



ECOLOGY
AUSTRALIA

Shipwreck Coast Targeted Flora and Fauna Survey Report



Prepared for: Parks Victoria

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Cover photo: Agile Antechinus *Antechinus agilis* caught at the Port Campbell Precinct during targeted surveys. Photo: Matthew Le Feuvre

Contents

Acknowledgments	1
Summary	2
1 Introduction	4
2 Methods	6
2.1 Threatened Flora	6
2.2 Threatened Fauna	6
3 Results	12
3.1 Threatened Flora	12
3.2 Threatened Fauna	12
3.3 Remote Cameras	12
3.4 Elliot Trapping	13
3.5 Other Evidence	13
4 Fauna of Conservation Significance	14
5 Policy & Legislative Implications	19
5.1 State	19
5.2 Commonwealth	19
6 References	21

Tables

Table 1	Species Listed by the Commonwealth EPBC act or the Victorian FFG Act, or classified by the threatened species advisory list (DSE 2013) detected during targeted surveys of three sites along shipwreck coast.	14
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Figures

Figure 1	Location of the three precincts surveyed within the Port Campbell National Park	8
Figure 2	Location of Elliot traps and remote cameras in the 12 Apostles Precinct.	9
Figure 3	Location of Elliot traps and remote cameras in the Loch Ard Precinct	10
Figure 4	Location of Elliot traps and remote cameras in the Port Campbell Precinct	11

Plates

Plate 1	Rufous Bristlebird (Otway sub-species) <i>Dasyornis broadbenti caryochrus</i> recorded on a remote camera as part of the targeted surveys.	15
Plate 2	Southern Brown Bandicoot (south-eastern subspecies) <i>Isodon obesulus obesulus</i> recorded at the Loch Ard precinct during camera surveys.	16

Plate 3	Swamp Antechinus (mainland sub-species) <i>Antechinus minimus maritimus</i> captured at the 12 Apostles precinct during surveys.	17
Plate 4	White-footed Dunnart <i>Sminthopsis leucopus</i> captured at the Loch Ard precinct during targeted surveys.	18

Appendices

Appendix 1	Plant species lists for the three precincts (12 Apostles, Loch Ard and Port Campbell) recorded 1-2 November 2017.	23
Appendix 2	Fauna species observed during targeted surveys at three sites (the 12 Apostles, Loch Ard and Port Campbell precincts) on the shipwreck coast. Surveys consisted of Motion-sensitive camera surveys, Elliot trapping surveys and incidental observations.	28

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Summary

This report documents the results of targeted flora and fauna surveys associated with the implementation of the Shipwreck Coast Masterplan at three precincts: Port Campbell, 12 Apostles and Loch Ard.

The targeted surveys follow an overview study of the three precincts, which identified key values and constraints, but also identified values that required further investigation, namely federal and/or state listed species (Ecology Australia 2017).

The surveys included searches for threatened flora (1-2 November 2017), and remote-sensing cameras (1-23 November 2017) and Elliot trapping (22-26 January 2018) for threatened fauna.

The flora surveys revealed no EPBC Act 1999 or FFG Act 1988 listed threatened species, nor species otherwise classified as threatened under the Advisory List (DSE 2013).

The fauna surveys recorded four FFG Act listed species inclusive of two EPBC Act listed fauna: Southern Brown Bandicoot and Swamp Antechinus.

Species Listed under the Commonwealth EPBC Act or the Victorian FFG Act, or otherwise classified as threatened [Advisory List (DSE 2013)] detected during targeted surveys.

Key

Sites: TA = Twelve Apostles; LA = Loch Ard; PC = Port Campbell

Listings: En = Endangered; Vu = Vulnerable; L = Listed; NT = Near Threatened

Species		Sites recorded at			Conservation Status		
Common Name	Species Name	TA	LA	PC	EPBC	FFG	Advisory
Rufous Bristlebird (Otway sub-species)	<i>Dasyornis broadbenti caryochrus</i>	X	X	X		L	NT
Southern Brown Bandicoot (South-eastern)	<i>Isoodon obesulus obesulus</i>	X	X	X	En	L	NT
Swamp Antechinus (Mainland)	<i>Antechinus minimus maritimus</i>	X		X	Vu	L	NT
White-footed Dunnart	<i>Sminthopsis leucopus</i>		X	X		L	NT

Other targeted fauna namely Broad-toothed Rat (EPBC, FFG) and Swamp Skink (FFG) were not recorded, but cannot be dismissed, as suitable habitat remains – notably at 12 Apostles – and there are previous records from within the National Park.

The policy and legislative implications of the targeted and overview studies are principally two fold:

the proposed developments at the respective precincts should be referred to the Commonwealth – as single referral - under the EPBC Act 1999; and

the proposed developments will require assessment under Victoria's recently gazetted (December 2017) vegetation clearance regulations: Guidelines for the removal, destruction or lopping of native vegetation. (DELWP 2017).

Both instruments require a three-step approach of avoid, minimise and offset, and the nature and extent of values at the three precincts suggest that minimisation of loss of habitat is the key step.

The state's vegetation clearance assessment and the Commonwealth referral can proceed once infrastructure footprints and associated construction methods are firm.

1 Introduction

This report responds to a recommendation for targeted surveys associated with the implementation of the Shipwreck Coast Masterplan at three precincts: Port Campbell, Twelve Apostles and Loch Ard (Figure 1). Ecology Australia (2017) previously provided an overview of the values and the implications of the proposed infrastructure at the respective sites, and identified several threatened flora and fauna that were likely to be present, but required additional surveys to firm their current status.

The present surveys focused on Environment Protection and Biodiversity Conservation Act 1999 (EPBC), and/or Flora and Fauna Guarantee Act 1988 (FFG) listed species and otherwise threatened Advisory List species (DSE 2013, DEPI 2014).

Further, previous studies e.g. Grant 1987, Duncan et al 1991, Belcher 1992, Biosis Research 1995, 1996a and 1996b, Ecology Australia 2010, suggest that several of these species are potentially widespread and therefore present as a probable constraint at most sites.

The following table outlines the candidate species for targeted surveys. the preparation of this list involved excluding species for which the habitats at the subject sites were clearly not suitable e.g. Hooded Plover (beaches), Swamp Greenhood *Pterostylis tenuissima* (Tea tree / paperbark swamps), and Clover Glycine *Glycine latrobeana* (grassy woodlands / grasslands). Also, while the overview survey (Ecology Australia 2017) identified a number of threatened Ecological Vegetation Classes (EVC's) there were no EPBC Act or FFG Act listed communities present.

Table 1 Shipwreck Coast Master Plan: candidate species for targeted surveys.

Scientific Name	Common Name	EPBC Act	FFG Act
FLORA			
<i>Caladenia fragrantissima</i>	Scented Spider-orchid	-	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>Thelymitra epipactoides</i>	Metallic Sun-orchid	Endangered	Listed
FAUNA			
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot (south-east mainland subspecies)	Endangered	Listed
<i>Antechinus minimum maritimus</i>	Swamp Antechinus	Vulnerable	Listed
<i>Dasyornis broadbenti caryochrous</i>	Rufous Bristlebird (eastern/Otways subspecies)	-	Listed
<i>Sminthopsis leucopus</i>	White-footed Dunnart	-	Listed
<i>Lissolepis coverntryi</i>	Swamp Skink	-	Listed
<i>Mastocomys fuscus mordicus</i>	Brood-toothed Rat	Endangered	Listed

2 Methods

2.1 Threatened Flora

Surveys were carried-out on 1-2 November 2017. Several hours were spent traversing each precinct on foot, and ensuring that representative habitats were adequately covered. A species inventory was compiled for each site (Appendix 1).

2.2 Threatened Fauna

Targeted surveys included both remote motion sensing cameras and Elliot trapping. In addition, any species of conservation concern seen or heard on site were recorded.

Remote Camera Surveys

Four motion sensing remote cameras were set up each at the Twelve Apostles (Figure 2) and Loch Ard (Figure 3). Seven cameras were deployed at the Port Campbell precinct, four on top of the escarpment near the Great Ocean Road and three along the estuary (Figure 4). The motion sensing cameras were a combination of Reconyx HC550 white flash cameras (with a 'traditional' visible camera flash that produces a colour image day and night, two per site) and Reconyx HC500/HC600 infrared cameras (an invisible infrared flash that gives a monochrome "night vision" image at night and colour image by day, two or five per site). A combination of white flash and infrared cameras were used as, while the infrared cameras minimise disturbance to the animals, the colour images produced by the white flash cameras are more useful for identifying smaller animals, such as dunnarts and antechinus of conservation significance.

Remote cameras were set up on the 1st and 2nd November 2017 and retrieved on the 22nd and 23rd November 2017. In total, cameras were deployed for between 20 and 22 nights. The majority of cameras were deployed using a standard horizontal set up but two of the cameras deployed along the Port Campbell estuary were set up in a vertical orientation to detect Swamp Skinks (*Lissolepis coventryi*). For the standard set up, cameras were attached to a tree or a star picket roughly 30 cm off the ground. An attractant consisting of peanut butter, rolled oats, golden syrup and pistachio essence was secured approx. 2 metres from the camera in a purpose-built bait holder. Sardines were added to the baits at Port Campbell to attract Swamp Skinks. Vegetation between the camera and bait station and immediately surrounding the bait station was trimmed with hedge trimmers to provide an unobstructed view of any animals photographed and reduce the number of false triggers. The Swamp Skink vertical cameras were attached to a star picket roughly 50 cm off the ground facing downwards over a 30 cm x 30 cm cork tile (sensu Welbourne 2013). A bait station as outlined above was pegged to the middle of the tile.

The images were downloaded to a computer for analysis and identification of any fauna species photographed. Fauna were identified to species level wherever possible. In some instances, species could not be fully identified; for example, as a consequence of fast-moving individuals resulting in poor image quality, or individuals being only partially photographed. However, it is not expected that unidentified animals would materially affect the results of the survey, particularly as the remote cameras were supplemented with Elliot trapping.

Elliot Trapping

Elliot trapping was undertaken over four nights between 22nd and 26th January 2018 to improve the likelihood of detecting small mammals, notably Swamp Antechinus *Antechinus minimus maritimus*, White-footed Dunnart *Sminthopsis leucopus* and Swamp Skink. Seventy-six Elliott traps were set over four consecutive nights, resulting in 304 trap nights. Elliot traps were set in the following arrangements:

Twenty-eight traps at the Twelve Apostles Precinct to the east of the footpath, arranged in a single transect to the east of the walking track (Figure 2).

Twenty-five traps at the Loch Ard Precinct around the blowhole, arranged in three separate transects as follows:

Thirteen traps in Coast Headland Scrub EVC to the east of the blowhole.

Five traps in Coastal Tussock Grassland EVC along the clifftop to the south of the blowhole.

Seven traps in the Coast Headland Scrub EVC to the west of the blowhole (Figure 3).

Twenty-three traps at Port Campbell on the western side of the estuary, arranged in four separate transects as follows:

Seven traps in Damp Heath Scrub EVC between the Great Ocean Road and the Discovery Walk.

Five traps in Damp Heath Scrub EVC east of the Discovery Walk.

One trap in Damp Heath Scrub EVC south of the Great Ocean Road.

Ten traps in Estuarine Flats Grassland EVC on the western bank of the estuary targeting Swamp Skinks (Figure 4).

Elliott trap transects were located to cover all fauna habitats within each precinct. Traps were generally spaced every 5 m, but in some habitats the spacing was governed by the availability of suitable trap locations. A GPS waypoint was taken at each trap location, as well as marking each position with flagging tape. Each trap was placed under vegetation, ensuring the trap entrance was clear of any potential obstructions. Traps were baited with a ball of rolled oats, peanut butter and golden syrup, with sardines added to the mixture for the Swamp Skink trap line along the Port Campbell estuary.

Traps were set in the evening within two hours of sunset and checked and closed each morning within two hours of sunrise. To maximise the likelihood of catching Swamp Skinks, when conditions allowed (i.e. not too hot) traps along the Port Campbell estuary were cleared first thing in the morning and left open until midday when they were cleared again and closed. Animals captured were identified to species level then released within 5 metres of the trap site.

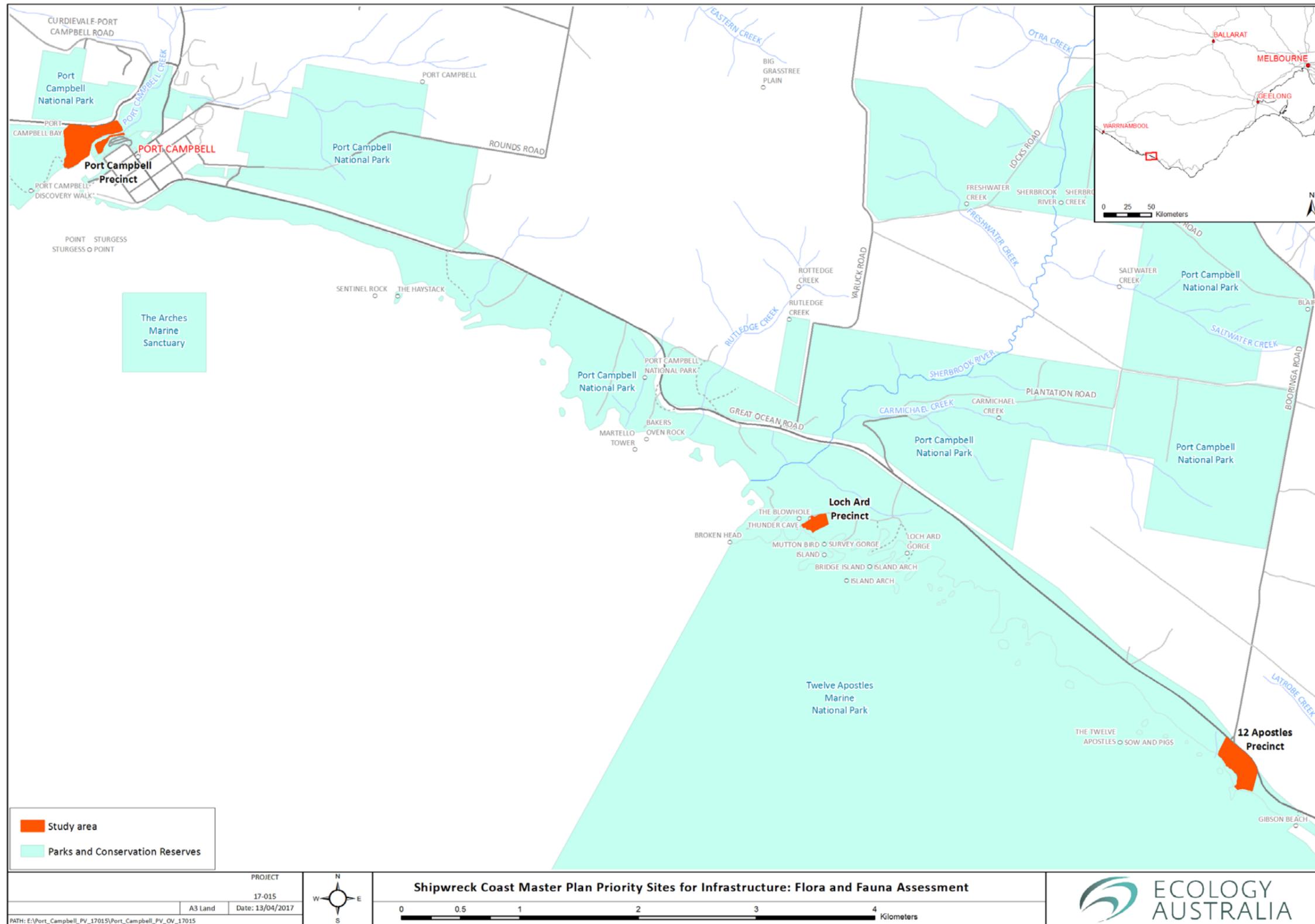


Figure 1 Location of the three precincts surveyed within the Port Campbell National Park

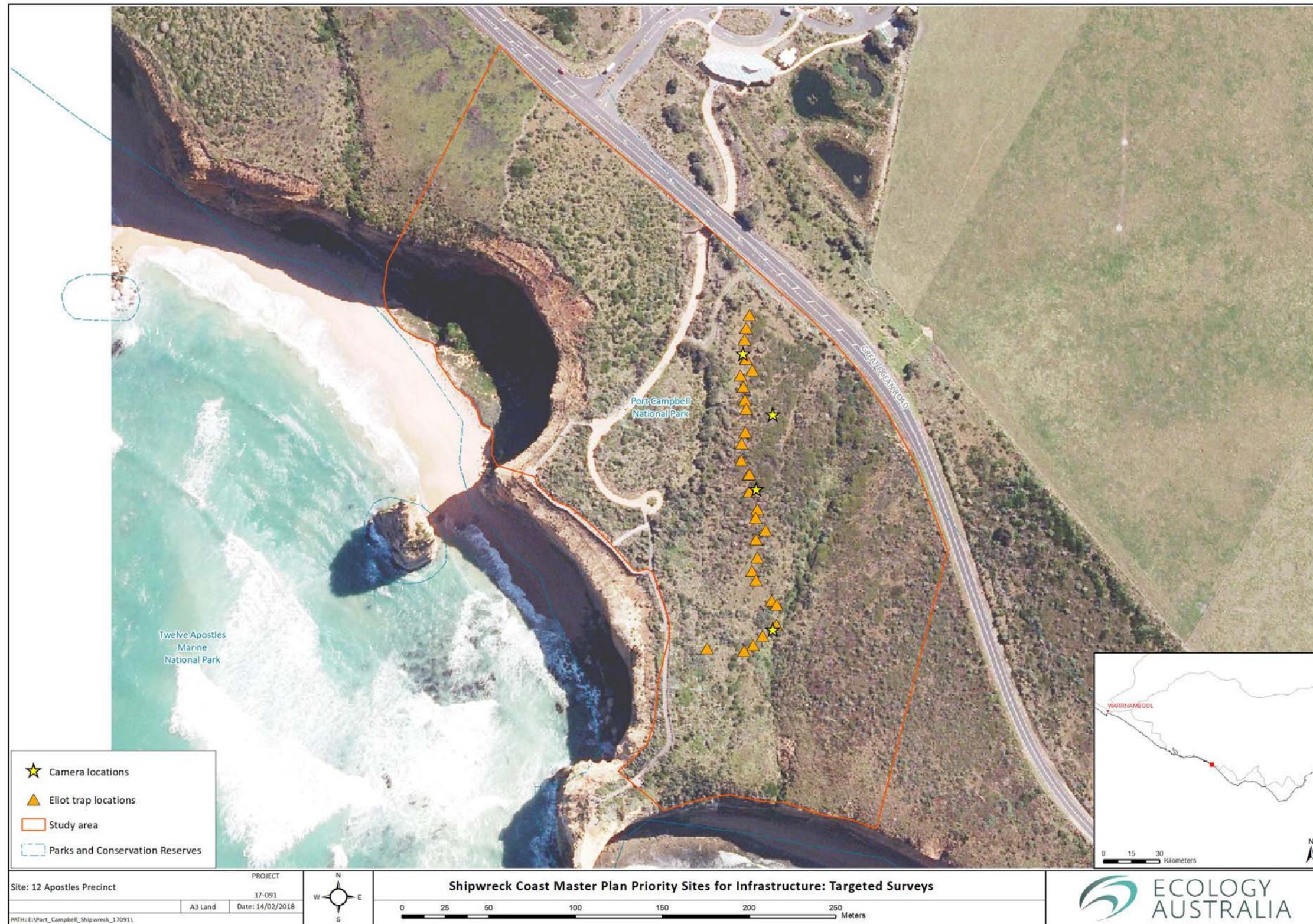


Figure 2 Location of Elliot traps and remote cameras in the 12 Apostles Precinct.

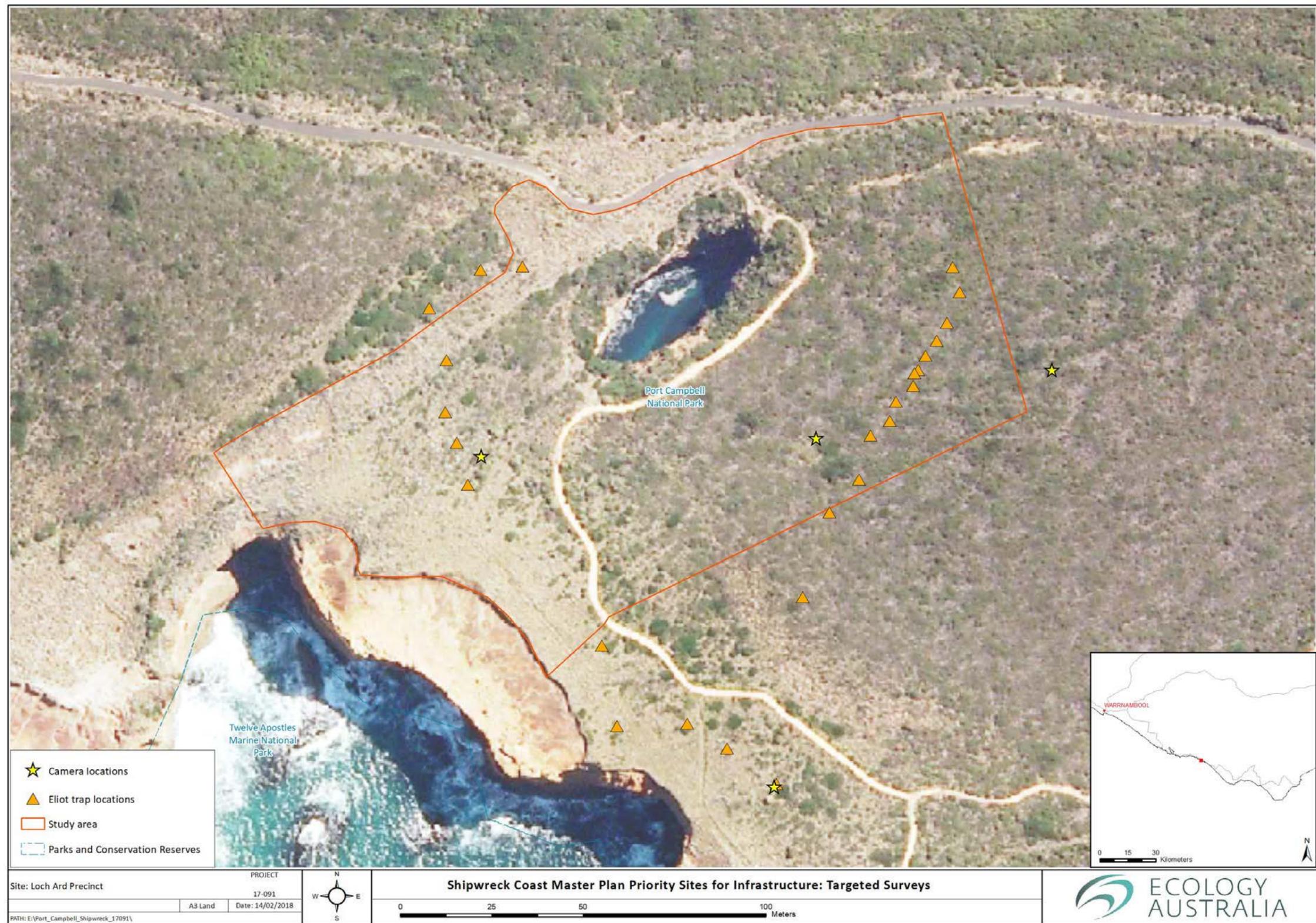


Figure 3 Location of Elliot traps and remote cameras in the Loch Ard Precinct

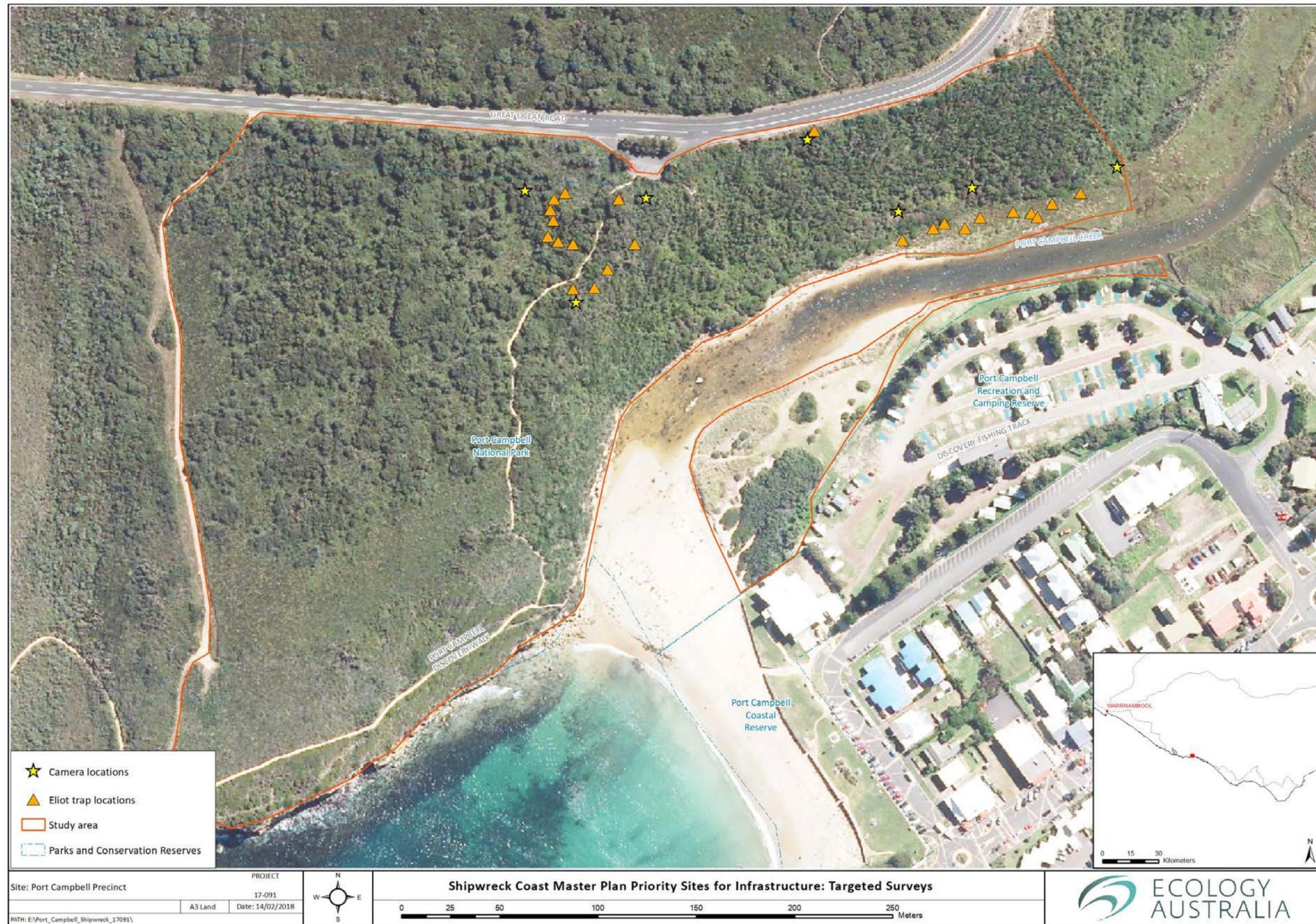


Figure 4 Location of Elliot traps and remote cameras in the Port Campbell Precinct

3 Results

3.1 Threatened Flora

No threatened flora were recorded at the respective precincts. While spring 2017 was generally regarded as a reasonable season for geophytes (orchids and lillies) these were very infrequent at the study sites. (Appendix 1). This could be due to a number of factors including:

the floristries at 12 Apostles and the Loch Ard in particular, indicate atmospheric deposition of salt e.g. Australia Salt-grass *Distichlis distichophylla* and Shing Swamp-mat *Selliera radicans* are common ground layer species;

the very dense vegetation across the estuary escarpment at Port Campbell is likely to be antagonistic to seasonal species;

the long-term absence of fire, namely at 12 Apostles, is resulting in open grassland vegetation being replaced by dense shrublands of Manuka *Leptospermum scoparium*, similarly antagonistic to seasonal species.

These results do not preclude the possibility that some species, currently not observable, may be stimulated by fire as Parks Vic have recorded for Metallic Sun-orchid at some site within the National Park. These records are being followed-up with Parks Vic to gain any further insights into the distribution and ecology of this species.

At present, and based on the current survey results, threatened plant species do not appear to be a key issue at the respective precincts.

3.2 Threatened Fauna

In total 28 species including seven introduced species were recorded during the targeted fauna surveys (Appendix 2). It should be noted that this is not an exhaustive list of all species encountered on site, as incidental records were only noted for species of conservation significance i.e. EPBC Act and/or FFG Act listed or Advisory List threatened. Four species of conservation significance were recorded including four FFG Act listed and (inclusive of) two EPBC Act listed species.

3.3 Remote Cameras

In total 25 species were recorded during remote camera surveys, including three species of conservation significance. Port Campbell had the highest species diversity and Twelve Apostles the lowest.

Twelve Apostles

In total 7 species were recorded on cameras at the Twelve Apostles site. This included one species of conservation significance (Rufous Bristlebird *Dasyornis broadbenti caryochrus*) and two exotic species (Red Fox *Vulpes vulpes* and Common Starling *Sturnus vulgaris*).

Loch Ard

Fifteen species were recorded on cameras at Loch Ard including three species of conservation significance: Rufous Bristlebird, Southern Brown Bandicoot *Isodon obesulus obesulus* and White-footed Dunnart *Sminthopsis leucopus*. The Southern Brown Bandicoot and White-footed Dunnart were both recorded in scrub approximately 90 m east of the blowhole. Four exotic species (Red Fox, Common Starling, Cat *Felis catus* and House Mouse *Mus musculus*) were recorded at Loch Ard.

Port Campbell

Eighteen species were recorded on cameras at Port Campbell including three species of conservation significance: Rufous Bristlebird, Southern Brown Bandicoot and White-footed Dunnart. Southern Brown Bandicoot and White-footed Dunnart were both recorded in dense scrub some 50 metres west of the car park at the start of the Discovery Walk. Five exotic species (Red Fox, Common Starling, Cat, Black Rat *Rattus rattus* and Common Blackbird *Turdus merula*) were also recorded.

3.4 Elliot Trapping

Overall, trapping success was relatively high, with 39% of trap nights resulting in a capture, with the highest success rate at Port Campbell. Diversity was also highest at Port Campbell. Note that abundances must be treated with caution, as it is unclear whether captures are recaptures or new individuals.

Twelve Apostles

Trapping success was moderate at the Twelve Apostles (23% of trap nights, 26 captures). Diversity was relatively low (3 species). One individual of conservation significance (Swamp Antechinus *Antechinus minimus*) was recorded. However, 96% of individuals captured were exotic Black Rats (13 captures) and House Mice (12 captures).

Loch Ard Gorge

Trapping success was low at Loch Ard Gorge (11% of trap nights, 11 captures). However diversity was high (5 species) and exotic species only made up 55% of captures (two Black Rats and four House Mice). One species of conservation significance was captured on site (White-footed Dunnart, 1 capture) in the dense scrub to the east of the blowhole.

Port Campbell

Trapping success was very high at Port Campbell (79% of trap nights, 89 captures) and diversity was high (6 species). One species of conservation significance was recorded (Swamp Antechinus) with three captures and two individuals caught in a single night. Native rodents were abundant at this site, with 12 Bush Rat (*Rattus fuscipes*) captures, including 5 in a single night, and 18 Swamp Rat (*Rattus lutreolis*) captures, including 5 in a single night. Sixty-one percent of captures were exotic species (24 Black Rats, 30 House Mice).

3.5 Other Evidence

Southern Brown Bandicoot was not caught on cameras at 12 Apostles but characteristic conical diggings were observed at several sites across the precinct. It is highly likely that the species is present.

4 Fauna of Conservation Significance

Four species of conservation significance were recorded during the surveys; Rufous Bristlebird, Southern Brown Bandicoot, Swamp Antechinus and White-footed Dunnart (Table 1).

Table 1 - Species Listed under the Commonwealth EPBC Act or the Victorian FFG Act, or otherwise classified as threatened [Advisory List (DSE 2013)] detected during targeted surveys.

Key

Sites: TA = Twelve Apostles; LA = Loch Ard; PC = Port Campbell

Listings: En = Endangered; Vu = Vulnerable; L = Listed; NT = Near Threatened

Species		Sites recorded at			Conservation Status		
Common Name	Species Name	TA	LA	PC	EPBC	FFG	Advisory
Rufous Bristlebird (Otway sub-species)	<i>Dasyornis broadbenti caryochrus</i>	X	X	X		L	NT
Southern Brown Bandicoot (South-eastern)	<i>Isoodon obesulus obesulus</i>	X	X	X	En	L	NT
Swamp Antechinus (Mainland)	<i>Antechinus minimus maritimus</i>	X		X	Vu	L	NT
White-footed Dunnart	<i>Sminthopsis leucopus</i>		X	X		L	NT

Rufous Bristlebird (Otway sub-species) *Dasyornis broadbenti caryochrus*

The Rufous Bristlebird is listed as a threatened taxon under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) and classified as endangered in Victoria (DSE 2013). The Rufous Bristlebird is a medium sized, predominantly ground dwelling songbird (Plate 1). It is made up of three subspecies; *Dasyornis broadbenti caryochrus* known from Anglesea to Peterborough, *D. b. broadbenti* from Portland to the Coorong, and an extinct subspecies (*D. b. litoralis*) from south-western Australia. Rufous Bristlebirds are generally found in coastal thickets, and in the Otways they are generally found in forested valleys a short distance inland (DSE 2003, Menkhorst et al. 2017). In Victoria, the Rufous Bristlebird's range has declined and become increasingly fragmented.

Key threatening processes to the Rufous Bristlebird are:

Loss, fragmentation and degradation of habitat due to clearing for agricultural and urban developments.

As it is predominantly ground dwelling, the Rufous Bristlebird is vulnerable to predation by Red Foxes and Cats.

Bushfires or inappropriate fire regimes may reduce habitat availability and quality. Frequent bushfires were implicated in the extinction of *D. b. litoralis* (DSE 2003).

Rufous Bristlebird (FFG Act 1988) is present at all three precincts and the evidence suggest the species is widespread throughout the National Park.



Plate 1 Rufous Bristlebird (Otway sub-species) *Dasyornis broadbenti caryochrus* recorded on a remote camera as part of the targeted surveys.

Southern Brown Bandicoot (south-eastern subspecies) *Isoodon obesulus obesulus*

The Southern Brown Bandicoot is listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and as a threatened taxon under the FFG Act, and classified as near threatened in Victoria (DSE 2013). The Southern Brown Bandicoot is a medium sized ground dwelling marsupial. The Southern Brown Bandicoot is distributed from Ku-ring-gai Chase National Park to the Fleurieu Peninsula and Kangaroo Island, including Tasmania. Additional sub-species are known from south-western Australia and Cape York. Southern Brown Bandicoots are found in variety of habitats, including heathland, shrubland, open forest and woodland, and generally inhabit areas with dense ground cover.

Key threatening processes to the Southern Brown Bandicoot are:

Habitat loss, degradation and fragmentation primarily due to clearing of vegetation for agricultural, pastoral, forestry and urban land uses.

Predation by Red Foxes and Cats.

Inappropriate fire regimes, leading to a reduction in habitat quality (i.e. reducing dense ground cover).

Road kill (Woinarski et al. 2014, DoE 2018).

Southern Brown Bandicoot is considered present at all three precincts, based on remote camera records and characteristic diggings. The species is listed as endangered under the EPBC Act 1999 and loss of habitat has implications under the Significant Impact Guidelines (DEWHA 2013). See Section 5.0 for further discussion.



Plate 2 Southern Brown Bandicoot (south-eastern subspecies) *Isodon obesulus obesulus* recorded at the Loch Ard precinct during camera surveys.

Swamp Antechinus (Mainland sub-species) *Antechinus minimus maritimus*

The Swamp Antechinus is listed as vulnerable under EPBC Act and as a threatened taxon under the FFG Act, and classified as near threatened in Victoria (DSE 2013). The Swamp Antechinus is a small carnivorous marsupial. It has a fragmented distribution in coastal areas from Robe to Wilson's Promontory. A second subspecies (*Antechinus minimus minimus*) is found in Tasmania. The Swamp Antechinus has specialised habitat requirements and is generally found in damp coastal habitats with a dense ground cover, such as wet heathlands, damp gullies and swamps.

The key threatening processes for Swamp Antechinus are:

Too frequent burning of habitat by bushfires. The Swamp Antechinus is considered to be a late successional species, going locally extinct following fire and recolonising patches 15 years or more post fire.

Habitat loss, degradation and fragmentation due to clearing of vegetation and draining of swamps for agricultural, pastoral and urban developments.

Predation by Red Foxes and Cats.

Habitat degradation (i.e. reduction in ground cover) due to grazing by exotic herbivores and overgrazing by native species.

Drier conditions predicted under future climate change will likely negatively impact Swamp Antechinus. Swamp Antechinus population size appear to be positively correlated with rainfall, and significant population declines have been recorded during dry periods (Wilson et al. 2001, Magnusdottir et al. 2008, Sale et al. 2008, Woinarski et al. 2014, Threatened Species Scientific Committee 2016)

Swamp Antechinus was recorded at Twelve Apostles and Port Campbell precincts. It is listed as vulnerable under the EPBC Act 1999 and is FFG Act 1988 listed. The population at Port Campbell National Park would be regarded as an Important Population under the EPBC Act and loss of habitat would invoke assessment under the Significance Impact Guidelines (DEWHA 2013). See Section 5.



Plate 3 Swamp Antechinus (mainland sub-species) *Antechinus minimus maritimus* captured at the 12 Apostles precinct during surveys.

White-footed Dunnart *Sminthopsis leucopus*

The White-footed Dunnart is listed as a threatened taxon under the FFG Act and classified as near threatened in Victoria (DSE 2013). It is a small carnivorous marsupial. The White-footed Dunnart is generally known from coastal areas south eastern Australia, from Portland to Jervis Bay and Tasmania, and there is a disjunct population in the Wet Tropics. The White-footed Dunnart is found in most vegetation types with a dense ground cover, including sclerophyll forest, heath, tussock grassland and rainforest.

The key threatening processes for White-footed Dunnarts are:

Inappropriate fire regimes.

Logging.

Habitat loss, degradation and fragmentation.

Predation by Red Foxes and Cats (Woinarski et al. 2014).

White-footed Dunnart (FFG Act) was recorded at Loch Ard and Port Campbell precincts. The species is classified as Near Threatened under the Advisory List. The FFG Act applies principally if not wholly to public land and impacts to the species will form part of the regulators decision-making process, and potential offsets may apply under Victoria's Vegetation Clearance Guidelines (DELWP 2017). See Section 5.



Plate 4 White-footed Dunnart *Sminthopsis leucopus* captured at the Loch Ard precinct during targeted surveys.

5 Policy & Legislative Implications

This section briefly outlines the State's and Commonwealth policy and legislative considerations as infrastructure design and planning approvals progresses.

5.1 State

Guidelines for the removal, destruction or lopping of native vegetation (the Guidelines).

Native vegetation removal in Victoria is regulated by the Guidelines (DELWP 2017) as specified by the purpose of Clause 52.17 (Native Vegetation) of the planning scheme. The policy came into effect on 12 December 2017. As for the former policy (see Ecology Australia 2017), the three step approach of avoid, minimise and offset is central to regulatory decision making, as is a firm offset strategy.

The assessment under the Guidelines can be completed once infrastructure footprints and associated construction techniques are firmed.

Flora and Fauna Guarantee Act 1988

The FFG Act lists flora and fauna species and ecological communities that are recognised to be rare or threatened in Victoria. It also identifies potentially threatening processes (e.g. loss of hollow-bearing trees) and flora that require protection (i.e. protected flora). Protected flora include those species listed as threatened under the FFG Act, plant taxa that belong to listed communities and plant taxa that are not threatened, but require protection for other reasons (e.g. from over-collection). A permit is required to remove protected flora from public land.

Four FFG Act listed threatened fauna species were recorded within the precincts: White-footed Dunnart, Rufous Bristlebird, Southern Brown Bandicoot and Swamp Antechinus.

No FFG Act listed threatened flora species were recorded. 'Protected flora' species were recorded within the precincts. As the study area is located on public land, a protected flora permit will be required for the removal of these species.

No FFG Act listed ecological communities occur within the precincts.

5.2 Commonwealth

Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth EPBC Act pertains to 'matters of national environmental significance', including Ramsar wetlands, listed threatened species and ecological communities, listed migratory species and Commonwealth Marine Areas. It applies to both public and private land.

A proponent is obliged to refer matters to the Commonwealth Environment Minister if such values may be affected by a proposed action. The Department of Energy and Environment decides whether there will be a significant impact and if it needs to be a 'controlled action' and requires a formal assessment under the EPBC Act. The Commonwealth can intervene to modify or block an action if it deems this necessary for the protection of a species or community of national significance.

Two EPBC Act listed species were recorded at the precincts: Southern Brown Bandicoot (Endangered) at all three precincts and Swamp Antechinus (Vulnerable) at Port Campbell and Loch Ard. This suggests that the proposals should be referred to the Commonwealth, desirably with supporting evidence that significant impacts can be avoided. This will place an emphasis on the (similar) minimise requirements of the Act which can be achieved through design and innovative construction methods. These were a topic of discussion at the design team meeting at Denton Corker Marshall (8 March 2018), and are fundamental to achieving a low impact outcome.

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Appendix 1 Plant species lists for the three precincts (12 Apostles, Loch Ard and Port Campbell) recorded 1-2 November 2017.

EPBC = Commonwealth Environment Protection and Biodiversity Conservation Act 1999. 'EN' indicates the species is classified as endangered, 'VU' indicates the species is classified as vulnerable.

FFG = Victorian Flora and Fauna Guarantee Act 1988. 'L' indicates that a species is listed.

Advisory = species listed under the 'advisory list of rare or threatened vertebrate fauna in Victoria' (DSE 2013). 'nt' indicates a species is classified as near threatened.

*=Exotic species

AP= The 12 Apostles Precinct

LG= The Loch Ard Precinct

PC= The Port Campbell Precinct

Note that this is not an exhaustive list, and incidental records were only taken for species of conservation concern.

VROT	Scientific Name	Common Name
Twelve Apostles Prec 1		
	<i>Acacia longifolia subsp. sophorae</i>	Coast Wattle
	<i>Acaena novae-zelandiae</i>	Bidgee-widgee
	<i>Acrotriche affinis</i>	Ridged Ground-berry
	<i>Acrotriche serrulata</i>	Honey-pots
	<i>Allocasuarina verticillata</i>	Drooping Sheoak
	<i>Alyxia buxifolia</i>	Sea Box
*	<i>Anagallis spp.</i>	Anagallis
	<i>Asperula conferta</i>	Common Woodruff
	<i>Austrostipa pubinodis</i>	Tall Spear-grass
	<i>Baumea acuta</i>	Pale Twig-sedge
*	<i>Briza minor</i>	Lesser Quaking-grass
*	<i>Bromus catharticus</i>	Prairie Grass
	<i>Carpobrotus rossii</i>	Karkalla
*	<i>Centaurium erythraea</i>	Common Centaury
*	<i>Cirsium vulgare</i>	Spear Thistle
	<i>Convolvulus erubescens s.l.</i>	Pink Bindweed
	<i>Correa reflexa</i>	Common Correa
*	<i>Dactylis glomerata</i>	Cocksfoot
	<i>Dianella revoluta s.l.</i>	Black-anther Flax-lily
	<i>Dichondra repens</i>	Kidney-weed
	<i>Distichlis distichophylla</i>	Australian Salt-grass
	<i>Ficinia nodosa</i>	Knobby Club-sedge
	<i>Frankenia pauciflora var. gunnii</i>	Southern Sea-heath
	<i>Gahnia trifida</i>	Coast Saw-sedge
	<i>Goodenia humilis</i>	Swamp Goodenia

VROT	Scientific Name	Common Name
*	<i>Helminthotheca echioides</i>	Ox-tongue
*	<i>Holcus lanatus</i>	Yorkshire Fog
*	<i>Hordeum marinum</i>	
*	<i>Hypochaeris radicata</i>	Flatweed
	<i>Juncus sarophorus</i>	Broom Rush
	<i>Lepidosperma gladiatum</i>	Coast Sword-sedge
	<i>Leptospermum scoparium</i>	Manuka
	<i>Leucophyta brownii</i>	Cushion Bush
	<i>Leucopogon parviflorus</i>	Coast Beard-heath
	<i>Linum marginale</i>	Native Flax
	<i>Lobelia anceps</i>	Angled Lobelia
	<i>Lomandra longifolia subsp. longifolia</i>	Spiny-headed Mat-rush
*	<i>Melilotus indicus</i>	Sweet Melilot
	<i>Olearia axillaris</i>	Coast Daisy-Bush
	<i>Oxalis exilis</i>	Shade Wood-sorrel
	<i>Ozothamnus ferrugineus</i>	Tree Everlasting
	<i>Ozothamnus turbinatus</i>	Coast Everlasting
*	<i>Plantago coronopus</i>	Buck's-horn Plantain
*	<i>Plantago lanceolata</i>	Ribwort
	<i>Poa poiformis var. poiformis</i>	Coast Tussock-grass
	<i>Pteridium esculentum</i>	Austral Bracken
	<i>Rhagodia candolleana</i>	
*	<i>Romulea rosea</i>	Onion Grass
	<i>Rubus parvifolius</i>	Small-leaf Bramble
	<i>Scaevola spp.</i>	Fan Flower
	<i>Schoenus apogon</i>	Common Bog-sedge
	<i>Schoenus lepidosperma</i>	Slender Bog-sedge
	<i>Schoenus nitens</i>	Shiny Bog-sedge
	<i>Selliera radicans</i>	Shiny Swamp-mat
	<i>Senecio glomeratus</i>	Annual Fireweed
	<i>Senecio odoratus</i>	Scented Groundsel
	<i>Senecio pinnatifolius</i>	Variable Groundsel
*	<i>Sonchus oleraceus</i>	Common Sow-thistle
*	<i>Stenotaphrum secundatum</i>	Buffalo Grass
*	<i>Taraxacum officinale spp. agg.</i>	Garden Dandelion
	<i>Tetragonia implexicoma</i>	Bower Spinach
	<i>Themeda triandra</i>	Kangaroo Grass
	<i>Veronica calycina</i>	Hairy Speedwell
	<i>Viola cleistogamoides</i>	Hidden Violet
Loch Ard Blowhole Prec 2		
#	<i>Acacia longifolia subsp. sophorae</i>	Coast Wattle
	<i>Acacia verticillata subsp. verticillata</i>	Prickly Moses
	<i>Acrotriche serrulata</i>	Honey-pots
	<i>Actites megalocarpus</i>	Dune Thistle
	<i>Alyxia buxifolia</i>	Sea Box
	<i>Astroloma humifusum</i>	Cranberry Heath
	<i>Austrostipa spp.</i>	Spear Grass
	<i>Banksia marginata</i>	Silver Banksia
	<i>Baumea juncea</i>	Bare Twig-sedge

VROT	Scientific Name	Common Name
	<i>Brachyscome parvula</i>	Coast Daisy
	<i>Brachyscome</i> spp.	Daisy
	<i>Carex breviculmis</i>	Common Grass-sedge
	<i>Cassytha glabella</i>	Slender Dodder-laurel
*	<i>Centaurium erythraea</i>	Common Centaury
	<i>Centrolepis aristata</i>	Pointed Centrolepis
	<i>Centrolepis strigosa</i> subsp. <i>strigosa</i>	Hairy Centrolepis
	<i>Comesperma volubile</i>	Love Creeper
	<i>Correa reflexa</i>	Common Correa
	<i>Correa reflexa</i>	Common Correa
	<i>Dianella admixta</i>	Black-anther Flax-lily
	<i>Dianella brevicaulis</i>	Small-flower Flax-lily
	<i>Distichlis distichophylla</i>	Australian Salt-grass
	<i>Drosera pygmaea</i>	Tiny Sundew
	<i>Ficinia nodosa</i>	Knobby Club-sedge
	<i>Frankenia pauciflora</i> var. <i>gunnii</i>	Southern Sea-heath
	<i>Gahnia trifida</i>	Coast Saw-sedge
	<i>Goodenia humilis</i>	Swamp Goodenia
	<i>Hibbertia aspera</i> s.l.	Rough Guinea-flower
*	<i>Holcus lanatus</i>	Yorkshire Fog
*	<i>Holcus lanatus</i>	Yorkshire Fog
	<i>Hydrocotyle laxiflora</i>	Stinking Pennywort
	<i>Hypoxis hygrometrica</i>	Golden Weather-glass
*	<i>Juncus acutus</i> subsp. <i>acutus</i>	Spiny Rush
	<i>Juncus bufonius</i>	Toad Rush
	<i>Lagenophora gracilis</i>	Slender Bottle-daisy
*	<i>Leontodon</i> spp.	Hawkbit
	<i>Lepidosperma concavum</i>	Sandhill Sword-sedge
	<i>Lepidosperma gunnii</i>	Slender Sword-sedge
	<i>Leptospermum scoparium</i>	Manuka
	<i>Leucophyta brownii</i>	Cushion Bush
	<i>Leucopogon parviflorus</i>	Coast Beard-heath
	<i>Lomandra longifolia</i> subsp. <i>longifolia</i>	Spiny-headed Mat-rush
*	<i>Melilotus</i> spp.	Melilot
#	<i>Myoporum insulare</i>	Common Boobialla
	<i>Olearia axillaris</i>	Coast Daisy-Bush
	<i>Opercularia varia</i>	Variable Stinkweed
	<i>Ozothamnus ferrugineus</i>	Tree Everlasting
	<i>Ozothamnus turbinatus</i>	Coast Everlasting
	<i>Patersonia fragilis</i>	Short Purple-flag
*	<i>Plantago coronopus</i>	Buck's-horn Plantain
	<i>Poa poiformis</i> var. <i>poiformis</i>	Coast Tussock-grass
	<i>Poaceae</i> spp.	Grass
	<i>Pteridium esculentum</i>	Austral Bracken
	<i>Pultenaea gunnii</i>	Golden Bush-pea
	<i>Ranunculus</i> spp.	Buttercup
	<i>Rhagodia candolleana</i>	
	<i>Rhytidosporum</i> spp.	Marianth
	<i>Schoenus apogon</i>	Common Bog-sedge
	<i>Schoenus nitens</i>	Shiny Bog-sedge

VROT	Scientific Name	Common Name
	<i>Selliera radicans</i>	Shiny Swamp-mat
	<i>Senecio odoratus</i>	Scented Groundsel
	<i>Senecio pinnatifolius</i>	Variable Groundsel
*	<i>Sonchus oleraceus</i>	Common Sow-thistle
	<i>Spyridium spp.</i>	Spyridium
	<i>Tetragonia implexicoma</i>	Bower Spinach
	<i>Themeda triandra</i>	Kangaroo Grass
*	<i>Trifolium repens var. repens</i>	White Clover
	<i>Viola cleistogamoides</i>	Hidden Violet
	<i>Viola hederacea sensu Entwisle (1996)</i>	Ivy-leaf Violet
Pt Campbell Escarpment - upper and middle slopes Prec 3a		
	# <i>Acacia longifolia subsp. longifolia</i>	Sallow Wattle
	# <i>Acacia longifolia subsp. sophorae</i>	Coast Wattle
	<i>Acacia melanoxylon</i>	Blackwood
	<i>Acacia myrtifolia</i>	Myrtle Wattle
v	<i>Acacia notabilis</i>	Mallee Golden Wattle
	<i>Acrotriche serrulata</i>	Honey-pots
	<i>Allocasuarina paludosa</i>	Scrub Sheoak
	<i>Allocasuarina paludosa</i>	Scrub Sheoak
	<i>Allocasuarina verticillata</i>	Drooping Sheoak
	<i>Alyxia buxifolia</i>	Sea Box
	<i>Asperula conferta</i>	Common Woodruff
	<i>Austrostipa pubinodis</i>	Tall Spear-grass
	<i>Banksia marginata</i>	Silver Banksia
	<i>Bursaria spinosa subsp. spinosa</i>	Sweet Bursaria
	<i>Carex breviculmis</i>	Common Grass-sedge
	<i>Cassytha pubescens s.s.</i>	Downy Dodder-laurel
*	<i>Centaurium erythraea</i>	Common Centaury
	<i>Clematis aristata</i>	Mountain Clematis
	<i>Comesperma volubile</i>	Love Creeper
	<i>Correa reflexa</i>	Common Correa
	<i>Dianella brevicaulis</i>	Small-flower Flax-lily
	<i>Drosera auriculata</i>	Tall Sundew
	<i>Eucalyptus ovata subsp. ovata</i>	Swamp Gum
	<i>Gahnia trifida</i>	Coast Saw-sedge
	<i>Geranium spp.</i>	Crane's Bill
	<i>Gonocarpus tetragynus</i>	Common Raspwort
	<i>Hibbertia aspera s.l.</i>	Rough Guinea-flower
	<i>Lepidosperma gladiatum</i>	Coast Sword-sedge
	<i>Lepidosperma gunnii</i>	Slender Sword-sedge
	<i>Lepidosperma laterale var. laterale</i>	Variable Sword-sedge
	<i>Leptospermum scoparium</i>	Manuka
	<i>Leucopogon parviflorus</i>	Coast Beard-heath
	<i>Lomandra longifolia subsp. longifolia</i>	Spiny-headed Mat-rush
	<i>Olearia axillaris</i>	Coast Daisy-Bush
	<i>Oxalis spp.</i>	Wood Sorrel
	<i>Ozothamnus ferrugineus</i>	Tree Everlasting
	<i>Poa morrisii</i>	Soft Tussock-grass
	<i>Poa poiiformis var. poiiformis</i>	Coast Tussock-grass

VROT	Scientific Name	Common Name
	<i>Pteridium esculentum</i>	Austral Bracken
	<i>Pultenaea gunnii</i>	Golden Bush-pea
	<i>Rhagodia candolleana subsp. candolleana</i>	Seaberry Saltbush
	<i>Schoenus apogon</i>	Common Bog-sedge
	<i>Senecio glomeratus</i>	Annual Fireweed
	<i>Senecio odoratus</i>	Scented Groundsel
	<i>Spyridium parvifolium</i>	Dusty Miller
	<i>Stylidium armeria</i>	Common Triggerplant
	<i>Tetrarrhena juncea</i>	Forest Wire-grass
	<i>Viola cleistogamoides</i>	Hidden Violet
	<i>Xanthorrhoea australis</i>	Austral Grass-tree
Pt Campbell Estuary - lower terraces Prec 3b		
	# <i>Acacia longifolia subsp. sophorae</i>	Coast Wattle
	<i>Apium prostratum subsp. prostratum</i>	Sea Celery
	* <i>Argyranthemum frutescens</i>	Marguerite
	<i>Asteraceae spp.</i>	Composite
	* <i>Bromus diandrus</i>	Great Brome
	* <i>Cakile maritima subsp. maritima</i>	Sea Rocket
	* <i>Coprosma repens</i>	Mirror Bush
	<i>Daucus glochidiatus</i>	Australian Carrot
	<i>Dianella brevicaulis</i>	Small-flower Flax-lily
	<i>Distichlis distichophylla</i>	Australian Salt-grass
	* <i>Euphorbia lathyris</i>	Caper Spurge
	* <i>Euphorbia paralias</i>	Sea Spurge
	* <i>Festuca arundinacea</i>	Tall Fescue
	<i>Ficinia nodosa</i>	Knobby Club-sedge
	<i>Frankenia pauciflora var. gunnii</i>	Southern Sea-heath
	* <i>Galium aparine</i>	Cleavers
	* <i>Gladiolus undulatus</i>	Wild Gladiolus
	<i>Juncus kraussii subsp. australiensis</i>	Sea Rush
	# <i>Leptospermum laevigatum</i>	Coast Tea-tree
	<i>Leucopogon parviflorus</i>	Coast Beard-heath
	* <i>Lycium ferocissimum</i>	African Box-thorn
	* <i>Melilotus indicus</i>	Sweet Melilot
	# <i>Myoporum insulare</i>	Common Boobialla
	<i>Poa poiformis var. poiformis</i>	Coast Tussock-grass
	* <i>Ranunculus repens</i>	Creeping Buttercup
	<i>Rhagodia candolleana subsp. candolleana</i>	Seaberry Saltbush
	<i>Sarcocornia quinqueflora</i>	Beaded Glasswort
	* <i>Senecio elegans</i>	Purple Groundsel
	<i>Senecio odoratus</i>	Scented Groundsel
	<i>Senecio pinnatifolius</i>	Variable Groundsel
	* <i>Sonchus oleraceus</i>	Common Sow-thistle
	* <i>Stenotaphrum secundatum</i>	Buffalo Grass
	<i>Tetragonia implexicoma</i>	Bower Spinach
	<i>Urtica incisa</i>	Scrub Nettle
	* <i>Vicia sativa subsp. nigra</i>	Narrow-leaf Vetch

Appendix 2 Species observed during targeted surveys at three sites (the 12 Apostles, Loch Ard and Port Campbell precincts) on the shipwreck coast. Surveys consisted of Motion-sensitive camera surveys, Elliot trapping surveys and incidental observations.

Scientific Name	Common Name	Conservation Status			Sites detected at		
		EPBC	FFG	Advisory	AP	LA	PC
<i>Antechinus agilis</i>	Agile Antechinus					X	X
<i>Antechinus minimus</i>	Swamp Antechinus	VU	L	nt	X		X
<i>Calamanthus fuliginosus</i>	Striated Fieldwren					X	
<i>Colluricincla harmonica</i>	Grey Shrike-thrush						X
<i>Corvus sp.</i>	Raven					X	
<i>Dasyornis broadbenti caryochrus</i>	Rufous Bristlebird (Otways subsp.)		L	nt	X	X	X
* <i>Felis catus</i>	Cat					X	
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot	EN	L	nt		X	X
<i>Lampropholis guichenoti</i>	Garden Skink						X
<i>Macropus giganteus</i>	Eastern Grey Kangaroo					X	
<i>Malurus cyaneus</i>	Superb Fairy-wren				X		X
* <i>Mus musculus</i>	House mouse				X	X	X
<i>Petrochelidon neoxena</i>	Welcome Swallow					X	
<i>Pseudemoia entrecasteauxii</i>	Southern Grass Skink					X	
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum						X
<i>Rattus fuscipes</i>	Bush rat					X	X
<i>Rattus lutreolis</i>	Swamp rat					X	X
* <i>Rattus rattus</i>	Black rat				X	X	X
<i>Sericornis frontalis</i>	White-browed Scrubwren						X
<i>Sminthopsis leucopus</i>	White-footed Dunnart		L	nt		X	X
<i>Stipiturus malachurus</i>	Southern Emu-wren						X
* <i>Sturnus vulgaris</i>	Common Starling				X	X	X
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna				X	X	
<i>Tiliqua nigrolutea</i>	Blotched Blue-tongued Lizard					X	X
* <i>Turdus merula</i>	Common Blackbird						X
* <i>Vulpes vulpes</i>	Red Fox				X	X	X

Scientific Name	Common Name	Conservation Status			Sites detected at		
		EPBC	FFG	Advisory	AP	LA	PC
<i>Wallabia bicolor</i>	Black Wallaby				X		X
<i>Zosterops lateralis</i>	Silvereeye						X
Total Species Recorded					9	18	21