before shooting and flowering in spring.	Unknown
	**Erodium cicutarium*	U	M		Apply Lontrel® at 6 ml/10 L + wetting agent applied before flowering or Verdict 520® at 1.5 ml/ 10 L + wetting agent.	May-Jul	NB. Information presented is for related species **Erodium botrys*.	3+ years
	**Euphorbia helioscopia*	H	U	Hand removal can stimulate germination of the soil seedbank. Ensure adequate personal protective clothing is worn to avoid contact with sap. Slash in November after seed production. Undertake control after any fire event.	Logran® at 12.5 g/100L + the penetrant Pulse ® is very effective on adults and juveniles. Since seed production is highest from plants which emerge early, it is important to control early cohorts, if not treated when small these become increasingly tolerant to herbicides.	Jun-Aug	Sap is poisonous and an irritant. NB. Information presented is for related species **Euphorbia terracina*.	3-5 years
	**Fumaria capreolata*	H	R		Spray metsulfuron methyl at 0.1 g/15 L (2.5 g/ha) + wetting agent or glyphosate 0.5%	Jul-Sept	Herbicide control can be unpredictable and variable. Tolerance and resistance varies among species of *Fumaria*.	20 years
	**Fumaria sp.*	H	R		Spray metsulfuron methyl at 0.1 g/15 L (2.5 g/ha) + wetting agent or glyphosate 0.5%	Jul-Sept	Herbicide control is unpredictable and variable, with tolerance and resistance varying among species of Fumaria.	20 years
	**Hypochaeris glabra*	H	R	Mowing and grazing ineffective and can promote growth and flowering. Hand remove small infestations ensuring the taproot is removed.	Alternatively wipe rosettes with glyphosate at 30%. For dense infestations, apply Lontrel® 10 ml /10 L + wetting agent. Apply herbicide regularly to prevent seeding.	May-Sept	Plants are usually killed by fire; however, heat stimulates germination of soil-stored seed.	Unknown
	**Juncus microcephalus*	U	U	Dig out isolated plants.	Spray 2% glyphosate + wetting agent in late summer/autumn if there is surface water present throughout the rest of the year. In dry conditions apply in spring/early summer.	Jan-Apr (if surface water present, Sept-Dec (in dry conditions)	When seeds mature, flowering stems bend with weight, and can release and spread seed into water if present.	Unknown
	**Lactuca serriola*	H	R	Manually remove small and/or isolated infestations, ensuring entire plant is removed, especially the taproot.	Apply glyphosate at early growth or rosette stages in spring, summer or autumn or metsulfuron methyl 5 g/ha (based on a minimum of 50 L/ha of water) + surfactant. Plants are difficult to	Sept-Nov	Can increase in abundance in suitable post-fire conditions. Populations in	1-3 years

Control Method Category	Weed Taxon	Ecological Impact	Invasiveness	Manual method	Herbicide - type and method	Treatment timing	Additional information	Seedbank persistence
					control with herbicides once the flowering stems have begun to elongate.		southern Australia have developed resistance to Group 2 herbicides.	
	**Lotus angustissimus*	H	R		Spot spray Lontrel® at 10 ml/10 L + 25 mL wetting agent.	Oct-Feb	NB. Information presented is for related species **Lotus uliginosus*.	Hard dormant seeds
	**Lupinus cosentinii*	H	M	Hand remove scattered plants prior to flowering.	Spray dense infestations with metsulfuron methyl 0.1g/15 L (2-3 g/ha) + wetting agent. Larger areas can be treated with more selective herbicides such as 200 g/ha Lontrel® or 50 g/ha Logran® (based on 500 L of water/ha). For spot spraying use 4 g Lontrel® or 1 g Logran® in 10 L of water + wetting agent. Glyphosate is relatively ineffective.	Jun-Sept	Has a well-established root system with strong taproot. Nitrogen fixing. Seed germinates in autumn, plants grow through winter and spring, and die with the onset of summer.	Some dormancy
	**Lysimachia arvensis*	U	R	Hand removal before seed set.	Glyphosate application well before flowering, but only in more degraded areas to prevent off-target impacts (before flowering).	Late autumn, early winter	Occurs as a winter annual in warmer climates.	Some dormancy
	**Lythrum hyssopifolia*	U	R	Hand removal before seed set.	2L/ha glyphosate 450 or a glyphosate plus triclopyr mix such as 2L glyphosate plus 500mL triclopyr 600 per hectare (before flowering).	Jun-Aug		Unknown
	**Medicago polymorpha*	U	R	Hand pull isolated plants in winter before flowering. Relatively tolerant to grazing and mowing.	Relatively tolerant to glyphosate. Lontrel® at 10 ml/10 L + wetting agent provides effective control in early winter. Otherwise metsulfuron methyl 0.1 g/10 L + wetting agent or 1 g/10 L of Logran® applied in early winter provides reasonably selective control. Repeat annually for several years.	Jun-Aug		5+ years
	**Nephrolepis cordifolia*	U	U	Manual removal of isolated, small seedlings can be attempted by hand pulling or digging them up. This is only practical for a small number of plants. It is important to remove the whole root system.	Can be spot sprayed with Glyphosate or Metsulfuron, however does not usually respond well to herbicides.	All year (does not flower)	A fern - reproduces via spores, and stoloniferous/rhizomatous vegetative reproduction. Grows well in moist, rocky and disturbed areas.	Spores only (unknown)
	**Oenothera drummondii* subsp. *drummondii*	U	R	Hand remove small populations in areas not susceptible to erosion.	Control in seedling stage, as older plants resistant to herbicide. Relatively resistant to glyphosate. Spot spray chlorsulfuron 0.4 g/10 L + spray oil.	Jul-Oct		Up to 80 years
	**Oenothera stricta* subsp. *stricta*	L	M	Hand remove small populations, ensuring removal of entire root stystem.	Control in seedling stage, as older plants are resistant to herbicide. Relatively tolerant of glyphosate. Spot spray chlorsulfuron 0.4 g/10 L + spray oil.	Jul-Oct		Unknown
	**Orobanche minor*	U	R	Hand-pulling, preferably at an early stage	There are no herbicides that are specific to Orobanche minor. Glyphosate may be effective.		Parasitic annual	Unknown
	**Pelargonium capitatum*	H	R	Hand pull isolated plants taking care to remove the entire stem as it can reshoot from below ground level.	Spot spray metsulfuron methyl 5 g/ha + Pulse®.	Jun-Oct	Frequent and/or intense fires create conditions suitable for greater invasion, particularly of Banksia woodland.	2+ years
	**Raphanus raphanistrum*	U	M	Hand remove isolated plants several times throughout the year.	Spot spray 1% glyphosate before flowering (a combination of approaches is usually most successful).	Jan-Dec	Germinates after significant autumn rains, otherwise germination can be sporadic and staggered throughout the year.	20 years
	**Senecio vulgaris*	L	U	Hand remove small/isolated populations.	Apply Lontrel® at 10 ml/10 L + wetting agent before stem elongation in late spring.	Sept-Oct	Resistant to some Group 5, 6 and 7 herbicides (including triazines, uracils and nitriles).	5 years
	**Solanum nigrum*	M	R	Prevent seed set for several years. Hand weed small infestations. In bushland situations, manually remove plants before flowering.	Large infestations: 1 L/ha Starane® (20 ml/10 L) applied when actively growing in summer, will provide reasonably selective control. Do not use in or near wetlands. Control infestations within 5 km of the target area to reduce dispersal of seed by birds. 1 L/ha 2,4-D amine (500 g/L) or 20 ml/10 L can be used for control of young plants in early summer.	Jul-Dec	Seed can have high germination rates (>90%) and germination is usually staggered. There is vigorous recruitment from soil stored seed in burnt and unburnt areas after rain.	5+ years
	**Sonchus oleraceus*	U	R	Remove small and/or isolated populations manually prior to seed set. Slashing is often ineffective as flowers continue to be produced.	Spot spray Lontrel® 10 ml/10 L + wetting agent preferably at the rosette stage.	Jun-Aug	Resistance to herbicides such as chlorsulfuron and atrazine.	1-2 years
	**Typha orientalis*	H	R	Cutting shoots 15 cm below the water surface two to three times in a season when actively growing, but before seeds are formed, greatly reduces stands. Repeat treatment annually to ensure against reinfestation.	Apply Roundup Biactive® (360 g/L) at 13 ml/L when actively growing through wiping, backpack/handheld spray or high volume spray. Complete coverage of foliage is necessary. Avoid producing run-off or spray drift. Plants with one third of the stem below water may not absorb enough herbicide to be killed by spraying - either wait till water levels are lower or plants have matured.	Dec-Feb	To avoid loss of water quality by anaerobic decomposition of dead plant material in water, consider physical removal of dead biomass or burning 6 weeks after spraying.	Unknown

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	**Ursinia anthemoides*	U	R	Can be hand-pulled, but usually not feasible for large infestations.	Lontrel is particularly effective on members of the Asteraceae (daisy family), but no specific recommendations exist for *U. anthemoides*.	May-Jun	Apply herbicide before flowering.	Unknown
	**Vicia sativa*	U	U	Hand remove small/isolated populations.	Lontrel® 10 mL/10 L + wetting agent provides effective control in early growth stages, otherwise apply metsulfuron methyl 0.1 g/10 L + wetting agent.	Jul-Sept	Can smother native plants.	Some dormancy
	**Wahlenbergia capensis*	U	R	No recommendations exist for this or related species	No recommendations exist for this or related species			Unknown
Woody weeds	**Acacia iteaphylla*	H	R	Hand pull seedlings. Fell mature plants.	Not recommended	Mar-Jul	Fire stimulates mass germination of seed and generally kills adult plants.	5+ years
	**Acacia longifolia* subsp. *longifolia*	H	R	Hand pull seedlings. Fell mature plants.	Apply 250 ml Access® in 15 L of diesel to basal 50 cm of trunk or cut and paint or drill and fill with 50% glyphosate. Older plants can be ringbarked. Monitor site for recruitment from seedbank.	Mar-Aug	Fire response. Fire stimulates mass germination of soil stored seed.	10+ years
	**Callistemon citrinus*	U	U	No recommendations exist for this species	No recommendations exist for this species		One individual located on road verge – does not need to be removed.	
	**Gomphocarpus fruticosus* (DPP)	H	R	No recommendations exist for this or related species	No recommendations exist for this or related species	Sept-Dec	All parts of the plant are poisonous and sap is a skin irritant. Can resprout and reproduce via root suckers. Can germinate any time after rain.	5+ years
	**Vitis vinifera*	U	U	No recommendations exist for this or related species	No recommendations exist for this or related species			Unknown