



Great Southern Bio Logic
environmental solutions

Level 1 Fauna Survey

Merivale Road, Esperance



SEPTEMBER 2015

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Executive Summary

The site contains approximately 15.28 ha of good quality fauna habitat, including heath and closed scrub on sandy and gravelly loams and Mallee over sandy loams in the depression. Assuming an impact width of 20m, about 2.8 ha of heath and scrub will be cleared and about 0.2 ha of Mallee. No specific fauna habitat attributes were identified as constraints during the fieldwork.

The site may provide suitable habitat for several conservation significant species; three birds (Carnaby's Black Cockatoo, Malleefowl, Western Ground Parrot), two reptiles (Southern Death Adder, Southern Carpet Python) and two mammals (Quenda, Western Brush Wallaby). Impacts are likely to be low for all species.

The site is located as potential habitat within the western extent of the Management Area 2 outlined in the South Coast Threatened Birds Recovery Plan (DPaW 2014). Whilst impacts to Western Ground Parrot at the site are likely to be low, as noted by Ecoscape (2015) any deleterious impact on this Critically Endangered species should not be an acceptable risk. Recommendations are made in Section 7 to ensure impacts to conservation significant fauna are low or less.

It is understood that the project will be referred to the federal Department of the Environment (DoE).

1 Introduction

1.1 Background

The State Barrier Fence (SBF) currently extends from the Zuytdorp Cliffs, north of Kalbarri, to 25 km east of Ravensthorpe, over a distance of about 1170 km. In an effort to protect the more-recently developed land east of Ravensthorpe from major emu migration events and wild dogs, the Department of Agriculture and Food Western Australia (DAFWA) proposes to extend the SBF by up to 622 km from east of Ravensthorpe to east of Esperance.

A scoping study was conducted in 2012 to identify project constraints associated with several potential fence alignment options by GHD Pty Ltd. A preferred alignment for the Esperance extension has since been identified. The majority of the proposed extension occurs on the boundary between agricultural land and Unallocated Crown Land (UCL).

The construction of the Esperance extension will require the clearing of native vegetation within a 20 m wide easement. Detailed biological surveys, including flora, fauna and dieback assessments, were undertaken by Ecoscape (2015). These assessments were required to provide baseline data and inform the need to refer the project to the Western Australian (WA) Environmental Protection Authority (EPA), Commonwealth Department of the Environment (DoE) and clearing permit application to the WA Department of Environmental Regulation (DER).

DAFWA has recently identified that topographic constraints will make the (previously assessed) alignment difficult to develop at some locations. One particular section located north of Merivale Road, Boyatup, approximately 100 km east of Esperance, will need to be realigned through approximately 1.6 km of vegetated UCL rather than the private property previously proposed, to avoid steep slopes and creek crossings. This Level 1 fauna survey is required to assess the fauna and habitat values of the proposed realignment within 100 m of Merivale Road, to supplement the existing surveys carried out by Ecoscape (2015). SW Environmental were commissioned to carry out this survey by Great Southern Bio Logic on behalf of DAFWA.

The study area includes a 100 m buffer from Merivale Road within the UCL to allow the fence to be micro-sited if needed to avoid any environmental constraints. The location of the study area is shown in Figure 1-1. For the purposes of this survey the 'locality' includes the areas within 20 km of the study area.

This report addresses the fauna values and impacts associated only with additional minor realignment proposed for the study area. It does not seek to address the broader implications of the SBF Esperance extension on fauna or the across the wider landscape. This was the focus of the Ecoscape (2015) report. It is understood that the project will be referred to the federal Department of the Environment (DoE).

1.2 Scope of works

The scope of work includes a Level 1 terrestrial vertebrate fauna survey of the study area (referred to above), consistent with the general criteria for 'Level 1 fauna surveys' (EPA Guidance Statement No. 56, EPA, 2004) within 100 m of the UCL north of Merivale Road. The fauna survey includes

- Desktop assessment,
- Field validation and general habitat assessment,
- Consultation, reporting (including a discussion on impacts), mapping and recommendations.



- Study area
- Cape Arid National Park

- Base map © Esri and its data suppliers and SLIP (2015).

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Figure 1-1 Location of the site

1.3 Regulatory context

1.3.1 Legislative framework

The conservation status of fauna species in Western Australia is assessed under the federal *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the state administered *Western Australian Wildlife Conservation Act 1950* (WC Act).

Species listed as threatened, migratory or priority under the above legislation are referred to collectively in this document as 'conservation significant fauna' or 'target species'.

WC Act

Species of fauna are afforded Declared Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes. The Department of Parks and Wildlife (DPaW) administers this Act. DPaW recognises these threats of extinction and consequently applies regulations towards population and species protection. The Western Australian Minister for the Environment regularly gazettes a notice where taxa are listed as protected and classified under Schedule 1 through to Schedule 4 according to their conservation status or need for protection. The most recent was issued on 4 December 2014.

- S1 - Schedule 1 Rare or likely to become extinct
- S2 - Extinct
- S3 - Protected under International agreements
- S4 - Other specially protected fauna

For the purposes of this report S1 scheduled species are also referred to as T – Threatened. DPaW also produces a list of priority species that have not been assigned statutory protection under the WC Act, but are under consideration as 'Scheduled' taxa, and are in urgent need of further survey or regular monitoring, and although not currently threatened may become so in the future.

- P 1: Taxa with few, poorly known populations on threatened lands.
- P 2: Taxa with few, poorly known populations on conservation lands.
- P 3: Taxa with several, poorly known populations, some on conservation lands.
- P 4: Taxa in need of monitoring.
- P 5: Taxa in need of monitoring.

EPBC Act

In accordance with Commonwealth legislation, the EPBC Act provides a list of matters of 'National Environmental Significance' (NES), which includes significant fauna, flora and communities. Under the EPBC Act threatened fauna may be listed in any one of the following categories as defined in *Section 179* of the Act:

- Extinct;
- *Extinct in the wild;
- *Critically endangered;
- *Endangered;
- *Vulnerable; and
- Conservation dependent.

*Only species in those categories marked with an asterisk are matters of NES under the Act.

The EPBC Act also lists migratory species that are recognized under international treaties including the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA) and the Bonn Convention (The Convention on the conservation of Migratory Species of Wild Animals). Species listed under JAMBA are also protected under Schedule 3 of the WC Act.

IUCN Red List

The IUCN Red List is an inventory of the global conservation status of species and used to assist DPAW and other agencies in attributing a given threatened species status. It does not have any statutory authority.

1.3.2 Guidelines

The survey also considers the guidelines below.

Federal, Department of Environment

- Commonwealth '*Matters of National Environmental Significance – Significant impact guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999, Department of the Environment, Water, Heritage and the Arts (DEWHA)*', (2009),
- Commonwealth '*EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered), Calyptorhynchus latirostris, Baudin's cockatoo (vulnerable), Calyptorhynchus baudinii, Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso*', (SEWPaC 2012),

WA, Office of the Environmental Protection Authority (OEPA)

- '*Environmental Protection of Native Vegetation in Western Australia Position Statement No. 2*', EPA (2000),
- '*Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3*', EPA (2002).
- EPA Guidance Statement No. 56 '*Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*', (2004), in particular 'Level 1 surveys', outlined in Appendix 2 of the Guidance Statement,
- '*Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*' EPA and DEC (2010).

2 Methods

2.1 Desktop Assessment

Prior to field surveys, a desktop assessment was undertaken to develop an understanding of the ecological values of the study area and to assist in identifying the likelihood of target species (threatened, migratory or priority listed fauna) occurring there. This involved a review of relevant databases, previous survey reports, the results of consultation and a review of books and other publications.

Information about target species records was also obtained from literature (books and scientific journals), management plans, recovery plans, and government species profile databases. Experts involved in ecological research were also consulted in the preparation of this report.

2.1.1 Database searches

Searches within the locality, i.e. 20 kilometres of the study area, were carried out using the Atlas of Naturemap (2015) and Living Australia (ALA, 2015)¹ databases. Both of these amalgamate records from sources including but not limited to

- WA Museum,
- Department of Parks and Wildlife (DPaW),
- Birds Australia.

GIS datasets were also queried, including

- Beard vegetation mapping dataset from the Department of Agriculture and Food WA (DAFWA) 'Native vegetation extent' dataset (current July 2013),
- Soils mapping datasets from DAFWA (2004),
- Aerial photography (ESRI and its data providers),
- GIS datasets (e.g. drainage lines and wetlands) sourced from the Shared Land Information Platform (SLIP) (2015).

2.1.2 Previous surveys and consultation

Few fauna surveys appeared to have been conducted locally or were available at the time of writing. Those that were available are listed below:

- Fauna records from Cape Le Grand, National Park derived from surveys conducted by DPaW (Esperance) through the Western Shield Program (provided by Stephen Butler 30.07.2014),
- Cowan. M. (2011) A preliminary fauna survey of New Island Bay, Cape Le Grand National Park. Department of Environment and Conservation, Woodvale, WA,
- Ecoscape (2015) State Barrier Fence Biological Surveys, Draft report prepared for DAFWA.
- GHD (2012) Report for State Barrier Fence Esperance Extension Scoping Study, Unpublished report for DAFWA.
- SW Environmental (2014) Level 1 Fauna survey for the Lucky Bay Recreation Site extension, Unpublished report to Great Southern Bio Logic on behalf of WA Department of Parks and Wildlife (DPaW).

2.1.3 Publications

Publications consulted for general distribution of fauna included:

- A Field Guide to the Mammals of Australia (Menkhorst and Knight, 2011),
- Common Birds of the South West Forests (Thomson-Dans and Hunter, 2009),
- Common Trees of the South West (Wheeler, 2007),
- Field guide to frogs of Western Australia (Doughty and Tyler, 2009)
- Frogs of Western Australia (Thomson-Dans and Wardell-Johnson, 2002),
- Mammals of the South West (Johnson and Thompson Dans, 2003),
- Michael Morcombe's Birds of Australia eGuide, (2011),
- Reptiles and Frogs in the Bush: Southwestern Australia (Bush et al., 2007),
- Scats, Tracks and Other Traces: A field guide to Australian mammals (Triggs, 2004),
- The Field Guide to the Birds of Australia (Pizzey and Knight, 2007),
- Threatened and Rare Birds of Western Australia (Burbidge and Blight, 2008),

¹ ALA (2015) search was only available within 10 kilometres of the study area.

- Waterbirds of South-west Wetlands (Thomson-Dans and Halse, 2001).
- Numerous online publications (see References section)
- Numerous other general species references are included in the References section.

2.2 Site Reconnaissance

Field work consisted of a site reconnaissance carried out on Wednesday 12th August (winter) 2015, by an experienced fauna and habitat surveyor (Shane Priddle). The days leading up to and immediately after the survey were wet, however the conditions during the survey were cool but sunny. The weather conditions from Esperance Airport are provided below.

Table 2-1 Weather conditions (Esperance Airport: station 009542, BOM 2015, 120km from the site)

Date	Min temp (°C)	Max temp (°C)	Rainfall (mm)	Temperature (°C), Wind (direction, km/hour)	
				9am	3pm
12/08/2015	10.9	17.2	6	12.2, WNW, 13	15.5, SW, 17

Survey methodology is described below and shown in Figure 2-1.

2.2.1 Validation of desktop study

The site attributes visible by aerial photo interpretation and habitat types identified during the desktop study were validated by walking over the study area. Other ecological features were identified, such as specific habitat features (see microhabitat elements below), presence or absence of ephemeral or permanent drainage features, during the fieldwork.

2.2.2 Habitat assessment plots

Broad structural fauna habitat types were identified and mapped. Nine habitat assessment plots (each approximately 10 x 10m) were undertaken (Figure 2-1). Sampling included at least one plot within each broad structural habitat type; multiple plots were undertaken in some types. Micro habitat elements assessed, where present, included vegetation structure, habitat condition, ground cover, presence of rocky outcrops, ground litter, type of substrate, habitat trees and fallen logs. In particular habitat attributes were considered with respect to species of conservation significance. Photos were taken. Notes were made about the quality of habitat based on the descriptions in Table 2-2 below.

Table 2-2 Fauna habitat quality categories and descriptions (from ngenvironmental, undated)

Quality	Description
Good	<ul style="list-style-type: none"> • Diverse habitat structure, structural components present at a range of stratum levels (ground, understorey, midstorey, canopy) and age classes. • Presence of shelter and refuges, that is, low shrub or tussock, rocky outcrop, hollow logs (ground dwelling fauna). • If forest or woodland: moderate to high abundance of hollow-bearing trees, including mature trees which are more likely to bear hollows of a range of sizes, including those with large internal dimensions. Mature trees also produce more foraging resources for nectar and seed eating fauna.

Quality	Description
	<ul style="list-style-type: none"> Habitat complexity, that is, areas of ecotones between vegetation types or areas with different management regimes, which produce a habitat mosaic. This increases the range of foraging and shelter opportunities within a habitat. Presence of key foraging and microhabitat components, which depend on subject species. Little to no obvious weed invasion. May be large patch in extent and connected to other areas of native vegetation.
Moderate	<ul style="list-style-type: none"> Medium complexity of habitat structure appropriate to vegetation type. Ground litter layer intact or slightly disturbed. More than one age class present. Some shelter and refuge present for ground dwelling fauna. If forest or woodland: hollow-bearing trees present in low to moderate abundance. Habitat complexity, that is, areas of ecotones between vegetation types or areas with different management regimes, which produce a habitat mosaic. This increases the range of foraging and shelter opportunities within a habitat. Presence of key microhabitat components, which depend on subject species. Native flora species dominant. May be small or large in scale, and isolated or well connected.
Poor	<ul style="list-style-type: none"> Habitat highly disturbed and simplified with very little structural complexity. Ground litter layer absent or highly modified. Complexity reduced by only one age class present. Little or no shelter and refuge for ground dwelling fauna. If forest or woodland: low abundance of hollow-bearing trees. Lack of key foraging and microhabitat components, which depend on subject species. May be narrow or small area and substantially influenced by edge effects, and isolated from other areas of native vegetation.

2.2.3 Fauna survey

Fauna observations were recorded. Secondary evidence of fauna such as tracks, nests, scat, bones, diggings, characteristic feed sign were also recorded.

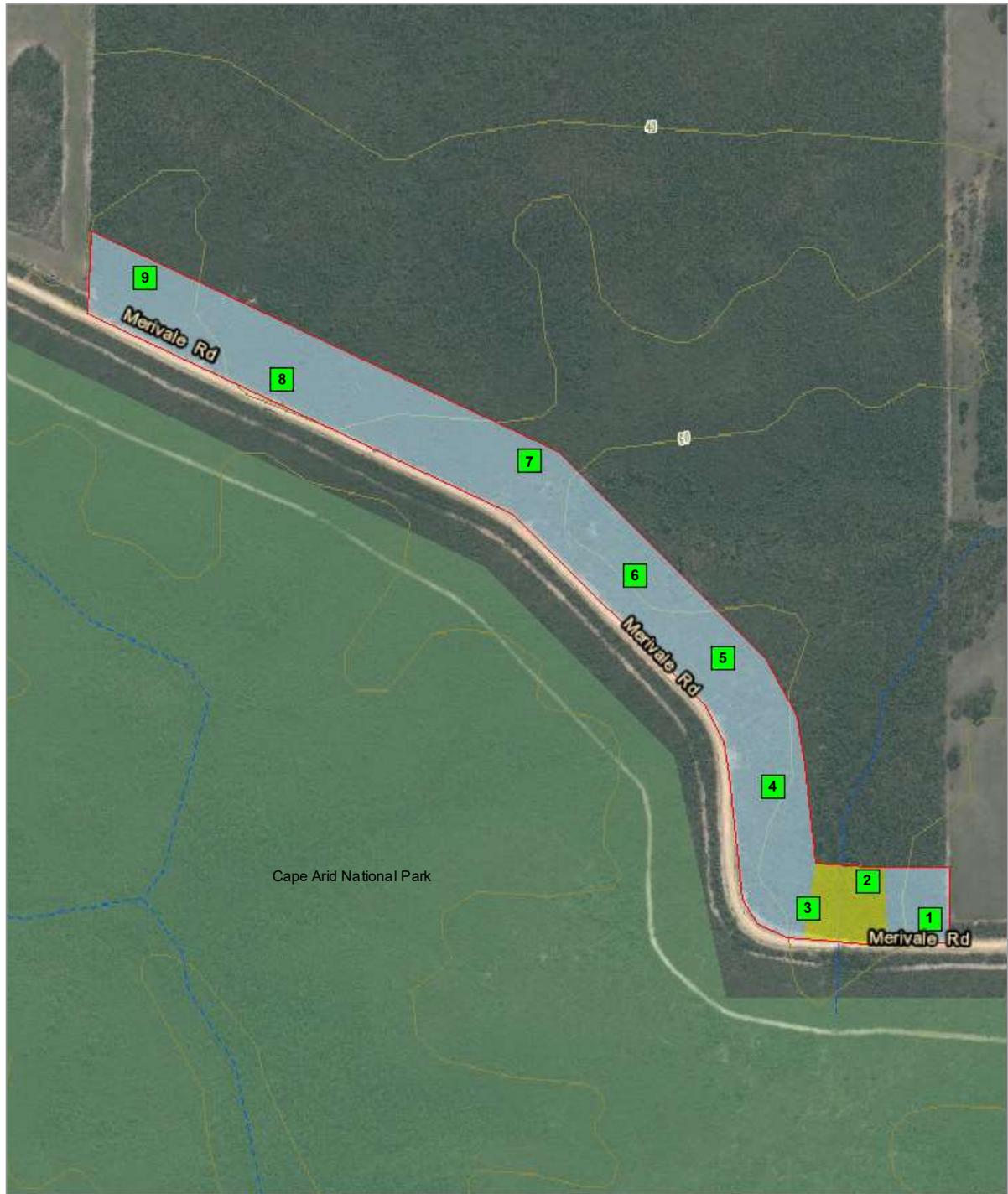
Some active searching was also undertaken when suitable microhabitat was encountered during the habitat assessments and broader survey. These aimed to locate the more elusive frog and reptile species that may inhabit the site. Active searching included investigating burrows, investigating scats, tracks and other traces, turning fallen timber and rocks, opening standing timber crevices, peeling bark.

2.2.4 HBT mapping and black cockatoo surveys

Hollow bearing trees (HBT) within the site were mapped and hollow height, size, and tree diameter (where species occur that typically form hollows) were noted into classes. Presence or absence of black cockatoo forage habitat and roosting evidence was also noted.

2.2.5 Mapping and data collection

Mapping was carried out using ArcGIS 10.0 geographic information system (GIS) software. Field data was captured using a Garmin GPSmap 60CSx high sensitivity handheld GPS.



- Habitat plot
- Study area
- Heath and closed scrub on sandy and gravelly loams
- Mallee on sandy loams in the depression
- Cape Arid National Park

- Base map © Esri and its data suppliers and SLIP (2015).

The accuracy and integrity of the information displayed in this map are not guaranteed by SW environmental, nor does SW environmental bear responsibility/liability for any errors, omissions or map uses.

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Figure 2-1 Habitat plot locations

2.3 Limitations

In accordance with the EPA Guidance Statement No. 56 (EPA 2004), potential limitations of the fauna survey have been identified below:

Competency	A suitably qualified individual carried out the site reconnaissance and habitat assessment: Shane Priddle, Certified Environmental Practitioner (EIANZ).
Access problems	The site was accessible and surveyed on foot.
Timing	Field surveys were undertaken in winter. Fauna, particularly reptiles, are generally likely to be less active in the winter months which may negatively affect detectability.
Scope	A level 1 vertebrate fauna survey was undertaken. Invertebrates and other short range endemics were not considered in the site reconnaissance. The single site visit and climate conditions are likely to have had some impact on the effectiveness of the survey though the survey effort applied is considered adequate to have met the scope of works required.
Hollow-bearing trees	No hollow bearing trees were observed. While every effort has been made to obtain accurate and reliable data about presence of hollow-bearing trees, it is difficult to be certain about whether an apparent hollow is actually hollow, and vice versa, without physical inspection. Thus, it is possible that some hollows may have been overlooked but it considered unlikely based on the type of vegetation present (i.e. mallee over shrubland, that trees were either not of sufficient diameter to develop hollows or not species that do not normally develop hollows).
Remoteness	The site is relatively remote and few surveys were available for referencing in the desktop assessment.
Seasonal or occasional visitations	Given the narrow width of the site (100m), that it is located on the edge of a larger patch of remnant vegetation and close to Cape Arid NP, there may be some species that utilise the site intermittently for foraging. It is probable that many of these species have not been identified in this survey and that the species list provided is only a small subset of fauna that may utilise the site.
Precautionary approach	As it is difficult to rule out the presence of any particular species without rigorous scientific surveys, a precautionary approach has been adopted. If suitable habitat is present and desktop assessment has determined the species could occur in the area, the species has been assumed to have potential to utilise habitat within the site.

3 Desktop Review

3.1 Environmental Context

3.1.1 Interim Biogeographic Regionalisation of Australia (IBRA) values

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia's landscapes into 89 large geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information. IBRA also provides for the national and regional planning framework for the systematic development of a comprehensive, adequate and representative (CAR) National Reserve System, endorsed by all levels of government as a key tool for identifying land for conservation under the Commonwealth's *Australia's Strategy for the National Reserve System 2009-2030* (DE, 2015).

According to the latest IBRA update (7), the study area is located within the ESP02 Recherche subregion of the Esperance Plains. The Esperance Plains bioregion is characterised by proteaceous scrub and mallee heaths on sandplain; herbfields and heaths occur on granite and quartzite ranges that rise from the plain. The heaths are rich in endemics. Eucalypt woodlands occur in gullies and alluvial foot-slopes (Comer et al. 2002).

3.1.2 Landform, soils and climate

ESP02 subregion has variable relief, consisting of Quaternary coastal sandplains and dunes overlying Proterozoic gneiss and granite as well as Eocene and more recent coastal limestones. Numerous granitic islands occur just off the coast of the mainland. Vegetation types are diverse and comprise of heath, coastal dune scrub, mallee, mallee-heath and granite heath. The subregion has a Temperate Mediterranean climate, with 400-700 mm annual rainfall (Comer et al. 2002).

3.1.3 Brief land use summary

Local land is typically used for grazing (improved pasture) and cultivation (dry-land agriculture), with some areas of conservation, UCL and Crown reserves, easements, and forestry plantations and National Park.

The study area is located immediately north (within 100 m) of Merivale Road within UCL containing remnant vegetation.

3.1.4 Important Bird Areas (IBA)

Important Bird Areas (IBAs) are areas identified by Birdlife International. IBAs are considered conservation priorities, sites able to be conserved in their entirety and are usually part of a protected-area network and recognised as having global bird conservation importance (Birdlife International, 2012). IBAs

- contain significant numbers of one or more globally threatened species,
- are one of a set of sites that together hold a suite of restricted-range species or biome-restricted species, or
- support exceptionally large numbers of migratory or congregatory species.

The closest IBA is located over five kilometres south and consists of islands recognised under the Recherche Archipelago IBA. The Recherche is an archipelago of about 300 islands, islets and rocks off the south coast, immediately south of the site.

According to Birdlife International (2015), this archipelago supports more than one percent (1%) of the world population of western subspecies of Cape Barren Goose *Cereopsis novaehollandiae grisea* and is the only breeding place for this species. Flesh-footed Shearwater *Ardenna carneipes*, Sooty Oystercatcher *Haematopus fuliginosus*, Fairy Tern *Sternula nereis* and probably White-faced Storm-

Petrel *Pelagodroma marina* also occur. Red-eared Firetail *Stagonopleura oculata* and Rock Parrots *Neophema petrophila* have been recorded. The Islands also provide refugial habitat for terrestrial fauna and relictual populations of fauna once widespread on the mainland (DEC 2012), and are therefore ecologically significant.

3.1.5 Conservation lands

The study area is located adjacent to the western end of the Cape Arid National Park (NP) (c. 280 000 ha), which is located south of Merivale Road. Recherche Archipelago Nature Reserve includes the islands south of the Cape Arid NP.

Numerous Nature Reserves occur within the region with the closest being the Alexander Nature Reserve located about 20 km south west of the study area.

The Cape Arid NP is managed under the *Esperance and Recherche parks and reserves draft management plan*, (DEC 2012) along with 70 other Parks and Reserves and 82 proposed additions. Extensive areas of UCL north of Fisheries Road, about five kilometres north of the study area, are proposed for NP status.

The site is not in close proximity to any RAMSAR wetland sites, the closest being the Lake Warden System at Esperance.

3.2 Fauna Habitat Values

3.2.1 Vegetation

Vegetation at the site has been mapped broadly by Beard (in DAFWA 2013) as vegetation associations Esperance 4801 and Fanny Cove 516. Descriptions are provided below:

- Esperance 4801: Shrublands; heath with scattered *Nuytsia floribunda* on sandplain.
- Fanny Cove 516: Shrublands; mallee scrub, black marlock.

The Cape Arid NP, and the study area, represents an ecotone of changing habitat from the arid zone in the east to the wetter coastal zone in the south west (DEC 2012).

3.2.2 Drainage lines and wetlands

An upper tributary of the non-perennial Thomas River passes through the UCL block associated with the study area. The closest section of this is about 400 m north of the study area. Several minor ephemeral depressions through the topography do occur through the study area but they are not likely to be considered actual drainage lines. Some localised and temporary pooling was present immediately downslope of some of the Merivale Road culverts. No other water features are associated with the study area.

3.2.3 Habitat connectivity, linkage and corridor values

The UCL block associated with the project is of a reasonable size (about 230 ha) and has some value in connecting the vegetation associated with the upper reaches of the Thomas River to Cape Arid NP in the south. It should be noted that existing barriers include cleared tracks and Merivale Road itself between the Cape Arid NP and the UCL block. From a landscape perspective the UCL block is overshadowed by the close proximity of Cape Arid NP which has contiguous reserved vegetation and fauna habitat and is significantly larger than the UCL associated with the project.

3.3 Fauna Records

3.3.1 Local records

Much of the local area however has not been systematically surveyed for fauna. Two hundred and twenty-two terrestrial vertebrate fauna species have been recorded in local survey results and database records (Appendix B). This figure includes eight amphibians, 159 birds, 17 mammals and 38 reptiles. It generally does not include numerous invertebrates or marine or aquatic dependant species (fish, marine turtles, albatrosses etc) as they will not be impacted by the project. Conversely some records may be seasonal visitors or may be associated with coastal or marine environments and may not occur at the site.

The *Esperance and Recherche parks and reserves draft management plan*, (DEC 2012) also identifies a higher number of locally occurring species within Plan's broader management area (c. 845 000 ha from Lake Shaster Nature Reserve in the west, the end of Wylie Scarp in Nuytsland Nature Reserve in the east):

- 16 amphibians,
- 258 birds, with 182 recorded within Cape Arid National Park alone,
- 31 mammals, and
- 72 reptiles.

At least three species from the list above are introduced (Fox, Rabbit and House Mouse).

3.3.2 Invertebrates and short range endemics

The Naturemap (2015) and EPBC PMST (2015) did not identify any local records of invertebrates or short range endemics of conservation significance. Short range endemic fauna, which includes species of insects, arachnids myriapods and crustaceans that have highly restricted distributions because of poor dispersal, slow growth, low fecundity, specific habitat preferences, are particularly vulnerable to extinction (Moir et al 2009b). Unfortunately very little is known about how many species there are or which areas within the south-west are most important for conservation.

Millipedes are a good example of short range endemic fauna with many species of conservation significance. Moir et al (2009b) identified the nearby Cape Arid as one of five main areas that as having a particularly speciose millipede fauna or were areas where the millipede fauna was highly endemic. The predicted decline in rainfall for the southwest through global climate change may result in less moist refugia required by many species of millipedes species have narrow geographic ranges.

Moir and Harvey (2008) note that one conservation significant species of millipede *E. sarahae* prefer coastal gullies, well shaded and with dense leaf litter. These areas are wetter with taller and denser canopy than surrounding heath/mallee. Other millipedes may also prefer similar habitats.

3.3.3 Conservation significant fauna

From the desktop assessment a number of conservation significant species may occur locally:

- Two specially protected species (a reptile and a bird),
- Three (terrestrial) migratory species (birds),
- Four Priority species (four mammals and a reptile),
- Eight threatened species (five birds and three mammals).

No fish of conservation significance are likely to occur at the site given the lack of water courses and other suitable habitat. A habitat evaluation table has been prepared for conservation significant fauna (Appendix A).

Table 3-1 Threatened, migratory and priority listed fauna that may occur locally (habitat may not necessarily be suitable within the study area for all species). Refer to Appendix A for habitat potential and risk assessment for impacts against each species.

Species Status*	Scientific name	Vernacular name	Status (State, Cth)
INVERTEBRATES			
-			
VERTEBRATES			
AMPHIBIA	-		
AVES	<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	T, E
	<i>Cereopsis novaehollandiae subsp. grisea</i>	Recherche Cape Barren Goose	T, V
	<i>Falco peregrinus subsp macropus</i>	Peregrine Falcon	S, -
	<i>Falco hypoleucos</i>	Grey Falcon	T, -
	<i>Haliaeetus leucogaster</i>	White-bellied Sea eagle	-, M
	<i>Leipoa ocellata</i>	Malleefowl	T, V, M
	<i>Merops ornatus</i>	Rainbow Bee-eater	-, M
	<i>Pezoporus flaviventris</i>	Western Ground Parrot	T, CE
MAMMALIA	<i>Dasyurus geoffroii</i>	Western Quoll, Chudich	T, V
	<i>Isodon obesulus fusciventers</i>	Quenda	P5, -
	<i>Macropus eugenii subsp. derbianus</i>	Tammar Wallaby	P5, -
	<i>Macropus irma</i>	Western Brush Wallaby	P4, -
	<i>Parantechinus apicalis</i>	Dibbler	T, E
	<i>Petrogale lateralis subsp. Hacketti</i>	Recherche Black-footed Rock-wallaby	T, V
REPTILIA	<i>Acanthopis antarcticus</i>	Southern Death Adder	P3, -
	<i>Morelia spilota imbricata</i>	Southern Carpet Python	S, -

WA

T: Threatened which includes
S1: Schedule 1 Rare or likely to become extinct
S2: - Extinct
S3: - Protected under International agreements
S4: - Other specially protected fauna
 This status criterion has been set by the *Wildlife Conservation Act 1950*.

Priority Fauna

P 1: Taxa with few, poorly known populations on threatened lands.
P 2: Taxa with few, poorly known populations on conservation lands.
P 3: Taxa with several, poorly known populations, some on conservation lands.
P 4: Taxa in need of monitoring.
P 5: Taxa in need of monitoring.
S: Specially protected
 These status criteria have been set by the WA Department of Environment and Conservation.

Federal

VU: Vulnerable
EN: Endangered
CE: Critically Endangered
Mig: Species listed under the JAMBA, CAMBA, ROKAMBA and Bonn Convention
 These status criteria have been set by the *Environmental Protection and Biodiversity Conservation Act 1999*.

4 Results

4.1 Fauna Habitat

4.1.1 General habitat condition

Fauna habitat is generally a function of local differences in structural vegetation types and other factors such as substrate (soils, rocky outcrops) and drainage. Key habitats at the site include

- Mallee over sandy loams in the depressions.
- Heath and closed scrub and on sandy and gravelly loams.

Rocky outcrops, dead wood and trees are essential habitat components for a variety of fauna. Where present these resources provide shelter and invertebrate, microbial and vertebrate species are supported by decaying wood and in turn provide food for other species. No rocky outcrops were observed within the project site and fallen timber was also typically small and not large enough to provide hollows or good refuge other than for small reptiles. Habitat condition (see Table 2-2 for the scale) was still considered to be good due to the dense cover provided by the heath and the diversity of flora and structure of vegetation, providing not only cover and refuge but abundant feed resources.

The two fauna habitat types are described below. See Figure 2.1 for approximate locations of each habitat type.

- Mallee over sandy loams in the depressions (Habitat Plot 2).

Located in a moderate depression with a northerly slope, at the eastern edge of the site, it contained little mid or understorey vegetation. There were signs of recent washout, probably exacerbated by the road side drainage, but a creek bed, running or pooling water were absent. Mallee occurred over most of the site, though in other areas it was mostly sporadic or in clumps emerging over the scrub and heath layer. There was an abundant leaf litter with some small fallen timber.



Figure 4-1 Mallee over sandy loams in the depressions

- Heath and closed scrub on sandy and gravelly loams (Habitat Plot 1, 3-9)

This habitat type was present over most of the site. Large and patchy areas over the site were dieback affected with dead or dying *Xanthorrhoea*, *Banksia* and other susceptible species. Where they weren't dead the scrub was generally dense (up to 2m height) however where it had died back it was more open and seemed to be dominated by the lower heath (c. 50m height). There were however still significant areas in very good to excellent condition, (e.g. east of the Mallee in the depression). Some pools of water had accumulated near the Merivale Road culverts. Large fallen timber and leaf litter was generally sparse.



Figure 4-2 Closed scrub on sandy and gravelly loams (east of the Mallee in the depression; Merivale Road spoil is present on the left)



Figure 4-3 Closed scrub on sandy and gravelly loams (intact and located west of the Mallee in the depression).



Figure 4-4 Dieback affected closed scrub on sandy and gravelly loams.



Figure 4-5 Heath on sandy loams

The site is bordered each side (east and west) by cleared paddocks with improved pastures. Extensive vegetation is connected to the north and Cape Arid NP is located to the south. Cape Arid NP and the vegetation to the north of the site is intact, well connected and also generally in very good condition except for where it is affected by dieback, minor tracks or fire breaks. Habitat within the site itself was continuous.

Ecotones such as those between the road or paddock edge and scrub vegetation, or the heath and woodland, may provide foraging opportunities for predators such as raptors. The site offers a range of habitat opportunities for a variety of fauna and is well connected at a landscape scale.

The seasonal pooling associated with the roadside drains and culverts may also provide watering opportunities for some fauna and may be important for some species such as frogs and Tiger snakes that feed on them.

4.1.2 Corridor value

The remnant vegetation patch associated with the site is fairly well connected locally including to Cape Arid NP along its southern boundary. The largest area of fauna habitat locally, Cape Arid NP provides similar habitat types to those occurring at the site, and is likely to provide habitat for similar fauna assemblages to those at the site. It is noted that whilst the local parks including Cape Arid NP are fairly secure in terms of connectivity, linkages with other areas of remnant vegetation are required to provide fauna with

- migratory routes,

- access to areas containing seasonally variable food and other resources,
- escape and recolonisation routes, especially relevant in terms of large bushfires and potential longterm climatic impacts of global warming.

(DEC 2012)

Given the site is connected to the larger areas of intact habitat, wider ranging fauna may use the site as part of the larger patch. The c. 30m clearing associated with Merivale Road may present a barrier to some fauna.

4.1.3 Habitat trees

The mallee trees on site were generally not thick enough to develop hollows of sufficient quality to be utilised by hollow dependent fauna. No large trees (greater than 50 cm at breast height or with hollows) were observed within the site. Further the site is well outside of the breeding range for black cockatoos (SEWPaC, 2012).

4.2 Species recorded

Twenty-three fauna species (or evidence of) were observed at the site during the site reconnaissance. They included two frogs, 14 birds, one reptile, five mammals and the possible presence of an additional conservation significant species (the Priority 5 listed Southern Brown Bandicoot). Possible Bandicoot diggings were observed at several locations but weren't clear enough to be definitively Bandicoot due to the confirmed presence of Rabbit (scat and diggings) and Short-beaked Echidna (scat). In addition to Rabbits, evidence of introduced Cat and Fox tracks were also observed.

Table 4-1 Fauna observed at the site (see Appendix B for additional information)

Scientific name	Vernacular
<i>Crinia georgiana</i>	Quacking frog
<i>Litoria cyclorhyncha</i>	Spotted-thighed tree frog
<i>Acanthiza (Acanthiza) apicalis</i>	Inland Thornbill
<i>Anthochaera (Anellobia) lunulata</i>	Western Wattlebird
<i>Anthochaera (Anthochaera) carunculata</i>	Red Wattlebird
<i>Cacomantis (Vidgenia) flabelliformis</i>	Fan-tailed Cuckoo
<i>Coracina (Coracina) novaehollandiae</i>	Black-faced Cuckoo-shrike
<i>Corvus coronoides</i>	Australian Raven
<i>Dromaius novaehollandiae</i>	Emu
<i>Grallina cyanoleuca</i>	Magpie-lark
<i>Hirundo (Hirundo) neoxena</i>	Welcome Swallow
<i>Ocyphaps lophotes</i>	Crested Pigeon
<i>Phaps (Phaps) chalcoptera</i>	Common Bronzewing
<i>Phaps (Phaps) elegans</i>	Brush Bronzewing
<i>Phylidonyris (Meliornis) novaehollandiae</i>	New Holland Honeyeater
<i>Smicrornis brevirostris</i>	Weebill
<i>Isoodon obesulus fusciventer</i>	Southern Brown Bandicoot (possible)
<i>Macropus fuliginosus</i>	Western Grey Kangaroo
<i>Oryctolagus cuniculus</i>	Rabbit *
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna

<i>Felix catus</i>	Cat *
<i>Vulpes vulpes</i>	Fox *
<i>Acritoscincus trilineatum</i>	Southwestern Cool Skink

* denotes introduced species.

The number of fauna observed is significantly less than the total fauna that occurs at the site or that may visit the site periodically. Many of the fauna listed in Section 3.3.1 (and Appendix B) may occur at least periodically.



Figure 4-6 Cat track, note claws are retracted (circled red), with Emu track on the left and Western Grey Kangaroo scat on the right.



Figure 4-7 Fox track, note the presence of claws.

A small network of runways through the heath created by a species of small mammal were observed approximately 50 m north of Merivale Road (51 H 500745 6259706). They were considered too small to be used by Rabbits or Bandicoots and they are likely to be made by *Rattus fuscipes* (Bush Rat),

(Figures 4-8 and 4-9) (Pers comm. Dr Kenny Travouillon, Curator – Mammology, WA Museum, 17.08.2015). Other small mammals that occur locally, but not necessarily at the site, may include:

- *Mus musculus* (House Mouse) (introduced)
- *Notomys michellii* (Mitchells Hopping Mouse)
- *Pseudomys occidentalis* (Western Mouse)
- *Rattus fuscipes* (Bush Rat)
- *Sminthopsis crassicaudata* (Fat-tailed Dunnart)
- *Sminthopsis granulipes* (White-tailed Dunnart)
- *Sminthopsis griseoventer* (Grey-bellied Dunnart)

There is a very slight chance that *Parantchinus apicalis* (Dibbler)² could occur locally but the likelihood that it would occur within the site are very low, given its known distribution has contracted much further to the west (CALM 2003).



Figures 4-8 and 4-9 Heath runways (in red) likely to be used by a small mammal.



² EN under the WC and EPBC Acts

4.3 Conservation significant fauna

No conservation significant fauna were positively recorded at the site, however several target species have potential to occur there. These are outlined below.

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (T En)

Black cockatoos are long-lived, slow-breeding birds that display strong pair bonds that are suffering the effects of population decline and habitat loss. Carnaby's Black Cockatoo breed in hollows that are usually only found in trees that are more than 200 years old and are generally known to breed throughout the southwest, west of Ravensthorpe in the higher rainfall areas (SEWPAC 2012). Suitable breeding habitat does not occur at the site. Carnaby's Black Cockatoo has specific requirements though they generally forage on Eucalypt woodlands and forest, and proteaceous woodland and heaths (often Marri (seeds, flowers, nectar and grubs) and proteaceous trees and shrubs). A lone male was observed five kilometres west of the site whilst travelling to the site. Suitable forage habitat does occur at the site.

Malleefowl (*Leipoa ocellata*) (T, Vu, M)

Malleefowl are mostly located to the south and west of a line extending from Cape Farquhar, which lies north of Carnarvon, to the Eyre Bird Observatory in the south-east of Western Australia. It occurs in semi-arid and arid zones of temperate Australia, where it occupies shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including *Eucalypt* or native pine *Callitris* woodlands, *Acacia* shrublands, Broombush (*Melaleuca uncinata*) vegetation or coastal heathlands. The breeding habitat of the Malleefowl, within its home range, is characterised by light soil and abundant leaf litter (DEC 2010). There are no local records from Naturemap (2015) however suitable habitat does occur at the site, along with marginal breeding habitat within the Mallee through the depression. No nesting mounds were observed during the site visit.

Western Ground Parrot (*Pezoporus flaviventris*) (T, CE)

The Western Ground Parrot inhabits low, dry or swampy, near-coastal heathlands on sandplains and uplands in areas that receive 400-500 mm of rainfall annually. In recent years, confirmed records of the Western Ground Parrot have only been obtained within Fitzgerald River NP, Cape Arid NP and Nuytsland NR. It is also possible that a small subpopulation could persist in Waychinicup NP (SPRAT 2014).

They occur in long unburnt (5 to 40 or more years); floristically diverse, near-coastal dry heath (400 to 500 millimetres rainfall). This vegetation is usually less than 0.5 metres high, though often up to one metre high, with more than 50 per cent cover. Sedges are generally abundant, making up 40 per cent of total cover. Although these parrots are usually found in long unburnt vegetation, they have been observed to feed in habitats two to three years post-fire, provided there is older vegetation nearby (DPaW 2014). In addition Ground Parrots fly mainly at dawn and dusk, fly short distances, low over vegetation, nest on or close to the ground and have good dispersal ability (DPaW 2014). The South Coast Threatened Birds Recovery Plan identifies that the site is within the Management Area for the species.

Alan Burbidge and Sarah Comer (DPaW) (August 2015), both of which have published numerous articles on the species, indicated that whilst there are no recent records, Ground Parrots have been known to occur further north (near Fisheries Rd). Also possibly due to fox and cat control programs local known populations of Western Ground Parrots may be spreading to other areas, possibly including the site.

Southern Brown Bandicoot, Quenda (*Isodon obesulus fusciventer*) (P5)

Quenda's habitat consists of dense scrubby, often swampy vegetation with a dense cover up to one metre high particularly near watercourses and wetlands. It often feeds in adjacent forest (Jarrah and Wandoo) and woodlands that are burnt on a regular basis. Nests can be concealed next to or under old logs, shrubs or piles of debris and are made up of ground litter piled up over a shallow depression providing internal chambers. Home ranges vary with population density, and range from

5-8.6 ha for males and 1-6 ha for females (DEC 2010). Feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous fungi. Their searches for food often create distinctive conical holes in the soil (DECCW 2010). It would be at the edge of its distribution if present (Menkorst and Knight 2013). Possible Quenda diggings were observed though there are no local Naturemap records (2015).

Western Brush Wallaby (*Macropus irma*) (P4)

Optimum habitat for the Western Brush Wallaby includes open Jarrah forest or woodland and seasonally wet flats with low grasses and scrubby thickets, but also areas of mallee and heathland. Common dietary flora includes *Carpobrotus edulis*, *Cynodon dactylon* and *Nuytsia floribunda* (DEC, 2007). The site would be at the edge of the species' distribution if present (Menkorst and Knight 2013). There are no local Naturemap records (2015).

Southern Death Adder (*Acanthopis antarcticus*) (P3)

Southern Death Adders inhabit a range of habitats, including rainforest, scrubland, semi arid zones and rocky outcrops. Typically during the day they remain mostly buried beneath sand, soil or debris, with just the tail and top of the head exposed (Pilbara Pythons 2014).

Southern Carpet Python (*Morelia spilota imbricata*) (S)

It may shelter in burrows made by other animals, hollow tree limbs or logs (especially 150mm diameter hollows extending at least to one metre deep), or rock crevices. It commonly uses hollow logs for shelter (Wilson and Swan, 2008). This subspecies has been recorded from semi-arid coastal and inland habitats, *Banksia* woodland, *Eucalypt* woodlands, and grasslands. The species would need to rely on heath due to lack of other good refuge (hollow timber, trees, or rocky areas).

5 POTENTIAL IMPACTS

Details on the fence specifications (height, cell size, etc) and exact location were not available at the time of writing. It is understood that the fence would however be approximately 1-2 m in height, constructed within a 20 m wide clearing and within 100 m of Merivale Rd. Impacts associated with clearing and construction activities will be both direct and indirect, short term and long term. Ecoscape (2015) provides a detailed assessment with references to other literature of general impacts associated with the SBF expansion. Subsequently the sections below generally only address issues that are relevant specifically for the site.

5.1 DIRECT IMPACTS

Anticipated direct impacts of the proposal are described below. Some of these can be mitigated through the recommendations included in Section 7.

5.1.1 Clearing of native vegetation

Typical impacts associated with clearing native vegetation include

- direct loss of habitat,
- loss of mature vegetation (provides more flowers, nectar, fruit, seeds, refuge),
- loss of below ground biomass (such as seed banks)
- changes to faunal assemblages near the fence, and
- fragmentation of habitat connectivity and populations (discussed further below).

Based on a 20 m clearing width, approximately 2.8 ha of heath and closed scrub will require clearing and 0.2 ha of mallee through the drainage depression. The heath and scrub is by the far the most common vegetation locally and is well represented within the adjacent Cape Arid NP. The clearing

required is unlikely to affect the quality and quantity of fauna habitat available locally given the abundance of similar habitat within the remaining UCL and in Cape Arid NP.

5.1.2 Construction environment

Construction, including clearing, would lead to a number of indirect impacts (see below) however there are risks of direct impacts such as injury and possibly death of reptiles, small mammals and birds that may occur within nests or hollows. Clearing would have greater impacts during spring, which is the nesting period for most fauna.

Introduction of disease or pathogens as a result of clearing may also have direct impacts, at a community level (*Phytophthora* dieback), or species level (amphibian chytrid fungus). Chytridiomycosis is caused by the amphibian chytrid fungus *Batrachochytrium dendrobatidis* which occurs in waterbodies or in soil (DPaW 2012).

5.1.3 Collision risk

The fence itself may present a risk of collision, entanglement or entrapment for some fauna species, including birds and large mammals (e.g. Western Grey Kangaroo). This is discussed in more detail in Ecoscape (2015). There may be some risk to Ground Parrots if they do occur near the site.

5.1.4 Habitat connectivity

Connectivity and corridor value is discussed in Sections 4.1.1 and 4.1.2. Clearing will increase fragmentation of the UCL and the cumulative impact of the gap in habitat already associated with Merivale Rd. The fence may act as a direct barrier to some species, in particular those in the size/weight range that are targeted by the fence (e.g. Emu, Mallee Fowl, Western Grey Kangaroo, Wallabies, etc should they occur). The impacts of the SBF on fauna at a landscape scale are discussed further in Ecoscape (2015).

5.2 INDIRECT IMPACTS

Indirect impacts may be associated with the construction period (short term) and ongoing impacts associated with the fence (long term). Activities that are likely to cause indirect impacts include

- accidental clearing and disturbance of native vegetation surrounding the site,
- machinery access to site,
- compaction of soils,
- noise, dust and vibration, and
- increased visitation and human use of the site.

Potential indirect impacts of the proposal may include

- Increased negative edge effects (degradation of habitat in the UCL) and impact of the 20 m wide corridor causing ingress of weeds, changes to microhabitat and increased access for invasive predators such as foxes and cats. Rabbits compete with native fauna, such as macropods, for feed resources and the habitat degradation caused by rabbits is well documented. Populations of small mammals and birds may be impacted further by foxes and cats.
- Further introduction or spread of pathogens. Localised dieback already appears to have had some impact on vegetation structure at the site, with dead or dying Proteaceous plants in some areas,
- Disruptions to fauna breeding cycles, for example Quendas are known to abandon their young if they sense danger, or the fence may present a risk to dispersing juvenile Western Ground Parrots.

Some potential indirect impacts are able to be mitigated through appropriate environmental management and implementing the recommendations below.

5.3 ADDITIONAL ASSESSMENT

5.3.1 Potential impact to conservation significant species

Ecoscape (2015) in an assessment of the entire SBF extension notes that potential impacts on conservation significant species may be 'minor' in proportion to the current distribution and populations, and result from:

- the fence acting as a barrier (Western Brush Wallaby), or
- collision/entanglement hazard (some birds, possibly including Western Ground Parrot, Malleefowl)
- loss of habitat area by clearing (some mammals, birds, reptiles)
- loss of habitat connectivity (some mammals, small birds, reptiles), or
- increased exposure to feral predators using the fence and associated clearing as a corridor.

An evaluation of the potential for conservation significant species to be impacted by direct and indirect effects of the proposal is given in Appendix A. The following species are considered to have potential to be impacted.

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (T, En) – Low impacts

The proposal may result in the clearing of approximately 2.8 ha of heath and closed scrub which contains numerous species of plants (e.g. *Banksia*) that are commonly grazed upon by black cockatoos. The loss of this amount of foraging habitat though at a local scale is considered to only have a low impact on the species.

Malleefowl (*Leipoa ocellata*) (T, Vu, M) – Low impacts

Impacts on Malleefowl, if they do occur, are likely to be low due to direct loss of habitat, risk of collision and potentially fragmentation though these impacts are generally likely to be low given the abundant similar habitat locally. Ecoscape (2015) note that 'clearing will result in marginal reduction of available foraging habitat. The fence may present a collision hazard during flights, but not a significant barrier to movement (adults can easily fly above fence height, juveniles can pass through the mesh) and also provide a corridor facilitating access to occupied habitat by feral predators.' No mounds were observed within the Mallee habitat which would be the most suitable for breeding.

Western Ground Parrot (*Pezoporus flaviventris*) (T, CE) – Low impacts

Western ground parrots are known to exist in only FRNP and CANP and nearby parts of Nuytsland Nature Reserve. Following post-natal dispersal, western ground parrots can occur away from known populations, sometimes in sub-optimal habitat. The site is located as potential habitat within the western extent of the Management Area 2 outlined in the South Coast Threatened Birds Recovery Plan DPaW (2014).

Burbidge and Comer (DPaW) (Pers comm. August 2015) indicated that whilst there are no recent records, Ground Parrots have historically been known to occur further north (near Fisheries Rd). Also possibly due to fox and cat control programs local known populations of Western Ground Parrots may be spreading to other areas, possibly including the site.

The Ecoscape (2015) assessment which only extended to Fisheries Road, north of the site, notes that the proposed fence extension will not result in habitat fragmentation for this species, or affect habitat quality or likelihood of predation, but would have some potential to cause injury and mortality to dispersing birds: mortality from fence and vehicle collisions are documented in the closely related Night Parrot *Pezoporus occidentalis* (Boles et al. 1994; McDougall et al. 2009 in Ecoscape 2015).

In consideration of this impacts to Western Ground Parrot at the site are likely to be low. However as noted by Ecoscape (2015) any deleterious impact on this Critically Endangered species should not be an acceptable risk. It is expected that visibility enhancement features (fluorescent orange droppers at regular intervals) will reduce the potential for bird collisions with the fence to an acceptable level (Ecoscape 2015). Additional recommendations to reduce potential impacts are provided in Section 7.

Southern Brown Bandicoot, Quenda (*Isodon obesulus fusciventers*) (P5) – Low impacts

Impacts to Quendas are likely to be associated directly with loss of habitat or direct impacts (injury/mortality) as a result of clearing. Possible Quenda diggings were observed though there are no local Naturemap records (2015). Given the abundance of habitat locally and that Quenda are unconfirmed from the site, impacts are assessed as being low.

Western Brush Wallaby (*Macropus irma*) (P4) – Low impacts

Ecoscape (2015) note that there may be minor impacts associated with barrier impacts, collision risk and direct loss of habitat. The site is at the very eastern edge of the species distribution; although the home range for the species is not known there are large areas of similar habitat on either side of the proposed fence at the site. Impacts to this species are likely to be low.

Southern Death Adder (*Acanthopis antarcticus*) (P3) – Low impacts

Southern Carpet Python (*Morelia spilota imbricata*) (S) – Low impacts

Individuals might be directly affected during clearing of vegetation or disruption of refuge sites by excavation, but no significant lasting impact on habitat is likely (Ecoscape 2015). Impacts on either species are assessed as being low.

6 Management Considerations

Fauna are generally most sensitive to disturbance during breeding periods. This is a particularly important consideration for threatened species. Birds disturbed from the nest (for example, from excessive noise or changes to light) may disrupt incubation or cease to feed their young (Webster 1999). Marsupials under stress may eject pouch young or change their nesting behaviour, e.g. Quenda (Rhind 2003). Stress may occur for a range of reasons including environmental factors such as drought as well as from anthropogenic habitat disturbance such as clearing. Many marsupials display a strong fidelity to their territory (Rhind 2003), and therefore disturbance can cause stress. An example of a stress factor may include loss of foraging resources (such as through clearing), thereby necessitating an increase in foraging effort, potential for loss of physical condition and potential for neglect or ejection of young.

In relation to the conservation significant fauna identified in Section 5 that may be impacted (particularly Western Ground Parrot, but also to a lesser degree Quenda and Malleefowl) clearing during the breeding periods between August to November (and through to February for Quenda and Malleefowl) should be avoided if possible.

7 Conclusions and Recommendations

The site contains approximately 15.28 ha of good quality fauna habitat, including heath and closed scrub on sandy and gravelly loams and Mallee over sandy loams in the depression. Assuming an impact width of 20 m about 2.8 ha of heath and scrub will be cleared and about 0.2 ha of Mallee. No particular fauna habitat attributes were identified as constraints during the fieldwork.

The site may provide suitable habitat for several conservation significant species; three birds (Carnaby's Black Cockatoo, Malleefowl, Western Ground Parrot), two reptiles (Southern Death

Adder, Southern Carpet Python) and two mammals (Quenda, Western Brush Wallaby). Impacts are likely to be low for all species.

It is understood that the project will be referred to the federal Department of the Environment (DoE) for assessment under the EPBC Act.

Recommendations to ensure that impacts are low (or less), include

- Construct the fence as close as possible to Merivale Road to minimise the depth of impact into the UCL patch and associated habitat.
- Ensure a licensed and experienced fauna surveyor conducts pre clearance surveys to ensure appropriate management and relocation of injured or displaced fauna.
- Avoid clearing between August and November for Western Ground Parrot (and if possible between August and February to include the breeding range for other species).
- Tie flagging tape along the top of the fence at appropriate defined intervals (e.g. 10 m) to decrease the likelihood of accidental entanglement of fauna (Western Ground Parrot in particular).
- General controls and mitigation measures should be implemented through an Environmental Management Plan (EMP). The EMP would ensure roles and responsibilities are clearly defined, site audits are conducted and construction staff are inducted to the fauna habitat values of the site. Dieback management and soil hygiene, fauna preclearance survey requirements and reporting, would also be addressed through the EMP in line with standard operating procedures.
- Final designs should quantify the amount of native vegetation required to be cleared and this should be assessed against any Matters of NES (e.g. Carnaby's Black Cockatoo forage habitat).

8 References

Note the not all of the following references are necessarily cited in the report text.

Atlas of Living Australia database (ALA) (2015) <http://www.ala.org.au/> search within 10km of the site, accessed in August 2015.

Birdlife International (2015) website accessed August 2015
<http://www.birdlife.org/datazone/sitefactsheet.php?id=23923>,

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