



ECOLOGY
AUSTRALIA

Shipwreck Coast Master Plan Priority Sites for Infrastructure: Flora and Fauna Assessment



Prepared for: Parks Victoria

©2017 Ecology Australia Pty Ltd

This publication is copyright. It may only be used in accordance with the agreed terms of the commission. Except as provided for by the Copyright Act 1968, no part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, without prior written permission from Ecology Australia Pty Ltd.

Document information

This is a controlled document. Details of the document ownership, distribution, status and revision history are listed below.

All comments or requests for changes to content should be addressed to the document owner.

Owner	Ecology Australia Pty Ltd	
Project	17-015	
Authors	Andrew McMahon and Darren Quin	
File	Shipwreck Coast Master Plan Priority Sites for Infrastructure FLora and Fauna Assessment.docx	
Bioregion	Otway Ranges	
Distribution	Ron Parker	Parks Vic

Document History

Status	Changes	By	Date
Draft 1	Text additions	A McMahon and D Quin	13/04/2017

Cover photo: View of coast west from Twelve Apostles Lookout (March 2017)



88B Station Street, Fairfield 3078 VIC
T: (03) 9489 4191
E: admin@ecologyaustralia.com.au
W: ecologyaustralia.com.au

Contents

Acknowledgments	1
Summary	2
1 Introduction	3
2 Overview	4
3 Methods	7
3.1 Data and Information Review	7
3.2 Flora	7
3.2.1 Vegetation sampling	7
3.2.2 Threatened flora	8
3.3 Fauna	9
3.3.1 General fauna habitat survey	9
3.3.2 Habitat suitability rating	10
3.4 Limitations	11
3.5 Conservation status	11
3.6 Nomenclature and taxonomy	12
4 Study Precincts	13
4.1 Port Campbell	13
4.2 Twelve Apostles Precinct	20
4.3 Loch Ard Precinct	26
5 Policy and legislative implications	30
6 Key issues and recommendations	31
7 References	32
8 Glossary	36

Tables

Table 1	Shipwreck Coast Master Plan Priority sites: Listed threatened flora	8
Table 2	Habitat Suitability Rating Guidelines	11
Table 3	Habitat Zones for Port Campbell Precinct	15

Figures

Figure 1	Shipwreck Coast Master Plan Priority Sites for Infrastructure: location of the three precincts proposed for infrastructure in the Port Campbell National Park.	6
Figure 2	Shipwreck Coast Master Plan Priority Sites for Infrastructure: Habitat Suitability Rating for threatened species in the Port Campbell Precinct.	16
Figure 3	Shipwreck Coast Master Plan Priority Sites for Infrastructure: Port Campbell Precinct showing Ecological Vegetation Classes, Habitat Zones and location of	

	Rufous Bristlebird records obtained during the assessment (22-22 March 2017).	19
Figure 4	Shipwreck Coast Master Plan Priority Sites for Infrastructure: Habitat Suitability Rating for threatened species in the Twelve Apostles Precinct.	21
Figure 5	Shipwreck Coast Master Plan Priority Sites for Infrastructure: Twelve Apostles Precinct showing Ecological Vegetation Classes, Habitat Zones and location of Rufous Bristlebird records obtained during the assessment (22-22 March 2017).	25
Figure 6	Shipwreck Coast Master Plan Priority Sites for Infrastructure: Habitat Suitability Rating for threatened species in the Twelve Apostles Precinct	27
Figure 7	Shipwreck Coast Master Plan Priority Sites for Infrastructure: Loch Ard Gorge Precinct showing Ecological Vegetation Classes, Habitat Zones and location of Rufous Bristlebird records obtained during the assessment	29

Plates

Plate 1	Port Campbell Precinct: view upstream along Port Campbell Creek estuary. The footbridge crossing is just upstream of the Norfolk Island Pine trees (March 2017).	17
Plate 2	Port Campbell Precinct: view across Port Campbell Creek showing the western shore in the approximate location of the footbridge crossing (March 2017).	17
Plate 3	Port Campbell Precinct: view to southwest across Port Campbell Creek showing the western shoreline where a linking track is proposed track (March 2017).	18
Plate 4	Port Campbell Precinct: aerial view upstream along Port Campbell Creek showing the approximate location of the footbridge crossing (March 2017).	18
Plate 5	Twelve Apostles Precinct: Coast Tussock Grassland / Shrubland Mosaic with invading shrubland in the absence of fire (March 2017).	23
Plate 6	Twelve Apostles Precinct: Coast Tussock Grassland / Shrubland Mosaic (March 2017).	23
Plate 7	Twelve Apostles Precinct: gully running through Coast Tussock Grassland / Shrubland Mosaic in east of investigation area (March 2017).	24
Plate 8	Loch Ard Gorge Precinct: Blowhole, southern side showing Coastal Headland Scrub and the proximity to the walking track.	28
Plate 9	Loch Ard Gorge Precinct: Blowhole, northern side showing disturbed Coastal Headland Scrub in the process of rehabilitation and the proximity to the walking track.	28

Appendices

Appendix 1	Vertebrate fauna species recorded at Precincts associated with the Shipwreck Coast Master Plan, 20-22 March 2017.	37
-------------------	-------------------------------------------------------------------------------------------------------------------	----

Acknowledgments

We gratefully acknowledge the assistance of:

- Ron Parker Parks Victoria
- Nicolette McNamara Parks Victoria
- Rihanna Burns Parks Victoria
- Jamie McMahon Ecology Australia
- Sarah Bedggood Ecology Australia

Summary

This report provides an overview of the flora and fauna at three priority precincts as part of the implementation of the Shipwreck Coast Master Plan.

The three precincts are: Port Campbell, Twelve Apostles and Loch Ard – Blowhole. The Master Plan identifies new infrastructure at these precincts and this report aims to identify the key flora and fauna issues, and the constraints and opportunities that arise.

At Port Campbell, most issues are attached to the new walkway on the western side of Campbell Creek estuary. This area supports intact Damp Heath Scrub Ecological Vegetation Class (EVC) (conservation status vulnerable), habitat for Rufous Bristlebird (FFG Act 1988) and likely habitat for Southern Brown Bandicoot (EPBC Act 1999) and Swamp Antechinus (EPBC Act 1999).

The infrastructure proposed for Twelve Apostles includes substantial upgrades in and around existing footprints and a new walkway to the east and north. The dominant EVC is long unburnt Coastal Tussock Grassland (conservation status vulnerable) which is now a grassland – shrubland mosaic. This vegetation provides suitable habitat for a diverse range of threatened fauna, including three EPBC Act-listed species (Southern Brown Bandicoot, Swamp Antechinus and Broad-toothed Rat) and three FFG Act-listed species (Rufous Bristle-bird, Swamp Skink and White-footed Dunnart).

Similar to Port Campbell, most issues emanate from infrastructure proposed for new areas – namely the walkway to the east and north.

At Loch Ard – Blowhole, the proposed viewing bridge largely replaces the former and now removed viewing platform. The new structure can utilise existing footprints with some extension into undisturbed vegetation represented by Coastal Headland Scrub EVC (conservation status vulnerable). While surrounding habitat is likely to support several threatened fauna, the minor loss of habitat within an existing disturbance footprint is unlikely to be significant.

The policy and legislative implications of the infrastructure are likely to include:

- An assessment to satisfy the Biodiversity Assessment Guidelines (DEPI 2013);
- An FFG Act 1988 Protected Flora permit; and
- Referral under the EPBC Act 1999.

This overview has also identified uncertainty, particularly regarding the status of threatened fauna at the respective precincts. While there is adequate information to gauge habitat suitability, likelihood of presence, and anticipated policy implications, it is insufficient to inform detailed design. As such, further work, including targeted surveys, are required at sites including the west side of the estuary at Port Campbell, and the eastern section of the Twelve Apostles precinct.

1 Introduction

Parks Victoria (Parks Vic) is implementing the 2015 Shipwreck Coast Master Plan (McGregor Coxall 2015), and has identified several priority sites for infrastructure. These sites include the precincts of Port Campbell, Twelve Apostles and Loch Ard.

The infrastructure proposed for the respective precincts include:

- Port Campbell: pedestrian bridge across Port Campbell Creek, and a new trail linking to the existing Discovery Walk;
- Twelve Apostles: new lookouts and trails; and
- Loch Ard: new viewing platform at the Blowhole.

Parks Vic has undertaken a number of studies to support the Master Plan, and this study aims to complement these with an overview of the flora and fauna at the respective sites. Specifically, the main study tasks are to:

- describe and map the Ecological Vegetation Classes (EVC's) present;
- describe and map the vegetation condition;
- assess the suitability of the site(s) to support threatened fauna and flora; and
- assess constraints and opportunities in relation to the proposed infrastructure.

Ecology Australia Pty Ltd was commissioned to undertake the study in February 2017.

The structure of this report is firstly to provide an overview of the study sites and the likely key issues and methodology, and secondly, to provide a site by site analysis, and the likely policy and legislative implications of the proposed infrastructure.

2 Overview

The study precincts are all located within Port Campbell National Park (PCNP) (Figure 1).

The PCNP is characterised by a relatively narrow band of coastal vegetation perched on a dramatic limestone plateau fronting the Southern Ocean. The hinterland is largely pasture, restricting most habitat connectivity to along the coast, with some northern links provided by roadside vegetation and the estuaries of Port Campbell Creek, and the Sherbrook and Gellibrand rivers.

The flora and fauna values of the Park are broadly known. While systematic park-wide (e.g. Grant 1987) or site intensive surveys (e.g. Duncan et al. 1991, Ecology Australia 2010) have been uncommon, there has been considerable work done on certain elements of the biota, including Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed and Victorian Flora and Fauna Guarantee Act 1988 (FFG Act) listed flora: Metallic Sun-orchid *Thelymitra epipactoides* and Square Raspwort *Haloragis exalata* subsp. *exalata* var. *exalata* (R. Burns, Park Victoria, pers. comm.).

The Ecological Vegetation Classes (EVCs) that dominate the Park are threatened at the bioregional (Warrnambool Plain) scale. These include:

- EVC161 Coast Headland Scrub – Conservation Status: vulnerable;
- EVC163 Coastal Tussock Grassland – Conservation Status: vulnerable;
- EVC181 Coast Gully Thicket – Conservation Status: endangered;
- EVC165 Damp Heath Scrub – Conservation Status: vulnerable; and
- EVC10 Estuarine Wetland – Conservation Status: depleted.

The PCNP is also known to support a host of threatened fauna (Duncan et al 1991; Belcher 1992; Biosis Research 1995, 1996a and 1996b; Parks Victoria 1998; Ecology Australia 2010). While knowledge of their current status and distribution within the Park may vary, the diversity of threatened species is likely to be equal to, or exceed most similar sized conservation reserves in the State. The list includes several EPBC Act 1999 and/or FFG Act 1988 listed species:

- Southern Brown Bandicoot (south-east mainland subspecies) *Isoodon obesulus obesulus* EPBC, FFG;
- Swamp Antechinus *Antechinus minimum maritimus* - EPBC, FFG;
- Rufous Bristlebird (eastern/Otways subspecies) *Dasyornis broadbenti caryochrous* - FFG;
- White-footed Dunnart *Sminthopsis leucopus* – FFG;
- Southern Toadlet *Pseudophryne semimarmorata* - Advisory List vulnerable (DSE 2013);
- Swamp Skink *Lissolepis coverntryi* – FFG;
- Broad-toothed Rat *Mastocomys fuscus mordicus* - EPBC, FFG; and
- Hooded Plover *Thinornis rubricollis rubricollis* - EPBC, FFG.

In addition, there are several records of migratory shorebird species (e.g. Pacific Golden Plover *Pluvialis fulva*), and suitable habitat in streams and estuaries for Lewins Rail *Rallus pectoralis pectoralis* (FFG), Australasian Bittern *Botaurus poiciloptilus* (EPBC, FFG) and Baillon's Crake *Porzana pusilla palustris* (FFG).

Overall, high biodiversity values characterise the PCNP landscape. This report employs a relatively simple model of species, preferred habitats and available habitats, to initially predict the likely occurrence of threatened species at the respective precincts.

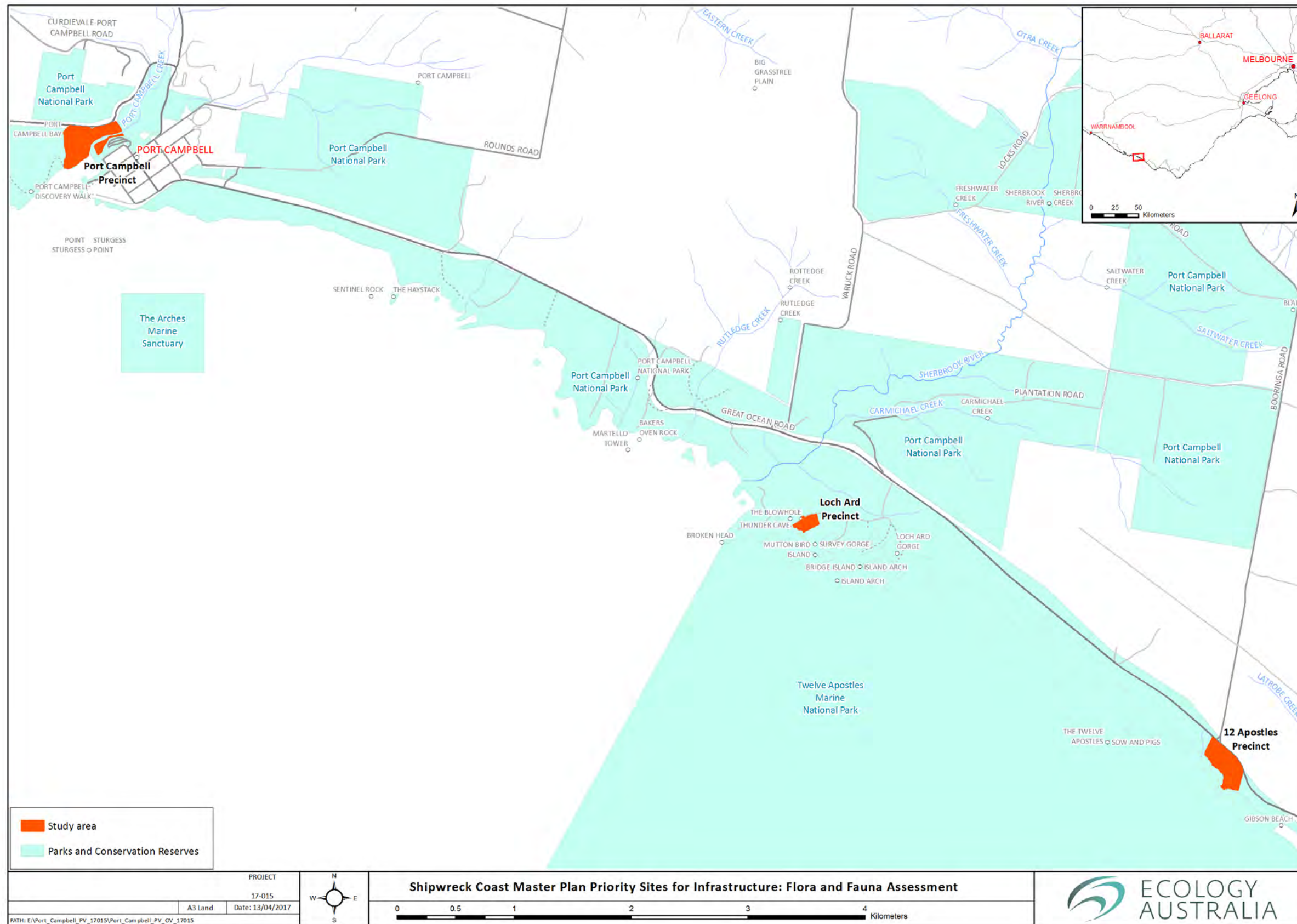


Figure 1 Shipwreck Coast Master Plan Priority Sites for Infrastructure: location of the three precincts proposed for infrastructure in the Port Campbell National Park.

3 Methods

3.1 Data and Information Review

The following literature and databases were reviewed to identify the flora and fauna values:

- Terrestrial and aquatic flora and fauna records within 5 km of the study area and held in the Victorian Biodiversity Atlas (VBA), a state-wide database maintained by the Department of Environment, Land, Water and Planning (DELWP 2017a);
- A search for ecological communities and flora and fauna species listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and potentially occurring within a 5 km radius of the study area using the EPBC Act Protected Matters Search Tool (DoEE 2017a);
- DELWP biodiversity interactive maps - Ecological Vegetation Class (EVC) modelling of the area (both extant and pre-1750) as well as modelling of Location Risk and Strategic Biodiversity Score (DELWP 2017c);
- DELWP's Native Vegetation Information Management System tool (NVIM) (DELWP 2017c);
- Planning zone(s) and applicable overlays on the DELWPs Planning Schemes Online website;
- Relevant GIS data and aerial photography;
- Relevant legislation, government policies and strategies;
- Review of documentation supplied (i.e. maps and Geotechnical Report); and
- Review of other reports relevant to the study area, including publications, reports or plans prepared by DCE (1991), Belcher (1992), Biosis Research (1995, 1996a and 1996b), Parks Victoria (1998), McGregor Coxall (2015), Ecology Australia (1997, 2001, 2002, 2004 and 2010) and Mitchell and Wilson (2007).

3.2 Flora

The three areas of investigation surrounding the proposed infrastructure, including trail alignments and areas proposed for bridges, viewing platforms and new seating were surveyed by a botanist from 20-22 March 2017.

The areas of investigation were assessed on foot to identify, map and assess the indigenous vegetation occurring within the study area, determine the likelihood of occurrence for rare or threatened plant species and identify sensitive areas and other ecological issues which require consideration in the refinement of the infrastructure location to avoid or minimise native vegetation losses.

3.2.1 Vegetation sampling

Vegetation sampling was undertaken in line with Victoria's Permitted Clearing of Native Vegetation - Biodiversity Assessment Guidelines (DEPI 2013).

Areas of indigenous vegetation were classified as remnant patches or Scattered Trees as defined by DEPI (2013):

Remnant patch

- An area of vegetation where at least 25% of the total perennial understorey plant cover is native; and
- Any area with three or more native canopy trees where the canopy foliage is at least 20% of the area.

Scattered Tree

- A native canopy tree that does not form part of a remnant patch.

All areas of remnant vegetation (patches and scattered trees) were mapped and assigned to an Ecological Vegetation Class (EVC) by reference to DELWP's vegetation modelling (DELWP 2017b) and EVC benchmarks (DELWP 2017d).

A Habitat Hectare assessment was completed for patches of remnant vegetation, following DELWP's Vegetation Quality Assessment Manual (DSE 2004).

Mapping of EVCs and Habitat Zones (areas of differing quality within an EVC) was undertaken for each investigation area to represent the variation in vegetation quality across each area.

Indigenous and exotic vascular plant species occurring in areas of remnant vegetation were opportunistically recorded as part of the Habitat Hectare assessment.

Notes were also made on vegetation condition and relevant factors (e.g. existing paths or tracks, weed invasions, etc.).

3.2.2 Threatened flora

The taxonomy and conservation status of threatened flora known from PCNP in 1998 (Parks Victoria 1998) has been updated in accordance with current VBA records. A shortlist of EPBC Act and/or FFG Act listed species was then compiled to help understand any potential legislative implications of the proposed infrastructure (Table 1).

Table 1 Shipwreck Coast Master Plan Priority sites: Listed threatened flora

Scientific Name	Common Name	EPCB Act	FFG Act
<i>Caladenia fragrantissima</i>	Scented Spider-orchid	–	Listed
<i>Diuris palustris</i>	Swamp Diuris	–	Listed
<i>Glycine latrobeana</i>	Clover Glycine	Vulnerable	Listed
<i>Haloragis exalata</i> sub. <i>exalata</i> var. <i>exalata</i>	Square Raspwort	Vulnerable	–
<i>Prasophyllum spicatum</i>	Dense Leek-orchid	Vulnerable	–
<i>Pterostylis tenuissima</i>	Swamp Greenhood	Vulnerable	Listed
<i>Thelymitra epipactoides</i>	Metallic Sun-orchid	Endangered	Listed

3.3 Fauna

3.3.1 General fauna habitat survey

A general fauna survey and habitat assessment was undertaken by a zoologist from 20-22 April 2017. This assessment focused on the following:

- Compiling an inventory of vertebrate fauna found in the study area, based on direct observation and indirect evidence (diggings, scats, tracks, nests, burrows, calls, etc.; Triggs 1996) (see Appendix 1);
- Identification of fauna habitats present within and immediately adjacent to the study area; and
- An evaluation of whether the site has the potential to support threatened fauna species.

Habitat assessment focussed on habitat characteristics important in supporting the threatened species known to occur in the area (see Section 2), including:

- Southern Brown Bandicoots: low, dense vegetation and sandy soils, such as heathy forest and woodland, coastal heathland, Swamp Scrub, and sedgy woodland along drainage lines with 50-80% average foliage density within the 0.2-1 m height range (e.g. see Stoddart and Brathwaite 1979; Menkhorst and Seebeck 1990; Menkhorst 1995; Paull 1995; Biosis Research 1996a and 1996b; Sanderson and Kraehenbuehl 2006; DSEWPC 2011);
- Swamp Antechinus: vegetation with high plant species richness, cover between 50-150 cm in height and a dominant shrub layer with a relatively open ground layer, characterise occupied low elevation coastal sites (Biosis Research 1996a and 1996b; Gibson et al. 2004, Cullen and White 2006);
- Broad-toothed Rat: at coastal sites, coastal heath and dune or tussock grasslands with a moderate to dense cover of grasses and sedges (Menkhorst 1995; Biosis Research 1996a) - at Two Mile Bay, it was recorded on dunes and lower talus slopes (Parks Victoria 1998);
- Rufous Bristlebird: vegetation with a dense mid-storey canopy overhead for protection and a clear ground layer, to allow free movement, such as coastal scrubs and low, dense shrublands and heathlands on coastal dunes and limestone cliffs (Belcher 1992; Biosis Research 1996a and 1996b; Wilson et al. 2001; Mitchell and Wilson 2007);
- White-footed Dunnart: coastal tussock grassland and sedgeland and more stable, permanent scrubs, including wet heath, and forest or woodland with a dense heathy understorey (>50% cover) (Menkhorst 1995; Biosis Research 1996a and 1996b);
- Swamp Skink: dense, ground level vegetation below 2 m in height at freshwater swamps and associated watercourses for basking, such as tussocks of grass, reeds, and sedges (e.g. *Poa*, *Gahnia* and *Baumea* spp.), and on logs and rocks adjacent to wet heaths, sedgelands and saltmarsh, especially those supporting Paperbarks (*Melaleuca* spp.) and Tea-trees (*Leptospermum* spp.) (e.g. Smales 1981; Schulz 1985; Biosis Research 1996a and 1996b; Clemann et al. 1998; Wildlife Profiles 1998; Clemann and Beardsell 1999; Clemann 2000, 2004 and 2006);

- Southern Toadlets: moist microhabitats, such as in leaf litter and under logs, rocks and debris in moist soaks and depressions in sclerophyll forests, woodlands, shrublands, grasslands and heathlands (Hero et al. 1991; Ecology Australia 2005, 2007 and 2010; Ecology Partners 2007 and 2008); and
- Hooded Plover: high energy, wide, flat, sandy ocean beaches with scattered piles of kelp for foraging, backed by recently formed and sparsely vegetated dunes that provide shelter and foraging and nesting habitat, and also creek mouths and inlet entrances and infrequently on rock platforms and reefs. Hooded Plovers are generally found close to the shore, but occasionally visit saline and freshwater lakes and lagoons a short distance inland, especially during the non-breeding season (Marchant and Higgins 1993; Dowling and Weston 1999; DSE 2003; Weston 2003; Weston and Elgar 2005, 2007; Maguire 2008; Weston et al. 2009; Garnett et al. 2011; BirdLife International 2012; DoEE 2017b).

3.3.2 Habitat suitability rating

A Habitat Suitability Rating, developed by Ecology Australia, was applied to each species identified by the VBA (DELWP 2017a) and Protected Matters Search Tool (DE 2014) to potentially occur in the study area; this rating is based on:

- The present survey results (presence or absence of the species, with regard to survey effort and ease of detection);
- Habitat assessment, including:
 - Site attributes, such as habitat structure, density of hollow-bearing trees, vegetation composition, level of coarse woody debris, etc.; and
 - Landscape context, such as degree of habitat connectivity [i.e. higher quality sites have contiguous habitat or substantial areas of habitat in close proximity, whereas lower quality sites may be isolated by infrastructure or unsuitable habitat (e.g. through anthropogenic disturbance)].
- Past records of the species, including an assessment of the degree of previous survey effort undertaken at the site as well as the ease of detection of the species in question.

Based on the survey results, habitat assessment and past records, the Habitat Suitability Rating provides a categorised rating for each target species from 0 to 1.0 (Table 1).

Table 2 Habitat Suitability Rating Guidelines

Habitat Suitability Rating	Habitat Suitability	Guidelines
0 - 0.2	Very low/ Negligible	<ul style="list-style-type: none"> No recent or historic records of the species Habitat considered to be largely unsuitable (i.e. few, if any, attributes required for a species life-cycle are present)
0.2 - 0.5	Low	<ul style="list-style-type: none"> No recent records and/or records suggest infrequent occurrence of the species Habitat generally suitable, but clearly limited with regard to one or more aspects of a species life-cycle (e.g. small area, isolation, paucity of a critical resource, higher levels of adverse disturbance)
0.5 - 0.7	Moderate	<ul style="list-style-type: none"> Recent records of the species (unless region poorly surveyed and/or species highly cryptic) Habitat suitable and life-cycle requirements for a species present to some extent (e.g. area of habitat, moderate or greater connectivity, essential habitat resources present, lower levels of adverse disturbance)
0.7 - 1.0	High	<ul style="list-style-type: none"> Multiple historic and recent records of the species indicating regular occurrence or residency (unless area poorly surveyed and/or species highly cryptic) High quality habitat and landscape attributes which meet the life-cycle requirements of a species (e.g. large area of habitat, high connectivity with surrounding habitat, moderate or greater availability of essential habitat resources, lower levels of adverse disturbance)

Confidence rating

The Confidence rating is used to illustrate the extent of evidence for the assigned Habitat Suitability Rating, whereby:

- High – supported by repeated scientific or empirical evidence;
- Medium – supported by single studies or observations, consensus within scientific community, or empirical evidence from highly relevant study/studies; and
- Low – supported by expert/professional opinion based on logical/plausible associations (i.e. rather than empirical evidence).

3.4 Limitations

This is an overview study with the aim of identifying the likely key issues at the respective precincts, and to guide more detailed design. It is subject to the limitations of a high level study.

3.5 Conservation status

Species of State and/or National conservation significance are determined by reference to DELWP advisory lists (DSE 2009 and 2013; DEPI 2014), listings under the Victorian *Flora and Fauna Guarantee*

Act 1988 and the Federal *Environment Protection and Biodiversity Conservation Act 1999*, and by reference to National Action Plans for vertebrates and invertebrates (Cogger et al. 1993; Tyler 1997; Pogonoski et al. 2002; Sands and New 2003; Wager and Jackson 2003; Garnett et al. 2011; Woinarski et al. 2014).

3.6 Nomenclature and taxonomy

Plant taxonomy and the use of common names follow *A Census of the Vascular Plants of Victoria* (Walsh and Stajsic 2007) and the *Victorian Biodiversity Atlas* (DEPI 2017a), respectively.

The scientific names, common names, and systematic orders of fauna species follow the *Victorian Biodiversity Atlas* (DELWP 2017a). In general, common names are used in the text for fauna species.

Where an asterisk (*) precedes a plant or animal name, it is used to signify non-indigenous taxon, those species which have been introduced to Victoria or Australia. A hash (#) is used to denote Victorian native plants that are not indigenous to the relevant vegetation type.

4 Study Precincts

This section provides site specific information for the respective precincts. It includes:

- Site description – an overview including landscape context and tourism related issues;
- Proposed infrastructure – reference to the type and location of infrastructure as per the Master Plan;
- Vegetation type – mapping and description of the Ecological Vegetation Classes (EVCs), other vegetation, and the likely presence of EPBC Act and/or FFG Act listed species from the Data Review Area and/or referred to in the Management Plan (Parks Victoria 1998), but with updated conservation status.
- Vegetation condition – designated by Habitat Zones and Vegetation Condition Scores;
- Fauna – focused on threatened species and their Habitat Suitability Rating and indicating the most likely species present;
- Key Values – a summary of the higher biodiversity values;
- Opportunities and constraints – examining the relationship between biodiversity values and the proposed infrastructure, and measures to mitigate potential impacts; and
- Policy and Legislation – the likely implications for the key elements, namely the EPBC Act and the State’s Vegetation Clearing regulations (DEPI 2013).

4.1 Port Campbell

Site description

The area of interest within this precinct is the lower reaches of Campbell Creek estuary, the adjoining beach and coastal escarpment (Figure 2).

The beach and estuary mouth about the Port Campbell Township and are subject to high user pressure, and the extant vegetation is either exotic or highly modified.

Upstream of the mouth, the estuary is bordered by low alluvial terraces which are modified to varying degrees.

The escarpment to the immediate west is substantially unmodified, the vegetation is dense, and the largely south-west facing slopes are moderate to steep.

Proposed infrastructure

The proposed infrastructure includes a pedestrian bridge across the estuary, roughly adjacent to the caravan park, and a newly constructed walking track on the west side, linking the bridge to the existing Discovery Walk (Figure 2).

Vegetation

The vegetation within the area of interest includes three EVCs, two areas of exotic and/or introduced vegetation, and a planted row of exotic trees, including Norfolk Island Pines (Figure 3).

The three EVCs are as follows:

Estuarine Flats Grassland: this vegetation occupies the lower terraces bordering the estuary. Common native species include, Coast Tussock-grass (*Poa poiformis* subsp. *poiformis*), Knobby Club-rush (*Ficinia nodosa*), and Sea Rush (*Juncus kraussii* subsp. *australiensis*). Weeds are frequent and include Kikuya (**Pennisetum clandestinum*), Buffalo Grass (**Stenotaphrum secundatum*) and Hare's-tail Grass (**Lagurus ovatus*).

The remnant on the east side of the estuary is heavily modified (Habitat Condition Score = 38) reflecting its proximity to the township and high user pressure.

On the west side of the estuary, this vegetation is in better condition with an estimated Habitat Condition Score of 64. The proposed pedestrian bridge would potentially start and finish and/or span this EVC.

Damp Heath Scrub: this EVC dominates the coastal escarpment on the west side of the estuary. The vegetation is dense, moderately species-rich (35 species recorded) and high quality (Habitat Condition Score = 80). Common natives include: Coast Beard-heath (*Leucopogon parviflorus*), Manuka (*Leptospermum scoparium*), Rough Guinea-flower (*Hibbertia aspera*), Coast Saw-sedge (*Gahnia trifida*), Silver Banksia (*Banksia marginata*), Drooping Sheoak (*Allocasuarina verticillata*), Coast Tussock-grass (*Poa poiformis*), Correa (*Correa* sp. aff. *reflexa*) (West), Coast Everlasting (*Ozothamnus turbinatus*) and Sea Box (*Alyxia buxifolia*). Upslope, in and around Discovery Walk, eucalypts, namely Messmate (*Eucalyptus obliqua*) and West Coast Swamp Gum (*E.ovata* var. *grandiflora*) form a low canopy.

The proposed walking track linking the pedestrian bridge to Discovery Walk would be constructed within this EVC.

Coastal Headland Scrub: this distinctly heath vegetation occupies exposed aspects and headlands to the immediate west of the area of interest.

It shares many species in common with the previous EVC, but salt-laden winds have produced a characteristic low, closed heath. While this vegetation was not sampled, as it is not affected by the proposed infrastructure, it is of high quality.

Other vegetation: The predominantly exotic and/or introduced vegetation is on the east side of the estuary, extending northwards from the Surf Lifesaving Club. Two areas are present (Figure 2):

- a thicket of Coast Teatree (*Leptospermum laevigatum*) – a non-indigenous and highly invasive species of Western Victoria; and
- exotic foredune grassland consisting of Marram Grass (**Ammophila arenaria*), Hare's-tail Grass, Sea Spurge (**Euphorbia paralias*) and **Kikuya*.

Habitat Zones

The area consists of three Habitat Zones (Table 3).

Table 3 Habitat Zones for Port Campbell Precinct

Habitat Zone	EVC	Habitat Condition Score
1	Estuarine Flats Grassland	38
2	Estuarine Flats Grassland	est. 64
3	Camp Heath Scrub	80

Fauna

The Rufous Bristlebird (FFG Act-listed) was recorded in the study area during the field assessment (Figure 2; Appendix 1).

Based particularly on the surveys previously undertaken in adjoining areas by Belcher (1992) and Biosis Research (1995a, 1996a and 1996b), and in other areas of the PCNP by Ecology Australia (1997, 2002, 2004 and 2010) and records presented in the VBA, the following species are considered likely to occur in the Port Campbell Precinct investigation area:

- Southern Brown Bandicoot in Damp Heath Scrub and Coastal Headland Scrub;
- Swamp Antechinus in Damp Heath Scrub and Coastal Headland Scrub;
- White-footed Dunnart in Damp Heath Scrub and Coastal Headland Scrub;
- Rufous Bristlebird Damp Heath Scrub and Coastal Headland Scrub;
- Swamp Skink in Estuarine Flats (opposite side of Port Campbell Creek to the township), Damp Heath Scrub and Coastal Headland Scrub; and
- Tussock Skink (opposite side of Port Campbell Creek to the township), Damp Heath Scrub and Coastal Headland Scrub.

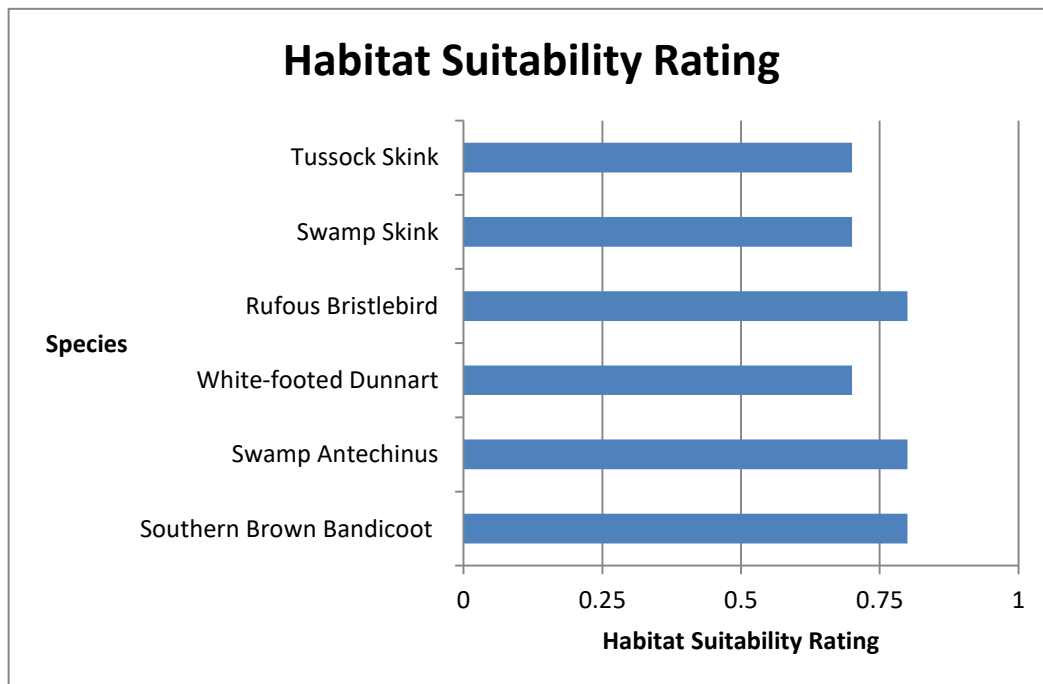


Figure 2 Shipwreck Coast Master Plan Priority Sites for Infrastructure: Habitat Suitability Rating for threatened species in the Port Campbell Precinct.

Key Values

Most key values are associated with the north side of the estuary and include:

- High quality Damp Heath Scrub (Conservation Status vulnerable);
- Suitable habitat for Rufous Bristle-bird (FFG), and Southern Brown Bandicoot (EPBC); and
- Moderate quality Estuarine Flats Grassland EVC (Conservation Status not formalised for the bioregion but most likely vulnerable or endangered).

Constraints and Opportunities

Overall, the south (township) side of the estuary is highly disturbed, and the proposed access (along the beach/estuary) and pedestrian bridge are likely to be consistent with existing levels of disturbance.

Most constraints apply to the north side where the new walking track will need to transverse intact Damp Heath Scrub including habitat for threatened fauna. While some loss of habitat would occur, a narrow track is unlikely to pose a barrier to fauna.

Policy and Legislation

The overall clearing of native vegetation would trigger an assessment under the Victoria's Permitted clearing of native vegetation – Biodiversity assessment guidelines.

The construction of the walking track has some complications in regard to the EBPC Act, but these are dealt with for all three infrastructure projects in Section 5.



Plate 1 Port Campbell Precinct: view upstream along Port Campbell Creek estuary.
The footbridge crossing is just upstream of the Norfolk Island Pine trees (March 2017).



Plate 2 Port Campbell Precinct: view across Port Campbell Creek showing the western
shore in the approximate location of the footbridge crossing (March 2017).



Plate 3 Port Campbell Precinct: view to southwest across Port Campbell Creek showing the western shoreline where a linking track is proposed track (March 2017).



Plate 4 Port Campbell Precinct: aerial view upstream along Port Campbell Creek showing the approximate location of the footbridge crossing (March 2017).



Figure 3 Shipwreck Coast Master Plan Priority Sites for Infrastructure: Port Campbell Precinct showing Ecological Vegetation Classes, Habitat Zones and location of Rufous Bristlebird records obtained during the assessment (22-22 March 2017).

4.2 Twelve Apostles Precinct

Site description

The area of interest within this precinct extends from the Great Ocean Road to the coast, incorporating all existing infrastructure associated with the Twelve Apostles.

The area is the tourist hub for the Twelve Apostles with pedestrian traffic confined to purpose-built walkways and boardwalks. These facilities are embedded in extensive areas of coastal vegetation, some of which include disused tracks, presumably a legacy of pre-PCNP disturbance.

Proposed infrastructure

The proposed infrastructure would build on the existing facilities with a new Twelve Apostles Lookout, relocation of walkways, removal of the most southern lookout, and a new track to the east, linking back to the north of the Great Ocean Road.

Vegetation

The precinct is dominated by Coastal Tussock Grassland EVC, which has a bioregional conservation status of vulnerable.

The vegetation presents as a grassland – shrubland mosaic, with a trajectory towards shrubland dominance.

The area was last burnt in the early 1970s (Parks Vic – PCNP Fire History 50 years), and it appears that shrubs, notably Manuka and Coast Beard-heath, have been actively recruiting into the grassland throughout the interfire period.

The dominants of the former grasslands include Kangaroo Grass *Themeda triandra*, and Coast Tussock-grass, but there are also distinctive patches of Coast Saw-sedge.

The incised gully that drains most of the site has rainfall-dependent flows, and the floristics are not substantially different from the surrounding vegetation. The EVC modelling suggests the vegetation to the east of the drainage line is Coastal Headland Scrub EVC (Biodiversity Interactive Map) but our observations suggest the floristics are consistent with the Coast Tussock Grassland. Effectively, the entire area of interest is the one EVC.

Habitat Zones

There are small-scale variations in vegetation condition, but none that are likely to generate meaningful Habitat Zones. This variability is the result of weediness, or shrub dominance, the latter reducing species and lifeform diversity. High threat weeds recorded include Buffalo Grass, Scotch Thistle *Cirsium vulgare* and Saffron Thistle *Carthamnus lanatus*. The patchiness is also reflected in the three Habitat Condition Scores recorded: 74, 64 and 70, but similarly, potential zone boundaries are very indistinct. At this overview stage, a single Habitat Zone is recognised.

Fauna

The Rufous Bristlebird (FFG Act listed) was recorded along the gully in Coast Tussock Grassland in the east of the investigation area (Figure 4; Appendix 1).

A colony of approximately 120 Little Penguins *Eudyptula minor* is known to nest in the Bird Colony Shrubland at the base of the cliffs (Rhianna Burns, Parks Victoria, pers. comm.).

A single Black-faced Cormorant *Phalacrocorax fuscescens* (classified as near threatened in Victoria by DSE 2013) was recorded on a rock stack opposite the Twelve Apostles Lookout.

Based on this assessment, the following species are considered likely to occur in the Coast Tussock Grassland/Shrubland Mosaic (Figure 4):

- Southern Brown Bandicoot (confidence high);
- Swamp Antechinus (confidence moderate);
- White-footed Dunnart (confidence moderate);
- Broad-toothed Rat (confidence moderate);
- Rufous Bristlebird (confidence high);
- Swamp Skink (confidence moderate); and
- Tussock Skink (confidence rating moderate).

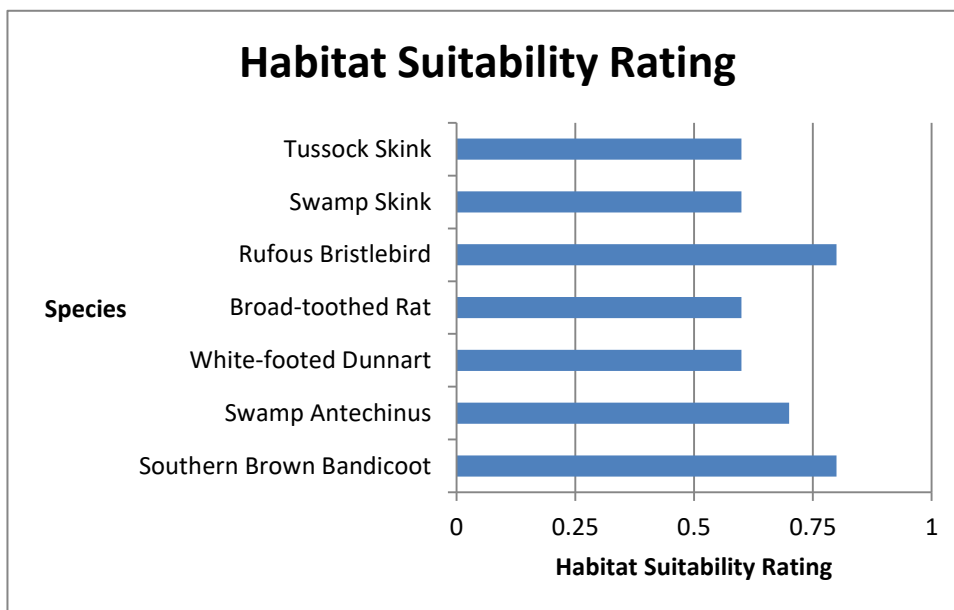


Figure 4 Shipwreck Coast Master Plan Priority Sites for Infrastructure: Habitat Suitability Rating for threatened species in the Twelve Apostles Precinct.

Key values

Key values extend across most of the site and include:

- Coastal Tussock Grassland – conservation status is vulnerable, and of at least moderate condition; and
- Potential habitat for a diverse range of threatened fauna including three EPBC Act-listed species (Southern Brown Bandicoot, Swamp Antechinus and Broad-toothed Rat) and three FFG Act-listed species (Rufous Bristle-bird, Swamp Skink and White-footed Dunnart).

Constraints and opportunities

Overall the site presents high level constraints in terms of infrastructure proposed for new terrain. This is potentially most obvious with the track proposed for the east of the site, which would extend some 250 m through undisturbed habitat.

The balance of the proposed infrastructure is substantially within areas already subject to heavy tourist traffic. Although some habitat would be lost, the context of further loss and possible disturbance is incremental.

Policy and legislation

The loss of native vegetation would require an assessment under Victoria's Permitted Clearing of native vegetation - – Biodiversity Assessment Guidelines (DEPI 2013).

Overall the proposed infrastructure is likely to require referral under the EPBC Act, but the most notable component would be the new path to the east.

As for the Port Campbell precinct, the EPBC Act implications for all precincts is summarised in Section 5.0.



Plate 5 Twelve Apostles Precinct: Coast Tussock Grassland / Shrubland Mosaic with invading shrubland in the absence of fire (March 2017).



Plate 6 Twelve Apostles Precinct: Coast Tussock Grassland / Shrubland Mosaic (March 2017).



Plate 7 Twelve Apostles Precinct: gully running through Coast Tussock Grassland / Shrubland Mosaic in east of investigation area (March 2017).

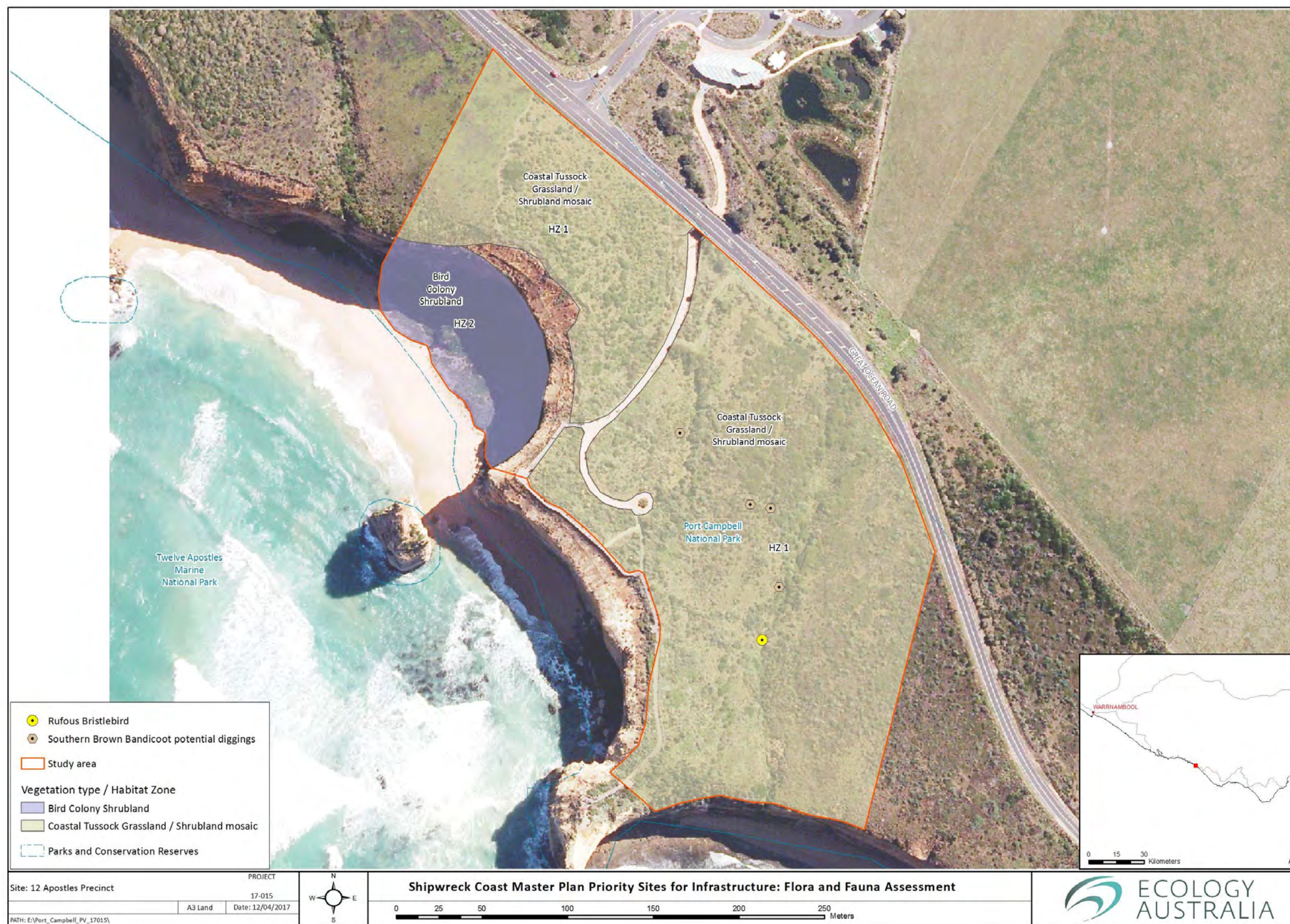


Figure 5 Shipwreck Coast Master Plan Priority Sites for Infrastructure: Twelve Apostles Precinct showing Ecological Vegetation Classes, Habitat Zones and location of Rufous Bristlebird records obtained during the assessment (22-22 March 2017).

4.3 Loch Ard Precinct

Site description

The area of interest is the environs of the Loch Ard Blowhole (Figure 9). The Blowhole is located on the Loch Ard Walking Trail approximately 500 m west of the main carpark. The Blowhole has long been part of the attractions at Loch Ard, but the former viewing area has been removed and the area revegetated.

The Blowhole is surrounded by mostly low coastal vegetation with a revegetation area to the immediate south.

Proposed infrastructure

The proposal is to replace the former (removed) viewing area with a viewing bridge which would span the northern end of the Blowhole.

Vegetation

The Blowhole forms a natural void in Coastal Headland Scrub EVC (conservation status vulnerable) (Figure 10). The revegetation area remains relatively open compared to the undisturbed vegetation, but shares many species in common – in part the result of active recolonisation.

Common species in the area include: Coast Beard-heath, Coast Daisy-bush *Olearia axillaris*, Coast Sword-sedge *Lepidosperma gladiatum*, Coast Tussock-grass, Coast Saw-sedge, Sea Box, Spiny-headed Mat-rush *Lomandra longifolia* subsp. *longifolia*, Scented Groundsel *Senecio odoratus* var. *odoratus*, Bower Spinach *Tetragonia implexicoma* and Knobby Club-sedge *Ficinia nodosa*.

Habitat Zones

Two Habitat Zones are recognised:

Habitat Zone 1: undisturbed Coastal Headland Scrub, Habitat Condition Score = 73

Habitat Zone 2: Revegetation area, syn. Coastal Headland Scrub, Habitat Condition Score = 63.

Fauna

The Rufous Bristlebird (FFG Act listed) was recorded on the northern side of the Blowhole in Coastal Headland Scrub (Figure 6; Appendix 1). The Loch Ard Gorge car park is a well known site for detecting this species (also see Ecology Australia 2010).

Based on this assessment, the following species are considered likely to occur in habitat surrounding the blowhole (Figure 6):

- Southern Brown Bandicoot (confidence high);
- Swamp Antechinus (confidence moderate);
- White-footed Dunnart (confidence moderate);
- Broad-toothed Rat (confidence moderate);
- Rufous Bristlebird in Coastal Headland Scrub (confidence high);
- Swamp Skink in Coastal Headland Scrub (confidence moderate); and
- Tussock Skink in Coastal Headland Scrub (confidence moderate).

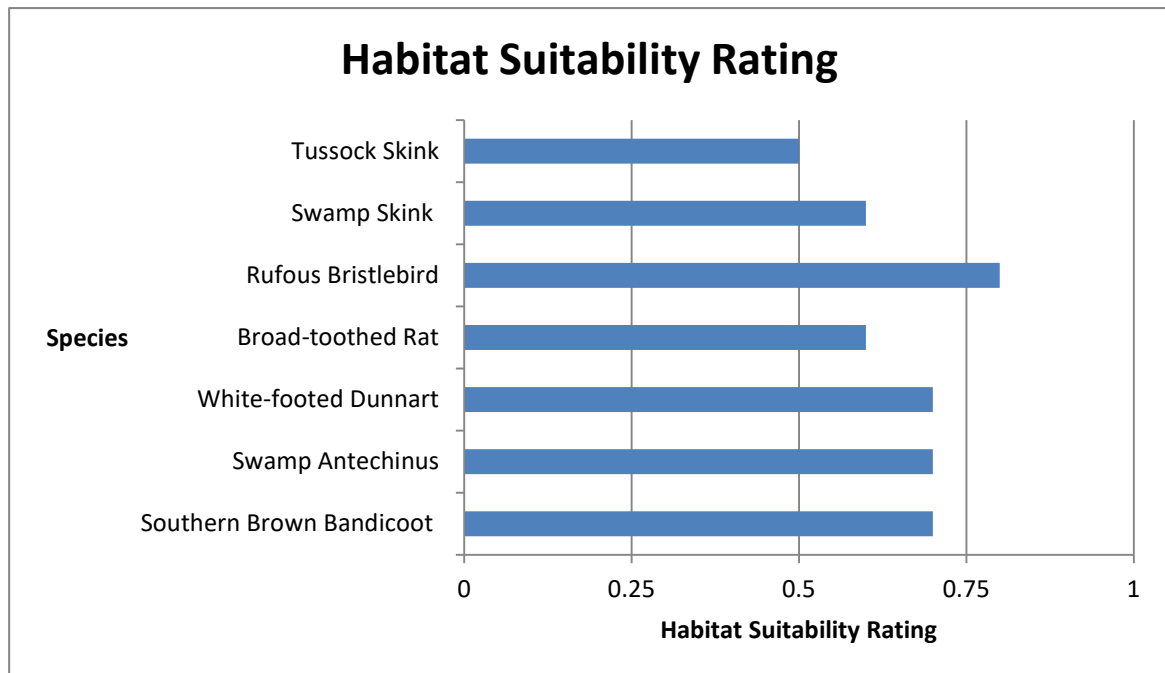


Figure 6 Shipwreck Coast Master Plan Priority Sites for Infrastructure: Habitat Suitability Rating for threatened species in the Twelve Apostles Precinct

Key values

The main values identified include:

- Undisturbed Coastal Heathland Scrub to the east and south of the Blowhole – effectively beyond the perimeter track;
- Undisturbed Coastal Tussock Grassland to the near south;
- Habitat for Rufous Bristlebird, and potentially for Southern Brown Bandicoot, Swamp Antechinus and White-footed Dunnart.

Constraints and opportunities

The viewing bridge would incorporate existing disturbance associated with the former structure, and what appears to be a relatively minor intrusion into undisturbed vegetation. The overall footprint of the viewing bridge appears to be relatively small. The Blowhole is already located in a highly trafficked tourist area.

Policy and legislation

The removal of native vegetation would trigger an assessment under Victoria's Permitted Clearing of native vegetation – Biodiversity Assessment Guidelines (DEPI 2013).

The proposed viewing bridge appears to have negligible EPBC Act implications but is included in the legislative summary in Section 5.0.



Plate 8 Loch Ard Gorge Precinct: Blowhole, southern side showing Coastal Headland Scrub and the proximity to the walking track.



Plate 9 Loch Ard Gorge Precinct: Blowhole, northern side showing disturbed Coastal Headland Scrub in the process of rehabilitation and the proximity to the walking track.

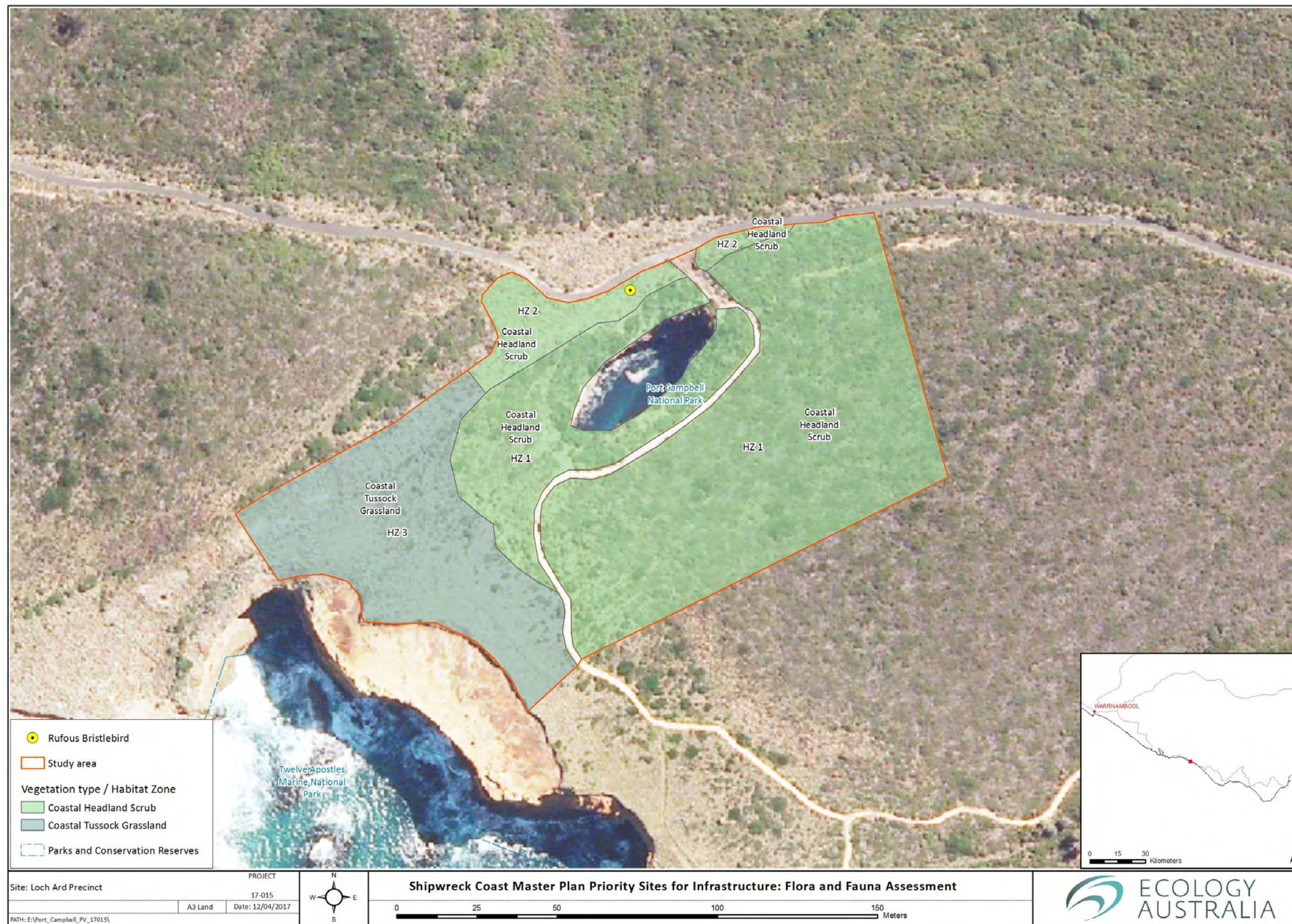


Figure 7 Shipwreck Coast Master Plan Priority Sites for Infrastructure: Loch Ard Gorge Precinct showing Ecological Vegetation Classes, Habitat Zones and location of Rufous Bristlebird records obtained during the assessment (22-22 March 2017).

5 Policy and legislative implications

The key policy elements for this overview are the State's Permitted Clearing Regulations, the FFG Act 1988, and the Commonwealth EPBC Act 1999. As summarised for the precincts, an assessment in accordance with the Biodiversity Assessment Guidelines (DEPI 2013) will be required for any vegetation that meets the definition of a 'patch' or 'scattered tree'. This assessment determines losses and the offsets required.

As the majority of vegetation potentially affected by the proposed infrastructure meets the definition of a patch, an assessment will be required.

Several FFG Act-listed species may also be impacted by the infrastructure. While it is most unlikely that fauna would be 'removed' as required for a permit, habitat will potentially be lost. As the FFG Act focus is on public land, the potential impact on listed species is likely to be considered as part of the approvals process.

The FFG Act also includes 'Protected Flora' which includes many non-threatened species in the precincts. A permit will be required to remove such species.

The precincts potentially support three EPBC Act-listed fauna: Southern Brown Bandicoot, Swamp Antechinus and Broad-toothed Rat. It is unlikely that either of the listed plant species Metallic Sun-orchid or Square Raspwort occur in areas of proposed infrastructure, but this can be confirmed once we have received Parks Victoria's records.

The precincts that are likely to have most exposure to the EPBC Act are the Twelve Apostles, and notably the proposed eastern walkway, and Port Campbell, similarly the new walkway on the west side of the estuary. The Commonwealth Department of Environment and Energy (DoEE) will likely see all three infrastructure projects as the one 'action'. While there is uncertainty about the status of listed species at the respective sites, this uncertainty is accounted for in the Significant Impact Guidelines 1.1 (Commonwealth of Australia 2013) and a referral should be considered.

In summary therefore, the following are likely to be required:

- an assessment under the Biodiversity Assessment Guidelines (DEPI 2013);
- an FFG Act Protected Flora permit; and
- a referral under the EPBC Act.

6 Key issues and recommendations

This overview has identified that the most issues arise from proposed infrastructure that is substantially outside existing footprints. Notably, the proposed walkway to the east and north at the Twelve Apostles and new walkway on the west side of the estuary at Port Campbell.

These issues arise from the intact condition and threatened status of the respective EVCs and the habitat potential for several EPBC Act, FFG Act or otherwise Advisory List threatened fauna. While current information is adequate to anticipate the policy and legislative implications of the infrastructure, it is insufficient to inform a detailed design phase.

We therefore recommend more detailed and targeted surveys in these areas. The aim is to obtain a firm understanding of values, and to prepare a solid foundation for mitigating impacts as design progresses.

7 References

- Belcher C (1992) Rufous Bristlebird Survey and Habitat Analysis, Port Campbell National Park. (Department of Natural Resources and Environment: Melbourne)
- Biosis Research (1995) Minerva Gas Field Development EIA Natural Environment Study (Phase 1). Preliminary Assessment of Ecological and Landform Sensitivities. Unpublished report prepared by C Meredith and C Costello for Sinclair Knight Merz Pty Ltd (Biosis Research Pty Ltd, Port Melbourne)
- Biosis Research (1996a) Minerva Gas Field Development EIA Natural Environment Study (Phase 2). Coastal Geomorphology, Land Capability and Flora and Fauna. Unpublished report prepared by C Meredith, J Yugovic, S Larwill, N Rosengren and C Costello for Sinclair Knight Merz Pty Ltd (Biosis Research Pty Ltd, Port Melbourne)
- Biosis Research (1996b) Minerva Gas Field Development EIA Natural Environment Study (Phase 3). Flora and Fauna and Land Capability. Unpublished report prepared by C Costello, R Delaney, L Williams and C Meredith for Sinclair Knight Merz Pty Ltd (Biosis Research Pty Ltd, Port Melbourne)
- Clemann N (2000) Survival in the suburbs! The rediscovery of the threatened Swamp Skink *Egernia coventryi* east of Melbourne, with comments on the failure of Elliott traps in a survey for this species. *The Victorian Naturalist* **117 (5)**, 180-183.
- Clemann N (2004) Tamarisk Creek Wetlands: Survey for Growling Grass Frogs *Litoria raniformis* and Swamp Skink *Egernia coventryi*. Unpublished report prepared by N Clemann for Melbourne Water (Arthur Rylah Institute for Environmental Research, Heidelberg)
- Clemann N (2006) Distribution and Ecology of the Swamp Skink *Egernia coventryi* in the Port Phillip and Western Port Region. Unpublished report prepared for Melbourne Water (Arthur Rylah Institute for Environmental Research, Heidelberg.)
- Clemann N and Beardsell C (1999) A new inland record of the Swamp Skink *Egernia coventryi* Storr, 1978. *The Victorian Naturalist* **116 (4)**, 127-128.
- Clemann N, Brown P and Brown G (1998) A note on bait selection when trapping the Swamp Skink *Egernia coventryi* in Elliott trap. *The Victorian Naturalist* **115 (3)**, 81-83.
- Cogger, HG, Cameron, EE, Sadler, RA and Eggler, P (1993) The Action Plan for Australian Reptiles (Australian Nature Conservation Agency: Canberra, ACT)
- Cullen M and White JW (2006) Habitat use by *Antechinus minimus* and *Antechinus swainsonii* in the Otway Ranges (Abstract). 52nd Scientific Meeting and Macropod Symposium (Australian Mammal Society: Melbourne)
- DCE (1991) Flora and Fauna of the Loch Ard Gorge and Lower Sherbrooke River Area and the Effects of Proposed Developments. Unpublished report prepared by S Duncan, J McLaughlin and B Peel (Department of Conservation and Environment, Flora Branch, Victoria)
- DELWP (2017a) Victorian Biodiversity Atlas Version 3.0.6 database. Available at <http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/victorian-biodiversity-atlas> [Accessed 17 March 2017]

- DELWP (2017b) Biodiversity Interactive Map 3.2. Available at: <http://mapshare2.dse.vic.gov.au/MapShare2EXT/imf.jsp?site=bim> [Accessed 17 March 2017]
- DELWP (2017c) Native Vegetation Permitted Clearing Regulations on the Native Vegetation Management System (Department of Environment, Land, Water and Planning, East Melbourne). Available at: <https://nvim.delwp.vic.gov.au/Biodiversity/RiskPathway#/>
- DELWP (2017d) EVC Benchmarks. Available at <http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/evc-benchmarks> [Accessed 17 March 2017].
http://www.dse.vic.gov.au/data/assets/pdf_file/0007/243286/Bioregional-Conservation-Status-for-each-BioEVC.pdf
- DEPI (2013) Permitted Clearing of Native Vegetation Biodiversity Assessment Guidelines (Department of Environment and Primary Industries, Melbourne)
- DoEE (2017a) Environment Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool. Available at: <http://www.environment.gov.au/epbc/protected-matters-search-tool> [Accessed 17 March 2017]
- DoEE (2017b) Species Profiles and Threats. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66726 (Department of Environment and Energy: Canberra) Accessed 11 April 2017
- Dowling B and Weston MA (1999) Managing a breeding population of the Hooded Plover *Thinornis rubricollis* in a high-use recreational environment. *Bird Conservation International* **9**, 255-270.
- DSE (2004) Vegetation Quality Assessment Manual – Guidelines for Applying the Habitat Hectares Scoring Method, Version 1.3. (Department of Sustainability and Environment: East Melbourne) Available at http://www.depi.vic.gov.au/data/assets/pdf_file/0009/228771/VQAM-V1_3-Chapters-1-11.pdf
- DSE (2013) Advisory list of threatened vertebrate fauna in Victoria - 2013. (Department of Sustainability and Environment: East Melbourne)
- DSEWPC (2011) Environment Protection and Biodiversity Conservation Act 1999 draft referral guidelines for the endangered southern brown bandicoot (eastern), *Isoodon obesulus obesulus* (Department of Sustainability, Environment, Water, Population and Communities, Canberra). Available at: <http://www.environment.gov.au/resource/epbc-act-draft-referral-guidelines-endangered-southern-brown-bandicoot-eastern-isoodon>
- Ecology Australia (1997) Proposed Twelve Apostles and Loch Ard Gorge Car Parking Facilities: Overview of Geomorphology, Flora, Fauna Archaeology and Potential Impacts. Report prepared by G. Carr, M. Bezuijen, A. McMahon, H. DuCros and N. Rosengren for Tract Consultants (Ecology Australia Pty Ltd: Fairfield, in association with DuCros and Associates and Latrobe University)
- Ecology Australia (2002) Port Campbell National Park Information Centre: Four Site Options – Preliminary Assessment. Report prepared by L Conole, G Carr and ARG McMahon (Ecology Australia Pty Ltd: Fairfield)
- Ecology Australia (2004) Loch Ard Gorge: Port Campbell Information Centre – Preliminary Environmental Assessment. Report prepared by LV Crowfoot, LE Conole and ARG McMahon for Roots Projects (Ecology Australia Pty Ltd: Fairfield)

- Ecology Australia (2005) Southern Toadlet - Targeted Surveys Hillview Quarry, Dromana. Unpublished report prepared by C Wilson and L Conole for Hillview Quarries (Ecology Australia, Fairfield)
- Ecology Australia (2007) Alcoa Anglesea Future Mine Options: Lower Seam Option Flora, Fauna and Net Gain Assessment: Existing Conditions. Unpublished report prepared by ARG McMahon, LE Conole, LV Crowfoot and C Renowden for Sinclair Knight Merz (Ecology Australia Pty Ltd, Fairfield)
- Ecology Australia (2008) Healesville – Koo Wee Rup Road Upgrade: Growling Grass Frog and Swamp Skink survey. Unpublished report prepared by D Quin and C Renowden for VicRoads (Ecology Australia Pty Ltd, Fairfield)
- Ecology Australia (2010) Loch Ard Gorge Visitor Centre Flora and Fauna Assessment Stage 1: Values and Constraints. Unpublished report prepared by ARG McMahon, B Schmidt and D Quin for Parks Victoria (Ecology Australia, Fairfield)
- Ecology Partners (2007) Distribution and Conservation Significance of Frog Species on the Mornington Peninsula. Unpublished report prepared by A Albotins and A Organ for Melbourne Water (Ecology Partners, Victoria)
- Ecology Partners (2008) Distribution and Conservation Status of Bibron's Toadlet and Southern Toadlet in Melbourne Water's Extended Area Schemes Area, Victoria. Unpublished report prepared by A Organ, J North, I Veltheim, C Steele and Z Senbergs for Melbourne Water (Ecology Partners, Victoria)
- Garnett ST, Szabo JK, Dutson G (2011) 'The Action Plan for Australian Birds 2010.' (CSIRO Publishing: Collingwood)
- Gibson LA, Wilson BA, Cahill DM and Hill J (2004) Modelling habitat suitability of the Swamp Antechinus in the coastal heathlands of southern Victoria, Australia. *Biological Conservation* **117**; 143-150.
- Hero J, Littlejohn M and Marantelli G (1991) Frogwatch Field Guide to Victorian Frogs (Department of Conservation and Environment, Victoria)
- McGregor Coxall (2015) Shipwreck Coast Master Plan Unpublished report prepared for Parks Victoria (McGregor Coxall, Melbourne)
- Maguire GS (2008) A Practical Guide for Managing Beach-nesting Birds. Unpublished report prepared for Australian Government (Birds Australia: Carlton)
- Mitchell, E. and Wilson, B. (2007). Detection and habitat use of the Rufous Bristlebird (*Dasyornis broadbenti*) in coastal heathland, in south-western Victoria, Australia. *Emu* **107**; 327-334.
- Paull D (1995) The distribution of Southern Brown Bandicoot (*Isodon obesulus obesulus*) in Southern Australia. *Wildlife Research* **22**; 585-600.
- Pogonaski JJ, Pollard DA and Paxten JR (2002) Conservation Overview and Action Plan for Australian Threatened and Potentially Threatened Marine and Estuarine Fishes (Environment Australia: Canberra)
- Sanderson, K.J., and Kraehenbuehl, J. (2006). Southern Brown Bandicoots *Isodon obesulus obesulus* in Belair National Park. *Australian Mammalogy*. 28(2); 147-152
- Sands DPA and New TR (2003) 'The Action Plan for Australia Butterflies' (Environment Australia: Canberra)

- Schulz M (1985) The occurrence of the mourning skink, *Egernia coventryi* Storr, in saltmarsh in Westernport Bay, Victoria. *The Victorian Naturalist* **102(5)**: 148-152.
- Seebeck J and Menkhorst PW (2000) Status and conservation of the rodents of Victoria. *Wildlife Research* **27**: 357- 369.
- Seymour J, Paton DC and Rogers DJ (2003) The conservation status of the Rufous Bristlebird, *Dasyornis broadbenti*, in South Australia. *Emu* **103**: 315-321.
- Smales I (1981) The Herpetofauna of Yellingbo State Faunal Reserve. *The Victorian Naturalist* **98**: 234-246.
- Stoddart MD and Braithwaite RW (1979) A strategy for utilisation of regenerating heathland habitat by the Brown Bandicoot (*Isodon obesulus*; marsupialia, peramelidae). *Journal of Animal Ecology* **48**: 165-179.
- Triggs B (1996) 'Tracks, Scats and Other Traces - A Field guide to Australian Mammals.' (Oxford University Press: Melbourne)
- Tyler M (1997) The Action Plan Australian Frogs (Wildlife Australia Endangered Species Program for Environment Australia, Canberra)
- Wager R and Jackson P (1993) The Action Plan for Australian Freshwater Fishes (Australian Nature Conservation Agency: Canberra, ACT)
- Walsh NG, Stajsic V (2007) 'A Census of the Vascular Plants of Victoria.' 8th edn. (Royal Botanic Gardens: Melbourne)
- Weston MA (2003) Managing the Hooded Plover in Victoria – a review of existing information. Parks Victoria Technical Series No. 4 (Parks Victoria: Melbourne)
- Weston MA and Elgar MA (2005) Disturbance to brood-rearing Hooded Plovers *Thinornis rubricollis*: responses and consequences. *Bird Conservation International* **15**, 193-209.
- Weston MA and Elgar MA (2007) Responses of incubating Hooded Plovers (*Thinornis rubricollis*) to disturbance. *Journal of Coastal Research* **23**, 569-576.
- Weston MA, Ehmke GC and Maguire GS (2009) Manage one beach or two? Movements and space-use of the threatened Hooded Plover (*Thinornis rubricollis*) in south-eastern Australia. *Wildlife Research* **36**, 289-298.
- Wildlife Profiles (1998) *Egernia coventryi* Swamp Skink Nomination prepared for Listing on Schedule 2 of the *Flora and Fauna Guarantee Act*, 1988. Unpublished report prepared by P Robertson P for the FFG Act Scientific Committee (Wildlife Profiles, Heidelberg)
- Wilson BA, Aberton JG, Reilly PN and MacDonald M (2001) The distribution and ecology of the Rufous Bristlebird (*Dasyornis broadbenti*) at Aireys Inlet, Victoria. *Emu* **101**: 341-347.
- Woinarski JCZ, Burbidge AA, Harrison PL (2014) 'The Action Plan for Australian Mammals 2012.' (CSIRO Publishing: Collingwood)

8 Glossary

Biodiversity	The variety of all life-forms, plants, animals, fungi, protists (including algae) and bacteria, their encoded genes, and the ecosystems of which they form a part
Bioregion	Defined geographical regions of Australia with similar climatic and geophysical characteristics, and which generally contain a suite of distinct ecosystems and species
Conservation status	Categorisation of the threat risk to biological assets (plant and animal species, EVCs or plant communities) at a defined scale (e.g. national, state), as determined by specific criteria
Ecological Vegetation Class (EVC)	A vegetation classification described through a combination of its floristic composition, life form and ecological characteristics, and its association with particular environmental attributes. EVCs may include one or more floristic communities that occur across a biogeographic range, and have similar habitat and ecological processes operating
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
Exotic	Plants, animals, fungi and other organisms that have been introduced (deliberately or accidentally) to Australia or a given area after European settlement
Exotic vegetation	Vegetation comprised wholly or substantially of exotic species
FFG Act	Victorian <i>Flora and Fauna Guarantee Act 1988</i>
Floristic	Of or pertaining to plant species, i.e. flora
GIS	Geographic Information System. A digital platform for creating, analysing and viewing maps and other spatially referenced data
High threat weeds	Introduced species (including non-indigenous 'natives') which, as invading species have highly deleterious impacts on indigenous vegetation and faunal habitats
Indigenous	Plant and animal species found naturally in pre-European Australia
Indigenous vegetation	Vegetation native to Australia or native to a specific geographic region
Introduced	Deliberately or accidentally brought to Australia or part of Australia, usually by human agency
Native vegetation	Species occurring naturally in Australia as part of the pre-European flora or fauna
Vegetation community	Term for interacting plant populations forming vegetation. A vegetation community in formal classifications may have characteristic plant species, composition and structure

Appendix 1 Vertebrate fauna species recorded at Precincts associated with the Shipwreck Coast Master Plan, 20-22 March 2017.

EPBC = Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

M = listed under the EPBC Act as a Marine-overfly species

FFG = Victorian *Flora and Fauna Guarantee Act 1988*

L = Listed under the FFG Act

DSE = Advisory list of threatened vertebrate fauna in Victoria – 2013 (Department of Sustainability and Environment: East Melbourne)

nt = classified as near threatened under the Advisory list (DSE 2013)

No. = number of individuals of the species, where determined

* = Introduced species

Port Campbell Precinct					
Scientific Name	Common Name	EPBC	FFG	DSE	No.
Birds					
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant				2
<i>Larus pacificus pacificus</i>	Pacific Gull	Ma		nt	2
<i>Chroicocephalus novaehollandiae</i>	Silver Gull	Ma			15
<i>Vanellus miles</i>	Masked Lapwing				20
<i>Egretta novaehollandiae</i>	White-faced Heron				1
<i>Ardea pacifica</i>	White-necked Heron				1
<i>Aquila audax</i>	Wedge-tailed Eagle				4
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo				1
<i>Rhipidura albiscapa</i>	Grey Fantail				
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				
<i>Acanthiza pusilla</i>	Brown Thornbill				
<i>Dasyornis broadbenti caryochrous</i>	Rufous Bristlebird (Otway)		L	nt	1
<i>Malurus cyaneus</i>	Superb Fairy-wren				
<i>Pardalotus punctatus punctatus</i>	Spotted Pardalote				
<i>Zosterops lateralis</i>	Silvereye	Ma-o			
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill				
<i>Lichenostomus virescens</i>	Singing Honeyeater				
<i>Lichenostomus leucotis</i>	White-eared Honeyeater				
<i>Phylidonyris pyrrhoptera</i>	Crescent Honeyeater				
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater				
<i>Anthochaera chrysoptera</i>	Little Wattlebird				
<i>Anthochaera carunculata</i>	Red Wattlebird				
<i>Cracticus tibicen</i>	Australian Magpie				
<i>Corvus mellori</i>	Little Raven	Ma-o			
* <i>Turdus merula</i>	Common Blackbird				
* <i>Passer domesticus</i>	House Sparrow				
Mammals					
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum				

Twelve Apostles Precinct					
Scientific Name	Common Name	EPBC	FFG	DSE	No.
Birds					
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant				1
<i>Eudyptula minor</i>	Little Penguin	Ma			
<i>Phalacrocorax carbo</i>	Great Cormorant				1
<i>Phalacrocorax fuscescens</i>	Black-faced Cormorant	Ma		nt	1
<i>Hirundo neoxena</i>	Welcome Swallow				
<i>Rhipidura albiscapa</i>	Grey Fantail				
<i>Eopsaltria australis</i>	Eastern Yellow Robin				
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				
<i>Acanthiza pusilla</i>	Brown Thornbill				
<i>Sericornis frontalis</i>	White-browed Scrubwren				
<i>Dasyornis broadbenti caryochrous</i>	Rufous Bristlebird (Otway)		L	nt	1
<i>Stipiturus malachurus</i>	Southern Emu-wren				
<i>Malurus cyaneus</i>	Superb Fairy-wren				
<i>Zosterops lateralis</i>	Silvereye	Ma-o			
<i>Lichenostomus virescens</i>	Singing Honeyeater				
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater				
<i>Anthochaera carunculata</i>	Red Wattlebird				
<i>Cracticus tibicen</i>	Australian Magpie				
<i>Corvus mellori</i>	Little Raven	Ma-o			
* <i>Sturnus vulgaris</i>	Common Starling				
Mammals					
<i>Wallabia bicolor</i>	Black Wallaby				
<i>Macropus giganteus</i>	Eastern Grey Kangaroo				
<i>Rattus lutreolus</i>	Swamp Rat				
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot	EN	L	nt	
* <i>Vulpes vulpes</i>	Red Fox				

Loch Ard Gorge Blowhole					
Scientific Name	Common Name	EPBC	FFG	DSE	No.
Birds					
<i>Eopsaltria australis</i>	Eastern Yellow Robin				
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				
<i>Acanthiza pusilla</i>	Brown Thornbill				
<i>Sericornis frontalis</i>	White-browed Scrubwren				
<i>Dasyornis broadbenti caryochrous</i>	Rufous Bristlebird (Otway)		L	nt	1
<i>Malurus cyaneus</i>	Superb Fairy-wren				
<i>Lichenostomus virescens</i>	Singing Honeyeater				
<i>Corvus mellori</i>	Little Raven	Ma-o			
Mammals					
<i>Macropus giganteus</i>	Eastern Grey Kangaroo				
* <i>Oryctolagus cuniculus</i>	European Rabbit				