2016

CITY OF ROCKINGHAM

Lewington Reserve Management Plan

city of Rockingham

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Abbreviations

Abbreviation	Description
AS3959	Australian Standard 3959: Construction of Buildings in Bushfire-Prone Areas
BAL	Bushfire Attack Level
BMP	Bushfire Management Plan
BoM	Bureau of Meteorology
CR	Critically endangered
DAFWA	Department of Agriculture and Food
DBH	Diameter at breast height
DEC	Department of Environment and Conservation (now known as Department of Parks and Wildlife)
DER	Department of Environment Regulation
DFES	Department of Fire and Emergency Services
DotE	Department of the Environment (formerly known as Department of Sustainability, Environment, Water, Populations and Communities [SEWPaC])
DRF	Declared Rare Flora
ESA	Environmentally Sensitive Area
ELA	Eco Logical Australia
EN	Endangered
EPA	Environmental Protection Authority
EP Act	Environmental Protection Act 1986 (State)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Federal)
et al.	and others
FCT	Floristic Community Type
FESA	Fire and Emergency Services Authority
GDA	Geocentric Datum of Australia
GPS	Global Positioning System
Ha	Hectares
IA	Migratory species protected under international agreement
IBRA	Interim Biogeographical Regionalisation for Australia
km	Kilometres
m	Metres
mm	Millimetres
MA	Marine species listed under EPBC Act
MGA	Map Grid Australia
P	Priority flora or Priority fauna listed by Parks and Wildlife
Parks and Wildlife	The Department of Parks and Wildlife

Abbreviations (continued)

Abbreviation	Description
PBP	Planning for Bushfire Protection Guidelines
PEC	Priority Ecological Community
Q	Quadrat
RNE	Register of the National Estate
S	Specially protected fauna
SEWPaC	Department of Sustainability, Environment, Water, Populations and Communities (now known as Department of the Environment [DotE])
T	Threatened
TEC	Threatened Ecological Community
TPFL	Threatened and Priority Flora Database
VU	Vulnerable
WA	Western Australia
WAH	Western Australian Herbarium Database
WAPC	Western Australian Planning Commission
WC Act	Wildlife Conservation Act 1950 (WA State)
WoNS	Weed of National Significance

1.0
Introduction

1.0 Introduction

1.1 Background

The City recently undertook a strategic assessment of 21 natural areas under its direct management in order to prioritise the reserves based on their respective environmental values and ecological viability. From this review, the City's Reserve Prioritisation Report (2015) was developed which identified Lewington Reserve as a high priority for environmental management in order to improve the overall condition of native vegetation.

Lewington Reserve is a small area of bushland located in the suburb of Rockingham, approximately 37 km south of Perth. The reserve is bound by Victoria Street to the south, Lewington Street to the west, Patterson Road to the east and the East Rockingham suburb boundary to the north (**Figure 1**).

In this regard, Eco Logical Australia (ELA) were commissioned by the City to undertake a comprehensive environmental assessment of Lewington Reserve, including a Level 2 flora survey, Level 1 fauna survey, bushfire fuel load assessment and subsequent management recommendations to maximise conservation outcomes and inform future management.

1.2 Purpose

The purpose of this Management Plan is to provide direction for the ongoing use and management of the reserve, with a focus on enhancing the area for unstructured recreation, nature appreciation and conservation of flora and fauna.

1.3 Legislative framework

This survey has been undertaken to meet requirements under the Western Australian (WA) *Environmental Protection Act 1986* (EP Act) and the Commonwealth *Environment Protection* and *Biodiversity Conservation Act 1999* (EPBC Act). The survey is also consistent with the Western Australia (WA) Environmental Protection Authority (EPA) guidelines. The survey has been undertaken in accordance with the following guidelines:

- EPA Guidance Statement No. 51 - Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia
- EPA Guidance Statement No. 56 - Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia
- EPA Position Statement No. 3 - Terrestrial Biological Surveys as an Element of Biodiversity Protection
- EPA and Department of Environment and Conservation (DEC) Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment
- EPBC Act referral guidelines for Threatened Black Cockatoos (Department of Sustainability, Environment, Water, Population and Communities (SEWPAC 2012).

1.4 Objectives

The objectives of this study were to conduct a holistic environmental assessment of Lewington Reserve to collect desktop and field based data, and the subsequent preparation of a management plan. Specifically, the objectives of the environmental assessment were to:

- Identify and map vegetation type and condition
- Undertake a desktop assessment (flora, fauna, Aboriginal and European heritage, fire history, landform, soil, land tenure)
- Undertake a Level 2 flora, Level 1 fauna survey additionally incorporating target surveys for potentially occurring species and communities, and provide associated recommendations for managing the ecological values identified and mapped
- Weed and feral fauna assessment and mapping, including control recommendations
- Carnaby's Cockatoo foraging and breeding habitat assessment
- Assessment and mapping of priority areas for revegetation including advice on appropriate plant species
- Undertake a bushfire risk assessment that includes fuel load assessment, fire hazard zones, and existing fire break suitability
- Review reserve access management including fencing and access control
- Review options for access track consolidation and closure
- Review reserve signage such as condition, location, interpretive function
- Assess land tenure for surrounding remnant bushland, and potential impacts on adjacent land, including management recommendations
- Identify opportunities to improve unstructured recreation.

FIGURE 1 - Study area location

Legend

- Study Area
- Tracks

N

0 50 100 200

Metres

2.0
Desktop review

2.0 Desktop review

2.1 Study area

Lewington Reserve (the study area) is 23.5 hectares (ha) in size, situated within coastal dunes to the east of Rockingham, approximately 37 km south of Perth (**Figure 1**). The reserve largely encompasses remnant bushland with a recreational area located in the south west of the site which includes a grassed Parkland area with a small playground.

The bushland of the study area has been disturbed in the past and includes previously cleared areas, previously rehabilitated areas and an old railway track. The study area supports coastal shrubland vegetation with patches of *Eucalyptus gomphocephala* (Tuart) and weed infestations are present throughout (City of Rockingham 2015).

2.1.1 Tenure

The study area is a Crown Reserve (No. 45509) which is managed by the City of Rockingham (**Figure 2**). The Baptist Church youth holiday camp lies to the north of the study area on Crown Reserve 22719 (Crown Lease 333-540; **Figure 2**). In addition, two public road reserves run through the study area. The study area is bordered by several public roads and a strip of unallocated crown land runs along the eastern boundary.

2.1.1.1 Proposed Kwinana Rail Loop

The Department of Transport is currently requesting an amendment to the Metropolitan Region Scheme (MRS) to reinstate a Railway Reservation through East Rockingham, as per an alignment which was originally deleted from the MRS in 1996. The requested amendment will facilitate the State Government's proposed extension to the existing Midland-Kwinana heavy freight railway, which will cross Patterson Road, Ennis Avenue, Day Road and Mandurah Road, in addition to intersecting the conservation area adjoining Lewington Reserve. The Railway Reservation on which the proposed extension is to be constructed can be seen abutting the eastern reserve boundary in Figure 2.

Although the City has noted its objection to the proposal, if the State Government proceeds with the amendment it will have significant implications on the ecological viability and recreational capacity of Lewington Reserve.

However, as the future of the proposal is unknown, this Plan addresses only the current environmental considerations for Lewington Reserve. The management of specific impacts relating to the proposed freight rail construction should be addressed if/when they arise.

2.1.2 Bioregion

The Interim Biogeographical Regionalisation for Australia (IBRA) Version 7 recognises 89 geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information. The 89 bioregions are further refined into 419 subregions which are more localised and homogenous geomorphological units in each bioregion (Department of the Environment [DotE] 2015a).

The study area lies within the Perth subregion of the Swan Coastal Plain bioregion, which is a low lying coastal plain mainly covered in woodlands (DotE 2015a). The Perth subregion is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbarks in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The outwash plains, once dominated by C. *obesa*, *Corymbia calophylla* (Marri) woodlands and *Melaleuca* shrublands, are only found extensively in the south. The Perth subregion covers an area of 1,333,901 ha (Mitchell et al. 2002).

2.1.3 Landform and soils

The study area is dominated by the Quindalup dune system which is a relatively recent landform comprising marine sands and Aeolian (wind-blown) soils. Aeolian soils are relatively young, having been laid down relatively recently. The Quindalup dunes are underlain by the Safety Bay sand formation which comprises calcareous soils derived from Tamala limestone (Semeniuk 1989) (**Figure 3**).

For the majority of the Swan Coastal Plain, the Quindalup dune system occurs as a thin stretch adjacent to the ocean; however in the City of Rockingham the dunes form a wide plain known as the Rockingham – Becher Plain (Semeniuk 1989). This plain consists of a series of multiple, parallel, linear sand-ridges that are stranded former beach ridges, providing an important example of Holocene sedimentation and stratigraphic evolution (City of Rockingham 2015).

FIGURE 2 - Tenure of the study area and surrounds

Legend

Study Area

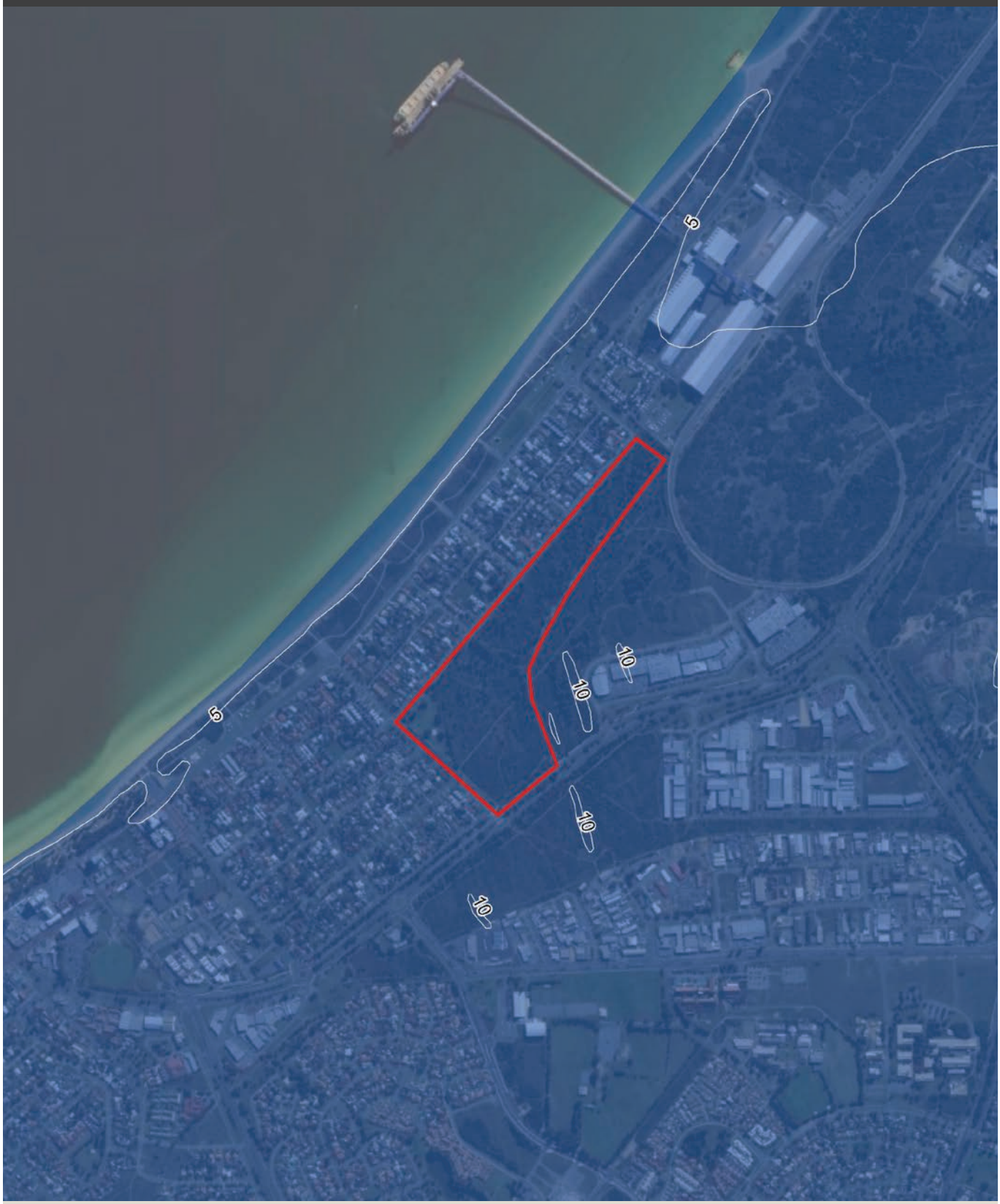
Tenure

N

0 50 100 200

Metres

FIGURE 3 - Landforms of the study area



Legend

- Study Area
- Contour (5m Intervals)

Geology

- Quindalup Dunes (Safety Bay Sand)

0 50 100 200
Metres

N

2.1.4 Vegetation

Regional vegetation has been mapped by Heddle et al. (1980) based on major geomorphic units on the Swan Coastal Plain. Heddle et al. (1980) mapping indicates that the study area occurs within the Quindalup complex.

The Quindalup complex is a coastal dune complex consisting mainly of two alliances – the strand and foredune alliance, and the mobile and stable dune alliance. Local variations include the low closed forest of *Melaleuca lanceolata – Callitris preissii* and the closed scrub of *Acacia rostellifera* (Heddle et al. 1980).

Vegetation type and extent has also been mapped at a regional scale by Beard (1975) who categorised vegetation into broad vegetation associations. Based on Beard's mapping at a scale of 1:1,000,000, the Department of Agriculture and Food WA (DAFWA) has compiled a list of the types and extent of vegetation associations across WA (Shepherd et al. 2001). The study area is situated on vegetation association 3048, described as 'Shrublands: scrub-heath on the Swan Coastal Plain',' (**Table 1**).

Two vegetation units have previously been described as occurring within the study area (City of Rockingham 2015; **Table 2**). These comprise *Eucalyptus gomphocephala* woodland over mixed shrubland and *Acacia rostellifera* shrubland.

Table 1: Beard's mapping units occurring within the study area

Beard's mapping unit (Shepherd association)	Shrublands; scrub-heath on the Swan Coastal Plain
Mapping unit description	Shrublands; scrub-heath on the Swan Coastal Plain
Extent within the study area (ha)	18.6
Current pre-European extent remaining in Swan Coastal Plain bioregion (Government of WA 2014)	30.2% (3147.97 ha)
Proportion of total extent remaining within study area	0.6%

Table 2: Vegetation units within the study area

Eucalyptus gomphocephala woodland over mixed shrubland	Woodland of *Eucalyptus gomphocephala* over tall open shrubland of *Acacia rostellifera* over open shrubland of *Schinus terebinthifolius, Melaleuca lanceolata, Olearia axillaris* over very open shrubland of *Xanthorrhoea preissii, Acacia lasiocarpa* over very open herbland of *Euphorbia terracina, *Asparagus asparagoides* over grassland of **Ehrharta calycinus, *Avena barbata, *Bromus diandrus.*
Acacia rostellifera shrubland	Tall open scrub of *Acacia rostellifera* over open shrubland of *Spyridium globulosum, Agonis flexuosa* over very open sedgeland of *Dianella revoluta, Lomandra maritima* over grassland of **Avena barbata *Lagurus ovatus*, over very open herbland of **Euphorbia terracina, Conostylis aculeata, Clematis linearifolia.*

2.1.5 Conservation Areas and Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are defined in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005 under section 51B of the EP Act. ESAs include areas declared as World Heritage, included on the Register of the National Estate defined wetlands, and vegetation containing rare (Threatened) flora, Threatened Ecological Communities (TECs) and Bush Forever sites.

There are no known records of Threatened flora or Bush Forever sites within the study area. Two TECs have previously been associated with the study area (City of Rockingham 2015).

Callitris preissii and *Melaleuca lanceolata* trees have previously been recorded within the study area and it is considered likely that the TEC '*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain' may have previously occurred here (City of Rockingham 2015). However, this vegetation is now largely degraded and as such this TEC is considered unlikely to occur (**Table 3**).

The TEC 'Sedgelands in Holocene dune swales of the southern Swan Coastal Plain (Swan Coastal Plain [SCP] 19)' was previously considered likely to occur within the study area in a degraded form, by the then Department of Environment and Conservation (DEC 2011). Due to the degraded nature of the study area, it is unlikely that this TEC occurs within the study area (**Table 3**).

In addition, the TEC 'Stromatolite like microbialite community of coastal freshwater lakes' at Lake Richmond occurs approximately 3 km west of the study area. This TEC only occurs in association with coastal freshwater lakes and as such does not occur within the study area (**Table 3**).

Table 3: Summary of Threatened Ecological Communities within or adjacent to the study area (Parks and Wildlife 2015a)

Community name	Community identifier	TEC/ PEC	Status		Likelihood of occurrence
			EPBC Act	EP Act	
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	SCP19	TEC	Endangered	Critically Endangered	*Unlikely*
Callitris preissii (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain	SCP30a	TEC	Not listed	Vulnerable	*Unlikely* (City of Rockingham 2015).
Stromatolite like microbialite community of coastal freshwater lakes	Richmond-microbial	TEC	Critically Endangered	Critically Endangered	*No*

2.1.6 Priority Ecological Communities

Priority Ecological Communities (PECs) are biological flora or fauna communities that are recognised to be of significance, but do not meet the criteria for a TEC. There are five categories of PECs, none of which are currently protected under legislation (see **Appendix A**). The latest listing of PECs recognises 31 PECs for the Swan bioregion (Department of Parks and Wildlife [Parks and Wildlife] 2015b).

There are no PECs mapped within 5 km of the study area and none of the vegetation units identified within the study area are listed as PECs or were inferred to be representative of a PEC.

2.1.7 Heritage

Aboriginal heritage

The Rockingham area has long been occupied by the Aboriginal Nyungar people. The area holds significance to the traditional owners and many sacred sites occur within the region (City of Rockingham 2015).

In Western Australia, the *Aboriginal Heritage Act 1972* protects places and objects customarily used by, or traditional to, the original inhabitants of Australia. A register of such places and objects is maintained under the Act, however, all sites are protected under the Act whether they have been entered on the register or not.

In Western Australia the Department of Aboriginal Affairs (DAA) manages the online Aboriginal Heritage Inquiry System, which identifies any registered Nyungar heritage sites within the vicinity of the search area. A search of this database determined that there are no Aboriginal heritage sites within or in close proximity to the study area.

European heritage

The Heritage Council and State Heritage Office manage an online database called InHerit. InHerit contains comprehensive information about cultural heritage places listed in the State Register of Heritage Places, local government inventories and other lists, the Australian Government's heritage list, and other non-government lists and surveys. A search of this database confirmed there are no European heritage sites within the study area (Heritage Council and State Heritage Office 2015).

2.1.8 Land use and threatening processes

The study area has historically been subject to a variety of land uses including farming, settlements and rail, but is now primarily used for conservation and recreation. Lawn and a children's playground can be found in the south west corner of the study area. Other unstructured recreational activities within the study area include dog walking, nature appreciation, as well as some unauthorised activities such as off-road dirt biking.

The study area is subject to a number of degrading processes which affect the overall functioning of the ecosystem, the productivity of the study area and the availability of foraging material for fauna. The main threat to the study area is from weeds, but other threats include:

- Feral animals
- Vandalism of infrastructure
- Trampling of vegetation
- Rubbish
- Off road vehicles and bikes
- Fire
- Disease.

2.1.9 Fire history

Historical information of fire occurrence has not been found for the study area. However, site inspections suggest that fires have been of low frequency over relatively small patches that have not posed risks to nearby homes or infrastructure. Ignition sources have been from road verge fires likely to be caused by cigarette butts thrown from vehicles or from pedestrians.

2.2 Database searches

The following Commonwealth and State databases were searched for information relating to conservation significant flora, ecological communities and fauna in order to compile and summarise existing data and use this to inform the focus of the field survey:

- Commonwealth EPBC Act Protected Matters search tool (DotE 2014b)
- Parks and Wildlife and Western Australian Museum's NatureMap online flora and fauna database (Parks and Wildlife 2015c).

Conservation codes, categories and criteria for flora and fauna protected under the Commonwealth EPBC Act and State WC Act can be found in **Appendix A**.

2.2.1 Conservation significant flora

Specific criteria were used to assess the likelihood of occurrence of conservation significant flora potentially occurring in the study area. The likelihood of occurrence assessment was based on the species matching the criteria described in **Appendix B**.

No conservation listed flora species have been previously recorded in the study area. An initial twenty-two conservation listed flora species were identified as possibly occurring based on the database searches and literature review. Of these, 10 species were considered to potentially occur, all of which are listed as Priority (P) species by Parks and Wildlife.
These include:

- *Cardamine paucijuga* (P2)
- *Beyeria cinerea* subsp. *cinerea* (P3)
- *Calandrinia oraria* (P3)
- *Lasiopetalum membranaceum* (P3)
- *Pimelea calcicola* (P3)
- *Sphaerolobium calcicola* (P3)
- *Conostylis pauciflora* subsp. *pauciflora* (P4)
- *Dodonaea hackettiana* (P4)
- *Jacksonia sericea* (P4)
- *Lepidium puberulum* (P4).

A full list of possibly occurring conservation listed flora species, including those that are considered unlikely to occur, is presented in **Appendix C**.

2.2.2 Conservation significant fauna

Specific criteria were used to assess the likelihood of occurrence of conservation significant fauna, based on the species matching the criteria described in **Appendix B**.

Based on the database searches, three species of fauna are considered likely to occur within the study area, based on close proximity of previous records and the likely occurrence of suitable habitat within the study area. These include:

- *Calyptorhynchus latirostris* (Carnaby's Cockatoo): listed as Vulnerable under the EPBC and WC Act
- *Merops ornatus* (Rainbow Bee-eater) listed as Migratory under the EPBC Act and WC Act
- *Lerista lineata* (Perth Slider; Lined Skink) listed as Priority 3 by Parks and Wildlife.

Nine species were identified as potentially occurring within the study area including:

- *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo) – listed as Vulnerable under the EPBC and WC Act
- C*alyptorhynchus baudinii* (Baudin's Cockatoo) – listed as Vulnerable under the EPBC Act and Endangered under the WC Act
- *Dasyurus geoffroii* (Chuditch, Western Quoll) - listed as Vulnerable under the EPBC and WC Act
- *Apus pacificus* (Fork-tailed Swift) – listed as Migratory under the EPBC and WC Act
- *Ardea ibis* (Cattle Egret) - listed as Migratory under the EPBC and WC Act
- *Ardea modesta* (Eastern Great Egret) - listed as Migratory under the EPBC and WC Act
- *Neelaps calonotos* (Black-striped Snake) – listed as Priority 3 by Parks and Wildlife
- *Synemon gratiosa* (Graceful Sun Moth) – listed as Priority 4 by Parks and Wildlife
- *Isoodon obesulus fusciventer* (Quenda, Southern Brown Bandicoot) – listed as Priority 5 by Parks and Wildlife.

A full list of possibly occurring conservation listed fauna species, including those that are considered unlikely to occur, is presented in **Appendix D**.

3.0
Methodology

3.0 Methodology

3.1 Survey team and survey timing

The field survey was conducted over three days from 9 to 11 September 2015 by two experienced field ecologists. **Table 4** below presents the survey team's qualifications, experience and relevant licences held.

There was 5.2 mm of rainfall recorded during the three day survey, and a total of 256.4 mm of rainfall was received in the three months prior to the survey (BoM 2015). This is below the long-term average for the period June to August (315.5 mm), however is considered suitable for flora survey timing.

Table 4: Survey team

Name	Katrina Zeehandelaar-Adams	Sarah Dalgleish
Qualification	BSc Conservation Biology and Management	BSc Environmental Management (Hons)
Relevant Experience	Experience undertaking Black Cockatoo habitat assessments, Level 1, Level 2 and targeted flora and fauna surveys throughout the Swan Coastal Plain biogeographic region.	Experience undertaking Black Cockatoo habitat assessments, Level 1, Level 2 and targeted flora surveys throughout the Swan Coastal Plain biogeographic region.
Licence Numbers	Flora scientific collection Licence No. SL011392 DRF collection licence No.33-1213	Flora scientific collection Licence No. SL011393 DRF collection licence No.15-1516

3.2 Level 2 flora survey

The Level 2 flora survey was undertaken in accordance with methodology outlined in EPA Guidance Statement No. 51 (EPA 2004a) and EPA Position Statement No. 3 (EPA 2002).

3.2.1 Vegetation communities and condition

Broad-scale vegetation communities were mapped by studying aerial imagery prior to the survey and ground-truthing these values in conjunction with the targeted survey. The overall condition of the vegetation communities present on site was also noted during the survey in accordance with the Keighery Bush Forever condition scale (Government of Western Australia 2000). In addition, the presence of any disease such as dieback was noted.

The vegetation community survey was undertaken by setting up eight 10 m x 10 m quadrats (**Figure 4**). The requirements were to establish two quadrats per vegetation community, however ELA set up eight quadrats throughout the study area to identify the two to three different vegetation types. The following data was recorded:

- Vegetation structure classes, cover of all species observed in quadrats and dominant species lists for each vegetation community in accordance with Keighery (1994)
- Full species inventory (angiosperm and gymnosperm) of both native and introduced species across the study area
- Vegetation condition assessment in accordance with the Bush Forever: Volume 2 Directory of Bush Forever Sites
- Other observational data such as abiotic/ environmental variables.

3.2.2 Conservation listed flora, communities and weeds

A targeted survey was completed within the study area for conservation listed flora, communities and weeds including:

- Threatened Flora listed under the EPBC Act
- Threatened (Declared Rare) Flora listed under the latest WA Wildlife Conservation (Rare Flora) Notice
- Priority Flora recognised by Parks and Wildlife
- Introduced weed species, including the following targeted species:
  - **Asparagus asparagoides*
  - **Agave americana*
  - **Gomphocarpus fruticosus*
  - **Pelargonium capitatum*
  - **Dimorphotheca ecklonis*
  - **Leptospermum laevigatum*

The survey methodology involved personnel walking meandering transects across the study area. Each person searched the study area for conservation listed flora and weed species as well as outside the study area boundary if required. The locations of ELA transects in the study area are shown in (**Figure 4**).

Where critical habitat for the targeted species was identified or when individuals of significant flora were encountered, the inspection effort was intensified to search the habitat more thoroughly, or to map the local population in more detail. This involved searching in a closer walking pattern to search critical habitat or to map the population systemically. If a population extended outside the study area, the extent was mapped up to approximately 100 to 150 m from the polygon boundary.

Any encountered conservation listed flora was recorded by taking a point location using an Android Nexus 7 tablet of each individual and/or a centroid location for a group of individuals. The software used to collect the point data was the ArcGIS Collector app developed by Environmental Systems Research Institute.

In addition to point locations, the following data were collected for any conservation listed species identified in the study area:

- Number of individuals and/or percentage coverage (recording a range of co-ordinates if necessary)
- Estimates were made for groups of individuals within a 20 m radius and for large populations to record a significant area polygon.
- Reproductive phase (flowering, fruiting etc.)
- Description of dominant vegetation unit in which the species is located
- Associated dominant species
- Photograph of the plant *in situ*
- Except where specifically noted, the field survey was undertaken using Android Nexus 7 tablet operating the ArcGIS Collector app. These units can have errors of 3-20 m (subject to availability of satellites on the day) with an average of +/- 5 m.

The detailed weed survey was completed in conjunction with the conservation listed flora and communities survey. This included pest plants, priority weeds, declared pest plants and weeds of national significance (WoNS). Particular focus was made along the boundaries of the study area, along tracks and other areas of increased disturbance, and potential for edge effects relevant to adjacent bushland areas.

When encountered, mapping of weeds was undertaken using "point" or "density" mapping, or a combination of both. Where density mapping was used, four density categories will be used: < 5%, 6 – 30%, 31 – 60% and > 61% cover for each species. Weed mapping was broken down according to type of weed: target species, grassy weeds, bulbous weeds, woody weeds and other weeds.

3.2.3 Floristic Community Type (FCT) analysis

To determine the likely Floristic Community Type (FCT) of the vegetation communities, statistical analysis is typically undertaken to allow comparisons between Gibson et al. (1994) and ELA quadrats based on species presence/absence. This process analyses the entire dataset using a hierarchical cluster analysis. Due to the highly degraded nature of the study area (e.g. high levels of weed cover, revegetation throughout and low native species diversity), a statistical FCT analysis was not considered valuable as degraded/modified sites do not produce a statistically conclusive result when compared with Gibson et al. (1994) FCT quadrats. If the FCT analysis was undertaken, it is highly likely the ELA quadrats would cluster to a large number of Gibson quadrats (e.g. over 70 quadrats) across many different FCT's, at a low percent similarity, thus not providing a reasonable outcome to allow for determination of potential FCT's.

As the study area is degraded, contains historic revegetation throughout, and a low number of native species, it is also considered unproductive to determine the likely FCT's using a more qualitative approach. For these reasons an FCT analysis was not undertaken for the study area.

3.2.4 Specimen identification and nomenclature

Nomenclature used for the flora species within this report follows the Western Australian Plant Census as available on FloraBase (Western Australian Herbarium [WAH] 2015). Voucher specimens were collected in the field of all actual or potential conservation listed flora species. Collections were made of other species, if required, that commonly occur in the habitat of the conservation listed species to enable correct identification. All collections were assigned a unique collecting number.

Specimen identification was undertaken by ELA Senior Botanist Joel Collins and ELA Botanist Sarah Dalgleish. Species identification utilised taxonomic literature and keys with all specimens confirmed using the WAH reference collection. Relevant specimens were confirmed by taxonomic specialists where required. Suitable material that meets WAH specimen lodgement requirements, such as flowering material and range extensions will be submitted, along with Threatened and Priority Report forms to Parks and Wildlife, as required by conditions of collection licences issued under the WC Act.

3.3 Level 1 fauna survey

The Level 1 fauna survey was undertaken in accordance with EPA Guidance Statement 56 (EPA 2004b) and EPA Position Statement No. 3 (EPA 2002).

The Level 1 fauna survey consisted of the following tasks:

- Direct observations of active fauna (birds, reptiles, mammals)
- Opportunistic searching for and identification of fauna based on activity signs such as scats, diggings, tracks
- Opportunistic hand searching for inactive fauna beneath surface debris (leaf litter, logs and other suitable shelter sites)
- Opportunistic observations and identification of active fauna (birds, reptiles, mammals)
- Comprehensive assessment and mapping of Black Cockatoo habitat including:
    - foraging plant recording species and quality
    - presence of feeding signs (foraging residue) e.g. chewed banksia cones
    - potential nest trees recording tree species, DBH, hollow presence/suitability
- Searching for occurrence of any other relevant declared threatened, specially protected, priority or EPBC listed fauna such as Rainbow Bee-eater
- Assessment for Graceful Sun Moth habitat (*Lomandra maritima*)
- Mapping of key pest fauna locations such as bee hives, fox warrens and rabbit warrens.

Figure 4 shows the locations of all fauna sampling locations.

3.3.1 Black Cockatoo habitat assessment

The purpose of this assessment was to qualify and quantify foraging, roosting and potential breeding habitat values for Black Cockatoo species listed under the EPBC Act. This primarily focused on *Calyptorhynchus latirostris* (Carnaby's Black Cockatoo). The assessment was carried out in line with the referral guidelines for threatened Black Cockatoo species (SEWPaC 2012).

Assessment of Black Cockatoo foraging habitat

Potential Black Cockatoo foraging habitat was assessed based on presence of foraging species in addition to foraging evidence such as chewed nuts or cones. The assessment was based on the foraging plant species used by Carnaby's Cockatoo (SEWPaC 2012). Feeding residue detected was recorded as waypoint locations and representative photos taken. However, the assessment and mapping of potential foraging habitat values was made primarily on the basis of presence of known Black Cockatoo food plants as outlined in the EPBC Act referral guidelines (SEWPaC 2012). Feeding residue presence provides an indication of the recent extent of usage of the study area by Black Cockatoos, and can support assessment of foraging resources.

Assessment of Black Cockatoo breeding habitat

The study area was searched for the presence of locally occurring potential breeding tree species, namely *Eucalyptus marginata* (Jarrah), *Corymbia calophylla* (Marri), *Eucalyptus gomphocephala* (Tuart) and *Eucalyptus grandis* (Flooded Gum) as outlined in the EPBC Act referral guidelines (SEWPaC 2012) Where detected, the trees were assessed for trunk diameter at breast height (DBH). Trees with a DBH greater than 50 centimetres were recorded and visually inspected for presence of potential breeding hollows. Where potential breeding trees were detected the following data for breeding resources was recorded:

- Global Positioning System (GPS) location
- Tree species
- Presence and type of hollows (branch, spout, trunk)
- Presence of chew marks around hollow entrance (indicating possible nesting activity)
- Presence of hollow competitors (e.g. European Honeybees, Galahs, Corellas).

It should be noted that in assessing potential breeding habitat for Black Cockatoos, the tree diameter measurement is recognized as a reliable and precise measurement, whereas the visual detection of actual hollows is known to be unreliable, particularly via ground based assessment. However, the Department of the Environment (DotE) considers that all trees with DBH greater than 50 cm have the potential to form hollows suitable for Black Cockatoo nesting. This takes into consideration medium term changes in breeding patterns of Carnaby's Black Cockatoo (SEWPaC 2012).

Assessment of Black Cockatoo roosting habitat

The study area was assessed for potential night roosting habitat for Black Cockatoos as outlined in the EPBC Act referral guidelines (SEWPaC 2012). According to the guidelines, roost sites are generally characterised by having tall Eucalyptus or non-native canopy trees that are often higher than surrounding vegetation, usually located adjacent to fresh water, and usually situated in proximity to foraging habitat. Areas of potential roosting habitat were recorded where present.

3.3.2 Other conservation significant fauna

During the survey, all other conservation significant fauna observations were noted opportunistically. This included any habitat, signs of activity or species listed under the State WC Act, or Commonwealth EPBC Act.

Graceful Sun Moth habitat assessment

The study area was assessed for the presence of *Lomandra maritima* – a host plant species for the Graceful Sun Moth, which is listed as Priority 4 by Parks and Wildlife. This was undertaken in conjunction with the flora/fauna survey by walking transects across the study area and recording areas of *Lomandra maritima*.

3.3.3 Opportunistic fauna observations

Fauna observations were recorded opportunistically throughout the survey. These included visual sightings of active fauna such as reptiles, birds, bird calls, and signs of species presence such as burrows and scats of mammals and reptiles. Evidence of key pest fauna locations such as bee hives, fox warrens and rabbit warrens was also recorded.

Active searches for any declared threatened, specially protected, priority or EPBC listed fauna was undertaken in areas of preferred habitat.

FIGURE 4 - Survey sampling locations

Legend

- Study Area
- Bushfire Risk Assessment Locations
- Flora Sampling Locations (quadrats)
- Flora & Fauna Sampling Locations (transects)

N

0 50 100 200

Metres

3.0 Methodology (continued)

3.4 Bushfire risk assessment

The bushfire risk assessment was undertaken in accordance with the principles outlined in the Planning for Bushfire Protection Guidelines ([PBP]; PBP 2010) and Australian Standard 3959 Construction of Buildings in Bushfire-Prone Areas (AS3959) (Standards Australia 2009).

During the three day survey, data was collected based on the Department of Fire and Emergency Services (DFES) visual fuel load guide relevant to vegetation of the Swan Coastal Plain (DFES 2015). The following data were recorded:

- Bushfire fuel loads (tonnes per hectare). Data collected included leaf litter depth, 1 x 1 m quadrat and wide view photos
- Adequate replicates for each fuel load assessment taken in each representative vegetation community based on the Australian Fuel Classification: Stage 2 (Gould and Cruz 2012)
- Suitability of fire breaks. Data collected to include firebreak location, condition and width.

The bushfire fuel load sampling sites are shown in **Figure 4**.

Bushfire fuel load assessment

An assessment of bushfire fuel loads within the study area was undertaken to produce a bushfire hazard map which provides an indication of the current fuel accumulation within the study area. This information may also provide a baseline upon which future fuel management decisions can be accurately based.

Bushfire fuel is the vegetative material in the landscape that burns during a bushfire or prescribed burn. Bushfire behaviour is influenced by fuel load and the availability of the fuel, which is determined by fuel arrangement and moisture content. Seven different strata of fuels are described below and presented in **Figure 5**. Each stratum contributes to fire behaviour in different ways. In essence, fine fuels burn more rapidly than larger fuels and well aerated fuels burn more readily than compacted fuels.

Bushfire Hazard Zones

Using the bushfire fuel load assessment, bushfire hazard zones were defined across the study area. Bushfire hazard zones were classified into three categories based on different vegetation characteristics: low, moderate and high (**Table 5**).

Suitability of fire breaks

During the flora/fauna survey, the location, condition and width of firebreaks present within the study area was recorded. Aerial imagery was also studied to further provide data on fire breaks.

FIGURE 5 - An indication of different fuel strata

Table 5: Bushfire hazard level category characteristics*

Category	Characteristic
Low	• Areas devoid of standing native vegetation (less than 0.25 ha cumulative area) • Inner urban or suburban areas with maintained gardens and very limited native standing vegetation (less than 0.25 ha cumulative area) • Pasture or cropping areas with very limited native standing vegetation that is a shrubland, woodland or forest • Generally areas with slopes of less than 10 degrees
Moderate	• Areas with slopes in excess of 10 degrees • Open woodlands • Open shrublands • Low shrubs with slopes of less than 10 degrees or flat land • Suburban areas with some native tree cover
High	• Forests • Woodlands • Tall shrubs • Any area not otherwise categorised as low or moderate

* Table adapted from WAPC/FESA (2010)

3.5 Site infrastructure

During the survey the various types of infrastructure present were recorded. Specifically, the following data was collected:

- Fencing suitability and effectiveness. Data collected included fence type, location and condition.
- Areas suitable for potential revegetation. Data collected included location, vegetation condition, characteristics of adjacent vegetation, weeds present, dieback or other pathogens and occurrence of rubbish, fire history, slope, aspect and soil type.
- Vehicle tracks with consideration for track consolidation and closure were recorded throughout the site. Data collected included track location, condition and erosion if present.
- Existing signage was recorded. Data collected included signage condition, location, and interpretive function.

3.6 Survey limitations

EPA Guidance Statements 51 (EPA 2004a) and 56 (EPA 2004b) recommend including discussion of the constraints and limitations of the survey methods used. Constraints and limitations for the environmental assessment of the study area are summarised in **Table 6**.

Table 6: Survey limitations of the environmental assessment

Factor	Limitations
Sources of information	The Swan Coastal Plain has been relatively well surveyed. Numerous flora and fauna surveys have been undertaken in the wider area. Database searches provide adequate information about Threatened and Priority flora and fauna, TECs and PECs.
Scope of works	The scope of works provided adequate detail to achieve the survey objectives.
Completeness of survey	The survey requirements of a Level 2 flora and Level 1 fauna assessment were adequately met. Transect sampling was undertaken to effectively search for threatened and priority flora.Flora quadrats were established to identify vegetation communities. Habitat assessment was conducted to effectively determine likelihood of occurrence of the relevant conservation significant flora and fauna species.
Intensity of survey	The survey effort was satisfactory for a Level 2 flora, Level 1 fauna and targeted flora survey and with consideration for the size and location of the study area as per Guidance Statement No. 51 and SEWPaC 2012.
Timing, weather, season, cycle	The survey was undertaken during spring when flora species are flowering and more easily detectable. The timing of the survey was appropriate for a targeted flora survey and in accordance with EPA Guidance Statement 51.
Disturbances	There were high indications of disturbances within the study area, including fires, human activity, historically previously cleared areas, and weeds were widespread throughout the study area.
Resources	The botanist and ecologist undertaking the surveys were suitably qualified to identify specimens, assess habitat, and detect species in their respective fields. Suitably qualified bushfire consultants assisted with the bushfire risk assessment component.
Accessibility	All relevant areas in the study area were easily accessed and surveyed on foot.

4.0
Results and Discussion

4.0 Results and Discussion

4.1 Flora of the study area

A total of 68 vascular plant species from 30 families were recorded from the study area (**Appendix E**). This total included 27 (40% of the total) native species and 41 (60%) introduced species.

The mean species richness for quadrats sampled was 16.3 species per quadrat (ranging between 14 -19 species/ quadrat). The species matrix by cover is presented in **Appendix F**. Quadrat data is provided in **Appendix G**.

4.1.1 Conservation significant flora recorded during the field survey

Following the field survey, the likelihood of occurrence ratings of conservation listed flora species identified in the desktop assessment were revised, to provide a more accurate reflection of the possibility of these species occurring, based on current habitat and condition within the study area (**Appendix C**).

No conservation significant flora was recorded in the study area despite the entire study area being thoroughly surveyed. Following the survey, the likelihood of occurrence for all the potentially occurring flora species was reduced to Unlikely (**Appendix C**). This was largely due to the highly degraded nature of the study area and the occurrence and distribution of introduced flora species.

4.1.2 Introduced flora occurring within the study area

A total of 41 introduced flora (weed) species were recorded within the study area (**Table 7**). The locations of these species are shown in **Figure 6**, **Figure 7**, **Figure 8**, **Figure 9** and **Figure 10**, and presented in **Appendix H**. Photographs of each species are presented in **Table 7**.

The extent and locations of the targeted weed species is shown in **Figure 6**.

All six target weed species were recorded in the study area. **Asparagus asparagoides* was recorded extensively throughout the study area with cover between 6-30% (**Figure 6**). **Asparagus asparagoides* has been assessed as a Weed of National Significance (WoNS) under the Australian Government and is also a declared pest under the *Biosecurity* and *Agriculture Management Act 2007* (Department of Agriculture and Food 2015).

Gomphocarpus fruticosus* is also a declared pest species (Department of Agriculture and Food 2015). One individual **Gomphocarpus fruticosus* plant was recorded (Figure 6**).

The control category of both declared pest species is C3 management (Department of Agriculture and Food 2015), which includes requirements such as:

- Prohibiting the introduction and/or supply of this pest into an area
- Infestations must be managed
- Persons undertaking work in an infested area must be aware of control measures.

Parks and Wildlife have prioritised environmental weeds in each of the Parks and Wildlife regions based on attributes such as invasiveness, current distribution and feasibility of control (Parks and Wildlife 2013). One weed species listed as high priority by Parks and Wildlife was recorded within the study area: **Leptospermum laevigatum*. This species is a weed of coastal sand dunes, cliffs and coastal heathlands in temperate and sub-tropical regions. The species is likely to suppress growth and regeneration of indigenous plant species and has the potential to change ecosystem structure and function. The species was recorded from the south-west portion of the study area with less than 5% cover (**Figure 6**).

A further three targeted weed species were found within the study area. These included: **Agave americana*, **Pelargonium capitatum* and **Dimorphotheca ecklonis* (**Figure 6**). Cover for all species was less than 5% with infestations found in multiple locations.

Additional species of note were non-targeted weed species that were widespread throughout the entire study area, with cover ranging from 6% to 30% including:

- **Avena barbata* (**Figure 7**)
- **Oxalis pes-caprae* (**Figure 10**)
- **Rhamnus alaternus* (**Figure 9**)
- **Sonchus oleraceus* (**Figure 10**).

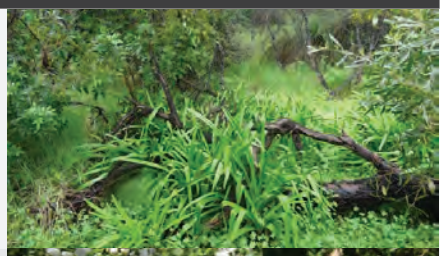
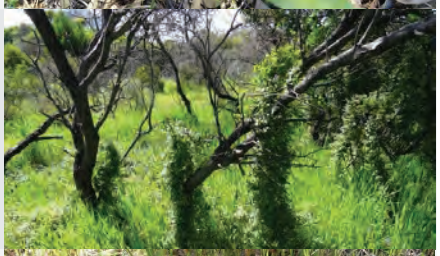
In addition, two individual **Schinus terebinthifolius* street trees were recorded within the Parkland in the south-west and south-east of the study area (**Figure 9**). These plants have the potential to disperse seed throughout the reserve, continuing to hinder eradication efforts, and therefore should be removed.

Melaleuca nesophila* was also recorded at seven locations throughout the study area with the number of plants at locations ranging from single individuals up to 50 plants (Figure 9**).

The remaining weed species recorded were found in low densities and are not considered as a priority for management including:

- **Bromus diandrus*
- **Ehrharta longiflora*
- **Euphorbia terracina*
- **Fumaria capreolata*
- **Lagurus ovatus*
- **Lysimachia arvensis*
- **Romulea rosea.*

TABLE 7 - Introduced flora species recorded in study area

Name	Species and common name	Photograph
Agapanthaceae	**Agapanthus praecox* Agapanthus	
Alliaceae	**Allium triquetrum* Three-cornered Garlic	
Anacardiaceae	**Schinus terebinthifolius* Brazilian Pepper/Broad-leaved Pepper Tree	
Apocynaceae	**Gomphocarpus fruticosus*[1] Narrowleaf Cottonbush	
Asparagaceae	**Agave americana* Century Plant	
Asparagaceae	**Asparagus asparagoides* Bridal Creeper	
Asphodelaceae	**Asphodelus fistulosus* Onion Weed	

4.0 Results and Discussion (continued)

TABLE 7 - Introduced flora species recorded in study area

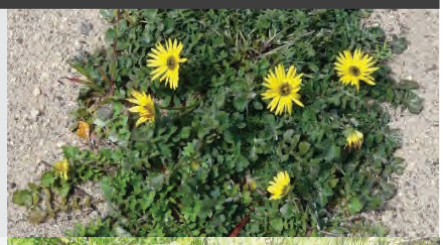
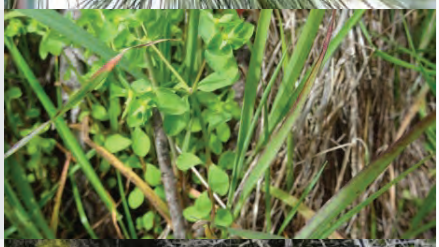
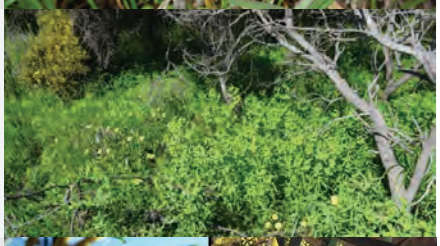
Name	Species and common name	Photograph
Asteraceae	**Arctotheca calendula* Cape Weed	
Asteraceae	**Dimorphotheca ecklonis*	
Asteraceae	**Hypochaeris radicata* Flat Weed	
Asteraceae	**Senecio vulgaris* Common Groundsel	
Asteraceae	**Sonchus oleraceus* Common Sowthistle	
Caprifoliaceae	**Scabiosa atropurpurea* Purple Pincushion	
Caryophyllaceae	**Silene gallica* French Catchfly	 Photo (Parks and Wildlife 2015d)

TABLE 7 - Introduced flora species recorded in study area

Name	Species and common name	Photograph
Casuarinaceae	**Casuarina cunninghamiana*	 Photo (TTF 2015)
Euphorbiaceae	**Euphorbia peplus* Petty spurge	
Euphorbiaceae	**Euphorbia terracina* Geraldton Carnation Weed	
Fabaceae	**Acacia longifolia* Sydney Golden Wattle	 Photo (Parks and Wildlife 2015d)
Fabaceae	**Acacia podalyriifolia* Queensland Silver Wattle/Mount Morgan Wattle	 Photo (QLD Government 2015)
Fabaceae	**Medicago polymorpha* Burr Medic	
Geraniaceae	**Pelargonium capitatum* Rose Pelargonium	

4.0 Results and Discussion (continued)

TABLE 7 - Introduced flora species recorded in study area

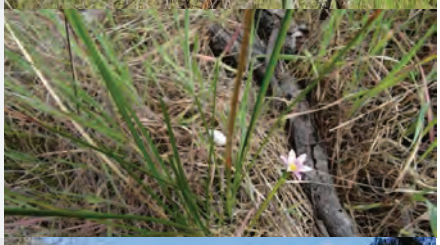
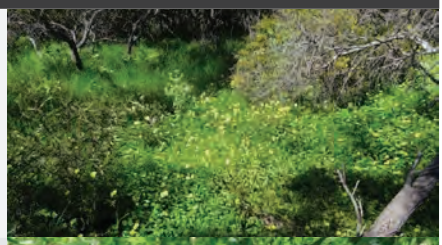
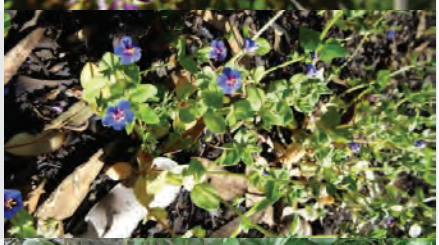
Name	Species and common name	Photograph
Iridaceae	**Freesia alba × leichtlinii* Freesia	
Iridaceae	**Gladiolus caryophyllaceus* Wild Gladiolus	
Iridaceae	**Romulea rosea var. australis* Guildford Grass	
Myrtaceae	**Chamelaucium uncinatum* Geraldton Wax	
Myrtaceae	**Leptospermum laevigatum* Coast Teatree	
Myrtaceae	**Melaleuca nesophila* Mindiyed	
Orobanchaceae	**Orobanche minor* Lesser Broomrape	 Photo (Parks and Wildlife (2015d))

TABLE 7 - Introduced flora species recorded in study area

Name	Species and common name	Photograph
Oxalidaceae	**Oxalis pes-caprae* Soursob	
Papaveraceae	**Fumaria capreolata* Whiteflower Fumitory	
Poaceae	**Avena barbata* Bearded Oat	
Poaceae	**Avena fatua* Wild Oat	
Poaceae	**Bromus diandrus* Great Brome	
Poaceae	**Cenchrus setaceus* Fountain Grass	
Poaceae	**Cynodon dactylon* Couch	 Photo (Parks and Wildlife (2015c))

4.0 Results and Discussion (continued)

TABLE 7 - Introduced flora species recorded in study area

Name	Species and common name	Photograph
Poaceae	**Ehrharta longiflora* Annual Veldt Grass	
Poaceae	**Lagurus ovatus* Hare's Tall Grass	
Polygalaceae	**Polygala myrtifolia* Myrtleleaf Milkwort	
Primulaceae	**Lysimachia arvensis* Pimpernel	
Rhamnaceae	**Rhamnus alaternus* Buckthorn	
Solanaceae	**Solanum nigrum* Black Berry Nightshade	

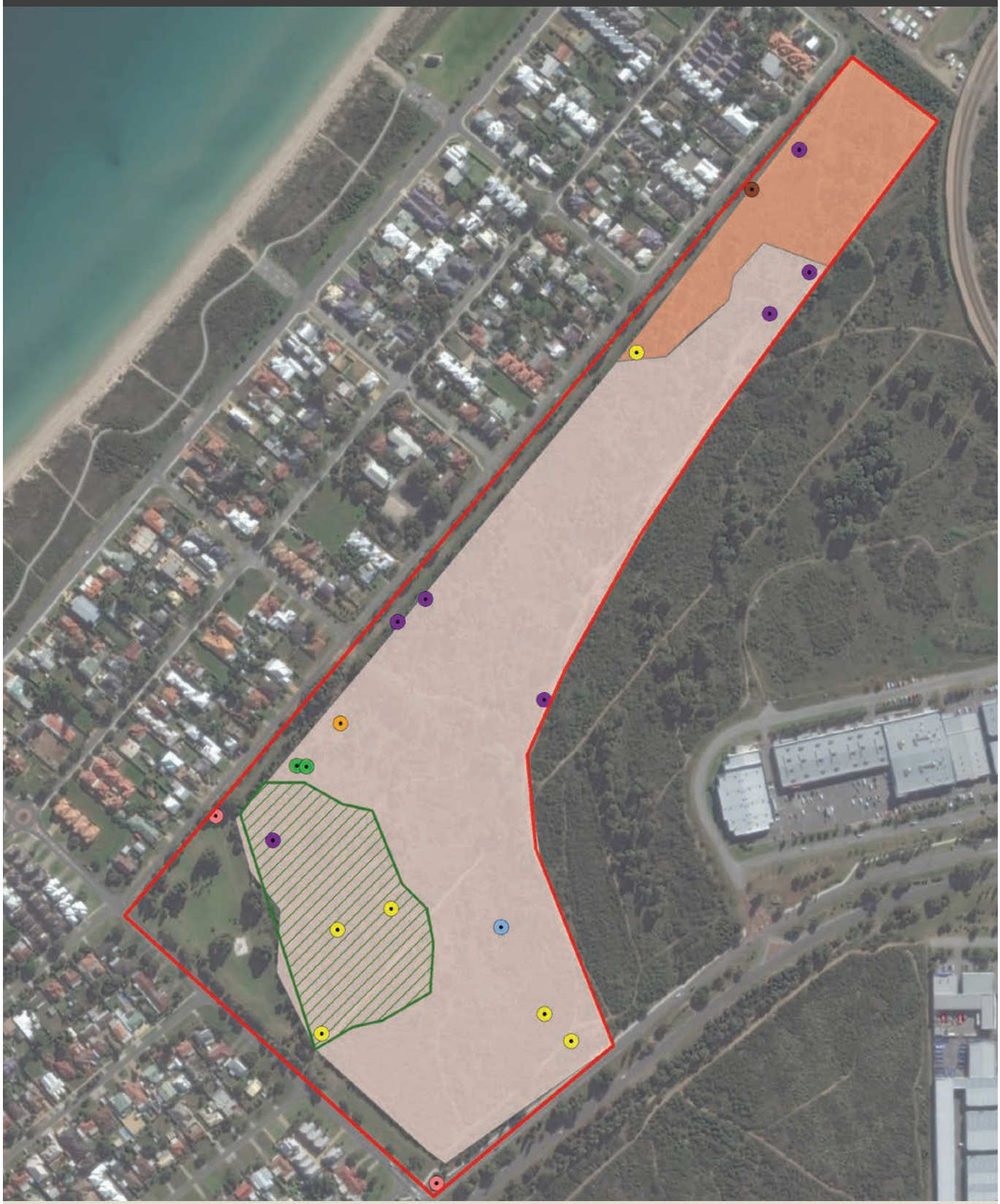
[1] Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (Department of Agriculture and Food 2015)

FIGURE 6 - Targeted weed species

FIGURE 7 - Grassy weed species

FIGURE 8 - Bulbous weed species

FIGURE 9 - Woody weed species



Legend

Study Area

Woody Weeds

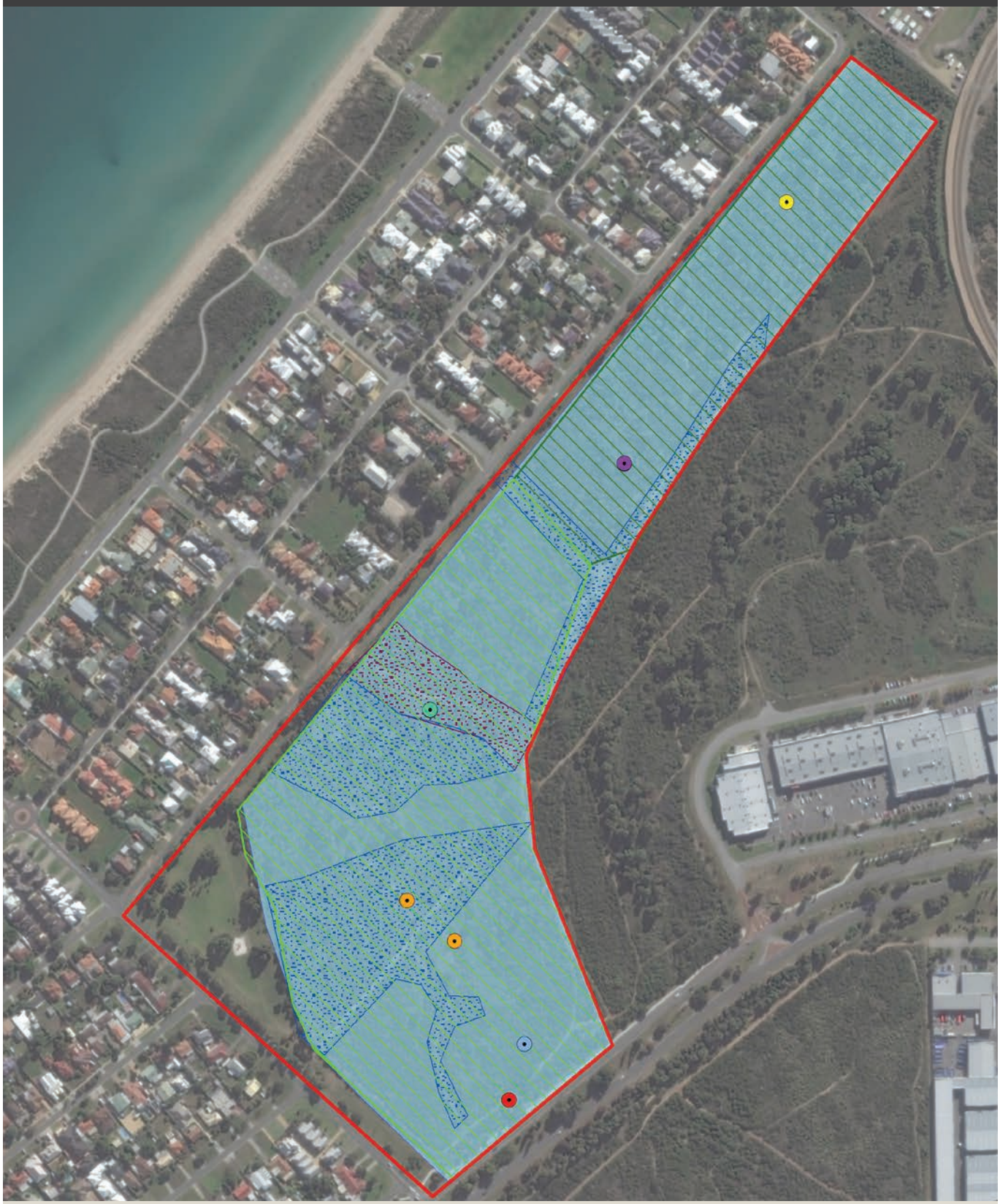
- **Acacia longifolia*
- **Acacia podalyriifolia*
- **Casuarina cunninghamiana*
- **Melaleuca nesophila*
- **Polygala myrtifolia*
- **Rhamnus alatemus*
- **Schinus terebinthifolius*
- **Chamelaucium uncinatum (6-30%)*
- **Schinus terebinthifolius (<5%)*
- **Schinus terebinthifolius (6-30%)*

0 50 100 200

Metres

N

FIGURE 10 - Other weed species



Legend

Study Area

Other Weeds

- **Arctotheca calendula*
- **Euphorbia peplus*
- **Medicago polymorpha*
- **Orobanche minor*
- **Senecio vulgaris*
- **Silene gallica*
- **Oxalis pes-caprae (<5%)*
- **Oxalis pes-caprae (6-30%)*
- **Scabiosa atropurpurea (<5%)*
- **Scabiosa atropurpurea (6-30%)*
- **Euphorbia terracina (<5%), *Fumaria capreolata (<5%), *Lysimachia arvensis (<5%), *Sonchus oleraceus (<5%), *Romulea rosea (<5%)*

N

0 50 100 200

Metres

4.0 Results and Discussion (continued)

4.2 Vegetation communities and condition

Two vegetation communities were identified as occurring within the study area (**Table 9** and **Figure 12**):

- **Vegetation community type 1**: *Eucalyptus gomphocephala* low open woodland over *Acacia rostellifera* and *Spyridium globulosum* tall open shrubland over mixed open shrubland of *Xanthorrhoea preissii*, **Schinus terebinthifolius* and *Hakea prostrata* over **Ehrharta longiflora*, **Bromus diandrus* and **Avena barbata* open grassland over **Euphorbia terracina* and **Asparagus asparagoides* very open herbland (EgArXpEcEt).
- **Vegetation community type 2**: *Acacia rostellifera* tall open scrub over *Spyridium globulosum* and *Xanthorrhoea preissii* open shrubland over **Ehrharta longiflora*, **Bromus diandrus* and **Avena barbata* open grassland over **Euphorbia terracina*, *Lomandra maritima* and **Asparagus asparagoides* very open herbland over *Lepidosperma pubisquameum* very open sedgeland (ArSgEcEtLp).

These were consistent with the vegetation mapping that was previously undertaken by City of Rockingham (2015) with the communities comprising *Eucalyptus gomphocephala* woodland over mixed shrublands, and *Acacia rostellifera* shrubland. The vegetation communities further described in **Table 9**.

In addition, an area designated as 'Parkland' was identified within the study area. The Parkland is located in the southwest corner of the study area and comprises grassed areas with remnant native trees. The Parkland was not considered in the assessment of vegetation condition. The spatial extent of each vegetation community and the Parkland is shown in **Figure 12**.

Vegetation condition within the study area ranged from Completely Degraded to Good (**Table 8**, **Figure 11** and **Figure 12**). The majority of the study area comprised vegetation in Good condition (15.6 ha) with approximately 2.8 ha representing habitat in Degraded condition. A total of 1.5 ha was classified as Completely Degraded and comprised tracks/paths and some small areas of vegetation.

There was a high level of disturbance across the study area from a number of threatening processes including weeds, feral animals, human disturbance (trampling and rubbish) and unauthorised access. It should be noted that due to the lack of Proteaceae species (i.e. *Banksia*) present within the study area, the risk of dieback is considered low/uninterpretable.

Table 8: Vegetation condition within the study area (excludes Parkland)

Vegetation community/type	Good (ha)	Degraded (ha)	Completely Degraded	Total area (ha)
Vegetation community 1 (EgArXpEcEt)	8.3	0	0.1	**8.4**
Vegetation community 2 (ArSgEcEtLp)	7.3	2.8	<0.1	**10.2**
Tracks/paths	0	0	1.4	**1.4**
Total area (ha)	**15.6**	**2.8**	**1.5**	**20**

Figure 11 - Summary of vegetation condition throughout the study area

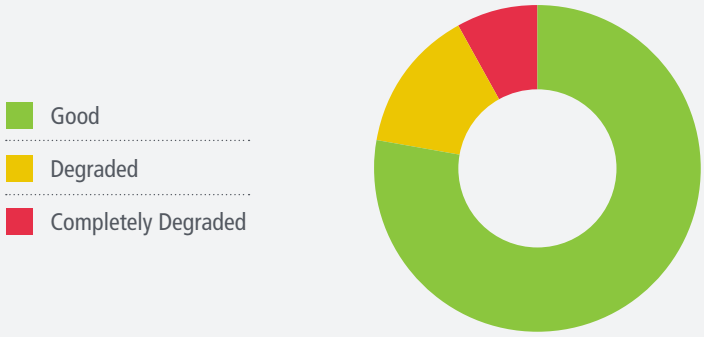


Table 9: Vegetation communities within the study area

Vegetation community	Dominant vegetation community description	Landform	Condition	Quadrats	Extent within study area ha
Vegetation community type 1 (EgArXpEcEt)	*Eucalyptus gomphocephala* low open woodland over *Acacia rostellifera* and *Spyridium globulosum* tall open shrubland over mixed open shrubland of *Xanthorrhoea preissii*, **Schinus terebinthifolius* and *Hakea prostrata* over **Ehrharta longiflora*, **Bromus diandrus* and **Avena barbata* open grassland over **Euphorbia terracina* and **Asparagus asparagoides* very open herbland	Quindalup dune complex	Completely Degraded to Good	SD03, SD07, SD15	8.43
					
Vegetation Community 2 (ArSgEcEtLp)	*Acacia rostellifera* tall open scrub over *Spyridium globulosum* and *Xanthorrhoea preissii* open *shrubland* over **Ehrharta longiflora*, **Bromus diandrus* and **Avena barbata* open grassland over **Euphorbia terracina*, *Lomandra maritima* and **Asparagus asparagoides* very open herbland over L*epidosperma pubisquameum* very open sedgeland	Quindalup dune complex	Degraded to Good	SD01, SD05, SD09, SD11, SD13	10.16
					

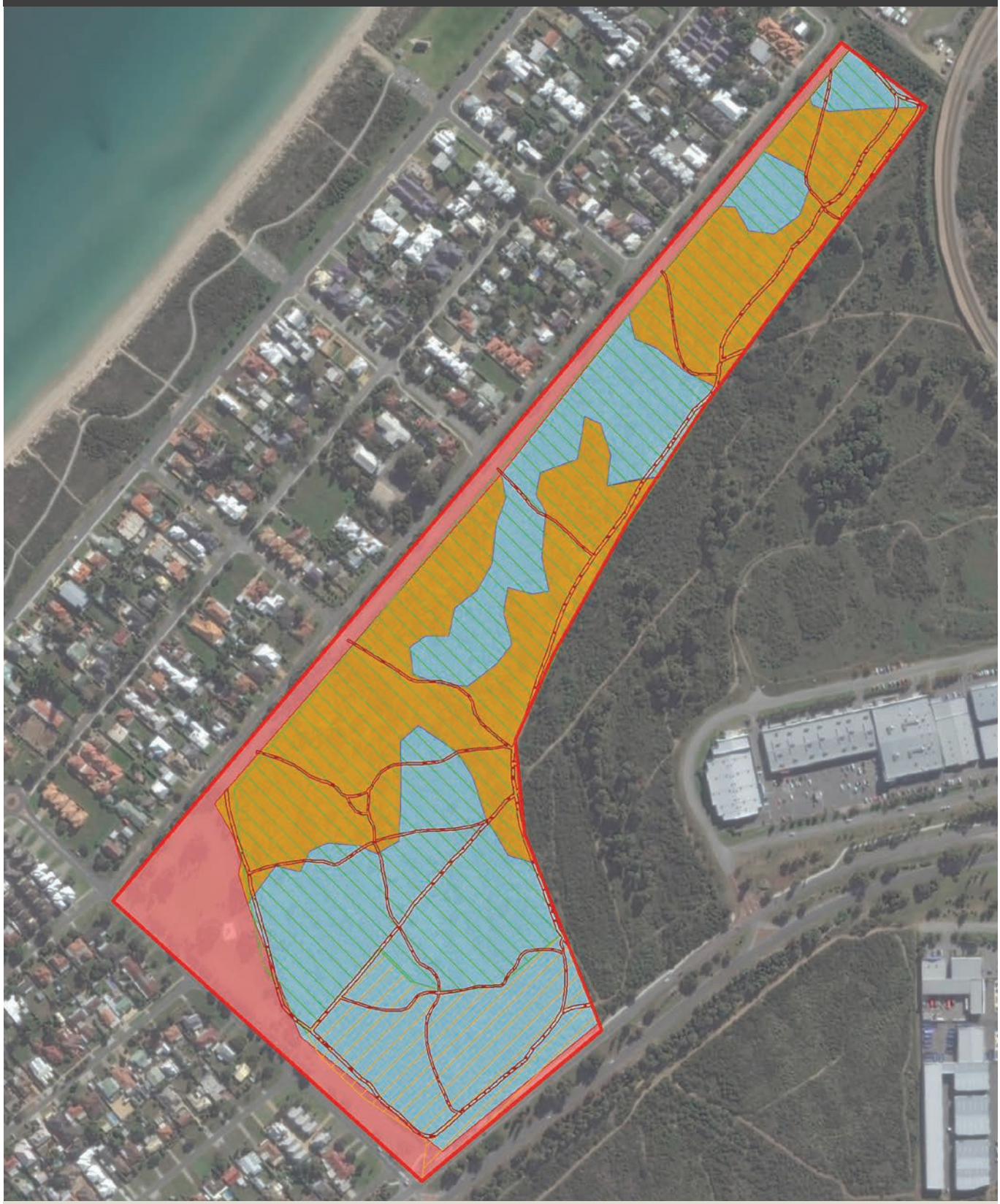
4.3 Floristic Community Type analysis

Due to the highly degraded nature of the study area (i.e. high levels of weed cover and low native species diversity), neither a FCT analysis or qualitative analysis were considered appropriate.

4.4 Vegetation of conservation significance

None of the vegetation units identified within the study area are listed as TECs or PECs, or were inferred to be representative of TECs or PECs.

FIGURE 12 - Vegetation communities and condition



4.5 Identification of potential revegetation areas

A number of areas suitable for revegetation were noted during the survey (**Figure 13** and **Table 10**).

Revegetation area A was located in an open area in the south-west of the study area that contained a number of introduced **Chamelaucium uncinatum* (Geraldton Wax) plants and seedlings. Revegetation area B was located in an area where revegetation looks to have previously occurred but was unsuccessful, and Revegetation area C was located in an area dominated by weed species in the understorey. In these areas the vegetation communities were not structurally intact and lacked a diverse low shrub layer (present in intact remnants of vegetation nearby), which has consequentially been replaced by numerous weeds.

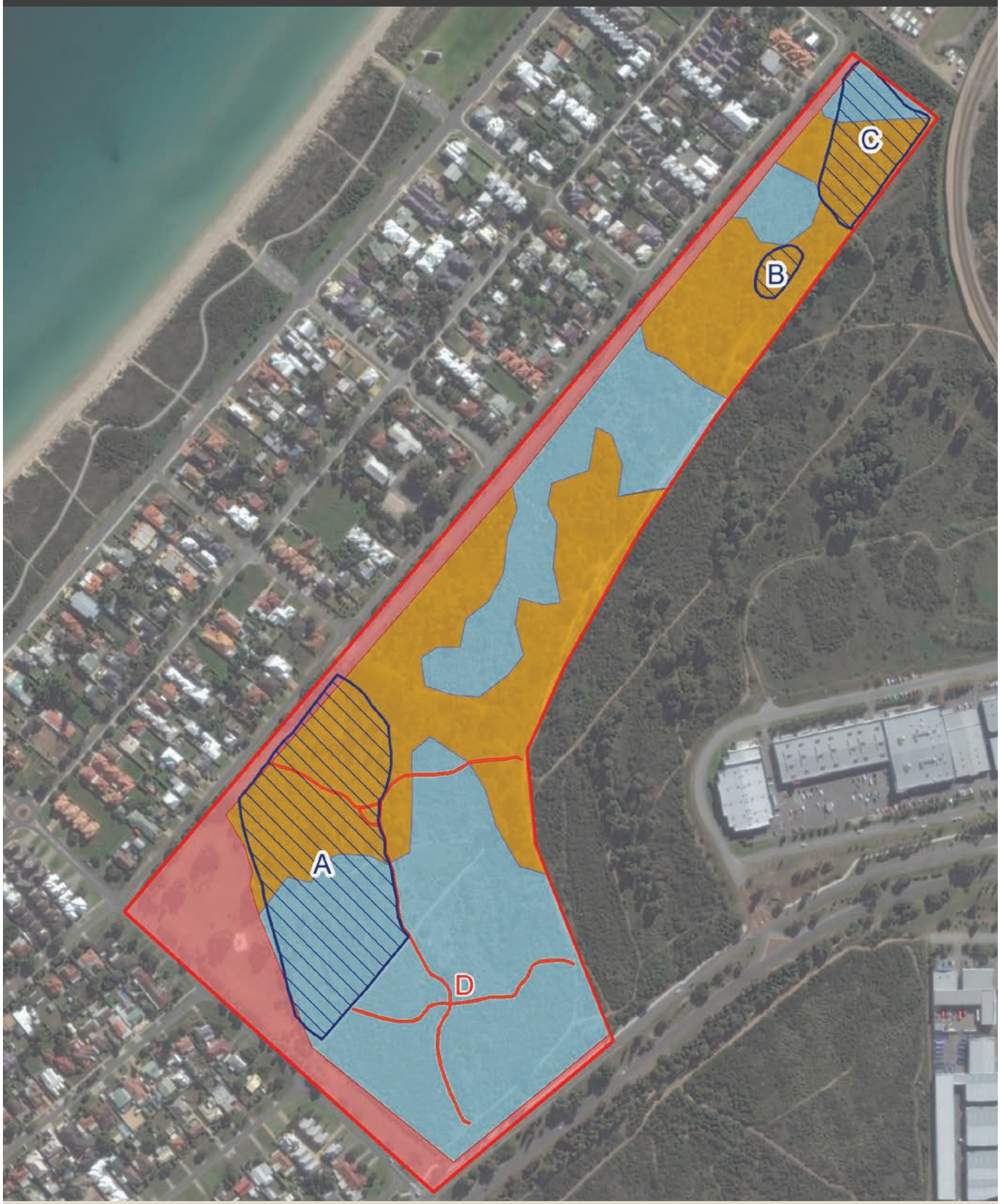
Revegetation area D comprises a number of tracks located within the southern portion of the study area that have been recommended for closure (see Section 4.8 for more information). These tracks would need to be revegetated and blocked off immediately upon closure to prevent access by pedestrians and/or off-road bikes, which would impede revegetation efforts. A list of suitable plant species for each area is provided in **Table 10**. Revegetation should include local species present in the surrounding vegetation, as well as local Proteaceae plants i.e. *Banksia sessilis*. *Banksia sessilis* is likely to have previously occurred within the study area and is also a suitable foraging species for Black Cockatoos. The suggested species list is based on dominant species recorded in the relevant vegetation community.

Revegetation works should aim to improve the overall condition and environmental function of the revegetation site, with a particular objective of creating, rehabilitating and enhancing Black Cockatoo foraging habitat. A detailed revegetation strategy should be developed to meet the individual requirements of each revegetation area. Refer to **Table 13** for more information on implementing a revegetation strategy.

Table 10: Potential revegetation areas

Potential revegetation area	Surrounding vegetation community	Species list	Priority
Revegetation areas A and C	Vegetation community 1 (EgArXpEcEt)	*Acacia rostellifera, Banksia sessilis, Eucalyptus gomphocephala, Eucalyptus decipiens, Hakea prostrata, Olearia axillaris, Spyridium globulosum, Templetonia retusa, Xanthorrhoea preissii*	Medium
	Vegetation community 2 (ArSgEcEtLp)	*Acacia rostellifera, Lomandra maritima, Melaleuca huegelii, Melaleuca systena, Spyridium globulosum, Xanthorrhoea preissii*	Medium
Revegetation area B	Vegetation community 1 (EgArXpEcEt)	*Acacia rostellifera, Banksia sessilis, Eucalyptus gomphocephala, Eucalyptus decipiens, Hakea prostrata, Olearia axillaris, Spyridium globulosum, Templetonia retusa, Xanthorrhoea preissii*	Low
Revegetation Area D	Vegetation community 1 (EgArXpEcEt)	*Acacia rostellifera, Banksia sessilis, Eucalyptus gomphocephala, Eucalyptus decipiens, Hakea prostrata, Olearia axillaris, Spyridium globulosum, Templetonia retusa, Xanthorrhoea preissii*	High
	Vegetation community 2 (ArSgEcEtLp)	*Acacia rostellifera, Lomandra maritima, Melaleuca huegelii, Melaleuca systena, Spyridium globulosum, Xanthorrhoea preissii*	High

FIGURE 13 - Potential revegetation sites



Legend

- Study Area
- Potential Revegetation Areas
- Revegetation Area S

Vegetation Communities

- Vegetation Community 1 (EgArXpEcEt)
- Vegetation Community 2 (ArSgEcEtLp)
- Parkland

0 50 100 200
Metres

N

4.6 Fauna survey

4.6.1 Black Cockatoo assessment

Black Cockatoo foraging habitat

No Black Cockatoo foraging habitat, such as Marri-Jarrah or Banksia woodlands, or evidence of foraging activity was recorded within the study area. The study area was therefore assessed as poor quality foraging habitat for Black Cockatoos.

Black Cockatoo breeding and roosting habitat

Whilst the study area does not provide suitable foraging habitat for Black Cockatoos, it does provide potential roosting and breeding habitat.

Fifty-one trees were identified as potential breeding trees (trees with DBH of greater than 50 cm) across the study area (**Figure 14**). All of the potential breeding trees recorded were Tuarts. None of the potential breeding trees had visible hollows considered potentially suitable for Black Cockatoo nesting; however many vertical or trunk hollows are not visible from the ground. The majority of potential breeding trees are located throughout the central portion of the study area, with several trees present within the Parkland, and a small cluster of trees present in the northern section (**Figure 14**).

Tuart trees are considered to be a secondary or non-preferred breeding tree species based on recorded usage of Tuart compared to the primary breeding trees, Wandoo and Salmon Gum. However, there are several records of Carnaby's Black Cockatoo breeding within Tuart trees on the Swan Coastal Plain (Johnstone et al 2011). The closest known breeding location to the study area is in Mandurah, approximately 30 km south of the study area.

The Tuart trees recorded within the study area also provide suitable roosting habitat for Black Cockatoos. Black Cockatoos roost in tall Eucalypts, usually close to an important water source or within an area of quality foraging (SEWPaC 2012). Although there is no suitable foraging habitat within the study area itself, suitable foraging habitat is available within 3 km of the study area at Dixon Road Conservation Area (City of Rockingham 2015). Black Cockatoos will generally forage within 6 km of a night roost when not breeding (SEWPaC 2012).

4.6.2 Other conservation significant fauna

Following the field survey, the likelihood of occurrence ratings of conservation listed fauna species identified in the desktop assessment were revised, to provide a more accurate reflection of the possibility of these species occurring, based on current habitat and condition within the study area (**Appendix D**).

No conservation significant fauna were recorded in the study area. Following the survey, Carnaby's Black Cockatoo (Endangered) and the Rainbow Bee-eater (Migratory) are considered likely to occur.

The Rainbow Bee-eater is a highly mobile migratory species that occurs widely over most of Australia. It breeds in Australia from August to January in a variety of sandy habitats, primarily sandy embankments along rivers and creeklines (Morcombe 2003). The study area represents suitable aerial foraging habitat for this species; however it is unlikely to support optimal breeding habitat.

The likelihood of occurrence was reduced from likely to unlikely for the Perth Slider (Priority 3) due to the lack of Banksias within the study area, which this species is often associated with (Bush et al. 1995).

The high level of degradation and presence of weeds within the study area is likely to reduce foraging opportunities for many fauna species and as such likelihood of occurrence for several 'potentially occurring' conservation significant species was reduced to Unlikely, including:

- Fork-tailed Swift (Migratory)
- Cattle Egret (Migratory)
- Eastern Great Egret (Migratory)
- Chuditch, Western Quoll (Endangered).

The following species remain as having the potential to occur:

- Forest Red-tailed Black Cockatoo (Vulnerable)
- Baudin's Cockatoo (Vulnerable, Endangered)
- Black-striped Snake (Priority 3)
- Graceful Sun Moth (Priority 4)
- Quenda, Southern Brown Bandicoot (Priority 5).

Graceful Sun Moth habitat assessment

During the survey, *Lomandra maritima* was recorded throughout the south west portion of the study area (**Figure 14**). Approximately 4.5 ha of the study area contains *Lomandra maritima*. *Lomandra maritima* is often present on open areas of herbland, heathland and shrubland on Quindalup soils (sand and limestone) close to the coast and is a known breeding plant for the Graceful Sun Moth. In addition, records of Graceful Sun Moth occur approximately 5.8 km north east and 12.5 km south of the study area (Parks and Wildlife 2015c). The study area therefore provides potentially suitable habitat for the Graceful Sun Moth.

4.6.3 Opportunistic fauna observations

A total of 34 fauna species were recorded opportunistically during the field survey including 22 birds, four mammals, three reptiles and five invertebrate species. A complete list of fauna recorded is provided in **Appendix I**.

Nine introduced species were recorded during the survey, either through direct observation or evidence of activity such as diggings and/or burrows (**Appendix I**). Only four of these species are considered to impact the study area including:

- **Apis mellifera* (European Honeybee)
- **Felis catus* (Cat)
- **Oryctolagus cuniculus* (Rabbit)
- **Vulpes vulpes* (Red Fox).

Whilst European Honeybees were observed on site, no hives were observed; however it is likely that bee hives are present within the study area. Locations of introduced species records are provided in **Figure 15** and **Appendix J**.

Figure 14 - Conservation significant fauna habitat mapping

FIGURE 15 - Introduced/feral fauna locations

Legend

Study Area

Other Weeds

- Fox den
- Old Fox den
- Rabbit activity (scats, diggings)
- Rabbit warren
- Cat (observed)

N

0 50 100 200

Metres

4.7 Bushfire risk assessment

Bushfire fuel load

Generally speaking, where intact, the vegetation communities of the study area have a canopy structure with some understorey shrubs and a groundcover of native perennial grasses with an abundance of exotic grass species and non-grass species, or leaf litter, typical of woodland structure.

Biophysical (species composition related to topography, soils, aspect) and anthropogenic influences provide variation in the canopy cover and presence of understorey in the woodland on the site. Some patches contain an intact canopy, while others do not and occur as scattered trees with regenerating canopy species.

Some localised variations in the canopy species and density and understorey density does provide some pockets of forest structured vegetation, however, despite these localised variations with higher fuel availability and potentially higher risk, the quantity and availability of fuel loads across the reserve remain generally consistent with the woodland structure and fuel accumulation.

The two main vegetation communities within the reserve were categorised as being woodland and a scrub classification for the purposes of Australian Standard 3959 (Standards Australia 2009).

The terrain of the study area was considered primarily flat with no discernible influence from the dune system to affect bushfire behaviour.

Bushfire hazard zones

Three bushfire hazard zones were mapped within the study area: low, moderate and high (**Figure 16**). The majority of the study area was classified as a moderate hazard zone (10.8 ha) whereas 8.9 ha was classified as a high. Approximately 3.8 ha were classified as low which coincides with the Parkland and areas that are Completely Degraded. This assessment represents a 'worse-case scenario' and is likely to overstate the bushfire risk due to the spatial pattern of the fuel. It is likely that the hazard and risk will reduce as fire management actions are implemented.

The likelihood of bushfires starting on or impacting the study area was considered relatively low. Currently, the visitation to the area is likely to be by locals who are less likely to purposefully set the bush alight. Nonetheless, there is a low risk of arson or accidental ignitions from people using the area or driving along neighbouring roads (via cigarette butts). It is therefore expected that occasional accidental or deliberate fires will continue to pose an infrequent bushfire risk.

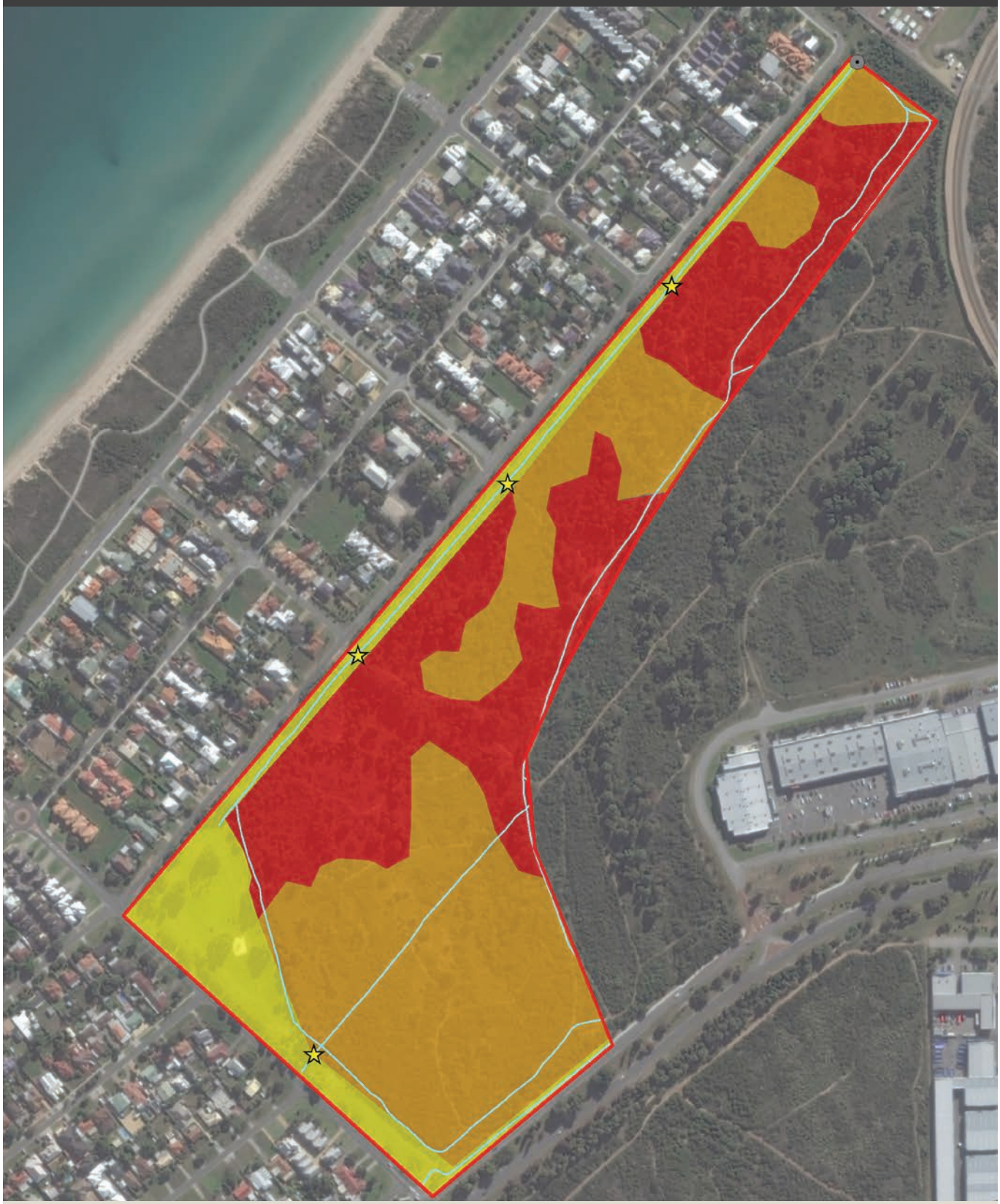
As use of the reserve increases with adjacent development and visitation, the fire mitigation strategies to reduce the risk of accidental or intentional lighting of fires become increasingly important.

Suitability of firebreaks

Existing tracks/paths act as strategic firebreaks within the study area and are shown in **Figure 16**. All the firebreaks were at least 3 m in width and in good condition, hence there is no requirement for additional fire breaks to be constructed.

Access routes connecting to the public road network to provide access for emergency vehicles is important. Currently, Lewington and Victoria Streets provide two access points to the study area in the form of major public roads. In addition, Jecks Street is a chained gravel access road which bisects the study area and connects onto a series of management trails and walking paths (**Figure 16**).

Figure 16 - Bushfire hazard zones and firebreaks



4.8 Site infrastructure

Site infrastructure provides access for unstructured recreation, pedestrians, cyclists, dog walkers and unauthorised off-road vehicle activity.

Paths and tracks

Well compacted limestone or sand paths are located throughout the study area. There is approximately 932 m of limestone pathways and 983 m of bare earth tracks (City of Rockingham 2015). However, some of these tracks are unauthorised and being used by off-road bikes/pedestrians. This access needs to be managed to ensure uncontrolled access does not lead to further degradation of the study area. A number of tracks suitable for closure were noted during the survey. These tracks would need to be revegetated and blocked off immediately upon closure to prevent continued use by pedestrians and/or off-road bikes. In addition, one path that could potentially be widened to benefit pedestrians was noted. This path has been created along the top of a man-made sand embankment. This path would ideally be closed and rehabilitated, however its position and elevation are likely to mean that unauthorised use and access would continue despite closure and revegetation efforts. As a result, it is recommended that this path is widened and made into a proper track. Path and track locations, including those suitable for closure or widening are illustrated in **Figure 17**.

The creation of these unauthorised tracks can lead to weed invasion, erosion and degradation of the surrounding areas. Creation of more tracks should be discouraged and community awareness programs should include information on the potential impacts of unauthorised tracks. In addition, existing sandy footpaths could potentially be upgraded to limestone to reduce risk of dieback spread (if present) and/or soil erosion.

Access

Fencing has been installed around the majority of the study area, in particular around bushland areas adjacent to the Parkland and roads (**Figure 17**). There is approximately 1,260m of post fencing around the study area which is in very good condition (**Figure 17**). There is unrestricted access from adjacent bushland on the eastern and northern boundaries of the study area.

In addition to fencing, there are chain link gates at four locations and limestone boulders restricting access at one location (**Figure 17**). Whilst this discourages and restricts unauthorised access, the lack of fencing and/or gates around the eastern and northern perimeters provides easy access for off-road vehicles. Additional fencing around these perimeters would help to restrict unauthorised access. Locations that require additional fencing were identified in the field and are shown in **Figure 17.**

Signage

A number of signs are present within the study area: one information sign, one naming and regulation sign and three regulation signs. The information sign located within the Parkland is badly damaged, out of date and requires upgrading (**Figure 17**). There is opportunity for further interpretive signage at this location. The historical, unused rail area was identified as an opportunity for interpretive signage (**Figure 17**), the development of which will require further investigation into the history of the old railway and/or railways in the region. Additional signage prohibiting off-road vehicles (i.e. dirt bikes) may further help to discourage unauthorised access to the study area. Areas suitable for additional signage identified in the field are shown in **Figure 17**.

Rubbish

Dumped rubbish was noted throughout the study area. In addition, there was evidence of dog fouling, particularly on bush tracks adjoining the roads. Rubbish dumping destroys native bushland and fauna habitats by introducing disease, weeds and pests, reducing biodiversity and hindering revegetation efforts. Only one rubbish bin is present within the study area, located within the Parkland (**Figure 17**). Locations that would benefit from having additional bins installed were identified in the field and are shown in **Figure 17**.

Figure 17 - Site infrastructure (existing and recommended)

5.0
Environmental assessment summary

5.0 Environmental assessment summary

The key findings of the environmental assessment are as follows:

- No conservation significant flora or vegetation communities occur within the study area.
- Weeds are present throughout the entire study area and represent one of the main threatening processes to the reserve.
- Targeted weeds that require high priority management include:
  - **Agave americana*
  - **Asparagus asparagoides*
  - **Dimorphotheca ecklonis, *Gomphocarpus fruticosus*
  - **Leptospermum laevigatum;* and
  - **Pelargonium capitatum.*
- A further seven weed species were noted as significant due to their abundance within the study area, including:
  - **Avena barbata*
  - **Melaleuca nesophila*
  - **Oxalis pes-caprae*
  - **Rhamnus alaternus*
  - **Schinus terebinthifolius*
  - **Sonchus oleraceus.*
- Several tracks and three areas suitable for revegetation were identified. Revegetation works should aim to improve the overall condition and environmental function of the revegetation site.
- The study area does not provide foraging habitat for Black Cockatoos but does provide potential breeding and roosting habitat due to the number of tall, Eucalypt trees and proximity to nearby foraging opportunities.
- Conservation significant fauna considered as likely to occur within the study area include Carnaby's Black Cockatoo and the Rainbow Bee-eater. A further five species potentially occur including: Forest Red-tailed Black Cockatoo, Baudin's Cockatoo, Black-striped Snake, Graceful Sun Moth, Quenda, and Southern Brown Bandicoot.
- Nine introduced species occur within the study area, four of which are considered as high priority for management including: European Honeybee, cat, rabbit, and Red Fox.
- Three bushfire hazard zones were mapped within the study area: low, moderate and high, with the majority of the study area being classified as a moderate hazard zone.
- The overall likelihood of bushfires starting on or impacting the study area was considered relatively low.
- The fire breaks within the study area are considered sufficient.
- Site infrastructure provides access for passive recreation, pedestrians, cyclists, dog walkers and unauthorised off-road vehicle activity, and includes authorised and unauthorised paths and tracks, fencing and gates, signage and rubbish bins. A number of improvements to site infrastructure are recommended including: upgrading and closing some paths/tracks; and installing additional signage, fencing, gates and bins.

6.0
Landscape concept plan

6.0 Landscape concept plan

With consideration for the environmental assessment outcomes, a landscape concept plan was developed to highlight a number of potential upgrades which would improve the visual amenity and recreational capacity of Lewington Reserve. The reserve has a great deal of potential to provide a central location for community recreation, as it lies within an established residential area and in close proximity to the Rockingham town centre and foreshore.


CITY OF ROCKINGHAM
WELCOME TO
LEWINGTON STREET RESERVE

Legend

UPGRADED TRACKS
Upgrade tracks with compacted limestone, min 2.0 metres wide for main track, and 1.5m for secondary links.

REVEGETATION AREAS
Selected pathways identified for closure shall be revegetated as priority. Plant selection should be in accordance with the Lewington Reserve Management Plan.

QUALITY TUART TREE STANDS
Good examples of Tuart trees and opportunity to view Black Cockatoos and other bird life.

FUTURE 'TEC' WETLAND PLANTING
Fenced areas of trial planting representing Threatened Ecological Communities (TEC). All fencing, planting and upgrade of tracks/firebreaks to be completed by others. Important to maintain public access throughout the site where possible.

TRACKS AND FIREBREAKS FOR UPGRADE
Identified tracks/firebreaks to be provided by others following installation of the 'TEC' wetland planting.

ENTRANCE AND WAYFINDING SIGNAGE PALETTE
Entrance signage to include park map, track distances, discovery stations and emergency information. Signage structures to take inspiration from the 'Graceful Sun Moth', which is likely to be found on the site.

WAYFINDING
At each entry point wayfinding signs are to be installed, which will be low key, minimal post with colour to identify locality and points of access/direction.

WILD FLOWER TRAIL
Locally flowering native wildflowers are planted along the path to create a seasonal trail. Species to be selected in accordance with the Lewington Reserve Management Plan or native to the Swan Coastal Plain.

DISCOVERY STATIONS
Each station has a unique subject that has been interpreted into a learning and a play feature. Ideal for families or community groups to explore the natural area, so close to Rockingham Foreshore.

1. **STATION ONE:**
Spot birdlife in the canopies of the Tuart trees, with interpretive signage to identify common species.

2. **STATION TWO:**
Scratch in the sand for plaques of insects and bird life, which can be found in the reserve, like the Graceful Sun Moth.

3. **STATION THREE:**
Find seasonal flowers along the wild flower trail.

4. **STATION FOUR:**
Listen for frogs,learn about the TEC wetland species.

1. **GATEWAY INTO LEWINGTON AND ROCKINGHAM BEACH**
Victoria Street is an access point to Rockingham Beach, with prime opportunity to enhance the intersection of Lewington and Patterson Roads. Simple bold planting, grass trees and mulch.

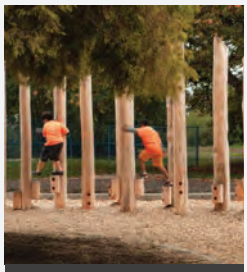
2. **IMPROVE ACCESS AND ENTRANCE TO RESERVE**
Weed removal, planting and wayfinding to encourage use of the reserve tracks.

3. **PLAYGROUND**
Existing playground revitalised into an environmental nature play based learning experience.

4. **COASTAL CONNECTIONS**
Improve connection to and from the Rockingham Foreshore along Roe, Weld, Hillman and Victoria Streets. Include references to the beach on wayfinding signs.

5. **TREE PLANTING**
Additional tree planting along street verges and along Lewington Street wide grass verge, to create an avenue.

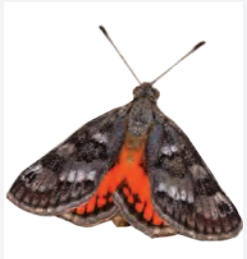
Wayfinding



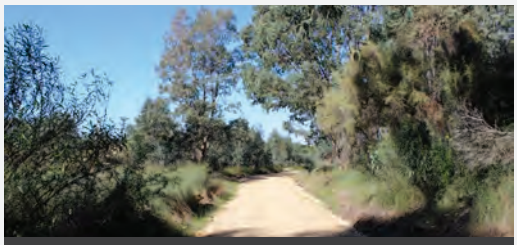
Nature play elements

Educational signage

Wildflower trail



Protect fauna habitat



Existing tracks improved to encourage use

Simple shade structure and picnic table for family gatherings

Imagery is indicative and for concept purposes only. Character images range from parks around the world and are included for inspirational purposes. Further detailed design is required prior to construction.

Legend

MAIN ACCESS PATH
Upgrade all paths with compacted limestone, min 1.5 metres wide.

REVEGETATION AREAS
Areas of pathways identified for closure shall be revegetated as a priority. Plant selection should be in accordance with the Lewington Reserve Management Plan or native to the Swan Coastal Plain

TREE PLANTING
Complimentary tree planting to street verges. Additional row of trees along Lewington Road wide grass verge to create an avenue of native trees and restrict vehicle access into the reserve.

1. **UPGRADE PLAYGROUND TO NATURE PLAY**
Existing playground upgraded to a nature play based experience. New structure with climbing and viewing tower amongst the tree canopy.

2. Maximise playspace under shade of tree, with timber logs to create balancing beams and feature posts to provide playful stilts, with local bird forms carved into the top of the posts.

3. **DISCOVERY STATION**
in the sand and find plaques of insects. There is space for children to draw, create rubbings of found insects and incorporates a black board stand for drawing or playing games.

4. **KEY TRAIL HEAD SIGNAGE**
Entrance is marked with coloured feature posts and has a large profile sign with map, path locations/times and outlines the discovery stations throughout the reserve. Hardstand space using compacted aggregate includes seating and relocated drinking fountain.

5. **SEATING CIRCLE - PERFORMANCE STAGE**
Area for picnics, groups to sit and listen, or alternatively a space for children to use as a performance stage. The raised table acts as a stage to the terraced low limestone retaining walls. Opportunity to include a shade structure over the seating area.

6. **INFORMAL SECONDARY PATH ON GRASS**
Review in future and consider compacted limestone, depending on level of use.

7. **NEW PEDESTRIAN PRAM RAMPS CONNECTIONS**
New access including pram ramp across Victoria Street connecting local residents to the park.

Discovery Stations

Sketching sharing and learning

Discovery searching

Imagery is indicative and for concept purposes only. Character images range from parks around the world and are included for inspiration purposes. Further detail design is required prior to construction.

7.0

Recommendations and implementation

7.0 Recommendations and implementation

7.1 Weed management

Potential impacts

Invasive species, such as weeds, represent the biggest threat to biodiversity after direct habitat loss (DotE 2014a).

Weeds may impact on the biodiversity values within the study area by:

- Out-competing native species for nutrients, water, space and sunlight
- Reducing the natural diversity by smothering native plants or preventing them from growing back
- Reducing habitat for native animals
- Altering fire regimes.

The major vectors for the introduction and spread of weeds in the study area includes:

- Edge effects from roads/cleared areas
- Dumping of rubbish
- Escape of garden plants, particularly in areas where gardens border, or are in close proximity to, the study area
- Human and animal transport (unauthorised tracks and off-road activity).

Management objectives and actions

Management objectives include: removing/reducing existing weed infestations, minimising the spread of weeds and preventing the introduction of new weeds.

Weed control methods and timing for targeted weed species and other aggressive/invasive weeds are provided in **Table 11**. Broad spectrum weed control methods should also be implemented prior to revegetation works commencing. A suitable weed control program as per Department of Environment Regulation (DER) guidelines (DER 2013) is provided below:

- Ideally one or two years before planting or seeding, a broad spectrum herbicide should be applied to the revegetation area.
- A follow-up application in autumn is also required.
- A third spray can be applied 10 weeks after the second spray to control opportunistic weeds.
- A final spray is required just before planting.

A number of other weed management actions are outlined in **Table 12**.

Table 11: Major weed control methods and timing

Major weeds	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Method*
Bridal Creeper (**Asparagus asparagoides*)								●	●				Spray 0.2 g metsulfuron methyl + Pulse® in 15 L water (or 2.5 - 5 g/ha + Pulse®).
Bearded Oat (**Avena barbata*)							●	●	●	●			Spray at 3-5 leaf stage with Fusilade® Forte at 16 ml/10 L + wetting agent or for generic fluazifop-p (212 g/L active ingredient) 10 mL/10L or 0.5 L/ha + wetting agent. Repeat over the following 2 years. Aim to prevent seed production.
Buckthorn (**Rhamnus alaternus*)			●	●	●				●	●	●		Hand pull seedlings and dig out small plants (<50 cm tall). Cut and paint base with 50% glyphosate or try basal bark application of 250 ml Access® in 15 L of diesel to basal 50 cm of trunk.
Century plant (**Agave americana*)	●										●	●	Dig out and/or hand remove small infestations. Stem inject into base of leaves 1 part Tordon®/5 parts diesel.

Table 11: Major weed control methods and timing

Major weeds	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Method*
Coast Teatree (**Leptospermum laevigatum*)							●	●	●	●			Hand pull seedlings. Fell mature plants and remove material. Where resprouting is observed, apply 250 ml Access® in 15 L of diesel to bottom 50 cm of trunk (basal bark).
Common Sowthistle (**Sonchus oleraceus*)						●	●	●					Remove small and/or isolated populations manually prior to seed set. Spot spray Lontrel® 10 ml/10 L + wetting agent preferably at the rosette stage.
Honey Myrtle (**Melaleuca nesophila*)[1]													Hand Removal/Pulling, Cut Trunk and Stems or Grubbing (Use a mattock to remove the weed and its roots) (Surf Coast Shire 2013)
Narrowleaf Cottonbush (**Gomphocarpus fruticosus*)									●	●	●	●	Small plants should be manually removed Larger plants - foliar spray with 1.5% glyphosate or cut and paint using 50% glyphosate
Pepper Tree (**Schinus terebinthifolius*)	●	●										●	Seedlings should be manually removed. Stem inject older plants using 50% glyphosate or basal bark with 250 ml Access® in 15 L of diesel to bottom 50 cm of trunk during summer.
Rose Pelargonium (**Pelargonium capitatum*)						●	●	●	●	●	●	●	Hand pull isolated plants taking care to remove the entire stem as it can reshoot from below ground level. Spot spray metsulfuron methyl 5 g/ha + Pulse®.
Sour Grass (**Oxalis pes-caprae*)						●	●						Spot spray metsulfuron methyl 0.2 g/15 L + Pulse®, or 1% glyphosate. Apply at bulb exhaustion, generally just on flowering. Exercise care if manually removing as physical removal can result in spread of bulbils
Veldt Daisy (**Dimorphotheca ecklonis*)													Glyphosate 10ml/L

* weed control methods recommended by DPaW 2015d

[1] Weed control measures not available from Parks and Wildlife

7.0 Recommendations and implementation (continued)

7.2 Revegetation

Potential impacts

Four areas suitable for revegetation were identified in Section 4.5 and are illustrated in **Figure 13**. Potential impacts to revegetation sites include:

- Introduction and spread of weeds
- Trampling by foot/vehicle
- Grazing by feral animals
- Disease
- Soil erosion.

It is recommended that revegetation focus on vegetated areas classed as Degraded, particularly next to access paths to enhance native biodiversity, fauna habitat and aesthetics. In addition, infill planting is recommended in areas of Good vegetation condition with the aim of increasing vegetation condition to Very Good or Excellent. The removal of threatening processes in these areas will also encourage natural regeneration and improvement in overall vegetation condition.

Species selected for use in revegetation should be consistent with the vegetation community types present in the study area. Seed or tubestock is to be sourced from local provenance seed, hardened off and in good condition prior to planting. Seed collection can be carried out from within the site and nearby bushland on the Swan Coastal Plain to obtain local provenance seed for propagation and use in future rehabilitation programs. Propagation of plants from provenance seed improves the potential for success, as the plants are suited to site conditions.

Weed control should be undertaken in these areas prior to revegetation activities to increase the plant survival rate and minimise further weed infestation.

It is recommended that:

- Tubestock be sourced from local provenance seed and planted at an approximate density of 1 plant/m^2
- Revegetation to focus on Degraded areas adjacent to paths to reduce edge effects, weed colonisation and to enhance native biodiversity and visual aesthetics.
- Infill planting should occur in areas of Good and Very Good vegetation condition to increase the vegetation of these areas to Very Good or Excellent.
- Removal of threatening processes be undertaken to encourage natural regeneration and support revegetation.
- All staff members and contractors are trained in hygiene practices while undertaking works in the revegetation areas to reduce potential for pathogen introduction.

Management objectives and actions

Management objectives include: implementing revegetation and minimising the potential impacts from weeds, feral animals and fire on the revegetation sites. These objectives will be achieved through the management actions outlined in **Table 12**.

7.3 Fauna management

Potential impacts

Feral animals impact on native species by:

- Predation
- Competition for food and shelter
- Destroying habitat
- Spreading disease.

Management objectives and actions

Management objectives include reducing the occurrence and spread of feral animals. These will be achieved through the management actions outlined in **Table 12**.

7.4 Bushfire risk assessment

Potential impacts

Fire impacts on native vegetation in a variety of ways, depending on the scale of the fire and the vegetation. The impacts of fire on vegetation can be very complex with both positive and negative effects. Potential negative impacts of fire on the study area include:

- Damage to native vegetation and fauna habitats
- Destruction or damage to infrastructure and nearby homes/buildings
- Risk lives of general public
- Pollute the air with emissions harmful to human health.

Management objectives and actions

Management objectives include developing a bushfire management plan, reducing the risk and/or spread of fire and minimising risk to lives in the event of a fire. These objectives will be achieved through the management actions outlined in **Table 12**.

It should be noted that prescribed burning is not considered as an option for the following reasons:

- Burning is often difficult to organise/achieve and requires specialist skills and equipment
- Weeds respond rapidly in the post-fire environment. They tend to establish quicker than native species in the post-fire environment that has elevated light and nutrient availability
- The smoke from prescribed fire represents a health and visibility concern for nearby residents and users of roads in the vicinity
- Soils are exposed to increased potential for wind erosion due to loss of vegetated cover
- The potential of the reserve to recover post-fire is unknown, and would most likely require supplementary planting due to the currently degraded state of the vegetation.

7.5 Site infrastructure

Potential impacts

The following potential impacts may occur to the study area from a lack of or damage to site infrastructure:

- Weed invasion
- Soil erosion
- Spread of disease
- Rubbish and littering
- Trampling
- Increased risk of fire
- Degradation of surrounding areas (edge effects).

Management objectives and actions

Management objectives include restricting unauthorised access to the study area, providing environmental, historical and conservation information to the general public, and reducing impacts from rubbish dumping. These will be achieved through the management actions outlined in **Table 12.**

Table 12: Management objectives and actions

		Management actions	Priority	Estimated cost
Weeds				
OBJECTIVES	Remove/ reduce existing weed infestations	1. Implement a weed control program to eradicate targeted weed species as well as aggressive/invasive species. Weed control methods and timing are provided in **Table 11**. Particular attention should be paid to tracks/paths and potential revegetation sites.	High	$15,000
		2. Initiate an ongoing weed monitoring/mapping program to identify new weed infestations before they become established or spread and to record weed species cover and/or distribution. The success of the weed control management actions can then be evaluated / measured based on the results of the monitoring program.	High	Officer time
	Prevent introduction of weeds	3. Prevent introduction of weeds by discouraging dumping of garden refuse (signage/ additional bins), preventing vehicle access through fencing and minimise soil disturbance (maintain pathways).	Medium	Ongoing according to need
	Minimise the spread of weeds	4. Close unnecessary tracks/paths, particularly around revegetation areas.	High	Ongoing according to need
		5. Implement a revegetation program to assist native regeneration.	High	See revegataion
		6. Install additional rubbish bins to discourage illegal rubbish disposal.	Medium	Ongoing according to need
		7. Notify surrounding landowners of weed control program and inform of practices that they can also use to reduce further weed invasion into the study area.	Medium	Officer time
Revegetation				
OBJECTIVES	Improve coverage of native vegetation	8. Establish priorities for ongoing rehabilitation efforts based on the protection of areas in better condition and progressive rehabilitation of completely cleared areas.	High	Officer time
		9. Undertake revegetation at a density of 1 plant/m^2 in the areas outlined in **Figure 13**. (Total revegtation area approximently 42,6000 m^2)	High	$120,000
		10. Flora species to be utilised in revegetation works will be those previously recorded during surveys (**Table 10**).	High	N/A
	Minimise impacts from weeds, feral animals, trampling and fire	11. Where direct seeding is to be undertaken, seed will be treated where required (i.e. to break dormancy) and spread with an appropriate medium.	Medium	Cost will vary according to need
		12. Where seedlings are to be planted, seedlings are to be produced from a nursery that is accredited by the Nursery Industry Accreditation Scheme Australia, specifically to reduce the risk of Phytophthora dieback introductions.	High	N/A
		13. Where planting of seedlings is to be undertaken, installation of tree guards to protect from feral animals shall be considered.	High	Cost will vary according to need
		14. It is recommended that temporary fencing be constructed around revegetation areas. In addition, more permanent options such as rabbit-proof fencing shall be considered to allow for improved revegetation success and to promote natural regeneration/recruitment from the soil seed bank.	Medium	Cost will vary according to need

7.0 Recommendations and implementation (continued)

Table 12: Management objectives and actions

		Management actions	Priority	Estimated cost
Feral animal control				
OBJECTIVES	Reduce occurrence of feral animals	15. Monitor feral animal populations and undertake control as required	High	Ongoing according to need
	Minimising impacts of feral animals and disease	16. Closure of some tracks/paths as indicated in Section 4.8.	Medium	Ongoing according to need
		17. Informative signage to discourage general public from creating new tracks.	Medium	Ongoing according to need
		18. Installation of additional bins across the study area to minimise litter.	Medium	Ongoing according to need
Bushfire risk				
OBJECTIVES	Reduce the risk and/or spread of fire	19. Maintain firebreaks.	High	Ongoing according to need
		20. Undertake revegetation following fire.	High	Ongoing according to need
		21. Undertake regular weed control to reduce incidence of weeds (in particular grassy weeds) and wind/soil erosion.	High	Ongoing according to need
	Minimise risk to lives in the event of a fire	22. Erection and maintenance of signage to enable prompt pedestrian egress from the reserve in the event of a fire.	Medium	Ongoing according to need
		23. Designate fire safe areas for users of the area and show these on signs. These would likely be the grassed area in the south western corner of the reserve.	Medium	N/A
Site infrastructure				
OBJECTIVES	Restrict access to the study area	24. Close recommended existing tracks as outlined in Section 4.8.	Medium	Ongoing
		25. Install approximately 1,110 m of boundary fencing as identified on infrastructure map.	High	$18,000
		26. Upgrade approcimentely 983m of bare earth tracks to limestone for all tracks on the site infrastructure map.	Medium	$50,000
		27. Invetsigate widneing recommended existing footpath (Section 4.8).	Low	Officer time
		28. Upgrade approximately 1,260 m to rural style 3 strand fencing for all existing fencing areas identified on the infrastructure map.	Medium	$18,000
		29. Inspect and repair boundary fencing, gates and signage on a regular basis as required (e.g. annually).	High	Ongoing
		30. Install one vechile access gate indentified on infrastructure map	High	$1000
		31. Repair existing, damaged signage.	Medium	Ongoing
	Provide information to general public to reduce impacts to study area	32. Install interpretive signage to inform general public of: • Historical rail use • Conservation status of land and importance of site for preservation of flora and fauna, including Black Cockatoos.	Medium	$20,000

Table 12: Management objectives and actions

		Management actions	Priority	Estimated cost
Site infrastructure				
OBJECTIVES	Reduce impacts from rubbish disposal	33. Remove all rubbish from illegal dumping activities within the study area regularly.	Medium	Ongoing
		34. Remove litter/rubbish on a regular basis as required (e.g. quarterly).	Medium	Ongoing
Recreation				
OBJECTIVES	Enhance the opportunities for unstructured recreation, nature appreciation and play	35. Initiate detailed design and community consultation for the landscape concept plan.	High	$30,000
		36. Construct concept plan.	Medium	$300,000

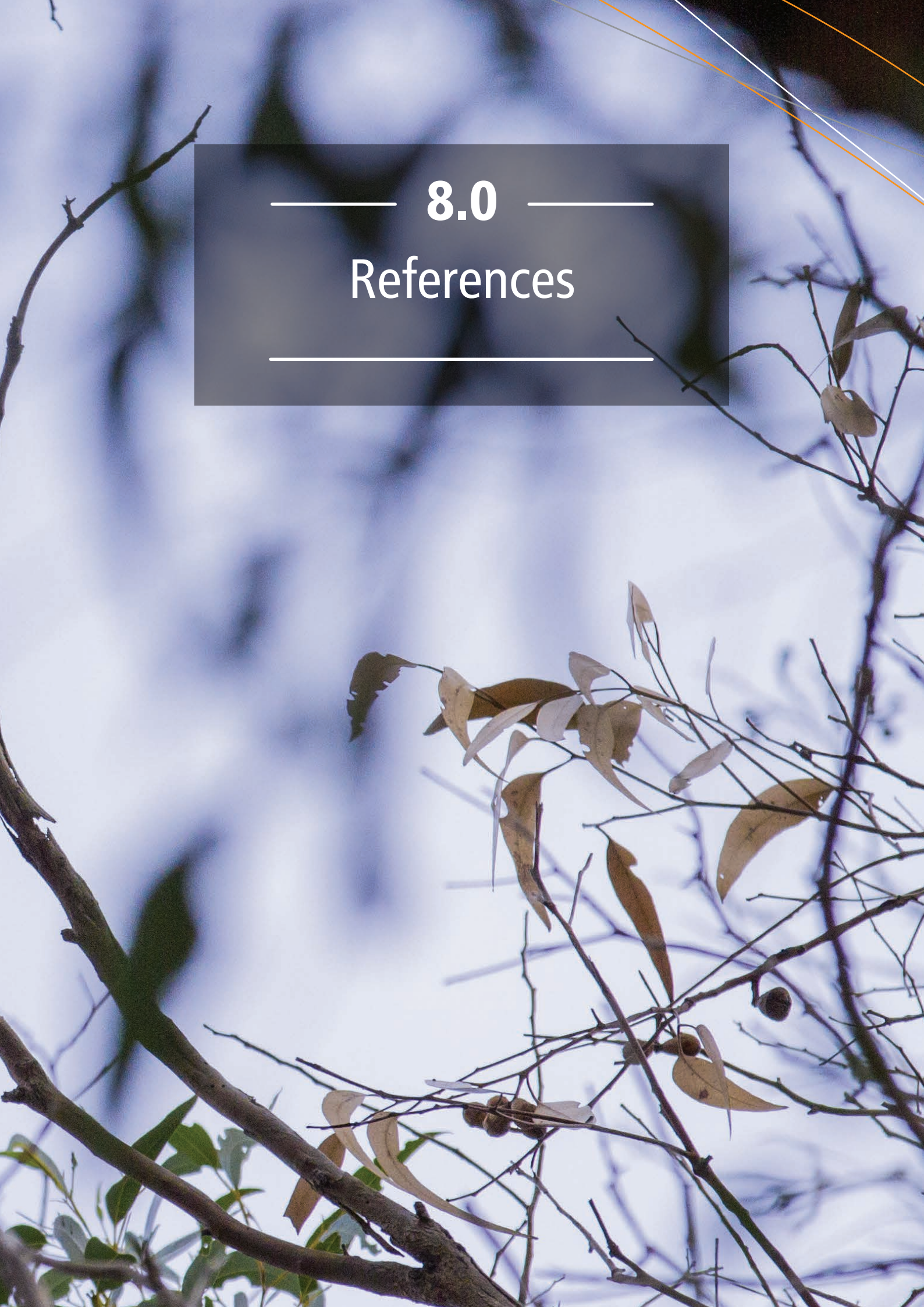
7.6 Key performance indicators

The evaluation of the following key performance indicators will provide a quantifiable measure of the delivery and efficacy of environmental management practices being undertaken in accordance with this plan.

The GPS location of all monitoring quadrats should be noted and recorded on the City's Intramaps system, with the same quadrats to be used annually. Photo monitoring points should be established in all quadrats, with photographs to be taken as part of the annual quadrat assessments to visually document changes in vegetation composition over time.

An annual summary report should be prepared, commencing in September 2016, to be saved in the Lewington Reserve file R/45509.

Parameter	Assessment Method	Performance Criteria	Frequency
Vegetation condition	10m x 10 m monitoring quadrats (minimum of three) Vegetation condition should be assessed according to the Keighery scale	Vegetation condition ≥ baseline condition identified in this Plan	Annually
Revegetation species representation	10m x 10 m monitoring quadrats (minimum of one per revegetation area)	80-90% of species planted being evident in any area of 100 m^2 during monitoring compared to baseline data	Annually
Revegetation survival	10m x 10 m monitoring quadrats (minimum of one per revegetation area)	Minimum 80% seedling survival rate after 12 months	Annually
Weeds	10 x 10 m monitoring quadrats (minimum of three)	Percentage weed coverage should be ≤ baseline data collected from first monitoring round	Annually



8.0
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9.0 References

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9.0 Appendices

10.0 Appendices

Appendix A Framework for conservation significant flora and fauna ranking

Categories of threatened species under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Threatened fauna and flora may be listed in any one of the following categories as defined in Section 179 of the EPBC Act:	
Category	**Description**
Extinct	A native species is eligible to be included in the **extinct** category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the **extinct in the wild** category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically endangered	A native species is eligible to be included in the **critically endangered** category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	A native species is eligible to be included in the **endangered** category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	A native species is eligible to be included in the **vulnerable** category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation dependent	A native species is eligible to be included in the **conservation dependent** category at a particular time if, at that time: (a) the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish*; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species. *fish includes all species of bony fish, sharks, rays, crustaceans, molluscs and other marine organisms, but does not include marine mammals or marine reptiles.

Species listed as '**conservation dependent**' and '**extinct**' are not Matters of National Environmental Significance and therefore do not trigger the EPBC Act.

Flora and fauna conservation codes under the State Wildlife Conservation Act 1950 (WC Act)		
Code	Conservation Status	Description
T	Threatened species*	Listed as Specially Protected under the WC Act, published under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora). • Fauna that is rare or likely to become extinct is declared to be fauna that is in need of special protection • Flora that are extant and considered likely to become extinct, or rare and therefore in need of special protection, are declared to be rare flora Species which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such. The assessment of the conservation status of these species is based on their national extent.
X	Presumed extinct species	Listed as Specially Protected under the WC Act, published under Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora (which may also be referred to as Declared Rare Flora). Species which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.
IA	Migratory birds protected under an international agreement	Listed as Specially Protected under the WC Act, listed under Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice. Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), relating to the protection of migratory birds.
S	Other Specially Protected fauna	Listed as Specially Protected under the WC Act. Fauna declared to be in need of special protection, otherwise than for the reasons mentioned for Schedules 1, 2 or 3, are published under Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice.

*Threatened Fauna and Flora are ranked according to their level of threat using IUCN Red List categories and criteria. For example: Carnaby's Cockatoo (Calyptorynchus latirostris) is listed as 'Specially Protected' under the WC Act, published under Schedule 1, and referred to as a 'Threatened' species with a ranking of 'Endangered':

CR Critically Endangered - considered to be facing an extremely high risk of extinction in the wild.

EN Endangered - considered to be facing a very high risk of extinction in the wild.

VU Vulnerable - considered to be facing a high risk of extinction in the wild.

10.0 Appendices (continued)

Priority flora and fauna categories used by the Department of Parks and Wildlife (2014).

Species that maybe threatened or near threatened but are data deficient, have not yet been adequately surveyed to be listed under the Schedules of the Wildlife Conservation (Specially Protected Fauna) Notice or the Wildlife Conservation (Rare Flora) Notice, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation dependent species that are subject to a specific conservation program are placed in Priority 5.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

Code	Conservation Status	Description
P1	Priority 1: Poorly known species	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2	Priority 2: Poorly known species	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3	Priority 3: Poorly known species	Species that are known from several locations and does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4	Priority 4: Rare, Near Threatened and other species in need of monitoring	**(a)** Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. **(b)** Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. **(c)** Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	Priority 5: Conservation Dependent species	Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Appendix B Likelihood of occurrence criteria for conservation significant flora and fauna

Likelihood: No

- Species not known to occur within the IBRA bioregion
- Study area lacks important habitat for a species that has highly selective habitat requirements
- Species has been historically recorded within study area or locally, however it is considered locally extinct due to significant habitat changes such as land clearing

Likelihood: Unlikely

- Species has been recorded locally through DEC database search, however, is unlikely to occur due to lack of critical habitat and/or the site being severely degraded
- Species has been recorded locally through DEC database search, however, is unlikely to occur due to few historic record/s, no other current collections in the local area, and extensive on site searching has not detected species.

Likelihood: Possible

- Species has been recorded regionally, but has not been previously recorded in the study area; however, targeted surveys may locate the species based on records occurring in proximity to the study area and suitable habitat potentially occurring in the study area
- Extensive survey efforts have not detected the species, however species is known to be cryptic and no effective standardised procedure is available, therefore occurrence should not be ruled out without further investigation
- Species has been recorded in the study area by a previous consultant survey, however, doubt remains over taxonomic identification
- Historical evidence of species occurrence within or outside of study area with coordinates doubtful
- Historical evidence of species occurrence within project area, and while not considered as locally extinct, occasionally recorded locally based on available data

Likelihood: Likely

- Critical or core habitat in excellent condition and landform for the species occurs within the study area
- Species has been recorded in proximity (<5 km) and in similar habitat to that which occurs within the area

Likelihood: Yes

- Species recorded during the survey, or previously recorded within study area from DEC database search results and the species has been confirmed through a current vouchered specimen at WA Herbarium
- Recent evidence of species positively identified within project area such as fresh scats, foot prints or burrows, or foraging residues.

10.0 Appendices (continued)

Appendix C Flora likelihood of occurrence

Scientific name	Common name	Conservation status[1]			Source	Likelihood of occurrence	
		EPBC Act	WC Act	Parks and Wildlife Priority List		Pre-survey	Post survey
Acacia benthamii				P2	NatureMap	Unlikely	Unlikely
Aponogeton hexatepalus	Stalked Water Ribbons			P4	NatureMap	Unlikely	Unlikely
Beyeria cinerea subsp. cinerea				P3	NatureMap	Potential	Unlikely
Caladenia huegelii	King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid	EN		T	PMST	Unlikely	Unlikely
Calandrinia oraria				P3	NatureMap	Potential	Unlikely
Cardamine paucijuga				P2	NatureMap	Potential	Unlikely
Centrolepis caespitosa		VU	T		PMST	Unlikely	Unlikely
Conostylis pauciflora subsp. pauciflora				P4	NatureMap	Potential	Unlikely
Dillwynia dillwynioides				P3	NatureMap	Unlikely	Unlikely
Diuris drummondii	Tall Donkey Orchid	VU	T		NatureMap	Unlikely	Unlikely
Diuris micrantha	Purdie's Donkey-orchid	EN	T		PMST	Unlikely	Unlikely
Diuris purdiei	Glossy-leafed Hammer-orchid, Praying Virgin	EN	T		PMST	Unlikely	Unlikely
Dodonaea hackettiana	Hackett's Hopbush			P4	NatureMap	Potential	Unlikely
Drakaea elastica	Glossy-leaved Hammer Orchid	EN	T		NatureMap	Unlikely	Unlikely
Jacksonia sericea	Waldjumi			P4	NatureMap	Potential	Unlikely
Lasiopetalum membranaceum				P3	NatureMap	Potential	Unlikely
Lepidium puberulum				P4	NatureMap	Potential	Unlikely
Parsonsia diaphanophleba				P4	NatureMap	Unlikely	Unlikely
Pimelea calcicola				P3	NatureMap	Potential	Unlikely
Schoenus capillifolius				P3	NatureMap	Unlikely	Unlikely
Sphaerolobium calcicola				P3	NatureMap	Potential	Unlikely
Stylidium longitubum	Jumping Jacks			P3	NatureMap	Unlikely	Unlikely

[1] VU = Listed as 'Vulnerable', EN= 'Endangered' and CR='Critically Endangered' under the EPBC Act, T = Threatened Flora under the WC Act and P = Priority Flora listed by Parks and Wildlife.

Appendix D Fauna likelihood of occurrence

Scientific name	Common name	Conservation status[1]			Source	Likelihood of occurrence	
		EPBC Act	WC Act	Parks and Wildlife Priority List		Pre-survey	Post survey
Actitis hypoleucos	Common Sandpiper	IA	S3		NatureMap	Unlikely	Unlikely
Anous tenuirostris subsp. melanops	Australian Lesser Noddy	VU			PMST	Unlikely	Unlikely
Apus pacificus	Fork-tailed Swift	IA	S3		PMST	Potentially	Unlikely
Ardea ibis	Cattle Egret	IA	S3		NatureMap	Potentially	Unlikely
Ardea modesta	Eastern Great Egret	IA	S3		NatureMap	Potentially	Unlikely
Arenaria interpres	Ruddy Turnstone	IA	S3		NatureMap	Unlikely	Unlikely
Bettongia penicillata subsp. ogilbyi	Woylie; Brush-tailed Bettong	EN	CR		PMST	Unlikely	Unlikely
Calidris acuminata	Sharp-tailed Sandpiper	IA	S3		NatureMap	Unlikely	Unlikely
Calidris alba	Sanderling	IA	S3		NatureMap	Unlikely	Unlikely
Calidris canutus	Red Knot	IA	S3		NatureMap	Unlikely	Unlikely
Calidris ferruginea	Curlew Sandpiper	CR	VU		NatureMap PMST	Unlikely	Unlikely
Calidris ruficollis	Red-necked Stint	IA	S3		NatureMap	Unlikely	Unlikely
Calidris subminuta	Long-toed Stint	IA	S3		NatureMap	Unlikely	Unlikely
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	VU		PMST	Potentially	Potentially
Calyptorhynchus baudinii	Baudin's Cockatoo; Long-billed black-cockatoo	VU	EN		NatureMap	Potentially	Potentially
Calyptorhynchus latirostris	Carnaby's Cockatoo	EN	EN		NatureMap PMST	Likely	Likely
Charadrius rubricollis	Hooded Plover			P4	NatureMap	Unlikely	Unlikely
Dasyurus geoffroii	Chuditch, Western Quoll	VU	VU		PMST	Potentially	Unlikely
Egretta sacra	Eastern Reef Egret; Eastern Reef Heron	IA	S3		NatureMap	Unlikely	Unlikely
Falco peregrinus	Peregrine Falcon		S4		NatureMap	Unlikely	Unlikely
Haliaeetus leucogaster	White-bellied Sea-Eagle	IA	S3		NatureMap	Unlikely	Unlikely
Isoodon obesulus fusciventer	Quenda, Southern Brown Bandicoot			P5	NatureMap	Potentially	Potentially
Ixobrychus minutus	Little Bittern			P4	NatureMap	Unlikely	Unlikely
Ixobrychus minutus subsp. dubius	Australian Little Bittern			P4	NatureMap	Unlikely	Unlikely

10.0 Appendices (continued)

Appendix D Fauna likelihood of occurrence

Scientific name	Common name	Conservation status[1]			Source	Likelihood of occurrence	
		EPBC Act	WC Act	Parks and Wildlife Priority List		Pre-survey	Post survey
Leipoa ocellata	Malleefowl	VU	VU		PMST	No	No
Lerista lineata	Perth Slider; Lined Skink			P3	NatureMap	Likely	Unlikely
Limosa lapponica	Bar-tailed Godwit	IA	VU		PMST	Unlikely	Unlikely
Limosa limosa	Black-tailed Godwit	IA			PMST	Unlikely	Unlikely
Merops ornatus	Rainbow Bee-eater	IA	S3		NatureMap	Likely	Likely
Neelaps calonotos	Black-striped Snake	-		P3	NatureMap	Potentially	Potentially
Notoscincus butleri	Lined Soil-crevice Skink			P4	NatureMap	Unlikely	Unlikely
Numenius madagascariensis	Eastern Curlew	CR	VU		NatureMap	Unlikely	Unlikely
Numenius phaeopus	Whimbrel	IA	S3		NatureMap	Unlikely	Unlikely
Onychoprion anaethetus	Bridled Tern	IA	S3		NatureMap	Unlikely	Unlikely
Oxyura australis	Blue-billed Duck			P4	NatureMap	Unlikely	Unlikely
Pletholax gracilis subsp. edelensis	Keeled Legless Lizard (Edel Land Pen. Shark Bay)			P3	NatureMap	Unlikely	Unlikely
Pogona minor subsp. minima	Dwarf Bearded Dragon (Houtman Abrolhos Is.), Dwarf Bearded Dragon		VU		NatureMap	Unlikely	Unlikely
Pseudocheirus occidentalis	Western Ringtail Possum	VU	EN		PMST	Unlikely	Unlikely
Rostratula australis	Australian Painted Snipe	EN	EN		PMST	Unlikely	Unlikely
Sterna anaethetus	Bridled Tern	IA			PMST	Unlikely	Unlikely
Sterna caspia	Caspian Tern	IA	S3		PMST	Unlikely	Unlikely
Sterna dougallii subsp. gracilis	Roseate Tern	IA	S3		PMST	Unlikely	Unlikely
Sterna hirundo longipennis	Common Tern	IA	S3		PMST	Unlikely	Unlikely
Sterna leucoptera	White-winged Black Tern	IA			PMST	Unlikely	Unlikely
Sternula nereis subsp. nereis	Fairy Tern	VU	VU		PMST	Unlikely	Unlikely
Synemon gratiosa	Graceful Sun Moth			P4	NatureMap	Potential	Potential
Tringa glareola	Wood Sandpiper	IA	S3		PMST	Unlikely	Unlikely
Tringa nebularia	Common Greenshank	IA	S3		NatureMap	Unlikely	Unlikely
Tringa stagnatalis	Marsh Sandpiper	IA	S3		PMST	Unlikely	Unlikely

VU = Listed as 'Vulnerable', EN = 'Endangered' and CR ='Critically Endangered' under the EPBC Act or Schedule 1 of the WC Act, MA = Marine species listed under the EPBC Act, S = Specially Protected fauna listed under the WC Act, IA = migratory species listed under an international agreement, P=Priority fauna listed by Parks and Wildlife.

Appendix E Flora species list

Family	Species
Agapanthaceae	**Agapanthus praecox*
Alliaceae	**Allium triquetrum*
Anacardiaceae	**Schinus terebinthifolius*
Apocynaceae	**Gomphocarpus fruticosus*
Asparagaceae	**Agave americana*
Asparagaceae	**Asparagus asparagoides*
Asparagaceae	*Acanthocarpus preissii*
Asphodelaceae	**Asphodelus fistulosus*
Asteraceae	**Arctotheca calendula*
Asteraceae	**Dimorphotheca ecklonis*
Asteraceae	**Senecio vulgaris*
Asteraceae	**Sonchus oleraceus*
Asteraceae	*Olearia axillaris*
Asteraceae	**Hypochaeris radicata*
Caprifoliaceae	**Scabiosa atropurpurea*
Caryophyllaceae	**Silene gallica*
Casuarinaceae	**Casuarina cunninghamiana*
Cupressaceae	*Callitris preissii*
Cyperaceae	*Lepidosperma pubisquameum*
Ericaceae	*Leucopogon australis*
Euphorbiaceae	**Euphorbia peplus*
Euphorbiaceae	**Euphorbia terracina*
Fabaceae	**Acacia longifolia*
Fabaceae	**Acacia podalyriifolia*
Fabaceae	**Medicago polymorpha*
Fabaceae	*Acacia pulchella var. pulchella*
Fabaceae	*Acacia rostellifera*
Fabaceae	*Acacia saligna*
Fabaceae	*Hardenbergia comptoniana*
Fabaceae	*Jacksonia furcellata*
Fabaceae	*Kennedia prostrata*
Fabaceae	*Templetonia retusa*
Geraniaceae	**Pelargonium capitatum*
Haemodoraceae	*Conostylis aculeata subsp. cygnorum*
Iridaceae	**Freesia alba × leichtlinii*

10.0 Appendices (continued)

Appendix E Flora species list

Family	Species
Iridaceae	**Gladiolus caryophyllaceus*
Iridaceae	**Romulea rosea var. australis*
Myrtaceae	**Chamelaucium uncinatum*
Myrtaceae	**Leptospermum laevigatum*
Myrtaceae	**Melaleuca nesophila*
Myrtaceae	*Calothamnus quadrifidus subsp. quadrifidus*
Myrtaceae	*Eucalyptus decipiens*
Myrtaceae	*Eucalyptus foecunda*
Myrtaceae	*Eucalyptus gomphocephala*
Myrtaceae	*Eucalyptus rudis*
Myrtaceae	*Eucalyptus utilis*
Myrtaceae	*Kunzea glabrescens*
Myrtaceae	*Melaleuca huegelii*
Myrtaceae	*Melaleuca systena*
Orobanchaceae	**Orobanche minor*
Oxalidaceae	**Oxalis pes-caprae*
Papaveraceae	**Fumaria capreolata*
Phyllanthaceae	*Phyllanthus calycinus*
Poaceae	**Avena barbata*
Poaceae	**Avena fatua*
Poaceae	**Bromus diandrus*
Poaceae	**Cenchrus setaceus*
Poaceae	**Cynodon dactylon*
Poaceae	**Ehrharta longiflora*
Poaceae	**Lagurus ovatus*
Polygalaceae	**Polygala myrtifolia*
Primulaceae	**Lysimachia arvensis*
Proteaceae	*Grevillea crithmifolia*
Proteaceae	*Hakea prostrata*
Ranunculaceae	*Clematis linearifolia*
Rhamnaceae	**Rhamnus alaternus*
Solanaceae	**Solanum nigrum*
Xanthorrhoeaceae	*Xanthorrhoea brunonis*

Appendix F Flora species matrix

Species	Vegetation type							
	1			2				
	SD03	SD07	SD15	SD01	SD05	SD09	SD11	SD13
**Acacia podalyriifolia*								●
**Asparagus asparagoides*	●		●	●	●		●	●
**Asphodelus fistulosus*			●		●			
**Avena barbata*	●	●	●	●	●	●	●	●
**Bromus diandrus*	●	●	●	●	●	●	●	●
**Ehrharta longiflora*	●	●	●	●	●	●	●	●
**Euphorbia peplus*			●					
**Euphorbia terracina*	●	●		●	●	●	●	●
**Fumaria capreolata*	●							
**Hypochaeris radicata*	●							
**Lagurus ovatus*	●	●	●	●	●	●		
**Lysimachia arvensis*	●	●	●	●		●	●	●
**Pelargonium capitatum*	●							
**Rhamnus alaternus*			●	●			●	●
**Romulea rosea var. australis*			●		●			●
**Schinus terebinthifolius*	●				●			●
**Sonchus oleraceus*	●		●		●	●	●	●
Acacia pulchella var. pulchella	●							
Acacia rostellifera	●	●	●	●	●	●	●	●
Acanthocarpus preissii	●							
Agonis flexuosa var. flexuosa						●		
Calothamnus quadrifidus subsp. Quadrifidus				●				
Clematis linearifolia	●		●	●			●	
Conostylis aculeata subsp. Cygnorum		●				●		
Dianella revoluta			●	●	●		●	●
Eucalyptus gomphocephala	●	●	●					
Hakea prostrata		●			●			
Lepidosperma pubisquameum		●		●	●	●	●	●

10.0 Appendices (continued)

Appendix F Flora species matrix

Species	Vegetation type							
	1			2				
	SD03	SD07	SD15	SD01	SD05	SD09	SD11	SD13
Leucopogon australis							●	
Lomandra maritima	●	●		●	●	●	●	●
Melaleuca huegelii		●						
Melaleuca systena						●		
Phyllanthus calycinus								●
Spyridium globulosum	●	●	●	●	●	●	●	●
Xanthorrhoea brunonis								●
Xanthorrhoea preissii		●	●				●	●

Appendix G Quadrat data

Site number	Date	Site type	Observer
SD_01	09/09/2015	Quadrat 10x10m	Sarah Dalgleish
Landform	**Soils**	**Easting**	**Northing**
Quindalup Dunes	Sandy loam - brown	382121	6429520
Condition	**Disturbance**	**Fire**	**Geology**
Very good		Old (>20)	Safety Bay Sand

Species	Cover (%)	Stratum	Sub-Stratum
Acacia rostellifera	10	M	Shrubs over 2 m
Calothamnus quadrifidus subsp. quadrifidus	0.1	L	Shrubs 1-2 m
Clematis linearifolia	0.1		Climber
Dianella revoluta	0.1	L	Shrubs under 1 m
Lepidosperma pubisquameum	0.25	L	Sedge
Lomandra maritima	0.5	L	Herbs
Spyridium globulosum	0.25	M	Shrubs 1-2 m
Xanthorrhoea preissii	30	M	Shrubs 1-2 m
**Asparagus asparagoides*	0.1		Climber
**Avena barbata*	2	L	Grasses
**Bromus diandrus*	2	L	Grasses
**Ehrharta longiflora*	2	L	Grasses
**Euphorbia terracina*	0.1	L	Herbs
**Lysimachia arvensis*	0.1	L	Grasses
**Rhamnus alaternus*	0.1	M	Herbs

10.0 Appendices (continued)

Appendix G Quadrat data

Site number	Date	Site type	Observer
SD_03	09/09/2015	Quadrat 10x10m	Sarah Dalgleish
Landform	**Soils**	**Easting**	**Northing**
Quindalup Dunes	Sandy loam – Black/brown	381926	6429234
Condition	**Disturbance**	**Fire**	**Geology**
Very good	Weeds	Old (>20)	Safety Bay Sand

Species	Cover (%)	Stratum	Sub-Stratum
Acacia pulchella var. pulchella	0.25	M	Shrubs under 1 m
Acacia rostellifera	5	M	Shrubs over 2 m
Acanthocarpus preissii	1	L	Herbs
Clematis linearifolia	0.1		Climber
Eucalyptus gomphocephala	40	U	Trees under 10 m
Lomandra maritima	0.25	L	Herbs
Spyridium globulosum	2	M	Shrubs over 2 m
**Asparagus asparagoides*	0.1		Climber
**Avena barbata*	2	L	Grasses
**Bromus diandrus*	2	L	Grasses
**Ehrharta longiflora*	2	L	Grasses
**Euphorbia terracina*	0.1	L	Herbs
**Fumaria capreolata*	0.1	L	Herbs
**Hypochaeris radicata*	0.1	L	Herbs
**Lagurus ovatus*	0.1	L	Grasses
**Lysimachia arvensis*	0.1	L	Grasses
**Pelargonium capitatum*	0.1	L	Shrubs under 1 m
**Schinus terebinthifolius*	0.5	M	Shrubs 1-2 m
**Sonchus oleraceus*	0.1	L	Herbs

Appendix G Quadrat data

Site number	Date	Site type	Observer
SD_05	09/09/2015	Quadrat 10x10m	Sarah Dalgleish
Landform	**Soils**	**Easting**	**Northing**
Quindalup Dunes	Sandy loam – Black/brown	381809	6429088
Condition	**Disturbance**	**Fire**	**Geology**
Very good	Weeds	Old (>20)	Safety Bay Sand

Species	Cover (%)	Stratum	Sub-Stratum
Acacia rostellifera	20	M	Shrubs over 2 m
Dianella revoluta	0.1	L	Shrubs under 1 m
Hakea prostrata	10	M	Shrubs 1 – 2 m
Lepidosperma pubisquameum	0.1	L	Sedge
Lomandra maritima	0.1	L	Herbs
Spyridium globulosum	20	M	Shrubs over 2 m
**Asparagus asparagoides*	0.1		Climber
**Asphodelus fistulosus*	0.1	L	Herbs
**Avena barbata*	3	L	Grasses
**Bromus diandrus*	3	L	Grasses
**Ehrharta longiflora*	3	L	Grasses
**Euphorbia terracina*	0.1	L	Herbs
**Lagurus ovatus*	0.1	L	Grasses
**Romulea rosea var. australis*	0.25	L	Herbs
**Schinus terebinthifolius*	5	M	Shrubs 1-2 m
**Sonchus oleraceus*	0.1	L	Herbs

10.0 Appendices (continued)

Appendix G Quadrat data

Site number	Date	Site type	Observer
SD_07	09/09/2015	Quadrat 10x10m	Sarah Dalgleish
Landform	**Soils**	**Easting**	**Northing**
Quindalup Dunes	Sandy loam – Black/brown	381656	6428920
Condition	**Disturbance**	**Fire**	**Geology**
Very good	Weeds	Old (>20)	Safety Bay Sand

Species	Cover (%)	Stratum	Sub-Stratum
Acacia rostellifera	10	M	Shrubs 1-2 m
Conostylis aculeata subsp. cygnorum	0.1	L	Herbs
Eucalyptus gomphocephala	2	U	Trees under 10 m
Hakea prostrata	1	M	Shrubs 1-2 m
Lepidosperma pubisquameum	0.1	L	Sedge
Lomandra maritima	0.1	L	Herbs
Melaleuca huegelii	3	M	Shrubs 1-2 m
Spyridium globulosum	0.5	M	Shrubs 1-2 m
**Avena barbata*	2	L	Grasses
**Bromus diandrus*	2	L	Grasses
**Ehrharta longiflora*	2	L	Grasses
**Euphorbia terracina*	1	L	Herbs
**Lagurus ovatus*	0.1	L	Grasses
**Lysimachia arvensis*	0.1	L	Herbs

Appendix G Quadrat data

Site number	Date	Site type	Observer
SD_09	10/09/2015	Quadrat 10x10m	Sarah Dalgleish
Landform	**Soils**	**Easting**	**Northing**
Quindalup Dunes	Sandy - grey/light brown	381754	6428721
Condition	**Disturbance**	**Fire**	**Geology**
Good	Weeds	Old (>20)	Safety Bay Sand

Species	Cover (%)	Stratum	Sub-Stratum
Acacia rostellifera	80	M	Shrubs 1-2 m
Agonis flexuosa var. flexuosa	1	M	Shrubs 1-2 m
Conostylis aculeata subsp. Cygnorum	0.1	L	Herbs
Lepidosperma pubisquameum	2	L	Sedge
Lomandra maritima	1	L	Herbs
Melaleuca systena	0.1	M	Shrubs under 1 m
Spyridium globulosum	0.25	M	Shrubs 1-2 m
**Avena barbata*	1	L	Grasses
**Bromus diandrus*	1	L	Grasses
**Ehrharta longiflora*	1	L	Grasses
**Euphorbia terracina*	0.5	L	Herbs
**Lagurus ovatus*	0.1	L	Grasses
**Lysimachia arvensis*	0.1	L	Grasses
**Sonchus oleraceus*	0.1	L	Herbs

10.0 Appendices (continued)

Appendix G Quadrat data

Site number	Date	Site type	Observer
SD_11	10/09/2015	Quadrat 10x10m	Sarah Dalgleish
Landform	**Soils**	**Easting**	**Northing**
Quindalup Dunes	Sandy loam – Dark Grey	381858	6428726
Condition	**Disturbance**	**Fire**	**Geology**
Very Good	Weeds	Old (>20)	Safety Bay Sand

Species	Cover (%)	Stratum	Sub-Stratum
Acacia rostellifera	45	M	Shrubs 1-2 m
Clematis linearifolia	1		Climber
Dianella revoluta	0.25	L	Shrubs under 1 m
Lepidosperma pubisquameum	0.25	L	Sedge
Leucopogon australis	0.25	M	Shrubs 1-2 m
Lomandra maritima	0.5	L	Herbs
Spyridium globulosum	1	M	Shrubs 1-2 m
Xanthorrhoea preissii	2	M	Shrubs 1-2 m
**Asparagus asparagoides*	0.1		Climber
**Avena barbata*	10	L	Grasses
**Bromus diandrus*	10	L	Grasses
**Ehrharta longiflora*	10	L	Grasses
**Euphorbia terracina*	0.25	L	Herbs
**Lysimachia arvensis*	0.1	M	Herbs
**Rhamnus alaternus*	0.25	L	Shrubs under 1 m
**Sonchus oleraceus*	0.1	M	Herbs

Appendix G Quadrat data

Site number	Date	Site type	Observer
SD_13	10/09/2015	Quadrat 10x10m	Sarah Dalgleish
Landform	**Soils**	**Easting**	**Northing**
Quindalup Dunes	Sandy loam – pale brown	381845	6428838
Condition	**Disturbance**	**Fire**	**Geology**
Very Good	Weeds	Old (>20)	Safety Bay Sand

Species	Cover (%)	Stratum	Sub-Stratum
Acacia rostellifera	25	M	Shrubs over 2 m
Dianella revoluta	0.25	L	Shrubs under 1 m
Lepidosperma pubisquameum	0.5	L	Sedge
Lomandra maritima	0.25	L	Herbs
Phyllanthus calycinus	0.1		Climber
Spyridium globulosum	15	M	Shrubs over 2 m
Xanthorrhoea brunonis	0.5	M	Shrubs under 1 m
Xanthorrhoea preissii	2	M	Shrubs 1-2 m
**Acacia podalyriifolia*	0.1	M	Shrubs under 1 m
**Asparagus asparagoides*	0.1		Climber
**Avena barbata*	30	L	Grasses
**Bromus diandrus*	30	L	Grasses
**Ehrharta longiflora*	20	L	Grasses
**Euphorbia terracina*	0.25	L	Herbs
**Lysimachia arvensis*	0.1	L	Herbs
**Rhamnus alaternus*	0.1	L	Shrubs under 1 m
**Romulea rosea var. australis*	0.1	L	Herbs
**Schinus terebinthifolius*	0.25	M	Shrubs over 2 m
**Sonchus oleraceus*	0.1	L	Herbs

10.0 Appendices (continued)

Appendix G Quadrat data

Site number	Date	Site type	Observer
SD_15	10/09/2015	Quadrat 10x10m	Sarah Dalgleish
Landform	**Soils**	**Easting**	**Northing**
Quindalup Dunes	Sandy loam – brown	382070	6429417
Condition	**Disturbance**	**Fire**	**Geology**
Very Good	Weeds	Old (>20)	Safety Bay Sand

Species	Cover (%)	Stratum	Sub-Stratum
Acacia rostellifera	30	M	Shrubs over 2 m
Clematis linearifolia	2		Climber
Dianella revoluta	0.1	L	Shrubs under 1 m
Eucalyptus gomphocephala	2	U	Trees under 10 m
Spyridium globulosum	30	M	Shrubs over 2 m
Xanthorrhoea preissii	0.25	L	Shrubs under 1 m
**Asparagus asparagoides*	0.1		Climber
**Asphodelus fistulosus*	0.1	L	Herbs
**Avena barbata*	0.25	L	Grasses
**Bromus diandrus*	40	L	Grasses
**Ehrharta longiflora*	40	L	Grasses
**Euphorbia peplus*	0.1	L	Herbs
**Lagurus ovatus*	0.1	L	Grasses
**Lysimachia arvensis*	0.1	L	Herbs
**Rhamnus alaternus*	0.1	L	Shrubs under 1 m
**Romulea rosea*	0.1	L	Herbs
**Sonchus oleraceus*	0.1	L	Herbs

Appendix H Introduced flora species locations

Weed species	Location		Population size (no. individuals)	% cover
	Easting	Northing		
*Acacia longifolia	382090	6429547	1	
*Acacia podalyriifolia	381849	6428837	1	
*Agapanthus praecox	382130	6429576	45	
*Agapanthus praecox	382130	6429576	45	
*Agave americana	381772	6429053		< 5 %
*Agave americana	381647	6428788		< 5 %
*Allium triquetrum	381830	6429226		< 5 %
*Arctotheca calendula	381857	6428671		< 5 %
*Arctotheca calendula	381857	6428671		< 5 %
*Asparagus asparagoides	381864	6429061		< 5 %
*Asparagus asparagoides	382201	6429588		6 - 30 %
*Asphodelus fistulosus	381763	6428847		< 5 %
*Avena barbata	381871	6429065		6 - 30 %
*Avena fatua	382226	6429634		< 5 %
*Avena fatua	381851	6428666		< 5 %
*Bromus diandrus	381871	6429065		6 - 30 %
*Casuarina cunninghamiana	381652	6428993	2	
*Casuarina cunninghamiana	381662	6428992	2	
*Cenchrus setaceus	382170	6429527	1	
*Cenchrus setaceus	382189	6429511	5	
*Cenchrus setaceus	382204	6429524	5	
*Cenchrus setaceus	382170	6429527	1	
*Cenchrus setaceus	382189	6429511	5	
*Cenchrus setaceus	382204	6429524	5	
*Chamelaucium uncinatum	381692	6428855		6 - 30 %
*Cynodon dactylon	382200	6429628		6 - 30 %
*Cynodon dactylon	381808	6428631		6 - 30 %
*Cynodon dactylon	381791	6428709		< 5 %
*Dimorphotheca ecklonis	381677	6429011		< 5 %
*Dimorphotheca ecklonis	381825	6429204		< 5 %
*Dimorphotheca ecklonis	381743	6429114		< 5 %
*Ehrharta longiflora	381871	6429065		6 - 30 %
*Euphorbia peplus	381872	6428725		< 5%
*Euphorbia peplus	381872	6428725		< 5%

10.0 Appendices (continued)

Appendix H Introduced flora species locations

Weed species	Location		Population size (no. individuals)	% cover
	Easting	Northing		
**Euphorbia terracina*	381867	6429053		< 5%
**Freesia alba × leichtlinii*	382132	6429509		< 5 %
**Freesia alba × leichtlinii*	381718	6428929		< 5 %
**Fumaria capreolata*	381675	6428725		< 5 %
**Fumaria capreolata*	381933	6429334		< 5 %
**Fumaria capreolata*	381873	6429074		< 5 %
**Gladiolus caryophyllaceus*	381904	6429091		< 5 %
**Gladiolus caryophyllaceus*	381904	6429091		< 5 %
**Gomphocarpus fruticosus*	381807	6429125	1	
**Gomphocarpus fruticosus*	381807	6429125	1	
**Hypochaeris radicata*	381930	6429234		< 5 %
**Lagurus ovatus*	381873	6429071		< 5 %
**Leptospermum laevigatum*	381717	6428916		< 5 %
**Lysimachia arvensis*	381874	6429070		< 5 %
**Medicago polymorpha*	381782	6429046		< 5 %
**Medicago polymorpha*	381782	6429046		< 5 %
**Melaleuca nesophila*	382136	6429585	1	
**Melaleuca nesophila*	381749	6429131	1	
**Melaleuca nesophila*	381776	6429153	1	
**Melaleuca nesophila*	381890	6429056	50	
**Melaleuca nesophila*	382145	6429467	5	
**Melaleuca nesophila*	382107	6429427	3	
**Melaleuca nesophila*	381629	6428921	1	
**Orobanche minor*	381968	6429283	5	
**Orobanche minor*	381968	6429283	5	
**Oxalis pes-caprae*	382060	6429424		6 - 30 %
**Oxalis pes-caprae*	381787	6428908		< 5 %
**Oxalis pes-caprae*	381787	6428908		< 5 %
**Pelargonium capitatum*	381722	6428929		< 5 %
**Pelargonium capitatum*	382103	6429494		< 5 %
**Pelargonium capitatum*	381947	6429269		< 5 %
**Polygala myrtifolia*	381695	6429033	1	
**Polygala myrtifolia*	381695	6429033	1	
**Rhamnus alaternus*	381676	6428735		6 - 30 %

Appendix H Introduced flora species locations

Weed species	Location		Population size (no. individuals)	% cover
	Easting	Northing		
**Rhamnus alaternus*	381979	6429390	1	
**Rhamnus alaternus*	381743	6428855		< 5 %
**Rhamnus alaternus*	381691	6428835		< 5 %
**Rhamnus alaternus*	381916	6428728		< 5 %
**Rhamnus alaternus*	381891	6428754		< 5 %
**Romulea rosea*	381867	6429075		< 5 %
**Scabiosa atropurpurea*	381735	6428830		< 5 %
**Scabiosa atropurpurea*	381733	6429004		< 5 %
**Scabiosa atropurpurea*	381790	6429061		6 - 30 %
**Scabiosa atropurpurea*	381956	6429225		< 5 %
**Schinus terebinthifolius*	382136	6429538		6 - 30 %
**Schinus terebinthifolius*	381830	6428994		< 5 %
**Senecio vulgaris*	381805	6428824	10	
**Senecio vulgaris*	381759	6428863		< 5 %
**Senecio vulgaris*	381805	6428824	10	
**Senecio vulgaris*	381759	6428863		< 5 %
**Silene gallica*	382124	6429534	1	
**Solanum nigrum*	381972	6429405	1	
**Solanum nigrum*	381972	6429405	1	
**Sonchus oleraceus*	381871	6429068		< 5 %

1 Declared Pest under the Biosecurity and Agriculture Management Act 2007 (Department of Agriculture and Food 2015)

10.0 Appendices (continued)

Appendix I Fauna species list

Species	Common name	Field notes
Birds		
**Columba livia*	Domestic Pigeon	Observation
**Streptopelia chinensis*	Spotted Turtle-Dove	Observation
**Streptopelia senegalensis*	Laughing Turtle-Dove	Observation
**Trichoglossus haematodus moluccanus*	Rainbow Lorikeet	Observation
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Observation
Anas superciliosa	Pacific Black Duck	Observation
Anthochaera carunculata	Red Wattlebird	Observation
Artamus personatus	Masked Woodswallow	Observation
Cacatua roseicapilla	Galah	Observation
Corvus coronoides	Australian Raven	Observation
Cracticus tibicen	Australian Magpie	Observation
Cracticus torquatus	Grey Butcherbird	Observation
Gerygone fusca	Western Gerygone	Observation
Larus novaehollandiae	Silver Gull	Observation
Malurus splendens	Splendid Fairy-wren	Observation
Pelecanus conspicillatus	Australian Pelican	Observation
Phylidonyris novaehollandiae	New Holland Honeyeater	Observation
Platycercus spurius	Red Capped Parrot	Observation
Platycercus zonarius semitorquatus	Twenty-eight Parrot	Observation
Rhipidura fuliginosa	Grey Fantail	Observation
Rhipidura leucophrys	Willie Wagtail	Observation
Smicrornis brevirostris	Weebill	Observation
Mammals		
**Felis catus*	Cat	Observation
Macropus fuliginosus	Grey Kangaroo	Diggings
**Oryctolagus cuniculus*	Rabbit	Burrow Diggings Scats
**Vulpes vulpes*	Red Fox	Burrow

Appendix H Introduced flora species locations

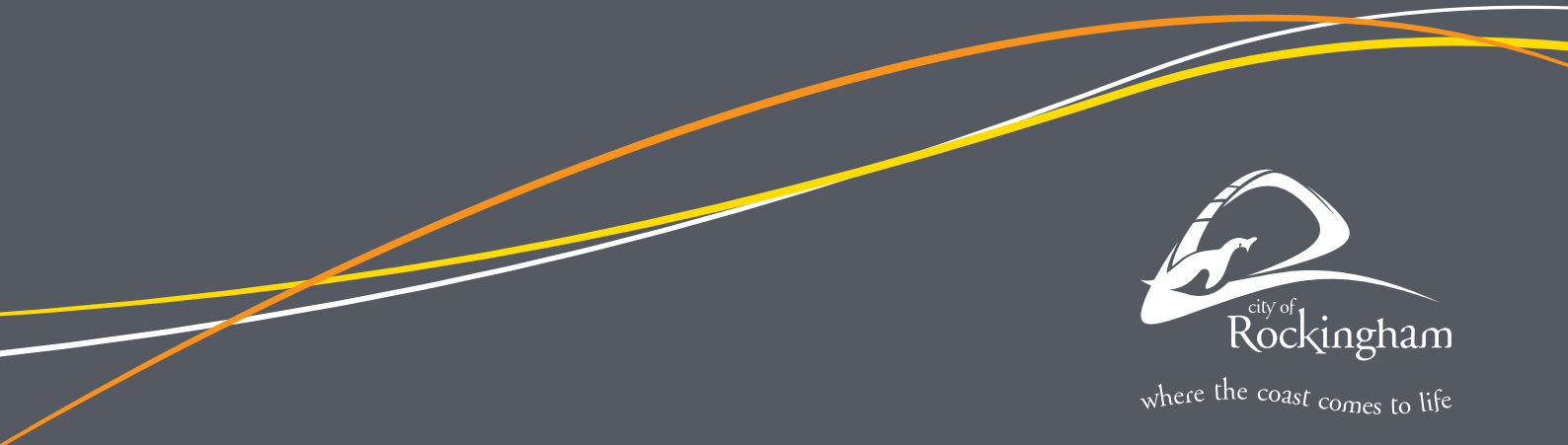
Species	Common name	Field notes
Reptiles		
Pogona minor subsp. minor	Bearded Dragon	Observation
Tiliqua rugosa	Bobtail	Observation
Varanus sp.	Goanna	Observation
Invertebrates		
Abispa ephippium	Australian Hornet	Observation
**Apis mellifera*	European Honeybee	Observation
Perga sp.	Sawfly Larvae	Observation
Pieris rapae	Cabbage White Butterfly	Observation
**Theba pisana*	White Italian Snail	Observation
Vanessa kershawi	Australian Painted Lady Butterfly	Observation

Appendix J Introduced fauna locations

Species	Common name	Evidence type	Location	
			Easting	Northing
**Felis catus*	Domestic Cat	Observed	382080	6429484
**Vulpes vulpes*	Red Fox	Old den	381867	6428736
**Vulpes vulpes*	Red Fox	Den	382148	6429466
**Oryctolagus cuniculus*	Rabbit	Diggings/scats	382053	6429327
**Oryctolagus cuniculus*	Rabbit	Scats	381986	6429246
**Oryctolagus cuniculus*	Rabbit	Diggings/scats	382104	6429420
**Oryctolagus cuniculus*	Rabbit	Diggings	381779	6428764
**Oryctolagus cuniculus*	Rabbit	Warren	381755	6428765

CITY OF ROCKINGHAM

Lewington Reserve
Management Plan



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