DEPARTMENT OF PLANNING, LANDS AND HERITAGE				
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Smiths 2014 Pty Ltd Environmental Assessment Report

> Lot 4131 Smiths Beach Road Yallingup WA 6282

10 December 2021 59550 134,863 (Rev 0) JBS&G Australia Pty Ltd T/A Strategen-JBS&G



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Appendix A Spring Flora and Vegetation Assessment – Lot 4131 Smiths Beach Road, Yallingup



- Appendix B Lot 4131 Smiths Beach Road, Yallingup Detailed Terrestrial Vertebrate Fauna Survey (Biologic 2021)
- Appendix C APZ Plan



# **Executive Summary**

Smiths 2014 Pty Ltd (Smiths 2014) is proposing to develop Lot 4131 Smiths Beach Road, Yallingup (Site) to deliver a sensitive coastal village. This proposed development (Proposal) incorporates an environmentally sensitive and landscape led design approach that prioritises the Site's unique natural elements and results in a built form proposal that integrates lightly into the landscape and is sympathetic to surrounding vegetation. The Proposal forms part of a Development Application (DA) to be determined by the Western Australian Planning Commission (WAPC) under the significant development assessment provisions. The Site is located within the City of Busselton, Western Australia, approximately 23 km west of Busselton CBD and covers an area of 40.53 ha. Smiths 2014 provides this Environmental Assessment Report (EAR) to document assessment of the existing physical, biological and social environment within and adjacent to the Site, determine the potential impact from the Proposal on any identified values and develop measures to mitigate potential impacts. The EAR will support planning and environmental assessment processes.

Assessment of existing environmental values against the disturbance footprint of the Proposal identified the following key environmental factors as requiring further assessment of potential impacts:

- vegetation and flora
- fauna and habitat
- Aboriginal heritage
- coastal processes
- visual amenity
- bushfire risk

A summary of environmental impact assessment, management and conclusions is provided in Table ES.1.

Environmental factor	Potential impacts	Management response	Conclusion
Vegetation and	8.17 ha of the site to be fully	Avoidance of 19.85 ha of the	All residual impacts to flora
flora	cleared (7.32 ha excluding already	site (18.43 ha excluding already	and vegetation within the
	cleared areas) and 12.52 ha of the	cleared areas), which will be	project area will be managed
	site to be partially modified (11.14	fully retained, revegetated	through the implementation
	ha excluding already cleared	(where required) and protected	of a Construction
	areas) to cater for proposed	in conservation areas.	Environmental Management
	landscaping and bushfire		Plan and development of an
	management.	Of the 7.32 ha of native	offset strategy to be
		vegetation proposed to be	incorporated as part of
	The clearing will reduce the	cleared, 2.8 ha will be subject to	standard environmental
	known extent of the Wilyabrup	revegetation. A further 1.28 ha	referral to the EPA (under
	complex by 7%, with 66% of its	of currently cleared areas,	the EP Act) and DAWE
	pre-European extent remaining.	outside of the proposed clearing	(under the EPBC Act).
	The clearing will reduce the	footprint, will be subject to	
	known extent of the Chapman 37	revegetation.	
	VSA by 2%, with 48% of its pre-		
	European extent remaining, while	The 12.52 ha subject to partial	
	the known extent of Chapman 990	modification for bushfire risk	
	VSA will be impacted by less than	management is anticipated to	
	0.3 ha, with 71% of its pre-	retain >60% of the existing	
	European extent remaining. The	canopy cover.	
	clearing will reduce the known		
	extent of the Chapman 1180 VSA	Preparation and	
		implementation of a	



Environmental	Potential impacts	Management response	Conclusion
factor			
	by 0.2%, with 87% of its pre-	Construction Environmental	
	European extent remaining.	Management Plan.	
	Approximately 0.24 ha (2.87%) of	Preparation of an offset strategy	
	the 'Low shrublands on acidic	where required.	
	grey-brown sands of the		
	Gracetown soil-landscape system'		
	PEC to be potentially impacted,		
	including 0.08 ha (0.96%) to be		
	fully cleared and 0.16 ha (1.91%)		
	to be partially modified.		
	As identified in Figure 4.2 there		
	are circumstances where Banksia		
	sessilis var. cordata (P4)		
	individuals may be potentially		
	impacted, site specific detailed		
	design will aim to retain as many		
<b>F</b>	individuals as possible.		
Fauna and habitat	Approximately 12.37 ha of	Avoidance of 19.85 ha of the	All residual impacts to fauna
	Western Ringtail Possum habitat	site, which will be fully retained,	will be managed through the
	to be impacted, including 4.64 ha	revegetated (where required)	Implementation of a
	to be fully cleared and 7.74 ha to	and protected in conservation	Construction Environmental
	be partially modified. This habitat	areas. This includes	Management Plan, a Fauna
	foraging for Wambonger bruch	approximately 18.52 ha of	Tree Retention Plan, as well
	to aging for wantbenger brush-	which comprises quality habitat	as development of an officiat
		for key conservation significant	strategy to be incorporated
	Approximately 4.41 ha of	fauna	as part of standard
	Carnaby's Black Cockatoo foraging		environmental referral to
	habitat to be impacted including	The 12 52 ha of vegetation and	the FPA (under the FP Act)
	1.6 ha to be fully cleared and 2.81	fauna habitat subject to	and DAWE (under the EPBC
	ha to be partially modified. This	modification for bushfire risk	Act).
	habitat also supports foraging for	management is anticipated to	
	Baudin's Black Cockatoo.	retain >60% of the existing	
	,	canopy cover. This canopy	
	Approximately 0.14 ha of Forest	retention represents the key	
	Red Tailed Black Cockatoo	values of the breeding and	
	foraging habitat to be impacted,	foraging habitat present for	
	including 0.04 ha to be fully	both Western Ringtail Possum	
	cleared and 0.10 ha to be partially	and black cockatoos within the	
	modified.	development footprint.	
	Approximately 10.8 ha of Quenda	The proposed canopy retention	
	habitat to be impacted, including	will also help preserve the	
	3.9 ha to be fully cleared and 6.9	linkage of fauna habitat across	
	ha to be partially modified.	the site from east to west.	
		Western Ringtail Possum drevs	
		(six) and potential black	
		cockatoo habitat trees (five)	
		situated within the	
		development footprint are	
		expected to be fully retainable	
		through avoidance measures	
		incorporated into detailed	
		development design.	
		Preparation and	
		implementation of a	
		Construction Environmental	



Environmental factor	Potential impacts	Management response	Conclusion	
		Management Plan, a Fauna Management Plan and a Tree Retention Plan.		
		Preparation of an offset strategy.		
Aboriginal heritage	Registered Aboriginal heritage site 15080 (artefacts/scatter), currently occupied by an existing track, is expected to be impacted by proposed road/pavement construction.	Application pursuant to Section 18 of the <i>Aboriginal Heritage</i> <i>Act 1972</i> which has been submitted. Development of a Cultural Strategy document with the Cultural Working Group to ensure integration of Aboriginal heritage in the Proposal. Development in accordance with the Aboriginal Heritage Due Diligence Guidelines (DPLH 2013).	All residual impacts to Aboriginal heritage are expected to be sufficiently mitigated by the management measures proposed.	
Coastal processes	<ul> <li>Potential impacts to the Smiths Beach foreshore include:</li> <li>foreshore stability and erosion</li> <li>disturbance to native vegetation</li> <li>residual impacts to public amenity</li> <li>residual impacts from poorly designed pedestrian and vehicular movements</li> <li>residual impacts from uncontrolled access.</li> </ul>	Implementation of the Foreshore Management Plan. Development in accordance with Smiths Beach Coastal Hazard Assessment (MP Rogers and Associates 2021).	All residual impacts to the foreshore are expected to be sufficiently mitigated by implementation of the Foreshore Management Plan.	
Visual amenity	<ul> <li>Potential impacts to visual and landscape amenity, such as the:</li> <li>natural systems and character</li> <li>ridge line associated with Smiths Beach Bay and southern facing skyline</li> <li>existing naturalistic landscape and Smiths Beach settlement</li> <li>landscape and visual character associated with topography and landforms east and west of the Site</li> <li>view-lines, particularly from the southwest (wilderness setting).</li> </ul>	Adopting visual management measures as design responses and landscape led site planning and design (i.e. strategies including the protection and maintenance of the visual character and best practice siting and design) to achieve a form that can contribute to the landscape positively, creating an unobtrusive coastal village that retains vegetation through a dispersed low rise built form and utilises materials that are complementary in colour and texture to the existing landscape. Disaggregated and low-density buildings will be dispersed to allow for retention of managed vegetation. The ridgeline that forms the skyline in panoramic	All residual impacts to visual and landscape amenity are expected to be sufficiently mitigated through the proposed visual management measures and landscape led site planning and design specified in the Visual and Landscape Assessment.	



Environmental factor	Potential impacts	Management response	Conclusion
		views is protected and form, colour and texture of buildings arranged to create a scene that respects and is equal to its setting.	
Bushfire risk	Residual impacts to vegetation, flora, fauna and habitat associated with vegetation modification associated with areas of bushfire risk management.	Implementation of the Bushfire Management Plan.	All residual impacts from bushfire risk are expected to be sufficiently mitigated by implementation of the Bushfire Management Plan.
	Potential impacts to life and property associated with a bushfire event post-development.		



# 1. Introduction

### 1.1 Overview

Smiths 2014 Pty Ltd is proposing to develop Lot 4131 Smiths Beach Road, Yallingup (Site) as a sensitive coastal village. The environmentally sensitive and landscape led design approach forms part of a Development Application (DA) to be determined by the Western Australian Planning Commission (WAPC) under the significant development assessment provisions. The Site covers an area of 40.53 ha and is located approximately 23 km west of Busselton CBD within the City of Busselton municipality, Western Australia. The Site is bound by Smiths Beach Road to the east, the Indian Ocean to the west, the existing Foreshore Reserve to the north and Lot 302 and the Leeuwin Naturaliste National Park to the south (Figure 1.1).

### 1.1.1 Design proposal

The Smiths Beach Masterplan proposes an environmentally sensitive and landscape led design approach that prioritises the Site's unique natural elements. The design vision for the Proposal is to embrace a strong sense of place that respects the Site and its flora and fauna, and takes a leading sustainable approach to all design and materials (see Figure 1.2 to Figure 1.5). The vision is to establish the area as a world-renowned iconic tourism attraction and destination and deliver a project that aligns with world's best-practices. Anchored by the Cape to Cape Track, the heart of the village will be the "Cape to Cape Welcome Centre", a highly curated and innovative 'welcome centre' providing tourist information, facilities and amenity within a central node for all visitors to the region.

The Design Vision has been formulated to achieve the following key objectives:

- Landscape Led allowing the landscape to define the appropriate location for development on the site
- Visual Integration design and location of built form sensitively located within the landscape to minimise visual impact
- Environmental Safeguard protecting the site from bushfire risk and coastal erosion processes
- Landscape Rehabilitation regenerating degraded areas of the site with endemic species.

The result is a builtform proposal that integrates lightly into the landscape and is sympathetic to surrounding vegetation. Overall, the Masterplan proposes a lower yield and dispersed footprint which has been shaped around vegetation classified as 'Excellent', resulting in significantly more vegetation being retained compared to what could occur under the current approved Structure Plan.

### 1.2 Purpose and scope of this document

This Environmental Assessment Report (EAR) has been prepared to support the Proposal and includes identification of:

- applicable legislation, policy and guidance for the environmental, bushfire and heritage characteristics of the Site
- potential impacts to the above characteristics associated with the Proposal
- management responses of the Proposal to ensure that any identified potential impacts can be suitably mitigated or managed.



#### **1.3** Supporting documents

The following documents have been reviewed and used to support development of this EAR:

- McGregor Coxall (2021), Smiths Beach Project Master Plan
- MP Rogers (2021), Smith Beach Coastal Hazard Assessment
- Hyd20 (2021), Urban Water Management Plan (including Golders 2021 geotechnical investigation)
- Emerge Associates (2019), Spring Flora and Vegetation Assessment
- Biologic (2020), Detailed Terrestrial Vertebrate Fauna Survey
- Strategen-JBS&G (2021a), Foreshore vegetation assessment
- Strategen-JBS&G (2021b), Foreshore Management Plan
- Strategen-JBS&G (2021c), Bushfire Management Plan
- Smiths Beach Project Cultural Strategy (2021)
- Ethnosciences (2021), Ethnographic Consultation and Archaeological Inspection
- EPCAD (2021), Visual and Landscape Assessment.







**Design Analysis** 



#### Landscape Led

· Optimises retention of "Excellent" vegetation and key fauna habitat



#### Visual Integration

- · External views to site considered
- · Vegetation retention
- Landform retention



#### Environmental Safeguard

· Coastal protection

- · Fire risk/hazard response Managed vegetation
- •

#### Landscape Rehabilitation

- · Degraded habitat
- . Environmental scars
- Unmanaged access

# Design Response



#### Reduced built form density within a dispersed footprint

- Managed Vegetation Retention
- · Minimise extent of permanent clearing
- Greater retention of managed
- vegetation · Optimize retention of "Excellent" vegetation



#### Fauna Habitat Retention

- · Campground located amongst Peppermint Forest to maintain fauna habitat
- · Eastern Holiday Homes dispersed and sensitively located to maximise retention of Banksia



#### Visual Response

.

- Dispersed and low profile built form Built form offset for optimisation of .
- vegetation retention
- · Meandering road design to maximise visual mitigation (no straight lines)
- Revegetation of firebreak •
- Corridors of vegetation retained

#### Built Form Dispersal

- · Intensity focused on foreshore as a logical extension of existing tourism offer and built form
- Intensity of Tourist Development reduced . westward closer to the headland
- Reduced intensity and height of Holiday . Homes westwards
- Increasing intensity of Holiday Homes built • form to the east, closer to existing settlements
- Increased lot sizes to optimise managed . vegetation retention on larger home sites

#### Figure 1.2: Design responses (1/2)





#### Design Response to Combined Methodologies and Redefined IDLA

#### Figure 1.3: Design responses (2/2)

Continued from previous page

1. 2.



- 1. Cape to Cape Track
- 2. Hotel Arrival
- 3. Restaurant
- 4. Universal Beach Access
- 5. Yarning Circle
- 6. Cape to Cape Welcome Centre
- 7. Surf Life Saving Club
- 8. Café & General Store
- 9. Smiths Lane Public Parking
- 10. Campground Facilities
- 11. Service Infrastructure









#### Figure 1.5: Smiths Beach Masterplan (Aerial view)



# 2. Legislation, policies and guidelines

Key statutory and policy documents are listed and described where relevant in the following subsections.

#### 2.1 Federal legislation

#### 2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Department of Agriculture, Water and the Environment (DAWE). The EPBC Act aims to protect and manage nine Matters of National Environmental Significance (MNES) throughout Australia including:

- World Heritage Properties;
- National Heritage Places;
- wetlands of international importance (listed under the Ramsar Convention);
- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Commonwealth Marine Areas;
- Great Barrier Reef Marine Park;
- nuclear actions (including uranium mines); and
- a water resource, in relation to coal seam gas development and large coal mining development.

MNES identified as relevant to the project area include:

- Western ringtail possum (Critically Endangered);
- Carnaby's black cockatoo (Endangered);
- Baudin's black cockatoo (Endangered);
- Forest red-tailed black cockatoo (Vulnerable);
- Chuditch (Vulnerable); and
- Osprey (Migratory).

Referral under the EPBC Act is currently underway for the Proposal.

#### 2.2 State legislation

The environmental assessment outlined in this report has been conducted with reference to the following State legislation:

- Biodiversity Conservation Act 2016 (BC Act)
- Environmental Protection Act 1986 (EP Act)
- Biosecurity and Agriculture Management Act 2007 (BAM Act)
- Rights in Water and Irrigation Act 1914 (RIWI Act)
- Metropolitan Water Supply, Sewerage and Drainage Act 1909
- Aboriginal Heritage Act 1972 (WA) (AH Act)



- Contaminated sites Act 2003 (CS Act)
- Contaminated Sites Regulations 2006 (CS regulations)
- Planning and Development Act 2005.

#### 2.2.1 State Planning Policies and strategies

The WAPC prepares and adopts state planning policies and strategies under statutory procedures set out in part 3 of the *Planning and Development Act 2005*. State planning policies and strategies relevant to the Proposal are listed as follows:

- State Planning Policy 2.6: State Coastal Planning Policy (SPP 2.6)
- State Planning Policy 6.1: Leeuwin-Naturaliste Ridge Policy (SPP 6.1)
- State Planning Policy 3.7: Planning in Bushfire Prone Areas (SPP 3.7)
- Leeuwin-Naturaliste Sub-regional Strategy.

#### 2.3 Environmental Protection Authority (EPA) guidance

The environmental assessment conducted in this report has consideration of the recommendations of relevant EPA regulatory guidance listed as follows:

- Environmental Factor Guideline Social Surroundings
- Environmental Factor Guideline Human Health
- Environmental Factor Guideline Inland Waters
- Environmental Factor Guideline Terrestrial Fauna
- Environmental Factor Guideline Terrestrial Environmental Quality
- Environmental Factor Guideline Landforms
- Environmental Factor Guideline Flora and Vegetation
- Technical Guidance Terrestrial fauna surveys
- Technical Guidance Sampling methods for terrestrial vertebrate fauna
- Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment
- EPA Guidance Statement No. 33 Environmental Guidance for Planning and Development (EPA 2008)
- Environmental Protection Bulletin No. 20 Protection of naturally vegetated areas through planning and development.

#### 2.4 Local government policies, strategies and guidance

City of Busselton has developed numerous polices, strategies and guidelines relevant to planning and the environment, with relevant documents listed as follows:

- Local Planning Scheme No. 21
- Local Environmental Planning Strategy (2011)
- Local Tourism Planning Strategy (2011).



## 3. Overview of existing environment

The following subsections provide an overview of the existing environment within and adjacent to the Site. Key environmental features are depicted in Figure 3.1.

### 3.1 Historical, current and surrounding land use

Historically, the Site was used for low-intensity sheep grazing. Farming of the Site was discontinued in the mid-1990s. Historical aerial imagery from 1996 to 2019 shows the Site as containing intact native vegetation (Emerge 2019). There is evidence of use of the area as an informal access point to the coast, beaches, Cape to Cape Track, with numerous informal tracks originating from existing roads.

The Leeuwin-Naturaliste Ridge (EPA Redbook Recommended Conservation Reserve) borders the Site to the north and west. The Leeuwin-Naturaliste National Park borders the Site to the south (incorporating Canal Rocks) and the Ngari Capes Marine Park is located approximately 100 m to the north and the west. The National Park also includes land to the northeast including Smiths Beach and the Torpedo Rocks scenic lookout. Immediately to the east of the Site is a tourist development (Chandlers Chalets) and cleared rural land.

The Site is currently identified under the City's Local Planning Scheme No. 21 as a combination of Tourism Zone and Recreation Reserve. The Site is also affected by Additional Use Site No. 36 which provides for residential development in accordance with the residential zone.

Immediately adjacent on the north-eastern side of the Site is the Canal Rock Beachfront Apartments and Smith's Beach Resort (formerly the Smiths Beach Caravan Park site).



Legend Project area (Lot 4131) Environmentally sensitive areas (DWER) Wetlands (Leeuwin layer)	Legislated lands and waters (DBCA)          National Park         Other Reserves	Strategen JBS&G		0 500 metres		Lot 4131 Smiths Beach Road Yallingup WA 6282
Paluslope Palusplain	Gunyulgup Brook	Job No: 59550		Scale 1:20,000 at A	3	KEY ENVIRONMENTAL FEATURES
raiuspiain		Client: Smiths 2014 Pty Ltd		Coord. Sys. GDA 199	94 MGA Zone 50	
		Drawn By: jcrute	Checked By: CT	Version: A	Date: 23-Nov-2021	FIGURE: 3.1

Document Path: W:\Projects\1)Open\Linc Property\59550 Smiths Beach Stage 2 Approvals\GIS\Maps\R02\_Rev\_A\59550\_03\_01\_A3\_KeyEnviroFeatures.mxd Image Reference: SLIP Public Services Locate 2019-2021.



### 3.2 Climate

The Naturaliste-Leeuwin coastline experiences a Mediterranean climate with warm to hot, dry summers and mild, wet winters. High-pressure cells dominate climatic patterns during summer and the passage of cold fronts and associated low-pressure cells dominate during winter. Strong sea breezes dominate during late November to early March with much of the Site being exposed to strong winds during winter storms.

The mean maximum temperature generally occurs in February and varies between 23°C at Cape Leeuwin and 25.6°C at Cape Naturaliste. Rainfall averages are 833 mm at Cape Naturaliste and 994 mm at Cape Leeuwin. Approximately 60% of the annual rainfall is received between May and August (Bureau of Meteorology 2020).



#### Figure 3.2: Long term and current climatic data for Cape Naturaliste (station # 9519)

(Source Bureau of Meteorology (BoM) 2020)

### 3.3 Topography and landform

The Site exists on the Leeuwin-Naturaliste Ridge, which is a unique geological feature approximately 93 km in length between Cape Naturaliste in the north and Cape Leeuwin in the south. As depicted in Figure 3.3, the Site has two major landform components: a gently sloping eastern section that rises to the south away from the beach; and a ridgeline in the western sector that extends seaward in a north westerly direction. The ridgeline forms a slightly raised headland with elevation up to 58 m AHD.

The highest point of the Site is located midway along the southern boundary of the Site having an elevation of 60 m AHD. The eastern half of the Site slopes downwards to the north towards the beach to a level of 4 m AHD. The general slope is moderate, descending approximately one metre in every seven. At the base of this slope is a low-lying area.





#### 3.4 Geology and soils

An overview of geotechnical features of the Site taken from Hyd2o (2021) is depicted in Figure 3.4.

The geology of the Site is described in the Yallingup Sheet of the Environmental Geology Map Series produced by the Geological Survey of Western Australia (Leonard 1991). Generally, the geology consists of Quaternary sand derived from Tamala Limestone overlying Archaean gneiss (Golder 2020):

- SAND derived from Tamala Limestone white to pale and olive-yellow, medium to coarse grained, sub-angular quartz; moderately sorted
- TAMALA LIMESTONE variably cemented calcareous limestone
- GNEISS medium grained mesocratic gneiss.

The Site lies in the Jarrah Forest bioregion and within the Southern Jarrah Forest subregion, as defined by the *Interim Biogeographic Regionalisation of Australia* (IBRA) (Environment Australia 2000). The Southern Jarrah Forest subregion extends from Collie in the north to Yallingup in the west and Albany in the southeast. This subregion comprises the southern part of the Darling Plateau, where it broadens and slopes gently to the southern coastline, being dissected by multiple rivers (Beard 1990). Generally, the soils within the Southern Jarrah Forest subregion comprise laterite gravels but clay/loam soils occur in the eastern portion where the Darling Plateau is flatter and drainage is poor (DEC 2002). The north-western portion of the Southern Jarrah Forest subregion comprises a combination of limestone and granites as it lies on the northern tip of the Leeuwin-Naturaliste Ridge (Emerge 2019).

The Site comprises four broad soil landscape units as mapped by DPIRD (2019) which are described in Table 3.1.

Name	Description
Gracetown exposed slopes Phase	Moderate slopes (gradients 10-15%) on the west coast exposed to prevailing wind directly off the ocean, with deep and shallow yellow brown siliceous sands over limestone (i.e. Spearwood Sands).
Wilyabrup granitic headland Phase	Areas on the west coast dominated by granitic outcrop.
Wilyabrup exposed slopes Phase	Low slopes (gradients generally 5-10%) exposed to strong winds off ocean.
Wilyabrup gentle slope Phase	Gradients 5-10%

#### Table 3.1: Soil Landscape mapping over the site (DPIRD 2019).

Within these landscape units, the Site may be divided into seven areas based on the work completed by Golder (2020). These are described as follows:

#### Area 1 – Shallow Rock

The subsurface conditions encountered in this area may be generalised as comprising:

- Silty SAND (SM), fine to medium grained, generally about 15% low plasticity fines, generally loose becoming medium dense to dense with depth, brown becoming pale brown orange and pale brown grey, extending to depths of between about 0 m (rock outcrops) and 1.9 m; overlying
- Inferred GNEISS/GRANITE cobbles, boulders or bedrock, causing refusal at depths between 0.2 m and 1.9 m.

#### Area 2 – Shallow Clay

The subsurface conditions encountered in this area may be generalised as comprising:



- Silty SAND (SM) or Sandy GRAVEL (GP), fine to medium grained sand, fine to coarse lateritised gneissgravel, generally about 15% low plasticity fines, medium dense to dense with depth, brown, extending to depths of between about 0.4 m and 0.5 m; overlying
- Sandy CLAY(CI/CH), medium to high plasticity, very stiff to hard, brown, orange and red, extending to the maximum depth investigated of 1.0 m.

#### Area 3 – Sand

The subsurface conditions encountered in this area may be generalised as comprising:

• SAND (SP), fine to medium grained, with silt in parts, loose becoming medium dense to dense with depth, orange brown to red brown, extending to the maximum depth investigated of 3.0 m.

#### Area 4 – Sand over Clayey Sand

The subsurface conditions encountered in this area may be generalised as comprising:

- SAND (SP), fine to medium grained, with silt, loose becoming medium dense to dense with depth, orange brown to grey brown, extending to depths of between about 1.5 m and 2.1 m; overlying
- Clayey SAND (SC), fine to coarse grained, about 15% to 25% low plasticity fines, dense to very dense, orange brown, orange yellow and yellow grey, containing a sand layer between 2.5 m and 3.0 m at HA31, extending to the maximum depth investigated of 3.0 m.

#### Area 5 – Silty Sand

The subsurface conditions encountered in this area may be generalised as comprising:

• Silty SAND (SP), fine to medium grained, about 10% to 20% low plasticity fines, loose becoming mediumdense to dense with depth, red brown to brown, extending to the maximum depth investigated of 2.0 m.

#### Area 6 – Silty Sand over Clay

The subsurface conditions encountered in this area may be generalised as comprising:

- SAND/Silty SAND (SP/SM), fine to medium grained, about 10% to 15% low plasticity fines, loose becoming medium dense to dense with depth, brown, extending to depths of between about 0.8 m and 1.4 m; overlying
- Clayey SAND/Sandy CLAY(SC/CL/CH), medium to high plasticity, very stiff to hard, brown, orange brownand grey, extremely weathered rock, extending to the maximum depth investigated of 2.6 m.

#### Area 7 – Shallow Rock

The subsurface conditions encountered in this area may be generalised as comprising:

- SAND/Silty SAND/Silty Gravelly SAND (SM), fine to medium grained, generally about 15% to 20% low plasticity fines, generally loose becoming medium dense to dense with depth, brown and red brown, fine to coarse gneiss gravel and cobbles, extending to depths of between about 0 m (rock outcrops) and 1.1 m; overlying
- Inferred GNEISS/GRANITE cobbles, boulders or bedrock, causing refusal at depths between 0.3 m and 1.3 m.

The soils across the Site vary in depth between 0.2 m up to 3.0 m (the maximum depth investigated). The depth to bedrock in some places across the Site is greater than 4.5 m.



#### 3.4.1 Acid sulfate soils

Acid sulfate soils (ASS) are naturally occurring, iron-sulfide rich soils, sediments or organic substrates, formed under waterlogged conditions. If exposed to air, these sulfides can oxidise and release sulfuric acid and heavy metals. This process can occur due to drainage, dewatering or excavation.

According to Planning Bulletin 64 Acid Sulfate Soils (WAPC 2009), the Site is classified as no risk of actual or potential ASS within 3 m of natural surface (Golder 2021 in Hyd2o 2021; see Figure 3.4). The closest moderate to low risk ASS site is associated with Gunyulgup Brook located approximately 200 m to the east of the Site.





### 3.5 Hydrology

#### 3.5.1 Groundwater

An overview of groundwater features of the Site taken from Hyd2o (2021) is depicted in Figure 3.5.

The Site is located within the Busselton-Capel groundwater catchment area and Cape to Cape North subarea. It is situated west of the Dunsborough Fault and within the area known as the Leeuwin Complex, which is classified as a fractured rock aquifer, where groundwater is restricted to fractures in the crystalline basement rocks (bedrock) and to thin weathered zone sand overlying surficial deposits.

Groundwater levels at the Site are also controlled by its proximity to the coast and are therefore located generally well below natural surface in permeable areas.

Groundwater was not encountered during a series of investigations completed at the Site since 2007 (Douglas Partners 2001, ATA 2007, Golders 2021 all in Hyd2o 2021).

With reference to the geology and soils across the site and the recent works by Hyd2o and Golder (2021) it is anticipated that groundwater observed in the waterhole at the Site is due to the presence of impermeable strata leading to the development of a perched water table at this location.

Hyd2o estimated, based in the 2021 investigation, that groundwater would be encountered at 3 m Australian Height Datum (AHD) at the site. This concurs with work completed by Douglas Partners and MP Rogers and Associates. It also reflects the changes in groundwater levels in relation to changes (i.e. a reduction) in rainfall across the southwest of the State over the past 20 years. Additional groundwater monitoring is currently being conducted across the Site to assess ongoing groundwater conditions and inform design response, particularly regarding wastewater management.

Results of an analysis of a sample of groundwater taken in 2021 (Hyd2o 2021) may be summarised as follows:

- pH is slightly basic (alkaline) but falls within the ANZECC guideline range of 6.5–8.0 for wetland ecosystems in south-western Australia
- the EC of 3.6 ms/cm was above the ANZECC guideline range of 0.30–1.50. This EC equates to a salinity of approximately 1800 mg/L
- TN of 6.6 mg/L was relatively high exceeding the ANZECC guideline value of 0.75 mg/L
- TP of 0.08 was above the ANZECC guideline value of 0.06 mg/L
- in relation to metals, Cadmium, Chromium, Lead, Mercury, and Nickel concentrations were all below the level of detection. Arsenic, Copper, and Zinc were below the recreational waters guideline values, and only Copper and Zinc were above the 95% target for 95% protection of freshwater species (Zinc within 90% protection level).

With respect to nutrient concentrations, TN and TP concentrations are typical of the expected water quality range in previously rural areas (ANZECC 2000).



#### Site

- Installed Bores (Name, Total drill depth)
- Manmade Waterhole
- Test Pit HA31 (Perched Water)
- Test Pits to 3m Depth without Groundwater

Note : Groundwater not encountered in any test pits. Deeper pits to 3m shown on plan as indicator of minimum groundwater depth in areas not subject to shallow perching.

0 60 120 180 240 Meters hyd<sub>2</sub>O Smiths Beach Urban Water Management Plan Groundwater Plan Figure 3.5



#### 3.5.2 Surface water

An overview of surface water features of the Site taken from Hyd2o (2021) is depicted in Figure 3.6.

The Gunyulgup Brook, a seasonally flowing stream, is located approximately 200 m to the northeast of the Site, at its closest point. The Brook flows in a north-westerly direction past the Site before meandering to the northeast and then discharging into Smiths Beach Bay (Hyd2o 2021).

A seasonal expression of groundwater is located within the Foreshore Reserve adjacent to the Site. There is evidence that this soak was previously enhanced for stock watering purposes; however, it is likely that the soak is a natural expression of groundwater flow during the wetter months.

The surface topography has been locally impacted by the construction of a farm dam circa 1962. The construction of the dam involved the excavation of the natural depression in which the dam is located to achieve an approximate depth of 1 m. The dam is set in the underlying granite bedrock and it is considered likely that the dam receives water by seepage of rainwater along the interface between soil and bedrock along with direct rainfall. No external drainage into the Site has been observed.

The catchment for the Site covers a total area of approximately 55.7 ha. 28.2 ha are located within the Site and 27.5 ha are located upstream of the Site.

Surface water (stormwater) from the adjacent Canal Rocks Apartments and Smiths Beach Resort are managed on the respective land areas through infiltration in accordance with the City of Busselton stormwater management guidelines (CoB 2021).

#### 3.5.3 Geomorphic wetlands

The Department of Biodiversity, Conservation and Attractions (DBCA) digital mapping of the southwest geomorphic wetlands determined that there are no geomorphic wetlands within the Site (Figure 3.1). The nearest mapped site is a Palusplain wetland located approximately 1 km to the east of the Site adjacent to Gunyulgup Brook (Hyd20 2021).

#### 3.5.4 Public drinking water source areas

The *Metropolitan Water Supply, Sewerage and Drainage Act 1909* (MWSSD Act) and the *Country Areas Water Supply Act 1947* (CAWS Act) identify and categorise Public Drinking Water Source Areas (PDWSAs) as catchment areas, water reserves, or underground water pollution control areas.

Regional mapping indicates that the Site is not within a PDWSA.



Date: 05/05/2021 Job No. H20045



#### 3.6 Vegetation and flora

Emerge (2019) undertook a detailed flora and vegetation survey of the Site in August 2018. More recently Strategen-JBS&G undertook a survey of the adjacent foreshore reserve. Results of these recent surveys are presented in the following subsections.

#### 3.6.1 Regional vegetation

The Site falls within the Southern Jarrah Forest IBRA subregion (JF2) (Hearn et al., 2002; Beard 1990). The vegetation of this subregion comprises jarrah-marri forest in the west grading to marri and wandoo woodlands in the east (McKenzie et al., 2002). The southeast portion of the Site contains swamp vegetation dominated by paperbarks and swamp yate (Hearn et al., 2002).

#### 3.6.2 Pre-European vegetation

Beard et al. (2013) mapping of pre-European vegetation shows the following vegetation associations within the Site:

- 'Chapman 37' over the majority of the Site, which is described as 'shrublands, teatree thicket' (Beard et al. 2013)
- 'Chapman 990' in very small areas in the eastern and western portions of the Site, which is described as 'low forest: peppermint (*Agonis flexuosa*) (Beard et al. 2013)
- 'Chapman 1180' in the south eastern and north western portions of the Site, which is described as 'shrublands, *Calothamnus quadrifidus* and *Hakea trifurcata*' (Beard et al. 2013).

'Chapman 37' has 50.38% of its pre-European extent remaining on the Southern Jarrah Forest subregion with 17.77% protected for conservation purposes (Government of Western Australia 2018). 'Chapman 990' has 77.14% of its pre-European extent remaining on the Southern Jarrah Forest subregion with 23.11% protected for conservation purposes (Government of Western Australia 2018). 'Chapman 1180' has 94.03% of its pre-European extent remaining on the Southern Jarrah Forest subregion with 76.28% protected for conservation purposes (Government of Western Australia 2018). The percentage remaining of the three regional vegetation associations mapped in the site exceeds 30%. However, less than 30% of the pre-European Chapman 37 and Chapman 990 vegetation associations are protected for conservation.

#### 3.6.3 Vegetation types

Based on work completed by Emerge (2019) and extended by Strategen-JBS&G (2021), 13 vegetation types were recorded across the Site. A description and the area of each plant community within the Site is provided in Table 3.2 and depicted in Figure 3.7.

Vegetation types	Description	Area (ha)
AfPe	Low open forest Agonis flexuosa over fernland Pteridium esculentum subsp.	8.06
	esculentum over open herbland mixed non-native species such as *Lysimachia	
	arvensis and *Asparagus asparagoides	
AhHe	Shrubland Allocasuarina humilis over low sparse herbland over low sparse	1.23
	grassland Austrostipa mollis and Rytidosperma occidentale over low open rushland	
	Hypolaena exsulca	
AsDc	Shrubland Acacia saligna and Dodonaea ceratocarpa over low herbland	3.31
	Trachymene Pilosa over low sparse grassland Rytidosperma occidentale	
AsHh	Shrubland Acacia saligna over low open shrubland Hibbertia hypericoides over	0.60
	grassland non-native species such as Vulpia bromoides	
BaMrXp	Low open forest Banksia attenuata and occasional Agonis flexuosa over open	4.13
	shrubland Macrozamia riedlei and Xanthorrhoea preissii over open mixed herbland	
CcHh	Low forest Corymbia calophylla over open shrubland Xanthorrhoea preissii and	0.67
	over low shrubland Hibbertia hypericoides over sparse low herbland Scaevola	
	calliptera	

#### Table 3.2: Vegetation types within the Site



Vegetation types	Description	Area (ha)
DciDcL	Shrubland Darwinia citriodora and Dodonaea ceratocarpa over low sedgeland	0.85
	Lepidosperma spp. over low open grassland of native and non-native species over	
	low open herbland <i>Crassula</i> spp.	
KcSg	Closed shrubland Kunzea ciliata and Spyridium globulosum over low open	8.37
	shrubland Eutaxia myrtifolia over sparse sedgeland over low sparse herbland	
KcDcPp	Low open shrubland Kunzea ciliata and Darwinia citriodora over low sparse	0.23
	herbland Stypandra glauca over low sparse grassland Poa poiformis on granite	
MhGl	Low woodland to low open forest Melaleuca huegelii, M. lanceolata and	3.80
	Guichenotia ledifolia over tall open shrubland Hakea oleifolia over shrubland	
	Hibbertia cuneiformis over low open herbland Stylidium adnatum	
MIDr	Low closed forest Melaleuca lanceolata over sparse shrubland Melaleuca systena	1.57
	and Spyridium globulosum over low open herbland Dianella revoluta var. revoluta	
	over low open sedgeland Lepidosperma spp. (understorey absent in areas of dense	
	canopy cover)	
MIKc	Closed shrubland Melaleuca lanceolata and Kunzea ciliata over occasional grasses	3.41
	and herbs	
NfCcXp	Low open forest Nuytsia floribunda and Corymbia calophylla over open shrubland	0.63
	Xanthorrhoea preissii over low open mixed herbland over low open grassland	
	native and non-native species	
Non-native	Heavily disturbed areas comprising tracks and non-native vegetation with	3.6
vegetation	occasional native plants	





#### 3.6.4 Vegetation condition

Vegetation condition within the Site was assessed by Emerge (2019) and results are depicted in Figure 3.8. Emerge (2019) determined the most intact native vegetation was in the western areas of the Site, containing vegetation types **KcDcPp**, **KcSg**, **MhGl**, **MlK**, and **MlDr**, mapped as being in an 'excellent' condition. Vegetation in the central portion of the Site contained vegetation types **AsDc**, **NfCcXp** and **AhHe**, in a 'very good' and 'very good – good' condition. Vegetation in the eastern portions of the Site including **MhGl** and **CcHh** was mapped as being in 'excellent' and 'very good' condition due to intact vegetation structure and low disturbance. The majority of vegetation within this area of the Site contained vegetation types **AfPe**, **DciDcL**, and **CcHh**, mapped in a 'very goodgood' condition. Remaining areas in the Site were mapped as being in 'completely degraded' condition and consist primarily of bare areas of ground such as tracks, as well as scattered native and non-native vegetation.

#### 3.6.5 Native flora

A total of 164 native and 50 non-native (weed) species were recorded within the Site during the Emerge (2019) field survey, representing 58 families and 145 genera. The dominant families containing native taxa were Fabaceae (22 native taxa and five weed taxa), Poaceae (11 native and 13 non-native taxa), Myrtaceae (ten native taxa) and Asteraceae (ten native and nine non-native taxa). The most common genera were Acacia (with eight taxa), Banksia and Hibbertia (with five taxa each) and Austrostipa, Rytidosperma and Stylidium (with four taxa each).

#### 3.6.6 Conservation significant flora

One priority 4 (P4) species, *Banksia sessilis var. cordata*, was recorded within the Site (Emerge 2019). A total of 210 individuals were recorded, primarily in the central and north western portions of the Site, as shown in Figure 3.9. No other threatened or priority flora species were recorded within the Site and no locally or regionally significant flora species were recorded within the Site.

### 3.6.7 Conservation significant vegetation

Emerge (2019) determined that no Threatened Ecological Communities (TECs) occur within the Site. However, the species present within vegetation type KcSg are consistent with those described as common within the 'Low shrublands on acidic grey-brown sands of the Gracetown soil-landscape system' Priority Ecological Community (PEC) P2. While the Site is not mapped as occurring within the Gracetown soil-landscape system, the soils within this Site can be described as acidic grey-brown sands and are therefore considered to be consistent with the description. Given this, the entire mapped extent of vegetation type KcSg is considered to represent the 'Low shrublands on acidic grey-brown sands of the Gracetown soil-landscape system' PEC. This PEC extends over approximately 8.37 ha of the Site, as depicted in Figure 3.10. While restricted in distribution, a significant portion of the 'low shrublands on acidic grey-brown sands' PEC is to be under formal protection as it is proposed to be transferred from private ownership to the Leeuwin Naturaliste National Park.

Furthermore, plant communities MIDr and MIKc were determined to meet the State listed 'Melaleuca lanceolata forests, Leeuwin Naturaliste Ridge' PEC (P2). This PEC extends over approximately 4.98 ha of the Site, as depicted in Figure 3.10. This PEC is considered to be relatively common in the local area (Emerge 2019).

#### 3.6.8 Ecological linkages

A regional ecological linkage (no. 86) runs through the eastern portion of the Site, connecting vegetation present within the Leeuwin-Naturaliste National Park to the northeast and south of the Site. The location of this linkage is shown in Figure 3.11. This has been a consideration during planning, noting the Smiths Beach Masterplan proposes an environmentally sensitive and landscape led design approach that prioritises the site's unique natural elements.





While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used




While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used



### 3.6.9 Introduced (exotic) taxa

A total of nine introduced (exotic) taxa were recorded within the Site during the Emerge (2019) survey, as follows:

- Briza maxima
- Euphorbia peplus
- Hypochaeris glabra
- Lagurus ovatus
- Limonium sinuatum
- Lotus subbiflorus
- Pelargonium capitatum
- Poaceae sp.
- Schinus terebinthifolia
- Tetragonia decumbens.

None of these species are Declared Plant species in Western Australia pursuant to section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM ACT) according to the Western Australian Department of Agriculture and Food (DPIRD 2021).



### 3.7 Fauna and habitat

The following subsections are based on results of the Biologic (2021) Detailed Terrestrial Vertebrate Fauna Survey report prepared for the Site.

### 3.7.1 Fauna habitat

A total of seven broad fauna habitat types were recorded and mapped across the Site (refer to Table 3.3 and Figure 3.12), comprising, in decreasing order of extent:

- Kunzea and Melaleuca Closed Shrubland (11.58 ha, 28.57% of site)
- Open Peppermint Forest (8.10 ha, 19.99% of site)
- Melaleuca over Hakea Shrubland (5.38 ha, 13.27% of site)
- Open Coastal Shrubland (5.36 ha, 13.22% of site)
- Open Banksia Forest (4.13 ha, 10.19% of site)
- Closed Low Marri Forest (1.52 ha, 3.75% of site)
- Rocky Outcrop (0.52 ha, 1.28% of site).

Approximately 3.9 ha (9.6%) of the site is Cleared or substantially disturbed so that it does not provide suitable fauna habitat.

Habitat	characteristics (Emerge 2019)	Veg Code (Emerge 2019)	Conservation Significant Species	Photo
Kunzea and Melaleuca Closed Shrubland 11.58 ha, 28.57%	Closed shrubland Kunzea ciliata and Spyridium globulosum over low open shrubland Eutaxia myrtifolia over sparse sedgeland over low sparse herbland as well as closed shrubland Melaleuca lanceolata and Kunzea ciliata over occasional grasses and herbs on a hillslope of granite outcropping	KcSg, MIKc	quenda - primary breeding, foraging and dispersal	
Open Peppermint Forest 8.1 ha, 19.99%	Low open forest Agonis flexuosa over fernland Pteridium esculentum subsp. esculentum over open herbland mixed non-native species such as Lysimachia arvensis and Asparagus asparagoides on a sandy hillslope	AfPe	western ringtail possum – primary breeding, foraging and dispersal habitat black cockatoos – secondary roosting habitat, and Baudin's - low quality foraging habitat wambenger brush- tailed phascogale - primary breeding, foraging and dispersal habitat quenda - foraging and dispersal habitat	

#### Table 3.3: Broad fauna habitats occurring within the Site



	Distinguishing habitat	Veg Code	Conservation	
Habitat	characteristics (Emerge	(Emerge	Significant Species	Photo
	2019)	2019)		
Melaleuca	Low woodland to low	MhGl, MlDr	Baudin's – primary	LV John State
over Hakea	open forest Melaleuca		foraging habitat (High	A and the second second
Shrubianu	nuegeni, M. Tunceolutu		Quality)	A CARLES A
5.50 Hd,	over tall open shruhland		forgging babitat	AND
13.2770	Hakea oleifolia over		(Quality)	
	shrubland Hibbertia		quenda - primary	
	cuneiformis over low		breeding, foraging	
	open herbland Stylidium		and dispersal	
	adnatum on a sandy		Ctenotus ora -	A A A A A A A A A A A A A A A A A A A
	midslopes. Progresses		primary breeding,	
	westward to a low		foraging and dispersal	
	closed forest Melaleuca		barking owl – primary	
	lanceolata over sparse		foraging and dispersal	
	shrubland Melaleuca			
	systend and Spyridium			
	open herbland Dignella			
	revoluta var. revoluta			
	over low open sedgeland			
	Lepidosperma spp.			
	(understorey absent in			
	areas of dense canopy			
	cove			
Open	Variable Shrubland	AsHh, AsDc,	Baudin's - low quality	
Coastal	progressing from a	NfCcXp,	foraging habitat	
Shrubland	granitic stony plain to a	AhHe	quenda - primary	
5.36 ha,	sandy plain (southward)		breeding, foraging	
13.22%	on a hillslope.		and dispersal	
	vegetation comprises		Ctenotus ora -	
	Acacia saliana over low		foraging and dispersal	and the second sec
	open shrubland			and a start appendix
	Hibbertia hypericoides			
	over grassland non-			
	native species,			
	shrubland Acacia saligna			
	and Dodonaea			
	ceratocarpa over low			
	herbland Trachymene			
	piloso over low sparse			
	grassianu kyliuusperinu			
	Allocasuarina humilis			
	over low sparse			
	herbland over low			
	sparse grassland			
	Austrostipa mollis and			
	Rytidosperma			
	occidentale over low			
	open rushland			
	Hypolaena exsulca and			
	floribunda and Commisting			
	calonhylla over opon			
	shruhland Xanthorrhoea			
	preissii over low onen			
	mixed herbland over low			
	open grassland native			
	and non-native species			



Habitat	Distinguishing habitat characteristics (Emerge 2019)	Veg Code (Emerge 2019)	Conservation Significant Species	Photo
Open Banksia Forest 4.13 ha, 10.19%	Low open forest Banksia attenuata and occasional Agonis flexuosa over open shrubland Macrozamia riedlei and Xanthorrhoea preissii over open mixed herbland on a sandy hillslope	BmMrXp	western ringtail possum – secondary breeding, foraging and dispersal habitat black cockatoos – potential breeding habitat and secondary roosting habitat Baudin's and Carnaby's primary foraging habitat (Very High and High Quality respectively) wambenger brush- tailed phascogale - primary breeding, foraging and dispersal habitat quenda - primary breeding, foraging and dispersal habitat western brush wallaby - primary breeding, foraging and dispersal habitat Ctenotus ora - primary breeding, foraging and dispersal habitat	
Closed Low Marri Forest 1.52 ha, 3.75%	Low forest Corymbia calophylla over open shrubland Xanthorrhoea preissii and over low shrubland Hibbertia hypericoides over sparse low herbland Scaevola calliptera surrounded by Shrubland Darwinia citriodora and Dodonaea ceratocarpa over low sedgeland Lepidosperma spp. over low open grassland of native and non-native species over low open herbland Crassula spp. on a sandy hillslope	CcHh, DciDcL	Western ringtail possum – secondary breeding, foraging and dispersal black cockatoos – primary foraging habitat and secondary roosting habitat wambenger brush- tailed phascogale - primary foraging and dispersal	
Rocky Outcrop 0.52 ha, 1.28%	Granite outcropping and boulders with low open shrubland <i>Kunzea ciliata</i> and <i>Darwinia citriodora</i> over low sparse herbland Stypandra glauca over low sparse grassland Poa poiformis on granite	KcDcPp		



Habitat	Distinguishing habitat characteristics (Emerge 2019)	Veg Code (Emerge 2019)	Conservation Significant Species	Photo
Cleared/ Disturbed 3.9 ha, 9.6%	No native vegetation			







Melaleuca over Hakea Shrubland

Open Banksia Forest

Open Coastal Shrubland

**Open Peppermint Forest** 

Rocky Outcrop



## **Smith's Beach Detailed** Vertebrate Fauna Survey

Figure 3.12: Fauna habitats

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### 3.7.2 Recorded fauna

A total of 78 vertebrate fauna species, comprising 15 mammal species (13 native and two introduced), 39 bird species (37 native and two introduced), 20 reptile species and four amphibian species were recorded within the Site (Biologic 2021).

### 3.7.3 Conservation significant fauna

A total of 80 species of conservation significance have the potential to occur within the Site based on results of desktop assessment, comprising 11 mammals, 65 birds and four reptiles. Furthermore, three vertebrate species of conservation significance have previously been recorded within the Site, including western ringtail possum (Critically Endangered – EPBC/BC Act), Baudin's black cockatoo (Endangered – EPBC/BC Act) and wambenger brush-tailed phascogale (Conservation Dependent – BC Act).

Six species of conservation significance were recorded within the Site during site survey (Biologic 2021). These included the following, as depicted in Figure 3.13:

- Western ringtail possum (Critically Endangered EPBC/BC Act)
- Carnaby's black cockatoo (Endangered EPBC/BC Act)
- Baudin's black cockatoo (Endangered EPBC/BC Act)
- Ctenotus ora (Priority 3 DBCA Priority List)
- Quenda (Priority 4 DBCA Priority List)
- Wambenger brush-tailed phascogale.

Additionally, a whimbrel (Migratory – EPBC/BC Act) was recorded on a shoreline approximately 40 m north of the Site.

Based on known species' distributions, previous records and the habitats present, three species were deemed Likely to occur on Site, four species were deemed Possible and 67 were considered Unlikely or Highly Unlikely to occur (refer to Table 3.4).



Melaleuca over Hakea Shrubland

**Open Banksia Forest** 

Open Coastal Shrubland

**Open Peppermint Forest** 

Rocky Outcrop

Legend

Study Area

Broad Fauna Habitats

Cleared/ Disturbed

Closed Low Marri Forest surrounded by open shrubland areas

Kunzea and Melaleuca Closed Shrubland



### STRATEGEN-JBS&G **Smiths Beach Detailed** Vertebrate Fauna Survey

Figure 3.13 Species of conservation significance recorded in the study area



### Table 3.4: Conservation significant species likelihood assessment

Constant	Conservation Status			Due forme d Due e d Heldhate	Potential Habitat Within Study	
Species	EPBC Act	BC Act	DBCA	Preferred Broad Habitats	Area	Likelihood of Occurrence
MAMMALS			•			
Brush-tailed bettong, woylie ( <i>Bettongia penicillata</i> )	EN	CR		Woodlands and adjacent heaths with a dense understorey of shrubs particularly <i>Gastrolobium</i> sp. (Woinarski <i>et al.</i> , 2014). Species confined to two indigenous colonies in south-west and a small number of reintroduced areas (Start <i>et al.</i> , 1995).	Marginal	Highly Unlikely - restricted to limited number of known populations
Western ringtail possum, Ngwayir ( <i>Pseudocheirus occidentalis</i> )	CR	CR		Coastal Agonis flexuosa forest or eucalypt woodland or forest with a midstorey of Agonis flexuosa (Burbidge & de Tores, 1998; Jones et al., 1994b)	Yes	Confirmed
Western quoll, chuditch ( <i>Dasyurus geoffroii</i> )	VU	VU		In the jarrah forest, Chuditch occur in moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest particularly in Riparian vegetation (Orell & Morris, 1994)	No	Possible
Quokka (Setonix brachyurus)	VU	VU		Habitat varies but prefer Acacia and Melaleuca thickets. In jarrah Forest associated with tea-tree, Taxandria linearifolia (de Tores, 2008a).	Yes	Unlikely - restricted to limited number of known populations
Wambenger brush-tailed phascogale (Phascogale tapoatafa wambenger)		CD		Dry sclerophyll forests and open woodlands that contain hollow- bearing trees but a sparse ground cover (Woinarski <i>et al.</i> , 2014)	Yes	Confirmed
Quenda (Isoodon fusciventer)			P4	Jarrah forest and swamp habitats, preferring dense vegetation around wetland fringes and heathland (Cooper, 1998; Woinarski <i>et al.</i> , 2014).	Yes	Confirmed
(Notamacropus irma)			24	of habitats including low Banksia	Yes	Цкеју



				woodlands, jarrah/marri		
				woodlands and moist Melaleuca		
				lowlands, favours open, grassy		
				areas (Wann & Bell, 1997:		
				Woinarski <i>et al.</i> 2014)		
Tammar wallaby			P4	Dense, low vegetation for davtime	Yes	Unlikely - restricted to limited
, (Notamacropus eugenii derbianus)				shelter and open grassy areas for		number of known populations
(				feeding. Inhabits coastal scrub.		population and a second s
				heath and dry scleronbyll forest		
				(Woinarski et al. $2014$ )		
Water rat			D4	Dermanent hadies of fresh er	Highly Marginal (disportal foraging)	Liplikoly based on Presence of
(Undromus chrusogastor)			P4	brackich water, subalaine streams	(Artificial Water Costure)	Ulinkely based on Presence of
(Hydromys chrysogaster)				brackish water, subaipine streams	(Artificial water Feature)	Highly Marginal habitat only
				to lakes and farm dams and on		Age of hearby previous records
				sheltered coastal beaches,		
				mangroves and offshore islands		
				(Van Dyck & Strahan, 2008).		
Western falsistrelle			P4	Tall forests and woodlands in the	Marginal	Possible
				higher rainfall parts of the south-		
(Falsistrellus mackenziei)				west, particularly karri forests but		
				also tuart and jarrah forests		
				(Woinarski <i>et al.,</i> 2014).		
BIRDS						
Baudin's black cockatoo	EN	EN		Species forages primarily in	Yes	Confirmed
(Calyptorhynchus baudinii)				Eucalypt forest, feeding on marri		
				nuts, flowers, nectar and seeds		
				(Johnstone & Storr, 1998b).		
				Nesting trees are karri, marri, and		
				wandoo (Johnstone & Kirkby.		
				2008b).		
Carnaby's black cockatoo	EN	EN		Occurs in semiarid eucalypt	Yes	Confirmed
(Calyptorhynchus latirostris)				woodlands, preferring wandoo		
				and Salmon Gum. Will also inhabit		
				proteaceous scrubland and heaths		
				dominated by dryandra grevillea		
				and banksia species. Prefer coastal		
				areas and banksia woodlands		
				during the non-breeding season		
				(Johnstone & Storr 1998a)		
Forest red-tailed black cockatoo	VII	VII		Inhabits humid and subhumid	Vec	Likoly
(Caluatorbynchus Banksia pasa)	vu	VO		aucolynts forests with an average	105	LINCIY
(Caryptornynchus Banksia naso)				eucarypis rorests with an average		



				of 600mm rainfall. They mainly		
				inhabit dense jarrah, karri and		
				marri forests with high rainfall.		
				Attracted to seeding Albany		
				blackbutt, blackbutt, karri,		
				Snottygobble and Sheok		
				(Johnstone & Storr, 1998a).		
Malleefowl	VU	VU		Inhabits semi-arid shrublands and	No	Highly Unlikely
(Leipoa ocellata)				low woodlands dominated by		
				mallee eucalypts and/or Acacias		
				with sandy loam soils		
				(Benshemesh, 2007).		
Grey falcon	VU	VU		Timbered lowlands, particularly	No	Highly Unlikely
(Falco hypoleucos)				Acacia shrubland and along inland		
				drainage systems. Also frequent		
				spinifex and tussock grassland		
				(Burbidge et al., 2010; Olsen &		
				Olsen, 1986)		
Peregrine falcon		OS		The species occurs along coastal	Yes	Possible
(Falco peregrinus)				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, 1998b).		
Fork-tailed swift	MI	MI		Aerial species, which forages high	Yes	Unlikely - based on age of nearby
(Apus pacificus)				above the tree canopy and rarely		previous records
				lower (Johnstone & Storr, 1998b).		
Grey wagtail	MI	MI		A rare vagrant to Western	Marginal	Highly Unlikely
(Motacilla cinerea)				Australia where it has been		
				recorded within various habitats		
				with open waterbodies (Johnstone		
				& Storr, 2004).		
Osprey	MI	MI		Occurs mainly in sheltered seas	No	Possible
(Pandion haliaetus)				around islands, tidal creeks,		
				estuaries and saltwork ponds, also		
				large river pools (Johnstone et al.,		
				2013)		
Barking Owl (southwest pop)			РЗ	The southern subspecies occurs	Yes	Likely
(Ninox connivens connivens)				primarily in dry sclerophyll		



			woodland, particularly that associated with riparian vegetation (Johnstone & Storr, 1998b).		
REPTILES			·		
Short-nosed snake (Elapognathus minor)		P2	Favours heathlands margining swamps, though also known from wet sclerophyll forests (Cogger, 2014)	No	Unlikely
Coastal plains skink ( <i>Ctenotus ora</i> )		Ρ3	Found on the Swan coastal plain inhabiting sandy coastal plains and coastal heaths with open <i>Eucalypt</i> and <i>Banksia</i> Woodland (Gaikhorst <i>et al.</i> , 2017).	Yes	Confirmed
Lined skink ( <i>Lerista lineata</i> )		Ρ3	Found in loose soil or sand, particularly in coastal heaths and low shrublands (Cogger, 2014), that provide a well-developed patchy litter ground cover (Maryan <i>et al.</i> , 2015). The majority of records are from the southern suburbs of the Perth metropolitan area on the Bassendean and Spearwood Dune systems (Maryan <i>et al.</i> , 2015),	Yes	Unlikely - based on age of nearby previous records
Dell's skink ( <i>Ctenotus delli</i> )		P4	Dry sclerophyll forest on stony hills and ranges (Cogger, 2014), but otherwise undocumented.	Yes	Unlikely - based on age of nearby previous records



### 3.7.4 Conservation significant fauna species recorded within the Site

### 3.7.4.1 Western Ringtail Possum (WRP)

During the Biologic (2021) survey, WRP was observed from a total of 49 records within the Site (Figure 3.14). Thirteen dreys (inclusive of three old dreys) were observed within the northern section of the Open Peppermint Forest (Figure 3.14). Additionally, scats were observed in 14 locations within the Open Peppermint Forest, Open Banksia Forest and Closed Low Marri Forest (Figure 3.14).

During diurnal active and targeted searches, a total of eight individuals were observed in the northern portion of the Open Peppermint Forest comprising two adults, one female with a single young and one female with two young. The female individual with a single young was observed using the same drey on two separate days.

Nocturnal searches for WRP were undertaken over the course of three days during which ten, four and six individuals were observed respectively. This equates to an estimated density of 0.5 to 1.3 possums per hectare within the search area.

Biologic (2021) determined the Site to contain primary breeding, foraging and dispersal habitat, as well as secondary foraging and dispersal habitat (Figure 3.14).

### 3.7.4.2 Carnaby's black cockatoo (CBC)

The Site lies within the non-breeding range of the species. There are 64 records of CBC within 10 km of the Site; the nearest record (observed in 2018) of the species exists approximately 1.5 km east of the Site. The database search returned 156 records of white-tailed black cockatoo within 10 km of the Site, one of which occurs within the Site (DBCA 2020b). Moreover, the species was recorded by two previous surveys within 12 km of the Site (Ecosystems Solutions 2014; NGH 2015).

The Biologic (2021) survey recorded CBC on a total of 39 occasions. Chewed Banksia, Hakea and marri nuts were recorded from 31 locations. During the survey, multiple flocks of CBC were observed, including:

- a flock of 40 individuals foraging on Hakea fruit within Melaleuca over Hakea Shrubland (VSMB-02)
- a flock of ten individuals foraging within the Open Banksia Forest
- two individuals foraging on Hakea within the Open Peppermint Forest
- a flock of 21 individuals flying over the Site.

### 3.7.4.3 Baudin's black cockatoo (BBC)

The Site lies within the known breeding distribution of the species. There are 160 records of BBC within 10 km of the Site; the nearest record (observed in 2000) of the species exists approximately 1.7 km east of the Site. The database search returned 156 records of white-tailed black cockatoo within 10 km of the Study Area, one of which occurs within the Site (DBCA 2020b). Moreover, the species was recorded by five previous surveys within 12 km of the Site (ATA 2007; BDS 2004; Ecologia 2001; Ecosystems Solutions 2014; NGH 2015), of which two previous surveys recorded the species foraging within the Site in 2001 and 2005 (ATA 2007; Ecologia 2001).

The Biologic (2021) survey recorded chewed marri nuts characteristic of BBC in four locations. Individuals were also observed flying over the Site.

#### 3.7.4.4 Wambenger brush-tailed phascogale

The species is known to occur within the Site, with 41 previous records within 10 km of the Site. The species was also recorded by How et al. (1987). While this survey was conducted in the vicinity (i.e. potentially within 12 km of the Site), locational data has not been provided and thus, distance from



the Site cannot be determined. However, the species was recorded in 2005 via nocturnal searches conducted within the Site during the previous survey (ATA 2007).

During the Biologic (2021) survey, one individual was captured (within an Elliott trap) in the Open Peppermint Forest (VSMB-01). Within the Site, the species may occur as a resident, primarily within Open Peppermint Forest and Open Banksia Forest habitat, which provides primary breeding and foraging habitat. Hollows of preferred size for the species (mean hollow entrance width of 3.9 cm and length of 7.3 cm; Rhind 1996) have the potential to occur within these habitats. Closed Low Marri Forest also provides primary foraging and dispersal habitat. The species may also move into adjacent habitats to forage and/or disperse, particularly when occurring in proximity to denning habitat (Biologic 2021).

### 3.7.4.5 Ctenotus ora

The species is known to occur within the Site, with 19 previous records within 10 km of the Site; the nearest record (observed in 2018) of the species exists approximately 185 m south of the Site. The species was recorded by two previous surveys within 12 km of the Site (Ecoscape 2012a, 2012b).

During the Biologic (2021) survey, a total of nine individuals were caught on seven occasions from two trapping sites, including:

- eight individuals from Melaleuca over Hakea Shrubland (VSMB-02) fauna habitat
- one individual from Open Coastal Shrubland (VSMB-05) fauna habitat.

Within the Site, the species may occur as a resident, primarily within Melaleuca over Hakea Shrubland, Open Coastal Shrubland and Open Banksia Forest fauna habitat, which provides primary breeding and foraging habitat (Biologic 2021).

### 3.7.4.6 Quenda

The species occurs in the local vicinity and has been recorded 73 times within 10 km of the Site. The closest record of quenda to the Site was in 2013, approximately 1.8 km east of the Site. The species was also recorded by one previous survey within 12 km of the Site (NGH 2015); and by How et al. (1987). While this survey was conducted in the vicinity (i.e. potentially within 12 km of the Study Area), locational data has not been provided and thus, distance from the Site cannot be determined.

Although the previous surveys within the Site did not record Quenda, the species was recorded on four occasions during the Biologic (2021) survey. Quenda were recorded via motion camera within the Kunzea and Melaleuca Closed Shrubland. The species was also recorded from secondary evidence (i.e. diggings) within the Melaleuca over Hakea Shrubland and Open Peppermint Woodland. The Open Banksia Forest, the Kunzea and Melaleuca Closed Shrubland, Open Coastal Shrubland and Melaleuca over Hakea Shrubland are likely to provide primary breeding, foraging and dispersal habitat for the species. Additionally, the Open Peppermint Forest provides foraging and dispersal habitat (Biologic 2021).

### 3.7.5 Conservation significant fauna species likely to occur within the Site

### 3.7.5.1 Forest red-tailed black cockatoo

There are 51 previous records of the species from within 10 km of the Site (DBCA 2020b). The nearest record of the species exists approximately 2 km east of the Site from 2012 (DBCA 2020b). However, the species was not recorded within the Site during the Biologic (2021) survey or previous surveys.

In consideration of the potentially suitable habitat present in the Site and contemporary records of the species in the near proximity, forest red-tailed black cockatoos are considered Likely to occur within the Site (Biologic 2021).



### 3.7.5.2 Western brush wallaby

The Site is within the distribution of the species, and there are eight records of the species occurring within 10 km of the Site (DBCA 2020b). Although the closest record is approximately 2.7 km northeast from 1975 (DBCA 2020b), the nearest contemporary record from 2005 exists approximately 8.3 km northeast (DBCA 2020b).

The Open Banksia Forest is considered primary breeding, foraging and dispersal habitat. In consideration of the potentially suitable habitat present within the Site and contemporary records of the species in the near proximity, western brush wallaby is considered Likely to occur within the Site (Biologic 2021).

### 3.7.5.3 Barking owl

The project area is within the distribution of the species and there are four records of the species occurring within 10 km of the project area (ALA 2020; DBCA 2020b). The closest record is approximately 8 km east from 2002 (DBCA 2020a).

The Melaleuca over Hakea Shrubland is considered primary foraging and dispersal habitat. In consideration of the potentially suitable habitat present within the Site and contemporary records of the species in the near proximity, western brush wallaby is considered Likely to occur within the Site (Biologic 2021).

### 3.7.6 Black cockatoo habitat assessment

### 3.7.6.1 Foraging habitat

The habitats of greatest foraging quality for CBC were the Open Banksia Forest and Closed Marri Forest, as well as Melaleuca over Hakea Shrubland (Biologic 2021; Figure 3.15). High quality habitats represent 11.4% (4.64 ha) and quality habitat represents 9.4% (3.8 ha) of the Site (Biologic 2021).

The habitats of greatest foraging quality for BBC were the Open Banksia Forest and Closed Marri Forest, as well as Melaleuca over Hakea Shrubland (Biologic 2021; Figure 3.16). Very High Quality habitats represent 11.4% (4.64 ha) and quality habitat represents 9.4% (3.8 ha) of the Site (Biologic 2021).

The habitat of greatest foraging quality for forest red-tailed black cockatoo was the Closed Low Marri Forest (Figure 3.17). This habitat represents 1.6% (0.66 ha) of the Site.

Evidence during the Biologic (2021) survey of CBC feeding on *Corymbia calophylla* (marri) nuts, Banksia and Hakea was observed in 31 locations within the Melaleuca over Hakea Shrubland, Open Banksia Forest, Peppermint Forest, Open Coastal Shrubland and Closed Low Marri Forest (Figure 3.15). During the survey, multiple flocks of CBC were observed foraging within the Site, including:

- a flock of 40 individuals foraging within Melaleuca over Hakea Shrubland (VSMB-02)
- a flock of ten individuals foraging within the Open Banksia Forest
- two individuals observed foraging on Hakea within the Open Peppermint Forest.

Evidence during the Biologic (2021) survey of BBC feeding on *C. calophylla* nuts was observed in four locations within the Open Banksia Forest (Figure 3.16).

Foraging evidence of forest red-tailed black cockatoo was not observed during the Biologic (2021) survey.

Due to the proximity of the adjacent Leeuwin-Naturaliste National Park, Gunyulgup Brook and numerous wetlands, it is highly likely that the surrounding region contains additional foraging habitat for black cockatoos (Biologic 2021).



### 3.7.6.2 Night roosting habitat

No evidence of black cockatoo roosting activity was recorded during the Biologic (2021) field survey. Additionally, no black cockatoos were observed at dusk. However, based on the habitat mapping conducted and the presence of recognised roosting species (i.e. marri and jarrah; DoEE 2017; Johnstone et al. 2011), stands of potential night roosting habitat were identified within the Site within the Open Peppermint Forest, Open Banksia Forest, Open Coastal Shrubland and Closed Low Marri Forest. The potential roosting habitat within the Site is considered to be low quality as it is generally limited in tall trees and foliage density (Biologic 2021).

### 3.7.6.3 Breeding habitat

The Biologic (2021) survey identified five trees within the Site that were of a suitable Diameter at Breast Height (DBH) and species (*Corymbia calophylla*) to support black cockatoo breeding. Details of tree species recorded with greater than 500 mm DBH within the Site are provided in Table 3.5, with locations depicted in Figure 3.15, Figure 3.16 and Figure 3.17 for CBC, BBC and forest red-tailed black cockatoo respectively. However, none of the trees contained suitable hollows.

Species	DBH (cm)	Height (m)	Feeding evidence	Hollow presence
Marri (Corymbia Calophylla)	74	8	No	0
Marri (Corymbia Calophylla)	53	5	No	0
Marri (Corymbia Calophylla)	51	6	No	0
Marri (Corymbia Calophylla)	65	8	No	0
Marri (Corymbia Calophylla)	60	6	No	0

### Table 3.5: Trees with 500 mm or greater DBH recorded in the Site

Although no hollows were present within the Site, nor has breeding been recorded within 12 km (Birdlife Australia 2020b), the importance of veteran and stag trees are recognized in their potential to develop hollows in the future (DoEE 2017; Johnstone et al. 2011). As such, the potential retention of these trees will be considered through detailed design.



### **Current Survey**

- △ Drey
- ▲ Drey (Old)
- Individual (alive)
- Individual (alive) dependent young on mother's back  $\land$
- Individual (alive) inside drey
- Individual (alive) mother with two dependent young
- △ Low denisty scat (Recent)

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- ▲ Low denisty scat (Very Old)
- △ Scat (Recent)
- **Previous Suvrey**
- 🗙 Drey



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Primary breeding, foraging and dispersal habitat

Secondary foraging and dispersal habitat





### STRATEGEN-JBS&G **Smith's Beach Detailed** Vertebrate Fauna Survey

Figure 3.14: Potential western ringtail possum habitat

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Secondary Evidence

Breeding Trees

Coordinate System: GDA 1994 MGA Zone 50 Projection: Transverse Mercator Datum: GDA 1994 Created 11/12/2020

### STRATEGEN-JBS&G **Smith's Beach Detailed** Vertebrate Fauna Survey

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Figure 3.15: Potential habitat for Carnaby's black cockatoo



Secondary Evidence

Breeding Trees



### STRATEGEN-JBS&G **Smith's Beach Detailed** Vertebrate Fauna Survey

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Figure 3.16: Potential habitat for Baudin's black cockatoo



Study Area

Wetland

Breeding Trees

Quality Habitat – Closed Low Marri Forest



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### STRATEGEN-JBS&G **Smith's Beach Detailed** Vertebrate Fauna Survey

Figure 3.17: Potential habitat for forest red-tailed black cockatoo



### 3.8 Conservation areas

The Site is not situated within any conservation areas. Ngari Capes Marine Park is located to the north of the Site and Leeuwin Naturaliste National Park is located to the south (Figure 3.1).

### 3.9 Contamination

The *Contaminated Sites Act 2003* (CS Act) defines contamination as having a substance present in land or water above background concentrations that presents a risk of harm to human health or the environment. The act also provides for the identification, recording, management and remediation of contaminated sites. Contamination commonly occurs through accidental leakage and spillage, or poor site management practices.

A search of the Department of Water and Environmental Regulation's (DWER) contaminated sites database (DWER 2019c) identified that no part of the Proposed Site is registered on the database under the *Contaminated Sites Act 2003*. The closest contaminated site is 10km to the north-east (Parcel ID: 68173).

### 3.10 Bushfire risk

Due to the vegetated status of the Site, it is entirely designated as bushfire prone according to the WA *Map of Bushfire Prone Areas* (DFES 2019; Figure 3.18). As a result, a Bushfire Management Plan (BMP) is being prepared to accompany the DA to address the following requirements of Policy Measure 6.5 of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7):

- a BAL assessment or BAL contour assessment clearly showing the assessed BAL rating or indicative acceptable BAL ratings across the Site, in accordance with Guideline for Planning in Bushfire Prone Areas (WAPC 2017)
- identification of any bushfire hazard issues arising from the BAL or BAL contour assessment
- assessment against the bushfire protection criteria requirements contained within the Guidelines demonstrating compliance within the boundary of the Site.

Additional requirements under the Department of Planning, Lands and Heritage (DPLH) *Position Statement: Tourism land uses in bushfire prone areas*, will also need to be addressed in relation to bushfire management planning for the vulnerable tourism land use.

### 3.11 Heritage

### 3.11.1 Aboriginal heritage

A desktop search of the Department of Planning, Lands and Heritage Aboriginal Heritage Inquiry System (AHIS) was undertaken to clarify potential Aboriginal heritage requirements (Ethnosciences 2021). The desktop search identified the following sites are located within or in close proximity to the Site (Figure 3.19):

- one Registered Site (ID 15080) is located within the northeast of the Site comprising scattered artefacts (seven locations);
- one Registered Site (ID 15081) is located adjacent west of the Site; and
- one Other Heritage Site (ID 15993) associated with Canal Rocks was mapped as overlapping the Site, however, ethnographic evidence indicates the site is not located within Lot 4131 and as such will not be impacted by the proposed development. Noting Canal Rocks is located approximately 1km south-west of the Site
- one Lodged Other Heritage Site (ID 4561) associated with Wyadup Brook, depicted as a 1x1 km polygon which touched the southern boundary of the site (the actual site is located



approximately 900 m south of the Canal Rocks Boat Ramp and therefore will not be impacted by the current development).

ID 15080 is located on a firebreak and artefacts were observed during the 2021 site visit. The Site may be a traditional camping area because of the local topography (hollow). In addition, the Cultural Working Group (CWG) indicated that additional archaeological material may be found in the area around ID 15080 including burial remains/artefacts.

A potential soak was identified by the CWG during the study field work at the junction of the existing firebreak and Smiths Beach Road towards the north of the Site (Ethnosciences 2021). It is understood that this area is to be incorporated in the Rockpool Natureplay area in the foreshore reserve.

The Other Heritage Place (ID 15993), which is associated with Canal Rocks, will not be impacted by the proposed development including the foreshore reserve. ID 15993 Canal Rocks was not identified by the CWG during the 2021 study and inspection (Ethnosciences 2021).

The 2021 study concluded that the development should be modified to avoid site ID 15080 and incorporate the potential soak into the design. In anticipation that it may not be possible to avoid potential impacts to this Aboriginal site (ID 15080), a s18 Notice for Ministerial consent has been lodged.

The foreshore area comprises areas of UCL which are subject to a native title claim. It is understood this claim is now settled and vesting to the relevant authorities is due to occur shorty.

### 3.11.2 European heritage

A search of the Government of Western Australia Heritage Council inheritance search tool determined that there are no National or Commonwealth Heritage Places listed under the *EPBC Act* within the Site.

A search of the Heritage Council of Western Australia *InHerit* database determined that there is no European heritage sites located within the Site. The closest historic State Register Place is Millbrook Farm (P429) located approximately 3.1 km away.

### 3.12 Coastal processes

The coastline within the existing and proposed foreshore reserve may be divided into two sections:

- rocky granite and granitic gneiss headland to the west and north-western boundary
- a sandy beach towards the north-eastern boundary.

As per SPP2.6, the Horizontal Shoreline Datum (HSD) is defined as the active limit of the shoreline under storm activity and should be determined against the physical features of the coast. The storm activity should be based on ocean forces and coastal processes, which have a one percent or one-in-one hundred probability of being exceeded in any given year over the planning timeframe.

MP Rogers & Associates (MRA 2021) through the Coastal Hazard Assessment have calculated the HSD for the Site by simulating the one in one hundred year storm and the extent of erosion expected at the Site. The HSD is presented in Figure 3.20 in relation to the foreshore reserve, existing development and the Proposal. A Foreshore Management Plan is being prepared to accompany the DA and has been informed by the Coastal Hazard Assessment.

### 3.13 Visual amenity

A Visual and Landscape Assessment has been completed by EPCAD (2021), which provided an evaluation of the existing visual landscape, an assessment of the anticipated visual impact of the Proposal and proposed management measures. An overview of the existing visual and landscape amenity values of the Site are discussed as follows.



The Site is situated towards the south end of a large sweeping bay extending northeast to Yallingup and Torpedo Rocks. The Smiths Beach bay lies below the primary ridge line that forms the skyline to the south. The Site is well vegetated with low granite heath dominating the western portion and headland and low woodland throughout the remainder (EPCAD 2021).

The Site and its immediate contextual landscape is a naturalistic landscape and includes the existing settlement of Smiths Beach. This comprises Smiths Beach Resort and Canal Rocks Apartments, a dense group of holiday units located adjacent the northeast boundary of the Site and the holiday units located higher on adjacent land to the east, known as Chandlers (EPCAD 2021).

The topography of the Site separates two primary areas of landscape character units. The promontory ridge and western side exhibiting wilderness like qualities and the eastern side, a naturalistic landscape forming a broadly convex landform containing existing buildings (EPCAD 2021).

Views to the Site from the southwest are all experienced within the context of a wilderness like setting with limited human infrastructure in the view. The views experienced from the northeast, generally have the great majority of the Site in view. These views commonly are within the context of the existing observed settlement but are naturalistic (EPCAD 2021).





Figure 3.18: Map of Bush Fire Prone Areas (DFES 2019)







### 4. Potential impacts, mitigation and management

### 4.1 Overview

A summary of EPA environmental factors is provided in Table 4.1, along with a brief statement of the expected significance of impact from the Proposal (if applicable) and the relevant section of this report that provides further discussion and detail on the potential impact.

Theme	Environmental factor	Environmental objective	Significance of impact
Sea	Benthic communities and habitats	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained	The Proposal is not considered to cause significant impacts to benthic communities and habitats since there will be no significant disturbance to the marine environment.
	processes	processes that shape coastal morphology so that the environmental values of the coast are protected	impacts to coastal processes in relation to the foreshore reserve, as confirmed in the Coastal Hazard Assessment (MRA 2021), through implementation of the Foreshore Management Plan (Strategen-JBS&G 2021b). Refer to Section 4.5 for additional discussion and detail.
	Marine environmental quality	To maintain the quality of water, sediment and biota so that environmental values are protected	The Proposal is not considered to cause significant impacts to marine environmental quality since there will be no significant disturbance to the marine environment.
	Marine fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained	The Proposal is not considered to cause significant impacts to marine fauna since there will be no significant disturbance to the marine environment.
Land	Flora and vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained	The Proposal will result in disturbance to native flora and vegetation; however, the potential impacts are not considered to be significant on the basis of the management measures proposed. Refer to Section 4.2 for additional discussion and detail.
	Landforms	To maintain the variety and integrity of significant physical landforms so that environmental values are protected	The Proposal is not considered to cause significant impacts to landforms since there will be no significant disturbance to the physical environment or its geology/morphology.
	Subterranean fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained	The Proposal is not considered to cause significant impacts to subterranean fauna since there will be no significant disturbance to any known stygofauna or troglofauna.
	Terrestrial environmental quality	To maintain the quality of land and soils so that environmental values are protected	The Proposal is not considered to cause significant impacts to terrestrial environmental quality since there will be no significant disturbance to soil structure or quality.
	Terrestrial fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained	The Proposal will result in disturbance to native fauna and habitats; however, the potential impacts are not considered to be significant on the basis of the management measures proposed. Refer to Section 4.3 for additional discussion and detail.
Water	Inland waters	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected	The Proposal is not considered to cause significant impacts to inland waters.
Air	Air quality	To maintain air quality and minimise emissions so that environmental values are protected	The Proposal is not considered to cause significant impacts to air quality.

Table 4.1: EPA Environmental Factors preliminary assessment



Theme	Environmental factor	Environmental objective	Significance of impact
People	Social	To protect social surroundings from	The Proposal may result in disturbance to an Aboriginal
	surroundings	significant harm	heritage site and visual amenity; however, the potential
			impacts are not considered to be significant on the basis
			of the management measures proposed. Refer to
			Sections 4.4 and 4.6 for additional discussion and detail.
	Human health	To protect human health from	The Proposal is not considered to cause significant
		significant harm	impacts to human health. Refer to Section 4.7 for
			additional discussion and detail regarding bushfire risk.

### 4.2 Vegetation and flora

### 4.2.1 Potential impacts

The following is a breakdown of the expected native vegetation clearing and modification requirements, as depicted in Figure 4.1:

- 8.17 ha of the Site (7.32 ha excluding already cleared areas) to be fully cleared for the purposes of buildings, roads and infrastructure, 2.8 ha of this area will be revegetated.
- 12.52 ha of the Site (11.14 ha excluding already cleared areas) to be partially modified/ managed to cater for modified vegetation and bushfire management. It is expected that >60% of the existing canopy cover will be retained.

The Proposal will directly impact 0.24 ha (2.87%) of the 'Low shrublands on acidic grey-brown sands of the Gracetown soil-landscape system' PEC situated in the western portion of the Site. Of this, 0.08 ha will be fully cleared, and 0.16 ha will be partially modified. This impact will be confined to the extreme north-eastern extent of the PEC, which is currently fragmented and represents a small proportion of the PEC. This impact will not cause further fragmentation, increase the potential for edge effects or reduce the viability of the PEC extent. Given this, the Proposal is not considered to significantly impact this PEC occurrence.

The Proposal will result in the clearing of vegetation representative of the Wilyabrup complex (We), described as Low woodland and woodland of *Corymbia calophylla-Eucalyptus marginata subsp. marginata* with some Banksia spp. on exposed slopes in hyperhumid to humid zones. This vegetation complex occurs along the Leeuwin-Naturaliste coasts over a large range approximately 94 km north to south. The clearing will reduce the known extent of the Wilyabrup complex by 7%, however, more broadly the complex will have 66% of its total pre-European extent remaining across its range.

The Proposal will result in the clearing of vegetation representative of the Chapman 37 Vegetation System Association (VSA), Chapman 990 VSA and the Chapman 1180 VSA. The Chapman 37 and 990 VSAs are described as an open forest or shrubland of Melaleuca and/or Agonis. These vegetation associations occur within the southwest corner of Western Australia. The clearing will reduce the known extent of the Chapman 37 VSA by 2%, with 48% of its pre-European extent remaining, while the known extent of Chapman 990 VSA will be impacted by less than 0.3 ha, with 71% of its pre-European extent remaining. The Chapman 1180 VSA is described as a Calothamnus mixed open shrubland, representative of the shrubland vegetation in the west of the site. The clearing will reduce the known extent of the Chapman 1180 VSA by 0.2%, however more broadly the complex will have 87% of its pre-European extent remaining across its range.

As identified in Figure 4.2 there are circumstances where a number of *Banksia sessilis var. cordata* (P4) individuals (up to 176) may be potentially impacted by the proposed clearing and vegetation modification extent. Site specific detailed design will aim to retain as many individuals as possible. This species is known from 30 additional populations located along the southwest and southern coast of Western Australia (DBCA 2007). Populations are located from Busselton in the north to Denmark in the south. While some impact is likely unavoidable, given the remaining locations are located in the proposed National Park extension, the large known range of the species, the number



of extant populations within this range and the representation protected throughout surrounding conservation areas, the proposed impact is not expected to be significant.

### 4.2.2 Mitigation and management

Approximately 19.85 ha of the Site (18.43 ha excluding already cleared areas) will be avoided by the Proposal and is to be fully retained, revegetated (where required) and protected in conservation areas. This represents a substantial proportion of the total Site area (49%). Importantly, this area includes the most intact vegetation in "Excellent" condition.

Of the 7.32 ha of native vegetation proposed to be cleared, 2.8 ha will be subject to revegetation, compliant to the prescribed vegetation densities detailed within the BMP. In addition, a further 1.28 ha of currently cleared areas, outside of the proposed clearing footprint, will be subject to revegetation. These areas are largely represented by existing informal tracks and fire access tracks.

The 12.52 ha subject to modification to allow for the reduction of fuel as part of bushfire risk minimisation will retain canopy cover (trees greater than 4 m in height) at varying densities but will have shrubs and understorey cover reduced as per the specification detailed within the BMP. It is anticipated that >60% of the existing canopy cover in these areas will be retained via this approach. These areas mostly occur within the Strategic Asset Protection Zone (APZ), as well as the proposed holiday home, campground and hotel areas (see Appendix C). This treatment is also required within areas of POS, creating a parkland cleared environment in which the retention of tree cover is maximised. This retention of canopy across the Site minimises the impact of the Proposal upon the ecological linkage currently present. The benefit of this retention is discussed further in Section 4.3.2.

Establishment of all low threat vegetation will be by the Proponent, with ongoing management the responsibility of the Community Corporation which will audit onsite landscaping prior to bushfire season, and conduct spots checks throughout the season. The Community Corporation will implement the BMP and BEMP for the entire precinct. Visitors and holiday homeowners will be required to comply with the management requirements and conditions of the BMP which will be enshrined within the Community bylaws.

All residual impacts to flora and vegetation within the Site will be managed through the implementation of a Construction Environmental Management Plan and development of an offset strategy to be incorporated as part of standard environmental referral to the EPA (under the EP Act) and DAWE (under the EPBC Act).

### 4.3 Fauna and habitat

### 4.3.1 Potential impacts

The following is a breakdown of expected clearing requirements within identified conservation significant fauna habitats:

- Western Ringtail Possum (refer to Figure 4.3)
  - 12.37 ha of WRP habitat, including 4.64 ha to be fully cleared and 7.74 ha to be partially modified, subject to landscape treatment and selective tree retention.
- Carnaby's black cockatoo & Baudin's black cockatoo (refer to Figure 4.4)
  - 4.41 ha of CBC & BBC foraging habitat, including 1.6 ha to be fully cleared and 2.81 ha to be partially modified, subject to landscape treatment and selective tree retention.
- Forest red-tailed black cockatoo (refer to Figure 4.5)
  - 0.14 ha of FRTBC foraging habitat, including 0.04 ha to be fully cleared and 0.10 ha to be partially modified, subject to landscape treatment and selective tree retention.



### • Wambenger brush-tailed phascogale

 12.9 ha of primary breeding and foraging habitat, including 4.6 ha to be fully cleared and 8.3 ha to be partially modified, subject to landscape treatment and selective tree retention.

### Quenda

• 10.8 ha of habitat, including 3.9 ha to be fully cleared and 6.9 ha to be partially modified, subject to landscape treatment and selective tree retention.

### 4.3.2 Mitigation and management

Approximately 18.52 ha of existing on-site fauna habitat will be avoided by proposed development and retained in open space and National Park. This represents a substantial percentage of the overall Site (45%) and comprises quality habitat for key conservation significant fauna. A breakdown of onsite fauna habitat retention is provided in Table 4.2 (by habitat type) and Table 4.3 (by conservation significant species).

#### Table 4.2: Proposed retention of on-site fauna habitat by type

Fauna habitat type	Area retained in conservation POS and National Park (ha)
Closed low marri forest surrounded by open shrubland	0.72
areas	
Kunzea and melaleuca closed shrubland	11.36
Melaleuca over hakea shrubland	5.03
Open banksia forest	0.07
Open coastal shrubland	0.24
Open peppermint forest	0.59
Rocky outcrop	0.52

#### Table 4.3: Proposed retention of on-site fauna habitat by conservation significant species

	High quality CBC/BBC habitat (ha)	Quality CBC/BBC habitat (ha)	Quality FRTBC habitat (ha)	Primary breeding, foraging and dispersal WRP habitat (ha)	Secondary foraging and dispersal WRP habitat (ha)
Conservation POS and National Park	0.58	3.45	0.52	0.59	0.77

As previously mentioned, the 12.52 ha of vegetation and fauna habitat subject to modification to allow for the reduction of fuel as part of bushfire risk minimisation will retain canopy cover (trees greater than 4 m in height) at varying densities but will have shrubs and understorey cover reduced as per the specification detailed within the BMP. This modification maintains as much as possible of the canopy present, which represents the key values of the breeding and foraging habitat present for both WRP and black cockatoos within the development footprint.

This canopy retention will also help preserve the linkage of fauna habitat across the Site from east to west. A small proportion of WRP dreys (six) and potential black cockatoo habitat trees (five) are situated within the proposed development footprint and these are expected to be fully retainable through avoidance measures incorporated into detailed development design.

In addition to ongoing management through the Community Corporation, residual impacts to fauna will be managed through the implementation of the following environmental management plans, as well as development of an offset strategy to be incorporated as part of standard environmental referral to the EPA (under the EP Act) and DAWE (under the EPBC Act):

- Construction Environmental Management Plan
- Fauna Management Plan
- Tree Retention Plan.



#### Vegetation Retention and Modification

Reduced built form density with a dispersed footprint has been integrated lightly into the landscape. This has limited the amount of permanent clearing and therefore allowed greater retention of existing vegetation (in a managed state for bushfire requirements) throughout the development.

Natural Vegetation Retained: existing vegetation that will remain untouched.

Managed Natural Vegetation: existing vegetation managed to achieve bushfire requirements, provide fauna habitat and improve visual integration.

**Permanently Cleared:** vegetation cleared for buildings and infrastructure.



LEGEND



Permanently Cleared

Figure 4.1: Vegetation retention and modification



### Legend Project area (Lot 4131) Cadastral boundary Proposed modified areas Proposed clearing Proposed buildings Proposed roads/tracks/pavement Vegetation type AfPe AhHe AsDc AsHh AsScSI BmMrXp CcHh DciDcL KcDcPp KcSg MhGl MIDr MIKc NfCcXp CL Development Footprint Roads (MRWA) Banksia sessilis var. cordata (P4) locations 0



Job No: 59550					
Client: Hesperia					
Version: A	Date: 23-Nov-2021				
Drawn By: jcrute	Checked By: CT				
Scale 1:4,000 at A3	(  )				
05	0 100				
metres					
Coord. Sys. GDA 1994 MGA Zone 50					
Lot 4131 Smiths Beach Road Yallingup WA 6282					
FIGURE 4.2					



Legend					
Project area	(Lot 4131)				
Proposed mo	Cadastral boundary     Proposed modified areas				
Proposed clearing					
Proposed buildings					
Proposed roads/tracks/pavement					
Western Ringtail Possum Habitat					
habitat	ding and foraging				
Secondary fo	oraging and				
dispersal habitat					
— Roads (MRWA)					
<ul> <li>Drey location</li> </ul>	S				
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Lot 4131 Smiths Beach Road					
rallingup WA 6282					
IMPACTS TO					
WESTERN RINGTAIL POSSUM HABITAT					

FIGURE 4.3



# Project area (Lot 4131) Cadastral boundary Proposed modified areas Proposed clearing **Proposed buildings** Proposed roads/tracks/pavement Carnaby's Black Cockatoo and Baudin's Black Cockatoo Habitat High quality habitat Quality habitat Development Footprint = Roads (MRWA) Habitat trees • Marri (Corymbia calophylla) Strategen JBS&G Job No: 59550 Client: Hesperia Date: 23-Nov-2021 Drawn By: jcrute Checked By: CT $(\uparrow)$ Scale 1:4,000 at A3 100 Coord. Sys. GDA 1994 MGA Zone 50 Lot 4131 Smiths Beach Road Yallingup WA 6282 IMPACTS TO CARNABY'S BLACK COCKATOO AND BAUDIN'S BLACK COCKATOO HABITAT

FIGURE 4.4


## Legend Project area (Lot 4131) Cadastral boundary Proposed modified areas Proposed clearing Proposed buildings Proposed roads/tracks/pavement Forest red tailed Back Cockatoo Quality habitat Development Footprint = Roads (MRWA) Habitat trees • Marri (Corymbia calophylla) Strategen JBS&G Job No: 59550 Client: Hesperia Date: 23-Nov-2021 Version: A Checked By: CT Drawn By: jcrute $(\uparrow)$ Scale 1:4,000 at A3 100 50 Coord. Sys. GDA 1994 MGA Zone 50 Lot 4131 Smiths Beach Road Yallingup WA 6282 IMPACTS TO FOREST RED TAILED BACK COCKATOO HABITAT

FIGURE 4.5



#### 4.4 Aboriginal heritage

One registered Aboriginal heritage site (Site 15080; artefacts/scatter) occurs within the northeast portion of the Site and is currently occupied by an existing track/firebreak.

Site 15080 is unable to be avoided as part of the Proposal; therefore, an application pursuant to Section 18 of the *Aboriginal Heritage Act 1972* has been submitted to ensure any potential impacts resulting from the proposed use of the land are sufficiently mitigated. Development of the Site will be in accordance with the Aboriginal Heritage Due Diligence Guidelines (DPLH 2013).

Smiths 2014 formed the CWG in 2020 with the Traditional Owners of the Wardandi community and through a series of workshops and site visits, a Cultural Strategy for the Smiths Beach Project was prepared. The strategy outlines the tangible opportunities and meaningful outcomes for Wardandi Traditional Owners, including traditional land management, employment and supply chain opportunities, cultural tourism and an overarching commitment to storytelling across the site in the form of wayfinding, site naming and immersive experiences.

Furthermore, ongoing consultation with the CWG and engagement of the group is recommended to provide monitoring during initial ground disturbance to ensure any burial or skeletal material is handled in accordance with Wardandi customs, traditions and relevant legislation. A Cultural Heritage Management Plan is to be prepared to provide a management strategy to ensure the appropriate handling of heritage artefacts should they be discovered during development.

The Registered Aboriginal Heritage site and Other Heritage site situated adjacent to the Site (Sites 15081 and 4561) will not be impacted by the Proposal.

#### 4.5 Coastal processes

A Foreshore Management Plan (FMP) has been prepared to define how the Proposal will interface with the existing Smiths Beach foreshore, including identifying opportunities to improve environmental, pedestrian movement and vehicular movement outcomes.

The objective of the FMP is to define management requirements to achieve the following:

- foreshore stability and erosion resilience
- improvement of native vegetation cover within the area of the Foreshore Reserve covered by the FMP
- enhancement of public amenity within the area of the Foreshore Reserve covered by the FMP
- improvement of pedestrian and vehicular movements
- rehabilitation of uncontrolled access areas and existing tracks in the future National Park extension.

The FMP will:

- support the planning and environmental assessment processes
- advise construction personnel, decision makers and future foreshore managers of the actions required to enhance the amenity value of the Foreshore Reserve for the community
- mitigate potential impacts to the environmental values within and surrounding the Foreshore Reserve.

Implementation of the FMP will be to the satisfaction of DBCA and the City, with timing to occur with the construction of the adjacent development.

It is intended that Smiths 2014 Pty Ltd will cede the portion of Lot 4131 that is within the Foreshore Reserve to the Crown. Once practical completion of the relevant section of the Foreshore Reserve



has been achieved, Smiths 2014 Pty Ltd will begin a five-year management program, whereby the management of the Foreshore Reserve covered by the FMP will be conducted in accordance with the objectives, targets and completion criteria outlined in the FMP.

Once the completion criteria within the FMP have been achieved, on-going management of the Foreshore Reserve not covered by the FMP will be handed over to the City of Busselton (CoB) and the DBCA. However, management portions of the Foreshore Reserve may be subject to a separate management agreement between CoB and the Community Corporation which will be subject to further discussions between the relevant parties.

#### 4.6 Visual amenity

Key objectives of the EPCAD (2021) assessment were to emphasise the natural and cultural qualities of the Site and region and conserve natural assets through adoption of the following guiding principles:

- retain the Site's natural systems and character, with a focus on the ecological and hydrological networks
- manage bushfire fuel loads through integrated cultural burning and strategic vegetation management
- regenerate all disturbed areas with naturally occurring endemic species
- enhance public space amenity with feature Western Australian species that complement the natural features of the Site.

Approximately 50% of the Site will consist of retained natural vegetation, with the remaining area comprising a combination of sensitive built form outcomes amongst partially modified vegetation that will have a proportion of canopy retention and landscaped treatments to mitigate potential impacts to visual amenity from the Proposal. A visually green outcome is the focus.

To address minimising adverse visual impacts, the approach to development is to adopt Visual Management Measures as design responses rather than to consolidate significant change to an area that would then be in contrast to the existing character. Consolidating to an area was considered to create an intrusive urban like element into all potential views and this is an outcome that could be delivered under the current Structure Plan. To address this, the Proposal has adopted landscape led site planning and design to achieve a form that can contribute to the landscape positively, creating an unobtrusive tourism facility that retains vegetation through dispersed and low density built form that utilises materials that are complementary in colour and texture to the existing landscape.

Disaggregated buildings are dispersed to allow for retention of managed vegetation and the ridgeline that forms the skyline in panoramic views is protected and form, colour and texture of buildings arranged to create a scene that respects and is equal to its setting.

#### 4.7 Bushfire risk

A Bushfire Management Plan (BMP) has been prepared to demonstrate how the Proposal intends to comply with the requirements of SPP3.7 through implementation of a bushfire risk management strategy that focusses on the following:

- various existing controls, such as planning, development and building controls, bushfire and emergency management policies and procedures, emergency forecasting and alert systems, a well maintained public road network and public education initiatives
- community bushfire refuge
- vegetation modification and management
- vehicular and pedestrian access



- water supply (including bushfire fighting supply)
- essential infrastructure, including power supply, telecommunications and site communication system, gas supply, reticulation system and sewer (wastewater services)
- bushfire building construction requirements
- bushfire emergency management, including preparedness and response actions.

Consideration has also been given to bushfire emergency management and evacuation through preparation of a Bushfire Emergency Management Plan (BEMP), which provides information to assist in planning for a bushfire emergency, as well as responding to a bushfire. The BEMP provides guidance in regard to:

- preparedness prior to and during the bushfire season to ensure the facility and the occupants are well prepared for a bushfire emergency, which is a critical element of effective emergency managements
- awareness and pre-emptive actions during the bushfire season to promote awareness of forecast high-risk bushfire conditions and enable pre-emptive actions to reduce exposure of people to this elevated risk
- actions to be undertaken during and following a bushfire emergency to provide the relevant personnel with the emergency management plan to effectively control and coordinate all occupants and liaise with relevant agencies during a bushfire emergency.

Establishment of all low threat vegetation will be by the Proponent, with ongoing management the responsibility of the Community Corporation which will audit onsite landscaping prior to bushfire season, and conduct spots checks throughout the season. The Community Corporation will implement the BMP and BEMP for the entire precinct. Visitors and holiday homeowners will be required to comply with the management requirements and conditions of the BMP which will be enshrined within the Community bylaws.

Implementation of the BMP and BEMP is expected to sufficiently mitigate the potential bushfire risk to life, property and the environment.



#### 5. Conclusion

This report has been developed as a supporting document to the proposed Development Application. Assessment of existing environmental values and potential impacts of the Proposal determined that the following environmental factors require management response:

- vegetation and flora
- fauna and habitat
- Aboriginal heritage
- coastal processes
- visual amenity
- bushfire risk.

Based on the environmental impact assessments undertaken, it is considered that any residual impacts associated with the factors identified above can be appropriately avoided, mitigated, managed or offset through the State planning process, through assessment under the EP Act/EPBC Act, through implementation of various management plans and through Section 18 under the *Aboriginal Heritage Act 1972*.



#### 6. Limitations

#### Scope of services

This report ("the report") has been prepared by Strategen-JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen-JBS&G. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

#### **Reliance on data**

In preparing the report, Strategen-JBS&G has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen-JBS&G has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen-JBS&G has also not attempted to determine whether any material matter has been omitted from the data. Strategen-JBS&G will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen-JBS&G. The making of any assumption does not imply that Strategen-JBS&G has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen-JBS&G disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

#### **Environmental conclusions**

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

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# Spring Flora and Vegetation Assessment

## Lot 4131 Smiths Beach Road, Yallingup

Project No: EP18-085(05)





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### Executive Summary

Smiths 2014 Pty Ltd engaged Emerge Associates (Emerge) to undertake a spring flora and vegetation survey within Lot 431 Smiths Beach Road in Yallingup (referred to herein as 'the site'). The site is approximately 40.53 hectares (ha) in size and is bound by Smiths Beach Road to the east and north, the Leeuwin-Naturaliste National Park to the south and unallocated crown land to the west.

Two botanists from Emerge Associates visited the site on 17 August 2018 and 26-28 November 2018 to conduct a detailed flora and vegetation survey. During the survey targeted searches were conducted for 'threatened' and 'priority' flora and an assessment was made on the type, condition and values of vegetation across the site. A regional survey was also undertaken to better understand the extent of the 'low shrublands on acidic grey-brown sands' PEC across the Leeuwin-Naturaliste Ridge.

Outcomes of the survey include the following:

- Remnant native vegetation is present across 37.97 ha of the site.
- Non-native vegetation is present across 2.56 ha of the site.
- A total of 164 native and 50 non-native (weed) species were recorded in the site.
- Approximately 210 individuals of the priority four species *banksia sessilis* var. *cordata* were recorded in the site.
- No other threatened or priority flora species were recorded within the site or are considered highly likely to occur.
- The native vegetation within the site was classified into 13 plant communities that are present in 'excellent', 'very good', 'very good to good', 'good', 'degraded' and 'completely degraded' condition.
- No threatened ecological communities (TECs) were found to occur within the site, but two State listed priority ecological communities (PECs) were recorded. The 9.25 ha of KcSg vegetation was considered to represent the 'low shrublands on acidic grey-brown sands' PEC. The 4.05 ha of plant communities MIKc and MIDr considered to represent the '*Melaleuca lanceolata* forests, Leeuwin Naturaliste Ridge' PEC. The occurrences of both PECs were located within the western portion of the site close to the coastline. All vegetation representing these PECs within the site was in excellent condition.
- The 'low shrublands on acidic grey-brown sands' PEC was found at six locations from the north-western portion of the Leeuwin-Naturaliste Ridge north of Gracetown, to just south of Yallingup.
- Native vegetation within the site is locally and regionally significant due to the fact that it provides habitat for threatened black cockatoo species and western ringtail possums.



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## Appendices

#### Appendix A

Additional Background Information

#### Appendix B

Species List

#### Appendix C

Sample Data



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## Abbreviation Tables

#### Table A1: Abbreviations – Organisations

Organisations	
EPA	Environmental Protection Authority
DBCA	Department of Biodiversity, Conservation and Attractions
DoW	Department of Water (now DWER)
DWER	Department of Water and Environmental Regulation
DPaW	Department of Parks and Wildlife (now DBCA)
WALGA	Western Australia Local Government Association

#### Table A2: Abbreviations - General terms

General terms	
ESA	Environmentally sensitive area
IBRA	Interim Biogeographic Regionalisation of Australia
NVIS	National Vegetation Inventory System (ESCAVI 2003)
P1	Priority 1
P2	Priority 2
Р3	Priority 3
P4	Priority 4
Р5	Priority 5
PEC	Priority ecological community
Т	Threatened
TEC	Threatened ecological community

#### Table A3: Abbreviations -Legislation

Legislation	
BAM Act	Biosecurity and Agriculture Management Act 2007
BC Act	Biodiversity Conservation Act 2016
EP Act	Environmental Protection Act 1986
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999

## Spring Flora and Vegetation Assessment

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#### Table A4: Abbreviations - planning

Planning terms	
LPS	Local planning scheme

#### Table A5: Abbreviations – units of measurement

Units of measurement					
cm	Centimetre				
ha	Hectare				
m	Metre				
m²	Square metre				
m AHD	m in relation to the Australian height datum				
mm	Millimetre				



### 1 Introduction

#### 1.1 Project background

Smiths 2014 Pty Ltd intends to develop part of Lot 4131 Smiths Beach Road in Yallingup for tourism purposes. This lot (referred to herein as 'the site') is located approximately 240 kilometres (km) south of the Perth Central Business District within the City of Busselton and is zoned 'tourism' under the City of Busselton *Local Planning Scheme (LPS) No. 21.* 

The site is approximately 40.53 hectares (ha) in size and is bound by Smiths Beach Road to the east and north, the Leeuwin-Naturaliste National Park to the south and unallocated crown land to the west. The location and extent of the site is shown in **Figure 1**.

#### 1.2 Purpose and scope of work

Emerge Associates (Emerge) were engaged by Smiths 2014 Pty Ltd to provide environmental consultancy services to support the development process for the site. The purpose of this survey is to provide sufficient information on the flora and vegetation values within the site to inform this process.

The scope of work was specifically to undertake a spring flora and vegetation assessment to the standard required of a detailed survey in accordance with the Environmental Protection Authority's (EPA's) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

As part of this scope of work, the following tasks were undertaken:

- Desktop review of relevant background information pertaining to the site and surrounds, including database searches for threatened flora species and ecological communities.
- Compilation of a comprehensive list of flora species recorded as part of the field survey.
- Mapping of plant communities and vegetation condition.
- Identification of conservation significant flora and vegetation.
- Regional survey for the 'low shrublands on acidic grey-brown sands' PEC.
- Documentation of the desktop assessment, survey methodology and results into a report.



## 2 Background

#### 2.1 Planning and approval context

The site has historically been subject to both Commonwealth and State environmental assessments, pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Environmental Protection Act 1986* (EP Act) respectively. These assessments were completed in response to a proposed development of the site for a range of tourism land uses including accommodation and residential lots (refer EPBC 2017/3483 and EPA assessment 1597). The proposed development was granted both State (15 June 2010) and Commonwealth (3 March 2011) environmental approval as part of these assessment processes.

#### 2.2 Environmental context

#### 2.2.1 Climate

Climate has a strong influence on the types of vegetation that grow in a region and the life cycles of the flora present. It is therefore critical for a flora and vegetation survey to respond appropriately to climatic conditions to ensure that surveys are conducted during times when flora species are easiest to detect and identify.

The south west of Western Australia experiences a Mediterranean climate of hot dry summers and cool wet winters. In Mediterranean type climates some flora species will typically spend part of their life-cycle as either underground storage organs or as seed. This is an adaptation to unfavourable environmental conditions such as excessive heat and drought that occur over the summer period. These species, known as 'geophytes' or 'annuals', tend to re-emerge during winter when favourable conditions return and are most visible during spring, which is the flowering period for a majority of plant species. Therefore, spring is the optimal time to complete flora and vegetation surveys in the south west of WA.

An average of 916.5 millimetres (mm) of rainfall is recorded annually from the Glenmore weather station, which is the closest weather station, located approximately 2.3 km south of the site. The majority of this rainfall is received between the months of May and August. Mean maximum temperatures at the Cape Naturaliste station, which is the nearest temperature recording station approximately 13.7 km north of the site, range from 16.4°C in July to 25.9°C in February, while mean minimum temperatures range from 10.1°C in August to 15.7°C in February (BoM 2018).

A total of 902.5 mm of rain was recorded from May to November 2019 (BOM 2019) indicating sufficient seasonal rainfall occurred at the site to promote the growth of flora species prior to this survey.

#### 2.2.2 Geomorphology and soils

Landform and soils influence vegetation types at regional and local scales. The site lies in the Jarrah Forest bioregion and within the Southern Jarrah Forest subregion, as defined by the *Interim Biogeographic Regionalisation of Australia* (IBRA) (Environment Australia 2000). The Southern Jarrah Forest subregion extends from Collie in the north to Yallingup in the west and Albany in the south east. This subregion comprises the southern part of the Darling Plateau, where it broadens and slopes gently to the southern coastline, being dissected by multiple rivers (Beard 1990). Generally, the soils within the Southern Jarrah Forest subregion comprise laterite gravels but clay/loam soils occur in the eastern portion where the Plateau is flatter and drainage is poor (DEC 2002). The northwestern portion of the Southern Jarrah Forest subregion comprises a combination of limestone and granites as it lies on the northern tip of the Leeuwin-Naturaliste Ridge.

The Department of Primary Industries and Regional Development (DPIRD) has compiled data from various surveys to produce a soil landscape mapping dataset for Western Australia (DPIRD 2018), which places the site within the following four soil landscapes:

- 'Wilyabrup granitic headland phase' which occurs in the western portion of the site and is described as 'areas on the west coast dominated by granitic outcrop'.
- 'Wilyabrup exposed slopes phase' which occurs in the central and north-eastern portions of the site and is described as 'low slopes (gradients generally 5-10%) exposed to strong winds off ocean'.
- 'Gracetown exposed slopes phase' which occurs in the south central portion of the site and is described as 'moderate slopes (gradients 10-15%) on the west coast exposed to prevailing wind directly off the ocean, with deep and shallow yellow brown siliceous sands over limestone (i.e. Spearwood Sands).'
- 'Wilyabrup gentle slope phase' which occurs in the south-eastern portion of the site and is described as 'gradients 5-10%'.

The site occurs on the Leeuwin-Naturaliste Ridge, which is a unique geological feature approximately 93 km in length, between Cape Naturaliste in the north and Cape Leeuwin in the south.

#### 2.2.3 Topography

The elevation of the site ranges from 55 m in relation to the Australian height datum (mAHD) on the central southern side of the site to 5 mAHD on the north western side of the site (WALIA 2019).

#### 2.2.4 Hydrology and wetlands

Wetlands include "areas of seasonally, intermittently or permanently waterlogged soils or inundated land, whether natural or otherwise, fresh and saline, e.g. waterlogged soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and their tributaries" (Wetlands Advisory Committee 1977). Wetlands can further be recognised by the presence of vegetation associated with waterlogging or the presence of hydric soils such as peat, peaty sand or carbonate mud (Hill *et al.* 1996).

Wetlands of national or international significance may be afforded special protection under Commonwealth or international agreements. The following lists of important wetlands were checked as part of this assessment:

- Ramsar List of Wetlands of International Importance (DBCA 2017d)
- A Directory of Important Wetlands in Australia (DBCA 2018).

No Ramsar or listed 'important wetlands' are located within or near the site.

Examination of the Department of Water and Environmental Regulation (DWER) hydrography dataset (DWER 2018) shows that no wetland or water related features occur in the site.

#### 2.2.5 Regional vegetation

Native vegetation is described and mapped at different scales in order to illustrate patterns of distribution due to a variety of factors such as climate, geomorphology, soils and topography. The south-west of Western Australia is internationally recognised as a biodiversity hotspot and contains a wide variety of endemic flora and vegetation types. The Southern Jarrah Forest IBRA subregion is characterised as mainly containing *Eucalyptus marginata* (jarrah) forest on lateritic soils of the Plateau and on the loam soils of the valleys, with *Corymbia calophylla* (marri) – *Eucalyptus wandoo* (wandoo) woodland on the drier laterite-free soils (Beard 1990).

Beard *et al.* (2013) mapping of pre-European vegetation shows the following vegetation associations in the site:

- 'Chapman 37' over the majority of the site, which is described as 'shrublands, teatree thicket' (Beard *et al.* 2013)
- 'Chapman 990' in very small areas in the eastern and western portions of the site, which is described as 'low forest: peppermint (Agonis flexuosa)' (Beard *et al.* 2013)
- 'Chapman 1180' in the south eastern and north western portions of the site, which is described as 'shrublands, *Calothamnus quadrifidus* and *Hakea trifurcata'* (Beard *et al.* 2013)

The extent of vegetation associations as assigned by Beard *et al.* (2013) within the site is shown in **Plate 1** 



*Plate 1: Regional vegetation association mapping showing the three different vegetation associations within the site (Beard et al. 2013).* 

'Chapman 37' has 50.38% of its pre-European extent remaining on the Southern Jarrah Forest subregion with 17.77% protected for conservation purposes (Government of Western Australia 2018). 'Chapman 990' has 77.14% of its pre-European extent remaining on the Southern Jarrah Forest subregion with 23.11% protected for conservation purposes (Government of Western Australia 2018). 'Chapman 1180' has 94.03% of its pre-European extent remaining on the Southern Jarrah Forest subregion with 76.28% protected for conservation purposes (Government of Western Australia 2018).

Studies have indicated that the loss of biodiversity caused by habitat fragmentation is significantly greater once a habitat type falls below 30% of its original extent (Miles 2001). The national objectives and targets for biodiversity conservation (Environment Australia 2001) established an objective of retaining 30% of the original extent of each vegetation complex. The percentage remaining of the three regional vegetation associations mapped in the site exceeds 30%. However, less than 30% of the pre-European Chapman 37 and Chapman 990 vegetation associations are protected for conservation.

#### 2.2.6 Historic land use

Review of historical images available from 1996 (WALIA 2019) onwards shows that the site supported intact native vegetation from 1996 to 2019. Some disturbance in the form of vegetation clearing (less dense vegetation) is visible in the central and north eastern portions of the site in imagery from 2001, and has appeared to regenerate in the intervening period. New tracks are visible within the eastern portion of the site in imagery from 2018.



#### 2.3 Significant flora and vegetation

#### 2.3.1 Threatened and priority flora

Certain flora taxa that are considered to be rare or under threat warrant special protection under Commonwealth and/or State legislation. At a Commonwealth level, flora taxa may be listed as 'threatened' pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any action likely to have a significant impact on species listed under the EPBC Act requires approval from the Commonwealth Minister for the Environment and Energy.

In Western Australia flora species may also be classed as 'threatened' under the *Biodiversity Conservation Act 2016* (BC Act). Threatened flora species are listed under sections 19(1) and 26(2) of the BC Act. It is an offence to 'take' or disturb threatened flora without Ministerial approval. Threatened flora listed under the EPBC Act and/or BC Act are further categorised as 'critically endangered', 'endangered' or 'vulnerable' depending on their level of threat.

Flora species that do not currently meet the criteria for listing as threatened but are potentially rare or threatened may be added to the DBCA's *Priority Flora List*. These species are classified into 'priority' levels based on level of threat. Whilst priority species are not under direct statutory protection, they are considered during State approval processes.

Further information on threatened and priority species and their categories is provided in **Appendix A**.

A search was conducted for threatened and priority flora within a 10 km radius of the site using the *Protected Matters Search Tool* (DoEE 2019a), *NatureMap* (DPaW 2019) and DBCA's threatened and priority flora database (reference no. 27-1218FL). A total of 17 threatened and 16 priority flora species were identified as potentially occurring in the wider local area as listed in **Table 1**. None of the recorded locations are present within the site.

Of the flora species potentially occurring in the local area, only those with habitat preferences of granitic, limestone or sandy coastal soils were deemed likely to occur in the site. On this basis 11 threatened flora species and nine priority flora species were identified as having potential to occur within the site (shaded green in **Table 1**).



Table 1: Significant flora species known or likely to occur within 10 km of the site (species considered to be potentially present within the site shaded green).

Creation	Level of significance		Life	11-1-1	Flowering	Likelihood of
Species	State	EPBC Act	strategy	Πασιτάτ	period	occurrence
Brachyscias verecundus	Т	CE	А	Granite outcrops.	Dec	Possible
Gastrolobium argyrotrichum	т	CE	Ρ	Granite rocks, slopes	Oct-Nov	Possible
Banksia nivea subsp. uliginosa	т	E	Ρ	Sandy clay, gravel.	Aug-Sep	Possible
Caladenia busselliana	т	E	PG	Sandy loam and winter-wet swamps.	Sep-Oct	Unlikely
Caladenia caesarea subsp. maritima	т	E	PG	Loam, granite and rock outcrops.	Aug-Sep	Possible
Caladenia excelsa	т	E	PG	White, grey or brown sand, sandy loam.	Sep-Oct	Possible
Caladenia huegelii	т	E	PG	Well-drained, deep sandy soils in lush undergrowth in a variety of moisture levels.	Sep-early Nov	Possible
Drakaea elastica	т	E	PG	Bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter- wet swamps.	Sep-Oct	Unlikely
Eucalyptus x phylacis	т	E	Р	Laterite, loam over granite in coastal area	May	Possible
Gastrolobium papilio	т	E	Ρ	Sandy clay over ironstone and laterite. Flat plains.	Oct-Dec	Unlikely
Lambertia echinata subsp. occidentalis	т	E	Ρ	White sandy soils over laterite, orange/brown-red clay over ironstone. Flats to foothills, winter-wet sites.	Feb or Apr or Dec	Unlikely
Petrophile latericola	т	E	Р	Red lateritic clay. Winter-wet flats.	Nov	Unlikely
Sphenotoma drummondii	т	E	Р	Stony or shallow soils over granite or quartzite.	Sep-Dec	Possible
Wurmbea calcicola	т	E	Р	Coastal limestone cliffs.	Jun	Possible
Banksia squarrosa subsp. argillacea	т	v	Р	White/grey sand, gravelly clay or loam.	Jun-Nov	Possible
<i>Chamelaucium</i> sp. S coastal plain (R.D. Royce 4872)	т	V	Р	Flat. Well drained, grey sandy loam.	Jul-Nov	Possible
Drakaea micrantha	т	v	PG	Open sandy patches often adjacent to winter-wet swamps.	Sep-early Oct	Unlikely



<b>6</b>	Level of significance		Life		Flowering	Likelihood of
Species	State	EPBC Act	strategy	Habitat	period	occurrence
Caladenia nivalis	P2	-	PG	Sand, loam, granite and coastal granite.	Sep-Oct	Possible
Caladenia viridescens	P2	-	PG	Loam, grey sand.	Sep-Oct	Possible
<i>Hydrocotyle</i> sp. Hamelinensis (G.J. Keighery s.n. PERTH 02391325)	P2	-	А	Brown and grey sand. Dunes and limestone ridges.	Jul-Oct	Possible
Acacia inops	Р3		Р	Black peaty sand, clay. Swamps, creeks.	Sep-early Nov	Unlikely
Acacia lateriticola var. Glabrous variant (B.R.Maslin 6765)	P3		Р	Lateritic soils	Aug or Oct	Unlikely
Boronia capitata subsp. gracilis	Р3	-	Р	White/grey or black sand in winter-wet swamps, hillslopes.	Jun-Nov	Unlikely
Cyathochaeta teretifolia	Р3	-	Р	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan	Unlikely
Johnsonia inconspicua	Р3	-	Р	White-grey or black sand. Low dunes, winter-wet flats	Oct-Nov	Unlikely
Pultenaea pinifolia	Р3	-	Р	Loam or clay. Floodplains, swampy areas.	Oct-Nov	Unlikely
Stylidium lowrieanum	P3	-	Р	Sand or sandy loam over limestone. Eucalypt or Agonis woodland, forest, scrub.	Oct-Nov	Possible
Tetratheca parvifolia	P3	-	Ρ	Dry, brown or grey sand over rocky outcrops of granite or laterite.	Oct	Possible
Banksia sessilis var. cordata	P4	-	Р	White/grey sand. Coastal limestone.	Jul-Oct	Possible
Boronia tenuis	P4	-	Р	Laterite, stony soils, granite.	Aug-Nov	Possible
Eucalyptus rudis subsp. cratyantha	P4	-	Р	Loam on flats and hillsides.	Jul-Sep	Possible
Gahnia sclerioides	P4	-	Р	Loam, sandy soils. Moist shaded situations	Unknown	Unlikely
Thysanotus isantherus	P4		Р	Hillsides, sand over granite.	Nov-Dec	Possible

Table 1: Significant flora species known or likely to occur within 10 km of the site (cont.)

Note: T=threatened, CE=critically endangered, E=endangered, V=vulnerable, P1=Priority 1, P2=Priority 2, P3=Priority 3, P4=Priority 4, P=perennial, PG=perennial geophyte, A=annual.

#### 2.3.2 Threatened and priority ecological communities

An ecological community is a naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat. An ecological community's structure, composition and distribution are influenced by environmental factors such as soil type, position in the landscape, altitude, climate and water availability (DoEE 2019b).

'Threatened ecological communities' (TECs) are ecological communities that are recognised as rare or under threat and therefore warrant special protection. Selected TECs are afforded statutory protection at a Commonwealth level under section 181 of the EPBC Act. Any action likely to have a significant impact on a community listed under the EPBC Act requires approval from the Commonwealth Minister for the Environment and Energy.

TECs are also listed within Western Australia under Section 27(1) and 33 of the BC Act and under the Biodiversity Conservation Regulations (BC Regulations). Their conservation significance is also acknowledged through other state environmental approval processes such as 'environmental impact assessment' pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. A plant community that is under consideration for listing as a TEC in Western Australia, but does not yet meet survey criteria or has not been adequately defined, may be listed as a 'priority ecological community' (PEC). Listing as a PEC is similarly considered during State approval processes. Further information on categories of TECs and PECs is provided in **Appendix A**.

Known locations of TECs and PECs within the Leeuwin-Naturaliste Ridge area were searched for using DBCA's threatened and priority ecological communities' database (reference no. 3-01218EC). A larger search area (20 km radius from the site) was used due to the low number of surveys undertaken within the immediate vicinity of the site. The publicly available *Protected Matters Search Tool* (DoEE 2019a) was also searched for known and likely TECs and PECs, also using a 20 km radius from the site. The search results indicated that no TECs or PECs are recorded within the site, but that 11 TECs and 12 PECs occur within 10 km of the site as listed in **Table 2**. Note that some of the communities in **Table 2** occur on the adjacent Swan Coastal Plain and would not occur in the site. Five communities (shaded green in **Table 2**) are considered to have potential to occur in the site based on geomorphology, soils and regional vegetation patterns including:

- 'Calothamnus graniticus heaths on south west coastal granites' TEC (vulnerable in WA)
- 'granite community dominated by the shrubs Calothamnus graniticus subsp. graniticus, Acacia cyclops, A. saligna, Hakea oleifolia, H. prostrata and Jacksonia furcellata (Sugar Loaf Rock)' PEC (P1)
- 'tall closed sedgeland on shallow soils derived from granite gneiss on the Leeuwin Naturaliste Ridge' PEC (P1)
- 'low shrublands on acidic grey-brown sands of the Gracetown soil-landscape system' PEC (P2)
- 'Melaleuca lanceolata forests, Leeuwin Naturaliste Ridge' PEC (P2)<sup>1</sup>.

<sup>&</sup>lt;sup>1</sup> The '*Melaleuca lanceolata* forests, Leeuwin Naturaliste Ridge' PEC was previously recorded within the site (ATA Environmental 2007a).



Table 2: TECs and PECs known or likely to occur within the region (communities considered to be potentially present within the site shaded green).

Code	Community name	TEC/ PEC	Level of significance	
			State	EPBC Act
SCP09	Dense shrublands on clay flats	TEC	Vulnerable	Critically Endangered (clay pans of the Swan Coastal Plain)
CAVES LEEUWIN01	Aquatic Root Mat Community Number 1 of Caves of the Leeuwin Naturaliste Ridge	TEC	Critically Endangered	Endangered
CAVES LEEUWIN02	Aquatic Root Mat Community Number 2 of Caves of the Leeuwin Naturaliste Ridge	TEC	Critically Endangered	Endangered
CAVES LEEUWIN03	Aquatic Root Mat Community Number 3 of Caves of the Leeuwin Naturaliste Ridge	TEC	Critically Endangered	Endangered
CAVES LEEUWIN04	Aquatic Root Mat Community Number 4 of Caves of the Leeuwin Naturaliste Ridge	TEC	Critically Endangered	Endangered
SCP10b	Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)	TEC	Critically Endangered	Endangered
Banksia WL SCP	Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region	TEC/ PEC	Priority 3	Endangered (Banksia Woodlands of the Swan Coastal Plain)
SCP21b	Southern Banksia attenuata woodlands	TEC/ PEC	Priority 3	
Whicher Scarp B2	West Whicher Scarp <i>Banksia attenuata</i> woodland (Swan Coastal Plain centred woodlands of grey/white sands community B2)	TEC/ PEC	Priority 1	
Coastal Saltmarsh	Subtropical and Temperate Coastal Saltmarsh	TEC/ PEC	Priority 3	Vulnerable
Augusta-microbial	Rimstone Pools and Cave Structures Formed by Microbial Activity on Marine Shorelines	TEC	Endangered	-
MEELUP GRANITES	Calothamnus graniticus heaths on south west coastal granites	TEC	Vulnerable	-
SCP3b	Corymbia calophylla - Eucalyptus marginata woodlands on sandy clay soils of the southern Swan Coastal Plain	PEC	Vulnerable	-
SCP1b	Corymbia calophylla woodlands on heavy soils of the southern Swan Coastal Plain	PEC	Vulnerable	-
Dunsborough Forest Swamp	Corymbia calophylla, Melaleuca rhaphiophylla, Banksia littoralis, Eucalyptus rudis, Agonis flexuosa low open forest with seasonal subsoil moisture (Dunsborough area)	PEC	Priority 1	-
Sugar Loaf Granites	Granite community dominated by the shrubs Calothamnus graniticus subsp. graniticus, Acacia cyclops, A. saligna, Hakea oleifolia, H. prostrata and Jacksonia furcellata (Sugar Loaf Rock)	PEC	Priority 1	-



Code	Community name	TEC/ PEC	Level of significance	
			State	EPBC Act
Reedia swamps - Blackwood Plateau	Reedia spathacea - Empodisma gracillimum - Sporadanthus rivularis dominated floodplains and paluslopes of the Blackwood Plateau	PEC	Priority 1	-
Whicher Scarp G2	Shrublands of near permanent wetlands in creeklines of the Whicher Scarp (Whicher Scarp community G2)	PEC	Priority 1	-
Whicher Scarp Paluslope Wetlands	Swan Coastal Plain Paluslope Wetlands	PEC	Priority 1	-
Sedgelands of Cape Leeuwin Spring	Tall closed sedgeland on shallow soils derived from granite gneiss on the Leeuwin Naturaliste Ridge ('Sedgelands of the Cape Leeuwin Spring')	PEC	Priority 1	-
Low shrublands (Gracetown)	Low shrublands on acidic grey-brown sands of the Gracetown soil-landscape system	PEC	Priority 2	-
Melaleuca lanceolata forests	<i>Melaleuca lanceolata</i> forests, Leeuwin Naturaliste Ridge	PEC	Priority 2	-

Table 2: TECs and PECs known or likely to occur within the region (cont.)

#### 2.3.3 Local and regional significance

Flora species and ecological communities may be significant for a number of reasons irrespective of whether they have special protection under policy or legislation.

Two key reasons that vegetation within the site may be significant are listed below:

- The site is in close proximity to the Leeuwin-Naturaliste National Park.
- Vegetation within the site and the wider area is identified as habitat for threatened and priority fauna species including, western ringtail possum (critically endangered), Carnaby's cockatoo (endangered), Baudin's cockatoo (endangered) and forest red-tailed black cockatoo (vulnerable) (ATA Environmental 2007b).

#### 2.3.4 Weeds

The term 'weed' can refer to any plant that requires some form of action to reduce its effect on the economy, the environment, human health and amenity. Many non-native flora species and some native species are considered to be weeds.

A particularly invasive or detrimental weed species may be listed as a 'declared pest' pursuant to the Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act), indicating that it warrants special management to limit its spread. At a national level, the Australian government has compiled a list of 32 Weeds of National Significance (WoNS) (DoEE 2018), of which many are also listed under the BAM Act. Further information on categories of declared pests is provided in **Appendix A.** 

Due to historical disturbance some weed species are expected to be present at the site (DoEE 2019c).

#### 2.4 Land use planning considerations

A range of legislation, regulations and polices are relevant to the evaluation of vegetation in Western Australia. Key considerations applicable to the site are described below and also shown in **Figure 2**.

#### 2.4.1 DBCA managed or legislated lands

DBCA has tenure of or interests in numerous areas of land across the state for a range of purposes. Tenure categories include 'national parks', 'nature reserves', 'conservation parks', 'marine parks', 'marine nature reserves', 'marine management areas', 'section 5(1)(g) reserves', 'state forest' and 'timber reserves'. These areas are mapped within the *Legislated Lands and Waters* (DBCA 2017a) and *Lands of Interest* (DBCA 2017b) datasets. The *Legislated Lands and Waters* (DBCA 2017a) dataset includes lands subject to the following legislation; the *Conservation and Land Management Act 1984* (CALM Act 1984), *Swan and Canning Rivers Management Act 2006* (SCRM Act) and lands identified under the *Land Administration Act 1997* (LA Act). The *Lands of Interest* (DBCA 2017b) dataset includes all other lands of which DBCA is recognised as the manager but is not vested under any act. These lands comprise of Crown land and freehold land which DBCA has been acknowledged by the Department of Planning, Lands and Heritage (DPLH) as the responsible agency.

The site is freehold and therefore not managed by DBCA. A large National Park (R 8428), referred to as 'Leeuwin-Naturaliste National Park', lies to the south of the site (DBCA 2017a). A narrow linear portion of land described in Landgate's cadastre as 'road isolation' lies to the south of the site and separates the site from the National Park. The Leeuwin-Naturaliste National Park also occurs approximately 240 m north east of the site and extends to the north. The extent of the Leeuwin-Naturaliste National Park close to the site is shown on **Figure 2**.

#### 2.4.2 Environmentally sensitive areas

'Environmentally sensitive areas' (ESAs) are prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and have been identified to protect native vegetation values of areas surrounding significant, threatened or scheduled flora, vegetation communities or ecosystems. Within an ESA none of the exemptions under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* apply. However, exemptions under Schedule 6 of the EP Act still apply, including any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* (a recognised exemption under the Schedule 6 of the EP Act).

No ESAs occur in the site. One large ESA occurs directly around the northern and western boundaries of the site and close to the southern boundary and appears to be associated with the Leeuwin-Naturaliste National Park. The location of this ESA is shown in **Figure 2**.



#### 2.4.3 Ecological linkages

Ecological linkages are linear landscape elements that allow the movement of fauna, flora and genetic material between areas of remnant habitat. The movement of fauna and the exchange of genetic material between vegetation remnants improve the viability of those remnants by allowing greater access to breeding partners and food sources, refuge from disturbances such as fire and maintenance of genetic diversity of plant communities and populations. Ecological linkages are ideally continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

The Perth Biodiversity Project, supported by the Western Australia Local Government Association (WALGA), have identified and mapped regional ecological linkages within the Perth Metropolitan Region (WALGA and PBP 2004). This study was extended beyond the Perth Metropolitan Region through the South West Biodiversity Project, resulting in the identification and mapping of the South West regional ecological linkages (Molloy *et al.* 2009). The regional ecological linkages are axis lines that assist in recognising the spatial relationship between patches of remnant vegetation when planning and managing biodiversity at both patch and landscape scales (Molloy *et al.* 2009).

A regional ecological linkage (no. 86) runs through the eastern portion of the site, connecting vegetation present within the Leeuwin-Naturaliste National Park to the north east and south of the site. The location of this linkage is shown in **Figure 2**.

#### 2.5 Previous flora surveys

Multiple flora and vegetation surveys have been previously undertaken within the site, including:

- Keating and Trudgen (1986) undertook a flora and vegetation survey of a wider region including the site, and mapped three native plant communities in the site.
- Maunsell & Partners (1987) described the vegetation but no quadrat data was collected.
- Bennett Environmental Consulting (2001) undertook a vegetation survey and mapped five native plant communities in the site.
- ATA Environmental undertook multiple flora and vegetation surveys of the site between 2003 and 2006, with the results combined in one report (ATA Environmental 2007a). A total of 179 plant species were recorded in the site, of which 146 are native. No threatened flora were recorded in the site. Seventy-five individuals of the priority flora species *Banksia sessilis* var. *cordata* (P4) were recorded. No other priority flora species were recorded. A total of 17 vegetation associations were mapped in the site. ATA Environmental (2007a) identified the '*Melaleuca lanceolata* forests on the Leeuwin Naturaliste Ridge' PEC (P2) as occurring in the site.



## 3 Methods

A detailed survey of the site was conducted during spring to describe the flora and vegetation, as described in **Section 3.1**. A subsequent regional survey was undertaken within the region to identify occurrences of PEC/s of interest in order to determine the regional context of the vegetation in the site, as described in **Section 3.2**.

#### 3.1 Site survey

#### 3.1.1 Field survey

An initial reconnaissance survey was undertaken by a botanist and an environmental consultant on 17 August 2018. Subsequently, two botanists from Emerge visited the site over three days (26-28 November 2018) to conduct the spring flora and vegetation assessment.

#### 3.1.2 Flora

The site was traversed on foot and searches were conducted for threatened and priority flora species with potential to occur in the site, with a particular focus on identifying areas of suitable habitat. The location of threatened or priority flora individuals or populations were recorded with a hand-held GPS unit.

#### 3.1.3 Vegetation

The site was traversed on foot and the composition and condition of vegetation was recorded.

Detailed sampling of the vegetation was undertaken using a combination of non-permanent 10 x 10 m quadrats and relevés. The quadrats were established using fence droppers bound by measuring tape. The relevés were completed over an equivalent 10 x 10 m area without the use of physical markers and were included to provide a more rapid sample of patches of vegetation in poorer condition and/or of smaller size.

A total of 37 locations were sampled, comprised of 34 quadrats and three relevés. The position of each sample location was recorded with a hand-held GPS unit, as shown in **Figure 3**.

The data recorded within each sample included:

- site details (site name, site number, observers, date, location)
- environmental information (slope, aspect, bare-ground, rock outcropping soil type and colour class, litter layer, topographical position, time since last fire event)
- biological information (vegetation structure and condition, degree of disturbance and species present).

The species percentage 'foliage projective cover' (FPC) was also recorded within each quadrat. Additional plant taxa not observed within samples were recorded opportunistically as the botanists traversed the site. Photographs were taken throughout the field visit to show particular site conditions.



All plant specimens collected during the field survey were dried, pressed and then named in accordance with requirements of the Western Australian Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys. Flora species not native to Western Australia are denoted by an asterisk ('\*') in text and raw data.

Vegetation condition was assigned at each sample and changes in vegetation condition were also noted and mapped across the site. The condition of the vegetation was assessed using the Keighery (1994) scale, as shown in **Table 3**.

Condition category	Definition (Keighery 1994)
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very good	Vegetation structure altered obvious signs of disturbance. For example, 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. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, 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. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, 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 or shrubs.

Table 3: Vegetation condition scale applied during the field assessment

#### 3.2 Regional PEC survey

#### 3.2.1 Rationale and desktop assessment

The DBCA threatened and priority ecological communities' database search results indicated that there are a few known occurrences of certain PECs in the area, as detailed in **Section 2.3.2**. In particular, the 'low shrublands on acidic grey-brown sands of the Gracetown soil-landscape system' PEC (P2) (hereafter referred to as the 'low shrublands on acidic grey-brown sands' PEC), which was recorded during the site survey (refer **Section 4.1.4**), was only represented by one occurrence in Gracetown. Due to the lack of information available for this PEC, a regional PEC survey was required to identify other occurrences of the PEC in the local area.

DBCA have published vegetation complex mapping of the south west forest region which comprises multiple datasets including mapping undertaken by Havel and Mattiske (1998) for the *Regional Forest Agreement* (RFA) (DBCA 2019). This mapping is an alternative to the regional vegetation mapping Beard *et al.* (2013) outlined in **Section 2.2.5** that is more useful for identifying potential areas of this PEC as it is based on units that better align to the PEC description. The DBCA (2019) vegetation complexes mapped in the site are shown in **Plate 2**.





*Plate 2: Regional vegetation complex mapping showing the three different vegetation complexes within the site (DBCA 2019).* 

A desktop assessment was undertaken to determine survey locations that may support the 'low shrublands on acidic grey-brown sands' PEC. Attributes used to determine the survey locations included the following:

- The location of the existing Gracetown occurrence of the 'low shrublands on acidic grey-brown sands' PEC.
- The intersection of the existing Gracetown occurrence of the PEC and the PEC within the site with vegetation and soil mapping including:
  - 'Wilyabrup granitic headland Phase' soil landscape mapping unit in which the Gracetown PEC occurrence and the PEC in the site occur
  - 'Gracetown exposed slopes Phase' soil landscape mapping unit in which the Gracetown PEC occurrence occurs
  - 'Wilyabrup exposed slopes Phase' soil landscape mapping unit in which the PEC in the site occurs
  - 'Wilyabrup, We' vegetation complex in (DBCA 2019) which the PEC in the site occurs
  - 'Wilyabrup, WE' or 'Gracetown, GE' vegetation complex in (DBCA 2019) within which the Gracetown PEC occurrence occurs.
- *Kunzea ciliata* records from Florabase (Western Australian Herbarium 1998–2019), which is a dominant species in the PEC occurrence in the site.
- The public accessibility of land parcels.

A total of 22 survey locations were chosen, including the DBCA Gracetown PEC occurrence. The sites lie between Yallingup in the north and Boranup in the south, as shown in **Figure 4**.
#### 3.2.2 Field survey

Two botanists from Emerge surveyed the 22 survey locations on the 24 February 2019. Each location was traversed on foot and an assessment was made as to whether the vegetation was considered likely to represent the 'low shrublands on acidic-brown sands' PEC. Attributes recorded during the assessment included:

- soil type
- type of rock (if present)
- vegetation structure
- flora species composition.

## 3.3 Mapping and data analysis

#### 3.3.1 Plant community identification and description

The local plant communities within the site were identified from the sample data collected during the field survey. A cluster analysis was performed by converting the FPC for each species in each sample to a Domin value (Kent and Coker 1994). Classification into communities was undertaken using hierarchical clustering within the analysis package PRIMER v6 (Clarke and Gorley 2006), with groups defined using the Bray-Curtis distance measure and further refined using a similarity probability measure (significance level of 0.05).

Once a group was defined from the cluster analysis, the vegetation was described according to the dominant species present using the structural formation descriptions of the *National Vegetation Inventory System* (NVIS) (ESCAVI 2003). The identified plant communities were then mapped on aerial photography (1:6,000) from the sample locations and boundaries were interpreted from aerial photography and notes taken in the field. Vegetation condition was mapped on aerial photography (1:6,000) based on the locations and notes recorded during the field survey to define areas with differing condition.

#### 3.3.2 Threatened and priority ecological communities

No published diagnostic characteristics exist for four of the five PECs considered to have potential to occur in the site (as listed in **Section 2.3.2**). Therefore areas of native vegetation potentially representing one of these four PECs were assessed against the community name and description in the *Priority Ecological Communities for Western Australia* (Version 27) document (DBCA 2017c).

Native vegetation potentially representing the 'low shrublands on acidic grey-brown sands of the Gracetown soil-landscape system' PEC (P2) was additionally compared to information provided in the document *Summary of landform, soil, vegetation and floristic data for the proposed ecological community: "Low heathland on acidic grey-brown sands of the Gracetown soil-landscape system"* (Smith 2005).

The boundaries of vegetation considered to represent a PEC during the site and regional surveys were mapped on aerial photography (1:105,000) and boundaries were interpreted from aerial photography and notes taken in the field.



#### 3.3.3 Species accumulation curve

A species accumulation curve was plotted from sample data by generating a trendline (log) in Microsoft *Excel*. The trendline was forecast to locate the asymptote of the curve (the point at which the curve flattens), which provides an indication of amount of sampling that would be required before it can be assumed few species remain undetected. PRIMER v6 also offers a range of estimators to predict minimum species richness (Clarke and Gorley 2006). Both the 'Jacknife1' and 'Chao2' non-parametric estimators are reported, as these are known to perform well in comparison to simulated and real data sets and are also recommended for small sample sizes (Gotelli and Colwell 2011). Comparison between actual and estimated species accumulation assists in evaluating the adequacy of sampling effort.

## 3.4 Survey limitations

It is important to note the specific constraints imposed on surveys and the degree to which these may have limited survey outcomes. An evaluation of the survey methodology against standard constraints outlined in the EPA document *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) is provided in **Table 4**.

Constraint	Degree of limitation	Details
Availability of contextual information	No limitation	The broad scale contextual information described in <b>Section 2</b> is adequate to place the site and vegetation in context.
		Information from previous assessments of the flora and vegetation values within the site was available. This information was used to characterise the general vegetation prior to the survey and inform the survey methodology.
	Minor limitation	There is no publicly available regional flora survey dataset available for the south-west region that would allow for statistical analysis to determine the presence or absence of conservation significant vegetation types. As such the plant communities identified were compared to the TECs and PECs within the wider local area based on the species presence, soils, landforms and location information available.
Experience level of personnel	No limitation	This flora and vegetation assessment was undertaken by two qualified botanists with eight years of botanical experience in Western Australia. Technical review was undertaken by a senior environmental consultant with 16 years' experience in environmental science in Western Australia.
Suitability of timing Minor limitation Minor limitation Suitability of timing Minor limitation Suitability of timing Minor limitation timing Minor limitation timitation timing Minor limitation tim		The site survey was conducted in August and November and thus within the main flowering season. High rainfall was recorded from May to October 2018 in the months preceding the site visit. Therefore it is likely that many plant species would have been in flower and/or visible at the time of survey. Some orchid species had finished flowering in November and were unidentifiable, but other species were still flowering and able to be identified. Including the reconnaissance visit in August, the survey timing was considered adequate to allow the detection of most species for which seasonal timing is critical. However, the November timing of the detailed component of the survey was later than ideal to allow detection of some orchid species that finish flowering in September or October, including threatened species <i>Caladenia caesarea</i> subsp. maritima and <i>C. excelsa</i> .

Table 4: Evaluation of survey methodology against standard constraints outlined in EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).

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Table 4: Evaluation of survey methodology against standard constraints outlined in EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016) (cont.)

Constraint	Degree of limitation	Details	
Suitability of timing (cont)	No limitation	The regional survey was conducted in February 2019 outside of the optimal season for flora detection. However, the timing did not result in significant limitation as perennial and easily detectable flora plus surficial soil information could be used indicate PEC occurrences.	
Temporal coverage	No limitation	Comprehensive flora and vegetation assessments can require multiple visits, at different times of year, and over a period of a number of years, to enable observation of all species present. The site was visited once in August 2018 and over three days in late November 2018. The August site visit provided an insight into the vegetation condition and composition out of the main flowering period. The detailed survey component allowed multiple formal samples and targeted searches to be completed across the entire site. Therefore, according to the EPA guidelines this survey is considered to meet the requirements of a 'detailed' survey.	
Spatial coverage and access	No limitation	Site coverage was comprehensive (track logged). All parts of the site could be accessed as required.	
	Limitation	A total of 22 locations from Yallingup to south of Gracetown were surveyed as part of the regional PEC survey which represents reasonable spatial coverage. Nonetheless, not all areas where suitable soils and landform were predicted to occur could be accessed during the regional survey due to time constraints. It is therefore likely that the number of occurrences identified provides an underestimate of the actual number of occurrences that are present.	
Sampling intensity	No limitation	A total of 214 species were recorded, of which 200 were recorded from 37 sample locations and 14 were recorded opportunistically. Minimum species richness within site is estimated at between 239 (Chao2) and 256 (Jacknife1) species (refer species accumulation curve and estimates shown in <b>Plate 18</b> ). The number of species recorded in the site is 89% of the Chaos 2 estimate indicating that survey effort was adequate to prepare a near-comprehensive species inventory for the site.	
	No limitation	A total of 22 locations from Yallingup to south of Gracetown were surveyed as part of the regional PEC survey which represents reasonable sampling intensity and provided sufficient information to predict the extent of occurrence of the PEC and refine predications of the likely location of as yet unidentified occurrences of the PEC.	
Influence of disturbance	Minor limitation	Time since fire is greater than 30 years as interpreted form aerial imagery and therefore short lived species more common after fire may not have been visible.	
	No limitation	Historical ground disturbance was evident in parts of the site. The disturbance history of the site was considered when undertaking field sampling.	
Adamuarist	No limitation	All resources required to perform the survey of the site were available.	
Adequacy of resources	Limitation	Additional resources (time) would have been required to complete a comprehensive regional survey of PEC locations.	



# 4 Results

#### 4.1 Site survey

#### 4.1.1 General site conditions

The site is undulating and supports a variety of landforms and soil types. The north western portion of the site contains a low ridgeline with north westerly and north easterly aspects. Soils on this ridge and associated slopes are grey-brown sand with outcropping granite, which increases in density towards the western boundary where granite becomes dominant. The south western portion of the site has a westerly aspect with some yellow sands and granite near the boundary that transitions into brown-grey sand and outcropping limestone as elevation increases. A rise with white-grey sand and outcropping limestone as elevation of the site. The eastern portion of the site is gently undulating with the highest point being the southern boundary, and the majority of this area supports deep brown sands without outcropping rock. A narrow linear portion of orange-brown sandy soils with outcropping granite occurs near the eastern boundary of the site.

Native vegetation occurs across the majority of the site except for a few access tracks that are devoid of native vegetation. The vegetation in the central portion of the site showed signs of disturbance such as lower native vegetation cover and higher cover of non-native species. The vegetation in the north eastern portion of the site, near Smiths Beach Road, also showed signs of disturbance as it was dominated by thick *Acacia saligna* which is a native shrub that can act as a coloniser of disturbed soils. The eastern portion of the site appears to have been subject to low level disturbance due to the presence of non-native species. The remainder of the site, particularly the western portion, supports relatively undisturbed native vegetation.

The entire site was accessible and able to be traversed during the field survey.

#### 4.1.2 Flora

A total of 164 native and 50 non-native (weed) species were recorded within the site during the field survey, representing 58 families and 145 genera. The dominant families containing native taxa were Fabaceae (22 native taxa and five weed taxa), Poaceae (11 native and 13 non-native taxa), Myrtaceae (ten native taxa) and Asteraceae (ten native and nine non-native taxa). The most common genera were *Acacia* (with eight taxa), *Banksia* and *Hibbertia* (with five taxa each) and *Austrostipa*, *Rytidosperma* and *Stylidium* (with four taxa each). Of the species recorded, 200 were recorded in sample locations and 14 were recorded opportunistically. The complete species list and species list by plant community are provided in **Appendix B** and sampled data in **Appendix C**.

#### 4.1.2.1 Threatened and priority flora

One priority 4 (P4) species, *Banksia sessilis* var. *cordata*, was recorded in the site. A total of 210 individuals were recorded, primarily in the central and north western portions of the site, as shown in **Figure 3**. No other threatened or priority flora species were recorded within the site.



## 4.1.2.2 Locally and regionally significant flora

No locally or regionally significant flora species were recorded within the site.

#### 4.1.2.3 Declared pests

Two species listed as declared pests (s22) pursuant to the BAM Act, \**Asparagus asparagoides* and \**Zantedeschia aethiopica*, were recorded within the site. These species were primarily found within vegetation in the eastern portion of the site. \**Asparagus asparagoides* was recorded mainly as individual plants and \**Zantedeschia aethiopica* was recorded as individual plants as well as dense populations, particularly in the south eastern portion of the site underneath native *Agonis flexuosa* trees.

\*Asparagus asparagoides is also listed as a WoNS.

#### 4.1.3 Vegetation

#### 4.1.3.1 Plant communities

A total of 13 native plant communities were identified within the site. A description and the area of each plant community is provided in **Table 5** and representative photographs of each are provided in **Plate 3** to **Plate 16**. The location of each plant community is shown in **Figure 5**.

Table 5: Plant communities	identified	within the site
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Plant community	Description	Area (ha)
AfPe	Low open forest <i>Agonis flexuosa</i> over fernland <i>Pteridium esculentum</i> subsp. <i>esculentum</i> over open herbland mixed non-native species such as <i>*Lysimachia arvensis</i> and <i>*Asparagus asparagoides</i> ( <b>Plate 3</b> ).	7.71
AhHe	Shrubland Allocasuarina humilis over low sparse herbland over low sparse grassland Austrostipa mollis and Rytidosperma occidentale over low open rushland Hypolaena exsulca (Plate 4).	1.25
AsDc	Shrubland Acacia saligna and Dodonaea ceratocarpa over low herbland Trachymene pilosa over low sparse grassland Rytidosperma occidentale (Plate 5).	3.26
AsHh	Shrubland Acacia saligna over low open shrubland Hibbertia hypericoides over grassland non-native species such as *Vulpia bromoides ( <b>Plate 6</b> ).	0.61
BaMrXp	Low open forest <i>Banksia attenuata</i> and occasional <i>Agonis flexuosa</i> over open shrubland <i>Macrozamia riedlei</i> and <i>Xanthorrhoea preissii</i> over open mixed herbland ( <b>Plate 7</b> ).	4.16
CcHh	Low forest <i>Corymbia calophylla</i> over open shrubland <i>Xanthorrhoea preissii</i> and over low shrubland <i>Hibbertia hypericoides</i> over sparse low herbland <i>Scaevola calliptera</i> ( <b>Plate 8</b> ).	0.99
DciDcL	Shrubland Darwinia citriodora and Dodonaea ceratocarpa over low sedgeland Lepidosperma spp. over low open grassland of native and non-native species over low open herbland Crassula spp. (Plate 9).	0.86
KcSg	Closed shrubland <i>Kunzea ciliata</i> and <i>Spyridium globulosum</i> over low open shrubland <i>Eutaxia myrtifolia</i> over sparse sedgeland over low sparse herbland ( <b>Plate 10</b> ).	9.40



Table 5: Plant communities identified within the site (cont.)

Plant community	Description	Area (ha)
КсDсРр	Low open shrubland <i>Kunzea ciliata</i> and <i>Darwinia citriodora</i> over low sparse herbland <i>Stypandra glauca</i> over low sparse grassland <i>Poa poiformis</i> on granite ( <b>Plate 11</b> ).	0.53
MhGl	Low woodland to low open forest <i>Melaleuca huegelii, M. lanceolata</i> and <i>Guichenotia ledifolia</i> over tall open shrubland <i>Hakea oleifolia</i> over shrubland <i>Hibbertia cuneiformis</i> over low open herbland <i>Stylidium adnatum</i> ( <b>Plate 12</b> ).	4.41
MIDr	Low closed forest <i>Melaleuca lanceolata</i> over sparse shrubland <i>Melaleuca systena</i> and <i>Spyridium globulosum</i> over low open herbland <i>Dianella revoluta</i> var. <i>revoluta</i> over low open sedgeland <i>Lepidosperma</i> spp. (understorey absent in areas of dense canopy cover) ( <b>Plate 13</b> ).	1.81
MIKc	Closed shrubland <i>Melaleuca lanceolata</i> and <i>Kunzea ciliata</i> over occasional grasses and herbs ( <b>Plate 14</b> ).	2.31
NfCcXp	Low open forest <i>Nuytsia floribunda</i> and <i>Corymbia calophylla</i> over open shrubland <i>Xanthorrhoea preissii</i> over low open mixed herbland over low open grassland native and non-native species ( <b>Plate 15</b> ).	0.67
Non-native vegetation	Heavily disturbed areas comprising tracks and non-native vegetation with occasional native plants ( <b>Plate 16</b> ).	2.56



Plate 3: Plant community **AfPe** in very good-good condition.





Plate 4: Plant community **AhHe** in very good condition.



Plate 5: Plant community AsDc in very good condition





Plate 6: Plant community **AsHh** in good condition.



Plate 7: Plant community **BaMrXp** in very good condition





Plate 8: Plant community CcHh in very good condition



Plate 9: Plant community **DciDcL** in very good-good condition.





Plate 10: Plant community KcSg in excellent condition



Plate 11: Plant community **KcDcPp** in excellent condition.





Plate 12: Plant community MhGl in excellent condition



Plate 13: Plant community **MIDr** in excellent condition





Plate 14: Plant community **MIKc** in excellent condition



Plate 15: Plant community **NfCcXp** in very good-good condition





*Plate 16: Non-native vegetation on cleared track in completely degraded condition.* 

#### 4.1.3.2 Vegetation condition

The most intact native vegetation was located in the western portion of the site (plant communities **KcDcPp**, **KcSg**, **MhGl**, **MlK**, and **MlDr**). This vegetation was mapped as being in excellent condition as it has an intact vegetation structure and low weed cover and diversity. Disturbance was low and appeared to be limited to fauna tracks and occasional weeds. Native vegetation cover was high in these plant communities, particularly those close to the western edge of the site.

Vegetation in the central portion of the site (west of the central north-south track), plant communities **AsDc**, **NfCcXp** and **AhHe**, were mapped as being in 'very good' and 'very good – good' condition due to historical disturbance which has resulted in a more open vegetation structure and slightly higher cover of non-native species.

Some vegetation in the eastern side of the site, such as plant community **MhGI** and portions of **CcHh**, were mapped as being in 'excellent' and 'very good' condition due to intact vegetation structure and low disturbance. However, the majority of vegetation in this portion of the site, plant communities **AfPe** and **DciDcL** and portions of **CcHh**, were mapped as an intermediate category: 'very good – good'. This vegetation supports a mosaic of high quality native vegetation interspersed with patches of non-native vegetation and/or aggressive non-native species such as \**Zantedeschia aethiopica*.

Remaining areas in the site were mapped as being in 'completely degraded' condition and consist primarily of bare areas of ground such as tracks, as well as scattered native and non-native vegetation.

The extent of vegetation by condition category is detailed in Table 6 and shown in Figure 6.



Table 6: Vegetation condition categories within the site

Condition category (Keighery (1994))	Size (ha)	
Pristine	0	
Excellent	18.59	
Very Good	8.82	
Very Good - Good	9.26	
Good	1.27	
Degraded	0.04	
Completely Degraded	2.56	

#### 4.1.4 Threatened and priority ecological communities

No TECs occur within the site.

Two PECs were recorded within the western portion of the site. Plant community **KcSg** was determined to meet the State listed 'low shrublands on acidic grey-brown sands' PEC (P2). This PEC extends over approximately 9.25 ha of the site.

Plant communities **KcDcPp** and **MIKc** were determined to meet the State listed '*Melaleuca lanceolata* forests, Leeuwin Naturaliste Ridge' PEC (P2). This PEC extends over approximately 4.05 ha of the site.

The locations of the two PECs within the site are shown in Figure 7.

No other PECs occur within the site.

#### 4.1.5 Locally and regionally significant vegetation

White-tailed black cockatoos<sup>2</sup> were observed foraging on the shrubland at the northern periphery of the site during the survey (**Plate 17**). Based on this and previous fauna surveys (ATA Environmental 2007b), the site comprises foraging habitat for Carnaby's, Baudin's and Forest red-tailed black cockatoos. Foraging habitat for black cockatoos within the site includes the shrubland at the northern periphery, the banksia woodland in the eastern portion of the site, as well as marri trees within the site. The site does not contain many habitat trees (mature eucalypt trees with a diameter at breast height larger than 500 mm), thus is not likely to provide important roosting or nesting habitat for black cockatoo species.



Plate 17: White-tailed black cockatoo observed foraging on vegetation during the survey.

Vegetation within the site, in particular, *Agonis flexuosa* trees within plant community **AfPe** provide habitat for western ringtail possums, as identified by ATA Environmental (2007b).

## 4.2 Species richness and sampling adequacy

A total of 200 species were recorded from 37 samples. A species accumulation curve derived from sample data is presented in **Plate 18**. After 37 samples the curve has reached its asymptote and is increasing more gradually. This indicates that a relatively small proportion of species are likely to remain undetected by sampling.

Species richness was estimated in PRIMER v6 to be between 239 (Chao2) and 256 (Jacknife1). Based on the trend of the species accumulation curve approximately 80 to 100 samples would be required to capture that many species. Including the 14 additional species recorded opportunistically, a total of 214 species was recorded in the site. This indicates that between 84-89% of the estimated 239-256 species in the site were recorded. Thus the survey effort was considered to be adequate to prepare a representative species inventory.

<sup>&</sup>lt;sup>2</sup> Carnaby's cockatoo or Baudin's cockatoo.

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# Spring Flora and Vegetation Assessment

Lot 4131 Smiths Beach Road, Yallingup



Plate 18: Species accumulation curve derived from sample data (y = 52.3ln(x) + 6.7354 $R^2 = 0.9878$ 

# 4.3 Regional PEC survey

Four of the 22 survey locations visited were considered to represent the 'low shrublands on acidic grey-brown sands' PEC (P2) due to the presence of grey-brown soils, outcropping granite and similar flora species composition to that recorded in the site. The PEC locations are shown on **Figure 8**. The remaining sites visited were not considered to represent the 'low shrublands on acidic grey-brown sands' PEC.

Two survey locations determined to represent the 'low shrublands on acidic grey-brown sands' PEC occur in the same location as the DBCA Gracetown PEC occurrence. This occurrence lies approximately 20 km south west of the site and was determined to comprise two patches of vegetation to the north and south of Cowaramup Bay Road, extending over approximately 10.57 ha. Some similarities were observed between this occurrence and the 'low shrublands on acidic grey-brown sands' PEC in the site, but some flora species differed.

An additional area adjacent to the Gracetown occurrence in the north (approximately 10.6 ha) is considered likely to represent the 'low shrublands on acidic grey-brown sands' PEC but was not confirmed during the survey due to its remoteness and time constraints during the survey.

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#### Spring Flora and Vegetation Assessment Lot 4131 Smiths Beach Road, Yallingup

The other survey locations determined to represent the PEC are located in Yallingup and Moses Rock. The Yallingup occurrence is located approximately 1.8 km north-west of the site and the vegetation determined to represent the 'low shrublands on acidic grey-brown sands' PEC lies primarily to the west of Yallingup Beach Road. This occurrence was most similar to the PEC vegetation identified in the site due to the presence of grey-brown soils, outcropping granite and similar flora species composition. The primary difference between this occurrence and the 'low shrublands on acidic grey-brown sands' PEC vegetation in the site is that the shrubs in this occurrence are lower; likely due to the difference in aspect. This PEC occurrence extends over approximately 3.9 ha.

The Moses Rock occurrence is located approximately 11 km south west of the site and the vegetation determined to represent the 'low shrublands on acidic grey-brown sands' PEC comprises a small patch of vegetation approximately 0.1 ha in size. This occurrence supported grey-brown soils, outcropping granite and similar flora species composition. Other native vegetation surrounds this PEC occurrence.



# 5 Discussion

## 5.1 Threatened and priority flora

In the south-west of Western Australia, September to November is considered the optimal period for undertaking flora and vegetation surveys, with this period also extending into December the further south the site is located. This is when the majority of flora species are flowering and therefore easiest to detect and identify. In 2018 many species in the south-west were still in flower later than usual due to the higher (albeit average) rainfall compared to previous years and the late start to the flowering period (anecdotally, some species were nearly a month behind their typical flowering times). The detection of flora was effective during this survey with the 204 species recorded representing an increase in flora of 35 species since the most recent previous survey (ATA Environmental 2007a).

An increased number of *B. sessilis* var. *cordata* individuals was also recorded within the site compared to previous surveys (ATA Environmental 2007a). The species is an emergent, tall shrub in the lower shrubland present in the western half of the site and the transects traversed over the **BaMrXp** vegetation (which contained the highest densities of *B. sessilis* var. *cordata*) were thorough. Thus it was relatively straightforward to confirm that *B. sessilis var. cordata* was only present at the identified location and the recorded locations are likely to represent the complete distribution of the species within the site. *B. sessilis* var. *cordata* is widespread in the region despite a relatively restricted distribution close to the coastline from Cape Naturaliste in the north around to Albany in the south (DBCA 2019). A total of 58 collected specimens exist within the WA Herbarium collection (DBCA 2019).

Other than the occurrences of *B. sessilis* var. *cordata* (P4), no other threatened or priority flora species were recorded within the site. The absence of the larger perennial species that had potential to occur within the site, such as *Eucalyptus x phylacis* and *Banksia squarrosa* subsp. *argillacea*, was also relatively easy to confirm. However, smaller geophytic species that had potential to occur within the site, such as *Caladenia excelsa* and *Caladenia huegelii*, can be more difficult to detect. Considerable search effort was applied to locate these species within the site, including within the main flowering period (albeit relatively late in the main flowering season). Orchids and geophytes were recorded during the survey including *Caladenia attingens* subsp. *attingens* and also some *Caladenia* sp. individuals that had finished flowering and were in fruit (and thus were not able to be identified to species level).

Despite not having full visibility of orchids within the site during this survey, it is not considered particularly likely that any other conservation significant species occur. The survey timing was adequate to allow the detection of most species for which seasonal timing is critical and no threatened or priority orchids have previously been recorded in any of the previous surveys (Keating and Trudgen 1986; Maunsell and Partners Pty Ltd. 1987; Bennett Environmental Consulting 2001; ATA Environmental 2007a) undertaken across the site. The timing of the survey was most relevant to the detection of orchid species that finish flowering in September or October (such as *Caladenia caesarea* subsp. maritima and *C. excelsa*). It is not considered likely that any of the unidentified orchid individuals were these species or that there is high likelihood that any threaten or priority orchids or geophytes occur within the site.

## 5.2 Vegetation condition

The site generally contains intact, high-quality vegetation (especially in the western portion), with approximately 45% of the site area comprising 'excellent' condition vegetation.

The disturbance to the vegetation recorded in the central and eastern portions of the site was also noted in previous assessments (Bennett Environmental Consulting 2001; ATA Environmental 2007a). This disturbance precedes the earliest publicly available historical aerial photography (1996) and is likely to have occurred many decades ago. Colonising native species such as *Acacia saligna* have overtaken some areas along the northern boundary of the site closest to the road. At the time of the survey, the **AfPe** vegetation in the north eastern portion of the site was considered to be in 'very good to good' or 'good' condition as it had a moderate diversity of native species present but was subject to higher weed loads (particularly the declared pest, *\*Zantedeschia aethiopica*).

## 5.3 Threatened and priority ecological communities

The two PECs recorded within the site were associated with excellent condition vegetation in the western portion of the site. The floristic information obtained during the survey was sufficient to accurately map the extent of these PECs within the site and also confirm that no other TECs or PECs occur.

The extent of each PEC within the site was defined based on each community's name, the descriptions provided in the *Priority Ecological Communities for Western Australia* (Version 27) document and information provided in the document *Summary of landform, soil, vegetation and floristic data for the proposed ecological community: "Low heathland on acidic grey-brown sands of the Gracetown soil-landscape system*" (Smith 2005). This information provided a reasoned basis for classification of areas of native vegetation that, in the absence of detailed diagnostic criteria for either PEC, was considered satisfactory basis for assessment.

With regards to the 'low shrublands on acidic grey-brown sands' PEC, the areas of the **KcSg** vegetation mapped within the site satisfied criterion as low shrubland or heath, on grey brown sand with a bleached surface, near the west coast of the Leeuwin-Naturaliste Ridge and as well as including dominant shrubs identified in PEC description such as *Calothamnus sanguineus, Hakea trifurcata, Kunzea ciliata, Pimelea ferruginea, Spyridium globulosum* and *Xanthorrhoea brunonis.* However, more generally distributed flora species were also present such as *Agonis flexuosa* that are less indicative of the PEC based on its description.

With regards to the '*Melaleuca lanceolata* forests, Leeuwin Naturaliste Ridge' PEC, the areas of **MIDr** and **MIKc** vegetation mapped within the site satisfied criterion as a low closed forest of *Melaleuca lanceolata* near the coastline of the Leeuwin-Naturaliste Ridge. The **MIDr** vegetation in the south western corner of the site tended to be taller (with a dominant shrub layer over two metres tall). Whereas the occurrences on the north-western boundary (comprising the **MIKc** vegetation) were somewhat lower (one to two m tall), while still satisfying the broad definition of the community.



#### 5.3.1 Regional context for 'low shrublands on acidic grey-brown sands' PEC

The 'low shrublands on acidic grey-brown sands' PEC was found to occur at six locations from the north-western portion of the Leeuwin-Naturaliste Ridge north of Gracetown, to just south of Yallingup. The occurrences of this PEC were recorded within approximately 500 m of the coast.

Some variation in species composition and structure was observed across the regional sites visited, which is explicable given the distance between occurrences. However, each identified occurrence was considered to satisfy criteria derived from the description provided in the *Priority Ecological Communities for Western Australia* (Version 27) document and information provided in the document *Summary of landform, soil, vegetation and floristic data for the proposed ecological community: "Low heathland on acidic grey-brown sands of the Gracetown soil-landscape system"* (Smith 2005).

Based on the regional survey the 'area of occupancy' of the community is at least 37 ha and its 'extent of occurrence' is approximately 37.21 ha (minimum convex polygon). The area of occupancy and extent of occurrence of this community indicate that it has a restricted geographic distribution (Bland *et al.* 2017).

The 'low shrublands on acidic grey-brown sands' PEC was consistently recorded in association with granite outcroppings. The regional data therefore has some value as a predictive tool for occurrences of this PEC. However, while there was a clear relationship between the identified locations of this PEC and specific regional soil or vegetation complexes, the PEC occurrences did not align with the entirety of associated mapping units in the regional data. The 'low shrublands on acidic grey-brown sands' PEC is therefore considered likely to occur near to areas of granite outcropping within the Kilcarnup exposed rocky dunes, Gracetown exposed slopes, Wilyabrup granitic headland and Wilybrup exposed slopes phases.

Not all targeted areas where the relevant soil or vegetation complexes occur could be assessed during the survey due to time constraints and/or a lack of access to privately owned land. Therefore, some potential sites could not be ground truthed and it is likely that further unrecorded occurrences of the 'low shrublands on acidic grey-brown sands' PEC occur.

The 'low shrublands on acidic grey-brown sands' PEC is likely to have a naturally restricted distribution due to its occurrence on granite outcroppings scattered along the Leeuwin-Naturaliste coastline. While restricted in distribution, a significant portion of the 'low shrublands on acidic grey-brown sands' PEC is likely to be under formal protection (approximately 78% of existing vegetation and 73% of the original extent based on the RFA vegetation complexes).

#### 5.3.2 Regional context for 'Melaleuca lanceolata forests, Leeuwin Naturaliste Ridge' PEC

With regard to the '*Melaleuca lanceolata* forests, Leeuwin Naturaliste Ridge' PEC there were approximately 25 other occurrences of the PEC in the DBCA search results, and areas dominated by *Melaleuca lanceolata* were observed whilst undertaking the regional context survey for the 'low shrublands on acidic grey-brown sands' PEC. Thus this PEC is considered to be relatively common in the local area.



## 5.4 Fauna habitat

The site contains foraging habitat for all three threatened species of black cockatoo (ATA Environmental 2007b), and white-tailed black cockatoos were observed foraging on the shrubland at the northern periphery of the site during the survey. The site does not contain many habitat trees (mature eucalypt trees with a diameter at breast height larger than 500 mm), thus is not likely to provide important nesting habitat for black cockatoo species, which is also supported by previous fauna investigations by ATA Environmental (2007b).

Vegetation within the site, in particular, *Agonis flexuosa* trees within plant community **AfPe** provide habitat for western ringtail possums, as identified by ATA Environmental (2007b).



# 6 Conclusions

The site generally contains intact, high-quality vegetation (especially in western portion), with approximately 45% of the site area comprising 'excellent' condition vegetation. The central and eastern portions showed signs of historical disturbance, were subject to higher levels of weed invasion and were largely mapped as being in 'very good', 'very good to good' and 'good' condition. A small proportion of the site (6.4%) was mapped as being in 'degraded' or 'completely degraded' condition.

A total of 210 individuals of the priority flora species *Banksia sessilis* var. *cordata* (P4) were recorded within the site. It is not considered highly likely that any other threatened or priority species occur within the site.

No TECs were found to occur within the site, but two State listed PECs were recorded. The 9.25 ha of **KcSg** vegetation was considered to represent the 'low shrublands on acidic grey-brown sands' PEC. The 4.05 ha of plant communities **MIKc** and **MIDr** were considered to represent the '*Melaleuca lanceolata* forests, Leeuwin Naturaliste Ridge' PEC. The occurrences of both PECs were located within the western portion of the site close to the coastline. All vegetation representing these PECs within the site was in excellent condition.

The 'low shrublands on acidic grey-brown sands' PEC was found at six locations from the northwestern portion of the Leeuwin-Naturaliste Ridge north of Gracetown, to just south of Yallingup. These occurrences are consistently recorded in association with granite outcroppings.

The vegetation within the site is locally and regionally significant due to the fact that some of it provides habitat for threatened black cockatoo species and western ringtail possums.



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- Figure 1: Site Location
- Figure 2: Environmental Features

## Figure 3: Conservation Significant Flora and Sample Locations

- Figure 4: Regional Survey Locations
- Figure 5: Plant Communities
- Figure 6: Vegetation Condition
- Figure 7: Priority Ecological Communities in the Site
- *Figure 8: Priority Ecological Community in the Region*












While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used



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# Conservation Significant Flora and Vegetation

### Threatened and priority flora

Flora species considered rare or under threat warrant special protection under Commonwealth and/or State legislation. At the Commonwealth level, flora species can be listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Flora species considered 'threatened' pursuant to Schedule 1 of the EPBC Act are assigned categories according to their conservation status, as outlined in **Table 1**.

In Western Australia, plant taxa may be classed as 'threatened' under the *Biodiversity Conservation Act 2016* (BC Act) which is enforced by Department of Biodiversity Conservation and Attractions (DBCA). Threatened flora species are listed under sections 19(1) and 26(2) of the BC Act. It is an offence to 'take' or disturb threatened flora without Ministerial approval. Section 5(1)1 of the Act defines to take as including "... to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means" or to cause or permit the same to be done. The definition of threatened flora under the BC Act is provided in **Table 1**.

Section 43 of the BC Act requires that an occurrence of a threatened species or threatened ecological community is reported to DBCA where the occurrence has been identified as part of field work completed:

- as part of an assessment under Part IV of the Environmental Protection Act 1986; or
- in relation to an application for a clearing permit under the *Environmental Protection Act 1986* section 51E(1)(d).

Penalties apply to individuals and organisations that fail to provide accurate reports of threatened species or communities.

The *Biodiversity Conservation Regulations 2018* (BC Regulations 2018) came into effect on January 1 2019. The BC Regulations include provisions for licencing, charges, penalties and other provisions associated with the BC Act.

Flora species that may be threatened or near threatened but lack sufficient information to be listed under the BC Act may be added to the DBCA's *Priority Flora List* (DBCA 2018c). Priority flora species are considered during State approval processes. Priority flora categories and definitions are listed in **Table 1**.

Table 1: Definitions of conservation significant flora species pursuant to the EPBC Act and BC Act and on DBCA's Priority Flora List (DBCA 2018c)

Conservation code	Description
EX <sup>†</sup>	Threatened Flora – Presumed Extinct Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.
T^†	Threatened Flora – Extant Taxa which are declared to be likely to become extinct or is rare, or otherwise in need of special protection.
CR^	Threatened Flora – Critically Endangered Taxa which are considered to be facing an extremely high risk of extinction in the wild.
EN^	Threatened Flora – Endangered Taxa which are considered to be facing a very high risk of extinction in the wild.
VU^	Threatened Flora – Vulnerable Taxa which are considered to be facing a high risk of extinction in the wild.
P1 <sup>0</sup>	Priority One – Poorly Known Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat e.g. road verges, urban areas, farmland, active mineral leases etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2 <sup>0</sup>	Priority Two – Poorly Known Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but urgently need further survey.
P3 <sup>0</sup>	Priority Three – Poorly Known Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but needs further survey.
P4 <sup>0</sup>	Priority Four – Rare Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

^pursuant to the EPBC Act, <sup>†</sup>pursuant to the BC Act, <sup>I</sup>on DBCA's Priority Flora List

### Threatened and priority ecological communities

'Threatened ecological communities' (TECs) are recognised as ecological communities that are rare or under threat and therefore warrant special protection. Selected TECs are afforded statutory protection at a Commonwealth level under section 181 of the EPBC Act. TECs nominated for listing under the EPBC Act are considered by the Threatened Species Scientific Committee and a final decision is made by the Commonwealth Minister for the Environment and Energy. Once listed under the EPBC Act, communities are categorised as either 'critically endangered', 'endangered' or 'vulnerable' as defined in **Table 2**. Any action likely to have a significant impact on a community listed under the EPBC Act requires approval from the Minister for the Environment and Energy.

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Additional Background Information

Within Western Australia TECs are determined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (WATECSAC) and endorsed by the State Minister for the Environment. The WATECSAC is an independent group comprised of representatives from organisations including tertiary institutions, the Western Australian Museum and DBCA. The TECs endorsed by the State Minister are published by DBCA (DBCA 2018b).

TECs are assigned to one of the categories outlined in **Table 2** according to their status (in relation to the level of threat). TECs are afforded direct statutory protection at a State level under the BC Act and BC Regulations. Ecological communities are listed under Section 27(1) and 33 of the BC Act. Their significance is also acknowledged through other state environmental approval processes such as 'environmental impact assessment' pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Conservation code	Description
PD	Presumably Totally Destroyed An ecological community that has been adequately searched for but for which no representative occurrences have been located.
CE	Critically Endangered An ecological community that has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.
E	Endangered An ecological community that has been adequately surveyed and is not critically endangered but is facing a very high risk of total destruction in the near future.
V	Vulnerable An ecological community that has been adequately surveyed and is not critically endangered or endangered but is facing a high risk of total destruction or significant modification in the medium to long- term future.

Table 2: Categories of threatened ecological communities (English and Blyth 1997; DEC 2009).

An ecological community that is under consideration for listing as a TEC, but does not yet meet survey criteria or has not been adequately defined may be listed as a 'priority ecological community' (PEC). PECs are categorised as priority category 1, 2 or 3 as described in **Table 3**. Ecological communities that are adequately known and are rare but not threatened, or meet criteria for 'near threatened', or that have been recently removed from the threatened list, are placed in 'priority 4'. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in 'priority 5' (DEC 2009). Listed PECs are published by DBCA (DBCA 2017b).



Table 3: Categories of priority ecological communities (DEC 2009).

Priority code	Description
P1	Priority One Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
P2	Priority Two Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Р3	Priority Three Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (i) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (ii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
P4	Priority Four Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring.
Р5	Priority Five Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.



### Weeds

A number of legislative and policy documents exist in relation to weed management at state and national levels. The *Biosecurity and Agriculture Management Act 2007* (BAM Act) is the principle legislation guiding weed management in Western Australia and lists declared pest species. At a national level, the Australian government has compiled a list of 32 Weeds of National Significance (WoNS) (DoEE 2018), of which many are also listed under the BAM Act.

### **Declared** Pests

Part 2.3.23 of the BAM Act requires a person must not; "a) keep, breed or cultivate the declared pest; b) keep, breed or cultivate an animal, plant or other thing that is infected or infested with the declared pest; c) release into the environment the declared pest, or an animal, plant or other thing that is infected or infested with the declared pest; or d) intentionally infect or infest, or expose to infection or infestation, a plant, animal or other thing with a declared pest".

Under the BAM Act, all declared pests are assigned a legal status, as described in **Table 4**. Species assigned to the 'declared pest, prohibited - s12' category are placed in one of three control categories, as described in

#### Table 5.

The *Biosecurity and Agriculture Management Regulations 2013* specify keeping categories for species assigned to the 'declared pest - s22(2)' category, which relate to the purposes of which species can be kept, as well as the entities that can keep them. The categories are described in

#### Table 6.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act (DAFWA 2016).

Table 4: Legal status of declared pest species listed under the BAM Act (DAFWA 2016).

Category	Description
Declared Pest Prohibited - s12	May only be imported and kept subject to permits. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.
Declared Pest s22(2)	Must satisfy any applicable import requirements when imported, and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia



Table 5: Control categories of declared pest species listed under the BAM Act (DAFWA 2016).

Category	Description
C1	Exclusion Not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2	Eradication Present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3	Management Established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

### Table 6: Keeping categories of declared pest species listed under the BAM Act (DAFWA 2016).

Category	Description
Prohibited	Can only be kept under a permit for public display and education purposes, and/or genuine scientific research, by entities approved by the state authority.
Exempt	No permit or conditions are required for keeping.
Restricted	Organisms which, relative to other species, have a low risk of becoming a problem for the environment, primary industry or public safety and can be kept under a permit by private individuals.



### References

#### General references

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Semeniuk, C. A. and Semeniuk, V. 1995, *A Geomorphic Approach to Global Classification for Inland Wetlands*, Vegetatio, 118(1/2): 103-124.

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Department of Environment and Energy (DoEE) 2018, Weeds of National Significance, <a href="http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html">http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html</a>.

Department of Primary Industries and Regional Development (DPIRD) 2019, The Western Australian Organism List (WAOL), < https://www.agric.wa.gov.au/bam/western-australian-organism-list-waol>.





Family	Species
Aizoaceae	
	Carpobrotus virescens
Amaranthaceae	
	Ptilotus drummondii
	Ptilotus manglesii
Apiaceae	
•	Daucus alochidiatus
	Homalosciadium homalocarpum
	Platysace tenuissima
	Xanthosia candida
	Xanthosia sn
	Xunthosid sp.
Araceae	
Alaceae	D. Zantedeschia aethionica
	D zumeueschia deimopica
Araliacoao	
Alallaceae	Trachymene nilosa
	nachymene phosa
Asparagacoao	
Aspaiagaceae	Acanthacarnus proiscii
	Acuntilocurpus preissi
	D'Asparagas projecti
	Dichopogon preissi
	Lomanara micrantna subsp. micrantna
	Lomandra pauciflora
	Lomandra suaveolens
	Thysanotus patersonii
	Thysanotus thyrsoideus
Asteraceae	
	* Arctotheca calendula
	Brachyscome iberidifolia
	* Carduus pycnocephalus
	* Cotula coronopifolia
	* Cotula turbinata
	Hyalosperma cotula
	* Hypochaeris glabra
	* Hypochaeris radicata
	Lagenophora huegelii
	* Logfia gallica
	Olearia axillaris
	Podolepis lessonii
	Quinetia urvillei
	Rhodanthe citrina

Family	Species
Asteraceae (cont.)	
	Rhodanthe corymbosa
	Senecio pinnatifolius var. maritimus
	Siloxerus humifusus
	* Sonchus oleraceus
	* Ursinia anthemoides
Campanulaceae	
	Isotoma hypocrateriformis
	Lobelia tenuior
	* Wahlenbergia capensis
	Wahlenbergia sp.
Caryophyllaceae	
	* Petrorhagia dubia
	* Polycarpon tetraphyllum
	* Silene gallica
	* Spergula arvensis
Casuarinaceae	
	Allocasuarina fraseriana
	Allocasuarina humilis
Celastraceae	
	Tripterococcus brunonis
Centrolepidaceae	
	Centrolepis drummondiana
Chenopodiaceae	
	Enchylaena tomentosa
	Rhagodia baccata subsp. baccata
	Threlkeldia diffusa
Colchicaceae	
	Burchardia congesta
Convolvulaceae	
	Dichondra repens
Crassulaceae	
	Crassula colorata
	Crassula exserta

Note: * denotes introduced	(weed) species	D denotes declared	pest species and P4 denotes	'priority 4' species.
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Family	Species
Cyperaceae	
	Cyathochaeta avenacea
	Ficinia nodosa
	Isolepis marginata
	Lepidosperma calcicola
	Lepidosperma gladiatum
	Lepidosperma squamatum
	Schoenus grandiflorus
	Schoenus sp.
	Tetraria octandra
Dennstaedtiaceae	
	Pteridium esculentum subsp. esculentum
Dilleniaceae	
	Hibbertia amplexicaulis
	Hibbertia cuneiformis
	Hibbertia cunninghamii
	Hibbertia hypericoides
	Hibbertia racemosa
Ericaceae	
	Astroloma ciliatum
	Leucopogon australis
	Leucopogon parviflorus
	Leucopogon propinquus
Euphorbiaceae	
	* Euphorbia peplus
	* Euphorbia terracina
Fabaceae	
	Acacia alata var. alata
	Acacia cochlearis
	Acacia cyclops
	* Acacia iteaphylla
	Acacia littorea
	Acacia pulchella var. pulchella
	Acacia rostellifera
	Acacia saligna
	Bossiaea eriocarpa
	Chorizema ?cordatum
	Chorizema diversifolium
	Eutaxia myrtifolia
	Fabaceae sp.
	Gastrolobium ebracteolatum

Family	Species
Fabaceae (cont.)	
	Gompholobium marginatum
	Gompholobium tomentosum
	Hardenbergia comptoniana
	Hovea ?chorizemifolia
	Isotropis cuneifolia subsp. cuneifolia
	Jacksonia furcellata
	Jacksonia horrida
	Jacksonia sp.
	Kennedia prostrata
	* Lotus subbiflorus
	* Lotus sp.
	* Trifolium campestre
	* Trifolium sp.
Gentianaceae	
	* Centaurium tenuiflorum
	* Cicendia filiformis
Geraniaceae	
	* Pelargonium capitatum
Goodeniaceae	
	Scaevola calliptera
	Scaevola crassifolia
Haemodoraceae	
nacinouoraceae	Aniaozanthos manalesii
	Conostylis aculeata, subsp. aracilis
	Haemodorum Jaxum
	Haemodorum simplex
	Haemodorum sp.
Hemerocallidaceae	Caesia 2micrantha
	Dianella brevicaulis
	Dianella revoluta var revoluta
	Stypandra alauca
	Tricoryne elatior
Iridaceae	
	Patersonia occidentalis
	* Romulea rosea var. australis
luncaceae	
Juncaleae	* ?luncus canitatus
	; suncus cupitutus

Family	Species
Lauraceae	
	Cassytha flava
	Cassytha racemosa
	Cassytha sp.
Linaceae	
Lindecae	* Linum triavnum
	Linam chgynam
Loranthaceae	
	Nuytsia floribunda
Malvaceae	
	Guichenotia ledifolia
	Thomasia foliosa
	Thomasia triphylla
Myrtaceae	
	Agonis flexuosa
	Calothamnus sanguineus
	Corymbia calophylla
	Darwinia citriodora Eucoluptus marginata
	Eucaryptus marginatu Kupzog ciligta
	Kunzea alabrascans
	Nullzeu glubiescens Melaleuca huegelii
	Melaleuca lanceolata
	Melaleuca systema
Orchidaceae	
	Caladenia ?attingens subsp. attingens
	Caladenia attingens subsp. attingens
	Caladenia sp.
Orobanchaceae	
	* Orobanche minor
	* Parentucellia latifolia
Uxalidaceae	* Ovalia agrainulata
	* Oxalis corniculata * Oxalis pos cantao
	Oxulls pes-caprae
Pittosnoraceae	
וונטאטומנכמכ	Marianthus candidus

Family	Species
Phyllanthaceae	
	Phyllanthus calycinus
	Poranthera microphylla
Plantaginaceae	
Tantaginaccac	* Plantago lanceolata
	Tuntugo funccolutu
Poaceae	
	* Aira cupaniana
	* Aira praecox
	Austrostipa flavescens
	Austrostipa mollis
	Austrostipa variabilis
	Austrostipa sp.
	* Avena sp.
	* Briza maxima
	* Briza minor
	* Bromus hordeaceus
	* Ehrharta calycina
	* Ehrharta longiflora
	* Hordeum leporinum
	* Lagurus ovatus
	Microlaena stipoides
	Neurachne alopecuroidea
	* Phleum arenarium
	Poa poiformis
	* Poaceae sp.
	Rytidosperma acerosum
	Rytidosperma occidentale
	Rytidosperma setaceum
	Rytidosperma sp.
	* Vulpia bromoides
Polygalaceae	
	Comesperma ciliatum
	, Comesperma confertum
Polygonaceae	
	Muehlenbeckia adpressa
Primulaceae	
	* Lysimachia arvensis

Note: * denotes introduced	d (weed) species,	D denotes declared	pest species and P4	denotes 'priority 4' species.
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Family	Species
Proteaceae	
	Banksia attenuata
	Banksia bipinnatifida
	Banksia dallanneyi var. dallanneyi
	Banksia dallanneyi var. sylvestris
	P4 Banksia sessilis var. cordata
	Hakea oleifolia
	Hakea prostrata
	Hakea trifurcata
	Persoonia longifolia
	Petrophile linearis
Pteridaceae	
	Cheilanthes austrotenuifolia
Ranunculaceae	Clematic linearifolia
	Banunculus colonorum
	Kununculus colonorum
Restionaceae	
	Desmocladus flexuosus
	Hypolaena exsulca
-	
Rhamnaceae	Counciliants alabada anno
	Spyriaium globulosum
Rubiaceae	
	* Galium murale
	Opercularia vaginata
Rutaceae	
	Diplolaena dampieri
Santalacaaa	
Sallalaceae	Santalum acuminatum
	Suntaian acanmatan
Sapindaceae	
•	Dodonaea ceratocarpa
Stylidiaceae	
	Levenhookia stipitata
	Stylidium adnatum
	Stylidium brunonianum
	Stylidium megacarpum
	Stylidium sp.

Family	Species	
Thymelaeaceae		
	Pimelea ferruginea	
	Pimelea rosea subsp. rosea	
Violaceae		
	Hybanthus calycinus	
Xanthorrhoeaceae		
	Chamaescilla corymbosa	
	Xanthorrhoea brunonis	
	Xanthorrhoea preissii	
Zamiaceae		
	Macrozamia riedlei	

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**retorder calendula **	Anigozanthos manglesii																																		
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Astrochong clinatum I <td>*Asparagus asparagoides</td> <td>х</td> <td>Х</td> <td></td> <td>x</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Х</td> <td></td> <td></td> <td></td> <td>X</td> <td>Х</td> <td></td> <td>Х</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>x</td> <td></td> <td>Х</td> <td>х х</td> <td>Х</td> <td>Х</td> <td>Х</td> <td></td> <td></td> <td>хх</td>	*Asparagus asparagoides	х	Х		x							Х				X	Х		Х							x		Х	х х	Х	Х	Х			хх
Austracting funcescends I X	Astroloma ciliatum						х										Х																		
Austrostiga mollis X <td>Austrostipa flavescens</td> <td></td> <td>)</td> <td>Х</td> <td></td> <td>x</td> <td></td> <td></td> <td>Х</td> <td>X</td> <td></td> <td></td> <td></td> <td></td> <td></td>	Austrostipa flavescens													)	Х											x			Х	X					
Austrostiga sp. Austrostiga sp. I <td>Austrostipa mollis</td> <td></td> <td>Х</td> <td></td> <td></td> <td>Х</td> <td>х</td> <td></td> <td>x x</td> <td>κх</td> <td>x</td> <td></td> <td></td> <td>x x</td> <td>Х</td> <td></td>	Austrostipa mollis		Х			Х	х		x x	κх	x			x x	Х																				
Austrainability Austrainability I <td>Austrostipa sp.</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>)</td> <td>K</td> <td></td>	Austrostipa sp.								)	K																									
**Avena sp.       Subsisticity	Austrostipa variabilis								Х																										
Banksia attenuata Banksia ditenuatifiab Si <	*Avena sp.							Х	)	K																x		Х			Х				
Banksia bipinatifida Rescuence of the second of the	Banksia attenuata													x x	х х																				
Banksia dallanneyi subsp. dallanneyi Sale S	Banksia bipinnatifida						х		)	K	х												x >	<	Х										
Banksia dallanney subsp. sylvestris       Bark is adallanney subsp. sylvestris <td>Banksia dallanneyi subsp. dallanneyi</td> <td></td> <td></td> <td></td> <td></td> <td>Х</td> <td>х</td> <td>Х</td> <td>X X</td> <td>ΧХ</td> <td></td> <td>Х</td> <td></td> <td></td> <td></td> <td></td> <td>Х</td> <td>x</td> <td>Х</td> <td></td> <td></td> <td></td> <td>Х</td> <td></td> <td>х</td>	Banksia dallanneyi subsp. dallanneyi					Х	х	Х	X X	ΧХ		Х					Х	x	Х				Х												х
Banksia sessilis var. cordata       I <t< td=""><td>Banksia dallanneyi subsp. sylvestris</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Х</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	Banksia dallanneyi subsp. sylvestris																								Х										
Bosside a eriocarpa       N       V       X	Banksia sessilis var. cordata													Х									Х												
Brachyscome iberidifolia       X </td <td>Bossiaea eriocarpa</td> <td></td> <td></td> <td></td> <td></td> <td>Х</td> <td></td> <td></td> <td></td> <td></td> <td>х</td> <td></td>	Bossiaea eriocarpa					Х					х																								
*Briza maxima       X       <	Brachyscome iberidifolia					Х															Х		Х					Х							
*Briza minor       X <t< td=""><td>*Briza maxima</td><td>х</td><td>Х</td><td></td><td>x</td><td>Х</td><td>х</td><td>Х</td><td>X X</td><td>ΧХ</td><td>х</td><td>Х</td><td></td><td>Х</td><td>Х</td><td>X</td><td>Х</td><td>x</td><td>Х</td><td>х</td><td>Х</td><td></td><td>Х</td><td></td><td></td><td></td><td></td><td></td><td>х х</td><td>Х</td><td></td><td></td><td></td><td></td><td>х</td></t<>	*Briza maxima	х	Х		x	Х	х	Х	X X	ΧХ	х	Х		Х	Х	X	Х	x	Х	х	Х		Х						х х	Х					х
*Bromus hordeaceus       X	*Briza minor		Х		x	Х		Х	Х	Х							Х			х									Х	Х					х
Burchardia congesta       X	*Bromus hordeaceus	х	Х		х			Х				Х				X		х	Х		Х														
Caladenia ?attingens       X       Image: Subsp. attingens       X       Image: Subsp. attingens       X       Image: Subsp. attingens       X       X       X       X       Image: Subsp. attingens       X       X       X       X       X       Image: Subsp. attingens       Image: Subsp. attingens       X	Burchardia congesta					Х								x x	Х	X																			
Caladenia attingens subsp. attingens       X       I	Caladenia ?attingens subsp. attingens																															Х			
Caladenia sp.XXX <t< td=""><td>Caladenia attingens subsp. attingens</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	Caladenia attingens subsp. attingens															X																			
Calothaming sanguineus       X <td>Caladenia sp.</td> <td></td> <td>Х</td> <td></td> <td>)</td> <td>Х</td> <td></td>	Caladenia sp.		Х											)	Х																				
*Carduus pycnocephalus Carpobrotus virescens Cassytha flava Cassytha racemosa Cassytha sp. *Contourium tonviforum	Calothamnus sanguineus					Х	х				x					X		x		х			Х												х
Carpobrotus virescens       X	*Carduus pycnocephalus																																		
Cassytha flava     X     X     X       Cassytha racemosa     X     X     X       Cassytha sp.     X     X       *Contrarium tonuiflorum     X     X	Carpobrotus virescens														Х						х													Х	1
Cassytha racemosa     X </td <td>Cassytha flava</td> <td></td> <td></td> <td></td> <td></td> <td>х</td> <td></td> <td>х</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>1</td>	Cassytha flava					х																				х									1
Cassytha sp. X X X X X X X X X X X X X X X X X X X	Cassytha racemosa									Х										х															1
	Cassytha sp.					Х																													1
	*Centaurium tenuiflorum								x x	K	х									х	х						Х			х		Х		х	хх

																Plan	t com	muni	ties															
		Afl	<b>Pe</b>	A	hHe			AsDc		AsHh	6	BaMr	Хр	C	cHh	1	DciDcL	L	KcDcPp		ŀ	(cSg				MhGl				MID	r	MI	Kc N	√fCcXp
Species	Q15	Q18	Q19 Q	32	Q7	Q10	Q12	Q3 Q4	4 Q5 Q9	Q11	opp C	Q13 C	Q14 R1	7 Q33	3 Q34	Q16	Q35	Q36	Q37	орр	Q1 (	Q2 Q	20 R24	4 Q25	GQ27	Q29	Q30 C	231	Q22	Q23 (	Q26 Q2	8 Q2	21 0	Q6 R8
Centrolepis drummondiana																	Х														Х			
Chamaescilla corymbosa												Х	Х	X	Х																			
Cheilanthes austrotenuifolia	Х		х				Х			X					Х		Х																	
Chorizema ?cordatum														X																				
Chorizema diversifolium	Х												Х																					
*Cicendia filiformis																															Х			
Clematis linearifolia			2																					X		Х	Х	Х	Х		Х			
Comesperma ciliatum																		Х																
Comesperma confertum						Х						Х						Х																
Conostylis aculeata subsp. gracilis								Х													Х			X		Х					Х			
Corymbia calophylla			X X									Х	Х	X	Х	X																		х х
*Cotula coronopifolia		Х																																
*Cotula turbinata															Х																			
Crassula colorata																					Х												<	Х
Crassula exserta																	Х												Х					
*Crassula glomerata														X															Х					
Cyathochaeta avenacea								х х	Х																									
Darwinia citriodora		Х						х							Х	X	Х	Х	х															
Daucus glochidiatus	Х		x											X																				
Desmocladus flexuosus					Х							Х	х										Х	X	Х	Х	х							
Dianella brevicaulis																			х															
Dianella revoluta var. revoluta										X					Х				х							Х	х	х	Х	Х	x x		<	
Dichondra repens	х		2																															Х
Dichopogon preissii													х																					
Diplolaena dampieri	Х		х										Х						х			2	K	X	Х			Х			х	>	<	
Dodonaea ceratocarpa						Х		х х	х х	X						X	Х	Х	Х		Х	X	к х		Х					Х			<	
*Ehrharta calycina		Х	2		Х			Х		X		Х	х х	X	Х	X	Х							X		Х	Х	Х						Х
*Ehrharta longiflora																												х						
Enchylaena tomentosa																						2	K											
Eucalyptus marginata								х	Х					X																				
*Euphorbia peplus																								X		Х	Х	Х			Х			
*Euphorbia terracina		Х	2										Х	X																				Х
Eutaxia myrtifolia								Х	ХХ				Х						Х		Х	X	к х		Х								<	
Fabaceae sp.			Х																															
Ficinia nodosa																						2	K									>	<	
*Galium murale																										Х					Х			
Gastrolobium ebracteolatum																		Х																
Gompholobium marginatum									Х																									
Gompholobium tomentosum					Х							Х									Х			X										
Guichenotia ledifolia			Х				Х																				Х		Х	Х	Х			
Haemodorum laxum								Х									Х																	
Haemodorum simplex								Х												1														
Haemodorum sp.								Х	Х						Х	Х				1														
Hakea oleifolia	Х	Х	Х					Х		Х										1	Х					Х	Х				X X			
Hakea prostrata						Х	Х	Х	Х	Х										1				X										
Hakea trifurcata																		Х			Х	Х												

																	Pla	nt cor	nmun	ities															
		Afl	Pe		AhHe			AsDc			AsHh		BaMr)	٢p		CcHh		DciDo	cL	KcDcPp		К	cSg			1	MhGl				MID	r	MIK	c Nf	CcXp
Species	Q15	Q18	Q19	Q32	Q7	Q10	Q12	Q3 (	Q4 Q5	5 Q9	Q11	opp	Q13 Q	14 R	17 Q3	33 Q34	4 Q16	5 Q35	Q36	Q37	opp	Q1 0	2 Q2	0 R24	4 Q25	Q27	Q29	Q30	Q31	Q22	Q23	Q26 Q2	8 Q2	1 Q6	6 R8
Hardenbergia comptoniana	Х	Х		Х									Х	Х	X	(																			
Hibbertia amplexicaulis	Х		Х					X	х х				Х	Х		Х	X					Х												X	
Hibbertia cuneiformis	Х	Х	Х	x			Х	X	Х		Х		Х	)	<	Х						Х			X	Х	Х	Х	Х	Х		х			
Hibbertia cunninghamii															X	(																			
Hibbertia hypericoides		Х			Х	Х	Х	X	х х	Х	Х		Х		X	х х	X	Х	Х			Х		Х							Х			X	X
Hibbertia racemosa					Х																				x		Х								
Homalosciadium homalocarpum		Х																																	
*Hordeum leporinum																		Х																	
Hovea ?chorizemifolia												X										Х													
Hyalosperma cotula						Х				Х				)	k   x	(																		X	
Hybanthus calycinus															X	(									X		Х	Х				х		X	
*Hypochaeris glabra		Х	Х	х				Х	Х	Х	Х		Х		X	(		Х	Х								Х	Х	х			х		X	Х
*Hypochaeris radicata	Х																																		
Hypolaena exsulca					Х																														
Isolepis marginata																																х			
Isotoma hypocrateriformis																						Х													
Isotropis cuneifolia subsp. cuneifolia					Х	x																													
Jacksonia furcellata								2	Х																										
Jacksonia horrida						Х					Х																							X	
Jacksonia sp.																						Х													
Kennedia prostrata																						Х													
Kunzea ciliata					Х	X		X	х х								X			x		X	х х	Х		Х							X		
Kunzea glabrescens							Х			Х	Х																								
Lagenophora huegelii				x	Х								Х	Х	X	(																х			
*Lagurus ovatus				x																x															
Lepidosperma calcicola																															Х				
Lepidosperma gladiatum														Х																					
Lepidosperma squamatum					Х	X		2	х х	Х					X	х х	X	Х	Х	X		X	х х	Х	X	Х	Х				Х		X		
Leucopogon australis																														Х					
Leucopogon parviflorus											Х					Х				X		X	х х	Х	X	Х	Х	Х	х		Х	х >	X		
Leucopogon propinquus					Х	X	Х	2	х х	Х	Х			Х		Х	2	Х	Х																Х
Levenhookia stipitata		Х	Х						Х				Х									Х													
*Linum trigynum								Х																									X		
Lobelia tenuior			Х										Х	Х											X		Х		Х						
*Logfia gallica																		Х																	
Lomandra hermaphrodita																																Х			
Lomandra micrantha subsp. micrantha									Х			X			X	х х						X	х	Х		Х									
Lomandra pauciflora													Х																						
Lomandra suaveolens					Х																														
*Lotus sp.																													х						
*Lotus subbiflorus				x														Х	Х	X															
*Lysimachia arvensis	Х	Х	Х	x	Х		Х	Х							X	х х									X	Х	Х	Х	х	Х		Х	X	X	. Χ
Macrozamia riedlei	х	Х		x						Х			Х	x x	<   x	х х	X		Х									Х	х					X	. 1
Marianthus candidus						1																									Х				
Melaleuca huegelii						1																			Х	Х	Х	Х	х	Х	Х	Х			
Melaleuca lanceolata										Х										Х		X	х х	Х	X		Х					X X	X	X	X

																		Plant o	commu	uniti	ies																	
		Af	Ре		AhHe			AsDc		1	AsHh		BaMr	хр		CcHh	۱ I	Dc	iDcL	ŀ	(cDcPp			KcSg	5			1	MhGl				M	Dr		MIKc	NfC	сХр
Species	Q15	Q18	Q19	Q32	Q7	Q10	Q12	Q3 C	Q4 Q5 (	Q9	Q11	opp C	Q13 (	Q14 R	17	Q33 Q	34	Q16 Q	Q35 Q3	36	Q37	opp	Q1	Q2	Q20	R24	Q25	Q27	Q29	Q30	Q31	Q22	Q23	Q26	Q28	Q21	Q6	R8
Melaleuca systena					Х	Х	Х	2	Х	Х			Х	Х	Х									Х		Х	Х		Х	Х	Х			Х			Х	Х
Microlaena stipoides		Х														)	x										X			Х	Х						х	
Muehlenbeckia adpressa							Х	2	Х		Х																		Х	Х	Х					Х		
Neurachne alopecuroidea					Х	X				x								Х	>	(																		
Nuytsia floribunda																																					х	Х
Olearia axillaris								X	Х		Х			Х		)	x				Х						X									Х		
Opercularia vaginata								2	х										>	(																		
*Orobanche minor			Х					2	х																													
*Oxalis corniculata																														Х	Х							
*Oxalis pes-caprae		Х	Х	Х							Х					X X	x																					
*Parentucellia latifolia								Х											Х																			
Patersonia occidentalis					2	X	Х	X	хх	x			Х		x	X X	x						Х	Х		Х	X	Х								Х		
*Pelargonium capitatum		Х						2	х																													
Persoonia longifolia																																						
Petrophile linearis																											X		Х									
*Petrorhagia dubia	Х	Х		Х	Х	X	Х	2	хх	x				Х					Х												Х		Х				х	
*Phleum arenarium																																Х						
Phyllanthus calycinus	Х	Х	Х	Х	Х		Х	X	хх	x			Х	Х	x	x >	x		X >				Х	Х			X		Х	Х		Х					х	Х
Pimelea rosea subsp. rosea					Х								Х	Х																							х	Х
Pimelea ferruginea		Х						X	х									Х			Х		Х	Х		Х				Х						Х		
*Plantago lanceolata		Х																																				
Platysace tenuissima																			Х																			
Poa poiformis																					Х						X											
*Poaceae sp.								Х	х														Х															
Podolepis lessonii										x									X >																			
Polycarpon tetraphyllum																																						
Poranthera microphylla													Х														X		Х	Х	Х			Х				
Pteridium esculentum subsp. esculentum		Х																																				
Ptilotus drummondii																)	x					X							Х									
Ptilotus manglesii														Х	x						Х																	
Quinetia urvillei																			Х																			
Ranunculus colonorum																Х																						
Rhagodia baccata	Х	Х				X	Х	2	хх		Х				x	)	x						Х	Х	Х		X		Х	Х	Х			Х		Х	х	Х
Rhodanthe citrina			Х		Х								Х														X		Х	Х								
Rhodanthe corymbosa					Х																Х																х	
Romulea rosea var. australis										x									Х																			
Rytidosperma acerosum																					Х																	
Rytidosperma occidentale					Х			Х	Х									Х					Х				X										х	Х
Rytidosperma setaceum									х										>																			
Rytidosperma sp.																												Х										
Santalum acuminatum						X	Х								x											Х												
Scaevola calliptera		Х	Х													Х																						
Scaevola crassifolia										x											х																	
Schoenus grandiflorus																																						
Schoenus sp.		Х																																				
Senecio pinnatifolius var. maritimus																					Х															Х		

																		Plant	t comn	nuni	ties																	
		Af	Pe		AhHe			AsDc			AsHh		BaM	lrXp		Cc	Hh	D	CiDcL		KcDcPp			KcSg				Ν	ИhGl				M	Dr		MIKc	NfC	cXp
Species	Q15	Q18	Q19	Q32	Q7	Q10	Q12	Q3 (	Q4 Q5	Q9	Q11	opp	Q13	Q14	R17	Q33	Q34	Q16	Q35 (	Q36	Q37	opp	Q1	Q2 (	Q20 R2	4 C	25	Q27	Q29	Q30	Q31	Q22	Q23	Q26	Q28	Q21	Q6	R8
*Silene gallica			Х																Х																			
Siloxerus humifusus									Х				Х																									
*Sonchus oleraceus		Х		Х												Х											Х			Х	Х							
*Spergula arvensis									Х																													
Spyridium globulosum	X	Х	Х	Х		X	Х	Х	Х	Х	Х		Х	Х	x	Х	х	Х		Х	х		Х	Х	>		Х	Х	Х	Х	Х	х	Х	Х	Х	х	х	
Stylidium adnatum	X	Х	Х	Х				Х					Х	Х	x	Х	х										Х		Х	Х	Х							Х
Stylidium brunonianum			Х		Х								Х	Х													Х											
Stylidium megacarpum						X				Х																												
Stylidium sp.									Х																													
Stypandra glauca																					Х																	
Tetraria octandra																Х																						
Thomasia foliosa											Х					Х				Х										Х	Х			Х				
Thomasia triphylla			Х																														Х					
Threlkeldia diffusa																					Х																	
Thysanotus patersonii																				Х							Х											
Thysanotus thyrsoideus																																					х	
Trachymene pilosa	X	Х	Х	Х	Х			Х		Х			Х		x	Х	х			Х			Х				Х		Х	Х	Х	х		Х			х	Х
Tricoryne elatior					Х	X			Х	Х																												
*Trifolium campestre		Х																																				
*Trifolium sp.									Х																												х	
Tripterococcus brunonis												X											Х															
*Ursinia anthemoides																																						
*Vulpia bromoides						X	Х		х х	Х								Х	Х	Х								Х	Х					Х				
*Wahlenbergia capensis																							Х									Х						
Wahlenbergia sp.			Х		Х								Х	Х						Х									Х	Х							х	
Xanthorrhoea brunonis									х х	Х															>													
Xanthorrhoea preissii	х	Х	Х		Х	X	Х	Х	х х	Х	Х		Х			Х	х						Х	Х	Х			Х						Х			х	Х
Xanthosia candida	х				Х	Х		Х					Х			Х					х		Х				Х											
Xanthosia sp.										Х									Х																			
*Zantedeschia aethiopica	х	Х	Х	Х	Х		Х				Х					Х	Х										Х		Х	Х	Х						Х	Х






Sample Na	me:	Q1	
Project no.:	EP18-085		
Date: 2	26/11/2018	Status	s Non-permanent
Author:	SKP		Q1: Page 1 of 3
Ouadrat and landform	details		
Sample type: 0	quadrat	Size:	: 10 m x 10 m
NW corner easting:	315399.2865	NW corner northing:	: 6273520.119
Altitude (m):	35	Geographic datum/zone:	:GDA94/Zone 50
Soil water content:	dry	Landform:	: mid-slope
Time since fire:	no evidence	Disturbance:	: low - Weeds
Soil type/texture	sand/clay	Bare ground (%):	: 30
Rocks (%) and type: 2	20%, granite	Soil colour:	: brown
Litter:	10% (branches,twigs,leaves)	Vegetation condition:	: excellent
Stucto		Hoight (m)	
Strata		Height (m)	
opper:	U%	ireeless	Quarta rocks lateritie group
	30 to 70	1 to 2	Quartz rocks, lateritic gravel
Ground layer 1:	<10	<0.5	
Ground layer 2:	<10	<0.5	

#### Vegetation description

Shrubland Kunzea ciliata, Melaleuca lanceolata and Calothamnus sanguineus over low sparse herbland Lepidosperma squamatum, Trachymene pilosa over low sparse tussock grassland





Sample I	Name: Q1	
Project	no.: EP18-085 ate: 26/11/2018	Status Non-nermanent
Aut	hor: SKP	Q1: Page 2 of 3
Species Data		
* denotes non-na	tive species	
Status	Confirmed name	Cover (%)
	Acacia cochlearis	0
	Acacia pulchella var. pulchella	2
	* Aira praecox	1
	Banksia bipinnatifida	2
	Banksia dallanneyi subsp. dallanneyi	орр
	Banksia sessilis var. cordata	орр
	Brachyscome iberidifolia	0
	* Briza maxima	0
	Calothamnus sanguineus	5
	Conostylis aculeata subsp. gracilis	0
	Crassula colorata	0
	Dodonaea ceratocarpa	2
	Dodonaea ceratocarpa	2
	Eutaxia myrtifolia	2
	Gompholobium tomentosum	орр
	Hakea oleifolia	2
	Hakea trifurcata	2
	Hibbertia amplexicaulis	0
	Hibbertia cuneiformis	1
	Hibbertia hypericoides	5
	Hovea ?chorizemifolia	0
	Isotoma hypocrateriformis	0
	Jacksonia sp.	0
	Kennedia prostrata	0
	Kunzea ciliata	20
	Lepidosperma squamatum	2
	Leucopogon parviflorus	1
	Levenhookia stipitata	0
	Lomandra micrantha subsp. micrantha	0
	Melaleuca lanceolata	5
	Patersonia occidentalis	0
	Phyllanthus calycinus	0
	Pimelea ferruginea	2
	* Poaceae sp.	1
	Rhagodia baccata	1
	Rytidosperma occidentale	1



Sample	e Name:	Q1		
Proj	ect no.: EP18-085			
	Date: 26/11/2018	Sta	tus Non-permanent	
	Author: SKP	Q1: Page 3	3 of 3	
Species Data				
* denotes nor	n-native species			
Status	Confirmed name		Cover (%)	
	Spyridium globulosum		1	
	Trachymene pilosa		1	
	Tripterococcus brunonis		0	
	* Wahlenbergia capensis		1	
	Xanthorrhoea preissii		2	
	Xanthosia candida		0	



Sample Nar	me:	Q2	
Project no.: E	EP18-085		
Date: 2	26/11/2018	Status	Non-permanent
Author: S	SKP		Q2: Page 1 of 2
Quadrat and landform	details		
Sample type: c	quadrat	Size:	10 m x 10 m
NW corner easting: 3	315342.8006	NW corner northing:	6273466.667
Altitude (m): 3	37	Geographic datum/zone:	GDA94/Zone 50
Soil water content: c	dry	Landform:	mid-slope
Time since fire: r	no evidence	Disturbance:	moderate - occ weeds, compacted, loss of u,
Soil type/texture s	and/clay	Bare ground (%):	20
Rocks (%) and type: 1	LO%, granite	Soil colour:	brown
Litter: 2	25% (branches,twigs,leaves)	Vegetation condition:	very good
Strata	Cover (%)	Height (m)	
Upper:	0%	0	
Mid:	70 to 100	1 to 2	gravel, compacted soil
Ground layer 1:	<10	<0.5	<u> </u>
Ground layer 2:	0%	0	

#### Vegetation description

Closed shrubland Kunzea ciliata, Acacia saligna, Spyridium globulosum and Eutaxia myrtifolia over low sparse sedgeland Lepidosperma squamatum.





Sample	Name: Q2		
Proje	Project no.: EP18-085		
	Date: 26/11/2018	Status Non-permanent	
A	uthor: SKP	Q2: Page 2 of 2	
Species Data			
* denotes non-	native species		
Status	Confirmed name	Cover (%)	
	Acacia saligna	5	
	Banksia bipinnatifida	0	
	Dodonaea ceratocarpa	2	
	Dodonaea ceratocarpa	1	
	Eutaxia myrtifolia	8	
	Hakea trifurcata	0	
	Kunzea ciliata	35	
	Lepidosperma squamatum	5	
	Leucopogon parviflorus	3	
	Lomandra micrantha subsp. micrantha	0	
	Melaleuca lanceolata	opp	
	Melaleuca systena	opp	
	Patersonia occidentalis	0	
	Phyllanthus calycinus	0	
	Pimelea ferruginea	2	
	Rhagodia baccata	2	
	Spyridium globulosum	20	
	Xanthorrhoea preissii	2	



Sample Name	:	Q3
Project no.: EP18	-085	
Date: 26/12	L/2018	Status Non-permanent
Author: SKP		Q3: Page 1 of 2
Quadrat and landform deta	ils	
Sample type: quad	rat	Size: 10 m x 10 m
NW corner easting: 3154	49.3963	NW corner northing: 6273504.887
Altitude (m): 32		Geographic datum/zone: GDA94/Zone 50
Soil water content: dry		Landform: mid-slope
Time since fire: no ev	idence	Disturbance: high - Weeds, partial clearing?
Soil type/texture sand		Bare ground (%): 2
Rocks (%) and type: No ro	ocks	Soil colour: brown
Litter: 30% (	twigs,leaves)	Vegetation condition: very good-good
Strata	Cover (%)	Height (m)
Upper:	0 to 5	<10
Mid:	30 to 70	1 to 2
Ground layer 1:	0%	<0.5
Ground layer 2:	0%	0

#### Vegetation description

low isolated clumps of trees Eucalyptus marginata over shrubland Acacia saligna, Dodonaea ceratocarpa, Eutaxia myrtifolia and Spyridium globulosum over low herbland





Projec	t no.: EP18-085	<b>.</b>
	Date: 26/11/2018	Status Non-permanent
Αι	ithor: SKP	Q3: Page 2 of 2
Spacias Data		
* denotes non-r	ative species	
Status	Confirmed name	Cover (%
Status	Acacia saliana	20
	* Aira cupaniana	20
	Austrosting mollis	-
	Austrostipa variabilis	opp
	Banksia dallannevi suhsn dallannevi	opp
	* Briza maxima	3
	* Briza minor	0
	* Centaurium tenuiflorum	1
	Conostylis aculeata subsp. aracilis	0
	Cvathochaeta avenacea	0
	Dodongeg ceratocarna	10
	* Ehrharta calveina	4
	Euralyntus marainata	2
	Eutaxia myrtifolia	- 5
	Haemodorum layum	1
	Hakea prostrata	1
	Hibbertia amplexicaulis	1
	Hibbertia cuneiformis	1
	Hibbertia hypericoides	2
	* Hypochaeris alahra	2
	Kunzea ciliata	1
	* Linum trigynum	0
	* Lysimachia arvensis	1
	Olearia axillaris	2
	* Parentucellia latifolia	0
	Patersonia occidentalis	1
	Phyllanthus calveinus	0
	Pimelea ferruainea	1
	* Poaceae sn	1
	Rytidosperma occidentale	2
	Spyridium alobulosum	с С
	Stylidium adnatum	J
	Trachymene nilosa	000 10
	Xanthorrhoea nreissii	2
	Vanthoria candida	2



Sample Nam	e:	Q4
Project no.: EP18	3-085	
Date: 27/1	.1/2018	Status Non-permanent
Author: SKP		Q4: Page 1 of 3
Quadrat and landform det	ails	
Sample type: qua	drat	Size: 10 m x 10 m
NW corner easting: 315	564.9098	NW corner northing: 6273629.255
Altitude (m): 14		Geographic datum/zone: GDA94/Zone 50
Soil water content: dry		Landform: mid-slope
Time since fire: no e	vidence	Disturbance: moderate - Weeds, ajd to track
Soil type/texture sand	I	Bare ground (%): 0
Rocks (%) and type: 1%,	granite	Soil colour: brown
Litter: 5% (	twigs)	Vegetation condition: very good-good
Strata	Cover (%)	Height (m)
Unner	0%	
Mid	30 to 70	1 to 2
Ground laver 1	<10	<0.5
Ground layer 2:	<10	<0.5

#### Vegetation description

Shrubland Dodonaea ceratocarpa, Darwinia citriodora, Pimelea ferruginea, Xanthorrhoea s pp. and Banksia dallanneyi subsp. dallanneyi over low sparse sedgeland Lepidosperma squamatum over low sparse herbland





Sample Name: Q4	
Project no.: EP18-085	
Date: 27/11/2018	Status Non-permanent
Author: SKP	Q4: Page 2 of 3
Species Data	
* denotes non-native species	
Status Confirmed name	Cover (%)
Acacia cochlearis	1
Acacia pulchella var. pulchella	2
Acacia saligna	2
Agonis flexuosa	орр
* Aira cupaniana	2
Austrostipa mollis	1
Austrostipa sp.	0
* Avena sp.	0
Banksia bipinnatifida	1
Banksia dallanneyi subsp. dallanneyi	10
* Briza maxima	1
* Centaurium tenuiflorum	2
Cyathochaeta avenacea	орр
Darwinia citriodora	3
Dodonaea ceratocarpa	5
Haemodorum simplex	орр
Haemodorum sp.	0
Hakea oleifolia	opp
Hibbertia amplexicaulis	0
Hibbertia cuneiformis	2
Hibbertia hypericoides	3
Jacksonia furcellata	2
Kunzea ciliata	2
Lepidosperma squamatum	3
Leucopogon propinquus	2
Leucopogon propinquus	2
Melaleuca systena	орр
Muehlenbeckia adpressa	2
Olearia axillaris	2
Opercularia vaginata	0
* Orobanche minor	0
Patersonia occidentalis	1
* Pelargonium capitatum	1
* Petrorhagia dubia	2
* Petrorhagia dubia	1
Phyllanthus calvcinus	1



Sample	e Name:	Q4
Proj	ect no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: SKP	Q4: Page 3 of 3
Species Data		
* denotes non	n-native species	
Status	Confirmed name	Cover (%)
	Pimelea ferruginea	10
	Rhagodia baccata	2
	Spyridium globulosum	орр
	Stylidium sp.	opp
	* Trifolium sp.	5
	* Vulpia bromoides	3
	Xanthorrhoea brunonis	1
	Yantharrhaea preissii	3



Sample Nam	ne:	Q5	
Project no.: EP	18-085		
Date: 27	/11/2018	Status N	on-permanent
Autior: SK	٢	ų	J. Fage I UI Z
Quadrat and landform d	etails		
Sample type: qu	adrat	Size: 10	0 m x 10 m
NW corner easting: 31	5516.5251	NW corner northing: 62	273554.882
Altitude (m): 28		Geographic datum/zone: G	DA94/Zone 50
Soil water content: dr	y	Landform: m	nid-slope
Time since fire: no	evidence	Disturbance: m	noderate - Weeds
Soil type/texture sa	nd/clay	Bare ground (%): 10	0
Rocks (%) and type: 1%	6, granite	Soil colour: b	rown
Litter: 2%	6 (twigs)	Vegetation condition: ve	ery good
Strata	Cover (%)	Height (m)	
Upper:	0%	Treeless	
Mid:	30 to 70	1 to 2	granite nearby
Ground layer 1:	10 to 30	<0.5	
Ground layer 2:	0%	0	

#### Vegetation description

Shrubland Kunzea ciliata, Hibbertia hypericoides, Dodonaea ceratocarpa, Xanthorrhoea spp. and Banksia dallanneyi subsp. dallanneyi over low open herbland Cyathochaeta avenacea, Lepidosperma squamatum over open tussock grassland Rytidosperma spp. Austrostipa mollis and \*Briza spp.





Proj	ect no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: SKP	Q5: Page 2 of 2
pecies Data		
denotes non	-native species	C
tatus	Confirmed name	Cover (%)
	Acacia puicnella var. puicnella	opp
	** Aira cupaniana	3
	Austrostipa mollis	1
	Banksia dallanneyi subsp. dallanneyi	1
	* Briza maxima	3
	* Briza minor	2
	Cassytha racemosa	0
	Cyathochaeta avenacea	2
	Dodonaea ceratocarpa	1
	Eutaxia myrtifolia	opp
	Haemodorum sp.	0
	Hibbertia amplexicaulis	1
	Hibbertia hypericoides	5
	* Hypochaeris glabra	1
	Kunzea ciliata	10
	Lepidosperma squamatum	2
	Leucopogon propinquus	2
	Levenhookia stipitata	0
	Lomandra micrantha subsp. micrantha	0
	Patersonia occidentalis	0
	* Petrorhagia dubia	1
	Phyllanthus calycinus	0
	* Poaceae sp.	0
	Rhagodia baccata	1
	- Rytidosperma occidentale	10
	Rytidosperma setaceum	1
	Siloxerus humifusus	0
	Siloxerus humifusus	0
	* Spergula arvensis	0
	Tricoryne elatior	onn
	* Vulpia bromoides	2
	Xanthorrhoea brunonis	- 2
	Vantharrhaag proissii	10



Sample Name:		Q6	
Project no.: EP18	8-085		
Date: 27/1	1/2018	Status Non-permanent	
Author: SKP		Q6: Page 1 of 3	
Quadrat and landform det	ails		
Sample type: quad	Irat	Size: 10 m x 10 m	
NW corner easting: 3155	35.8177	NW corner northing: 6273497.233	
Altitude (m): 32		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: mid-slope	
Time since fire: no evidence		Disturbance: moderate - weeds, diggings	
Soil type/texture sand with organic layer		Bare ground (%): 5	
Rocks (%) and type: No rocks		Soil colour: brown	
Litter: 40%	(twigs,leaves)	Vegetation condition: very good-good	
Strata Cover (%)		Height (m)	
Upper: 30 to 70		<10	
Mid: 10 to 30		1 to 2	
Ground layer 1:	10 to 30	<0.5	
Ground layer 2: 0%		0	

#### Vegetation description

low open forest Nuytsia floribunda and Corymbia calophylla over open shrubland Melaleuca lanceolata, Spyridium globulosum and Xanthorrhoea preissii over low open herb \*Petrorhagia dubia and \*Trifolium sp.





Dr	oiect no · ED18-085	
F1	Date: 27/11/2018	Status Non-permanent
	Author: SKP	O6: Page 2 of 3
Species Data	3	
* denotes no	on-native species	
Status	Confirmed name	Cover (%)
	Acacia pulchella var. pulchella	opp
	* Aira cupaniana	3
	Allocasuarina humilis	1
	* Arctotheca calendula	0
	*DP Asparagus asparagoides	1
	Banksia dallanneyi subsp. dallanneyi	1
	* Briza maxima	1
	* Briza minor	2
	Calothamnus sanguineus	0
	* Centaurium tenuiflorum	0
	Corymbia calophylla	5
	Crassula colorata	1
	Dichondra repens	1
	* Ehrharta calycina	3
	Hibbertia amplexicaulis	opp
	Hibbertia hypericoides	10
	Hyalosperma cotula	0
	Hybanthus calycinus	opp
	* Hypochaeris glabra	2
	Jacksonia horrida	opp
	* Lysimachia arvensis	0
	Macrozamia riedlei	1
	Melaleuca lanceolata	5
	Melaleuca systena	1
	Microlaena stipoides	0
	Nuytsia floribunda	25
	* Petrorhagia dubia	2
	Phyllanthus calycinus	2
	Pimelea rosea subsp. rosea	opp
	Rhagodia baccata	2
	Rhodanthe corymbosa	1
	Rytidosperma occidentale	5
	Spyridium globulosum	5
	Thysanotus thyrsoideus	орр
	Trachymene pilosa	2
	* Trifolium sp.	3



Sample	e Name:	Q6	
Proj	ect no.: EP18-085		
-,	Date: 27/11/2018	Status	s Non-permanent
	Author: SKP	Q6: Page 3 of	f 3
Species Data			
* denotes non	n-native species		
Status	Confirmed name		Cover (%)
	Mahlanhanain an		1

wanienbergia sp.	T
Xanthorrhoea preissii	5
*DP Zantedeschia aethiopica	2



Sample Name:		Q7	
Project no.: EP18	8-085		
Date: 27/1	1/2018	Status Non-permanent	
Author: SKP		Q7: Page 1 of 3	
Quadrat and landform det	ails		
Sample type: quad	Irat	Size: 10 m x 10 m	
NW corner easting: 3154	68.1774	NW corner northing: 6273372.677	
Altitude (m): 42		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: mid-slope	
Time since fire: no evidence		Disturbance: moderate - weeds, diggings	
Soil type/texture sand		Bare ground (%): 15	
Rocks (%) and type: No r	ocks	Soil colour: yellow/brown	
Litter: 10%	(twigs,leaves)	Vegetation condition: very good	
Strata Cover (%)		Height (m)	
Upper: N/A		Treeless	
Mid: 30 to 70		1 to 2	
Ground layer 1: <10		<0.5	
Ground layer 2: <10		<0.5	

#### Vegetation description

Shrubland Allocasuarina humilis, Hibbertia hypericoides and Melaleuca systena over low sparse herbland Brachyscome iberidifolia, Cassytha spp. Lepidosperma squamatum over low sparse tussock grassland Austrostipa mollis, \*Briza spp.





Samp	le Name: Q7	
Pr	oject no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: SKP	Q7: Page 2 of 3
Cuesies Det		
* denotes n	a on-native species	
Status	Confirmed name	Cover (%)
otatao	Acacia cochlearis	2
	* Aira cupaniana	0
	Allocasuarina humilis	25
	Austrostipa mollis	1
	Banksia dallanneyi subsp. dallanneyi	2
	Bossiaea eriocarpa	0
	Brachyscome iberidifolia	1
	* Briza maxima	3
	* Briza minor	3
	Burchardia congesta	0
	Calothamnus sanguineus	орр
	Cassytha flava	3
	Cassytha sp.	2
	Desmocladus flexuosus	1
	* Ehrharta calycina	0
	Gompholobium tomentosum	1
	Hibbertia hypericoides	15
	Hibbertia racemosa	0
	Hypolaena exsulca	3
	Isotropis cuneifolia subsp. cuneifolia	0
	Kunzea ciliata	1
	Lagenophora huegelii	0
	Lepidosperma squamatum	3
	Leucopogon propinquus	1
	Lomandra suaveolens	0
	* Lysimachia arvensis	0
	Melaleuca systena	3
	Neurachne alopecuroidea	0
	Patersonia occidentalis	1
	Patersonia occidentalis	0
	* Petrorhagia dubia	0
	Phyllanthus calycinus	1
	Pimelea rosea subsp. rosea	2
	Rhodanthe citrina	0
	Rhodanthe corymbosa	1
	Rytidosperma occidentale	5



Sample	e Name:	Q7
Proj	ect no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: SKP	Q7: Page 3 of 3
Species Data		
* denotes non	-native species	
Status	Confirmed name	Cover (%)
	Rytidosperma occidentale	0
	Stylidium brunonianum	0
	Trachymene pilosa	0
	Tricoryne elatior	2
	Wahlenbergia sp.	0
Xanthorrhoea preissii		1
	Xanthosia candida	0
	*DP Zantedeschia aethionica	0



Sample Name:		R8	
Project no.: EP18-	-085		
Date: 27/11	l/2018	Status Non-permanent	
Author: SKP		R8: Page 1 of 2	
Quadrat and landform deta	ils		
Sample type: releve	e	Size: 10 m x 10 m	
NW corner easting: 31544	44.7624	NW corner northing: 6273413.162	
Altitude (m): 40		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: mid-slope	
Time since fire: no ev	idence	Disturbance: moderate - weeds	
Soil type/texture sand		Bare ground (%): 10	
Rocks (%) and type: No ro	ocks	Soil colour: yellow/brown	
Litter: 30% (	twigs,leaves)	Vegetation condition: very good-good	
Strata	Cover (%)	Height (m)	
Upper: 30 to 70		<10	
Mid: <10		1 to 2	
Ground layer 1: 30 to 70 <0.5		<0.5	
Ground layer 2: 0%		0	

#### Vegetation description

low open forest Nuytsia floribunda and Corymbia calophylla over open sparse shrubland Rhagodia baccata., Melaleuca spp.and Xanthorrhoea preissii over low herb \*Zantedeschia aethiopica and \*Lysimachia arvensis





Г

F	Project no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: SKP	R8: Page 2 of 2
Spaciac Da	ta	
* denotes	la non-native species	
Status	Confirmed name	
otatao	Agonis flexuosa	
	Allocasuarina humilis	
	*DP Asparaaus asparaaoides	
	* Centaurium tenuiflorum	
	Corvmbia calophylla	
	* Euphorbia terracina	
	, Hibbertia hypericoides	
	* Hypochaeris glabra	
	Leucopogon propinguus	
	* Lysimachia arvensis	
	Melaleuca lanceolata	
	Melaleuca systena	
	Nuytsia floribunda	
	Phyllanthus calycinus	
	Pimelea rosea subsp. rosea	
	Rhagodia baccata	
	Rytidosperma occidentale	
	Rytidosperma occidentale	
	Stylidium adnatum	
	Trachymene pilosa	
	Xanthorrhoea preissii	
	*DP Zantedeschia aethiopica	



Sample Name:		Q9	
Project no.: EP1	.8-085		
Date: 27/	11/2018	Status Non-permanent	
Author: SKP		Q9: Page 1 of 3	
Quadrat and landform de	tails		
Sample type: qua	drat	Size: 10 m x 10 m	
NW corner easting: 315	610.0306	NW corner northing: 6273511.752	
Altitude (m): 26		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: mid-slope	
Time since fire: no evidence		Disturbance: low -	
Soil type/texture san	d	Bare ground (%): 25	
Rocks (%) and type: 5%,	quartz	Soil colour: grey	
Litter: 15%	<pre>% (twigs,leaves)</pre>	Vegetation condition: very good	
Strata	Cover (%)	Hoight (m)	
Opper: N/A		Ireeless	
Mid: 10 to 30		1 to 2	
Ground layer 1:	<10	<0.5	
Ground layer 2: <10		<0.5	

#### Vegetation description

Open shrubland Calothamnus sanguineus, Xanthorrhoea spp., Kunzea glabrescens over low sparse herbland over low sparse tussock grassland





	. ५३	
Project no.: EP18-	085	
Date: 27/11	/2018	Status Non-permanent
Author: SKP		Q9: Page 2 of 3
Species Data		
* denotes non-native species		
Status Confir	med name	Cover (%)
Αсасіс	cocniearis	opp
Acacio	pulchella var. pulchella	U
* Aira ci	ipaniana	2
Austro	stipa mollis	0
Banks	a bipinnatifida	0
Bossia	ea eriocarpa	0
* Briza r	naxima	4
Caloth	amnus sanguineus	5
* Centa	ırium tenuiflorum	0
Dodor	aea ceratocarpa	3
Eucaly	ptus marginata	орр
Eutaxi	a myrtifolia	орр
Gomp	holobium marginatum	0
Hakea	prostrata	1
Hibbe	rtia hypericoides	4
Hyalos	sperma cotula	1
* Нурос	haeris glabra	1
Kunze	a glabrescens	5
Lepido	sperma squamatum	5
Leuco	pogon propinquus	орр
Leuco	pogon propinquus	2
Macro	zamia riedlei	орр
Melale	euca lanceolata	орр
Melale	euca systena	3
Neura	chne alopecuroidea	2
Neura	chne alopecuroidea	1
Paters	onia occidentalis	1
* Petror	hagia dubia	2
Phvlla	nthus calycinus	0
Podole	pis lessonii	0
* Romu	ea rosea var. australis	1
Scaev	ola crassifolia	- 0
Sovrid	ium alobulosum	opp
Stylidi	um meaacarpum	3
Trach	imene pilosa	0
i ach		0



Name:	Q9	
<b>ct no.:</b> EP18-085		
Date: 27/11/2018	Statu	us Non-permanent
uthor: SKP	Q9: Page 3 of 3	
native species		
Confirmed name		Cover (%)
* Vulpia bromoides		3
Xanthorrhoea brunonis		2
Xanthorrhoea preissii		5
Xanthosia sp.		2
	Name: tt no.: EP18-085 Date: 27/11/2018 uthor: SKP native species Confirmed name * Vulpia bromoides Xanthorrhoea brunonis Xanthorrhoea preissii Xanthosia sp.	Name:Q9ct no: EP18-085Date: 27/11/2018athor: SKPCorfirmed namenative speciesConfirmed name* Vulpia bromoidesXanthorrhoea brunonisXanthorrhoea preissiiXanthosia sp.



Sample Name:		Q10	
Project no.: EP18-	-085		
Date: 27/11	L/2018	Status Non-permanent Q10: Page 1 of 2	
Author: SKP			
Quadrat and landform deta	ils		
Sample type: quad	rat	Size: 10 m x 10 m	
NW corner easting: 3156	04.1661	NW corner northing: 6273551.355	
Altitude (m): 22		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: mid-slope	
Time since fire: no evidence		Disturbance: low - weeds	
Soil type/texture sand/clay		Bare ground (%): 3	
Rocks (%) and type: No ro	ocks	Soil colour: grey	
Litter: 10% (	twigs,leaves)	Vegetation condition: very good	
Strata	Cover (%)	Height (m)	
Upper:	N/A	Treeless	
Mid:	10 to 30	1 to 2	
Ground layer 1:	<10	<0.5	
Ground layer 2:	<10	<0.5	

#### Vegetation description

Open shrubland Dodonaea ceratocarpa, Kunzea ciliata, Melaleuca systena, Xanthorrhoea preissii over low sparse herbland Lepidosperma squamatum, Stylidium megacarpum, \*Petrorhagia dubia over low sparse tussock grassland \*Briza maxima, \*Vulpia bromoides, Austrostipa mollis





Proi	ect no.: EP18-085	
,	Date: 27/11/2018	Status Non-permanent
	Author: SKP	Q10: Page 2 of 2
Species Data		
* denotes non	-native species	
Status	Confirmed name	Cover (%)
	Acacia cochlearis	2
	* Aira cupaniana	2
	Astroloma ciliatum	0
	Austrostipa mollis	0
	Banksia bipinnatifida	1
	Banksia dallanneyi subsp. dallanneyi	1
	* Briza maxima	4
	Calothamnus sanguineus	2
	Comesperma confertum	0
	Dodonaea ceratocarpa	10
	Hakea prostrata	1
	Hibbertia hypericoides	2
	Hyalosperma cotula	0
	Isotropis cuneifolia subsp. cuneifolia	0
	Jacksonia horrida	2
	Kunzea ciliata	3
	Lepidosperma squamatum	5
	Leucopogon propinquus	1
	Leucopogon propinquus	1
	Melaleuca systena	5
	Neurachne alopecuroidea	1
	Patersonia occidentalis	0
	* Petrorhagia dubia	2
	Rhagodia baccata	2
	Santalum acuminatum	орр
	Spyridium globulosum	1
	Stylidium megacarpum	5
	Tricoryne elatior	0
	* Vulpia bromoides	5
	Xanthorrhoea preissii	5
	Xanthosia candida	0



Sample Name:		Q11	
Project no.: EP	18-085		
Date: 27	/11/2018	Status Non-permanent	
Author: SK	Р	Q11: Page 1 of 2	
Quadrat and landform de	etails		
Sample type: qu	adrat	Size: 10 m x 10 m	
NW corner easting: 31	5607.7704	NW corner northing: 6273576.164	
Altitude (m): 18		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry	ý	Landform: mid-slope	
Time since fire: no evidence		Disturbance: moderate - weeds, changes to structure	
Soil type/texture sand		Bare ground (%): 0	
Rocks (%) and type: 1%	5, granite	Soil colour: brown	
Litter: 20	% (branches,twigs,leaves)	Vegetation condition: good	
Strata	Cover (%)	Haight (m)	
Strata			
opper:	IN/A	Treeless	
Mid:	10 to 30	>2	
Ground layer 1:	10 to 30	1 to 2	
Ground layer 2:	<10	<0.5	

#### Vegetation description

Tall open shrubland Acacia saligna and Spyridium globulosum over open shrubland Hibbertia cuneiformis and Dodonaea ceratocarpa over low sparse herbland Cheilanthes austrotenuifolia





Samp	le Name: Q11	L
P	roject no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: SKP	Q11: Page 2 of 2
Spacias Dat		
* denotes r	a ion-native species	
Status	Confirmed name	Cover (%)
otatuo	Acacia pulchella var. pulchella	0
	Acacia saliana	20
	Agonis flexuosa	ααο
	*DP Asparagus asparagoides	0
	Banksia dallannevi subsp. dallannevi	0
	* Briza maxima	0
	* Bromus hordeaceus	0
	Cheilanthes austrotenuifolia	3
	Dianella revoluta var. revoluta	0
	Dodonaea ceratocarpa	3
	* Ehrharta calvcina	3
	Hakea oleifolia	1
	Hakea prostrata	1
	Hibbertia cuneiformis	3
	Hibbertia hypericoides	1
	* Hypochaeris glabra	2
	Jacksonia horrida	1
	Kunzea glabrescens	0
	Leucopogon parviflorus	1
	Leucopogon propinquus	0
	Muehlenbeckia adpressa	1
	Olearia axillaris	0
	* Oxalis pes-caprae	0
	Rhagodia baccata	2
	Spyridium globulosum	3
	Thomasia foliosa	0
	Xanthorrhoea preissii	3
	*DP Zantedeschia aethiopica	2



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#### Vegetation description

Shrubland Acacia saligna, Guichenotia ledifolia, Hakea prostrata, Hibbertia cuneiformis, Santalum acuminatum and Spyridium globulosum over tussock grassland \*Vulpia bromoides, \*Aira cupaniana and \*Briza spp.





Sampl	e Name: Q12	2
Pro	iject no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: SKP	Q12: Page 2 of 2
Snecies Data		
* denotes no	n-native species	
Status	Confirmed name	Cover (%)
otatao	Acacia cochlearis	3
	Acacia pulchella var. pulchella	ממס
	Acacia saliana	40
	Acanthocarpus preissii	0
	* Aira cupaniana	5
	* Avena sp.	1
	Banksia dallanneyi subsp. dallannevi	2
	* Briza maxima	10
	* Briza minor	5
	* Bromus hordeaceus	0
	Cheilanthes austrotenuifolia	0
	Guichenotia ledifolia	8
	Hakea prostrata	5
	Hibbertia cuneiformis	10
	Hibbertia hypericoides	1
	Kunzea glabrescens	орр
	Leucopogon propinquus	0
	* Lysimachia arvensis	3
	Melaleuca systena	3
	Muehlenbeckia adpressa	2
	Patersonia occidentalis	0
	* Petrorhagia dubia	0
	Phyllanthus calycinus	1
	Rhagodia baccata	3
	Santalum acuminatum	8
	Spyridium globulosum	5
	* Vulpia bromoides	15
	Xanthorrhoea preissii	0
	*DP Zantedeschia aethiopica	2



Sample Name: Project no.: EP18-085		Q13	
Date: 27/1	.1/2018	Status Non-permanent	
Author: SKP		Q13: Page 1 of 3	
Quadrat and landform det	ails		
Sample type: qua	drat	Size: 10 m x 10 m	
NW corner easting: 315	707.2046	NW corner northing: 6273432.193	
Altitude (m): 24		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: mid-slope	
Time since fire: no evidence		Disturbance: low - weeds	
Soil type/texture sand with organic layer		Bare ground (%): 10	
Rocks (%) and type: No r	ocks	Soil colour: brown	
Litter: 50%	(branches,leaves)	Vegetation condition: very good	
Chroto	Cover (%)		
Strata		Height (m)	
Opper:	30 to 70	<10	
Mid:	10 to 30	1 to 2	
Ground layer 1:	<10	<0.5	
Ground layer 2:	<10	<0.5	

#### Vegetation description

low open forest Banksia spp. and Agonis flexuosa over open shrubland Spyridium globulosum over low sparse herbland Stylidium adnatum, Trachymene pilosa, \*Hypochaeris glabra over low sparse tussock grassland \*Briza maxima, \*Ehrharta calycina, Austrostipa mollis





Pro	ject no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: SKP	Q13: Page 2 of 3
Species Data		
* denotes nor	n-native species	
Status	Confirmed name	Cover (%)
	Agonis flexuosa	20
	Austrostipa mollis	0
	Austrostipa mollis	0
	Austrostipa mollis	0
	Banksia attenuata	20
	Banksia sessilis var. cordata	5
	* Briza maxima	4
	Burchardia congesta	0
	Chamaescilla corymbosa	0
	Comesperma confertum	0
	Corymbia calophylla	1
	Desmocladus flexuosus	0
	* Ehrharta calycina	2
	Gompholobium tomentosum	0
	Hardenbergia comptoniana	0
	Hibbertia amplexicaulis	0
	Hibbertia cuneiformis	0
	Hibbertia hypericoides	0
	* Hypochaeris glabra	1
	* Hypochaeris glabra	1
	Lagenophora huegelii	0
	Lagenophora huegelii	0
	Levenhookia stipitata	0
	Lobelia tenuior	0
	Lomandra pauciflora	0
	Macrozamia riedlei	2
	Melaleuca systena	1
	Patersonia occidentalis	0
	Phyllanthus calycinus	1
	Pimelea rosea subsp. rosea	0
	Poranthera microphylla	1
	Rhodanthe citrina	0
	Siloxerus humifusus	0
	Spyridium globulosum	5
	Stylidium adnatum	2
	Stylidium brunonianum	1



Sample	e Name:	Q13	
Proje	ect no.: EP18-085		
	Date: 27/11/2018	Status Non-permanent	
Author: SKP		Q13: Page 3 of 3	
Species Data			
* denotes non	-native species		
Status	Confirmed name	Cover (%)	
	Trachymene pilosa	1	
	Wahlenbergia sp.	0	
	Xanthorrhoea preissii	2	
	Xanthosia candida	0	
	Xanthosia candida	0	



Sample Name:		Q14
Project no.: EP18	-085	
Date: 27/12	l/2018	Status Non-permanent
Author: SKP		Q14: Page 1 of 2
Ouadrat and landform deta	ils	
Sample type: quad	rat	Size: 10 m x 10 m
NW corner easting: 3156	58.2431	NW corner northing: 6273374.31
Altitude (m): 32		Geographic datum/zone: GDA94/Zone 50
Soil water content: dry		Landform: mid-slope
Time since fire: no evidence		Disturbance: moderate - weeds, adj to track
Soil type/texture sand with organic layer		Bare ground (%): 10
Rocks (%) and type: No ro	ocks	Soil colour: brown
Litter: 40%	branches, leaves)	Vegetation condition: very good
Strata	Cover (%)	Height (m)
Upper:	30 to 70	<10
Mid:	<10	1 to 2
Ground laver 1:	10 to 30	<0.5
Ground layer 2:	<10	<0.5

#### Vegetation description

low open forest Banksia spp., Corymbia calophylla and Agonis flexuosa over open shrubland Spyridium globulosum and Diplolaena dampieri over low sparse herbland Lepidosperma gladiatum, Stylidium spp. over low sparse tussock grassland \*Ehrharta calycina, Austrostipa spp.





Pro	ject no.: EP18-085	Status Non-permanent
	Author: SKP	Q14: Page 2 of 2
<b>pecies Data</b>	n-native species	
itatus	Confirmed name	Cover (%)
	Agonis flexuosa	40
	* Aira cupaniana	1
	Austrostipa flavescens	0
	Austrostipa mollis	0
	Banksia attenuata	10
	Burchardia congesta	0
	Caladenia sp.	0
	Chamaescilla corymbosa	0
	Chorizema diversifolium	0
	Corymbia calophylla	2
	Desmocladus flexuosus	1
	Dichopogon preissii	0
	Diplolaena dampieri	3
	* Ehrharta calycina	0
	* Euphorbia terracina	0
	Eutaxia myrtifolia	0
	Hardenbergia comptoniana	0
	Hibbertia amplexicaulis	0
	Lagenophora huegelii	0
	Lepidosperma gladiatum	10
	Leucopogon propinquus	0
	Lobelia tenuior	0
	Macrozamia riedlei	2
	Melaleuca systena	1
	Olearia axillaris	1
	* Petrorhagia dubia	0
	* Petrorhagia dubia	0
	Phyllanthus calycinus	1
	Pimelea rosea subsp. rosea	0
	Ptilotus manglesii	0
	Spyridium globulosum	5
	Stylidium adnatum	1
	Stylidium brunonianum	0
	Wahlenbergia sp.	0



Sample Name: Project no.: EP18-085		Q15	
Date: 27/12	1/2018	Status Non-permanent	
Author: SKP		Q15: Page 1 of 2	
Quadrat and landform deta	ils		
Sample type: quad	rat	Size: 10 m x 10 m	
NW corner easting: 3158	42.1411	NW corner northing: 6273434.233	
Altitude (m): 16		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: mid-slope	
Time since fire: no evidence		Disturbance: moderate - weeds	
Soil type/texture sand with organic layer		Bare ground (%): 5	
Rocks (%) and type: No ro	ocks	Soil colour: brown	
Litter: 60% (	branches, leaves)	Vegetation condition: good-very good	
Chucho	Cover(9)		
Strata	Cover (%)	Height (m)	
Upper:	30 to 70	<10	
Mid:	30 to 70	1 to 2	
Ground layer 1:	<10	>0.5	
Ground layer 2:	<10	<0.5	

#### Vegetation description

low open forest Agonis flexuosa over shrubland Spyridium globulosum, Hakea oleifolia, Diplolaena dampieri and Macrozamia riedlei over tall sparse herbland \*Zantedeschia aethiopica, Dichondra repens, Stylidium adnatum and Trachymene pilosa over low sparse tussock grassland \*Briza maxima, \*Bromus hordeaceus





Sample	e Name:	Q15
Proje	ect no.: EP18-085	
Date: 27/11/2018		Status Non-permanent
ŀ	Author: SKP	Q15: Page 2 of 2
Species Data		
* denotes non-	-native species	
Status	Confirmed name	Cover (%)
	Agonis flexuosa	40
	*DP Asparagus asparagoides	0
	* Briza maxima	1
	* Bromus hordeaceus	0
	Cheilanthes austrotenuifolia	0
	Chorizema diversifolium	0
	Daucus glochidiatus	0
	Dichondra repens	2
	Diplolaena dampieri	5
	Hakea oleifolia	5
	Hardenbergia comptoniana	0
	Hibbertia amplexicaulis	орр
	Hibbertia cuneiformis	орр
	* Hypochaeris radicata	1
	* Lysimachia arvensis	1
	Macrozamia riedlei	5
	* Petrorhagia dubia	0
	* Petrorhagia dubia	0
	Phyllanthus calycinus	2
	Rhagodia baccata	1
	Spyridium globulosum	30
	Stylidium adnatum	1
	Trachymene pilosa	1
	Xanthorrhoea preissii	1
	Xanthosia candida	0
	*DP Zantedeschia aethiopica	5


Sample Name:		Q16	
Project no.: EP18-	-085		
Date: 27/11	l/2018	Status Non-permanent	
Author: SKP		Q16: Page 1 of 2	
Quadrat and landform deta	ils		
Sample type: quad	rat	Size: 10 m x 10 m	
NW corner easting: 3160	18.3748	NW corner northing: 6273459.585	
Altitude (m): 24		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: mid-slope	
Time since fire: no evidence		Disturbance: moderate - weeds, adj to track	
Soil type/texture clay		Bare ground (%): 20	
Rocks (%) and type: 10%,	granite	Soil colour: orange	
Litter: 25% (	twigs,leaves)	Vegetation condition: good-very good	
Churche	Cover (%)	llaiaht/m)	
Strata	cover (%)	Height (m)	
Upper: ~0		<10	
Mid: 30 to 70		1 to 2	
Ground layer 1: <10		<0.5	
Ground layer 2: 10 to 30		<0.5	

#### Vegetation description

Low isolated trees Corymbia calophylla over shrubland Darwinia citriodora and Dodonaea ceratocarpa over low sparse sedgeland Lepidosperma squamatum over low open tussock grassland \*Aira cupaniana, \*Vulpia bromoides, \*Briza maxima, Rytidosperma occidentale





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Sampl	e Name: Q16	5
Prc	oject no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: SKP	Q16: Page 2 of 2
Species Data	 I	
* denotes no	n-native species	
Status	Confirmed name	Cover (%)
	Acacia cochlearis	2
	Acacia pulchella var. pulchella	орр
	Acacia saligna	2
	Agonis flexuosa	орр
	* Aira cupaniana	3
	Banksia dallanneyi subsp. dallanneyi	1
	* Briza maxima	5
	* Bromus hordeaceus	орр
	Calothamnus sanguineus	орр
Corymbia calophylla		2
Darwinia citriodora		30
	Dodonaea ceratocarpa	20
	* Ehrharta calycina	opp
	Haemodorum sp.	opp
	Hibbertia amplexicaulis	opp
	Hibbertia hypericoides	2
	Kunzea ciliata	opp
	Kunzea ciliata	opp
	Lepidosperma squamatum	5
	Leucopogon propinquus	орр
	Leucopogon propinquus	орр
	Macrozamia riedlei	opp
	Neurachne alopecuroidea	3
	Pimelea ferruginea	2
	Rytidosperma occidentale	3
	Spyridium globulosum	3
	* Vulpia bromoides	5



Sample Name:		R17	
Project no.: E	P18-085		
Date: 2	27/11/2018	Status Non-permanent	
Author: S	SKP	R17: Page 1 of 2	
Quadrat and landform	details		
Sample type: r	eleve	Size: 10 m x 10 m	
NW corner easting: 3	15688.2973	NW corner northing: 6273532.562	
Altitude (m): 1	4	Geographic datum/zone: GDA94/Zone 50	
Soil water content: c	Iry	Landform: mid-slope	
Time since fire: r	no evidence	Disturbance: moderate - weeds	
Soil type/texture s	and	Bare ground (%): 15	
Rocks (%) and type: N	lo rocks	Soil colour: brown	
Litter: 3	80% (branches,twigs,leaves)	Vegetation condition: very good	
Churche	Cover (%)		
Strata Cover (%)		Height (m)	
Upper: 30 to 70		<10	
Mid: 10 to 30		1 to 2	
Ground layer 1:	<10	<0.5	
Ground layer 2: <10		<0.5	

### Vegetation description

low open forest Banksia attenuata over open shrubland Macrozamia riedlei over low sparse herbland over low sparse tussock grassland





Proj	ect no.: EP18-085	
Date: 27/11/2018 Author: SKP		Status Non-permanent
		R17: Page 2 of 2
Species Data		
• • denotes non	n-native species	
Status	Confirmed name	Cover (%)
	Acacia cochlearis	орр
	* Aira cupaniana	орр
	Banksia attenuata	орр
	* Briza maxima	орр
	Carpobrotus virescens	орр
	* Ehrharta calycina	орр
	Hibbertia cuneiformis	орр
	Hyalosperma cotula	орр
	Macrozamia riedlei	орр
	Melaleuca systena	орр
	Patersonia occidentalis	орр
	Phyllanthus calycinus	орр
	Ptilotus manglesii	орр
	Rhagodia baccata	орр
	Santalum acuminatum	орр
	Spyridium globulosum	орр
	Stylidium adnatum	opp
	Trachymene pilosa	opp



Sample Name:		Q18	
Project no.: El	218-085		
Date: 28	3/11/2018	Status Non-permanent	
Author: SI	(P	Q18: Page 1 of 3	
Quadrat and landform d	letails		
Sample type: q	uadrat	Size: 10 m x 10 m	
NW corner easting: 32	15910.0048	NW corner northing: 6273354.33	
Altitude (m): 24	1	Geographic datum/zone: GDA94/Zone 50	
Soil water content: di	γ	Landform: mid-slope	
Time since fire: no	o evidence	Disturbance: moderate - weeds, diggings	
Soil type/texture sand with organic layer		Bare ground (%): 1	
Rocks (%) and type: N	o rocks	Soil colour: brown/orange	
Litter: 70	)% (logs,leaves)	Vegetation condition: good-very good	
Strata Cover (%)		Height (m)	
Upper:	30 to 70	<10	
Mid: <10		1 to 2	
Ground layer 1: 70 to 100		<0.5	
Ground layer 2: 10 to 30		<0.5	

#### Vegetation description

low open forest Agonis flexuosa over sparse shrubland Pimelea ferruginea and Hibbertia hypericoides over low closed herbland Scaevola calliptera, \*Cotula coronopifolia over low tussock grassland Microlaena stipoides, Austrostipa mollis and \*Ehrharta calycina





Project no.: EP18-085 Date: 28/11/2018 Author:	Status Non-permanent Q18: Page 2 of 3
ecies Data	
enotes non-native species	
tus Confirmed name	Cover (%)
?Caesia micrantha	1
Agonis flexuosa	opp
* Aira cupaniana	0
*DP Asparagus asparagoides	opp
Austrostipa mollis	2
* Briza maxima	1
* Briza minor	1
* Bromus hordeaceus	1
Caladenia sp.	2
* Cotula coronopifolia	1
Darwinia citriodora	0
* Ehrharta calycina	2
* Euphorbia terracina	0
Hakea oleifolia	1
Hardenbergia comptoniana	5
Hibbertia cuneiformis	0
Hibbertia hypericoides	3
Homalosciadium homalocarp	<i>um</i> 0
* Hypochaeris glabra	1
Levenhookia stipitata	1
** Lysimachia arvensis	opp
Macrozamia riediei	0
Microidena stipoides	20
* Delargonium canitatum	3
* Detrorbagia dubia	Ομμ
Petromagia aubia	0
Pimelea ferruainea	5
* Plantago lanceolata	1
Pteridium esculentum subsn	esculentum 2
Rhaaodia baccata	0
Scaevola callintera	ت ح
Schoenus sp.	2
* Sonchus oleraceus	_
Spyridium globulosum	
Stylidium adnatum	



Sample Name:		Q18	
Proj	ject no.: EP18-085		
	Date: 28/11/2018	Status Non-permanent	
	Author: SKP	Q18: Page 3 of 3	
Species Data			
* denotes nor	n-native species		
Status	Confirmed name	Cover (%)	
	Trachymene pilosa		
	* Trifolium campestre		
Xanthorrhoea preissii			
	*DP Zantedeschia aethiopica		



Sample Name:		Q19	
Project no.: EP18	3-085		
Date: 28/1	1/2018	Status Non-permanent	
Author: SKP		Q19: Page 1 of 2	
Quadrat and landform det	ails		
Sample type: quad	drat	Size: 10 m x 10 m	
NW corner easting: 3157	72.5885	NW corner northing: 6273307.646	
Altitude (m): 34		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: mid-slope	
Time since fire: no e	vidence	Disturbance: moderate - weeds	
Soil type/texture sand		Bare ground (%): 10	
Rocks (%) and type: No r	ocks	Soil colour: brown	
Litter: 60%	(branches,twigs,leaves)	Vegetation condition: very good	
Churche	Cover (9/)		
Strata Cover (%)		Height (m)	
Upper:	30 to 70	<10	
Mid: <10		1 to 2	
Ground layer 1: 10 to 30		<0.5	
Ground layer 2: ~0		<0.5	

#### Vegetation description

low open forest Agonis flexuosa and Corymbia calophylla over sparse shrubland Spyridium globulosum over low herbland \*Lysimachia arvensis, \*Hypochaeris glabra, \*Zantedeschia aethiopica and Trachymene pilosa over low isolated tussock grassland





Sample Na	me: Q	19
Project no.:	EP18-085	
Date:	28/11/2018	Status Non-permanent
Author:	SKP	Q19: Page 2 of 2
Species Data		
* denotes non-native s	species	
Status	Confirmed name	Cover (%)
*	Acacia iteaphylla	opp
	Agonis flexuosa	40
	Cheilanthes austrotenuifolia	3
	Corymbia calophylla	20
	Daucus glochidiatus	0
	Diplolaena dampieri	2
	Fabaceae sp.	орр
	Guichenotia ledifolia	0
	Hakea oleifolia	2
	Hibbertia amplexicaulis	0
	Hibbertia cuneiformis	3
*	Hypochaeris glabra	2
	Levenhookia stipitata	0
	Lobelia tenuior	0
*	Lysimachia arvensis	3
*	Orobanche minor	0
*	Oxalis pes-caprae	2
	Phyllanthus calycinus	1
	Rhodanthe citrina	0
	Scaevola calliptera	0
*	Silene gallica	1
	Spyridium globulosum	5
	Stylidium adnatum	1
	Stylidium brunonianum	орр
	Thomasia triphylla	0
	Trachymene pilosa	2
	Wahlenbergia sp.	0
	Xanthorrhoea preissii	2
*DP	Zantedeschia aethiopica	5



Sample Na	me:	Q20	
Project no.:	EP18-085		
Date:	28/11/2018	Status Non-permanent	
Author:	SKP,RAO	Q20: Page 1 of 2	
Quadrat and landform	n details		
Sample type:	quadrat	Size: 10 m x 10 m	
NW corner easting:	315312.5229	NW corner northing: 6273444.45	
Altitude (m):	42	Geographic datum/zone: GDA94/Zone 50	
Soil water content:	dry	Landform: lower slope	
Time since fire:	no evidence	Disturbance: low - diggings	
Soil type/texture	sand/clay with organic layer	Bare ground (%): 10	
Rocks (%) and type:	10%, granite	Soil colour: brown	
Litter:	80% (branches,leaves)	Vegetation condition: excellent	
Strata	Cover (%)	Height (m)	
Upper:	N/A	Treeless	
Mid:	70 to 100	>2	
Ground layer 1:	<10	<1	
Ground layer 2: 0%		0	

### Vegetation description

Tall closed shrubland Melaleuca lanceolata





Sample Name.		Q20
Proje	ect no.: EP18-085	
Date: 28/11/2018		Status Non-permanent
Α	uthor: SKP, RAO	Q20: Page 2 of 2
pecies Data		
denotes non-	native species	
tatus	Confirmed name	Cover (%)
	Diplolaena dampieri	орр
	Dodonaea ceratocarpa	1
	Enchylaena tomentosa	0
	Eutaxia myrtifolia	0
	Ficinia nodosa	0
Kunzea ciliata		1
	Lepidosperma squamatum	0
	Leucopogon parviflorus	0
	Melaleuca lanceolata	80
	Rhagodia baccata	0
	Xanthorrhoea preissii	орр



Sample Name:		Q21	
Project no.: EP18	-085		
Date: 26/1	1/2018	Status	Non-permanent
Author: RAO			Q21: Page 1 of 2
Quadrat and landform deta	nils		
Sample type: quad	rat	Size:	10 m x 10 m
NW corner easting: 3152	85	NW corner northing:	6273593
Altitude (m): 20		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: upper slope	
Time since fire: no evidence		Disturbance:	low - fauna
Soil type/texture sand/clay		Bare ground (%):	10
Rocks (%) and type: 10%,	granite	Soil colour: brown	
Litter: 3% (l	eaves,twigs)	Vegetation condition: excellent	
Strata	Cover (%)	Height (m)	
Upper:	N/A	Treeless	
Mid:	70 to 100	1 to 2	Quartz rocks, lateritic gravel
Ground layer 1: ~0		<0.5	
Ground layer 2: ~0		<0.5	

### Vegetation description

Closed shrubland Melaleuca lanceolata, Kunzea ciliata, Rhagodia baccata, Spyridium globulosum, Leucopogon parviflorus, Eutaxia myrtifolia over low isolated tussock grassland \*Aira praecox over low isolated herbland





Sample	e Name:	Q21
Proj	ject no.: EP18-085	
-	Date: 26/11/2018	Status Non-permanent
	Author: RAO	Q21: Page 2 of 2
Species Data		
• * denotes nor	n-native species	
Status	Confirmed name	Cover (%)
	Acacia pulchella var. pulchella	0
	* Aira praecox	0
	Carpobrotus virescens	0
	* Centaurium tenuiflorum	0
	Crassula colorata	0
	Dianella revoluta var. revoluta	0
	Diplolaena dampieri	1
	Dodonaea ceratocarpa	1
	Eutaxia myrtifolia	5
	Ficinia nodosa	орр
	Kunzea ciliata	15
	Lepidosperma squamatum	0
	Leucopogon parviflorus	10
	* Linum trigynum	0
	* Lysimachia arvensis	0
	Melaleuca lanceolata	60
	Muehlenbeckia adpressa	opp
	Olearia axillaris	opp
	Patersonia occidentalis	opp
	Pimelea ferruginea	opp
	Rhagodia baccata	5
	Senecio pinnatifolius var. maritimu	s 0
	Spyridium globulosum	10



Sample Name	2:	Q22	
Project no.: EP18	-085		
Date: 26/1	1/2018	Status N	on-permanent
Author: RAO		Q2	22: Page 1 of 2
Ouadrat and landform deta	ails		
Sample type: quad	rat	Size: 10	0 m x 10 m
NW corner easting: 3151	26	NW corner northing: 62	273179
Altitude (m): 20		Geographic datum/zone: G	DA94/Zone 50
Soil water content: dry		Landform: m	id-slope
Time since fire: no ev	vidence	Disturbance: m	oderate - weeds, fauna, humans
Soil type/texture sand	/clay	Bare ground (%): 10	)
Rocks (%) and type: 1%, g	granite	Soil colour: bi	rown
Litter: 30%	(twigs,branches)	Vegetation condition: go	pod
Strata	Cover (%)	Height (m)	
Unner	N/A		
Mid <sup>.</sup>	10 to 30	>2	gravel
Ground laver 1	30 to 70	1 to 2	0.0.0.
Ground layer 2:	<10	>0.5	

### Vegetation description

Tall open shrubland Acacia rostellifera and Spyridium globulosum over shrubland Guichenotia ledifolia, Leucopogon australis and Melaleuca huegelii over tall sparse herbland Dianella revoluta var. revoluta, Crassula spp. and \*Phleum arenarium





Sampl	le Name:	Q22
Pro	oject no.: EP18-085	
	Date: 26/11/2018	Status Non-permanent
	Author: RAO	Q22: Page 2 of 2
Species Data	3	
* denotes no	on-native species	
Status	Confirmed name	Cover (%)
	Acacia cyclops	0
	Acacia rostellifera	10
	*DP Asparagus asparagoides	0
	Austrostipa flavescens	0
	* Briza maxima	0
	* Briza minor	1
	* Centaurium tenuiflorum	0
	Clematis linearifolia	0
	Crassula exserta	1
	* Crassula glomerata	1
	Dianella revoluta var. revoluta	5
	Guichenotia ledifolia	10
	Guichenotia ledifolia	0
	Hibbertia cuneiformis	0
	Leucopogon australis	10
	* Lysimachia arvensis	1
	Melaleuca huegelii	5
	* Phleum arenarium	2
	Phyllanthus calycinus	0
	Spyridium globulosum	15
	Trachymene pilosa	1
	* Wahlenbergia capensis	0



Sample Name:		Q23	
Project no.: EP18-	085		
Date: 26/11	/2018	Status Non-permanent	
Author: RAO		Q23: Page 1 of 2	
Quadrat and landform detai	ils		
Sample type: quadr	at	Size: 10 m x 10 m	
NW corner easting: 31514	2	NW corner northing: 6273185	
Altitude (m): 22		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: upper slope	
Time since fire: no evi	dence	Disturbance: low -	
Soil type/texture sand/	clay	Bare ground (%): 10	
Rocks (%) and type: 20%, §	granite	Soil colour: brown	
Litter: 2% (le	aves)	Vegetation condition: very good	
Strata	Cover (%)	Height (m)	
Unner	N/A		
Mid	10 to 30	1 to 2	
Ground laver 1	10 to 30	<0.5	
Ground layer 2:	10 to 30	<0.5	

### Vegetation description

Open shrubland Acacia rostellifera, Leucopogon parviflorus over low open herbland Dianella revoluta var. revoluta over low open sedgeland Lepidosperma calcicola and Lepidosperma squamatum





Sample	e Name: Q	23
Proj	ect no.: EP18-085	
	Date: 26/11/2018	Status Non-permanent
	Author: RAO	Q23: Page 2 of 2
Species Data		
* denotes non	-native species	
Status	Confirmed name	Cover (%)
	Acacia rostellifera	5
	*DP Asparagus asparagoides	0
	* Avena sp.	0
	Dianella revoluta var. revoluta	25
	Dodonaea ceratocarpa	1
	Guichenotia ledifolia	0
	Hibbertia hypericoides	0
	Lepidosperma calcicola	20
	Lepidosperma squamatum	5
	Leucopogon parviflorus	10
	Marianthus candidus	0
	Melaleuca huegelii	1
	* Petrorhagia dubia	0
	Spyridium globulosum	1
	Thomasia triphylla	0



Sample Name:		R24	
Project no.: EP1	.8-085		
Date: 26/	11/2018	Status Non-permanent	
Author: RAG	0	R24: Page 1 of 2	
Quadrat and landform de	tails		
Sample type: rele	eve	Size: other	
NW corner easting: 315	264	NW corner northing: 3273266	
Altitude (m): 32		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: lower slope	
Time since fire: no	evidence	Disturbance: low -	
Soil type/texture clay	/	Bare ground (%): 20	
Rocks (%) and type: 5%	, granite	Soil colour: brown	
Litter: 109	6 (leaves,branches)	Vegetation condition: excellent	
Churche			
Strata	Cover (%)	Height (m)	
Upper:	N/A	Treeless	
Mid:	<10	>2	
Ground layer 1:	70 to 100	1 to 2	
Ground layer 2:	<10	<0.5	

### Vegetation description

Tall sparse shrubland Melaleuca lanceolata over closed shrubland Kunzea ciliata, Leucopogon parviflorus over low sparse forbland





-		
Proje	ect no.: EP18-085	
	Date: 26/11/2018	Status Non-permanent
	Author: RAO	R24: Page 2 of 2
Species Data		
* denotes non-	native species	
Status	Confirmed name	Cover (%)
	Acacia pulchella var. pulchella	0
	Acacia rostellifera	1
	Agonis flexuosa	1
	Banksia bipinnatifida	0
	Banksia dallanneyi subsp. sylvestris	1
	Desmocladus flexuosus	1
	Dodonaea ceratocarpa	1
	Eutaxia myrtifolia	2
	Hibbertia hypericoides	0
	Kunzea ciliata	70
	Lepidosperma squamatum	0
	Leucopogon parviflorus	5
	Lomandra micrantha subsp. micrantha	0
	Melaleuca lanceolata	5
	Melaleuca systena	0
	Patersonia occidentalis	0
	Pimelea ferruginea	1
	Santalum acuminatum	0
	Spyridium globulosum	1
	Xanthorrhoea brunonis	0



Sample Name:		Q25
Project no.: EP18	-085	
Date: 27/1	1/2018	Status Non-permanent
Author:		Q25: Page 1 of 3
Ouadrat and landform deta	ils	
Sample type: quad	rat	Size: 10 m x 10 m
NW corner easting: 3154	94	NW corner northing: 6273272
Altitude (m): 48		Geographic datum/zone: GDA94/Zone 50
Soil water content: dry		Landform: upper slope
Time since fire: no ev	vidence	Disturbance: low - fauna
Soil type/texture sand		Bare ground (%): 5
Rocks (%) and type: 1%, li	mestone	Soil colour: brown/orange
Litter: 60%	(leaves,branches)	Vegetation condition: very good-excellent
	Cover (9/)	
Strata	Cover (%)	Height (m)
Upper:	10 to 30	<10
Mid:	30 to 70	1 to 2
Ground layer 1:	<10	<0.5
Ground layer 2:	10 to 30	<0.5

### Vegetation description

Low woodland Melaleuca lanceolata over shrubland Melaleuca huegelii, Acacia rostellifera, Hibbertia cuneiformis over low sparse tussock grassland over low open rushland Desmocladus flexuosus





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Sample Name: Q2	5
Project no.: EP18-085	
Date: 27/11/2018	Status Non-permanent
Author: RAO	Q25: Page 2 of 3
Species Data	
* denotes non-native species	
Status Confirmed name	Cover (%)
Acacia rostellifera	10
*DP Asparagus asparagoides	0
Austrostipa flavescens	0
* Avena sp.	0
Cassytha flava	0
Clematis linearifolia	0
Conostylis aculeata subsp. gracilis	1
Desmocladus flexuosus	20
Diplolaena dampieri	1
* Ehrharta calycina	0
* Euphorbia peplus	0
Gompholobium tomentosum	0
Hakea prostrata	2
Hibbertia cuneiformis	5
Hibbertia racemosa	0
Hybanthus calycinus	1
Lepidosperma squamatum	0
Leucopogon parviflorus	1
Lobelia tenuior	0
* Lysimachia arvensis	15
Melaleuca huegelii	10
Melaleuca lanceolata	3
Melaleuca systena	1
Microlaena stipoides	1
Olearia axillaris	2
Patersonia occidentalis	1
Petrophile linearis	0
Phyllanthus calvcinus	0
Pog poiformis	0
Poranthera micronhylla	0
Rhaaodia baccata	0
Rhodanthe citring	0
Rytidosperma occidentale	0 0
* Sonchus oleraceus	ů Ú
Spyridium alohulosum	40
Stylidium adnatum	0



Sample	e Name:	Q25
Proj	iect no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: RAO	Q25: Page 3 of 3
Species Data		
* denotes nor	n-native species	
Status	Confirmed name	Cover (%)
	Stylidium brunonianum	0
	Thysanotus patersonii	0
	Trachymene pilosa	0
	Xanthosia candida	0



Sample Name:		Q26	
Project no.: EP18	8-085		
Date: 27/1	1/2018	Status Non-permanent	
Author: RAO		Q26: Page 1 of 2	
Quadrat and landform det	ails		
Sample type: quad	Irat	Size: 10 m x 10 m	
NW corner easting: 3153	349	NW corner northing: 6273207	
Altitude (m): 50		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: upper slope	
Time since fire: no e	vidence	Disturbance: low - fauna	
Soil type/texture sand	with organic layer	Bare ground (%): 5	
Rocks (%) and type: No r	ocks	Soil colour: brown	
Litter: 70%	(branches,leaves)	Vegetation condition: very good	
Strata	Cover (%)	Height (m)	
Unner	10 to 30	<10	
Mid	10 to 30	1 to 2	
Ground laver 1:	<10	<05	
Ground layer 2:	0%	0	

### Vegetation description

Low woodland Melaleuca lanceolata over open shrubland Spyridium globulosum and Melaleuca huegelii over low sparse herbland





Project no.: EP18-085			
Date: 27/11/2018		Status Non-permanent	
Author: RAO		Q26: Page 2 of 2	
species Data			
denotes non-native species			
Status Confirmed n	ame	Cover (%)	
Acacia roster	lifera	1	
* Aira cupania	na	0	
*DP Asparagus a	sparagoides	0	
Caladenia ?a	ttingens subsp. attingens	0	
* Centaurium	tenuiflorum	0	
Centrolepis d	Irummondiana	0	
* Cicendia filifo	ormis	0	
Clematis line	arifolia	0	
Conostylis ac	uleata subsp. gracilis	0	
Dianella revo	oluta var. revoluta	0	
Diplolaena d	ampieri	0	
* Euphorbia pe	eplus	0	
* Galium mura	le	0	
Guichenotia	ledifolia	орр	
Hakea oleifo	lia	орр	
Hibbertia cu	neiformis	1	
Hybanthus c	alycinus	0	
* Hypochaeris	glabra	0	
Isolepis marg	ginata	0	
Lagenophore	n huegelii	0	
Leucopogon	parviflorus	0	
Lomandra he	ermaphrodita	0	
* Lysimachia a	rvensis	1	
Melaleuca h	uegelii	5	
Melaleuca la	nceolata	25	
Melaleuca sy	vstena	1	
, Poranthera r	nicrophylla	0	
Rhagodia ba	ccata	0	
Spyridium al	obulosum	10	
Thomasia for	liosa	0	
Trachvmene	pilosa	0	
* Vulpia brom	, pides	0	
Vanthorrhoo	a preissii	2	



Sample Name:		Q27	
Project no.: EP18-085			
Date: 27/1	1/2018	Status Non-permanent	
Author: RAO		Q27: Page 1 of 2	
Quadrat and landform det	ails		
Sample type: quad	Irat	Size: 10 m x 10 m	
NW corner easting: 0		NW corner northing: 0	
Altitude (m): 0		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: mid-slope	
Time since fire: no evidence		Disturbance: low -	
Soil type/texture sand		Bare ground (%): 10	
Rocks (%) and type: 1%,	granite	Soil colour: brown/orange	
Litter: 20%	(branches,leaves)	Vegetation condition: very good	
Church-	Cover(%)		
Strata	Cover (%)	Height (m)	
Upper:	N/A	Treeless	
Mid: <10		1 to 2	
Ground layer 1:	30 to 70	1 to 2	
Ground layer 2:	<10	<0.5	

### Vegetation description

Sparse shrubland Diplolaena dampieri, Acacia rostellifera, Eutaxia myrtifolia, Dodonaea ceratocarpa, Melaleuca huegelii and Xanthorrhoea preissii





	ect no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: RAO	Q27: Page 2 of 2
Species Data		
* denotes non-	-native species	
Status	Confirmed name	Cover (%)
	Acacia rostellifera	5
	* Aira cupaniana	0
	* Centaurium tenuiflorum	0
	Desmocladus flexuosus	0
	Diplolaena dampieri	20
	Dodonaea ceratocarpa	5
	Eutaxia myrtifolia	20
	Hibbertia cuneiformis	0
	Kunzea ciliata	1
	Lepidosperma squamatum	1
	Leucopogon parviflorus	10
	Lomandra micrantha subsp. micrantha	0
	* Lysimachia arvensis	0
	Melaleuca huegelii	5
	Patersonia occidentalis	0
	Rytidosperma sp.	0
	Spyridium globulosum	5
	* Vulpia bromoides	0
	Xanthorrhoea preissii	5



Sample Name:		Q28	
Project no.: EF	218-085		
Date: 27	7/11/2018	Status Non-permanent	
Author: RA	40	Q28: Page 1 of 2	
Quadrat and landform d	letails		
Sample type: qu	uadrat	Size: 10 m x 10 m	
NW corner easting: 31	15181	NW corner northing: 6273173	
Altitude (m): 38		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dr	Ŋ	Landform: hilltop	
Time since fire: no	o evidence	Disturbance: low -	
Soil type/texture sa	nd/clay with organic layer	Bare ground (%): 10	
Rocks (%) and type: 10	0%, limestone	Soil colour: brown	
Litter: 40	)% (branches,leaves)	Vegetation condition: very good	
Strata	Cover (%)	Height (m)	
Upper:	70 to 100	<10	
Mid: <10		1 to 2	
Ground layer 1: <10		<0.5	
Ground layer 2: 0%		0	

### Vegetation description

Low closed forest Melaleuca lanceolata over sparse shrubland Acacia rostellifera over low sparse herb Dianella revoluta var. revoluta





Campie		420
Proje	ect no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
ŀ	Author: RAO	Q28: Page 2 of 2
Species Data		
* denotes non-	native species	
Status	Confirmed name	Cover (%)
	Acacia littorea	0
	Acacia rostellifera	5
	Dianella revoluta var. revoluta	0
	Hakea oleifolia	0
	Leucopogon parviflorus	1
	Melaleuca lanceolata	80
	Spyridium globulosum	0



Sample Name:		Q29	
Project no.: EP18	Project no.: EP18-085		
Date: 27/1	1/2018	Status N	Non-permanent
Author: RAO		С	Q29: Page 1 of 3
Quadrat and landform deta	ils		
Sample type: quad	rat	Size: 1	10 m x 10 m
NW corner easting: 315424		NW corner northing: 6273232	
Altitude (m): 47		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: upper slope	
Time since fire: no evidence		Disturbance: I	ow -
Soil type/texture sand/clay with organic layer		Bare ground (%): 5	5
Rocks (%) and type: 1%, limestone		Soil colour: brown	
Litter: 40%	(branches,leaves)	Vegetation condition: N	very good-good
Strata	Cover (%)	lleight (m)	
Strata	20 to 70	Height (m)	
Mid.	10 to 20	<10	hrvonhytes present
		>2	biyophytes present
Ground laver 1:	<10	1 to 2	
Ground layer 2: <10		<0.5	

### Vegetation description

Low open forest Melaleuca lanceolata over tall open shrubland Hakea oleifolia, Spyridium globulosum and Acacia rostellifera over sparse shrubland Melaleuca huegelii over low sparse rushland Desmocladus flexuosus





Sam	ple Name: Q2	29
	Project no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: RAO	Q29: Page 2 of 2
Species D	ata	
* denotes	non-native species	
Status	Confirmed name	Cover (%)
	Acacia rostellifera	5
	*DP Asparagus asparagoides	0
	* Avena sp.	0
	Brachyscome iberidifolia	0
	Clematis linearifolia	0
	Conostylis aculeata subsp. gracilis	0
	Desmocladus flexuosus	1
	Dianella revoluta var. revoluta	0
	* Ehrharta calycina	0
	* Euphorbia peplus	0
	* Galium murale	0
	Hakea oleifolia	20
	Hibbertia cuneiformis	0
	Hibbertia racemosa	0
	Hybanthus calycinus	1
	* Hypochaeris glabra	0
	Lepidosperma squamatum	0
	Leucopogon parviflorus	1
	Lobelia tenuior	0
	* Lysimachia arvensis	1
	Melaleuca huegelii	10
	Melaleuca lanceolata	30
	Melaleuca systena	0
	Muehlenbeckia adpressa	0
	Petrophile linearis	0
	Phyllanthus calycinus	0
	Poranthera microphylla	0
	Ptilotus drummondii	0
	Rhagodia baccata	0
	Rhodanthe citrina	0
	Spyridium globulosum	25
	Stylidium adnatum	0
	Trachymene pilosa	0
	* Vulpia bromoides	0
	* Vulpia bromoides	0
	Wahlenbergia sp.	0



Jampi		~~~ <i>~</i> ~	
Proj	ect no.: EP18-085		
	Date: 27/11/2018	Status Non-per	manent
	Author: RAO	Q29: Page 3 of 3	
Species Data			
* denotes nor	n-native species		
Status	Confirmed name		Cover (%)
	*DP Zantedeschia aethiopica		0



Sample Name:		Q30	
Project no.: EP18-085			
Date: 27/11/2018		Status Non-permanent	
Author: RA	40	С	Q30: Page 1 of 3
Quadrat and landform d	etails		
Sample type: qu	Jadrat	Size: 2	10 m x 10 m
NW corner easting: 315632		NW corner northing: 6273234	
Altitude (m): 39		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: upper slope	
Time since fire: no evidence		Disturbance: moderate - weeds, fauna	
Soil type/texture sand/clay with organic layer		Bare ground (%): 5	
Rocks (%) and type: 1%	%, limestone	Soil colour: brown	
Litter: 30	)% (branches,leaves)	Vegetation condition: N	very good
Churche	Course (9/)		
Strata	Cover (%)	Height (m)	
Upper:	30 to 70	<10	
Mid:	<10	>2	bryophytes present
Ground layer 1:	10 to 30	1 to 2	
Ground layer 2:	10 to 30	<0.5	

### Vegetation description

Tall shrubland Acacia rostellifera, Spyridium globulosum over open shrubland Guichenotia ledifolia, Melaleuca huegelii, Hibbertia cuneiformis over low open herbland Acanthocarpus preissii





Sample Name: Q	30
Project no.: EP18-085	
Date: 27/11/2018	Status Non-permanent
Author: RAO	Q30: Page 2 of 3
Species Data	
* denotes non-native species	
Status Confirmed name	Cover (%)
Acacia rostellifera	1
Acacia saligna	орр
Acanthocarpus preissii	2
* Aira cupaniana	0
*DP Asparagus asparagoides	0
Austrostipa flavescens	0
* Briza maxima	0
* Briza minor	0
Clematis linearifolia	0
Desmocladus flexuosus	орр
Dianella revoluta var. revoluta	0
* Ehrharta calycina	0
* Euphorbia peplus	0
Guichenotia ledifolia	30
Hakea oleifolia	орр
Hibbertia cuneiformis	5
Hybanthus calycinus	орр
* Hypochaeris glabra	0
Leucopogon parviflorus	1
* Lysimachia arvensis	1
Macrozamia riedlei	0
Melaleuca huegelii	20
Melaleuca systena	2
Microlaena stipoides	0
Muehlenbeckia adpressa	0
* Oxalis corniculata	0
Phyllanthus calycinus	0
Pimelea ferruginea	0
Poranthera microphylla	0
Rhagodia baccata	0
Rhodanthe citrina	0
* Sonchus oleraceus	0
Spyridium globulosum	15
Stylidium adnatum	0
Thomasia foliosa	1
Trachymene pilosa	0



Sample Name:	Q30	
Project no.: EP18-085		
Date: 27/11/2018	Status Non-permanent	
Author: RAO	Q30: Page 3 of 3	
Species Data		
* denotes non-native species		

Status	Confirmed name	Cover (%)
	Wahlenbergia sp.	0
	*DP Zantedeschia aethiopica	2



Sample Name:		Q31	
Project no.: EP1	8-085		
Date: 27/2	11/2018	Status N	Non-permanent
Author: RAC	)	C	231: Page 1 of 2
Quadrat and landform det	ails		
Sample type: qua	drat	Size: 1	10 m x 10 m
NW corner easting: 315604		NW corner northing: 6	5273194
Altitude (m): 48		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: upper slope	
Time since fire: no evidence		Disturbance: r	moderate - weeds
Soil type/texture sand/clay with organic layer		Bare ground (%): 10	
Rocks (%) and type: 1%,	limestone	Soil colour: brown	
Litter: 10%	(branches,twigs)	Vegetation condition: g	good-very good
Churche	Cover (%)	11=:=h+ (m)	
Strata	Cover (%)	Height (m)	
Opper.	501070	<10	hruonhutas prosont
IVIIC:	<10 10 to 20	>2	biyophytes present
Ground layer 1:	10 to 30	1 to 2	
Ground layer 2:	10 to 30	<0.5	

### Vegetation description

Low open forest Melaleuca huegelii over tall sparse shrubland Spyridium globulosum over open shrubland Diplolaena dampieri over low open herbland \*Lysimachia arvensis





Sample Name:	Q31
Project no.: EP18-085	
Date: 27/11/2018	Status Non-permanent
Author: RAO	Q31: Page 2 of 2
Spacias Data	
* denotes non-native species	
Status Confirmed name	Cover (%)
Acacia saliana	0
*DP Asparaaus asparaaoides	0
* Briza maxima	0
Clematis linearifolia	0
Dianella revoluta var. revolu	uta O
Diplolaena dampieri	20
* Ehrharta calycina	0
* Ehrharta longiflora	0
* Euphorbia peplus	1
Hibbertia cuneiformis	2
* Hypochaeris glabra	0
Leucopogon parviflorus	1
Lobelia tenuior	0
* Lotus sp.	0
* Lysimachia arvensis	10
Macrozamia riedlei	1
Melaleuca huegelii	40
Melaleuca systena	1
Microlaena stipoides	0
Muehlenbeckia adpressa	0
* Oxalis corniculata	0
* Petrorhagia dubia	0
Poranthera microphylla	0
Rhagodia baccata	1
* Sonchus oleraceus	0
Spyridium globulosum	2
Stylidium adnatum	0
Thomasia foliosa	2
Trachymene pilosa	0
*DP Zantedeschia aethiopica	1


Sample Name:		Q32	
Project no.: EP18	-085		
Date: 27/1	1/2018	Status Non-permanent	
Author: RAO		Q32: Page 1 of 2	
Quadrat and landform deta	ails		
Sample type: quad	rat	Size: 10 m x 10 m	
NW corner easting: 3158	45	NW corner northing: 6273231	
Altitude (m): 35		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: mid-slope	
Time since fire: no evidence		Disturbance: moderate - weeds, altered vegetation struc	
Soil type/texture sand		Bare ground (%): 2	
Rocks (%) and type: No ro	ocks	Soil colour: brown	
Litter: 15%	(branches,leaves)	Vegetation condition: good-degraded	
Strata	Cover (%)	Height (m)	
Upper:	30 to 70	<10	
Mid:	<10	1 to 2	
Ground layer 1:	70 to 100	<0.5	
Ground layer 2:	~0	<0.5	

#### Vegetation description

Low open forest Corymbia calophylla and Agonis flexuosa over sparse shrubland Spyridium globulosum over low closed herbland Dichondra repens, \*Zantedeschia aethiopica over low isolated tussock grassland Ehrharta calycina, \*Briza spp. and \*Bromus hordeaceus





Sample	e Name: C	232
Proj	ect no.: EP18-085	
	Date: 27/11/2018	Status Non-permanent
	Author: RAO	Q32: Page 2 of 2
Species Data		
* denotes non	-native species	
Status	Confirmed name	Cover (%)
	Agonis flexuosa	30
	*DP Asparagus asparagoides	0
	* Briza maxima	0
	* Briza minor	0
	* Bromus hordeaceus	0
	Clematis linearifolia	0
	Corymbia calophylla	40
	Daucus glochidiatus	0
	Dichondra repens	орр
	* Ehrharta calycina	0
	* Euphorbia terracina	0
	Hardenbergia comptoniana	0
	Hibbertia cuneiformis	орр
	* Hypochaeris glabra	0
	Lagenophora huegelii	орр
	* Lagurus ovatus	0
	* Lotus subbiflorus	0
	* Lysimachia arvensis	0
	Macrozamia riedlei	0
	* Oxalis pes-caprae	0
	* Petrorhagia dubia	0
	Phyllanthus calycinus	qqo
	* Sonchus oleraceus	0
	Spyridium globulosum	15
	Stylidium adnatum	0
	Trachymene pilosa	0
	*DP Zantedeschia aethiopica	80



Sample Name:		Q33	
Project no.: E	P18-085		
Date: 2	27/11/2018	Status Non-permanent	
Author: F	AO	Q33: Page 1 of 3	
Quadrat and landform	details		
Sample type: o	quadrat	Size: 10 m x 10 m	
NW corner easting: 3	316037	NW corner northing: 6273244	
Altitude (m): 4	14	Geographic datum/zone: GDA94/Zone 50	
Soil water content: c	lry	Landform: upper slope	
Time since fire: r	no evidence	Disturbance: low -	
Soil type/texture s	and/clay with organic layer	Bare ground (%): 1	
Rocks (%) and type: 1	1%, ironstone	Soil colour: brown	
Litter: 2	20% (branches,twigs,leaves)	Vegetation condition: excellent	
Strata	Cover (%)	Height (m)	
Upper	30 to 70		
оррег.	20 to 70	<10	
IVIIU:	50 t0 70	1 to 2	
Ground layer 1:	10 to 30	<0.5	
Ground layer 2:	0%	0	

### Vegetation description

low open forest Corymbia calophylla and Eucalyptus marginata over shrubland Hibbertia hypericoides and Xanthorrhoea preissii over low open herb Scaevola calliptera, and Lomandra micrantha subsp. micrantha





- D		
Pro	Date: 27/11/2018	Status Non-permanent
		O33: Page 2 of 2
Species Data	3	
* denotes no	on-native species	
Status	Confirmed name	Cover (%)
	?Caesia micrantha	0
	Agonis flexuosa	1
	* Aira cupaniana	0
	*DP Asparagus asparagoides	0
	* Briza maxima	0
	* Bromus hordeaceus	0
	Burchardia congesta	0
	Caladenia attingens subsp. attingens	0
	Calothamnus sanguineus	орр
	Chamaescilla corymbosa	0
	Chorizema ?cordatum	0
	Corymbia calophylla	30
	* Crassula glomerata	0
	Daucus glochidiatus	0
	* Ehrharta calycina	0
	Eucalyptus marginata	20
	* Euphorbia terracina	0
	Hardenbergia comptoniana	0
	Hibbertia cunninghamii	0
	Hibbertia hypericoides	40
	Hyalosperma cotula	орр
	Hybanthus calycinus	0
	* Hypochaeris glabra	0
	Lagenophora huegelii	0
	Lepidosperma squamatum	0
	Lomandra micrantha subsp. micrantha	1
	* Lysimachia arvensis	0
	Macrozamia riedlei	1
	* Oxalis pes-caprae	0
	Patersonia occidentalis	0
	Phyllanthus calycinus	1
	Ranunculus colonorum	орр
	Scaevola calliptera	10
	* Sonchus oleraceus	0
	Spyridium globulosum	0
	Stylidium adnatum	0



Sample	e Name:	Q33	
Proj	ect no.: EP18-085		
Date: 27/11/2018 Author: RAO		<b>Status</b> Non-permanent Q33: Page 3 of 3	
Species Data			
* denotes non	-native species		
Status	Confirmed name	Cover (%)	
	Tetraria octandra	0	
	Thomasia foliosa	0	
	Trachymene pilosa	0	
	Xanthorrhoea preissii	30	
	Xanthosia candida	0	
	*DD Zantodoschia aathionica	1	



Sample Name:		Q34
Project no.: EP18	-085	
Date: 28/11	L/2018	Status Non-permanent
Author: RAO		Q34: Page 1 of 3
Quadrat and landform deta	ils	
Sample type: quad	rat	Size: 10 m x 10 m
NW corner easting: 0		NW corner northing: 0
Altitude (m): 25		Geographic datum/zone: GDA94/Zone 50
Soil water content: dry		Landform: mid-slope
Time since fire: no evidence		Disturbance: moderate - weeds, fauna
Soil type/texture sand/clay		Bare ground (%): 5
Rocks (%) and type: No ro	ocks	Soil colour: brown
Litter: 70% (	branches, leaves)	Vegetation condition: good-very good
Strata	Cover (%)	Height (m)
Upper:	70 to 100	<10
Mid:	<10	>2
Ground layer 1:	<10	_ 1 to 2
Ground layer 2:	<10	<0.5

### Vegetation description

Low closed forest Corymbia calophylla over tall sparse shrubland Spyridium globulosum over sparse shrubland Hibbertia hypericoides, Xanthorrhoea preissii over low sparse tussock grassland





Pro	<b>bject no.:</b> EP18-085	
	Date: 28/11/2018	Status Non-permanent
	Author: RAO	Q34: Page 2 of 3
necies Data		
denotes no	on-native species	
Status	Confirmed name	Cover (%)
	Acacia pulchella var. pulchella	0
	Acacia saligna	0
	Agonis flexuosa	1
	* Aira cupaniana	0
	*DP Asparagus asparagoides	0
	Astroloma ciliatum	1
	Banksia dallanneyi subsp. dallanneyi	0
	* Briza maxima	0
	* Briza minor	0
	Chamaescilla corymbosa	0
	Cheilanthes austrotenuifolia	0
	Corymbia calophylla	70
	* Cotula turbinata	0
	Darwinia citriodora	орр
	Dianella revoluta var. revoluta	0
	* Ehrharta calycina	0
	Haemodorum sp.	0
	Hibbertia amplexicaulis	0
	Hibbertia cuneiformis	1
	Hibbertia hypericoides	20
	Lepidosperma squamatum	1
	Leucopogon parviflorus	0
	Leucopogon propinquus	1
	Lomandra micrantha subsp. micrantha	1
	* Lysimachia arvensis	0
	Macrozamia riedlei	0
	Microlaena stipoides	0
	Olearia axillaris	1
	* Oxalis pes-caprae	0
	Patersonia occidentalis	0
	Phyllanthus calycinus	0
	Ptilotus drummondii	0
	Rhagodia baccata	1
	Spyridium globulosum	10
	Stylidium adnatum	1
	Trachymene pilosa	0



Sample Name:	Q34	
Project no.: EP18-085		
Date: 28/11/2018	Status Non-permanent	
Author: RAO	Q34: Page 3 of 3	
Species Data		
* denotes non native species		

* denotes nor	n-native species	
Status	Confirmed name	Cover (%)
	Xanthorrhoea preissii	15
	*DP Zantedeschia aethiopica	0



Sample Name:		Q35		
Project no.: EP18-085 Date: 28/11/2018		Status N	lon-permanent	
Author: RAO		Q	35: Page 1 of 2	
Quadrat and landform deta	ils			
Sample type: quad	rat	Size: 1	0 m x 10 m	
NW corner easting: 31603	31	NW corner northing: 6	273357	
Altitude (m): 32		Geographic datum/zone: G	Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry	Soil water content: dry		nid-slope	
Time since fire: no evidence		Disturbance: h	igh - fauna, clearing?	
Soil type/texture clay		Bare ground (%): 2	0	
Rocks (%) and type: 12%,	Rocks (%) and type: 12%, granite		Soil colour: brown	
Litter: 10% (	branches,leaves)	Vegetation condition: g	ood-very good	
Strata	Cover (%)	Hoight (m)		
Strata				
Mid.	30 to 70		hrvonhytes present	
Ground laver 1:	<10		bryophytes present	
Ground layer 2:	<10	<0.5		
Ground layer 2.	10	NU.3		

### Vegetation description

Shrubland Darwinia citriodora and Dodonaea ceratocarpa over low sparse tussock grassland over low sparse sedgeland Lepidosperma squamatum





т

Sample Name: Q35	5
Project no.: EP18-085	
<b>Date:</b> 28/11/2018	Status Non-permanent
Author: RAO	Q35: Page 2 of 2
Species Data	
* denotes non-native species	
Status Confirmed name	Cover (%)
* ?Juncus capitatus	0
Acacia cochlearis	opp
Acacia pulchella var. pulchella	0
Agonis flexuosa	1
* Aira cupaniana	0
* Aira praecox	0
*DP Asparagus asparagoides	0
Banksia dallanneyi subsp. dallanneyi	орр
* Briza maxima	0
* Bromus hordeaceus	1
Centrolepis drummondiana	0
Cheilanthes austrotenuifolia	0
Crassula exserta	0
Crassula exserta	0
Darwinia citriodora	40
Dodonaea ceratocarpa	30
* Ehrharta calycina	2
Haemodorum laxum	1
Hibbertia hypericoides	0
* Hordeum leporinum	1
* Hypochaeris glabra	0
Lepidosperma squamatum	10
Leucopogon propinquus	0
* Logfia gallica	0
* Lotus subbiflorus	0
* Parentucellia latifolia	0
* Petrorhagia dubia	0
Phyllanthus calycinus	0
Platysace tenuissima	0
Podolepis lessonii	0
Quinetia urvillei	0
* Romulea rosea var. australis	1
* Silene gallica	0
* Vulpia bromoides	2
* Vulpia bromoides	0
Xanthosia sp.	0



Sample Name:		Q36	
Project no.: EP18	-085		
Date: 28/1	1/2018	Status Non-permanent Q36: Page 1 of 2	
Author: RAO			
Quadrat and landform deta	nils		
Sample type: quad	rat	Size: 10 m x 10 m	
NW corner easting: 3159	74	NW corner northing: 6273300	
Altitude (m): 36		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: upper slope	
Time since fire: no evidence		Disturbance: low - weeds, fauna	
Soil type/texture clay		Bare ground (%): 15	
Rocks (%) and type: 20%,	granite	Soil colour: brown/orange	
Litter: 20%	(branches,leaves)	Vegetation condition: very good-excellent	
	Cover (9/)		
Strata	Cover (%)	Height (m)	
Upper:	N/A	Treeless	
Mid:	30 to 70	1 to 2	
Ground layer 1:	<10	<0.5	
Ground layer 2:	<10	<0.5	

### Vegetation description

Shrubland Darwinia citriodora, Hakea trifurcata and Dodonaea ceratocarpa over low sparse sedgeland Lepidosperma squamatum over low sparse herbland Podolepis lessonii





Proj	ect no.: EP18-085	
	Date: 28/11/2018	Status Non-permanent
	Author: RAO	Q36: Page 2 of 2
Species Data		
* denotes nor	-native species	
Status	Confirmed name	Cover (%)
	Acacia alata var. alata	0
	Acacia pulchella var. pulchella	1
	* Aira cupaniana	0
	* Briza maxima	0
	* Briza minor	0
	Calothamnus sanguineus	0
	Cassytha racemosa	0
	* Centaurium tenuiflorum	0
	Comesperma ciliatum	0
	Comesperma confertum	0
	Darwinia citriodora	35
	Dodonaea ceratocarpa	20
	Gastrolobium ebracteolatum	0
	Hakea trifurcata	10
	Hibbertia hypericoides	2
	* Hypochaeris glabra	0
	Lepidosperma squamatum	10
	Leucopogon propinquus	0
	* Lotus subbiflorus	0
	Macrozamia riedlei	0
	Neurachne alopecuroidea	0
	Opercularia vaginata	0
	Phyllanthus calycinus	0
	Podolepis lessonii	1
	Rytidosperma setaceum	0
	Spyridium globulosum	2
	Thomasia foliosa	0
	Thysanotus patersonii	0
	Trachymene pilosa	0
	* Vulpia bromoides	1
	Wahlenberaia sp	0



Sample Name:		Q37	
Project no.: EP18	3-085		
Date: 28/1	1/2018	Status Non-permanent	
Author: RAO		Q37: Page 1 of 2	
Quadrat and landform det	ails		
Sample type: quad	Irat	Size: 10 m x 10 m	
NW corner easting: 3153	808	NW corner northing: 6273716	
Altitude (m): 13		Geographic datum/zone: GDA94/Zone 50	
Soil water content: dry		Landform: lower slope	
Time since fire: no e	vidence	Disturbance: low -	
Soil type/texture clay		Bare ground (%): 10	
Rocks (%) and type: 60%	, granite	Soil colour: brown	
Litter: 2% (	branches)	Vegetation condition: very good-excellent	
Strata	Cover (%)	Height (m)	
Upper:	N/A	Treeless	
Mid:	, 10 to 30	<1	
Ground laver 1: <10		<0.5	
Ground layer 2: <10		<0.5	

### Vegetation description

Low open shrubland Kunzea ciliata, Pimelea ferruginea, Eutaxia myrtifolia, Dodonaea ceratocarpa over low sparse herbland over low sparse tussock grassland





Sample	e Name: Q37	7
Proj	ect no.: EP18-085	
	Date: 28/11/2018	Status Non-permanent
/	Author: RAO	Q37: Page 2 of 2
Species Data		
* denotes non	-native species	
Status	Confirmed name	Cover (%)
	Acacia pulchella var. pulchella	0
	Brachyscome iberidifolia	0
	* Briza maxima	0
	* Bromus hordeaceus	0
	Carpobrotus virescens	0
	* Centaurium tenuiflorum	0
	Darwinia citriodora	5
	Dianella brevicaulis	0
	Dianella revoluta var. revoluta	0
	Diplolaena dampieri	1
	Dodonaea ceratocarpa	5
	Eutaxia myrtifolia	5
	Kunzea ciliata	10
	* Lagurus ovatus	0
	Lepidosperma squamatum	орр
	Leucopogon parviflorus	орр
	* Lotus subbiflorus	0
	Melaleuca lanceolata	1
	Olearia axillaris	0
	Pimelea ferruginea	5
	Poa poiformis	0
	Ptilotus manglesii	орр
	Rhodanthe corymbosa	0
	Rytidosperma acerosum	0
	Scaevola crassifolia	0
	Senecio pinnatifolius var. maritimus	0
	Spyridium globulosum	0
	Stypandra glauca	0
	Threlkeldia diffusa	0
	Xanthosia candida	0



Appendix B Lot 4131 Smiths Beach Road, Yallingup - Detailed Terrestrial Vertebrate Fauna Survey (Biologic 2021)





Biologic Environmental Survey Report to Strategen-JBS&G

December 2020



Document Status					
Revision	Author	Review / Approved for Issue	Approved for Issue to		
No.			Name	Date	
1	B. Downing	C. Knuckey A. Hide	D. Newsome	11/12/2020	

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## **EXECUTIVE SUMMARY**

Lot 4131 Smiths Beach Road, Yallingup (the Study Area) is located approximately 23 kilometres west of Busselton and covers a total area of approximately 40.53 hectares. To support future development of the Study Area, Biologic Environmental Survey Pty Ltd (Biologic) was commissioned to undertake a Detailed terrestrial vertebrate fauna assessment, inclusive of black cockatoo and western ringtail possum habitat assessments.

A desktop assessment was conducted prior to the field survey to identify all fauna species which have the potential to occur in the Study Area inclusive of two Detailed fauna assessment conducted within the Study Area in 2001 and 2005. A spring field survey was conducted between 1<sup>st</sup> and 10<sup>th</sup> of November 2020 (the current survey). The primary objective of the field survey was to identify the occurrence of terrestrial vertebrate fauna species and their supporting habitats within the Study Area, with a focus on species of conservation significance; species listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Biodiversity Conservation Act 2016* (BC Act) and/or listed as Priority by the Department of Biodiversity, Conservation and Attractions (DBCA). Specific methods included systematic trapping (pitfall, Elliott, funnel and cage trapping), avifauna censuses, spotlighting, motion-sensor cameras, bat echolocation recordings, targeted searches and habitat assessments.

Seven broad fauna habitat types were recorded and mapped within the Study Area, comprising, in decreasing order of extent, *Kunzea* and *Melaleuca* Closed Shrubland (11.6 ha, 29% of Study Area), Open Peppermint Forest (8.1 ha, 20% of Study Area), *Melaleuca* over *Hakea Shrubland* (5.4 ha, 13% of Study Area), Open Coastal Shrubland (5.4 ha, 13% of Study Area), Open Banksia Forest (4.1 ha, 10% of Study Area), Closed Low Marri Forest (1.5 ha, 4% of Study Area), and Rocky Outcrop (0.5 ha, 1% of Study Area). (Table 4.1; Figure 4.1). Approximately 3.9 ha (10%) of the Study Area is Cleared/ Disturbed. The fauna habitats identified during the survey extend beyond the Study Area boundary.

*Kunzea* and *Melaleuca* Closed Shrubland and Open Coastal Shrubland provides primary breeding, foraging and dispersal habitat for quenda (*Isoodon fusciventer*) and Low quality foraging habitat for Baudin's black cockatoo (*Calyptorhynchus baudinii*). The Open Peppermint Forest provides primary breeding, foraging and dispersal habitat for the western ringtail possum (*Pseudocheirus occidentalis*) and wambenger brush-tailed phascogale (*Phascogale tapoatafa wambenger*), secondary roosting habitat for black cockatoos, Low quality foraging habitat for Baudin's black cockatoo and foraging and dispersal habitat for quenda. *Melaleuca* over *Hakea* Shrubland provides primary breeding, foraging and dispersal habitat for quenda and *Ctenotus ora*. It also provides primary foraging habitat for Baudin's cockatoo (High quality), Carnaby's cockatoo (*Calyptorhynchus latirostris*) (quality) and barking owl (*Ninox connivens connivens*). Open Coastal Shrubland provides primary breeding, foraging and dispersal habitat for *Ctenotus ora*. The Open *Banksia* Forest provides potential breeding and secondary roosting for black cockatoo, primary foraging habitat for Baudin's and Carnaby's cockatoo (Very High and High Quality respectively), wambenger brush-tailed phascogale, western brush wallaby (*Notamacropus irma*) and *Ctenotus ora*. It also provides secondary habitat for western ringtail possum. Closed Low Marri Forest areas provide primary foraging (High quality for Carnaby's, Very High quality



for Baudin's and quality for forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*)) and secondary roosting habitat for black cockatoo, primary foraging and dispersal habitat for wambenger brush-tailed phascogale as well as secondary habitat for western ringtail possum. The Rocky Outcrop fauna habitat is not considered to provided primary or secondary habitat to the species confirmed or considered Likely to occur.

The literature review and database searches identified a total of 285 species of vertebrate fauna, which have previously been recorded and/or have the potential to occur within the Study Area. This comprised 37 mammals (including 27 native and 10 non-native), 217 birds (including 213 native and four non-native), 17 reptiles and 14 amphibians. Of the 285 species with the potential to occur, 80 have previously been recorded during surveys conducted within the Study Area.

During the current survey, a total of 78 vertebrate fauna species, comprising 15 mammal species (13 native and two introduced), 39 bird species (37 native and two introduced), 20 reptile species and four amphibian species were recorded. Species accumulation curves for sampling adequacy indicated 70-84% of mammal species, 80-87% of avifauna species and 83-92% of herpetofauna species were identified from systematic sampling methods. This, however, does not include species recorded from non-systematic sampling methods and is likely to be an under representation of the percentage of diversity recorded. Species diversity recorded within the Study Area was comparable to previous surveys of similar survey effort included in the desktop assessment indicating the species assemblages of the Study Area was adequately sampled. Vertebrate fauna species recorded and all species have been recorded by previous surveys in the region.

Of the 80 species of conservation significance identified in the desktop assessment, six were recorded within the Study Area during the current survey:

- Western ringtail possum (Critically Endangered EPBC/BC Act)
- Carnaby's cockatoo (Endangered EPBC/BC Act)
- Baudin's cockatoo (Endangered EPBC/BC Act)
- Wambenger brush-tailed phascogale (Conservation Dependent BC Act)
- Ctenotus ora (Priority 3 DBCA Priority List)
- Quenda (Priority 4 DBCA Priority List)

Based on known species' distributions, previous records and the habitats present within the Study Area, three species were deemed Likely to occur comprising;

- Forest red-tail cockatoo (Vulnerable EPBC/BC Act)
- Western brush wallaby (Priority 4 DBCA Priority List)
- Barking Owl (Priority 3 DBCA Priority List)

Based on known species' distributions, previous records and the habitats present within the Study Area, four species were deemed Possible to occur comprising;

- Western quoll *Dasyurus geoffroii* (Vulnerable EPBC/BC Act)
- Osprey Pandion haliaetus (Migratory EPBC/BC Act)



- Peregrine falcon Falco peregrinus (Other specially protected species BC Act)
- Western falsistrelle Falsistrellus mackenziei (Priority 4 DBCA Priority List)

Finally 67 were considered Unlikely or Highly Unlikely to occur.



## 1 INTRODUCTION

### 1.1 Project Background

Lot 4131 Smiths Beach Road, Yallingup (the Study Area) is located approximately 23 kilometres west of Busselton and covers a total area of approximately 40.53 hectares. The Study Area is zoned for recreation, residential and tourism (Busselton, 2018).To support future development of the Study Area, Biologic Environmental Survey Pty Ltd (Biologic) was commissioned by Strategen-JBS&G (Strategen) to undertake a Detailed terrestrial vertebrate fauna assessment, inclusive of black cockatoo and western ringtail possum habitat assessments.

### 1.2 Scope and Objectives

The overarching objective of this assessment was to identify the occurrence of terrestrial vertebrate fauna species and their supporting habitats within the Study Area, with a focus on species of conservation significance. Specifically, the key objectives of the assessment were to:

- conduct a comprehensive desktop assessment (database searches and literature review) to identify vertebrate fauna species potentially occurring within the Study Area;
- refine broad fauna habitats occurring within the Study Area, and describe their significance to vertebrate fauna, particularly species of conservation significance;
- conduct a single-phase (spring) Detailed terrestrial vertebrate fauna survey to identify vertebrate fauna species and fauna assemblages occurring within the Study Area;
- assess the likelihood and distribution of vertebrate fauna of conservation significance occurring within the Study Area, and where determined to be present, map areas of suitable habitat by use (e.g. foraging, denning, roosting etc.);
- conduct a black cockatoo habitat assessment; and
- conduct a target survey and define habitats for western ringtail possum.





### **1.3 Background to Protection of Fauna**

Terrestrial fauna may be significant for a range of reasons, including (EPA, 2016a):

- being identified as a threatened or priority species;
- being a species with restricted distribution;
- enduring a degree of historical impact from threatening processes; or
- providing an important function required to maintain the ecological integrity of a significant ecosystem.

All native fauna in Western Australia (WA) are protected at a state level under the *Biodiversity Conservation Act 2016* (BC Act) and at a national level under the *Environmental 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.

While all native fauna is protected under these Acts, some species are afforded extra protection. These include: species that are considered Threatened under the EPBC Act and/or BC Act, or migratory bird species that are protected under international agreements and subsequently listed as Migratory under the EPBC Act and/or BC Act (Table 1.1). Furthermore, any species that may be threatened but for which there is insufficient information available to allocate a threatened status under the EBPC Act and/or BC Act, can also be listed as Priority species by the WA Department of Biodiversity, Conservation and Attractions (DBCA) (Table 1.1).

For the purposes of this assessment, species considered to be of conservation significance are those that are afforded protection under the EPBC Act, BC Act and/or listed as Priority by DBCA (Table 1.1). A summary of applicable legislation and status codes is provided in Table 1.1.

Table 1.1: Definitions and terms fo	r fauna of co	onservation	significance
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Act, Agreement or List	Status Codes <sup>1</sup>	
Federal		
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) In Australia, native fauna are protected under the EPBC Act. This Act makes provisions for an independent committee (the Threatened Species Scientific Committee [TSSC]), which is charged with maintaining a list of threatened species. Threatened species are listed under one of six categories, depending on their specific conservation status. 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	<ul> <li>Extinct:</li> <li>EX – Extinct</li> <li>EW – Extinct in the Wild</li> <li>Threatened:</li> <li>CR – Critically Endangered</li> <li>EN – Endangered</li> <li>VU – Vulnerable</li> <li>CD – Conservation Dependent</li> <li>Other:</li> <li>MI – Migratory</li> </ul>	
State		
<i>Biodiversity Conservation Act 2016</i> (BC Act) In WA, native fauna are protected under the BC Act. Species in special need of protection are listed as being Extinct, Threatened or Specially Protected. Within these groups, species are listed under one of eight categories, depending on their specific conservation status. Migratory bird species are those listed under the Bonn Convention and/or CAMBA, JAMBA and ROKAMBA agreements.	<ul> <li>Extinct:</li> <li>EX – Extinct</li> <li>Threatened:</li> <li>CR – Critically Endangered</li> <li>EN – Endangered</li> <li>VU – Vulnerable</li> <li>Specially Protected:</li> <li>MI – Migratory</li> <li>CD – Conservation Dependent</li> <li>OS – Other specially protected fauna</li> </ul>	
<b>DBCA Priority List</b> The DBCA maintains a list of Priority species that are considered to be possibly threatened but have not been assigned statutory protection under the BC Act, as not enough information is available for an accurate determination of conservation status. These species are generally in urgent need of survey to determine their distribution and abundance.	<ul> <li>Poorly Known:</li> <li>P1 – Priority 1</li> <li>P2 – Priority 2</li> <li>P3 – Priority 3</li> <li>Rare, Near Threatened and other</li> <li>P4 – Priority</li> </ul>	

<sup>1</sup>See Appendix A for definitions of status codes



#### 1.1 Conformance

This assessment was carried out in a manner consistent with the following guidelines and recommendations from the Western Australian Environmental Protection Authority (EPA), the Department of Agriculture. Water and the Environment (DAWE; formerly the Department of Environment and Energy (DoEE) and Department of Sustainability, Water, Population, and Communities (DSEWPaC)), as outlined below in Table 1.2.

Survey component	Guidance documents
	EPA (2020) Technical guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment
	DEWHA (2010b) Survey guidelines for Australia's threatened birds.
Desis Detailed and	DEWHA (2010a) Survey guidelines for Australia's threatened bats
Targeted terrestrial	DSEWPaC (2011a) Survey guidelines for Australia's threatened mammals
vertebrate fauna	DSEWPaC (2011b) Survey guidelines for Australia's threatened reptiles
Survey	EPA (2016a) Environmental factor guideline: Terrestrial fauna.
	EPA (2018) Statement of environmental principles, factors and objectives
	DoE (2013) Significant impact guidelines 1.1: Matters of national environmental significance.
	DoEE (2017) Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo
Black cockatoo habitat assessment	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
Western ringtail possum targeted survey and habitat assessment	Williams et al. (2017) Ringtail Possum (Pseudocheirus occidentalis) Recovery Plan.
	DEWHA (2009) Significant Impact Guidelines for the Vulnerable Western Ringtail Possum (Pseudocheirus occidentalis) in the Southern Swan Coastal Plain, Western Australia.

#### Table 1.2: Guidelines, technical guidelines and procedures for the assessment

#### 1.2 Environment

#### 1.2.1 Bioregion

The Study Area falls within the Jarrah Forest biogeographical region (Figure 1.1) as defined by the Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway & Cresswell, 1995). The Jarrah Forest region is subdivided into two subregions, the Study Area lies within the Southern Jarrah Forest subregion (JF2) (Hearn *et al.*, 2002). The vegetation of the subregion comprises jarrah-marri forest in the west grading to marri and wandoo woodlands in the east (McKenzie *et al.*, 2002). There are extensive areas of swamp vegetation in the south-east, dominated by paperbarks and swamp yate (Hearn *et al.*, 2002). The understorey component of the forest and woodland reflects the more mesic nature of this area (Hearn *et al.*, 2002). Most of the diversity in the communities occurs on the lower slopes or near granite soils where there are rapid changes in site conditions. Approximately 54.7% of the Southern Jarrah Forest subregion lies within DBCA managed conservation estate, as represented by five national parks (Hearn *et al.*, 2002). The subregion has a warm temperate climate, characterised



by warm and dry summers with cool, wet winters. Rainfall ranges from 1200 millimetres (mm) in the south-west of the subregion to 500 mm in the east (Hearn *et al.*, 2002).

#### 1.2.2 Pre-European Vegetation

Vegetation complexes have been mapped by Mattiske and Havel (1998) at a scale of 1:50,000. Three vegetation complexes occur within the Study Area as outlined in Table 1.3.

Table 1.3: Vegetation complexes within the Stud	y Area	(Mattiske &	Havel,	1998)
- and	, <del>.</del>	(		,

Vegetation Class; Complex Name	SW Subregion	Description
GE; Gracetown (SWF: 126)	Leeuwin - Naturaliste Coast	Closed heath of Olearia axillaris- Rhagodia baccata-Agonis flexuosa on seaward slopes in hyperhumid to humid zones.
W2 Wilyabrup (SWF: 288)	Margaret River Plateau	Open forest of <i>Corymbia</i> <i>calophylla-Allocasuarina</i> <i>decussata-Agonis flexuosa</i> on deeply incised valleys in perhumid and humid zones.
We Wilyabrup (SWF: 293)	Leeuwin - Naturaliste Coast	Low woodland and woodland of Corymbia calophylla-Eucalyptus marginata subsp. marginata with some Banksia spp. on exposed slopes in hyperhumid to humid zones.

#### 1.2.3 Soils and Geology

The Study Area is situated on exposed bedrock (GSWA, 2020) can comprises four broad soil landscape unit as mapped by DPIRD (2019) and are described in Table 1.4.

Table 1.4: Soil Landscape mapping over	r the Study Area (DPIRD, 2019)
--	--------------------------------

Name	Description
Gracetown exposed slopes Phase	Moderate slopes (gradients 10-15%) on the west coast exposed to prevailing wind directly off the ocean, with deep and shallow yellow brown siliceous sands over limestone (i.e. Spearwood Sands).
Wilyabrup granitic headland Phase	Areas on the west coast dominated by granitic outcrop.
Wilyabrup exposed slopes Phase	Low slopes (gradients generally 5-10%) exposed to strong winds off ocean.
Wilyabrup gentle slope Phase	Gradients 5-10%

#### 1.2.4 Land Use

The Leeuwin-Naturaliste Ridge (EPA Redbook Recommended Conservation Reserve) borders the Study Area to the north and to the west, the Leeuwin-Naturaliste National Park borders the Study Area to the south, the Ngari Capes Marine Park ~100 m to the north and the west of the Study Area and the Canal Rock Beachfront Apartments and Smith's Beach Resort border the Study Area to the north (Figure 1.1). The Study Area approximates (deemed an 1a remnant as it has an edge touching or <100 m) an Ecological Linkage (WALGA, 2018). Ecological 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, 2009). Therefore, remnants of <100m from an Ecological Linkage helps to improve the overall landscape viability (Molloy, 2009).

Although not considered faunal priority ecological communities, vegetation associations MIDr and MIKc previously mapped within the Study Area are considered to represent the Priority 2 '*Melaleuca lanceolata* forests, Leeuwin Naturaliste Ridge' Priority Ecological Community (PEC) (Emerge, 2019). Additionally, vegetation association KcSg is considered to represent the Priority 2 '*Low shrublands on acidic grey-brown sands of the Gracetown soil-landscape system*' PEC (Emerge, 2019).



## 2 DESKTOP ASSESSMENT

A desktop assessment, comprising database searches and a literature review of the Study Area 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.

### 2.1 Methodology

#### 2.1.1 Database Searches

Six fauna databases were searched, three to obtain information on all species previously recorded (NatureMap, Birdata and Atlas of Living Australia), one to identify species of conservation significance previously recorded (DBCA Threatened Fauna Database), one to identify species of conservation significance known or likely to occur within the region (Protected Matters Search Tool), and one to identify black cockatoo roosts and potential breeding areas within 12 km of the Study Area (Table 2.1).

#### Table 2.1: Details of database searches conducted

Database	Data Access/ Receival Date	Search Area		
DBCA (2020a) NatureMap	07/10/2020			
DBCA (2020b) Threatened and Priority Fauna Database	22/10/2020			
Birdlife Australia (2020a) Birdata	30/10/2020	Central coordinate		
Department of Environment and Energy (DoEE) (2020) Protected Matters Search Tool	23/09/2020	10 km buffer		
Atlas of Living Australia (ALA) (2020) Occurrence search	07/10/2020			
Birdlife Australia (2020b) Black Cockatoo Roost Database	19/11/2020	Central coordinate (-33.66325, 115.0108) with a 12 km buffer		

#### 2.1.2 Literature Review

A review of available literature relevant to the Study Area was undertaken to compile a list of fauna habitats and vertebrate fauna species with the potential to occur within the Study Area. A total of 14 assessments were reviewed, comprising seven Detailed surveys, six basic surveys (including four targeted/basic surveys) and one desktop and targeted assessment (Table 2.2).



#### Table 2.2: Literature sources used for the review

Report Title	Reference	Survey Type	Distance from Study Area (km)
ATA (2007) Vertebrate Fauna Assessment Smiths Beach, Yallingup. Unpublished report prepared for Canal Rocks Pty. Ltd.	A	Detailed	Overlapping
ecologia (2001) Location 413 Smiths Beach Fauna Assessment. Unpublished report prepared for ATA Environmental	В	Detailed	Overlapping
How <i>et al.</i> (1987) The ground vertebrate fauna of coastal areas between Busselton and Albany, Western Australia. Records of the Western Australian Museum, 13(4), 553-574.	С	Detailed	Busselton to Albany
Ecosystems Solutions (2014) City of Busselton Road Widening Level 1 Fauna and Level 2 Flora/Vegetation Assessment. Unpublished report prepared for City of Busselton.	D	Basic	~7.5km SE
Ecoscape (2012a) Armstrong Reserve, Dunsborough <i>Ctenotus ora</i> Potential Impact Assessment. Unpublished report prepared for Ray Village Aged Services	E	Desktop/ Targeted	~10 km NE
Ecoscape (2012b) Armstrong Reserve Level Two Fauna Survey. Unpublished report prepared for Ray Village Aged Services	F	Detailed	~10 km NE
NGH (2015) Level 2 Fauna Survey Meelup Regional Park. Unpublished report prepared for Meelup Regional Park Management Committee.	G	Detailed	~11km NE
BDS (2004) Lot 50 Eagle Crescent, Eagle Bay Environmental Assessment Unpublished report prepared for Eagle Bay Joint Venture.	н	Basic	~11.5 km NE
Harewood (2014) Fauna Assessment Lots 1, 2, 1490 and Reserve 20554 Wildwood Road Carbanup. Unpublished report prepared for Palmer Group.	I	Basic/ Targeted	~14km SE
Harewood (2017) Black Cockatoo Habitat Assessment of Proposed Clearing Areas Lot 2682 and Lot 2683 Gale Road Kaloorup. Unpublished report prepared for Lundstrom Environmental Consultants Pty Ltd.	J	Basic/ Targeted	~24km SE
Ecosystems Solutions (2017) Reconnaissance Flora, Vegetation and Fauna Survey Busselton Strategic Network Corridors. Unpublished report prepared for Strategen Environmental.	к	Basic/ Targeted	~28km SE
GHD (2017) Vasse Diversion Drain Upgrade Flora and Fauna Study. Unpublished report prepared for The Water Corporation.	L	Basic/ Targeted	~28.5km E
Harewood (2012) Phase 1 and Phase 2 Seasonal Fauna Surveys (Level 2), Yoongarillup Mineral Sands Project. Unpublished report prepared for Doral Mineral Sands Pty Ltd	М	Detailed	~38km SE
Biota (2009) Milyeannup Wind Farm Terrestrial Fauna Survey. Unpublished report prepared for Verve Energy.	Ν	Detailed	~76km SE



### 2.2 Results

#### 2.2.1 Database Search Results (Excluding Black Cockatoos)

The literature review and database searches identified a total of 285 species of vertebrate fauna, which have previously been recorded and/or have the potential to occur within the Study Area. This comprised 37 mammals (including 27 native and 10 non-native), 217 birds (including 213 native and four non-native), 17 reptiles and 14 amphibians (Table 2.3; Appendix C). Due to the size of the desktop assessment search area, and likelihood of encompassing habitats which may not occur within the Study Area, results of the desktop review are likely to include species which may not occur within the Study Area. Additionally, many species tend to be patchily distributed even where appropriate habitats are present, and many species of birds can occur as regular migrants, occasional visitors or vagrants.

Of the 285 species of vertebrate fauna identified by the desktop assessment, 80 species are of conservation significance, comprising 11 mammals, 65 birds and four reptiles (Table 2.4). Three vertebrate fauna species of conservation significance have previously been recorded within the Study Area; western ringtail possum (*Pseudocheirus occidentalis*), Baudin's cockatoo (*Calyptorhynchus baudinii*) and wambenger brush-tailed phascogale (*Phascogale tapoatafa wambenger*).

Reference	Mammals (native)	Mammals (introduced)	Birds (native)	Birds (introduced)	Reptiles	Amphibians	Total
Literature Sources							
A	6	4	30	0	20	4	64
В	7	4	31	0	9	1	52
С	23	7	0	0	35	11	76
D	1	0	2	0	0	0	3
E	0	0	0	0	1	0	1
F	1	3	16	0	4	5	29
G	15	4	59	0	17	7	102
Н	0	1	14	0	0	3	18
I	3	2	43	0	0	3	51
J	0	0	3	0	0	0	3
К	1	0	0	0	0	0	1
L	3	5	20	1	2	3	34
М	13	6	53	0	25	4	101
Ν	8	5	51	0	16	4	84
Database Searches							
NatureMap	14	1	126	4	21	6	172
DoEE	2	0	45	0	0	0	47
DBCA	10	0	46	0	2	0	58
ALA	15	1	154	4	23	10	207
Birddata	0	0	184	4	0	0	188

 
 Table 2.3: Summary of fauna species recorded within and in the vicinity of the Study Area in the desktop assessment



Reference	Mammals (native)	Mammals (introduced)	Birds (native)	Birds (introduced)	Reptiles	Amphibians	Total
Total							
Total species recorded	27	10	213	4	17	14	285
Conservation Significant species	11	N/A	65	N/A	4	0	80

## Table 2.4: Species of conservation significance identified and their conservation status

		Conservation Status			
Scientific Name	Common Name	EPBC	BC	DBCA	
Mammals					
DASYURIDAE					
Dasyurus geoffroii	Chuditch	VU	VU		
Phascogale tapoatafa wambenger	Wambenger brush-tailed phascogale		CD		
MACROPODIDAE		1			
Notamacropus eugenii derbianus	Tammar			P4	
Notamacropus irma	Western brush wallaby			P4	
Setonix brachyurus	Quokka	VU	VU		
MURIDAE		-			
Hydromys chrysogaster	Water-rat			P4	
PERAMELIDAE					
Isoodon fusciventer	Quenda			P4	
POTOROIDAE					
Bettongia penicillata	Woylie	EN	CR		
PSEUDOCHEIRIDAE					
Pseudocheirus occidentalis	Western ringtail possum, ngwayir	CR	CR		
THYLACOMYIDAE					
Macrotis lagotis	Bilby	VU	VU		
VESPERTILIONIDAE					
Falsistrellus mackenziei	Western false pipistrelle			P4	
Birds					
ANATIDAE					
Cereopsis novaehollandiae grisea	Cape barren goose	VU	VU		
Oxyura australis	Blue-billed duck			P4	
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 leschenaultii	Greater sand plover	VU/MI	VU/MI		



		Conservation Status			
Scientific Name	Common Name	EPBC	вс	DBCA	
Charadrius mongolus	Lesser sand plover	EN/MI	EN/MI		
DIOMEDEIDAE					
Diomedea epomophora	Royal albatross	VU/MI	VU/ MI		
Diomedea exulans	Wandering albatross	VU/MI	VU/ MI		
Diomedea exulans amsterdamensis	Amsterdam albatross	EN/MI	CR/MI		
Diomedea exulans dabbenena	Tristan albatross	MI	CR/ MI		
Diomedea sanfordi	Northern royal albatross	EN/MI	EN/MI		
Phoebetria fusca	Sooty albatross	VU/MI	EN/MI		
Thalassarche cauta	Shy albatross	VU/MI	VU/ MI		
Thalassarche steadi	White-capped albatross	VU/MI	VU/ MI		
Thalassarche chlororhynchos	Yellow-nosed albatross	VU/MI	VU/ MI		
Thalassarche carteri	Indian yellow-nosed albatross	VU/MI	EN/MI		
Thalassarche impavida	Campbell albatross	VU/MI	VU/ MI		
Thalassarche melanophris	Black-browed albatross	VU/MI	EN/MI		
FALCONIDAE					
Falco hypoleucos	Grey falcon	VU	VU		
Falco peregrinus	Peregrine falcon		OS		
HYDROBATIDAE					
Oceanites oceanicus	Wilson's storm petrel	MI	MI		
LARIDAE					
Anous tenuirostris melanops	Australian lesser noddy	VU	EN		
Sterna anaethetus	Bridled tern	MI	MI		
Thalasseus bergii	Crested tern	MI	MI		
Hydroprogne caspia	Caspian tern	MI	MI		
Sterna dougallii	Roseate tern	MI	MI		
Sterna hirundo	Common tern	MI	MI		
Sterna nereis nereis	Fairy tern	VU	VU		
MEGAPODIIDAE		1	1	1	
Leipoa ocellata	Malleefowl	VU	VU		
MOTACILLIDAE		1	1	r	
Motacilla cinerea	Grey wagtail	MI	MI		
PANDIONIDAE		1	1	1	
Pandion haliaetus	Osprey, eastern osprey	MI	MI		
PHAETHONTIDAE		1	1	r	
Phaethon rubricauda	Red-tailed tropicbird	MI	MI	P4	
PROCELLARIIDAE		I	I	I	
Halobaena caerulea	Blue petrel	VU			
Macronectes giganteus	Southern giant petrel	EN/MI	MI		
Macronectes halli	Northern giant petrel	VU/MI	MI		
Pachyptila turtur subantarctica	Fairy prion	VU			
Pterodroma mollis	Soft-plumaged petrel	VU			
Ardenna carneipes	Fleshy-footed shearwater	MI	VU/MI		
Ardenna grisea	Sooty shearwater	MI	MI		
Puffinus huttoni	Hutton's shearwater		EN		


		Conservation Status		
Scientific Name	Common Name	EPBC	BC	DBCA
Ardenna pacifica	Wedge-tailed shearwater	MI	MI	
STRIGIDAE				
Ninox connivens connivens	Barking Owl (southwest pop)			P3
SCOLOPACIDAE				
Calidris acuminata	Sharp-tailed sandpiper	MI	MI	
Calidris alba	Sanderling	MI	MI	
Calidris canutus	Red knot	EN/MI	EN/MI	
Calidris ferruginea	Curlew sandpiper	CR/MI	CR/MI	
Calidris melanotos	Pectoral sandpiper	MI	MI	
Calidris ruficollis	Red-necked stint	MI	MI	
Limosa lapponica	Bar-tailed godwit	MI	MI	
Limosa lapponica baueri	Bar-tailed godwit (western Alaskan)	MI/VU	VU	
Limosa lapponica menzbieri	Bar-tailed godwit (northern Siberian)	CR/MI	CR	
Limosa limosa	Black-tailed godwit	MI	MI	
Numenius madagascariensis	Eastern curlew	CR/MI	CR/MI	
Numenius phaeopus	Whimbrel	MI	MI	
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	
STERCORARIIDAE				
Stercorarius parasiticus	Arctic skua	MI	MI	
Stercorarius pomarinus	Pomarine skua	MI	MI	
Reptiles				
ELAPIDAE				
Elapognathus minor	Short-nosed snake			P2
SCINCIDAE				
Ctenotus delli	Dell's skink			P4
Ctenotus ora	Coastal plains skink			P3
Lerista lineata	Lined skink			P3

# 2.2.2 Black Cockatoo Database Search Results

Black cockatoos rely upon the availability of foraging resources across their range, particularly to build condition in the post-breeding period (DoEE, 2017). Black cockatoos will forage up to 12 km from breeding hollows during the breeding season and rely on this proximity of foraging resources to breeding hollows to successfully raise chicks (DoEE, 2017). Of the ten reports that undertook assessments for black cockatoo, all identified potential black cockatoo foraging habitat within their respective Study Area, with many also recording foraging evidence of black cockatoos (e.g. ATA, 2007; Biota, 2009; Ecosystems Solutions, 2014; Harewood, 2014, 2017; NGH, 2015) (Table 2.5). Of the previous reports that recorded foraging evidence of black cockatoos, three were within the Study Area (ATA, 2007) or within 12 km of the Study Area (Ecosystems Solutions, 2014; NGH, 2015).



Roosting habitat is defined as a suitable tree (generally the tallest) or group of tall trees, native or introduced, usually close to an important water source, and within an area of quality foraging habitat within the range of the black cockatoo species (DoEE, 2017). Ten confirmed roosting sites have been recorded within 12 km of the Study Area comprising eight confirmed white-tailed black cockatoo (Carnaby's and/ or Baudin's black cockatoo) and two forest-red tailed black cockatoo roosts (Birdlife Australia, 2020b). Both roosts for forest red-tailed black cockatoo (BUSQUIR003 and BUSQUIR004) are located ~8 km southeast of the Study Area. These roosts have only been surveyed on one occasion (one in 2016 and one in 2018) during which five and nine forest red-tailed black cockatoo were recorded respectively (Birdlife Australia, 2020b). The nearest roost for white-tailed black cockatoo (BUSYALR006) is located ~2.7 km east of the Study Area. This roost has only been surveyed on one occasion (in 2018) during which three white-tailed black cockatoos were recorded (Table 2.6) (Birdlife Australia, 2020b). Of the ten roosting sites in the black cockatoo roost database, the most significant (BUSQUIR001 recorded between 30 and 251 individual white-tailed black cockatoos each survey year) is located ~7.2 km east of the Study Area (Birdlife Australia, 2020b). Only one previous survey report (located ~38 km SE), recorded four trees that showed evidence of being used as night roosting sites (Harewood, 2012).

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 <u>or</u> 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, 2017; DSEWPaC, 2012b). Modelled distributions show the Study Area lies within the breeding range for Baudin's cockatoo and within Carnaby's cockatoo and forest red-tailed black cockatoo distribution (DoEE, 2017). No confirmed breeding locations are known within 12 km of the Study Area (Birdlife Australia, 2020b). None of the previous reports recorded breeding by the three species of black cockatoo. However, six of the previous surveys recorded trees with hollows or suitable DBH, one of which was within 7.5 km of the Study Area (Table 2.5).

Reference	Foraging results	Night roosting results	Breeding results	
Literature Revi	ew			
	Baudin's black cockatoo recorded feeding on marri and Banksia within the Study Area.	No rooting sites were	No trace of quitable DPH	
A	Suitable foraging habitat for forest red-tailed black cockatoo. However, the species was not recorded.	recorded.	No trees of suitable DBH recorded	
В	Unknown	Unknown	Unknown	
С	N/A	N/A	N/A	
D	Recorded extensive foraging evidence of Baudin's black cockatoo in eight locations and of Carnaby's black cockatoo in four locations.	No black cockatoos observed during dusk surveys	In total, 73 trees with hollows or suitable DBH present.	
E	N/A	N/A	N/A	
F	N/A	N/A	N/A	



Reference	Foraging results	Night roosting results	Breeding results
G	All three species of black cockatoo were recorded foraging in the Study Area	Not assessed	Not assessed
н	Suitable foraging species present for Carnaby's black cockatoo	Not assessed	Small group of Baudin's black cockatoo including one young individual observed. Nest hollows may be present
1	Foraging evidence of Baudin's and forest red-tailed black cockatoo observed	No roosting trees were identified during the survey.	In total, 185 trees with suitable DBH recorded, with four containing potentially suitable hollows.
J	Suitable foraging species present. Foraging evidence of all three black cockatoo observed.	No roosting trees were identified during the survey.	In total, 50 trees with suitable DBH recorded, with three containing potentially suitable hollows. None showed signs of current or previous utilisation by the species.
к	Suitable foraging species present. No foraging evidence observed.	No black cockatoos observed roosting during dusk surveys	Seven trees of suitable DBH recorded in the at the Fairway Drive Study Area
L	Study Area contains 5.67 ha of suitable foraging habitat. No foraging was observed during the survey.	Study Area contains 2.41 ha of suitable foraging habitat. No roosting was observed.	In total, 37 trees with suitable DBH recorded, with three containing small hollows that may be suitable in the future.
М	Suitable foraging species present. Evidence of foraging by all three species observed.	Four tree showed evidence of being used as roosting sites.	In total, 172 trees with suitable DBH recorded, with 19 containing suitable hollows. None showed signs of current or previous utilisation by the species.
Ν	Baudin's and Carnaby's observed foraging.	N/A	No suitable nesting trees.
Black Cockatoo	Roost Database		
N	N/A	Ten-night roosts within 12km; two of which are night roosts for forest red-tailed black cockatoo and eight of which are night roost for white-tailed black cockatoo.	No confirmed breeding within 12km



Site	White-tailed Black Cockatoo				Forest Red-tailed Black Cockatoo								
Site	2013	2014	2015	2016	2017	2018	2019	2014	2015	2016	2017	2018	2019
BUSDUNR001	32	99	0	0	0	5	87	0	0	0	0	0	0
BUSDUNR002				82	8	10	0			0	0	0	0
BUSMEER002					14		67				0		0
BUSQUIR001	71	107	31	64	30	137	251	0	0	0	0	0	0
BUSQUIR003				0						5			
BUSQUIR004						0						9	
BUSYALR001	0	57				0		0				0	
BUSYALR004				8	0	30	0			0	0	0	0
BUSYALR005					0	30	0				0	0	0
BUSYALR006						3						0	

# Table 2.6: Summary of black cockatoo results from Birdlife Australia (2020b) black cockatoo roost database

288720	298720	308720	318720	328720
<ul> <li>288720</li> <li>DBCA Threatened an Priority Fauna Databa Bird</li> <li>Rufous bristlebird - EX</li> <li>Curlew sandpiper - CR</li> <li>Eastern curlew - CR</li> <li>Lesser Sand Plover - El</li> <li>Hutton's shearwater - E</li> <li>Black-browed albatross</li> <li>Indian yellow-nosed alb EN</li> <li>Greater sand plover, lar sand plover - VU</li> <li>Wandering albatross - VU</li> <li>Flesh-footed Shearwate</li> <li>Recherche Cape Barrent - VU</li> <li>Malleefowl - VU</li> </ul>	298720 I Bar-tailed godwit - MI Black-tailed godwit - MI Bridled tern - MI Caspian Tern - MI Common Sandpiper - MI Common greenshank, greenshank - MI Common tern - MI Crested tern - MI Grey-tailed tattler - MI Grey-tailed tattler - MI Marsh sandpiper, little greenshank - MI Northern giant petrel - MI Northern giant petrel - MI Pectoral Sandpiper - MI Pomarine jaeger, pomarine skua - MI Red-necked stint - MI			
<ul> <li>Atlantic yellow-nosed al - VU</li> <li>Barking owl (southwest subpop.) - P3</li> <li>Hooded plover, hooded - P4</li> <li>Red-tailed tropicbird - M</li> <li>Brown Skua, Subantard - P4</li> <li>Blue-billed duck - P4</li> <li>Peregrine falcon - OS</li> <li>Arctic jaeger, Arctic sku</li> </ul>	<ul> <li>Red-tailed tropicbird - MI, P</li> <li>Sanderling - MI</li> <li>Southern giant petrel - MI</li> <li>Southern giant petrel - MI</li> <li>Wedge-tailed Shearwater -</li> <li>Whimbrel - MI</li> <li>Wilson's storm-petrel - MI</li> <li>Wood sandpiper - MI</li> </ul>	P4		

6257614

Legend

Study Area

ATA (2007)

🗙 Western ringtail possum, ngwayir - CR





# DBCA Threatened and Priority Fauna Database

# Mammal

- Western ringtail possum, ngwayir CR
- Bilby, dalgyte, ninu VU
- Chuditch, western quoll VU
- Quokka VU
- Quenda, southwestern brown bandicoot P4

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- Tammar wallaby P4
- Water-rat, rakali P4
- Western brush wallaby P4
- Western false pipistrelle, western falsistrelle P4
- South-western brush-tailed phascogale, wambenger CD
- Reptile
- ▲ Ctenotus ora P3
- ▲ Ctenotus delli P4





DBCA Threatened and Priority Fauna Database

- Baudin's cockatoo
- Carnaby's cockatoo
- Forest red-tailed black cockatoo
- White-tailed black cockatoo
- Forest red-tailed black cockatoo
  - 分 White-tailed black cockatoo

Distributions Baudin's

Forest Red-tailed

Carnaby's



# Vertebrate Fauna Survey

\_Busselton

Figure 2.2: Previous records of black-cockatoos in the vicinity, including roost locations



# 3 FIELD SURVEY METHODS

# 3.1 Survey Timing and Weather

A single-phase Detailed terrestrial vertebrate fauna survey was undertaken from 1<sup>st</sup> to the 10<sup>th</sup> of November 2020. Observed weather conditions prior to and during the surveys are shown in Figure 3.1, alongside long-term climatic data for Cape Naturaliste (station # 9519), located 14 km north of the Study Area.

In the 12 months prior to the surveys, mean minimum and maximum temperatures recorded at Cape Naturaliste were similar to or slightly higher than the long-term average for most months, with above average temperatures recorded throughout most of the year (Figure 3.1). Overall, rainfall in the 12 months prior to the survey (664.2mm) was below the long-term average (798.3 mm) (Figure 3.1). While below average rainfall was recorded during most months, above average rainfall was recorded during the Autumn months (i.e. February to April 2020) as well as during the month of the survey (i.e. November 2020) (Figure 3.1).

Observed temperatures during the surveys were comparable to long-term averages; minimum daily temperatures ranged between 8.7°C and 15.6°C and maximum temperatures ranged between 17.5°C and 26.5°C, compared to the long-term minimum average of 12.5°C and maximum average of 21.5°C. Rainfall recorded during November 2020 (61.2 mm) was well above long-term average (25.4 mm), with a total of 38.2 mm recorded during the survey.



# Figure 3.1: Long-term and current climatic data for Cape Naturaliste (station # 9519) (BoM, 2020) with approximate survey timing shown in green shaded boxes

# 3.2 Survey Team and Licensing

The assessment was undertaken by senior zoologist Andrew Hide and zoologist Brighton Downing, who collectively have 17 years of experience conducting surveys across Western Australia.

The fauna sampling for this survey was conducted under a DBCA Regulation 27 "Fauna Taking (Biological Assessment) Licence" (BA27000340) issued to Chris Knuckey. In accordance with Section 40 of the BC Act, threatened species sampling was completed under a DBCA "Authorisation to Take or Disturb Threatened Species" (authorisation number TFA 2020-0151) issued to Chris Knuckey.

# 3.3 Habitat Assessments

During the current survey, habitat assessments were undertaken in the field to further characterise and define habitats and their significance to vertebrate fauna. Habitat assessments were undertaken at 16 locations within the Study Area, including at all sampling sites (Figure 3.3; Appendix D). Additionally, seven habitat assessments were conducted in areas immediately surrounding the Study Area to determine the extent and connectivity of broad fauna habitats within the Study Area.

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) with habitat



condition adapted from EPA (2016b) vegetation condition assessment criteria. 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
- condition/ disturbance: time since last fire, evidence of weeds, grazing, or human disturbances.

# 3.4 Sampling and Survey Methods

# 3.4.1 Systematic Trapping Sites

A total of five systematic trapping sites were established and sampled during the survey, with sites representing most fauna habitats present within the Study Area (Figure 3.2; Figure 3.3). The sites were setup to sample the most widespread and significant habitats, while ensuring adequate coverage across the entire Study Area. Three trapping sites (VSMB-01 to VSMB-03) were open for at least seven nights between the 1<sup>st</sup> and 11<sup>th</sup> of November. Due to heavy rainfall on the 9<sup>th</sup> of November, pitfall traps were closed for animal welfare reasons. Therefore, two sites (VSMB-04 and VSMB-05) were open for seven nights over an eight-night period. Each site was checked daily within three hours of sunrise. Trapping sites 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 two parallel transects (or one single transect at site VBSM-04 and VSMB-05 where there was sufficient habitat to extend the transect) with a 7.5 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 the broad fauna habitat occurring at the site. Styrofoam cups and trays were placed within all pits to provide refuge for any captured fauna from exposure to environmental conditions (i.e. temperature, wind and rainfall) 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). Small sponges were places inside the



traps to provide refuge for any captured fauna from exposure to environmental conditions (i.e. temperatures, wind and rainfall).

• 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 (Figure 3.2).

Shade covers for funnel, cage and Elliot traps were used to reduce exposure to environmental elements (i.e. temperature, rainfall and wind). Elliot and cage traps were baited with a universal bait mix comprising oats, peanut butter and sardines, and rebaited when consumed.



Figure 3.2: Layout of traps at a systematic sampling site

# 3.4.2 Avifauna Sampling

A daily 20-minute avifauna census was undertaken at each systematic trapping site during the survey, totalling 14.6 hours during the survey. Each census was undertaken within an area confined to the habitat type represented by each trapping site to collect assemblage data for each habitat. Each census



was conducted between whilst undertaking trap clearing and avifauna were recorded from either direct observation, call and/or secondary evidence (e.g. nests, feathers and/or tracks). The recorders were rotated where possible to reduce observers' bias (Lindenmayer *et al.*, 2009). Opportunistic avifauna sampling was undertaken throughout the survey while traversing the Study Area. Additional sampling was undertaken during different periods of likely activity, including evening sampling and during nocturnal searches.

# 3.4.3 Ultrasonic Bat Recording

SongMeter (SM; Wildlife Acoustics Inc.) ultrasonic bat recorders were deployed at six locations including all systematic trapping sites and opportunistically at an artificial water feature within the Study Area (Figure 3.3). At each location, recorders were placed in or in the vicinity of areas of prospective foraging and/or roosting habitats and features most likely to be utilised by bats, such as natural or artificial waterbodies. Recorders were deployed between three and seven nights at each location for a total of 28 recording nights. The jumper and 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.

# 3.4.4 Motion Cameras

A total of 20 individual motion cameras were deployed at 11 sites within the Study Area to survey for larger and/or cryptic species (i.e. conservation significant and introduced species) which may not be recorded by other sampling methods (Figure 3.3). One camera was deployed at each of the systematic trapping sites (except at site VBSM-04 at which two cameras were deployed). Five cameras were deployed within the northern third of the Open Peppermint Forest, to target western ringtail possum and wambenger brush-tailed phascogale. The remaining cameras were deployed opportunistically throughout the Study Area to ensure adequate coverage.

Cameras were deployed between three and seven consecutive nights for a total of 102 camera trap nights over the duration of the survey. Each camera was set to record five seconds of video footage when triggered, continuously during their deployment. Camera traps were baited with a universal bait mixture.

# 3.4.5 Targeted Western Ringtail Possum Sampling

# **Diurnal Surveys**

Targeted searches were undertaken to identify the occurrence of western ringtail possum and their habitat. Targeted searches were conducted within the most prospective areas (i.e. within Melaleuca over Hakea Shrubland, Open Peppermint Forest, Open Banksia Forest, Closed Low Marri Forest and Open Coastal Shrubland). During the targeted searches, and while traversing the Study Area, the team recorded all opportunistic primary (i.e. direct observation) or secondary (e.g. dreys, hollows and scats) evidence encountered.



### **Nocturnal Surveys**

Targeted spotlighting was conducted to determine the density and distribution of western ringtail possum. Owing to the density of vegetation, spotlighting was conducted along cleared tracks (DSEWPaC, 2011a) that bisected suitable habitat for the species. These provided pre-defined transects covering ~2. km in total within Closed Low Marri Forest, Open Peppermint Forest, Open Banksia Forest. As recommended by the DSEWPaC (2011a), three non-consecutive nights of spotlighting (on the 5<sup>th</sup>, 7<sup>th</sup>, and 10<sup>th</sup> of November for a total of 13.3 person hours). All targeted transects were searched on the 5<sup>th</sup> and 7<sup>th</sup> of November. However, only one (most northern) transect was search on the 10<sup>th</sup> of November. Each possum encountered during the targeted transect was recorded. These records were later used to generate an indicative estimate of density. Density was calculated by dividing the number of possums per night by the number of hectares searched. The number of hectares searched was calculated based on the area of the cleared tracks buffered by 15 m (represent the approximate maximum visibility as the furthered possum was observed from 12 m).

Spotlighting was also undertaken to detect the presence of any nocturnal fauna species within the Study Area. For this purpose, meandering spotlighting was undertaken in Open Coastal Shrubland, Kunzea and Melaleuca Closed Shrubland and rocky outcrop in addition to the targeted nocturnal transects.

Nocturnal surveys were undertaken between sunset (approximately 1900) and 2230 when activity levels were highest for most nocturnal species. Each survey consisted of searches using head torches to detect fauna from movement, eye shine and other evidence of species presence.

### 3.4.6 Black Cockatoo Habitat Assessment

A black cockatoo habitat assessment was conducted in each broad fauna habitat type within the Study Area in line with the DSEWPaC (2012a) *Referral guidelines for three species of black cockatoo species* and the DoEE (2017) *Revised draft referral guideline for three threatened black cockatoo species* for potential breeding, roosting and foraging habitat within the Study Area.

# **Potential Foraging Habitat**

Foraging habitat quality was assessed throughout the Study Area using the habitat scoring tool provided by DoEE (2017) (refer to Table 3.3 and Table 3.4). In determining the quality of foraging habitat for each of the black cockatoo species, the scoring tool considers key attributes of foraging habitat for each species to give them a score between 1 and 10. This includes connectivity and proximity of the foraging habitat to other foraging habitat in the area, as well as other threats that can reduce the functionality of that habitat for respective species. DoEE (2017) defines 'high quality' foraging habitat as habitat scoring of 7 or above, which, particularly in proximity to roosting and/or breeding sites, is considered important for the long-term survival and recovery of black cockatoos.

Any tree and shrub species known to be staple food resources for black cockatoos (i.e. *Corymbia* and *Banksia* species) or any evidence of foraging (i.e. chewed nuts or *Banksia* cones and/or flowers) within the Study Area was also documented.



### Potential Night Roosting

The potential for night roosting to occur within the Study Area was interpreted and extrapolated from the identification of potential breeding trees, mapping of potential breeding habitat, proximity to suitable watering spots, and knowledge of any known roosting sites within the vicinity of the Study Area. A Birdlife Australia black cockatoo search was conducted within the 12 km of the Study Area to identify the presence of any known roosting locations (refer to Section 1.2).

The Study Area was inspected from a vantage point at dusk on the 5<sup>th</sup> and the 7<sup>th</sup> of November to document any black cockatoos moving into the Study Area to roosting for the night. Moreover, any evidence of possible roosting events (i.e. clipped leaves and branches or droppings under suitable trees) recorded during the field survey was documented.

### **Potential Breeding Trees**

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, 2017) (Table 3.1). DBH was measured at 1.3 m from ground level. For most tree species, suitable DBH is 500 mm, while for salmon gum and wandoo, suitable DBH is 300 mm (DoEE, 2017; 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, 2017; DSEWPaC, 2012b).

### Table 3.1: Known breeding trees for Black Cockatoo species

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

<sup>1</sup> List excludes species for which Study Area occurs outside the known distribution of the species, as provided in Florabase

The location and attributes of all potential black cockatoo breeding habitat trees (as defined by DAWE; formerly the Department of Environment and Energy (DoEE) and Department of Sustainability, Water, Population, and Communities (DSEWPaC)) were recorded within the Study Area during the field survey.



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).

Where suitably sized hollows were recorded, further inspections were undertaken with a camera mounted on a telescopic pole to identify the presence/absence of any known breeding signs, i.e. hollows showing evidence of wear and chew marks around the hollow entrance that may be attributed to black cockatoos. Where possible, hollow usage by fauna was also recorded, including use by introduced honeybees or rainbow lorikeets. Potentially suitable nest hollows were considered to be hollows that appeared to be deep enough with an opening large enough to be used by black cockatoos, of both natural and artificial origin, as determined by the criteria shown below in Table 3.2.

Overall hollow suitability	Hollow present?	Suitable diameter? (> 100 mm and unobstructed)	Suitable depth? (> 250 mm)	Evidence of chewing around hollow rim?	Other factors to alter suitability?	
Active (Currently in use)	Yes	Yes	Yes	Yes	Orientation     (vertical is	
Suitable (No evidence of use)	Yes	Yes	Yes	No	preferred) • Diameter at base (>30 cm)	
Possible (Potential to support cockatoo but cannot confirm)	Yes	Yes	Potential	Νο	<ul> <li>Evidence of bees</li> <li>Common breeding tree species</li> <li>Height above</li> </ul>	
Not suitable	Yes	No	No	No	ground (> 2m)	

## Table 3.2: Hollow suitability criteria for potential use by black cockatoo species

# Table 3.3: Habitats used by black cockatoos for breeding, night roosting and foraging (DoEE, 2017)

	Baudin's cockatoo	Carnaby's cockatoo	Forest red-tailed B
Description of foraging habitat	Primarily seeds of marri and jarrah in woodlands and forest, and seeds of native proteaceous plant species (for example, <i>Banksia</i> spp., <i>Hakea</i> spp. and <i>Dryandra</i> spp.). During the breeding season feed primarily on native vegetation, particularly marri (seeds, flowers, nectar and grubs). Also, insects and insect larvae; pith of kangaroo paw ( <i>Anigozanthos flavidus</i> ); juice of ripe persimmons; tips of <i>Pinus</i> spp.; and seeds of apples and pears.	Native shrubland, Kwongan heathland and woodland on seeds, flowers and nectar of native proteaceous plant species ( <i>Banksia</i> spp., <i>Hakea</i> spp., <i>Dryandra</i> spp., and <i>Grevillea</i> spp.), as well as <i>Callistemon</i> spp. and marri. Also seeds of introduced species including <i>Pinus</i> spp., <i>Erodium</i> spp., wild radish, canola, almonds and pecan nuts; insects and insect larvae; occasionally flesh and juice of apples and persimmons.	Primarily seeds of ja edges of karri fores Eucalyptus caesia, snotty gobble (Pers haematoxylon). Also gum (E. camalduler the Swan Coastal P azedarach).
Base habitat score			
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of, successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10.	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10.	Foraging habitat that habitat that is the fo some level of protect described below with
7 (High quality)	Native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly marri, including along roadsides. Does not include orchards or areas under an RFA.	Native shrubland, Kwongan heathland and woodland dominated by proteaceous plant species such as <i>Banksia</i> spp. (including Dryandra spp.), Hakea spp. and Grevillea spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under an RFA.	Jarrah and marri wo including wandoo a including along road
5 (Quality)	Pine plantation or introduced eucalypts.	Pine plantation or introduced eucalypts.	Introduced eucalypt azedarach).
1 (Low quality)	Individual foraging plants or small stand of foraging plants.	Individual foraging plants or small stand of foraging plants	Individual foraging
Additions	habitat	Context adjustor - attributes improving functionality of foraging habitat	Context adjustor - habitat
Additions +3	Context adjustor - attributes improving functionality of foraging habitat         Is within the known foraging area	Context adjustor - attributes improving functionality of foraging habitat         Is within the Swan Coastal Plain (important foraging area).	Context adjustor - habitat Jarrah and/or marri trees).
Additions +3 +3	Context adjustor - attributes improving functionality of foraging habitat         Is within the known foraging area         Contains trees with suitable nest hollows.	Context adjustor - attributes improving functionality of foraging habitat         Is within the Swan Coastal Plain (important foraging area).         Contains trees with suitable nest hollows.	Context adjustor - habitat Jarrah and/or marri trees). Contains trees with
Additions +3 +3 +2	Context adjustor - attributes improving functionality of foraging habitat         Is within the known foraging area         Contains trees with suitable nest hollows.         Primarily contains marri.	Context adjustor - attributes improving functionality of foraging habitat         Is within the Swan Coastal Plain (important foraging area).         Contains trees with suitable nest hollows.         Primarily comprises marri.	Context adjustor - habitat Jarrah and/or marri trees). Contains trees with Primarily contains n
Additions +3 +3 +2 +2	Context adjustor - attributes improving functionality of foraging habitat         Is within the known foraging area         Contains trees with suitable nest hollows.         Primarily contains marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).	Context adjustor - attributes improving functionality of foraging habitat         Is within the Swan Coastal Plain (important foraging area).         Contains trees with suitable nest hollows.         Primarily comprises marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).	Context adjustor - habitat Jarrah and/or marri trees). Contains trees with Primarily contains n Contains trees with mm or ≥ 300 mm D
Additions +3 +3 +2 +2 +1	Context adjustor - attributes improving functionality of foraging habitat         Is within the known foraging area         Contains trees with suitable nest hollows.         Primarily contains marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.	Context adjustor - attributes improving functionality of foraging habitat         Is within the Swan Coastal Plain (important foraging area).         Contains trees with suitable nest hollows.         Primarily comprises marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.	Context adjustor - habitat Jarrah and/or marri trees). Contains trees with Primarily contains n Contains trees with mm or ≥ 300 mm D Is known to be a roo
Additions +3 +3 +2 +2 +1 Subtractions	Context adjustor - attributes improving functionality of foraging habitat         Is within the known foraging area         Contains trees with suitable nest hollows.         Primarily contains marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.         Context adjustor - attributes reducing functionality of foraging habitat	Context adjustor - attributes improving functionality of foraging habitat         Is within the Swan Coastal Plain (important foraging area).         Contains trees with suitable nest hollows.         Primarily comprises marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.         Context adjustor - attributes reducing functionality of foraging habitat	Context adjustor - habitat Jarrah and/or marri trees). Contains trees with Primarily contains n Contains trees with mm or ≥ 300 mm D Is known to be a roo Context adjustor - habitat
Additions         +3         +3         +2         +2         +1         Subtractions         -2	Context adjustor - attributes improving functionality of foraging habitat         Is within the known foraging area         Contains trees with suitable nest hollows.         Primarily contains marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.         Context adjustor - attributes reducing functionality of foraging habitat         No clear evidence of feeding debris.	Context adjustor - attributes improving functionality of foraging habitat         Is within the Swan Coastal Plain (important foraging area).         Contains trees with suitable nest hollows.         Primarily comprises marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.         Context adjustor - attributes reducing functionality of foraging habitat         No clear evidence of feeding debris.	Context adjustor - habitat Jarrah and/or marri trees). Contains trees with Primarily contains n Contains trees with mm or ≥ 300 mm D Is known to be a roo Context adjustor - habitat No clear evidence of
Additions         +3         +3         +2         +2         +1         Subtractions         -2         -2	Context adjustor - attributes improving functionality of foraging habitat         Is within the known foraging area         Contains trees with suitable nest hollows.         Primarily contains marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.         Context adjustor - attributes reducing functionality of foraging habitat         No clear evidence of feeding debris.         No other foraging habitat within 6 km.	Context adjustor - attributes improving functionality of foraging habitat         Is within the Swan Coastal Plain (important foraging area).         Contains trees with suitable nest hollows.         Primarily comprises marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.         Context adjustor - attributes reducing functionality of foraging habitat         No clear evidence of feeding debris.         No other foraging habitat within 6 km.	Context adjustor - habitat Jarrah and/or marri trees). Contains trees with Primarily contains n Contains trees with mm or ≥ 300 mm D Is known to be a roo Context adjustor - habitat No clear evidence of No other foraging h
Additions         +3         +3         +2         +2         +1         Subtractions         -2         -1	Context adjustor - attributes improving functionality of foraging habitat         Is within the known foraging area         Contains trees with suitable nest hollows.         Primarily contains marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.         Context adjustor - attributes reducing functionality of foraging habitat         No clear evidence of feeding debris.         No other foraging habitat within 6 km.         Is > 12 km from a known breeding location.	Context adjustor - attributes improving functionality of foraging habitat         Is within the Swan Coastal Plain (important foraging area).         Contains trees with suitable nest hollows.         Primarily comprises marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.         Context adjustor - attributes reducing functionality of foraging habitat         No clear evidence of feeding debris.         No other foraging habitat within 6 km.         Is > 12 km from a known breeding location.	Context adjustor - habitat Jarrah and/or marri trees). Contains trees with Primarily contains n Contains trees with mm or ≥ 300 mm D Is known to be a roo Context adjustor - habitat No clear evidence of No other foraging h Is > 12 km from a k
Additions         +3         +3         +2         +2         +1         Subtractions         -2         -1	Context adjustor - attributes improving functionality of foraging habitat         Is within the known foraging area         Contains trees with suitable nest hollows.         Primarily contains marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.         Context adjustor - attributes reducing functionality of foraging habitat         No clear evidence of feeding debris.         No other foraging habitat within 6 km.         Is > 12 km from a known breeding location.         Is > 12 km from a known roosting site.	Context adjustor - attributes improving functionality of foraging habitat         Is within the Swan Coastal Plain (important foraging area).         Contains trees with suitable nest hollows.         Primarily comprises marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.         Context adjustor - attributes reducing functionality of foraging habitat         No clear evidence of feeding debris.         No other foraging habitat within 6 km.         Is > 12 km from a known breeding location.         Is > 12 km from a known roosting site.	Context adjustor - habitat Jarrah and/or marri trees). Contains trees with Primarily contains n Contains trees with mm or ≥ 300 mm D Is known to be a roo Context adjustor - habitat No clear evidence of No other foraging h Is > 12 km from a k Is > 12 km from a k
Additions         +3         +3         +2         +2         +1         Subtractions         -2         -1         -1	Context adjustor - attributes improving functionality of foraging habitat         Is within the known foraging area         Contains trees with suitable nest hollows.         Primarily contains marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.         Context adjustor - attributes reducing functionality of foraging habitat         No clear evidence of feeding debris.         No other foraging habitat within 6 km.         Is > 12 km from a known breeding location.         Is > 2 km from a watering point.	Context adjustor - attributes improving functionality of foraging habitat         Is within the Swan Coastal Plain (important foraging area).         Contains trees with suitable nest hollows.         Primarily comprises marri.         Contains trees with potential to be used for breeding (DBH ≥ 500 mm or ≥ 300 mm DBH for salmon gum and wandoo).         Is known to be a roosting site.         Context adjustor - attributes reducing functionality of foraging habitat         No clear evidence of feeding debris.         No other foraging habitat within 6 km.         Is > 12 km from a known breeding location.         Is > 12 km from a known roosting site.         Is > 2 km from a watering point.	Context adjustor - habitat Jarrah and/or marri trees). Contains trees with Primarily contains n Contains trees with mm or ≥ 300 mm D Is known to be a roo Context adjustor - habitat No clear evidence of No other foraging h Is > 12 km from a k Is > 12 km from a ka

### Table 3.4: Habitat quality scoring totals for black cockatoo foraging habitat

Final habitat quality score	8 - 10	6 - 8	3 - 5	1-3
Habitat Quality Category	Very High Quality	High Quality	Quality	Low Quality



# Black cockatoo

arrah and marri in woodlands and forest, and tts, including wandoo and blackbutt. Forages on *E. erythrocorys*, Allocasuarina cones, fruits of soonia longifolia) and mountain marri (*Corymbia* so, some introduced eucalypts such as river red *nsis*) and flooded or rose gum (*E. grandis*). On Plain, often feeds on introduced Cape lilac (*Melia*)

at is being managed for black cockatoos such as ocus of successful rehabilitation, and/or has ction from clearing, and/or is quality habitat th attributes contributing to meet a score of ≥10.

oodlands and forest, and edges of karri forests, and blackbutt, within the range of the subspecies, dsides. Does not include areas under a RFA.

ts as well as the introduced Cape lilac (Melia

plants or small stand of foraging plants

attributes improving functionality of foraging

show good recruitment (i.e. evidence of young

suitable nest hollows.

narri and/or jarrah.

potential to be used for breeding (DBH ≥ 500 BH for salmon gum and wandoo).

osting site.

attributes reducing functionality of foraging

of feeding debris.

abitat within 6 km.

nown breeding location.

nown roosting site.

tering point.

.g. Phytophthora cinnamomi or marri canker).



# 3.4.7 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.



- Survey Method
- Avifauna Survey
- O Black Cockatoo Foraging Assessment

▲ Ultrasonic Recorder

- Systematic Trapping
- --- Systematic Trapping Lines



Figure 3.3: Vertebrate fauna sampling sites within the Study Area

\_Busseltor



- Walking Active Search
- Targeted Search
- Nocturnal Search

eters Coordinate System: GDA 1994 MGA Zone 50 Projection: Transverse Mercator Datum: GDA 1994 Created 24/11/2020

150

Scale: 1:3,000 50 100

Figure 3.4: Vertebrate fauna search effort within the Study Area

\_Busselton



# 3.5 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, with the exception of taxonomic changes published subsequent to the checklist. 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 publications and authorities.

# 3.6 Animal Welfare and Ethics

All sampling and survey methods implemented during the field survey were undertaken in accordance with relevant survey-specific licence conditions, EPA (2020) Technical guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment and DBCA Standard Operating Procedures (SOPs), and complied with the Western Australian *Animal Welfare Act* 2002 (AW Act) and the *Australian Code for the Care and Use of Animals for Scientific Purposes* (NHMRC, 2013) where applicable.

Relevant DBCA SOPs applicable to this survey include:

- DBCA (2018c) Dry Pitfall Trapping or Vertebrates;
- DBCA (2018a) Aluminium Box Traps for Capture of Terrestrial Vertebrates;
- DBCA (2018b) Cage Traps for Live Capture of Terrestrial Vertebrates;
- DBCA (2018d) Funnel Trapping for Terrestrial Fauna;
- DBCA (2018e) Hand Capture of Wildlife;
- DBCA (2017c) Hand Restraint of Wildlife;
- DBCA (2017a) Animal Handling and Restraint Using Soft Containment;
- DBCA (2017e) Transport and Temporary Holding of Wildlife;
- DBCA (2017d) Tissue Sample Collection and Storage for Mammals;
- DBCA (2018g) Vouchering Vertebrate Fauna Specimens;
- DBCA (2017b) First Aid for Animals; and
- DBCA (2018f) Managing Disease Risk in Wildlife Management.



# 3.7 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, 2020). 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, Jacknife 1 and Bootstrap 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).

# 3.8 Fauna Habitat Mapping

Fauna habitat mapping was refined using the vertebrate fauna habitat assessments conducted during the field surveys, as well as high-resolution aerial imagery, vegetation, topographical, land system and drainage mapping. These assessment were applied to the vegetation mapping defined and delineated by Emerge (2019) and later refined by Strategen. Habitats were delineated and mapped across the Study Area at a scale of approximately 1:6,000.

# 3.9 Likelihood of Vertebrate Fauna Occurrence

The likelihood of occurrence within the Study Area was assessed for all conservation significant species identified in the desktop assessment using the decision matrix shown in Table 3.5. The occurrence assessment was based on known information relating to species' distribution, habitat preferences (landforms, substrates and vegetation associations), locality records from database searches and previous studies within and/or in the vicinity of the Study Area and results of the current survey pertaining to species records and/or habitats occurring within the Study Area. The fauna assessments assigned each species to one of six ratings, ranging from Confirmed to Highly Unlikely.



Due to several factors influencing species occurrence (i.e. known distribution, habitat preferences, ecology and/or dispersal capabilities), interpretation of occurrence assessment criteria may vary between species (i.e. a small species with limited dispersal capabilities previously recorded close to the Study Area may not necessarily occur within the Study Area, whereas larger species with greater dispersal and/or foraging capabilities may have an increased likelihood of occurring).

Where a species determined likelihood of occurrence differs from the assessment criteria in Table 3.5, detailed justification for the determined assessment will be provided in the discussion of that species. For example, historic or presumed erroneous records which may not be representative of species' current known distribution (i.e. locally/regionally extinct species) or limited sampling within or in the vicinity of the Study Area resulting in lack of contextual records which may influence a higher or lower determined likelihood of occurrence to criteria.

Range/occurrence		Habitat Categories (within Study Area)			
(<50 years only)	Core/critical habitat present	Foraging/dispersal habitat present	Marginal/intermittent habitat present	No suitable habitat present	
Recorded in Study Area	Confirmed	Confirmed	Confirmed	Confirmed	
Recorded within 10 km	Highly Likely	Likely	Possible	Possible	
Recorded within 10–50km	Likely	Possible	Possible	Unlikely	
Recorded within 50–100 km	Possible	Possible	Unlikely	Unlikely	
Recorded >100 km	Possible	Unlikely	Unlikely	Highly Unlikely	
Species considered locally/regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely	

# Table 3.5: Species likelihood of occurrence decision matrix

# 3.1 **Potential Limitation and Constraints**

EPA (2020) outlines several potential limitations to fauna surveys. These aspects are assessed and discussed in Table 3.6 below. The sampling techniques used during the survey were not constrained by any significant limitations.



Table 3.6: Survey	/ limitations and	constraints
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Potential limitation or constraint	Limitation to current survey	Applicability to this survey
Experience of personnel	No	The field personnel involved in the survey are experienced in undertaking fauna surveys of similar nature, including with conservation significant fauna species targeted during the survey. Experience of field personnel undertaking the field surveys ranged from three to 14 years' experience completing surveys of similar scope within the region of the Study Area and more broadly across WA.
Scope (faunal groups sampled and whether any constraints affect this)	No	The scope was a Detailed terrestrial vertebrate fauna survey and was conducted within that framework. All trapping methods were able to be undertaken as expected to sample all target fauna groups.
		All recorded vertebrate fauna was identified at the point of observation. All recorded bat calls were analysed, and species identification was undertaken by Robert Bullen of Bat Call WA expert.
Proportion of fauna identified	No	Overall, 78 species of were recorded during the survey, representing approximately 27% of the total number of species identified in the desktop assessment ( $n = 285$ ). Species accumulation curves for sampling adequacy indicated 70-84% of mammal species, 80-87% of avifauna species and 83-92% of herpetofauna species were identified from systematic sampling methods. This, however, does not include species recorded from non-systematic sampling methods and is likely to be an under representation of the percentage of diversity recorded.
Sources of information (recent or historic) and availability of contextual information	No	All contextual resources required to complete the assessment were available (previous surveys, database searches, environmental information, climate data). This included information from 13 biological surveys previously conducted in the vicinity of the Study Area, comprising a reasonable amount of previous survey effort.
Proportion of the task achieved	No	A Detailed terrestrial vertebrate fauna survey of the Study Area was completed in spring and related to the results of surveys in the broader area identified in the desktop assessment.
Timing / weather / season / cycle	No	Above averages temperatures may have resulted in greater activity and captures of some vertebrate groups during the surveys. Lower than average rainfall was recorded preceding the survey, potentially reducing the abundance and activity levels of some vertebrate groups.
Disturbances (e.g. fire or flood)	No	No disturbance occurred during or immediately prior to the surveys. No recent fire has occurred in parts of the Study Area which may have influenced species diversity and abundance recorded where vegetation cover was heavily reduced.
Intensity of survey	No	The trapping intensity, targeted searches, motion cameras, ultrasonic recordings and avifauna censuses were assessed as sufficient to meet the requirements of a Detailed terrestrial vertebrate fauna survey and survey effort was appropriate for the size of the Study Area.



Potential limitation or constraint	Limitation to current survey	Applicability to this survey
Completeness of survey	No	The survey achieved enough coverage of the Study Area and associated habitats through the survey techniques employed and the habitat assessments undertaken.
Resources (e.g. degree of expertise available)	No	All relevant resources and expertise required to complete the survey were available.
Remoteness or access issues	No	The Study Area was largely accessible either by vehicle or on foot, thus the sampling techniques used during this survey were unconstrained by accessibility or remoteness.
Availability of contextual information on the region	No	Fauna assemblages of the region are fairly well documented, particularly for vertebrate fauna groups. All contextual resources required to complete the survey were available (previous surveys, database searches, environmental information, climate data etc.)



# 4 FIELD SURVEY RESULTS AND DISCUSSION

# 4.1 Fauna Habitats

A total of seven broad fauna habitat types were recorded and mapped across the Study Area, comprising, in decreasing order of extent, *Kunzea* and *Melaleuca* Closed Shrubland (11.6 ha, 29% of Study Area), Open Peppermint Forest (8.1 ha, 20% of Study Area), *Melaleuca* over *Hakea Shrubland* (5.4 ha, 13% of Study Area), Open Coastal Shrubland (5.4 ha, 13% of Study Area), Open Banksia Forest (4.1 ha, 10% of Study Area), Closed Low Marri Forest (1.5 ha, 4% of Study Area), and Rocky Outcrop (0.5 ha, 1% of Study Area). (Table 4.1; Figure 4.1). Approximately 3.9 ha (10%) of the Study Area is Cleared/ Disturbed. Based on habitat assessments conducted beyond the Study Area boundary the broad fauna habitats extend beyond the Study Area.

Descriptions of the distinguishing characteristics and the occurrence within the Study Area for each of these habitat types are presented in Table 4.1, and the data from on-site habitat assessments are presented in Appendix D.

As mentioned, vegetation association MIDr (contained within the western extent of the *Melaleuca* over *Hakea* Shrubland) and MIKc (contained within stands of the *Kunzea* and *Melaleuca* Closed Shrubland) are considered to represent the Priority 2 '*Melaleuca lanceolata* forests, Leeuwin Naturaliste Ridge' PEC. Additionally, vegetation associations KcSg (contained within the remainder of the *Kunzea* and *Melaleuca* Closed Shrubland) is considered to represent the Priority 2 '*Low shrublands on acidic grey- brown sands of the Gracetown soil-landscape system*' PEC (Emerge, 2019). However, these PEC's are not listed for faunal values.



# Table 4.1: Broad fauna habitats occurring within the Study Area

Habitat	Distinguishing habitat characteristics (Emerge, 2019)	Veg. Code (Emerge, 2019)	Conservation Significant Species	Photo
Kunzea and Melaleuca Closed Shrubland 11.6 ha, 29%	Closed shrubland <i>Kunzea ciliata</i> and <i>Spyridium globulosum</i> over low open shrubland <i>Eutaxia</i> <i>myrtifolia</i> over sparse sedgeland over low sparse herbland as well as closed shrubland <i>Melaleuca</i> <i>lanceolata</i> and <i>Kunzea ciliata</i> over occasional grasses and herbs on a hillslope of granite outcropping	KcSg, MIKc	<b>quenda</b> - primary breeding, foraging and dispersal	
Open Peppermint Forest 8.1 ha, 20%	Low open forest <i>Agonis flexuosa</i> over fernland <i>Pteridium</i> <i>esculentum</i> subsp. <i>esculentum</i> over open herbland mixed non- native species such as <i>Lysimachia arvensis</i> and <i>Asparagus asparagoides</i> on a sandy hillslope	AfPe	<ul> <li>western ringtail possum – primary breeding, foraging and dispersal habitat</li> <li>black cockatoos – secondary roosting habitat</li> <li>o Baudin's - low quality foragin habitat</li> <li>wambenger brush-tailed phascogale -</li> <li>primary breeding, foraging and dispersal habitat</li> <li>quenda - foraging and dispersal habitat</li> </ul>	



Habitat	Distinguishing habitat characteristics (Emerge, 2019)	Veg. Code (Emerge, 2019)	Conservation Significant Species	Photo
Melaleuca over Hakea Shrubland 5.4 ha, 13%	Low woodland to low open forest Melaleuca huegelii, M. lanceolata and Guichenotia ledifolia over tall open shrubland Hakea oleifolia over shrubland Hibbertia cuneiformis over low open herbland Stylidium adnatum on a sandy midslopes. Progresses westward to a low closed forest Melaleuca lanceolata over sparse shrubland Melaleuca systena and Spyridium globulosum over low open herbland Dianella revoluta var. revoluta over low open	2019) MhGl, MIDr	<ul> <li>Baudin's – primary foraging habitat (High Quality)</li> <li>Carnaby's – primary foraging habitat (Quality)</li> <li>quenda - primary breeding, foraging and dispersal</li> <li>Ctenotus ora - primary breeding, foraging and dispersal</li> <li>barking owl – primary foraging and dispersal</li> </ul>	
	(understorey absent in areas of dense canopy cove			



Habitat	Distinguishing habitat characteristics (Emerge, 2019)	Veg. Code (Emerge, 2019)	Conservation Significant Species	Photo
Open Coastal	Variable Shrubland progressing	AsHh,	Baudin's - low quality foragin habitat	
Shrubland	from a granitic stony plain to a sandy plain (southward) on a	AsDc, NfCcXn	quenda - primary breeding, foraging and	
5 4 ha	hillslope. Vegetation comprises	AhHe	dispersal	
13%	distinct associations of Acacia		Ctenotus ora - primary breeding, foraging	
	saligna over low open shrubland Hibbertia hypericoides over grassland non-native species, shrubland Acacia saligna and Dodonaea ceratocarpa over low herbland Trachymene pilosa over low sparse grassland Rytidosperma occidentale, shrubland Allocasuarina humilis over low sparse herbland over low sparse grassland Austrostipa mollis and Rytidosperma occidentale over low open rushland Hypolaena exsulca and low open forest Nuytsia floribunda and Corymbia calophylla over open shrubland Xanthorrhoea preissii over low open mixed herbland over low open grassland native and non- native species		and dispersal	



Habitat	Distinguishing habitat characteristics (Emerge, 2019)	Veg. Code (Emerge, 2019)	Conservation Significant Species	Photo
Open <i>Banksia</i>	Low open forest Banksia	BmMrXp	western ringtail possum – secondary	
Forest	attenuata and occasional Agonis		breeding, foraging and dispersal habitat	
4.1 ha,	Macrozamia riedlei and		black cockatoos – potential breeding habitat	
10%	Xanthorrhoea preissii over open mixed herbland on a sandy		and secondary roosting habitat	Alter and the second
	hillslope		Baudin's and Carnaby's primary foraging	which the second of
			habitat (Very High and High Quality	
			respectively)	
			wambenger brush-tailed phascogale -	AND
			primary breeding, foraging and dispersal habitat	
			quenda - primary breeding, foraging and	
			dispersal habitat	
			western brush wallaby - primary breeding,	
			foraging and dispersal habitat	
			Ctenotus ora - primary breeding, foraging and	
			dispersal habitat	
Closed Low Marri	Low forest Corymbia calophylla	CcHh,	<ul> <li>western ringtail possum – secondary</li> </ul>	
Forest	over open shrubland Xanthorrhoea preissii and over	DCIDCL	breeding, foraging and dispersal	
	low shrubland Hibbertia		<ul> <li>black cockatoos – primary foraging habitat</li> </ul>	CASE S
1.5 ha,	hypericoides over sparse low herbland Scaevola calliptera		and secondary roosting habitat	
4%	surrounded by Shrubland		<ul> <li>wambenger brush-tailed phascogale -</li> </ul>	
	Dodonaea ceratocarpa over low sedgeland <i>Lepidosperma spp.</i> over low open grassland of native and non-native species over low open herbland <i>Crassula</i> <i>spp.</i> on a sandy hillslope		primary foraging and dispersal	

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Habitat	Distinguishing habitat characteristics (Emerge, 2019)	Veg. Code (Emerge, 2019)	Conservation Significant Species	Photo
Rocky Outcrop 0.5 ha, 1%	Granite outcropping and boulders with low open shrubland <i>Kunzea ciliata</i> and <i>Darwinia citriodora</i> over low sparse herbland Stypandra glauca over low sparse grassland Poa poiformis on granite	KcDcPp		
Cleared/ Disturbed 3.9 ha, 10%	No native vegetation			







Melaleuca over Hakea Shrubland

Open Banksia Forest

Open Coastal Shrubland

**Open Peppermint Forest** 

Rocky Outcrop



# STRATEGEN-JBS&G **Smith's Beach Detailed** Vertebrate Fauna Survey

\_Busselton

Figure 4.1: Broad fauna habitats occurring within the Study Area



# 4.2 Fauna Recorded

# 4.2.1 Species Richness of Study Area

A total of 78 vertebrate fauna species, comprising 15 mammal species (13 native and two introduced), 39 bird species (37 native and two introduced), 20 reptile species and four amphibian species were recorded from the Study Area during the current survey (Table 4.2; Appendix E). This comprises approximately 27% of the total number of species identified in the desktop assessment (n = 285) as potentially occurring within the Study Area (see section 2.2). Moreover, four species were recorded just outside of the Study Area comprising a whimbrel, pacific gull, little pied cormorant and red fox. However, the red fox was previously recorded within the Study Area (ATA, 2007). In comparison with the results from previous surveys undertaken in the vicinity of the Study Area (Table 4.2), the total species diversity recorded during the current survey was comparable to other larger scale surveys comprising a Detailed survey. Specifically, total species diversity recorded during the current survey was greater in comparison with the results from previous surveys undertaken previous surveys undertaken within the Study Area (ATA, 2007; ecologia, 2001).

Table 4.2: Summary of fauna species	recorded during the current survey and previous surveys
in the vicinity of the Study	Area

Source	Reference	Mammals (native)	Mammals (introduced)	Birds (native)	Birds (introduced)	Reptiles	Amphibians	Total
Lite	rature S	ources						
ATA (2007) Vertebrate Fauna Assessment Smiths Beach, Yallingup. Unpublished report prepared for Canal Rocks Pty. Ltd.	A	6	4	30	0	20	4	64
ecologia (2001) Location 413 Smiths Beach Fauna Assessment. Unpublished report prepared for ATA Environmental	В	7	4	31	0	9	1	52
How <i>et al.</i> (1987) The ground vertebrate fauna of coastal areas between Busselton and Albany, Western Australia. Records of the Western Australian Museum, 13(4), 553-574.	С	23	7	0	0	35	11	76
Ecosystems Solutions (2014) City of Busselton Road Widening Level 1 Fauna and Level 2 Flora/Vegetation Assessment. Unpublished report prepared for City of Busselton.	D	1	0	2	0	0	0	3
Ecoscape (2012a) Armstrong Reserve, Dunsborough <i>Ctenotus ora</i> Potential Impact Assessment. Unpublished report prepared for Ray Village Aged Services	E	0	0	0	0	1	0	1
Ecoscape (2012b) Armstrong Reserve Level Two Fauna Survey. Unpublished report prepared for Ray Village Aged Services	F	1	3	16	0	4	5	29
NGH (2015) Level 2 Fauna Survey Meelup Regional Park. Unpublished report prepared for Meelup Regional Park Management Committee.	G	15	4	59	0	17	7	102
BDS (2004) Lot 50 Eagle Crescent, Eagle Bay Environmental Assessment Unpublished report prepared for Eagle Bay Joint Venture.	Н	0	1	14	0	0	3	18



Source	Reference	Mammals (native)	Mammals (introduced)	Birds (native)	Birds (introduced)	Reptiles	Amphibians	Total
Harewood (2014) Fauna Assessment Lots 1, 2, 1490 and Reserve 20554 Wildwood Road Carbanup. Unpublished report prepared for Palmer Group.	I	3	2	43	0	0	3	51
Harewood (2017) Black Cockatoo Habitat Assessment of Proposed Clearing Areas Lot 2682 and Lot 2683 Gale Road Kaloorup. Unpublished report prepared for Lundstrom Environmental Consultants Pty Ltd.	J	0	0	3	0	0	0	3
Ecosystems Solutions (2017) Reconnaissance Flora, Vegetation and Fauna Survey Busselton Strategic Network Corridors. Unpublished report prepared for Strategen Environmental.	к	1	0	0	0	0	0	1
GHD (2017) Vasse Diversion Drain Upgrade Flora and Fauna Study. Unpublished report prepared for The Water Corporation.	L	3	5	20	1	2	3	34
Harewood (2012) Phase 1 and Phase 2 Seasonal Fauna Surveys (Level 2), Yoongarillup Mineral Sands Project. Unpublished report prepared for Doral Mineral Sands Pty Ltd	М	13	6	53	0	25	4	101
Biota (2009) Milyeannup Wind Farm Terrestrial Fauna Survey. Unpublished report prepared for Verve Energy.	N	8	5	51	0	16	4	84
Current Survey		13	3	37	2	20	4	79

# 4.2.2 Fauna Assemblages

# Systematic Sampling Sites

Locations of systematic trapping sites were situated in areas considered to give a good representation of broad fauna habitats occurring within the Study Area (Figure 3.3). Systematic trapping sites were located in Open Peppermint Forest (VSMB-01), *Melaleuca* over *Hakea* Shrubland (VSMB-02), Open *Banksia* Forest (VSMB-03), *Kunzea* and *Melaleuca* Closed Shrubland (VSMB-04) and Open Coastal Shrubland (VSMB-05). All broad fauna habitats were subject to further survey effort using alternative sampling methods, including active foraging, motion cameras and SongMeter ultrasonic recordings to sample overall species diversity and target conservation significant species.

# Mammals

A total of 16 mammal species from 12 families were recorded within the Study Area from 234 individual records (Appendix E). Bats were the most diverse native mammal group recorded (six species from two families). The most abundantly recorded species were western ringtail possum (n = 49) and western grey kangaroo (n = 15). Three introduced mammal species were recorded within the Study Area from a total of 16 records. Species diversity and abundance recorded via systematic methods (i.e. pitfall, funnel, Elliot and cage trapping) at the five trapping sites was comparable; one site recorded no mammals (VSMB-05), one site recorded one species from three individual records (VSMB-03) and the remaining sites recorded two species from two individual records.



During the current survey, four species were recorded that had previously not been recorded in the Study Area comprising, southern brown bandicoot (*Isoodon fusciventer*), short-beaked echidna (*Tachyglossus aculeatus*), lesser long-eared bat (*Nyctophilus geoffroyi*) and greater long-eared bat (*Nyctophilus major*). However, five species were not recorded during the current survey that were previously recorded in the Study Area comprising; dog (*Canis familiaris*), cat (*Felis catus*), wester bush rat (*Rattus fuscipes*), common brushtail possum (*Trichosurus vulpecula*) and chocolate wattled bat (*Chalinolobus morio*).

### Birds

A total of 42 bird species representing 23 families were recorded within the Study Area from a total of 156 individual records (Appendix E). The warblers (family Acanthizidae) were the most diverse family with five species recorded from a total of 15 individual records. The family Cacatuidae (cockatoo) was the most abundant with a total of 44 individual records of three species. Carnaby's black cockatoo was the most recorded species during the survey, with 40 individual records.

Species diversity, abundance and complexity was variable throughout the Study Area. While many common and widespread species were shared between sites, several species were recorded at only one or few sites, particularly due to the variable presence and abundance of vegetation between sites. Species diversity and abundance recorded (via systematic bird census) at the five trapping sites varied, with between 11 (VSMB-03) and 41 (VSMB-01 and VSMB-05) individual records occurring at each site, and total species diversity at each site ranging from seven (VSMB-03) to 17 (VSMB-05). Inclusive of all sampling methods bird census, targeted searches, motion cameras and opportunistic records, VSMB-01 recorded the highest number of species (n=18) from 60 individual records.

The current survey recorded 14 species that had not previously been recorded in the Study Area including one species of conservation significance; Carnaby's cockatoo (*Calyptorhynchus latirostris*). However, 13 species were not recorded during the current survey that had previously been recorded in the Study Area.

### Herpetofauna

A total of 24 Herpetofauna species representing nine families were recorded from 300 individual records (Appendix E). Among the reptiles, skinks (Scincidae) were the most abundant group with 249 individual records, representing 12 species. The remaining families were represented by three or fewer species (Appendix E). The most recorded species was a skink (*Morethia lineoocellata*), recorded 69 times from all five systematic sites and one opportunistic site.

Species diversity at the systematic trapping sites range between five (VSMB-01) and 12 (VSMB-05) species, whereas abundance varied between all trapping sites, with the number of individual records ranging from 30 (VSMB-01) to 64 (VSMB-02). Additionally, 12 species from 39 individual records were recorded via motion camera or opportunistically during the field survey, some of which were not recorded at sampling sites.

Among the amphibians, the western banjo frog (*Limnodynastes dorsalis*) was the most abundant having been recorded on 15 occasions across all systematic trapping site bar one (VSMB-04). Moaning frog



(*Heleioporus eyrei*) was captured at three systematic sampling sites (VSMB-01, VSMB-03, VSMB-05). Slender tree frog (*Litoria adelaidensis*) and motorbike frogs (*Litoria moorei*) were recorded opportunistically (inclusive of at the water feature within the Study Area). Via sampling methods trapping methods VSMB-04 recorded the highest abundance (n=7).

The current survey recorded four species that had not previously been recorded in the Study Area comprising *Delma hebesa, Pygopus lepidopodus, Lerista elegans* and *Morethia obscura*. However, four species were not recorded during the current survey that had previously been recorded in the Study Area: *Morelia spilota, Elapognathus coronatus, Lerista distinguenda* and *Varanus rosenbergi.* 

# 4.1 Field Survey Adequacy

The results below represent this survey accumulation curves for each faunal group (mammals, birds and herpetofauna). 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.

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.

### Mammals

The species accumulation curve for mammals produced a steadily increasing line, indicating that an asymptote had not been reached; however, the curve was starting to gradually flatten towards a point plateau (Figure 4.2). Richness estimators indicated that between 70% (Jacknife 1) and 84% (Bootstrap) of species had been recorded. A total of four species were recorded and it was indicated that between four and six species would be 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, thus the capture of a single new species on any given day makes a proportionately large change to the overall dataset. 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. ultrasonic records, motion camera records and opportunistic records) within habitats trapped are not included. These include, but are not limited to, quenda, rabbit (*Oryctolagus cuniculus*) and numerous bat species (Appendix E).





# 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 4.3). Richness estimators indicated that the survey recorded 80% (Jacknife 1), 87% (Chao 1) and 89% (Chao 2 and Bootstrap) of possible species occurring. A total of 24 species were recorded and it was indicated that between 26 and 30 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 western thornbill (*Acanthiza inornata*), Baudin's cockatoo (*Calyptorhynchus baudinii*) and brown goshawk (*Accipiter fasciatus*) (Appendix E).



# Figure 4.3: Species accumulation curve for birds recorded during avifauna census at systematic sampling sites

### Herpetofauna

Analysis of the herpetofauna data set from the survey produced a steadily increasing line over the 7day sampling period, indicating that an asymptote had not been reached; however, was close to reaching a point of plateau (Figure 4.4). Richness estimators indicated that between 83% (Jacknife 1) and 92% (Chao 2 and Bootstrap) of species had been recorded. A total of 18 species were recorded and it was indicated that 19 and 22 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 marbled gecko (*Christinus marmoratus*), slender tree frog (*Litoria adelaidensis*) and motorbike frog (*Litoria moorei*) (Appendix E).


Figure 4.4: Species accumulation curve for herpetofauna trapped at systematic sampling sites



### 4.2 Fauna of Conservation Significance

A total of 80 species of conservation significance have the potential to occur within the Study Area, based on the results of the desktop assessment (see Section 2.2), comprising 11 mammals, 65 birds and four reptiles (see Table 2.4). Three vertebrate species of conservation significance have previously been recorded within the Study Area; western ringtail possum (Critically Endangered – EPBC/BC Act), Baudin's cockatoo (Endangered – EPBC/BC Act), wambenger brush-tailed phascogale (Conservation Dependent – BC Act).

Six species of conservation significance were recorded within the Study Area during the current survey (Figure 4.5); western ringtail possum, Carnaby's black cockatoo (Endangered – EPBC/BC Act), Baudin's black cockatoo, *Ctenotus ora* (Priority 3 – DBCA Priority List), quenda (Priority 4 – DBCA Priority List) and wambenger brush-tailed phascogale. Additionally, a whimbrel (Migratory – EPBC/BC Act) was recorded on a shoreline ~40 m north of the Study Area.

Based on known species' distributions, previous records and the habitats present, three species were deemed Likely to occur, four species were deemed Possible and 67 were considered Unlikely or Highly Unlikely to occur (Table 4.3). The occurrence of those species of conservation significance which have either been Confirmed as occurring in the Study Area or are considered Highly Likely to occur or Likely to occur, are discussed in more detail (Section 4.2.1 to 4.2.3).

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. For this reason, marine and shorebird species (i.e. species belonging to families Anatidae, Ardeidae, Charadriidae, Charadriidae, Hydrobatidae, Laridae, Phaethontidae, Procellariidae, Scolopacidae And Stercorariidae) are no longer considered in this report as the Study Area does not include marine or wetland environments required by these species. Although they may flyover occasionally if they do occur, their presence is not influenced by the habitats present. Moreover, Bilby has historic distribution over the southwest and is no longer considered in this report as they are known to be extinct from the region. As such these species are no longer discussed in this report.



Melaleuca over Hakea Shrubland

**Open Banksia Forest** 

Open Coastal Shrubland

**Open Peppermint Forest** 

Rocky Outcrop

Legend

Study Area

Broad Fauna Habitats

Cleared/ Disturbed

Closed Low Marri Forest surrounded by open shrubland areas

Kunzea and Melaleuca Closed Shrubland



# STRATEGEN-JBS&G **Smith's Beach Detailed** Vertebrate Fauna Survey

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Figure 4.5: Species of conservation significance recorded in the Study Area

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### Table 4.3: Conservation significant species likelihood assessment

	Conservation Status							
Species	EPBC Act	BC Act	DBCA	Preferred Broad Habitats	Within Current Known Distribution	Distance to Nearest Record – Year	Potential Habitat Within Study Area	Likelihood of Occurrence
MAMMALS	-		-					-
Brush-tailed bettong, woylie ( <i>Bettongia penicillata</i> )	EN	CR		Woodlands and adjacent heaths with a dense understorey of shrubs particularly <i>Gastrolobium</i> sp. (Woinarski <i>et al.</i> , 2014). Species confined to two indigenous colonies in south-west and a small number of reintroduced areas (Start <i>et al.</i> , 1995).	No	~28 km S (2010) (DBCA, 2020a)	Marginal	Highly Unlikely - restricted to limited number of known populations
Western ringtail possum, Ngwayir ( <i>Pseudocheirus occidentalis</i> )	CR	CR		Coastal <i>Agonis flexuosa</i> forest or eucalypt woodland or forest with a midstorey of <i>Agonis flexuosa</i> (Burbidge & de Tores, 1998; Jones <i>et al.</i> , 1994b)	Yes	Recorded within Study Area	Yes	Confirmed
Western quoll, chuditch ( <i>Dasyurus geoffroii</i> )	VU	VU		In the jarrah forest, Chuditch occur in moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest particularly in Riparian vegetation (Orell & Morris, 1994)	Yes	~2.3 km NE (1985), ~9.6 km S (2012) (DBCA, 2020b)	No	Possible
Quokka (Setonix brachyurus)	VU	VU		Habitat varies but prefer <i>Acacia</i> and <i>Melaleuca</i> thickets. In jarrah Forest associated with tea-tree, <i>Taxandria linearifolia</i> (de Tores, 2008a).	No	~0.9 km NW (1933) (DBCA, 2020b)	Yes	Unlikely - restricted to limited number of known populations
Wambenger brush-tailed phascogale ( <i>Phascogale tapoatafa wambenger</i> )		CD		Dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover (Woinarski <i>et al.</i> , 2014)	Yes	Recorded within Study Area	Yes	Confirmed
Quenda ( <i>Isoodon fusciventer</i> )			P4	Jarrah forest and swamp habitats, preferring dense vegetation around wetland fringes and heathland (Cooper, 1998; Woinarski <i>et al.</i> , 2014).	Yes	Recorded within Study Area	Yes	Confirmed
Western brush wallaby ( <i>Notamacropus irma</i> )			P4	The species inhabits a wide-range of habitats including low Banksia woodlands, jarrah/marri woodlands and moist <i>Melaleuca</i> lowlands, favours open, grassy areas (Wann & Bell, 1997; Woinarski <i>et al.</i> , 2014).	Yes	~2.7 km NE (1975) ~8.3 km NE (2005) (DBCA, 2020b)	Yes	Likely
Tammar wallaby ( <i>Notamacropus eugenii derbianus</i> )			P4	Dense, low vegetation for daytime shelter and open grassy areas for feeding. Inhabits coastal scrub, heath and dry sclerophyll forest (Woinarski <i>et al.</i> , 2014).	No	14 km N (no date – museum specimen) (DBCA, 2020b)	Yes	Unlikely - restricted to limited number of known populations
Water rat (Hydromys chrysogaster)			P4	manent bodies of fresh or brackish water, subalpine streams to lakes and farm dams and on Itered coastal beaches, mangroves and offshore islands (Van Dyck & Strahan, 2008).		~2 km N (no date – museum specimen) ~10 km SE (2018) (DBCA, 2020b)	Highly Marginal (dispersal, foraging) (Artificial Water Feature)	Unlikely based on - Presence of Highly Marginal habitat only - Age of nearby previous records
Western falsistrelle (Falsistrellus mackenziei)			P4	Tall forests and woodlands in the higher rainfall parts of the south-west, particularly karri forests but also tuart and jarrah forests (Woinarski <i>et al.</i> , 2014).	Yes	~10 km NE (2014) (NGH, 2015)	Marginal	Possible



	Con	servation	Status					
Species	EPBC Act	BC Act	DBCA	Preferred Broad Habitats	Within Current Known Distribution	Distance to Nearest Record – Year	Potential Habitat Within Study Area	Likelihood of Occurrence
BIRDS	-	•		·				
Baudin's cockatoo ( <i>Calyptorhynchus baudinii</i> )	EN	EN		Species forages primarily in Eucalypt forest, feeding on marri nuts, flowers, nectar and seeds (Johnstone & Storr, 1998b). Nesting trees are karri, marri, and wandoo (Johnstone & Kirkby, 2008b).	Yes	Recorded within Study Area	Yes	Confirmed
Carnaby's cockatoo ( <i>Calyptorhynchus latirostris</i> )	EN	EN		Occurs in semiarid eucalypt woodlands, preferring wandoo and Salmon Gum. Will also inhabit proteaceous scrubland and heaths dominated by dryandra, grevillea and banksia species. Prefer coastal areas and banksia woodlands during the non-breeding season . (Johnstone & Storr, 1998a).	Yes	Recorded within Study Area	Yes	Confirmed
Forest red-tailed black cockatoo (Calyptorhynchus Banksia naso)	VU	VU		Inhabits humid and subhumid eucalypts forests with an average of 600mm rainfall. They mainly inhabit dense jarrah, karri and marri forests with high rainfall. Attracted to seeding Albany blackbutt, blackbutt, karri, Snottygobble and Sheok (Johnstone & Storr, 1998a).	Yes	~368m W (1999) ~2 km E (2012) (DBCA, 2020b)	Yes	Likely
Malleefowl ( <i>Leipoa ocellata</i> )	VU	VU		Inhabits semi-arid shrublands and low woodlands dominated by mallee eucalypts and/or <i>Acacias</i> with sandy loam soils (Benshemesh, 2007).	No	~2 km NE (1910) (DBCA, 2020b)	No	Highly Unlikely
Grey falcon ( <i>Falco hypoleucos</i> )	VU	VU		Timbered lowlands, particularly Acacia shrubland and along inland drainage systems. Also frequent spinifex and tussock grassland (Burbidge <i>et al.</i> , 2010; Olsen & Olsen, 1986)	No	~210 km NE (1929) (DBCA, 2020a)	No	Highly Unlikely
Peregrine falcon ( <i>Falco peregrinus</i> )		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, 1998b).	Yes	~1.4 km E (2004) (DBCA, 2020b)	Yes	Possible
Fork-tailed swift ( <i>Apus pacificus</i> )	мі	МІ		Aerial species, which forages high above the tree canopy and rarely lower (Johnstone & Storr, 1998b).	Yes	~11 km NE (1979) (DBCA, 2020b)	Yes	Unlikely - based on age of nearby previous records
Grey wagtail ( <i>Motacilla cinerea</i> )	МІ	МІ		A rare vagrant to Western Australia where it has been recorded within various habitats with open waterbodies (Johnstone & Storr, 2004).	Yes	~159 km (2013) (DBCA, 2020a)	Marginal	Highly Unlikely
Osprey ( <i>Pandion haliaetus</i> )	MI	МІ		Occurs mainly in sheltered seas around islands, tidal creeks, estuaries and saltwork ponds, also large river pools (Johnstone <i>et al.</i> , 2013)	Yes	~1.4 km NE (2003) (DBCA, 2020b)	No	Possible
Barking Owl (southwest pop) ( <i>Ninox connivens connivens</i> )			P3	The southern subspecies occurs primarily in dry sclerophyll woodland, particularly that associated with riparian vegetation (Johnstone & Storr, 1998b).	Yes	~8km E (2002) (DBCA, 2020a)	Yes	Likely
REPTILES								
Short-nosed snake ( <i>Elapognathus minor</i> )			P2	Favours heathlands margining swamps, though also known from wet sclerophyll forests (Cogger, 2014)	Yes	~25 km E (1969) (DBCA, 2020a)	No	Unlikely
Coastal plains skink ( <i>Ctenotus ora</i> )			P3	Found on the Swan coastal plain inhabiting sandy coastal plains and coastal heaths with open <i>Eucalypt</i> and <i>Banksia</i> Woodland (Gaikhorst <i>et al.</i> , 2017).	Yes	Recorded within Study Area	Yes	Confirmed



Conservation Status			Status					
Species	EPBC Act	BC Act	DBCA	Preferred Broad Habitats	Within Current Known Distribution	Distance to Nearest Record – Year	Potential Habitat Within Study Area	Likelihood of Occurrence
Lined skink ( <i>Lerista lineata</i> )			P3	Found in loose soil or sand, particularly in coastal heaths and low shrublands (Cogger, 2014), that provide a well-developed patchy litter ground cover (Maryan <i>et al.</i> , 2015). The majority of records are from the southern suburbs of the Perth metropolitan area on the Bassendean and Spearwood Dune systems (Maryan <i>et al.</i> , 2015),	Yes	~37 km E (1949), ~83 km (2008) (DBCA, 2020a)	Yes	Unlikely - based on age of nearby previous records
Dell's skink ( <i>Ctenotus delli</i> )			P4	Dry sclerophyll forest on stony hills and ranges (Cogger, 2014), but otherwise undocumented.	No	~13 km (1994 – museum specimen under review) (DBCA, 2020b)	Yes	Unlikely - based on age of nearby previous records





#### 4.2.1 Species Confirmed within Study Area

#### Western Ringtail Possum

The western ringtail possum (*Pseudocheirus occidentalis*) is currently listed as Critically Endangered under the EPBC Act and BC Act. This species was formerly distributed throughout much of the southwestern Australia (de Tores, 2008b) but is now confined to five regional locations, one of which encompasses the Study Area (i.e. the near-coastal area between Bunbury and Augusta) (de Tores, 2008b; de Tores *et al.*, 2004). Throughout its range, this species shelters in dreys constructed from leaves (Jones, 1995).

#### **Previous Records**

The DBCA Threatened and Priority Database search return 872 records of western ringtail possum within the vicinity of the Study Area (DBCA, 2020b). A dense cluster of records (132 records comprising 98 records from 2003, six records from 2004, 13 records from 2007 and 15 records from 2016) are located in Yallingup ~2 km northeast of the Study Area. Within 12 km of the Study Area, western ringtail possum were recorded from five of the previous surveys inclusive of a previous survey conducted over the Study Area (ATA, 2007; Ecoscape, 2012b; Ecosystems Solutions, 2014; NGH, 2015). The species was also recorded by How *et al.* (1987). While this survey was conducted in the vicinity (i.e. potentially within 12 km of the Study Area), locational data has not been provided and thus, distance from the Study Area cannot be determined.

During the previous survey, 50 possum dreys were recorded within the Study Area. Moreover, eight individuals were observed during spotlighting surveys conducted during the survey. However, it was noted that weather conditions possibly resulted in an underestimate of individuals (ATA, 2007).

#### **Records During the Survey**

During the current survey, the species was observed from a total of 49 records within the Study Area. Thirteen dreys (inclusive of three old dreys) were observed within the northern section of the Open Peppermint Forest (Figure 4.6). Additionally, scats were observed in 14 locations within the Open Peppermint Forest, Open *Banksia* Forest and Closed Low Marri Forest (Figure 4.6).

During diurnal active and targeted searches, a total of eight individuals were observed in the northern portion of the Open Peppermint Forest comprising two adults, one female with a single young and one female with two young. The female individual with a single young was observed using the same drey on two separate days (2<sup>nd</sup> and 4<sup>th</sup> of November).

Nocturnal searches for western ringtail possum were undertaken on the 5<sup>th</sup>, 7<sup>th</sup> and 10<sup>th</sup> of November during which ten, four and six individuals were observed respectively. This equates to an estimated density of 0.5 to 1.3 possums per hectare within the search area. Their home ranges vary between 0.5 and 2.5 hectares and consists of 3-8 nesting sites (Jones, 1995) but may consist of a total of 20 throughout the year (Wayne *et al.*, 2005). While the species is solitary, the home ranges of adjacent individuals tend to overlap (Jones *et al.*, 1994a).



#### Habitats within Study Area

Habitat preference differs across its known range. The western ringtail possum is associated with peppermint dominated forest and woodland with a tuart *Eucalyptus gomphocephala* canopy in some areas along the coast south of Bunbury and in peppermint forest in the Busselton area (de Tores, 2008b). It feeds on the leaves of peppermint (*Agonis flexuosa*) (near the coast) and jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*) trees (further inland where such vegetation predominates).

The Significant Impact Guidelines for the western ringtail possums applies to actions and impacts on the on the southern Swan Coastal Plain and is defined as the *"area between Bunbury and Dunsborough from the base of the Whicher Scarp to the coast"* (DEWHA, 2009). In accordance with the Recovery Plan for western ringtail possum (Williams *et al.*, 2017), the Study Area falls within the Swan Coastal Plain Management Zone. Within this management zone habitat critical to the survival of the species comprises long unburnt mature peppermint woodlands with high canopy connectivity, as well as habitat connecting patches of remnants (Williams *et al.*, 2017). High canopy connectivity provides protection and refuge from predators. Consequently, the Open Peppermint Forest within the Study Area is considered primary breeding, foraging and dispersal habitat (Figure 4.6). The degree of connectivity between peppermint trees is considered suitable for western ringtail possum. Connectivity is greatest toward the northern extent of the Open Peppermint Forest (Plate 4.1). Although habitat understory condition is poor due to the presence of arum lily (*Zantedeschia aethiopica*), this is unlikely to affect the presence of western ringtail possum as understory may not be important to the species provided the canopy is adequately continuous (Williams *et al.*, 2017).



Plate 4.1: Connectivity of the northern extent of the Open Peppermint Forest

Western ringtail possum also utilise jarrah, marri and *banksia* forest and *Melaleuca* dominant shrublands, although usually in lower densities. These habitats also provide refuge site and food resources (Shedley & Williams, 2014). Therefore, the Open *Banksia* Forest and Closed Low Marri Forest provide secondary feeding and dispersal habitat for the species (Figure 4.6).



#### **Current Survey**

- △ Drey
- ▲ Drey (Old)
- Individual (alive)
- Individual (alive) dependent young on mother's back  $\land$
- Individual (alive) inside drey
- Individual (alive) mother with two dependent young
- △ Low denisty scat (Recent)
- ▲ Low denisty scat (Old)

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- ▲ Low denisty scat (Very Old)
- △ Scat (Recent)
- **Previous Suvrey**
- 🗙 Drey



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Study Area

Primary breeding, foraging and dispersal habitat

Secondary foraging and dispersal habitat





## STRATEGEN-JBS&G **Smith's Beach Detailed** Vertebrate Fauna Survey

Figure 4.6: Potential western ringtail possum habitat

\_Busselton



#### Baudin's cockatoo

Baudin's cockatoo 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, 1998a). Baudin's cockatoos nest in tree hollows in the deep southwest of Western Australia, with primary nesting trees being karri, marri, and wandoo (Johnstone & Kirkby, 2008a).

The Study Area lies within the known breeding distribution of the species. There are 160 records of Baudin's cockatoo within 10 km of the Study Area; the nearest record (observed in 2000) of the species exists approximately 1.7 km east of the Study Area. 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 possible that additional Baudin's cockatoo records occur in proximity to the Study Area. The database search returned 156 records of white-tailed black cockatoo within 10 km of the Study Area, one of which occurs within the Study Area (DBCA, 2020b). Moreover, the species was recorded by five previous surveys within 12 km of the Study Area (ATA, 2007; BDS, 2004; ecologia, 2001; Ecosystems Solutions, 2014; NGH, 2015) of which two previous surveys recorded the species foraging within the Study Area in 2001 and 2005 (ATA, 2007; ecologia, 2001).

The current survey recorded chewed marri nuts characteristic of Baudin's cockatoo in four locations. Moreover, individuals were observed flying over the survey area on the 1<sup>st</sup> of November. The black cockatoo habitat assessment is discussed in further detail in Section 4.3 below.

#### Carnaby's cockatoo

Carnaby's cockatoo is classified as Endangered under the EPBC and BC Act. The species is distributed from the Murchison River to Esperance, and inland toward Lake Cronin, Coorow and Kellerberrin. The species breeds in areas that typically receive between 300 and 750 mm of rainfall. Following breeding, the species typically moves to higher rainfall areas to forage (Cale, 2003). Carnaby's cockatoos nest in tree hollows, with primary nesting trees being karri, marri, jarrah, bullich, tuart and wandoo (DoEE, 2017).

The Study Area lies within the non-breeding range of the species. There are 64 records of Carnaby's cockatoo within 10 km of the Study Area; the nearest record (observed in 2018) of the species exists approximately 1.5 km east of the Study Area. As mentioned, Carnaby's cockatoo has very similar morphological characteristics to Baudin's cockatoo, and it is possible that additional Carnaby's cockatoo records occur in proximity to the Study Area. The database search returned 156 records of white-tailed black cockatoo within 10 km of the Study Area, one of which occurs within the Study Area (DBCA, 2020b). Moreover, the species was recorded by two previous surveys within 12 km of the Study Area (Ecosystems Solutions, 2014; NGH, 2015).

The current survey recorded Carnaby's cockatoos on a total of 39 occasions. Chewed *Banksia*, *Hakea* and marri nuts were recorded from 31 locations. During the survey, a flock of 40 individual Carnaby's were observed foraging on *Hakea* fruit, within *Melaleuca* over *Hakea* Shrubland (VSMB-02) on the 2<sup>nd</sup> of



November, a flock of ten individuals were observed foraging within the Open *Banksia* Forest on the 3<sup>rd</sup> of November 2020 and two individuals were observed foraging on *Hakea* within the Open Peppermint Forest on the 6<sup>th</sup> of November. Finally, a flock of 21 individuals were observed flying over the Study Area on the 3<sup>rd</sup> of November. The black cockatoo habitat assessment is discussed in further detail in Section 4.3 below.

#### Wambenger brush-tailed phascogale

Wambenger brush-tailed phascogales (BC Act Conservation Dependent) are known from Perth southwards to Albany (DEC, 2000), although it is less common in the wetter forests of the extreme southwest (Cannella *et al.*, 2019). The wambenger brush-tailed phascogale populations in Western Australia fluctuate markedly in response to climatic conditions (Rhind, 2002); however, the species is thought to have declined significantly, most likely due to habitat degradation, clearance, and fragmentation (Woinarski *et al.*, 2014). The species is an obligate arborealist, highly dependent on trees for nest hollows and bark invertebrates, especially jarrah and marri below 400 mm DBH (Rhind, 1996).

The species is known to occur within the area, with 41 previous records within 10 km of the Study Area. The species was also recorded by How *et al.* (1987). While this survey was conducted in the vicinity (i.e. potentially within 12 km of the Study Area), locational data has not been provided and thus, distance from the Study Area cannot be determined. However, the species was recorded in 2005 via nocturnal searches conducted within the Study Area during the previous survey (ATA, 2007).

During the current survey one individual was captured (within an Elliott trap) in the Open Peppermint Forest (VSMB-01; Figure 4.5). Within the Study Area, the species may occur as a resident, primarily within Open Peppermint Forest and Open *Banksia* Forest habitat which provides primary breeding and foraging habitat. Hollows of preferred size for the species (mean hollow entrance width of 3.9 cm and length of 7.3 cm; Rhind, 1996) have the potential to occur within these habitats. Closed Low Marri Forest also provides primary foraging and dispersal habitat. The species may also move into adjacent habitats to forage and/or disperse, particularly when occurring in proximity to denning habitat.

#### Ctenotus ora

*Ctenotus ora* is classified as Priority 3 by the DBCA. The species occurs on Swan Coastal Plain from Pinjarra to Yallingup Brook. The species appears to inhabit sandy open *Eucalyptus* and *Banksia* woodlands (Kay & Keogh, 2012).

The species is known to occur within the area, with 19 previous records within 10 km of the Study Area; the nearest record (observed in 2018) of the species exists approximately 185 m south of the Study Area. Moreover, the species was recorded by two previous surveys within 12 km of the Study Area (Ecoscape, 2012a, 2012b). The previous survey conducted within the Study Area recorded *C. labillardieri* (ATA, 2007), however, since the previous survey, the species was split and the former *C. labillardieri* is now represented by two species; *C. ora* and *C. labillardieri* (which is represented by seven clades) (Kay & Keogh, 2012). Both species can occur in sympatry, therefore, it is possible that some, or all, of the previous *C. labillardieri* records represent *C. ora*.



During the current survey a total of nine individuals were caught on seven occasions from two trapping sites: eight individuals from *Melaleuca* over *Hakea* Shrubland (VSMB-02) fauna habitat and one individual from Open Coastal Shrubland (VSMB-05) fauna habitat (Figure 4.5). Within the Study Area, the species may occur as a resident, primarily within *Melaleuca* over *Hakea* Shrubland, Open Coastal Shrubland and Open *Banksia* Forest fauna habitat which provides primary breeding and foraging habitat.

#### Quenda

The quenda 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 Wyalcatchem 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.*, 2014). The species prefers dense, low shrubland to forage underneath (Woinarski *et al.*, 2014), 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 occurs in the local vicinity and has been recorded 73 times within 10 km of the Study Area. The closest record of quenda to the Study Area is approximately 1.8 km east from 2013. Moreover, the species was recorded by one previous surveys within 12 km of the Study Area (NGH, 2015). The species was also recorded by How *et al.* (1987). While this survey was conducted in the vicinity (i.e. potentially within 12 km of the Study Area), locational data has not been provided and thus, distance from the Study Area cannot be determined.

Although the previous surveys within the Study Area did not record Quenda, the species was recorded on four occasions during the current survey. Quenda were recorded via motion camera within the *Kunzea* and *Melaleuca* Closed Shrubland on the 7<sup>th</sup> and 8<sup>th</sup> of November. The species was also recorded from secondary evidence (i.e. Diggings) within the *Melaleuca* over *Hakea* Shrubland and Open Peppermint Woodland. The Open *Banksia* Forest, the *Kunzea* and *Melaleuca* Closed Shrubland, Open Coastal Shrubland and *Melaleuca* over *Hakea* Shrubland are likely to provide primary breeding, foraging and dispersal habitat for the species. Additionally, the Open Peppermint Forest provides foraging and dispersal habitat.

### 4.2.2 Species Highly Likely to Occur

No species of conservation significance identified in the desktop assessment are considered Highly Likely to occur in the Study Area (Table 4.3).

#### 4.2.3 Species Likely to Occur

#### Forest red-tailed black cockatoo

The forest red-tailed black cockatoo is classified as Vulnerable under the EPBC and BC Act. The Study Area falls within the modelled distribution of the species. Forest red-tailed black cockatoos nest in tree



hollows, with primary nesting trees being karri, marri, jarrah, bullich, blackbutt, tuart and wandoo (DoEE, 2017).

There are 51 previous records of the species from within 10 km of the Study Area (DBCA, 2020b). The nearest record of the species exists approximately 2 km east of the Study Area from 2012 (DBCA, 2020b). However, the species was not recorded within the Study Area during the previous or current survey.

As above, the quantitative classification of potential black cockatoo habitat within the Study Area is discussed in detail in Section 4.3. However, in consideration of the potentially suitable habitat present in the Study Area and contemporary records of the species in the near proximity, forest red-tailed black cockatoos is considered Likely to occur within the Study Area.

#### Western brush wallaby

The western brush wallaby (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.*, 2012). The species abundance is noted to have significantly declined until widespread fox control was implemented in state forests and conservation estates (Woinarski *et al.*, 2012). The Study Area lies within the distribution of the species, and there are eight records of the species within 10 km of the Study Area (DBCA, 2020b). Although the closest record is approximately 2.7 km north east from 1975 (DBCA, 2020b), the nearest contemporary record from 2005 exists approximately 8.3 km north east (DBCA, 2020b).

The Open *Banksia* Forest is considered primary breeding, foraging and dispersal habitat. In consideration of the potentially suitable habitat present in the Study Area and contemporary records of the species in the near proximity, western brush wallaby is considered Likely to occur within the Study Area.

#### **Barking Owl**

The southern subspecies of barking owl occurs primarily in dry sclerophyll woodland, particularly that associated with riparian vegetation in the south-west (Johnstone & Storr, 1998a) and on forest edges in the south-east (Taylor & Kirsten, 1999). It prefers densely-wooded habitats, particularly stands of *Melaleuca* forest. It inhabits coastal and subcoastal Western Australia from Esperance to Greenough R. (Johnstone & Storr, 1998a).

The Study Area lies within the distribution of the species, and there are four records of the species within 10 km of the Study Area (ALA, 2020; DBCA, 2020b). The closest record is approximately 8 km east from 2002 (DBCA, 2020a).

The *Melaleuca* over *Hakea* Shrubland is considered primary foraging and dispersal habitat. In consideration of the potentially suitable habitat present in the Study Area and contemporary records of



the species in the near proximity, western brush wallaby is considered Likely to occur within the Study Area.

#### 4.3 Black Cockatoo Habitat Assessment

#### 4.3.1 Potential Foraging Habitat

DoEE (2017) defines 'high quality' foraging habitat as habitat scoring a seven or above (according to the foraging quality scoring tool (Table 3.4)), which, particularly in proximity to roosting and/ or breeding sites, is considered important for the long-term survival and recovery of black cockatoos. Overall ten assessments were made throughout the Study Area, which categorised the foraging quality within the Study Area between "Very High Quality" (score of >11) and "Nil" (score of  $\leq$  0) for each of the black cockatoo species (Table 4.5).

Specific to the black cockatoo, the habitats of greatest foraging quality for Carnaby's black cockatoo were the Open *Banksia* Forest and Closed Marri Forest (High Quality with scores of eight) as well as *Melaleuca* over *Hakea* Shrubland (Quality with a score of six). High Quality habitats represent 12 % (4.8 ha) and quality habitat represents 9 % (3.8 ha) of the Study Area. The habitats of greatest foraging quality for Baudin's black cockatoo were the Open *Banksia* Forest and Closed Marri Forest (Very High Quality with scores of 13 and nine respectively) as well as *Melaleuca* over *Hakea* Shrubland (High Quality with a score of seven). Very High Quality habitats represent 12 % (4.8 ha) and quality habitat represents 9 % (3.8 ha) of the Study Area. The *Banksia* Woodland is considered of most significance for Carnaby's cockatoo due to its strong association with *Banksia* species for foraging in comparison to the other black cockatoo species (TSSC, 2016). The remaining habitats (Open Peppermint Forest, *Kunzea* and *Melaleuca* Closed Shrubland, Open Coastal Shrubland and Rocky Outcrop) were considered of "Low Quality" due to the general characteristic of containing only individual or small stands of foraging plants.

Overall, the habitat of greatest foraging quality for forest red-tailed black cockatoo were the Closed Low Marri Forest (Quality with a score of six). This habitat represents 1 % (0.33 ha) of the Study Area. The remaining habitats (Open Peppermint Forest, *Kunzea* and *Melaleuca* Closed Shrubland, Open Coastal Shrubland, *Melaleuca* over *Hakea* Shrubland, Open *Banksia* Forest and Rocky Outcrop) were considered of "Low Quality" due to the general characteristic of containing only individual or small stands of foraging plants.

The Study Area contains foraging species considered primary food resources for black cockatoo, in particular jarrah and marri (Table 4.4). These two species make up over 90 % of the diet of the forest redtailed black cockatoo (Johnstone & Storr, 1998a); marri is also considered a major food source for both white-tailed black cockatoo species (DoEE, 2017). Several *Banksia* and *Hakea* species were present that are known common food resources, primarily for Carnaby's cockatoo (e.g. *Banksia attenuate, B. sessilis, H. oleifolia, H. prostrata and H. trifurcate*) (Groom, 2011). Some secondary food resources were present, including *Acacia saligna* (Orange Wattle), *Agonis flexuosa* (Peppermint Tree), *B. dallanneyi* (Couch Honeypot Dryandra), *Darwinia citriodora* (Lemon-scented Darwinia), *Romulea rosea* (Guildford Grass) and *Xanthorrhoea preissii* (Grasstree) (Groom, 2011) (Table 4.4). Potential foraging habitat for black cockatoo is displayed in Figure 4.7.



Evidence of feeding on *Corymbia calophylla* (marri) nuts (Plate 4.2) by Baudin's black cockatoo was observed in four locations within the Open *Banksia* Forest. Evidence of feeding on *C. calophylla* nuts, *Banksia* and *Hakea* (Plate 4.2) by Carnaby's black cockatoo was observed in 31 locations within the *Melaleuca* over *Hakea* Shrubland, Open *Banksia* Forest, Peppermint Forest, Open Coastal Shrubland and Closed Low Marri Forest. During the survey, a flock of 40 individual Carnaby's were observed foraging within *Melaleuca* over *Hakea* Shrubland (VSMB-02) on the 2<sup>nd</sup> of November, a flock of ten individuals were observed foraging within the Open Banksia Forest on the 3<sup>rd</sup> of November 2020 and two individuals were observed foraging on *Hakea* within the Open Peppermint Forest on the 6<sup>th</sup> of November. Foraging evidence of forest red-tailed black cockatoo was not observed during the survey.

Black cockatoos rely upon the availability of foraging resources across their range, particularly to build condition in the post-breeding period (DoEE, 2017). Black cockatoos will forage up to 12 km from breeding hollows during the breeding season and rely on this proximity of foraging resources to breeding hollows to successfully raise chicks (DoEE, 2017). The Study Area borders the Leeuwin-Naturaliste National Park. Moreover, the Gunyulgup Brook is location~250 m north east of the Study Area and numerous wetlands exist within the vicinity of the Study Area (the nearest of which is 1 km east; refer to Figure 4.7). and such it is highly likely that the surrounding region contains additional foraging habitat for black cockatoos.



Plate 4.2: Evidence of Baudin's black cockatoo feeding in the Study Area



### Table 4.4: Black cockatoo food resources present in the Study Area, and species utilising them

Food resources	Carnaby's cockatoo	Baudin's cockatoo	Forest red- tailed black cockatoo
Primary			_
Jarrah ( <i>Eucalyptus marginata</i> )	•	•	•
Marri (Corymbia calophylla)	•	•	•
Slender Banksia ( <i>Banksia attenuate</i> )	•		
Parrotbush ( <i>Banksia sessilis)</i>	•	•	
Dungyn or Olive-leaved Hakea (Hakea oleifolia)	•		
Harsh Hakea ( <i>Hakea prostrata</i> )	•	•	
Two-leaved Hakea (Hakea trifurcate)	•	٠	
Grey Stinkwood (Jacksonia furcellata)	•		
Secondary			
Orange Wattle (Acacia saligna)	•		
Peppermint Tree ( <i>Agonis flexuosa</i> )	•		
Couch Honeypot Dryandra (Banksia dallanneyi)	•		
Lemon-scented Darwinia (Darwinia citriodora)	•	٠	
Guildford Grass (Romulea rosea)	•		
Grasstree (Xanthorrhoea preissii)	•	•	

Table 4.5: Summary of foraging ha	nabitat quality scores for the Study Ar	ea

Habitat	Carnaby's cockatoo foraging score				Baudin's cockatoo foraging score				Forest red-tailed black cockatoo foraging score			
type	Starting score	Additions	Subtractions	Total	Starting score	Additions	Subtractions	Total	Starting score	Additions	Subtractions	Total
Open Peppermint Forest	Low - Individual foraging plants or small stand of foraging plants (1)		-ls > 12 km from a known breeding location (-1)	0 (Nil)	Low - Individual foraging plants or small stand of foraging plants (1)	-Is within the known foraging area (+3)	-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	1 (Low Quality)	Low - Individual foraging plants or small stand of foraging plants (1)		-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	-2 (Nil)
Open Banksia Forest	High - Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species, as well as native Eucalypt woodland and forest (7)	Contains trees with potential to be used for breeding (+2)	-ls > 12 km from a known breeding location (-1)	8 (High Quality)	High - Native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly marri, including along roadsides (7)	-Is within the known foraging area (+3) -Contains trees with potential to be used for breeding (+2)	-Is > 12 km from a known breeding location (-1)	13 (Very High Quality)	Low - Individual foraging plants or small stand of foraging plants (1)		-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	-2 (Nil)
Closed Low Marri Forest DciDcL	Low - Individual foraging plants or small stand of foraging plants (1)		-ls > 12 km from a known breeding location (-1)	0 (Nil)	Low - Individual foraging plants or small stand of foraging plants (1)	-Is within the known foraging area (+3)	-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	1 (Low Quality)	Low - Individual foraging plants or small stand of foraging plants (1)		-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	-2 (Nil)
Closed Low Marri Forest CcHh	High - Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species, as well as native Eucalypt woodland and forest (7)	Primarily comprised marri (+2)	-ls > 12 km from a known breeding location (-1)	8 (High Quality)	High - Native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly marri, including along roadsides (7)	-ls within the known foraging area (+3) -Primarily contains marri (+2)	-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	9 (Very High Quality)	High -jarrah and marri woodlands and forest, and edges of karri forests, including wandoo and blackbutt, within the range of the subspecies, including along roadsides. (7)	-Primarily contains marri and/or jarrah (+2)	-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	6 (Quality)
Kunzea and Melaleuca Closed Shrubland KcSg	Low - Individual foraging plants or small stand of foraging plants (1)		-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	-2 (Nil)	Low - Individual foraging plants or small stand of foraging plants (1)	-Is within the known foraging area (+3)	-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	1 (Low Quality)	-Individual foraging plants or small stand of foraging plants (1)		-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	-2 (Nil)
Kunzea and Melaleuca Closed Shrubland MIKc	Nil (0)		<ul> <li>-No clear evidence of feeding debris (-2)</li> <li>-Is &gt; 12 km from a known breeding location (-1)</li> </ul>	-3 (Nil)	Nil (0)	-Is within the known foraging area (+3)	-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	0 (Nil)	Nil (0)		-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	-3 (Nil)
Open Coastal Shrubland AsDc	Low - Individual foraging plants or small stand of foraging plants (1)		-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	-2 (Nil)	Low - Individual foraging plants or small stand of foraging plants (1)	-Is within the known foraging area (+3)	-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	1 (Low Quality)	-Individual foraging plants or small stand of foraging plants (1)		-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	-2 (Nil)



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Habitat	Carnaby's cockatoo foraging score				Baudin's cockatoo foraging score				Forest red-tailed black cockatoo foraging score			
type	Starting score	Additions	Subtractions	Total	Starting score	Starting score Additions		Total	Starting score	Additions	Subtractions	Total
Open Coastal Shrubland AhHe	Low - Individual foraging plants or small stand of foraging plants (1)		-Is > 12 km from a known breeding location (-1)	0 (Nil)	Low - Individual foraging plants or small stand of foraging plants (1)	-ls within the known foraging area (+3)	-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	1 (Low Quality)	Nil (0)		-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	-3 (Nil)
Melaleuca over Hakea Shrubland MhGl	High - Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species, as well as native Eucalypt woodland and forest (7)		-Is > 12 km from a known breeding location (-1)	6 (Quality)	High - Native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly marri, including along roadsides (7)	-Is within the known foraging area (+3)	-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	7 (High Quality)	Nil (0)		-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	-3 (Nii)
Melaleuca over Hakea Shrubland MIDr	Low - Individual foraging plants or small stand of foraging plants (1)		-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	-2 (Nil)	Low - Individual foraging plants or small stand of foraging plants (1)	-ls within the known foraging area (+3)	-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	1 (Low Quality)	Nil (0)		-No clear evidence of feeding debris (-2) -Is > 12 km from a known breeding location (-1)	-3 (Nil)





#### 4.3.2 Potential Night Roosting Habitat

No evidence of black cockatoo roosting activity was recorded during the field survey (e.g. clipped leaves and branches or droppings under suitable trees). Additionally, no black cockatoos were observed at dusk (i.e. arriving to roost for the night) on the 5<sup>th</sup> or 7<sup>th</sup> of November. However, based on the habitat mapping conducted and the presence of recognised roosting species (i.e marri and jarrah; DoEE, 2017; Johnstone *et al.*, 2011), stands of potential night roosting habitat were identified in the Study Area within the Open Peppermint Forest, Open *Banksia* Forest, Open Coastal Shrubland and Closed Low Marri Forest. However, suitable roosting habitat exist outside of the Study Area and the potential roosting habitat within the Study Area is considered to be low quality as it is generally limited in other characteristics of suitable night roosting habitat inclusive of tall trees (> 8 m) (Glossop. B et al., 2011) and medium foliage density (i.e. habitats that are not too densely forested amongst other trees) (Le Roux, 2017)). Well-spaced and tall trees may offer greater protection from predators, and may allow cockatoos to enter and exit more easily (Le Roux, 2017).

Although the habitats are considered of low quality, the presence of black cockatoos (430 records exist within 10 km of the Study Area; DBCA, 2020b) and night roosts within 12 km of the Study Area (n = 10) justifies the potential for the Study Area to provide night roosting habitat. The nearest roost for white-tailed black cockatoo (BUSYALR006) is located ~2.7 km east of the Study Area (refer to Section 2.2.2). Alternatively, the most significant roost (BUSQUIR001) is located ~7.2 km east of the Study Area. Both forest red-tailed black cockatoo roosts identified in the database search (BUSQUIR003 and BUSQUIR004) are located ~8 km southeast of the Study Area. Night roosts can include tall trees within approximately 1 km of a central roost area of larger roost sites (>150 birds at any given time), with patches of trees usually 2-3 ha in area with smaller clumps used on any individual night for roosting (Glossop. B *et al.*, 2011). Moreover, black cockatoos will favour night roost sites that are within two kilometres to water sources (DoEE, 2017). An artificial water sources is present in the north-eastern corner of the Study Area. The Gunyulgup Brook is location~250 m north east of the Study Area and numerous wetlands exist within the vicinity of the Study Area (the nearest of which is 1 km east; refer to Figure 4.7). As such, it cannot be eliminated that the Study Area may on occasion be used for night roosting by birds from larger nearby night roosts.

The remaining habitats (*Kunzea* and *Melaleuca* Closed Shrubland, *Melaleuca* over *Hakea* Shrubland, and Rocky Outcrop) were not considered to be potential night roosting habitat.



#### 4.3.3 Potential Breeding Tree Records

Five trees identified within the Study Area boundary were of a suitable DBH and species (marri - *Corymbia calophylla*) to support black cockatoo breeding. Details of tree species recorded with greater than 500 mm DBH within the Study Area are shown in Table 4.6 and Figure 4.7. However, none of the trees contained suitable hollows.

Species	DBH (cm)	Height (m)	Feeding Evidence	Hollow Presence
Marri Corymbia calophylla	74	8	No	0
Marri Corymbia calophylla	53	5	No	0
Marri Corymbia calophylla	51	6	No	0
Marri Corymbia calophylla	65	8	No	0
Marri Corymbia calophylla	60	6	No	0

#### Table 4.6: Trees with 500 mm or greater DBH recorded in the Study Area

Although no hollows were present in the Study Area nor has breeding been recorded within 12 km (Birdlife Australia, 2020b), 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, 2017; Johnstone *et al.*, 2011). Therefore, potential hollow-forming trees within the Study Area are of significance.



Secondary Evidence

Breeding Trees

Coordinate System: GDA 1994 MGA Zone 50 Projection: Transverse Mercator Datum: GDA 1994 Created 11/12/2020

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Figure 4.7: Potential habitat for Carnaby's black cockatoo



Secondary Evidence

Breeding Trees



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Figure 4.8: Potential habitat for Baudin's black cockatoo



Study Area

Wetland

Breeding Trees

Quality Habitat – Closed Low Marri Forest



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Figure 4.9: Potential habitat for forest red-tailed lack cockatoo



## 5 CONCLUSION

Seven broad fauna habitat types were recorded and mapped within the Study Area, comprising, in decreasing order of extent, *Kunzea* and *Melaleuca* Closed Shrubland (11.6 ha, 29% of Study Area), Open Peppermint Forest (8.1 ha, 20% of Study Area), *Melaleuca* over *Hakea Shrubland* (5.4 ha, 13% of Study Area), Open Coastal Shrubland (5.4 ha, 13% of Study Area), Open Banksia Forest (4.1 ha, 10% of Study Area), Closed Low Marri Forest (1.5 ha, 4% of Study Area), and Rocky Outcrop (0.5 ha, 1% of Study Area). Approximately 3.9 ha (10%) of the Study Area is Cleared/ Disturbed.

A total of 78 vertebrate fauna species, comprising 15 mammal species (13 native and two introduced), 39 bird species (37 native and two introduced), 20 reptile species and four amphibian species were recorded from the Study Area during the current survey. Of the 80 species of conservation significance identified in the desktop assessment, six were recorded within the Study Area during the current survey:

The western ringtail possum (Critically Endangered – EPBC/BC Act) has previously been recorded from the Study Area from 50 possum dreys and eight individuals during spotlighting surveys. During the current survey, the species was observed from a total of 49 records within the Study Area comprising; 13 dreys (inclusive of three old dreys) within the northern section of the Open Peppermint Forest, scats in 14 locations within the Open Peppermint Forest, Open *Banksia* Forest and Closed Low Marri Forest, eight individuals observed during diurnal searches in the northern portion of the Open Peppermint Forest (inclusive of dependent young) and between four and ten individuals observed during nocturnal searches. Open Peppermint Forest within the Study Area is considered habitat critical to the survival of the species and thus, primary breeding, foraging and dispersal habitat. Moreover, the Open *Banksia* Forest and Closed Low Marri Forest and Closed Low Marri Forest and Closed Low Marri Forest and thus, primary breeding, foraging and dispersal habitat.

The Baudin's cockatoo (Endangered – EPBC/BC Act) has previously been recorded within the Study Area in 2001 and 2005. The current survey recorded chewed marri nuts characteristic of Baudin's cockatoo in four locations. Moreover, individuals were observed flying over the survey area During the survey. The Carnaby's cockatoo (Endangered – EPBC/BC Act) may have previously been recorded within the Study Area (one white-tailed black cockatoo record was returned from the DBCA Threatened and Priority Fauna Database Search). The current survey recorded Carnaby's cockatoos on a total of 39 occasions. Comprising; chewed *Banksia*, *Hakea* and marri nuts were recorded from 31 locations, a flock of 40 individual Carnaby's foraging on *Hakea* fruit, within *Melaleuca* over *Hakea* Shrubland, a flock of ten individuals foraging within the Open *Banksia* Forest, two individuals foraging on *Hakea* within the Open Peppermint Forest a flock of 21 individuals flying over the Study Area. No forest red-tailed black cockatoos were recorded during the survey.

Specific to the black cockatoo, the habitats of greatest foraging quality for Carnaby's black cockatoo were the Open *Banksia* Forest and Closed Marri Forest (High Quality with scores of eight) as well as *Melaleuca* over *Hakea* Shrubland (Quality with a score of six). The habitats of greatest foraging quality for Baudin's black cockatoo were the Open *Banksia* Forest and Closed Marri Forest (Very High Quality with scores of 13 and nine respectively) as well as *Melaleuca* over *Hakea* Shrubland (High Quality with a score of seven). Overall, the habitat of greatest foraging quality for forest red-tailed black cockatoo were the



Closed Low Marri Forest (Quality with a score of six). The remaining habitats were considered of "Low Quality" due to the general characteristic of containing only individual or small stands of foraging plants.

The wambenger brush-tailed phascogale (Conservation Dependent – BC Act) was recorded during the current survey from one individual captured within an Elliot trap in the Open Peppermint Forest. Within the Study Area, the species may occur as a resident, primarily within Open Peppermint Forest and Open *Banksia* Forest habitat which provides primary breeding and foraging habitat. Closed Low Marri Forest also provide primary foraging and dispersal habitat.

*Ctenotus ora* (Priority 3 – DBCA Priority List) was recorded during the current survey from nine individual from two trapping sites: eight individuals from *Melaleuca* over *Hakea* Shrubland fauna habitat and one individual from Open Coastal Shrubland fauna habitat. Within the Study Area, the species may occur as a resident, primarily within *Melaleuca* over *Hakea* Shrubland, Open Coastal Shrubland and Open *Banksia* Forest fauna habitat which provides primary breeding and foraging habitat.

The quenda (Priority 4 – DBCA Priority List) was recorded during the current survey via motion camera within the *Kunzea* and *Melaleuca* Closed Shrubland, as well as secondary evidence (i.e. Diggings) within the *Melaleuca* over *Hakea* Shrubland and Open Peppermint Woodland. The Open *Banksia* Forest, the *Kunzea* and *Melaleuca* Closed Shrubland, Open Coastal Shrubland and *Melaleuca* over *Hakea* Shrubland are likely to provide primary breeding, foraging and dispersal habitat for the species. Additionally, the Open Peppermint Forest provides foraging and dispersal habitat.

Based on known species' distributions, previous records and the habitats present, three species were deemed Likely to occur (i.e. forest red-tailed black cockatoo, western brush wallaby and barking owl), four species were deemed Possible and 67 were considered Unlikely or Highly Unlikely to occur.



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Appendix A – Conservation listings

## 7 APPENDICES



#### Environment Protection and Biodiversity Conservation Act 1999

Category	Definition				
Threatened					
Extinct (EX)	Presumed extinct i.e. there is no reasonable doubt that the last member of the species has died.				
Extinct in the Wild (EW)	Presumed extinct in the wild, only surviving in cultivation, captivity or as a naturalised population well outside its past range.				
Critically Endangered (CE)	Taxa facing an extremely high risk of extinction in the wild in the immediate future (i.e. 50% chance of extinction in the immediate future).				
Endangered (EN)	Taxa facing a very high risk of extinction in the wild in the near future i.e. 20% chance of extinction in the near future.				
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild in the medium-term future i.e. 10% chance of extinction in the medium-term future.				
Conservation Dependent (CD)	Taxa which will become Vulnerable, Endangered or Critically Endangered if specific conservation efforts cease.				
Other					
Migratory (MI)	Birds listed under international agreements relating to the protection of migratory birds i.e. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).				

#### **Biodiversity Conservation Act 2016**

Category	Definition
Extinct	
Extinct (EX)	Presumed extinct i.e. there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Presumed extinct in the wild i.e. species which have been adequately searched for and there is no reasonable doubt that the last wild individual has died.
Threatened	
Critically Endangered (CE)	Taxa facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild.
Specially Protected	
Migratory (MI)	Birds listed under international agreements relating to the protection of migratory birds i.e. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan- Australia Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).
Conservation Dependent (CD)	Species dependent on ongoing conservation intervention to prevent them becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Species otherwise in need of special protection to ensure their conservation.

### Department of Biodiversity, Conservation and Attractions Priority codes

Category	Definition
Poorly known	
Priority 1 (P1)	Species that are known from one or a few locations which are potentially at risk. Species whose occurrences are either small, on lands not managed for conservation or otherwise threatened with habitat destruction or degradation. Species that are well known from one or more locations but are under immediate threat from threatening processes. In urgent need of further survey.
Priority 2 (P2)	Species that are known from one or a few locations, some of which are on lands managed for conservation. Species that are well known from one or more locations but are under threat from threatening processes. In urgent need of further survey. In need of further survey.
Priority 3 (P3)	Species that are well known from several locations and are not are under imminent threat. Species known from few but widespread locations with either a large population size or with large areas of suitable habitat remaining, much of which is not under imminent threat. Species that are well known from one or more locations and threatening processes exist that could affect them.
Rare, Near Threatened and	other species in need of monitoring
Priority 4 (P4)	<ul> <li>Rare – Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection but could be if present circumstances change.</li> <li>Near Threatened – Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable but are not listed as Conservation Dependent.</li> <li>In need of monitoring - Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy</li> </ul>



## Appendix B – Locations of vertebrate fauna sampling sites


SiteName	SiteType	HabitatType	Latitude	Longitude
VSMB-01	Active Search	Open Peppermint Forest	-33.6646	115.0143
VSMB-02	Active Search	Melaleuca over Hakea Shrubland	-33.6652	115.0105
VSMB-05	Active Search	Open Coastal Shrubland	-33.6631	115.0104
VSMB-06	Active Search	Open Peppermint Forest	-33.6628	115.0151
VSMB-07	Active Search	Kunzea and Melaleuca Closed Shrubland	-33.6616	115.0079
VSMB-09	Active Search	Melaleuca over Hakea Shrubland	-33.6651	115.0082
VSMB-14	Active Search	Rocky Outcrop	-33.6604	115.0081
VSMB-15	Active Search	Rocky Outcrop	-33.6621	115.0071
VSMB-16	Active Search	Kunzea and Melaleuca Closed Shrubland	-33.6631	115.0078
VSMB-01	Avifauna Survey	Open Peppermint Forest	-33.6646	115.0143
VSMB-02	Avifauna Survey	Melaleuca over Hakea Shrubland	-33.6652	115.0105
VSMB-03	Avifauna Survey	Open Banksia Forest	-33.6631	115.0117
VSMB-04	Avifauna Survey	Kunzea and Melaleuca Closed Shrubland	-33.6601	115.009
VSMB-05	Avifauna Survey	Open Coastal Shrubland	-33.6631	115.0104
BSMB-01	Black Cockatoo Foraging Assessment	Melaleuca over Hakea Shrubland	-33.6647	115.0101
BSMB-02	Black Cockatoo Foraging Assessment	Melaleuca over Hakea Shrubland	-33.6651	115.0082
BSMB-03	Black Cockatoo Foraging Assessment	Cleared/ Disturbed	-33.665	115.0069
BSMB-04	Black Cockatoo Foraging Assessment	Open Banksia Forest	-33.6636	115.0109
BSMB-05	Black Cockatoo Foraging Assessment	Open Coastal Shrubland	-33.663	115.0105
BSMB-06	Black Cockatoo Foraging Assessment	Open Coastal Shrubland	-33.6618	115.0109
BSMB-07	Black Cockatoo Foraging Assessment	Open Peppermint Forest	-33.6652	115.0143
BSMB-08	Black Cockatoo Foraging Assessment	Closed Low Marri Forest	-33.6648	115.0159
BSMB-09	Black Cockatoo Foraging Assessment	Closed Low Marri Forest	-33.6639	115.0158
BSMB-12	Black Cockatoo Foraging Assessment	Kunzea and Melaleuca Closed Shrubland	-33.661	115.0084
VSMB-01	Camera	Open Peppermint Forest	-33.6646	115.0143
VSMB-02	Camera	Melaleuca over Hakea Shrubland	-33.6652	115.0105
VSMB-03	Camera	Open Banksia Forest	-33.6631	115.0117
VSMB-04	Camera	Kunzea and Melaleuca Closed Shrubland	-33.6601	115.009
VSMB-05	Camera	Open Coastal Shrubland	-33.6631	115.0104



SiteName	SiteType	HabitatType	Latitude	Longitude
VSMB-06	Camera	Open Peppermint Forest	-33.6628	115.0151
VSMB-07	Camera	Kunzea and Melaleuca Closed Shrubland	-33.6616	115.0078
VSMB-09	Camera	Melaleuca over Hakea Shrubland	-33.6654	115.0081
VSMB-11	Camera	Closed Low Marri Forest	-33.6649	115.016
VSMB-12	Camera	Closed Low Marri Forest	-33.6639	115.0158
VSMB-13	Camera	Open Coastal Shrubland	-33.6617	115.0126
VSMB-01	Habitat Assessment	Open Peppermint Forest	-33.6646	115.0143
VSMB-02	Habitat Assessment	Melaleuca over Hakea Shrubland	-33.6652	115.0105
VSMB-03	Habitat Assessment	Open Banksia Forest	-33.6631	115.0117
VSMB-04	Habitat Assessment	Kunzea and Melaleuca Closed Shrubland	-33.6601	115.009
VSMB-05	Habitat Assessment	Open Coastal Shrubland	-33.6631	115.0104
VSMB-06	Habitat Assessment	Open Peppermint Forest	-33.6628	115.0151
VSMB-07	Habitat Assessment	Kunzea and Melaleuca Closed Shrubland	-33.6616	115.0079
VSMB-08	Habitat Assessment	Melaleuca over Acacia and Hakea Shrubland	-33.6656	115.0097
VSMB-09	Habitat Assessment	Melaleuca over Hakea Shrubland	-33.6651	115.0082
VSMB-10	Habitat Assessment	Open Coastal Shrubland	-33.6618	115.0109
VSMB-11	Habitat Assessment	Closed Low Marri Forest	-33.6648	115.0159
VSMB-12	Habitat Assessment	Closed Low Marri Forest	-33.6639	115.0158
VSMB-13	Habitat Assessment	Open Coastal Shrubland	-33.6616	115.0126
VSMB-14	Habitat Assessment	Rocky Outcrop	-33.6604	115.0081
VSMB-15	Habitat Assessment	Rocky Outcrop	-33.6621	115.0071
VSMB-16	Habitat Assessment	Kunzea and Melaleuca Closed Shrubland	-33.6631	115.0078
VSMB-17	Habitat Assessment	Melaleuca over Hakea Shrubland	-33.6656	115.0068
VSMB-18	Habitat Assessment	Kunzea and Melaleuca Closed Shrubland	-33.6654	115.0042
VSMB-19	Habitat Assessment	Open Peppermint Forest	-33.6656	115.0123
VSMB-20	Habitat Assessment	Melaleuca over Acacia and Hakea Shrubland	-33.667	115.011
VSMB-21	Habitat Assessment	Melaleuca over Acacia and Hakea Shrubland	-33.6678	115.0058
VSMB-22	Habitat Assessment	Open Peppermint Forest	-33.6678	115.0155
VSMB-23	Habitat Assessment	Open Peppermint Forest	-33.665	115.0128



SiteName	SiteType	HabitatType	Latitude	Longitude
VSMB-01	Nocturnal Search	Open Peppermint Forest	-33.6646	115.0143
VSMB-01	Nocturnal Search	Open Peppermint Forest	-33.6646	115.0143
VSMB-03	Nocturnal Search	Open <i>Banksia</i> Forest	-33.6631	115.0117
VSMB-03	Nocturnal Search	Open <i>Banksia</i> Forest	-33.6631	115.0117
VSMB-03	Nocturnal Search	Open <i>Banksia</i> Forest	-33.6631	115.0117
VSMB-06	Nocturnal Search	Open Peppermint Forest	-33.6628	115.0151
VSMB-06	Nocturnal Search	Open Peppermint Forest	-33.6628	115.0151
VSMB-06	Nocturnal Search	Open Peppermint Forest	-33.6628	115.0151
VSMB-14	Nocturnal Search	Rocky Outcrop	-33.6604	115.0081
VSMB-14	Nocturnal Search	Rocky Outcrop	-33.6604	115.0081
VSMB-01	Targeted Search	Open Peppermint Forest	-33.6646	115.0143
VSMB-02	Targeted Search	Melaleuca over Hakea Shrubland	-33.6652	115.0105
VSMB-02	Targeted Search	Melaleuca over Hakea Shrubland	-33.6652	115.0105
VSMB-03	Targeted Search	Open Banksia Forest	-33.6631	115.0117
VSMB-03	Targeted Search	Open <i>Banksia</i> Forest	-33.6631	115.0117
VSMB-06	Targeted Search	Open Peppermint Forest	-33.6628	115.0151
VSMB-11	Targeted Search	Closed Low Marri Forest	-33.6648	115.0159
VSMB-12	Targeted Search	Closed Low Marri Forest	-33.6639	115.0158
VSMB-01	Trapping Site	Open Peppermint Forest	-33.6646	115.0143
VSMB-02	Trapping Site	Melaleuca over Hakea Shrubland	-33.6652	115.0105
VSMB-03	Trapping Site	Open Banksia Forest	-33.6631	115.0117
VSMB-04	Trapping Site	Kunzea and Melaleuca Closed Shrubland	-33.6601	115.009
VSMB-05	Trapping Site	Open Coastal Shrubland	-33.6631	115.0104
VSMB-01	Ultrasonic Recorder	Open Peppermint Forest	-33.6653	115.0144
VSMB-02	Ultrasonic Recorder	Melaleuca over Hakea Shrubland	-33.6653	115.0101
VSMB-03	Ultrasonic Recorder	Open <i>Banksia</i> Forest	-33.6637	115.0109
VSMB-04	Ultrasonic Recorder	Kunzea and Melaleuca Closed Shrubland	-33.6603	115.009
VSMB-05	Ultrasonic Recorder	Open Coastal Shrubland	-33.6628	115.0105
VSMB-13	Ultrasonic Recorder	Open Coastal Shrubland	-33.6619	115.0127



# Appendix C – Vertebrate fauna identified in the desktop assessment

			Conserva	tion Status			Database	Search	es (10km	ı)							Prev	vious Rep	oorts						
Scientific Name	Common Name	EPBC	BC	DBCA	IUCN	NatureMap	Protected Matters	DBCA	ALA	Birdata	4	۵	v	٩	ш	L	U	Ŧ	_	7	¥	L	Σ	z	Current Survey
Mammals																•									
BOVIDAE												-													
Bos taurus	*european cattle																					•	•	•	1
BURRAMYIDAE																									
Cercartetus concinnus	western pygmy-possum					•			•		•		•				•						•		•
CANIDAE		1	1	<b>1</b>	1	1					1	1	-	-	1	1	1	T	r	-		1			
Canis familiaris	*dog											•	•			•						•			ļ
Vulpes vulpes	*red fox										•						•					•	•	•	•
CERVIDAE		1	1	1	1	1		1	1			1			1	1	1	1	1	1		1			
Capreolus capreolus	*roe deer												•												I
DASYURIDAE		1	1	T	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	[	1			
Antechinus flavipes	yellow-footed antechinus												•										•		
Dasyurus geoffroii	chuditch	VU	VU			•	•	•	•				•												
Phascogale tapoatata wambenger	wambenger brush-tailed phascogale		CD			•		•	•		•		•										ļ		•
Sminthopsis griseoventer	grey-bellied dunnart								•				•											•	<u> </u>
	*~~1	1	1	1	1			1	1								1								
	Cal										•	<u> </u>	<b> •</b>			<u> </u>						<u> </u>			
	*rahhit	1			1				1															•	
MACROPODIDAE	Tabbit										•	<b>_</b>	1•			•	•	•	<b>_</b>			•	-	•	-
Macropus fuliginosus	western grev kangaroo		1	1		•			•		•	•	•				•		•			•	•	•	•
Notamacropus eugenii derbianus	tammar			P4				•	-		-		•						-					-	
Notamacropus irma	western brush wallaby			P4		•		•	•				•										•		
Setonix brachyurus	quokka	VU	VU			•		•	•				•										<del> </del>		
MOLOSSIDAE	<u> </u>	1	1	1	1	I	I	I	1	I		1	1	1	<u>I</u>	I	I	<u>I</u>	I						
Austronomus australis	white-striped freetail-bat											v	<u> </u>				•						•		•
Ozimops kitcheneri	south-western free-tailed bat											•					•						•		•
MURIDAE	•	•	•	•	•							<u> </u>	<u> </u>	<u> </u>	<u> </u>		•	<u> </u>		<u> </u>					
Hydromys chrysogaster	water-rat			P4		•		•	•				•												
Mus musculus	*house mouse										•	v	•				•						•	•	•
Rattus fuscipes	western bush rat					•			•			•	•										•	•	
Rattus norvegicus	*brown rat																						•		ļ
Rattus rattus	*black rat					•			•				•				•		•					•	1
PERAMELIDAE		1	1	<b>1</b>	1	1					1	1	-	-	1	1	1	T	r	-		1			
Isoodon fusciventer	southern brown bandicoot			P4		•		•	•				•				•					•	•		•
PHALANGERIDAE		1	1	1	1	1		1	1			1			1	1	1	1	1	1		1			
Trichosurus vulpecula	common brushtail possum					•			•			•					•		•				•		l
POTOROIDAE				1	1	1	1	1	1		1	1	1	1	1	1	1	1	1						
Bettongia penicillata	woylie	EN	CR										•												1
PSEUDOCHEIRIDAE				1	1	1							1	1	1			1							
Pseudocheirus occidentalis	western ringtail possum, ngwayir	CR	CR			•	•	•	•		•		•	•		•	•		•		•	•		•	•



			Conserva	tion Status		[	Database	Searche	es (10km	ı)							Prev	vious Re	ports						
Scientific Name	Common Name	EPBC	BC	DBCA	IUCN	NatureMap	Protected Matters	DBCA	ALA	Birdata	A	m	υ	٥	ш	L	U	I	-	7	¥	_	Σ	z	Current Survey
SUIDAE																									
Sus scrofa	*pig												•										•	1	
TACHYGLOSSIDAE				•	•	•						•					•	•	•	•					
Tachyglossus aculeatus	short-beaked echidna												•				•								•
TARSIPEDIDAE				•	•	<u> </u>						<u> </u>	<u> </u>	<u> </u>			<u> </u>	<u> </u>	<u> </u>	<u> </u>					
Tarsipes rostratus	honey possum					•			•		•		•				•								•
THYLACOMYIDAE	•			•	•	•						•						•	•	•					
Macrotis lagotis	bilby	VU	VU		VU			•																1	
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					•			•			•	•				•						•	•	•
Birds				•	•	•						•													
ACANTHIZIDAE																									
Acanthiza apicalis	inland thornbill					•			•	•	•	•					•		•				•	•	•
Acanthiza chrysorrhoa	yellow-rumped thornbill					•			•	•							•		•				•	•	
Acanthiza inornata	western thornbill					•			•	•		•					•								•
Gerygone fusca	western gerygone					•			•	•							•		•				•	•	•
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								•	•														•	
Elanus axillaris	black-shouldered kite					•			•	•															
Haliaeetus leucogaster	white-bellied sea-eagle					•	•		•	•															
Haliastur sphenurus	whistling kite					•			•	•	•	•				•									
Hamirostra isura	square-tailed kite					•			•	•							•								•
Hieraaetus morphnoides	little eagle					•			•	•															
ACROCEPHALIDAE						•						•	•	•	•	•	•	•	•	•	•				
Acrocephalus australis	Australian reed warbler									•														1	
AEGOTHELIDAE	•			•	•	•						•						•	•	•					
Aegotheles cristatus	Australian owlet-nightjar									•							•								
ALCEDINIDAE																									
Dacelo novaeguineae	laughing kookaburra					•			•	•	•	v				•	•		•			•	•	•	•
Todiramphus sanctus	sacred kingfisher					•			•	•							•								
Todiramphus sanctus	sacred kingfisher					•			•	•							•						<u> </u>		



			Conservat	tion Status		[	Database	Search	es (10kn	n)							Prev	vious Rep	ports						
Scientific Name	Common Name	EPBC	BC	DBCA	IUCN	NatureMap	Protected Matters	DBCA	ALA	Birdata	A	۵	U	۵	ш	L	U	I	_	7	¥		Σ	z	Current Survey
ANATIDAE	•				•	•	•	•	•	•					•				•			•			
Anas gracilis	grey teal					•			•	•									•						
Anas platyrhynchos	*mallard					•			•	•															
Anas rhynchotis	Australasian shoveler									•															
Anas superciliosa	Pacific black duck					•			•	•						•			•			•			
Aythya australis	hardhead					•			•	•							•								
Biziura lobata	musk duck					•			•	•															
Cereopsis novaehollandiae grisea	Cape Barren goose	VU	VU					•																	
Chenonetta jubata	Australian wood duck					•			•	•									•			•	•		
Cygnus atratus	black swan					•			•	•														•	
Oxyura australis	blue-billed duck			P4	NT			•		•															
Tadorna tadornoides	Australian shelduck					•			•	•													•	•	
ANHINGIDAE																									
Anhinga novaehollandiae	Australiasian darter					•			•	•															
APODIDAE																									
Apus pacificus	fork-tailed swift	МІ	МІ				•	•	•																
ARDEIDAE																									
Ardea garzetta	little egret					•			•	•															
Ardea ibis	cattle egret					•	•		•	•															
Ardea modesta	eastern great egret					•	•		•	•															
Ardea novaehollandiae	white-faced heron					•			•	•									•			•	•		
Ardea pacifica	white-necked heron					•			•	•															
Ardea sacra	eastern reef egret								•	•															
Botaurus poiciloptilus	Australasian bittern	EN	EN				•																		
Nycticorax caledonicus	rufous night heron									•							•		•						
ARTAMIDAE			•	•	•	•	•						•						•						
Artamus cinereus	black-faced woodswallow					•			•	•									•						
Artamus cyanopterus	dusky woodswallow					•			•	•															
CACATUIDAE			•	•	•	•	•				•		•	•	•			•	•						
Cacatua pastinator	western long-billed corella								•	•															
Cacatua roseicapilla	galah					•			•	•	•	•				•	•		•						•
Cacatua sanguinea	little corella								•	•									•						
Calyptorhynchus banksii naso	forest red-tailed black cockatoo	VU	VU			•	•	•	•	•							•		•	•			•		
Calyptorhynchus baudinii	Baudin's cockatoo	EN	EN			•	•	•	•	•	•	•		•			•	•	•	•			•	•	•
Calyptorhynchus latirostris	Carnaby's cockatoo	EN	EN			•	•	•	•	•				•			•			•			•	•	•
Calyptorhynchus sp. 'white-tailed black cockatoo'	white-tailed black cockatoo	EN	EN					•		•														•	
CAMPEPHAGIDAE			1	1		1	1	-		-									_						
Coracina novaehollandiae	black-faced cuckoo-shrike					•			•	•		•					•	•	•				•	•	<b> </b>
Lalage tricolor	white-winged triller								•	•															L
CHARADRIIDAE			1		1	1	1	1			1	1						1	1	1		1			
Charadrius leschenaultii	greater sand plover	VU/MI	VU/MI			•		•	•	•															ı



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Scientific Name	Common Name	EPBC	BC	DBCA	IUCN	NatureMap	Protected Matters	DBCA	ALA	Birdata	۷	m	U	٩	ш	L	U	Ŧ	-	٦	¥	_	Σ	z	Current Survey
Charadrius melanops	black-fronted dotterel					•			•	•															
Charadrius mongolus	lesser sand plover	EN/MI	EN/MI					•		•															
Charadrius ruficapillus	red-capped plover					•			•	•												•		•	
Erythrogonys cinctus	red-kneed dotterel					•			•	•															
Thinornis cucullatus	hooded plover					•	•	•	•	•															
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																									
Cracticus nigrogularis	pied butcherbird									•	•	•													
Cracticus torquatus	grey butcherbird					•			•	•		•				•	•		•				•	•	
Gymnorhina tibicen	Australian magpie					•			•	•	•	•				•	•	•	•			•	•	•	•
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		-	1						•	1				1	-	r				1	-	1		-	
Dicaeum hirundinaceum	mistletoebird					•			•	•															
DIOMEDEIDAE		-	1						•	1				1	-	r				1	-	1		-	
Diomedea epomophora	royal albatross	VU/MI	VU/ MI				•																		
Diomedea exulans	wandering albatross	VU/MI	VU/ MI				•	•																	
Diomedea exulans amsterdamensis	Amsterdam albatross	EN/MI	CR/MI				•																		
Diomedea exulans dabbenena	Tristan albatross	МІ	CR/ MI				•																		
Diomedea sanfordi	northern royal albatross	EN/MI	EN/MI				•																		
Phoebetria fusca	sooty albatross	VU/MI	EN/MI				•																		
Thalassarche cauta	shy albatross	VU/MI	VU/ MI				•	•	•	•															
Thalassarche steadi	white-capped albatross	VU/MI	VU/ MI				•			•															
Thalassarche chlororhynchos	yellow-nosed albatross	VU/MI	VU/ MI			•		•	•																
Thalassarche carteri	Indian yellow-nosed albatross	VU/MI	EN/MI				•	•		•															



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Scientific Name	Common Name	EPBC	BC	DBCA	IUCN	NatureMap	Protected Matters	DBCA	АГА	Birdata	٩	m	υ	۵	ш	Ľ	U	т	-	7	×	-	۶	z	Current Survey
Thalassarche impavida	Campbell albatross	VU/MI	VU/ MI				•																		
Thalassarche melanophris	black-browed albatross	VU/MI	EN/MI				•	•	•	•															
DROMAIIDAE	·		•		•			•	•				•	•	•				•	•	•	•		•	
Dromaius novaehollandiae	emu																						•	•	
ESTRILDIDAE	•		•	•	•			•	•				•	•	•				•	•	•	•			
Stagonopleura oculata	red-eared firetail					•			•	•						•									
FALCONIDAE	•		•	•	•			•	•				•	•	•				•	•	•	•			
Falco berigora	brown falcon					•			•	•		•													•
Falco cenchroides	Australian kestrel					•			•	•	•								•			•	•	•	
Falco hypoleucos	grey falcon		VU		VU		•																		
Falco longipennis	Australian hobby					•			•	•														•	
Falco peregrinus	peregrine falcon		OS			•		•	•	•															
HAEMATOPODIDAE			•	1	1	<u> </u>			<u> </u>		<u> </u>				<u> </u>	<u> </u>			<u> </u>	<u> </u>	<u> </u>	<u> </u>		<u> </u>	
Haematopus fuliginosus	sooty oystercatcher					•			•	•															
Haematopus longirostris	pied oystercatcher					•			•	•														•	
HIRUNDINIDAE			<u> </u>		I	1		1	1		1		1	1	1		I		1	1	1	1	1	1	
Hirundo neoxena	welcome swallow					•			•	•	•	•				•	•					•	•	•	•
Petrochelidon ariel	fairy martin								•	•															
Petrochelidon nigricans	tree martin					•			•	•	•						•		•				•	•	•
HYDROBATIDAE			•	1	1	<u> </u>			<u> </u>		<u> </u>				<u> </u>	<u> </u>			<u> </u>	<u> </u>	<u> </u>	<u> </u>		<u> </u>	
Oceanites oceanicus	wilson's storm petrel	МІ	МІ			•		•	•	•															
LARIDAE			<u> </u>		I	1		1	1		1		1	1	1		I		1	1	1	1	1	1	
Anous tenuirostris melanops	Australian lesser noddy	VU	EN				•																		
Larus novaehollandiae	silver gull					•			•	•	•						•					•		•	•
Larus pacificus	pacific gull					•			•	•							•							•	•
Sterna anaethetus	bridled tern	МІ	МІ				•	•		•															
Thalasseus bergii	crested tern	МІ	МІ			•		•	•	•															
Hydroprogne caspia	caspian tern	МІ	МІ			•	•	•	•	•							•								
Sterna dougallii	roseate tern	MI	МІ							•															
Sterna hirundo	common tern	МІ	МІ					•																	
Sterna nereis nereis	fairy tern	VU/	VU		VU	•	•		•	•															
LOCUSTELLIDAE			•	1	1	<u> </u>			<u> </u>		<u> </u>				<u> </u>	<u> </u>			<u> </u>	<u> </u>	<u> </u>	<u> </u>		<u> </u>	
Megalurus cruralis	brown songlark									•													•		
Megalurus gramineus	little grassbird									•															
Megalurus mathewsi	rufous songlark									•															
MALURIDAE	•										1														1
Malurus elegans	red-winged fairy-wren					•			•	•													•	•	
Malurus splendens	splendid fairy-wren					•		1	•	•	•	•	1	1		•	•		•				•	•	•
Stipiturus malachurus	southern emu-wren					•		1	•	•	•	•	1	1			•								1
MEGAPODIIDAE	·										1														
Leipoa ocellata	malleefowl	VU	VU			•		•																	
	1	1	1	1	1	1	1		1	1	1	1			1	1	1		1	1		1	1	1	<u> </u>



			Conserva	ation Status			Databas	e Search	nes (10km	n)							Prev	vious Re	ports						
Scientific Name	Common Name	EPBC	BC	DBCA	IUCN	NatureMap	Protected Matters	DBCA	АГА	Birdata	٨	ш	U	D	ш	Ŀ	U	т	-	J	¥	L	×	z	Current Survey
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					•			•	•	•	•					•		•				•		•
Melithreptus brevirostris	brown-headed honeyeater									•															
Melithreptus chloropsis	western white-naped honeyeater								•	•															
Phylidonyris nigra	white-cheeked honeyeater					•			•	•															
Phylidonyris novaehollandiae	new holland honeyeater					•			•	•	•						•		•			•	•	•	•
MEROPIDAE			•																	·					
Merops ornatus	rainbow bee-eater					•	•		•	•							•		•				•	•	
MONARCHIDAE		•	•	•		•	•	•	•		•	•		•	•	•	•	•	•	•	•	•	•		
Grallina cyanoleuca	magpie-lark					•			•	•									•				•		
Myiagra inquieta	restless flycatcher									•															
MOTACILLIDAE		•	•	•	•		•		•					•	•	•	•	•				•	•		
Anthus australis	Australian pipit								•	•												•	•	•	
Motacilla cinerea	grey wagtail	МІ	МІ				•																		
NEOSITTIDAE			•																						
Daphoenositta chrysoptera	varied sittella					•			•	•							•	•					•	1	1
PACHYCEPHALIDAE		•	•	•	•		•		•					•	•	•	•	•				•	•		
Colluricincla harmonica	grey shrike-thrush					•			•	•							•	•					•	•	•
Falcunculus frontatus	crested shrike-tit								•																
Pachycephala occidentalis	western golden whistler								•	•	•	•					•	•	•				•	•	•
Pachycephala rufiventris	rufous whistler					•			•	•									•				•		
PANDIONIDAE																									
Pandion haliaetus	osprey, eastern osprey	МІ	МІ			•	•	•	•	•							•					•			
PARDALOTIDAE																									
Pardalotus punctatus	spotted pardalote					•			•	•														•	
Pardalotus striatus	striated pardalote					•			•	•							•		•				•	•	•
PELECANIDAE																									
Pelecanus conspicillatus	Australian pelican					•			•	•															
PETROICIDAE																									
Eopsaltria australis griseogularis	western yellow robin								•	•							•	•					•	•	•
Eopsaltria georgiana	white-breasted robin					•			•	•	•	•					•	•						•	•
Microeca fascinans	jacky winter									•															
Petroica boondang	scarlet robin					•			•	•	•						•						•	•	
PHAETHONTIDAE																									
Phaethon rubricauda	red-tailed tropicbird	МІ	МІ	P4		•		•	•	•															



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Scientific Name	Common Name	EPBC	BC	DBCA	IUCN	NatureMap	Protected Matters	DBCA	ALA	Birdata	4	۵	υ	۵	ш	Ľ	U	т	-	7	¥	_	Σ	z	Current Survey
PHAETHONTIDAE	•												•												
Phalacrocorax carbo	great cormorant					•			•	•												•			
Phalacrocorax melanoleucos	little pied cormorant					•			•	•												•			•
Phalacrocorax sulcirostris	little black cormorant					•			•	•									•						
Phalacrocorax varius	pied cormorant					•			•	•							•								
PHASIANIDAE	1	1	1	T	1	-	1	1	1	1		1	1			1	1		1			1			
Coturnix pectoralis	stubble quail					•			•	•													•		
PODARGIDAE		1	1		1	1	1	1	1	1		1	1		1	1	1	r	1		r	1			
Podargus strigoides	tawny frogmouth					•			•	•		•							•						
PODICIPEDIDAE	I	1	T	T	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1			
Poliocephalus poliocephalus	hoary-headed grebe					•			•	•													ļ!	'	
Tachybaptus novaehollandiae	Australasian grebe					•			•	•							•								
PROCELLARIIDAE		1	T	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1			
Daption capense	cape petrel									•															
Halobaena caerulea	blue petrel	VU					•																<u> </u>	'	
Macronectes giganteus	southern giant petrel	EN/MI	MI				•	•	•	•													<u> </u>	'	
Macronectes halli	northern giant petrel		MI				•	•		•													┢───┘	'	
Pacnyptila turtur subantarctica	tairy prion	VU					•																<u> </u> ]	'	
Pterodroma macropiera	great-winged petrel									•													┝───┤	'	
Puerodroma monis		VU					•		-	•													┝───┤	'	
Ardenna carneines	fleshy-footed shearwater	M																					┝───┦		
Puffinus gavia	fluttering shearwater	1011	VO/W						-														┝───┦	'	
Ardenna grisea	sooty shearwater	М	МІ						•	•													<b> </b>	 	
Puffinus huttoni	hutton's shearwater		EN					•	•	•															
Ardenna pacifica	wedge-tailed shearwater	МІ	МІ			•		•	•	•															
PSITTACIDAE	1	<u>I</u>	<u>I</u>	1	1	<u> </u>	I	I	I	<u> </u>	I	I	<u> </u>	I	I	I	I	I	I		I				<b></b>
Neophema elegans	elegant parrot					•			•	•	•	•											•		•
Neophema petrophila	rock parrot					•			•	•															
Parvipsitta porphyrocephala	purple-crowned lorikeet								•	•		•					•						•	•	
Platycercus icterotis	western rosella					•			•	•	•						•							•	
Platycercus spurius	red-capped parrot					•			•	•		•					•	•	•				•	•	•
Platycercus zonarius	Australian ringneck					•			•	•	•	•				•	•	•	•			•	•	•	•
Polytelis anthopeplus	regent parrot					•			•	•															
RALLIDAE																									
Fulica atra	Eurasian coot					•			•	•															
Gallinula tenebrosa	dusky moorhen					•			•	•															
Gallirallus philippensis	buff-banded rail					•			•																
Porphyrio porphyrio	purple swamphen					•			•	•													ļ <sup> </sup>	ļ'	<u> </u>
Porzana fluminea	Australian spotted crake									•													ļ <sup> </sup>	ļ'	<u> </u>
Tribonyx ventralis	black-tailed native-hen									•															



			Consonua	tion Status			Databas	Soarch	hos (10kr	n)							Brow		norte					- Tik	
										1		1					Fiev			1					
Scientific Name	Common Name	EPBC	BC	DBCA	IUCN	NatureMap	Protected Matters	DBCA	ALA	Birdata	A	œ	U	٥	ш	u	U	Ŧ	-	-	×	_	Þ	z	Current Survey
RECURVIROSTRIDAE																									
Himantopus himantopus	black-winged stilt					•	T		•	•	T									[					T
Cladorhynchus leucocephalus	banded stilt									•														<u> </u>	
Recurvirostra novaehollandiae	red-necked avocet					•			•	•														<u> </u>	
RHIPIDURIDAE		1	1	1		I		1	1	1		1	1	1	1	1	1	<u> </u>		1		1		<b></b>	L
Rhipidura albiscapa	grev fantail					•	T		•	•	•	•					•	•	•	[			•	•	•
Rhipidura leucophrys	willie wagtail					•			•	•	•	•				•	•		•			•	•	•	•
SCOLOPACIDAE						1-		1	1-	1-	1-	1-	I		1	-	-		1-	<u> </u>		<u> </u>	_	<u> </u>	<u> </u>
Calidris acuminata	sharp-tailed sandpiper	MI	MI	1		•	•	•	1	1	1	1			1	1			1						1
Calidris alba	sanderling	МІ	М			•		•	•	•														<u> </u>	
Calidris canutus	red knot	EN/MI	EN/MI		NT		•																	<u> </u>	
Calidris ferruginea	curlew sandpiper	CR/MI	CR/MI		NT		•	•		•														<u> </u>	
Calidris melanotos	pectoral sandpiper	МІ	МІ				•	•		•															
Calidris ruficollis	red-necked stint	МІ	МІ		NT	•		•	•	•															
Limosa lapponica	bar-tailed godwit	МІ	МІ				•	•	•	•															
Limosa lapponica baueri	bar-tailed godwit (western alaskan)	ΜΙ/VU	VU				•																		
Limosa lapponica menzbieri	bar-tailed godwit (northern siberian)	CR/MI	CR		NT		•																		
Limosa limosa	black-tailed godwit	МІ	МІ		NT			•																	
Numenius arquata	Eurasian curlew						•																		
Numenius madagascariensis	eastern curlew	CR/MI	CR/MI		EN		•	•	•	•															
Numenius phaeopus	whimbrel	МІ	МІ			•		•	•	•															•
Tringa brevipes	grey-tailed tattler	МІ	МІ	P4	NT			•		•															
Tringa glareola	wood sandpiper	МІ	МІ					•																	
Tringa hypoleucos	common sandpiper	МІ	МІ			•	•	•	•	•															
Tringa nebularia	common greenshank	МІ	МІ			•		•	•	•															
Tringa stagnatilis	marsh sandpiper	МІ	МІ					•		•															
STERCORARIIDAE																									
Stercorarius antarcticus	brown skua					•		•	•	•															
Stercorarius parasiticus	arctic skua	МІ	МІ					•	•	•															
Stercorarius pomarinus	pomarine skua	МІ	МІ					•		•															
STRIGIDAE																									
Ninox boobook	boobook owl								•	•	•						•		•				•		
Ninox connivens connivens	barking owl (southwest pop)			P3		•		•	•	•															
SULIDAE					_	-				-	_	-	-				-			-					
Sula serrator	Australasian gannet					•			•	•															
THRESKIORNITHIDAE																									
Platalea flavipes	yellow-billed spoonbill					•			•	•															
Platalea regia	royal spoonbill									•															
Threskiornis molucca	Australian white ibis								•	•												•	•	•	<u> </u>
Threskiornis spinicollis	straw-necked ibis					•			•	•									•				•	•	



			Conserva	tion Status			Database	Search	es (10kn	n)							Prev	vious Re	ports						
Scientific Name	Common Name	EPBC	BC	DBCA	IUCN	NatureMap	Protected Matters	DBCA	ALA	Birdata	۲	œ	υ	۵	ш	Ľ	Ø	т	-	7	¥	_	Σ	z	Current Survey
TURNICIDAE																									
Turnix varia	painted button-quail					•			•	•							•								•
TYTONIDAE		•		•	•	•	•		•		•	•	•		•		•	•	•	•				•	
Tyto alba	barn owl								•	•															
ZOSTEROPIDAE																									
Zosterops lateralis	silvereye					•			•	•	•	•				•	•	•	•					•	•
Reptiles																									
AGAMIDAE						•		-								1	1		1		-	1	-	1	
Pogona minor						•			•		•	•	•										•		•
PYTHONIDAE		1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	
Morelia spilota	carpet python					•			•		•		•												
CHELUIDAE		1		T	1	1	1	-	1	r	1	-	-	r		1	1	r	1	1	r	r	-	1	
Chelodina colliei	oblong turtle												•												
DIPLODACTYLIDAE	1	1	[	1	1	1	1		1	1	1		1	1	1	1	1	1	1		[	1		1	
Diplodactylus polyophthalmus																							•		
GEKKONIDAE	1	1	r	r	1	1	1		1	1	1	-	1	1	1	1	1	1	1	1	1	1		1	
Christinus marmoratus	marbled gecko					•			•		•	•	•				•						•	•	•
ELAPIDAE				1		1	1		1	1	1	1	1.	1	1	1	1	1		1	[	1			
Echiopsis curta	bardick										•		•				•							•	•
Elapognathus coronatus	crowned snake										•		•										•	•	
Elapognathus minor	short-nosed snake			P2									•												
Notechis scutatus	tiger snake												•											•	
Parasuta gouldii																									
Parasuta nigriceps	al verte					•			•														•	_	<u> </u>
Pseudonaja aminis						•			•		•		•				•						•	•	•
	square-nosed snake												•												
				1	1		1			[				1	[	[		[				1			-
						•			•		•						•						•		
Delma hebesa	heath delma												-										•		-
													-				•						•		-
Pyannus lenidonodus	common scalv foot												•												-
SCINCIDAE	common cody root						1					1					1				l				1.
Acritoscincus trilineatus				[		•			•		•		•				•						•	•	•
Cryptoblepharus buchananii												•	•				•						•		•
Ctenotus australis													•												
Ctenotus catenifer						•			•				•				•						•		
Ctenotus delli	dell's skink			P4				•				1													
Ctenotus impar						•			•		•	•	•				•						•		•
Ctenotus labillardieri											•		•			•								•	
Ctenotus ora	coastal plains skink			P3	VU	•		•	•						•	•							•		•
		I	I	1	1	1	1	I	1	1	I	1	1	1	1	1	I	1	1	1	I	I	l	1	1



					Conservation Status			Database Searches (10km)			Previous Reports														
Scientific Name	Common Name	EPBC	BC	DBCA	IUCN	NatureMap	Protected Matters	DBCA	ALA	Birdata	٩	۵	υ	۵	ш	Ľ	U	т	_	-	¥		×	z	Current Survey
Egernia kingii	king's skink								•		•		•				•						•		•
Egernia napoleonis						•			•		•		•										•	•	•
Hemiergis peronii						•			•		•		•			•	•						•	•	•
Hemiergis quadrilineata													•												
Lerista distinguenda						•			•		•		•				•					•	•		
Lerista elegans						•			•				•				•						•	•	•
Lerista lineata	lined skink			P3	EN								•												
Lerista microtis																								•	
Liopholis pulchra													•												
Menetia greyii						•			•		•	•	•				•						•		•
Morethia lineoocellata						•			•		•	•	•			•	•						•	•	•
Morethia obscura																							•	•	•
Tiliqua occipitalis	western bluetongue					•																			
Tiliqua rugosa									•		•	•	•				•					•	•	•	•
TYPHLOPIDAE	•	•		•	•			•		•	•	•	•	•	•	•	•	•	•	•	•	•			
Anilios australis									•		•	•	•										•	•	•
Anilios pinguis																							•		
VARANIDAE																									
Varanus rosenbergi	heath monitor					•			•		•	•	•				•						•	•	
Amphibians				•														·							
PELODRYADIDAE																									
Litoria adelaidensis	slender tree frog					•			•		•		•				•		•			•			•
Litoria moorei	motorbike frog								•		•		•					•						•	•
LIMNODYNASTIDAE																									
Heleioporus eyrei	moaning frog					•			•		•	•	•			•	•					•	•	•	•
Heleioporus inornatus	whooping 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								•				•				•								
Metacrinia nichollsi	forest toadlet								•				•										•		
Myobatrachus gouldii	turtle frog															•									
Pseudophryne guentheri	crawling toadlet												•				•								





Appendix D – Vertebrate fauna habitat assessments

Site ID	Lat	Long	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Aval.	Outcrop	Outcrop Type	Rock Size	Veg. Lit.	Last Fire	Hab. Cond.	Cracks and Crevices	Burrowing Suitability
VSMB-01	-33.665	115.014	Open Peppermint Forest	Sand Plain	North	Low	Sand	Few Small Patches	Negligible		Negligible	Many Small Patches	Old (6+ yr)	Poor	Nil	High
VSMB-02	-33.665	115.010	Melaleuca over Hakea Shrubland	Sand Plain	North	Low	Sandy Loam	Many Small Patches	Negligible		Negligible	Many Small Patches	Old (6+ yr)	Very Good	Nil	Moderate
VSMB-03	-33.663	115.012	Open Banksia Forest	Sand Plain	North	Low	Sand	Few Small Patches	Negligible		Negligible	Many Small Patches	Old (6+ yr)	Very Good	Nil	High
VSMB-04	-33.660	115.009	Kunzea and <i>Melaleuca</i> Closed Shrubland	Hillslope	North	Low	Clayey Sand	Many Large Patches	Limited Outcropping	Limestone	Boulders (>61cm)	Many Small Patches	Old (6+ yr)	Very Good	Low	Low
VSMB-05	-33.663	115.010	Open Coastal Shrubland	Sand Dune	North	Low	Sand	Few Small Patches	Negligible		Gravel (1-4cm)	Few Small Patches	Old (6+ yr)	Good	Nil	Moderate
VSMB-06	-33.663	115.015	Open Peppermint Forest	Sand Plain	North	Low	Sand	Few Small Patches	Negligible		Negligible	Many Small Patches	Old (6+ yr)	Poor	Nil	High
VSMB-07	-33.662	115.008	Kunzea and <i>Melaleuca</i> Closed Shrubland	Hillslope	North	Low	Clayey Sand	Many Large Patches	Minor Outcropping	Granite	Boulders (>61cm)	Many Large Patches	Old (6+ yr)	Very Good	Moderate	Nil
VSMB-08	-33.666	115.010	Melaleuca over Acacia and Hakea Shrubland	Sand Plain	North	Low	Sandy Loam	Many Small Patches	Negligible		Negligible	Many Small Patches	Old (6+ yr)	Very Good	Nil	Moderate
VSMB-09	-33.665	115.008	<i>Melaleuca</i> over <i>Hakea</i> Shrubland	Sand Plain	North	Low	Sand	Few Small Patches	Negligible		Negligible	Many Large Patches	Old (6+ yr)	Very Good	Nil	Moderate
VSMB-10	-33.662	115.011	Open Coastal Shrubland	Sand Dune	North	Low	Sand	Few Small Patches	Negligible		Gravel (1-4cm)	Few Small Patches	Old (6+ yr)	Good	Nil	Moderate
VSMB-11	-33.665	115.016	Closed Low Marri Forest	Sand Plain	Flat	Low	Sand	Scarce	Negligible		Negligible	Evenly Spread	Old (6+ yr)	Good	Nil	Low
VSMB-12	-33.664	115.016	Closed Low Marri Forest	Sand Plain	Flat	Low	Sand	Few Small Patches	Limited Outcropping	Sandstone	Boulders (>61cm)	Few Small Patches	Old (6+ yr)	Good	Low	Low
VSMB-13	-33.662	115.013	Open Coastal Shrubland	Wetland	Flat	Flat	Sandy Loam	Few Small Patches	Negligible		Negligible	Many Small Patches	Old (6+ yr)	Degraded	Nil	Moderate
VSMB-14	-33.660	115.008	Rocky Outcrop	Boulders/ Rockpiles	North	Low	Sandy Loam	Many Small Patches	Major Outcropping	Granite	Boulders (>61cm)	Few Small Patches	Old (6+ yr)	Very Good	High	Low
VSMB-23	-33.665	115.013	Open Peppermint Forest	Sand Plain	North	Low	Sandy Loam	Few Small Patches	Limited Outcropping	Granite	Negligible	Many Small Patches	Old (6+ yr)	Poor	Nil	Nil
VSMB-15	-33.662	115.007	Rocky Outcrop	Granite Outcrops/ Domes	North	Steep	Sandy Loam	Few Small Patches	Extensive Outcropping	Granite	Boulders (>61cm)	Scarce	Old (6+ yr)	Very Good	Very High	Low
VSMB-16	-33.663	115.008	Kunzea and <i>Melaleuca</i> Closed Shrubland	Sand Plain	Flat	Flat	Sandy Loam	Many Small Patches	Minor Outcropping	Granite	Small Rocks (11-20cm)	Many Small Patches	Old (6+ yr)	Excellent	Low	Moderate
VSMB-17	-33.666	115.007	<i>Melaleuca</i> over <i>Hakea</i> Shrubland	Sand Plain	North	Low	Sand	Few Small Patches	Negligible		Negligible	Many Large Patches	Old (6+ yr)	Very Good	Nil	Moderate
VSMB-18	-33.665	115.004	Kunzea and <i>Melaleuca</i> Closed Shrubland	Sand Plain	Flat	Flat	Sandy Loam	Many Small Patches	Minor Outcropping	Granite	Small Rocks (11-20cm)	Many Small Patches	Old (6+ yr)	Excellent	Low	Moderate
VSMB-19	-33.666	115.012	Open Peppermint Forest	Sand Plain	North	Low	Sand	Few Small Patches	Negligible		Negligible	Many Small Patches	Old (6+ yr)	Poor	Nil	High
VSMB-20	-33.667	115.011	Melaleuca over Acacia and Hakea Shrubland	Sand Plain	North	Low	Sandy Loam	Many Small Patches	Negligible		Negligible	Many Small Patches	Old (6+ yr)	Very Good	Nil	Moderate
VSMB-21	-33.668	115.006	Melaleuca over Acacia and Hakea Shrubland	Sand Plain	North	Low	Sandy Loam	Many Small Patches	Negligible		Negligible	Many Small Patches	Old (6+ yr)	Very Good	Nil	Moderate
VSMB-22	-33.668	115.015	Open Peppermint Forest	Sand Plain	North	Low	Sand	Few Small Patches	Negligible		Negligible	Many Small Patches	Old (6+ yr)	Poor	Nil	High





# Appendix E – Fauna recorded during the current survey

		Conservation Status			Total Number of Individuals by Site								
Scientific Name	Common Name	EPBC	BC	DBCA	Other sampling sites/ Opportunistic	VSMB-01	VSMB-02	VSMB-03	VSMB-04	VSMB-05	Total		
Mammals					104	20	9	20	49	32	234		
Burramyidae							1	3			4		
Cercartetus concinnus	western pygmy-possum, mundarda						1	3			4		
Canidae					4		1		1		6		
Vulpes vulpes	red fox				4		1		1		6		
Dasyuridae						1					1		
Phascogale tapoatafa wambenger	wambenger brush-tailed phascogale		CD			1					1		
Leporidae					7						7		
Oryctolagus cuniculus	rabbit				7						7		
Macropodidae					26	3			13	4	46		
Macropus fuliginosus	western grey kangaroo				26	3			13	4	46		
Molossidae					6			3	12	7	28		
Austronomus australis	white-striped free-tailed bat				6			3	6	7	22		
Ozimops kitcheneri	western free-tailed bat								6		6		
Muridae						1	1		1		3		
Mus musculus	house mouse					1	1		1		3		
Peramelidae					2				2		4		
Isoodon fusciventer	quenda			P4	2				2		4		
Pseudocheiridae					46	6		5			57		
Pseudocheirus occidentalis	western ringtail possum	CR	CR		46	6		5			57		
Tachyglossidae					1				1		2		
Tachyglossus aculeatus	short-beaked echidna				1				1		2		
Tarsipedidae									1		1		
Tarsipes rostratus	honey possum, noolbenger								1		1		
Vespertilionidae					12	9	6	9	18	21	75		
Chalinolobus gouldii	Gould's wattled bat				6	3	3	3	6	7	28		
Nyctophilus geoffroyi	lesser long-eared bat								6		6		
Nyctophilus major	greater long-eared bat					3		3		7	13		
Vespadelus regulus	southern forest bat				6	3	3	3	6	7	28		
Birds	·				140	74	103	54	32	64	467		
Acanthizidae					7	11	9	9	6	5	47		
Acanthiza apicalis	broad-tailed thornbill (inland thornbill)				1	2	8	3		2	16		
Acanthiza inornata	western thornbill				1						1		
Gerygone fusca	western gerygone				2	8		3			13		
Sericornis frontalis	white-browed scrubwren				3		1	3	6	3	16		
Smicrornis brevirostris	weebill					1					1		
Accipitridae					3					1	4		
Accipiter cirrocephalus	collared sparrowhawk				1						1		
Accipiter fasciatus	brown goshawk				1						1		
Hamirostra isura	square-tailed kite				1					1	2		
Alcedinidae						3					3		
Dacelo novaeguineae	laughing kookaburra					3					3		
Cacatuidae					34	20	57	26		6	143		
Cacatua roseicapilla	galah				1	2				4	7		



		Conservation Status			Total Number of Individuals by Site								
Scientific Name	Common Name	EPBC	BC	DBCA	Other sampling sites/ Opportunistic	VSMB-01	VSMB-02	VSMB-03	VSMB-04	VSMB-05	Total		
Calyptorhynchus baudinii	Baudin's cockatoo	CR	CR		1	12		3			16		
Calyptorhynchus latirostris	Carnaby's cockatoo	CR	CR		32	6	57	23		2	120		
Columbidae					8	2	1		1		12		
Phaps chalcoptera	common bronzewing					1					1		
Phaps elegans	brush bronzewing						1		1		2		
Spilopelia senegalensis	*laughing turtle dove				8	1					9		
Corvidae					3	2	2			2	9		
Corvus coronoides	Australian raven				3	2	2			2	9		
Cracticidae					3	14	3	7	1	9	37		
Cracticus tibicen	Australian magpie				1	10	3	5	1	8	28		
Strepera versicolor	grey currawong				2	4		2		1	9		
Cuculidae							1				1		
Chrysococcyx basalis	Horsfield's bronze cuckoo						1				1		
Falconidae					1						1		
Falco berigora	brown falcon				1						1		
Hirundinidae					3						3		
Hirundo neoxena	welcome swallow				2						2		
Petrochelidon nigricans	tree martin				1						1		
Laridae					3				4		7		
Larus novaehollandiae	silver gull				1				4		5		
Larus pacificus	pacific gull				2						2		
Maluridae					14		8		10	15	47		
Malurus splendens	splendid fairywren				14		8		10	15	47		
Meliphagidae					18		5	7	8	16	54		
Anthochaera carunculata	red wattlebird				3				2	3	8		
Lichmera indistincta	brown honeyeater				4		4	6	1	8	23		
Phylidonyris novaehollandiae	new holland honeyeater				11		1	1	5	5	23		
Pachycephalidae					2	6	2	1		2	13		
Colluricincla harmonica	grey shrikethrush					1	1			1	3		
Pachycephala occidentalis	western golden whistler (western whistler)				2	5	1	1		1	10		
Pardalotidae					1						1		
Pardalotus striatus	striated pardalote				1						1		
Petroicidae					1	1					2		
Eopsaltria australis griseogularis	western yellow robin					1					1		
Eopsaltria georgiana	white-breasted robin				1						1		
Phalacrocoracidae					1						1		
Phalacrocorax melanoleucos	little pied cormorant				1						1		
Psittacidae					5	6	1		1	1	14		
Neophema elegans	elegant parrot				2						2		
Platycercus spurius	red-capped parrot				1	2					3		
Platycercus zonarius	Australian ringneck				2	4	1		1	1	9		
Rhipiduridae					9	9	4	4		1	27		
Rhipidura albiscapa	grey fantail				7	9	4	4		1	25		
Rhipidura leucophrys	willie wagtail				2						2		



		Conservation Status			Total Number of Individuals by Site								
Scientific Name	Common Name	EPBC	BC	DBCA	Other sampling sites/ Opportunistic	VSMB-01	VSMB-02	VSMB-03	VSMB-04	VSMB-05	Total		
Scolopacidae					2						2		
Numenius phaeopus	whimbrel				2						2		
Turnicidae							3				3		
Turnix varius	painted buttonquail						3				3		
Zosteropidae					22		7		1	6	36		
Zosterops lateralis	silvereye				22		7		1	6	36		
Reptiles					27	36	90	83	47	61	344		
Agamidae					1		2	1	1	1	6		
Pogona minor	western bearded dragon				1		2	1	1	1	6		
Elapidae					5					1	6		
Echiopsis curta	bardick				1						1		
Pseudonaja affinis					4					1	5		
Gekkonidae					3			1			4		
Christinus marmoratus	marbled gecko				3			1			4		
Pygopodidae					1					7	8		
Aprasia pulchella										5	5		
Delma hebesa	heath delma									2	2		
Pygopus lepidopodus	common scaly foot				1						1		
Scincidae					17	36	88	80	44	51	316		
Acritoscincus trilineatus						1	11	3		1	16		
Cryptoblepharus buchananii					1			1			2		
Ctenotus impar								1	13	13	27		
Ctenotus ora							8			2	10		
Egernia kingii	king skink				1				1		2		
Egernia napoleonis					4						4		
Hemiergis peronii					1	6	5		2		14		
Lerista elegans						12	37	15	1	13	78		
Menetia greyii								3		2	5		
Morethia lineoocellata					1	8	14	47	5	16	91		
Morethia obscura							1				1		
Tiliqua rugosa	bobtail				9	9	12	10	22	4	66		
Typhlopidae								1	2	1	4		
Anilios australis								1	2	1	4		
Amphibians					7	6	1	7		4	25		
Limnodynastidae					2	6	1	7		4	20		
Heleioporus eyrei	moaning frog				1	1		1		2	5		
Limnodynastes dorsalis	western banjo frog				1	5	1	6		2	15		
Pelodryadidae					5						5		
Litoria adelaidensis	slender tree frog				1						1		
Litoria moorei	motorbike frog				4						4		
Total					278	136	203	164	128	161	1070		





Appendix C APZ Plan



# LEGEND



APZ – Modified (Medium Modification)

Low Threat Veg. (Low Modification)





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