



BACKGROUND RESEARCH DISCUSSION PAPER

City of Port Phillip Biodiversity Study and Action Plan

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City of Port Phillip Biodiversity Study and Action Plan

Client: City of Port Philip

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SUMMARY

The City of Port Phillip is a highly urbanised Council with limited remnant native vegetation persisting, primarily restricted to the foreshore and a small number of parks and reserves. However, the biodiversity values remaining are quite significant and warrant protection and enhancement for future generations.

This Background Research and Discussion Paper was prepared by Arcadis as part of a larger Biodiversity Study and Action Plan project. It presents a summary of the findings of an extensive desktop review undertaken to compile all the biodiversity records contained across a number of different platforms including online government databases, existing ecological reports and local species lists. The results of the data review were used to assist selection of the most appropriate sites and taxonomic groups to target during the field surveys.

Biodiversity of the City of Port Phillip

The following summarises species that were identified as previously recorded in or immediately adjoining the municipality:

- 1,059 flora species comprising 102 algae (most of which are marine macroalgae), 32 bryophytes (mosses and liverworts) and 920 vascular plants.
- 1,090 fauna species comprising:
 - 464 vertebrate species including 276 birds, 115 fish, nine frogs, 34 mammal (17 marine mammals) and 30 reptiles.
 - 626 invertebrate species, including 23 crustaceans, 424 invertebrates (spiders, insects, worms etc.), 52 marine invertebrates (jellyfish, worms, starfish, tunicates etc.), and 127 molluscs.
- 113 fungal species, including seven lichens
- 2 protist species of slime mould

Rare or threatened species identified included:

- Three flora and 30 fauna species listed under the *Environment Protection and Biodiversity Conservation Act 1999*
- Eight flora and 44 fauna species listed under the *Flora and Fauna Guarantee Act 1988*
- 20 flora and 74 fauna species classified as rare or threatened in Victoria by the Department of Environment, Land, Water and Planning.

There is a notable absence of threatened invertebrate, fungus and protist species, with none having been recorded in the municipality. This is more likely the result of a lack of listings for the less commonly studied taxonomic groups, rather than a lack of species that should be classed as rare or threatened.

Keystone species

Keystone species provide important ecological functions such as pollination, feeding resources, habitat (roosts, sand dune stability, microclimate, etc.). The most notable keystone species include Hairy Spinifex, Seagrasses, prolific and seasonally flowering canopy species, almost all invertebrates (terrestrial, freshwater and marine), the Australian Anchovy *Engraulis australis* and the pollinator Grey-headed Flying-fox *Pteropus poliocephalus*.

Many fungus and protist species also provide important ecological functions (e.g. decomposing biological material) and have important relationships with other groups of species. Of all the species in this group, one was identified during the consultation phase as keystone due to its symbiotic relationship with plants, particularly Eucalypts: *Scleroderma cepa*, a type of Puff Ball.

Flagship species

Flagship species act as nature ambassadors, icons or symbols to improve the wider community's connection with, understanding of and appreciation for the natural world.

Flagship species identified included 64 flora, 45 fauna and one fungus species. They can be categorised as:

- Characteristic Australian species that are indigenous to the region such as Eucalypts, Wattles, Banksias
- Dominant grasses such as Hairy Spinifex, Kangaroo Grass *Themeda triandra*, Spear Grass *Austrostipa* species and Wallaby Grass *Rytidosperma* species
- Other culturally or ecologically significant flora species such as Murnongs, Noon-flowers and saltmarsh species.
- The introduced Canary Island Palm *Phoenix canariensis* that has been widely planted as an iconic foreshore feature. However, to improve biodiversity values, it is not considered a species requiring further promotion in future plantings.
- Fauna such as the tourist attracting Little Penguin *Eudyptula minor* and the culturally significant Wedge-tailed Eagle *Aquila audax* and Australian Raven *Corvus coronoides*, along with some common and easily identifiable species such as the Black Swan *Cygnus atratus*, Grey Fantail *Rhipidura albiscapa* and Rakali (Water-rat) *Hydromys chrysogaster*.
- Iconic fauna species groups such as Dolphins, Whales, Shearwaters, Seagulls, Seahorses and Whiting.
- The recently recorded rare and beautiful Green-staining Coral *Ramaria abietina* a rare coral fungus that was recently recorded in Westgate Park.

Susceptibility to climate change

With the projected warming and drying of Melbourne's climate, the most vulnerable biodiversity groups to climate change impacts within the City of Port Phillip include:

- Flora and fauna species restricted to foreshore and estuarine habitats. e.g. dune vegetation communities and shorebirds
- Flora species more sensitive to prolonged dry periods
- Impacts on food resources for migratory and / or nectivorous species e.g. swift parrot.

There is little information on the likely response to climate change for most fungus and slime mould species occurring with the City of Port Phillip. Fungal growth, reproduction and distributions have changed in the last few decades, and these changes have flow on effects given the importance of fungi in decomposition, nutrient cycling, plant mycorrhizal relationships and animal food resources. However, there are many information gaps requiring further investigation.

Susceptibility to urban development

Biodiversity remaining in the municipality primarily consists of species that are more tolerant of negative impacts of urbanisation. However, some less resilient species do remain or occasionally visit. Efforts to provide safe habitats for more sensitive species could increase the biodiversity in the municipality.

At this stage there are no urban development plans known that are likely to have significant implications for biodiversity over and above the cumulative impacts on the wider ecosystem. The impacts of a high density of pet dogs and cats is of concern to biodiversity values, particularly fauna species. Cat curfews and dog access restrictions in important biodiversity sites are essential to maintain or improve ecological values.

Susceptibility to management practices and policies

There are a number of management practices and policies that could negatively impact biodiversity. These include practices such as beach grooming/combing, herbicide spraying



and pedestrian and dog access to name just a few. However, for the most part these potential threats are well managed through Council's adaptive management program where issues raised are usually promptly addressed.

A number of historic management practices and policies that can be detrimental to environmental values are still in place, community consultation has tended to decline and a number of initiatives have lapsed over the past decade. Consideration should be given to counteracting these to incite a more wholistic biodiversity management program that utilises the community's extensive natural history knowledge and results in improved biodiversity outcomes.

Determining the location of ecological field surveys

A variety of somewhat ad hoc ecological surveys have been undertaken across the municipality in the past, including surveys by ecological consultants, local naturalists and through the NatureSpot program.

Based on the location and extent of ecological data already collected, and that also underway, the surveys to be undertaken as part of the Biodiversity Study and Action Plan are recommended to occur at the following locations:

- Sandridge Foreshore and First Point (vegetation mapping)
- West beach (vegetation mapping)
- Point Ormond (vegetation mapping, fauna habitat, microbat survey)
- Elwood Teatree (vegetation mapping)
- Elwood Foreshore and Reserve (vegetation mapping, fauna habitat, microbat survey)
- MO Moran Reserve: vegetation mapping
- Port Melbourne Light Rail (vegetation mapping)
- Elwood Canal Linear Reserve, Elster Creek (vegetation mapping, microbat, amphibian and reptile surveys)
- Alma Park (vegetation mapping)
- Canterbury Forest- Middle Park (fauna habitat and microbat survey)
- St Kilda Breakwater (fauna habitat, reptile and rakali survey)
- St Kilda Botanical Gardens (fauna habitat, microbat and amphibian survey)

1 INTRODUCTION

Biodiversity values, within the City of Port Phillip are significant, albeit highly modified through urban development. As a part of our natural heritage, they are inherited from past generations, maintained in our generation and then bestowed to future generations. The City of Port Phillip is committed to improving biodiversity values across the municipality, reversing the long-term downward trajectory.

Located near the heart of Melbourne, the Council's 176 hectares of parkland and open space, which includes 11.6 km of Port Phillip Bay shoreline, are important assets for biodiversity values. However, ecological data of natural heritage values for the municipality is spread across a number of resources including a variety of different online databases, in ecological reports, in collated species lists and in the minds of many local naturalists.

Arcadis was commissioned by the City of Port Phillip to undertake a Biodiversity Study and Action Plan, which included:

- A thorough desktop review to compile all ecological data made available
- A discussion paper to identify ecological knowledge gaps that could be filled with further survey work
- Field surveys to build upon the existing ecological knowledge
- A Biodiversity Action Plan to promote, protect and enhance biodiversity values within the municipality
- Stakeholder consultation to provide input from the important stakeholders such as Council departments, contractors, Boon Wurrung Foundation, environmental organisations and local naturalists in the community.

The results of the data review have been provided to the City of Port Phillip in an Excel spreadsheet, and are discussed in this report. The aims of the data review and this Discussion Paper are to:

- Provide the City of Port Phillip with a complete list of ecological data recorded within or immediately adjoining the municipality
- Guide where future ecological field surveys should be completed as part of the next phase of the Biodiversity Study and Action Plan project
- Consider where future citizen science BioBlitz field surveys could target

The methods of assessment and results of the investigation are presented herein.

1.1 Study area

The study area includes the entire City of Port Phillip municipality, approximately 20.62 km² in size. The City of Port Phillip lies within the Port Phillip and Westernport Catchment Management Authority region and Gippsland Plain bioregion. Bioregions are used to classify the environment using a range of attributes such as climate, geomorphology, geology, soils and vegetation. The Gippsland Plain bioregion includes flat low lying coastal and alluvial plains with a gently undulating terrain dominated by sandy barrier dunes and fertile floodplains and swampy flats (DELWP 2019a).

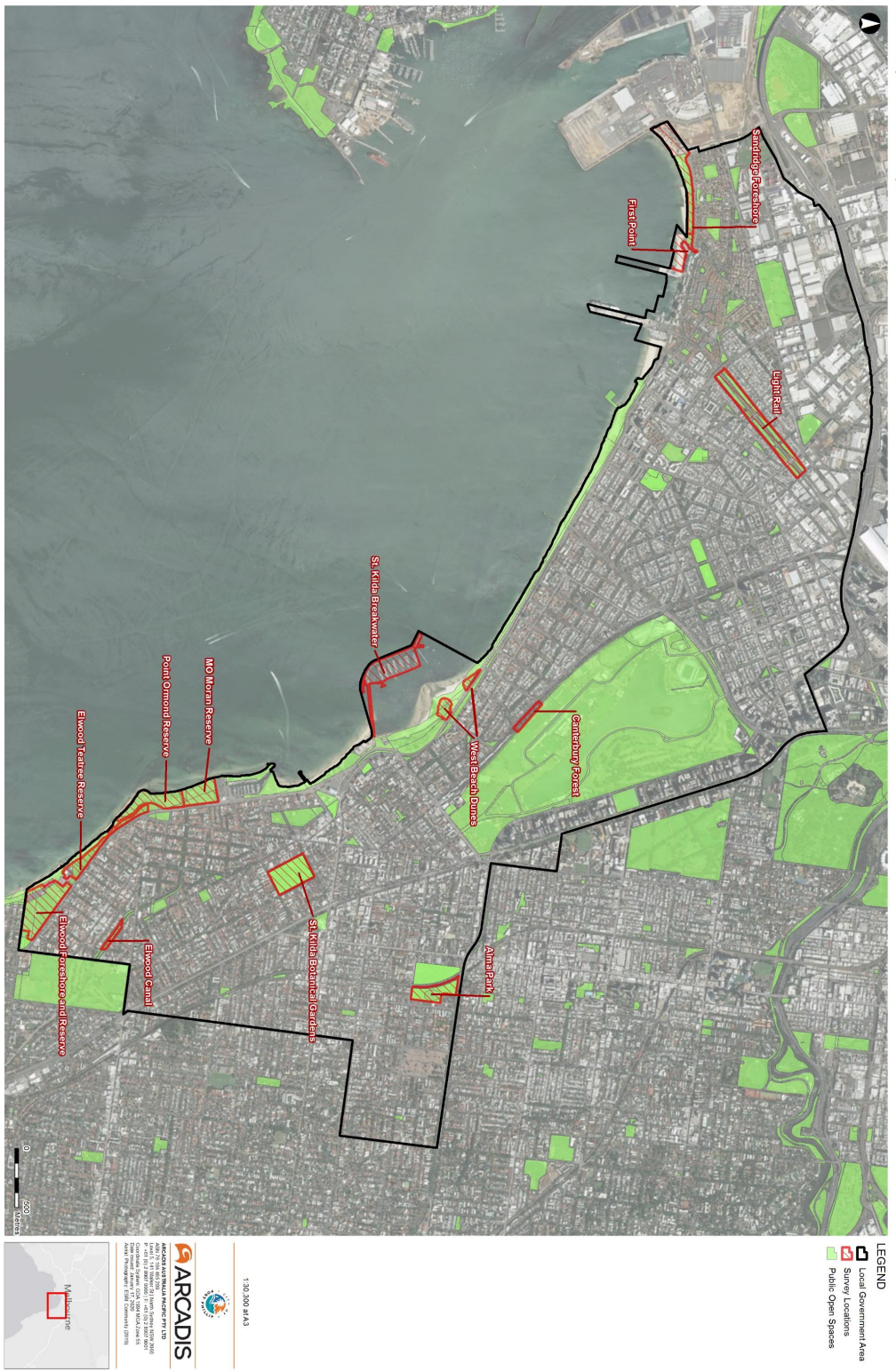
The municipality has been highly modified due to the close proximity to Melbourne's central business district, approximately 2.5 km away. The area is mainly utilised for residential, industrial, and commercial purposes, currently limiting the diversity of species to those that have been able to withstand the highly urbanised environment. Immediately adjoining the western boundary of the Port Phillip municipality is the Port of Melbourne, a major shipping terminal that may be a source of potentially new invasive biota entering Australia via international cargo ships.



The study area does support a range of small vegetated areas and larger patches of green space such as Albert Park, J L Murphy Reserve, St Kilda Botanic Gardens, M O Moran Reserve, as well as over 11 km of foreshore. These areas of green space provide important habitat and connectivity for native flora and fauna species to persist.

The geology of the municipality is often referred to as the 'sandbelt', primarily consists of coastal dunes from the Quaternary period or older (Cenozoic period) dunes that have formed into consolidated siliclastic rocks. Other geologies exist in the municipality, though at a much smaller scale. These include Quaternary alluvium along the banks of the Yarra River, Cenozoic volcanic rocks to the north of Albert Park Lake and a small outcrop of Silurian sedimentary rock (mudstone, siltstone, sandstone and conglomerate) (GeoScience 2019).

The following climate summary is from the nearest weather station, located at Essendon Airport approximately 11 km north west of the study area (BOM 2019). The long-term (1929-2019) average annual rainfall is 585.6 mm per year, mostly falling in October and November (and December), and least in March. However, this average rainfall has reduced by 15% to an average of 498.3 mm per year in more recent years (1981-2010). The warmest month is January with an average daily maximum of 26.6°C while the coldest is July with an average daily maximum of 13.1°C.



Study Area and Survey Locations
 Figure 1. The City of Port Phillip study area and sites recommended for further ecological investigations.

2 METHODS

2.1 Data Review

The collation of all available ecological data took place in October and November 2019. The following sources were collected and transferred into a single ecological dataset for the municipality:

Online databases (search included the municipality area plus a 1 km buffer, completed on 7 October 2019)

- Victorian Biodiversity Atlas (VBA) (DELWP 2019b)
- Atlas of Living Australia (ALA 2019)
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (DoEE 2019)
- eBird Checklist for Port Phillip (downloaded on the 21 October 2019) (The Cornell Lab of Ornithology 2019)
- Birddata species list for Port Phillip Municipality (download on the 13 November 2019) (Birdlife Australia 2019)

Existing ecological reports

- Flora species list from the Foreshore Vegetation Management Plan taken in March/April 2015 (Practical Ecology 2015)

Local species lists (provided by City of Port Phillip, Port Phillip EcoCentre and Westgate Biodiversity – Bili Nursery and Landcare)

- St Kilda Botanic Gardens bird species list (City of Port Phillip 2009)
- Westgate Park bird species list (Westgate Biodiversity- Bill Nursery and Landcare 2018)
- Flora species list (Westgate Biodiversity- Bill Nursery and Landcare 2012)
- Albert Park bird species list collected by Mary Ellen Talmage (Port Phillip EcoCentre 2017)
- BioBlitz Adventure September 2018 Elsternwick Park and Elster Creek (Port Phillip EcoCentre 2018)
- Terrestrial and aquatic invertebrate species list for Elster Creek (Port Phillip EcoCentre no date)
- Vertebrate fauna species list for Elster Creek (Port Phillip EcoCentre 2015)
- Combined shoreline Shell surveys (Port Phillip EcoCentre 2019)
 - St Kilda Beach (2008-2017)
 - St Kilda Beach West (2012-2017)
 - St Kilda Pier (2011-2019)
- Bird Species Checklists compiled by Peter Parrington (Parrington 2019)
 - Westgate Park (Andrew McCutcheon and Friends of Westgate Park from March 2007)
 - Perc White Reserve (Peter Parrington from September 2018, eBird from April 2012)
 - Garden City Reserve (Peter Parrington from February 2019)
 - JL Murphy Reserve
 - 109 Light Rail (Peter Parrington from July 2018, eBird from July 2012)
 - Edwards Pk/Lagoon Reserve (eBird from December 2010 to September 2015, Peter Parrington from February 2019)

- Gasworks Park (Rob Youl and Friends of Gasworks Park from 2014)
- St Vincent’s Gardens (eBird from April 2016, Rob Youl & Peter Parrington from August 2019)
- Albert Park (Mary Ellen Talmage from 1979)
- West St Kilda/Catani Gardens/ St Kilda Pier (eBird intermittently from January 1986)
- Peanut Reserve
- St Kilda Botanical Gardens (eBird from May 2006 including Andrew McCutcheon and Neil Blake ‘07 – ‘09)
- Elster Ck/ Point Ormond/ Elwood Park (Gio Fitzpatrick et al from November 2009)
- Elsternwick Park (Gio Fitzpatrick and others from November 2009)
- Ripponlea (eBird from July 2013)
- Port Phillip Foreshore (eBird)

The data sets were merged into a complete species list for the municipality with reference to the data source included.

A review of the data then took place once the sources had been combined to:

- Remove duplicate records
- Removal of terrestrial vertebrate fauna species with records older than 30 years whose habitat is unlikely to persist in the area currently
- Removal of species listed in the protected matters search tool based on potential presence habitat
- The VBA, Birdlife and ebird were the primary sources as the records have been peer reviewed
- Remove a species with insufficient taxonomic information provided such as a generic common name e.g. “skink”
- Update flora taxonomy

As the VBA search was conducted with a 1 km buffer around the municipality, all flora species recorded within the Royal Botanic Gardens were included in the original search. As many of these species are planted, and not naturalised, flora species in this area were reviewed and removed if unlikely to occur in the area naturally. As a result, 73 plant species were also removed.

2.1.1 Determining the year of last record

A year of last record was used to help in determining whether a species is still likely to occur within the study area. The year of last record was determined based on the latest year or record for each species across all data sets. For datasets with a date range (e.g. bird species lists dated as “records from 2012- 2018”) the earlier date was used as the latest record. For records that did not include a date (e.g. DoEE 2019, ALA 2019, Birdlife Australia 2019) no date was included.

2.2 Consultation

Arcadis held a stakeholder consultation workshop with City of Port Phillip on 12 November 2019 to summarise the datasets included in the data review and determine if additional datasets were available that had not yet been included. The workshop was also used to discuss the flagship and keystone species, field survey types (e.g. flora, general fauna, bat, bird) and locations based on knowledge of where the largest data deficiencies were located.



This consultation session was attended by:

- Renae Walton, Amanda Banks, Jonathan (Jack) Fisher, David Hehir, Greg Alcock (City of Port Phillip)
- Damien Connell (City Wide)
- Robert Anthony, Steve Partner and David Tournier (Boon Wurrung Foundation)
- Neil Blake (Port Phillip EcoCentre)
- Jo Samuel-King (Friends of Elster Creek)
- Gio Fitzpatrick (local naturalist)
- Judi Solomon and Rob Youl (Biolinks Alliance)

2.3 Species attribute designations

Each species was assigned the following information, as relevant:

- Origin
 - Introduced (*)
 - Victorian native but populations/stands may be introduced to the Port Phillip municipality (#)
 - Uncertain (U) – only applies to flora species.
 - Native/ Uncertain origin¹ fauna species (*BLANK*)

Table 1 Discipline and life form (plants) or guild (animals) assigned to each species recorded in the data review, Port Phillip municipality (November 2019).

Discipline	Life form/Guild
• Flora	<ul style="list-style-type: none"> – Algae – Bryophyte (liverworts, hornworts and mosses) – Epiphyte (a plant that grows on another plant) – Fern – Fern allies (fern like but not true ferns) – Forb (herbaceous plant that in not a graminoid) – Mallee tree – Marine non-tufted Graminoid (graminoid refers to herbaceous plant with grass-like leaves) – Non-tufted Graminoid – Palm – Scramble/Vine – Shrub – Tree – Tufted Graminoid
• Aquatic Fauna	<ul style="list-style-type: none"> – Bird – Crustaceans
• Aquatic invertebrates	<ul style="list-style-type: none"> – Fish – Frog
• Marine Fauna	<ul style="list-style-type: none"> – Invertebrates (Spiders, worms, insects etc.) – Mammals – Marine invertebrates (Jellyfish, worms, starfish, tunicates etc.)
• Terrestrial Fauna	<ul style="list-style-type: none"> – Mollusc – Reptiles

¹ The origin for several groups of species is not well documented, most notably fungi, invertebrates and marine species. The origin of these has been left blank unless known to be introduced.

Discipline	Life form/Guild
• Fungi	– Fungi – Lichen
• Protista	– Slime Mould

- Conservation statuses as listed under the following:
 - Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
 - Critically endangered (CR)
 - Endangered (EN)
 - Vulnerable (VU)
 - Conservation Dependent (CD)
 - Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act)
 - Listed as Threatened (L)
 - Nominated for listing as threatened (N)
 - Rejected for listing as threatened; taxon ineligible (X)
 - Victorian rare or threatened (VROT) species as classified by the Department of Environment, Land Water and Planning (DELWP) in the advisory lists for flora (DEPI 2014), vertebrate fauna (DSE 2013) and invertebrate fauna (DSE 2009)
 - Regionally Extinct (rx)
 - Critically Endangered (cr)
 - Endangered (en)
 - Vulnerable (v)
 - Near Threatened (nt)
 - Rare ®
 - Data Deficient (dd)
 - Poorly Known (k)
- Year of last record where known
- Keystone species: species that are important for the ecological function and services they provide.
- Flagship species: iconic species that represent important cultural, ecological and amenity values of the Port Phillip municipality.

2.3.1 Susceptibility to threats

Groups of species most susceptible to the following threats were also identified:

- Climate change
- Management practices/policies
- Urban development pressure

This was undertaken based on the authors knowledge and experience of the likely impacts of the threats, a review of key literature and consultation with relevant stakeholders, notably the EcoCentre and natural resource management staff/contractors.

2.4 Nomenclature, taxonomy and conservation status

Plant taxonomy and the use of common names follow the online Victorian Biodiversity Atlas (DELWP 2019a) where possible. For fauna, common names are generally used in the text.

Where an asterisk (*) precedes a plant or animal name, it is used to indicate those which are not indigenous to Victoria. A hash (#) is used to denote a Victorian indigenous plant species that is generally accepted as not indigenous i.e. outside of its natural range where recorded within the study area.

The conservation status of species was determined using DELWP's advisory lists (DEPI 2014, DSE 2013, DSE 2009) and separately for listings under the Commonwealth EPBC Act 1999 and Victorian FFG Act.

Although there are no direct legal requirements that flow from inclusion of a species in the advisory lists, taxa assessed as rare, vulnerable or endangered in this list are considered through native vegetation planning permit approval and offset processes under Victoria's Native Vegetation Removal Regulations (DELWP 2017).

2.5 Limitations

The results of the data review are only as good as the data available from the various resources included. There is potential for errors in the dataset if the source data includes errors in the species recorded, location coordinates, etc.

For the flora dataset, it is notable that many of the plant species recorded are likely based on planted individuals that have not actually naturalised (i.e. are not recruiting naturally). For exotic species that are not native to Victoria, the implications of this limitation are relatively minor, however for Victorian native species that occur in the general region, it poses the question over the locally indigenous nature of the species. Without visiting each species record to confirm if it has naturalised, there is no way to confirm the validity of these records, thus a precautionary approach has been taken when assigning the origin of such species.

For the fauna dataset, many species lists provided only the common name. As it is often difficult to determine a species without the scientific name, an assumption was made to determine the species which were most likely. In cases where not enough information was provided i.e. a provided name was too vague/broad e.g. "skink", the species was removed from the list. Further, due to limited sources of up to date taxonomic information, not all fauna records species names could be updated to the most recent taxonomic name. Taxonomic updates were made where possible, otherwise defaulting to the name provided in the relevant data source.

3 SPECIES DIVERSITY IN THE MUNICIPALITY

A complete list of flora, fauna and fungal species recorded within the City of Port Phillip is provided in a separate spreadsheet (Attachment A). The following is a summary of the ecological data review findings.

3.1 Flora species

The results of the data review identified 1,059 flora species as previously recorded within the Port Phillip municipality. Of these, 102 are algae (most of which are marine macroalgae), 32 are bryophytes (mosses and liverworts) and 920 vascular plants (mistletoes, ferns, fern allies, forbs, shrubs, graminoids, scramblers/vines and trees).

Table 2 documents the proportional origin of these species. The vast majority of algae and bryophytes are indigenous to the municipality (98% and 88% respectively), while for vascular plants there is a much higher proportion of exotic species with 54% considered indigenous. Two species, Coast Tea-tree *Leptospermum laevigatum* and Coast Wattle *Acacia longifolia* subsp. *sophorae*, are considered indigenous along the coast but naturalised outside their natural range in areas more than about 0.5 km away. There have also been large numbers of plantings of Victorian native species in parks and residential and botanic gardens, however it is likely that many of these are not part of the original flora for the City of Port Phillip. For species with distributions that are clearly outside the municipality, these have been considered introduced, however for species that have naturally nearby distributions these have been considered as native but some stands may be alien.

Table 2. Number of species for each origin type within the three main flora groupings.

Flora group	Indigenous	Indigenous but non-coastal population likely alien	Native but some stands may be alien	Introduced	Uncertain
Algae	100 (98%)	-	-	2 (2%)	-
Bryophytes	28 (88%)	-	-	4 (12%)	-
Vascular plants	494 (54%)	2 (<1%)	62 (7%)	358 (39%)	4 (<1%)

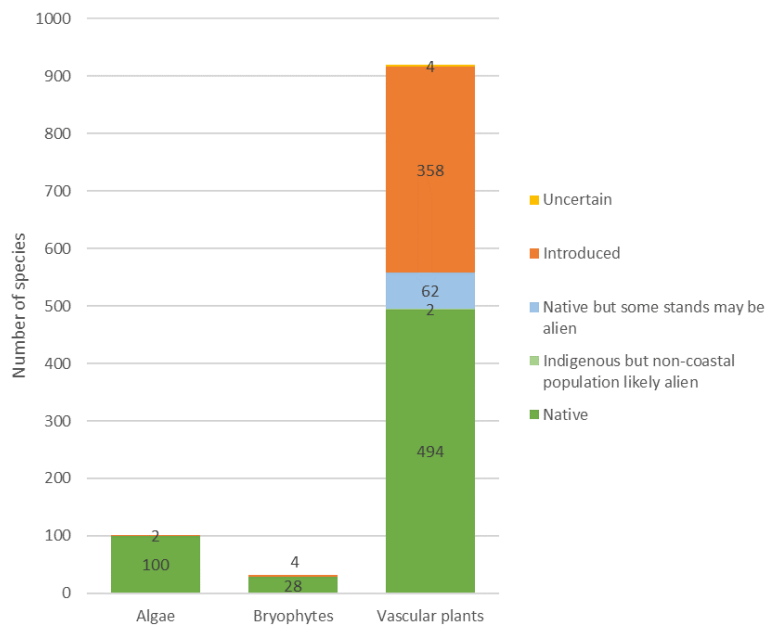


Figure 2. Origin of flora species previously recorded within the Port Phillip municipality.

3.1.1 Threatened flora

Of the indigenous flora species identified in the data review, one is listed under the EPBC Act and five are listed under the FFG Act (plus one nominated species) and 16 are classified as rare or threatened in Victoria (DEPI 2014).

See Table 3 for full list of threatened flora species within the Port Phillip municipality including those that are not considered or likely to be indigenous within the study area.

Table 3 Threatened flora species within the Port Phillip Municipality

Key:	VROT	Victorian Rare or threatened species in Victoria (DEPI 2014)
	en	Classified as Endangered in Victoria
	vu	Classified as Vulnerable in Victoria
	r	Classified as Rare in Victoria
	k	Classified as Poorly known in Victoria but thought to be rare or threatened
	FFG	Victorian <i>Flora and Fauna Guarantee Act 1988</i>
	L	Listed as threatened under the FFG Act
	N	Nominated for listing under the FFG Act
	X	Rejected for listing under the FFG Act
	EPBC	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
	CR	Listed as Critically Endangered under the EPBC Act
	EN	Listed as Endangered under the EPBC Act
	VU	Listed as Vulnerable under the EPBC Act
	()	Species not considered indigenous to the Port Phillip municipality

Scientific Name	Common Name	VROT	FFG	EPBC	Origin	Year of last record
<i>Acacia howittii</i>	Sticky Wattle	®			Native but some stands may be alien	2015
<i>Acacia uncifolia</i>	Coast Wirildra	r				2012
<i>Atriplex paludosa</i> subsp. <i>paludosa</i>	Marsh Saltbush	®			Native but some stands may be alien	2015
<i>Banksia spinulosa</i> var. <i>cunninghamii</i>	Hairpin Banksia		N			2015
<i>Callitriche umbonata</i>	Winged Water-starwort	r	X			1909
<i>Carpobrotus glaucescens</i>	Bluish Pigface	®			Native but some stands may be alien	Year not recorded
<i>Cladium procerum</i>	Leafy or Tall Twig Rush	r				2012
<i>Comesperma polygaloides</i>	Small Milkwort	vu	L			Year not recorded
<i>Coprosma perpusilla</i>	Creeping Coprosma	®			Native but some stands may be alien	Year not recorded
<i>Coronidium gunnianum</i>	Pale Everlasting	vu				2012
<i>Corymbia maculata</i>	Spotted Gum	(vu)			Native but some stands may be alien	2015
<i>Craspedia canens</i>	Billy Buttons	en	L			2012
<i>Cullen tenax</i>	Tough Scurf-pea, Emu's Foot	en	L			2012
<i>Dianella callicarpa</i>	Swamp Flax-lily	®			Native but some stands may be alien	1991
<i>Eucalyptus brookeriana</i>	Brooker's Gum	®			Native but some stands may be alien	2013
<i>Eucalyptus crenulata</i>	Buxton Gum	(en)	(L)	(EN)	Native but some stands may be alien	2015
<i>Eucalyptus globulus</i> subsp. <i>maidenii</i>	Maiden's Gum	®			Native but some stands may be alien	2013
<i>Eucalyptus polybractea</i>	Blue Mallee	®			Native but some stands may be alien	2015
<i>Euphrasia collina</i> subsp. <i>muelleri</i>	Purple Eyebright	en	L	EN		Year not recorded
<i>Euphrasia scabra</i>	Rough Eyebright	en	L			Year not recorded
<i>Grevillea infecunda</i>	Anglesea Grevillea	(vu)	(L)	(VU)	Native but some stands may be alien	Year not recorded
<i>Heterozostera nigricaulis</i>	Australian Grass-wrack	r				2009
<i>Hibiscus insularis</i>	Philip Island Hibiscus			(CR)	Introduced	Year not recorded
<i>Kunzea leptospermoides</i>	Yarra Burgan	k				2012
<i>Lawrenzia spicata</i>	Salt Lawrenzia	r				2012
<i>Lotus australis</i>	Austral Trefoil	k				2012
<i>Malva preissiana</i>	Australian Hollyhock	vu				2012
<i>Melaleuca armillaris</i> subsp. <i>armillaris</i>	Giant Honey-myrtle	®			Native but some stands may be alien	2016
<i>Philydrum lanuginosum</i>	Woolly Waterlily	(vu)			Uncertain	2012
<i>Ranunculus papulentus</i>	Large River Buttercup	k				2012
<i>Roepera billardierei</i>	Coast Twin-leaf	r				2015

3.2 Fauna species

The results of the data review identified 1,090 fauna species as previously recorded or potential habitat occurring (for EPBC Act listed species) within the Port Phillip municipality. Of these, 464 are vertebrate species including 276 birds, 115 fish, nine frogs, 34 mammals (17 marine mammals) and 30 reptiles. Of the 626 invertebrate species, 23 are crustaceans, 52 are marine invertebrates (jellyfish, worms, starfish, tunicates etc.), 127 are molluscs and 424 are other invertebrates (spiders, insects, worms etc.).

Table 4 and Figure 3 document the number of species in each origin category for each fauna guild. The vast majority of species in each fauna guild are indigenous to the municipality, though it should be noted that the origin of species in some guilds is not well documented.

Table 4. Number of fauna species for each origin type within the different fauna guilds.

Fauna guild	Native	Native but some stands may be alien	Introduced
Vertebrates			
Birds	257		19
Fish	106	1	8
Frogs	9		
Mammals	27		7
Reptile	29		1
Invertebrates			
Crustaceans	20		3
Marine Invertebrates (jellyfish, worms, starfish, tunicates etc.)	42		10
Molluscs	117	1	9
Other invertebrates (spiders, insects, worms etc.)	406	5	13

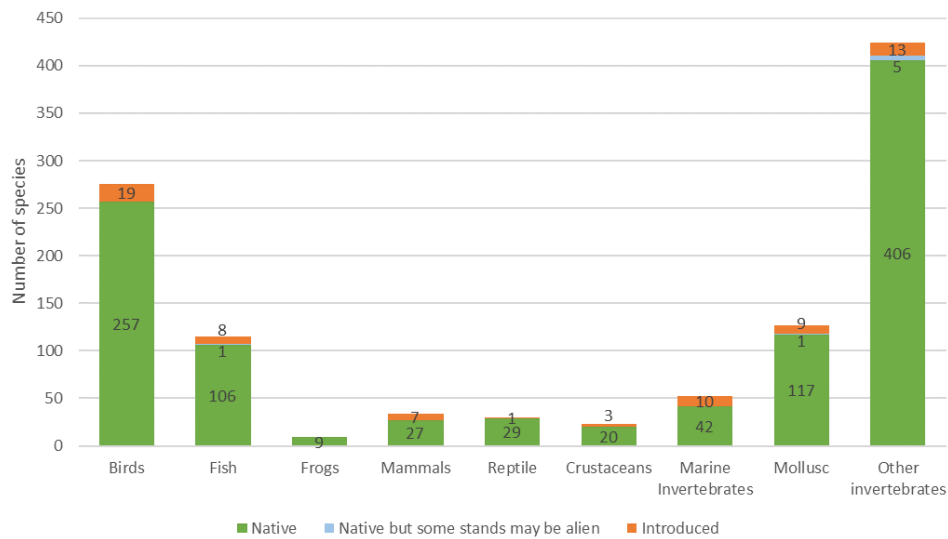


Figure 3. Origin of fauna species previously recorded within the Port Phillip municipality.

3.2.1 Threatened fauna

Of the indigenous fauna species identified in the data review, 24 are listed under the EPBC Act, 43 are listed under the FFG Act and 67 are classified as threatened in Victoria (DSE 2009, 2013). These included 53 bird, five fish, two frog, eight mammal and five reptile species. See Table 5 for full list of threatened fauna species within the Port Phillip municipality.

There is a notable absence of threatened invertebrate species, with none having been recorded in the municipality. This is the unfortunate result of a bias in the process of getting species recognised as rare or threatened as it relies on input from experts and the community. There is generally less funding, fewer experts and overall less interest in many of the invertebrate taxonomic groups, and as such fewer have been listed or classified as threatened. This point is worth raising as invertebrates comprise 57% of the fauna species recorded in Port Phillip, and it is considered more likely that at least some should be considered rare or threatened.

Table 5 Threatened fauna species within the Port Phillip municipality

Key: VROT Victorian Rare or threatened species in Victoria (DEPI 2014)
 cr Classified as Critically Endangered in Victoria
 en Classified as Endangered in Victoria
 vu Classified as Vulnerable in Victoria
 nt Classified as Near Threatened in Victoria
 dd Classified as Data Deficient in Victoria
 FFG Victorian *Flora and Fauna Guarantee Act 1988*
 L Listed as threatened under the FFG Act
 N Nominated for listing under the FFG Act
 X Rejected for listing under the FFG Act
 EPBC Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
 CR Listed as Critically Endangered under the EPBC Act
 EN Listed as Endangered under the EPBC Act
 VU Listed as Vulnerable under the EPBC Act
 ^ Applies to *Ardea intermedia plumifera*
 Year not recorded Date of record not accessible in the ALA (2019) and Birdlife Australia (2019) datasets

Life Form/Guild	Scientific Name	Common Name	VROT	FFG	EPBC	LAST RECORD
Bird	<i>Accipiter novaehollandiae</i>	Grey Goshawk	vu	L		2016
Bird	<i>Actitis hypoleucos</i>	Common Sandpiper	vu			2017
Bird	<i>Anseranas semipalmata</i>	Magpie Goose	nt	L		2015
Bird	<i>Ardea intermedia</i>	Intermediate Egret	en	L	EN ^	2015
Bird	<i>Ardea alba modesta</i>	Eastern Great Egret	vu	L		2018
Bird	<i>Aythya australis</i>	Hardhead	vu			2019
Bird	<i>Biziura lobata</i>	Musk Duck	vu			2019
Bird	<i>Botaurus poiciloptilus</i>	Australasian Bittern	en	L	EN	2015
Bird	<i>Ceyx azureus</i>	Azure Kingfisher	nt			2008
Bird	<i>Chalcites osculans</i>	Black-eared Cuckoo	nt			2015
Bird	<i>Chlidonias hybrida</i>	Whiskered Tern	nt			2018
Bird	<i>Chlidonias leucopterus</i>	White-winged Black Tern	nt			2015

Life Form/Guild	Scientific Name	Common Name	VROT	FFG	EPBC	LAST RECORD
Bird	<i>Circus assimilis</i>	Spotted Harrier	nt			2015
Bird	<i>Egretta garzetta</i>	Little Egret	en	L		2015
Bird	<i>Falco subniger</i>	Black Falcon	vu	L		2015
Bird	<i>Gallinago hardwickii</i>	Latham's Snipe	nt			2018
Bird	<i>Geopelia cuneata</i>	Diamond Dove	nt	L		2015
Bird	<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	nt			2019
Bird	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	vu	L		2015
Bird	<i>Hirundapus caudacutus</i>	White-throated Needletail	vu	L	VU	2015
Bird	<i>Hydroprogne caspia</i>	Caspian Tern	nt	L		2019
Bird	<i>Larus pacificus</i>	Pacific Gull	nt			2019
Bird	<i>Lathamus discolor</i>	Swift Parrot	en	L	CR	2018
Bird	<i>Lewinia pectoralis</i>	Lewin's Rail	vu	L		2015
Bird	<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo	vu	L		2015
Bird	<i>Macronectes giganteus</i>	Southern Giant-Petrel	vu	L	EN	1980
Bird	<i>Ninox strenua</i>	Powerful Owl	vu	L		2018
Bird	<i>Numenius madagascariensis</i>	Eastern Curlew	vu	L	CR	2015
Bird	<i>Nycticorax caledonicus</i>	Nankeen Night Heron	nt			2019
Bird	<i>Oxyura australis</i>	Blue-billed Duck	en	L		2019
Bird	<i>Pachyptila turtur</i>	Fairy Prion	vu			1980
Bird	<i>Pedionomus torquatus</i>	Plains-wanderer	cr	L	CR	1985
Bird	<i>Pelagodroma marina</i>	White-faced Storm-Petrel	vu			2010
Bird	<i>Pelecanooides urinatrix</i>	Common Diving-Petrel	nt			2012
Bird	<i>Phalacrocorax fuscescens</i>	Black-faced Cormorant	nt			2018
Bird	<i>Phalacrocorax varius</i>	Pied Cormorant	nt			2019
Bird	<i>Phoebastria palpebrata</i>	Light-mantled Sooty Albatross		L		1977

Life Form/Guild	Scientific Name	Common Name	VROT	FFG	EPBC	LAST RECORD
Bird	<i>Platalea regia</i>	Royal Spoonbill	nt			2017
Bird	<i>Plegadis falcinellus</i>	Glossy Ibis	nt			2018
Bird	<i>Polytelis alexandrae</i>	Princess Parrot			VU	2019
Bird	<i>Porzana pusilla</i>	Baillon's Crake	vu	L		2018
Bird	<i>Spatula rhynchotis</i>	Australasian Shoveler	vu			2018
Bird	<i>Sterna striata</i>	White-fronted Tern	nt			2015
Bird	<i>Sternula albifrons</i>	Little Tern	vu	L		2016
Bird	<i>Sternula nereis</i>	Fairy Tern	en	L	VU	2015
Bird	<i>Stictonetta naevosa</i>	Freckled Duck	en	L		2014
Bird	<i>Synoicus chinensis</i>	King Quail	en	L		2007
Bird	<i>Thalassarche cauta</i>	Shy Albatross	vu	L	VU	2015
Bird	<i>Thalassarche melanophris</i>	Black-browed Albatross	vu		VU	1978
Bird	<i>Tringa nebularia</i>	Common Greenshank	vu			2015
Bird	<i>Turnix pyrrhotorax</i>	Red-Chested Button-Quail	vu	L		2018
Bird	<i>Turnix velox</i>	Little Button-quail	nt			2015
Bird	<i>Xenus cinereus</i>	Terek Sandpiper	en	L		Year not recorded
Fish	<i>Carcharodon carcharias</i>	Great White Shark	vu	L	VU	2015
Fish	<i>Maccullochella macquariensis</i>	Trout Cod	cr	L	EN	2002
Fish	<i>Macquaria ambigua</i>	Golden Perch	nt	X		2002
Fish	<i>Nannoperca obscura</i>	Yarra Pygmy Perch	vu	L	VU	Year not recorded
Fish	<i>Seriola brama</i>	Blue Warehou			CD	Year not recorded
Frog	<i>Litoria raniformis</i>	Growling Grass Frog	en	L	VU	1996
Frog	<i>Pseudophryne bibronii</i>	Brown Toadlet	en	L		Year not recorded
Mammals	<i>Arctocephalus pusillus doriferus</i>	Australian Fur Seal		X		2016
Mammals	<i>Dasyurus viverrinus</i>	Eastern Quoll	rx	L	EN	Year not recorded

Life Form/Guild	Scientific Name	Common Name	VROT	FFG	EPBC	LAST RECORD
Mammals	<i>Eubalaena australis</i>	Southern Right Whale	cr	L	EN	2006
Mammals	<i>Megaptera novaeangliae australis</i>	Southern Humpback Whale	vu	L	VU	2000
Mammals	<i>Mirounga leonina</i>	Southern Elephant Seal			VU	2001
Mammals	<i>Ornithorhynchus anatinus</i>	Platypus		N		1963
Mammals	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	vu	L	VU	2018
Mammals	<i>Tursiops australis</i>	Burrnan Dolphin	en	L		2015
Reptiles	<i>Chelodina longicollis</i>	Eastern Snake-necked Turtle	dd			2015
Reptiles	<i>Dermochelys coriacea</i>	Leathery Turtle	cr	L	EN	Year not recorded
Reptiles	<i>Emydura macquarii</i>	Murray River Turtle	vu			2019
Reptiles	<i>Pseudemoia rawlinsoni</i>	Glossy Grass Skink	vu			1972
Reptiles	<i>Tympanocryptis pinguicolla</i>	Grassland Earless Dragon	cr	L	EN	1912



3.3 Fungal and protist species

The results of the data review found a total of 113 fungal (including seven lichen species) and two protists (slime moulds) are known to occur within the Port Phillip municipality.

The origin of fungal species is not well documented and often difficult to determine as many species can disperse very long distances on wind currents, event reaching the Troposphere and Stratosphere for dispersal around the globe (Smith et al 2009). Two fungal species have been identified as introduced while all other fungus, lichen and slime mould species are currently documented as native (Table 6; Figure 4).

Table 6. Number of native and introduced fungus, lichen and slime mould species.

Taxonomic group	Native	Introduced
Fungi	104	2
Lichens	7	0
Slime moulds	2	0

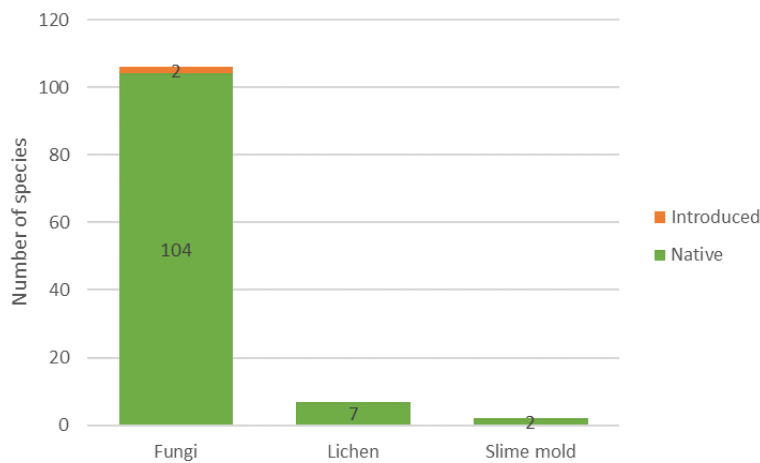


Figure 4. Origin of fungus species previously recorded within the Port Phillip municipality.

3.3.1 Threatened fungi and protists

It is likely that at least some fungus or protist species occurring within the Port Phillip municipality would qualify as rare or threatened. However, like invertebrates, less research into the conservation status of these less popular taxonomic groups has been conducted, so none are yet assigned a conservation status.

4 KEYSTONE AND FLAGSHIP SPECIES

4.1 Keystone species

Keystone species provide important ecological function such as notable feeding resources, sand dune stability, or important habitat features.

4.1.1 Keystone flora

The 22 most notable keystone species include marine and terrestrial sand dune binding species such as Spinifex and Seagrasses, and prolific and seasonally flowering canopy species that provide a seasonal feeding resource, a variety of habitats for fauna and affect the microclimate surrounding them. Table 7 lists the most notable keystone species as identified by the authors and during the consultation phase.

Table 7. Keystone flora species within the Port Phillip municipality

Key: VROT Victorian Rare or threatened species in Victoria (DEPI 2014)
r Classified as Rare in Victoria

Table 7 Scientific Name	Common Name	VROT	Origin	Reasoning for keystone status
<i>Allocasuarina verticillata</i>	Drooping Sheoak			Habitat for many insects and bats
<i>Atriplex cinerea</i>	Coast Saltbush			Dune stability
<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>	Coast Banksia			Winter flowering
<i>Eucalyptus camaldulensis</i> var. <i>camaldulensis</i>	River Red-gum			
<i>Eucalyptus cephalocarpa</i>	Silver-leaf Stringybark			
<i>Eucalyptus leucoxylon</i> subsp. <i>connata</i>	Melbourne Yellow Gum, White Ironbark			
<i>Eucalyptus leucoxylon</i> subsp. <i>pruinosa</i>	Waxy Yellow-gum			
<i>Eucalyptus macrorhyncha</i>	Red Stringybark			
<i>Eucalyptus melliodora</i>	Yellow Box			Feeding and habitat resource
<i>Eucalyptus microcarpa</i>	Grey Box			
<i>Eucalyptus muelleriana</i>	Yellow Stringybark			
<i>Eucalyptus obliqua</i>	Messmate Stringybark			
<i>Eucalyptus ovata</i> subsp. <i>ovata</i>	Swamp Gum			
<i>Eucalyptus radiata</i> subsp. <i>radiata</i>	Narrow-leaf Peppermint			
<i>Eucalyptus viminalis</i> subsp. <i>pyroriana</i>	Coast Manna-gum			
<i>Ficus carica</i>	Fig		Introduced	Feeding resource for Grey-headed Flying-fox
<i>Ficus macrophylla</i>	Moreton Bay Fig		Introduced	
<i>Heterozostera nigricaulis</i>	Australian Grass-wrack			Seagrasses provide important feeding and nursery resources for many marine species
<i>Lepilaena bilocularis</i>	Water-Mat	r		
<i>Lepilaena cylindrocarpa</i>	Water-Mat			
<i>Ruppia megacarpa</i>	Large-fruit Tassel			
<i>Ruppia polycarpa</i>	Many-fruit Tassel			
<i>Spinifex sericeus</i>	Hairy Spinifex			Dune stability
<i>Zostera muelleri</i>	Dwarf Grass-wrack			Seagrasses provide important feeding and nursery resources for many marine species

4.1.2 Keystone fauna

Fauna species identified as keystone during the consultation phase include the entire suite of 626 invertebrate species (crustaceans, marine invertebrates, molluscs and other invertebrates) and the Australian Anchovy *Engraulis australis* as they are significant food resource to a wide variety of fauna in the food-web. Many are also important pollinators or decomposers. The Grey-headed Flying-fox *Pteropus poliocephalus* is also considered Keystone as it is also a significant pollinator.

Table 8 Keystone fauna species

Guild	Species or group	Reasoning for Keystone Status
Invertebrates	Crustaceans	Invertebrates are important food resources, pollinators and/or decomposers
	Marine Invertebrates (jellyfish, worms, starfish, tunicates etc.)	
	Molluscs	
	Other invertebrates (spiders, insects, worms etc.)	
Fish	<i>Engraulis australis</i> (Australian Anchovy)	Food resource for many species
Mammals	<i>Pteropus poliocephalus</i> (Grey-headed Flying-fox)	Pollination

4.1.3 Keystone fungal and protist species

Many fungal and protist species provide important ecological functions (e.g. decomposing biological material) and have important relationships with species. Of all the species in this group, one was identified during the consultation phase as keystone due to its symbiotic relationship with plants, particularly Eucalypts: *Scleroderma cepa*, a type of Puff Ball.

4.2 Flagship species

Flagship species act as nature ambassadors, icons or symbols to improve the wider community's connection with understanding of and appreciation for the natural world. The species selected in this task largely comprise indigenous species and include some common easy to observe species along with some culturally significant species and less common but important species.

During the consultation phase, stakeholders were asked to nominate flagship species they think characterise the Port Phillip municipality. The following lists of species identified is quite extensive but provides a good snapshot through which further refinement or selection can be made to better target the intended purpose of advertising and promotion, etc.

4.2.1 Flagship flora

Flagship flora include characteristic Australian species that are indigenous to the region such as Eucalypts, Wattles, Banksias and the dominant grasses such as Hairy Spinifex, Kangaroo

Grass *Themeda triandra*, Spear Grass *Austrostipa* species and Wallaby Grass *Rytidosperma* species. Other species considered Flagship include Murnongs, Noon-flowers and saltmarsh species due to the cultural and/or ecological value.

One introduced species is also considered to be a Flagship species: Canary Island Palm *Phoenix canariensis*. It has been widely planted as an iconic foreshore feature and highlights the current level of disconnection that much of the wider community has with local biodiversity and nature. To improve biodiversity values, it is not considered a species requiring further promotion in future plantings.

In total 64 flora species are considered flagship species (Table 9).

Table 9 Flagship flora species representing the City of Port Phillip

Scientific Name	Common Name	Origin
<i>Acacia acinacea</i>	Gold-dust Wattle	
<i>Acacia brownii</i>	Heath Wattle	
<i>Acacia dealbata</i>	Silver Wattle	
<i>Acacia leprosa</i>	Cinnamon Wattle	Native but some stands may be alien
<i>Acacia longifolia</i> subsp. <i>sophorae</i>	Coast Wattle	Indigenous but non-coastal populations likely alien
<i>Acacia mearnsii</i>	Black Wattle	
<i>Acacia obliquinervia</i>	Mountain Hickory Wattle	
<i>Acacia oxycedrus</i>	Spike Wattle	
<i>Acacia paradoxa</i>	Hedge Wattle	
<i>Acacia provincialis</i>	Wirildra, Swamp Wattle	
<i>Acacia pycnantha</i>	Golden Wattle	
<i>Acacia stricta</i>	Hop Wattle	
<i>Acacia suaveolens</i>	Sweet Wattle	
<i>Acacia verniciflua</i>	Varnish Wattle	
<i>Actites megalocarpus</i>	Dune Thistle	
<i>Allocasuarina verticillata</i>	Drooping Sheoak	
<i>Atriplex cinerea</i>	Coast Saltbush	
<i>Austrostipa elegantissima</i>	Elegant Spear-grass	
<i>Austrostipa flavescens</i>	Coast Spear-grass	
<i>Austrostipa mollis</i>	Supple Spear-grass	
<i>Austrostipa nodosa</i>	Knotty Spear-grass	
<i>Austrostipa scabra</i> subsp. <i>falcata</i>	Rough Spear-grass	
<i>Austrostipa scabra</i> subsp. <i>scabra</i>	Rough Spear-grass	
<i>Austrostipa stipoides</i>	Prickly Spear-grass	
<i>Austrostipa stupos</i>	Quizzical Spear-grass	
<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>	Coast Banksia	
<i>Banksia marginata</i>	Silver Banksia	
<i>Carpobrotus modestus</i>	Inland Noonflower, Pigface	

Scientific Name	Common Name	Origin
<i>Carpobrotus rossii</i>	Karkalla	
<i>Disphyma crassifolium</i> subsp. <i>clavellatum</i>	Rounded Noon-flower	
<i>Distichlis distichophylla</i>	Australian Salt-grass	
<i>Eucalyptus leucoxylon</i> subsp. <i>connata</i>	Melbourne Yellow Gum	
<i>Eucalyptus leucoxylon</i> subsp. <i>pruinosa</i>	Waxy Yellow-gum	
<i>Eucalyptus macrorhyncha</i>	Red Stringybark	
<i>Eucalyptus melliodora</i>	Yellow Box	
<i>Eucalyptus microcarpa</i>	Grey Box	
<i>Eucalyptus muelleriana</i>	Yellow Stringybark	
<i>Eucalyptus obliqua</i>	Messmate Stringybark	
<i>Eucalyptus ovata</i> subsp. <i>ovata</i>	Swamp Gum	
<i>Eucalyptus radiata</i> subsp. <i>radiata</i>	Narrow-leaf Peppermint	
<i>Eucalyptus viminalis</i> subsp. <i>pyroriana</i>	Coast Manna-gum	
<i>Kennedia prostrata</i>	Running Postman	
<i>Melaleuca lanceolata</i>	Moonah	
<i>Microseris scapigera</i>	Yam Daisy	
<i>Microseris walteri</i>	Murnong	
<i>Phoenix canariensis</i>	Canary Island Palm	Introduced
<i>Poa labillardierei</i> var. <i>labillardierei</i>	Common Tussock-grass	
<i>Poa morrisii</i>	Soft Tussock-grass	
<i>Poa poiformis</i> var. <i>poiformis</i>	Coast or Blue Tussock Grass	
<i>Poa sieberiana</i> var. <i>sieberiana</i>	Grey Tussock-grass	
<i>Rytidosperma bipartitum</i>	Leafy Wallaby-grass	
<i>Rytidosperma caespitosum</i>	Common Wallaby-grass	
<i>Rytidosperma carphoides</i>	Short Wallaby-grass	
<i>Rytidosperma duttonianum</i>	Brown-black Wallaby Grass	
<i>Rytidosperma erianthum</i>	Hill Wallaby-grass	
<i>Rytidosperma fulvum</i>	Copper-awned Wallaby-grass	
<i>Rytidosperma geniculatum</i>	Kneed Wallaby-grass	
<i>Rytidosperma racemosum</i> var. <i>racemosum</i>	Slender Wallaby-grass	
<i>Rytidosperma setaceum</i> var. <i>setaceum</i>	Bristly Wallaby-grass	
<i>Salicornia quinqueflora</i> subsp. <i>quinqueflora</i>	Beaded Glasswort	
<i>Spinifex sericeus</i>	Hairy Spinifex	
<i>Sporobolus virginicus</i>	Salt Couch	
<i>Tecticornia arbuscula</i>	Shrubby Glasswort	
<i>Zostera muelleri</i>	Dwarf Grass-wrack	

4.2.2 Flagship fauna

Flagship fauna comprises a suite of 45 iconic species such as the tourist attracting Little Penguin *Eudyptula minor* and the culturally significant Wedge-tailed Eagle *Aquila audax* and Australian Raven *Corvus coronoides*, along with some common and easily identifiable species such as the Black Swan *Cygnus atratus*, Grey Fantail *Rhipidura albiscapa* and Rakali (Water-rat) *Hydromys chrysogaster*. They also include groups of iconic species such as Dolphins, Whales, Shearwaters, Seagulls, Seahorses and Whiting.

Table 10 lists the flagship fauna species identified by the authors and during the consultation process.

Table 10 Flagship fauna species representing the City of Port Phillip

Key:

VROT	Victorian Rare or threatened species in Victoria (DEPI 2014)
cr	Classified as Critically Endangered in Victoria
en	Classified as Endangered in Victoria
vu	Classified as Vulnerable in Victoria
nt	Classified as Near Threatened in Victoria
FFG	Victorian <i>Flora and Fauna Guarantee Act 1988</i>
L	Listed as threatened under the FFG Act
EPBC	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
CR	Listed as Critically Endangered under the EPBC Act
EN	Listed as Endangered under the EPBC Act
VU	Listed as Vulnerable under the EPBC Act

Guild	Scientific Name	Common Name	VROT	FFG	EPBC	Flagship grouping
Birds	<i>Corvus coronoides</i>	Australian Raven				Cultural significance
	<i>Cygnus atratus</i>	Black Swan				
	<i>Cincloramphus cruralis</i>	Brown Songlark				
	<i>Cereopsis novaehollandiae</i>	Cape Barren Goose				
	<i>Puffinus gavia</i>	Fluttering Shearwater				Shearwaters
	<i>Ardea alba</i>	Great Egret				
	<i>Rhipidura albiscapa</i>	Grey Fantail				Migratory
	<i>Larus dominicanus</i>	Kelp Gull				Seagulls
	<i>Dacelo novaeguineae</i>	Laughing Kookaburra				
	<i>Eudyptula minor</i>	Little Penguin				
	<i>Corvus mellori</i>	Little Raven				Cultural significance
	<i>Larus pacificus</i>	Pacific Gull	nt			Seagulls
	<i>Falco peregrinus</i>	Peregrine Falcon				
	<i>Haematopus longirostris</i>	Pied Oystercatcher				
	<i>Ninox strenua</i>	Powerful Owl	vu	L		
	<i>Calidris ruficollis</i>	Red-necked Stint				
	<i>Myiagra cyanoleuca</i>	Satin Flycatcher				
	<i>Ardena tenuirostris</i>	Short-tailed Shearwater				Shearwaters
	<i>Chroicocephalus novaehollandiae</i>	Silver Gull				Seagulls

Guild	Scientific Name	Common Name	VROT	FFG	EPBC	Flagship grouping
Birds	<i>Puffinus grisea</i>	Sooty Shearwater				Shearwaters
	<i>Malurus cyaneus</i>	Superb Fairy-wren				
	<i>Lathamus discolor</i>	Swift Parrot	en	L	CR	
	<i>Podargus strigoides</i>	Tawny Frogmouth				
	<i>Aquila audax</i>	Wedge-tailed Eagle				Cultural significance
Fish	<i>Hippocampus abdominalis</i>	Bigbelly Seahorse				Seahorses
	<i>Haletta semifasciata</i>	Blue Weed Whiting				Whiting
	<i>Sillaginodes punctatus</i>	King George Whiting				Whiting
	<i>Neoodax balteatus</i>	Little Weed Whiting				Whiting
	<i>Myxus elongatus</i>	Sand Mullet				
	<i>Mugil cephalus</i>	Sea Mullet				
	<i>Hippocampus breviceps</i>	Shorthead Seahorse				Seahorses
	<i>Chrysophrys auratus</i>	Snapper				
	<i>Sillago bassensis</i>	Southern School Whiting				Whiting
	<i>Anguilla australis</i>	Southern Shortfin Eel				
	<i>Stigmatopora nigra</i>	Widebody Pipefish				
Invertebrates (Spiders, worms, insects etc.)	<i>Papilio anactus</i>	Dainty Swallowtail				
	<i>Opodiphthera eucalypti</i>	Emperor Gum Moth				
Mammals	<i>Tursiops australis</i>	Burrnunan Dolphin	en	L		Dolphins
	<i>Tursiops truncatus</i>	Common Bottle-nosed dolphin				Dolphins
	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	vu	L	VU	
	<i>Tursiops aduncus</i>	Indian Ocean Bottlenose Dolphin				Dolphins
	<i>Hydromys chrysogaster</i>	Rakali				
	<i>Delphinus delphis</i>	Short-beaked Common Dolphin				Dolphins
	<i>Megaptera novaeangliae australis</i>	Southern Humpback Whale	vu	L	VU	Whales
	<i>Eubalaena australis</i>	Southern Right Whale	cr	L	EN	Whales

4.2.3 Flagship fungal and protist species

One flagship fungal species was identified, Green-staining Coral *Ramaria abietina*. This species is a rare and beautiful coral fungus which was recently recorded in Westgate Park (Lyn Allison, pers. comm.).

5 SUSCEPTIBILITY TO THREATENING PROCESSES

The following summarises the species that are most susceptible to the threatening processes of climate change, urban development and management practices and policies. It's important to remember that nearly all species can be susceptible to these threats given appropriate circumstances, however the following relates to the species or groups of species most vulnerable.

5.1 Climate Change

In 2019, climate projections for Victoria and the Greater Melbourne region were developed by CSIRO and DELWP (Clarke et al 2019a, b). According to these reports the projected climate for Melbourne will show maximum and minimum daily temperatures continuing to increase over this century (very high confidence). Meanwhile rainfall will continue to be very variable over time, with a long-term projection of continued decline in winter and spring (medium to high confidence), and autumn (low to medium confidence), but with some chance of little change. There is expected to be an increase in the intensity of extreme rainfall events, but these will remain very variable in space and time. Overall, the climate of Melbourne could be more like the current climate of Wangaratta by the 2050s.

These changes will affect the ability of species to adapt and evolve, reside within ecosystems and migrate to more suitable environments. Given the above climate projections, the biodiversity groups considered to be most vulnerable to climate change include:

- Flora and fauna species restricted to foreshore and estuarine habitats:
 - As sea levels rise, habitats available for these species will be consumed within the sea and they will unlikely be able to re-establish further inland due to the presence of existing buildings and infrastructure. These primarily include plant species that occur within the Coastal Dune Grassland, Berm Grassy Shrubland, Coastal Dune Shrubland, Coast Banksia Woodland, Coastal Alkaline Scrub, Coastal Tussock Grassland, Estuarine Wetland, Estuarine Flats Grassland and Coastal Saltmarsh EVCs.
 - Migratory birds in the East Asian – Australasian Flyway (EAAF) are at particular risk of rising sea levels as a result of climate change. An Australian study found that the loss of 23% to 40% of the migratory waterbirds' main coastal feeding areas due to sea level rise would result in a 70% decline in the population (Iwamura et al, 2013).
- Flora species more sensitive to prolonged dry periods
 - With the predicted increased prevalence and severity of droughts, species along riparian fringes and dryland areas that are currently on the edge of their dryland extent will be more vulnerable to localised extinctions. The pressures of urban development, habitat modification and weeds will hinder or completely remove the ability of these vulnerable species to migrate across the landscape into more suitable environments. However, the response of many species or groups of species remains largely unknown as research continues. It is suspected that the drying climate will be challenging for the survival of some canopy species such as River Red-gums, and will likely effect recruitment of many species, however to what extent also depends on the accessibility of these values to a natural and/or artificial water sources. Further research into specific species/communities/reserves of concern is required to best inform the future management of bushland, parks and gardens across the municipality.
- The EPBC Act listed Swift Parrot is also at particular risk. Bennett et al. (1991) undertook modelling that details how the current range could be reduced by up to 50% in Victoria as a result of increased temperatures.

There is little information on the likely response to climate change for most fungus and slime mould species occurring with the City of Port Phillip. It is known that fungal reproduction, geographic distributions, physiology and activity have changed markedly in the last few decades, through direct climate change effects on fungal growth and indirect effects on their

habitats (Bidartondo et al 2018). These will have flow on effects given the important role fungi play in terrestrial decomposition and nutrient cycling, mycorrhizal relationships with plants and food resources for many animals. However, there are many information gaps requiring further investigation.

5.2 Urban development

Urban development within the municipality has imposed a number of threatening processes to biodiversity. These include direct impacts to biodiversity such as vegetation removal and habitat modification, as well as indirect impacts associated with pressures from human activities (e.g. trampling of dune vegetation), wildlife disturbance and predation by pet dogs and cats, weed and pest animal invasions (notably foxes) and litter for example.

To highlight some examples:

- The indirect threat of off-lead dogs in areas where migratory birds forage can have direct and indirect impacts. Migratory birds need to obtain enough energy resources for their long flights to other parts of the world. The impacts of interrupted feeding and excess energy expansion fleeing from dogs can reduce their ability to make the long flights, reduce their breeding capacity and result in starvation and death.
- Although not directly related to urban development, the location of the Little Penguin colony at the St Kilda breakwater provides an excellent opportunity for Melbourne residents and interstate and international visitors to view wildlife in a natural setting close to the Central Business District. The numbers of nightly visitors viewing the penguins has increased exponentially in recent years and now puts the penguins at physical and behavioural risk (Lustig 2019).
- The increase in fox populations in urban areas poses a significant risk to much of the wildlife across the City of Port Phillip, notably Black Swans, Little Penguins, migratory birds and Rakali. Like dogs off-lead, foxes can have direct (predation) and indirect (interrupted feeding and injury) impacts to wildlife that further jeopardise their survival.

Generally, biodiversity remaining in the municipality primarily consists of species that are more tolerant of negative impacts of urbanisation. However, some less resilient species do remain or occasionally visit. Efforts to provide safe habitats for more sensitive species could increase the biodiversity in the municipality.

At this stage there are no urban development plans known that are likely to have significant implications for biodiversity over and above the cumulative impacts on the wider ecosystem. Given that there is only a very small amount of native vegetation left within the municipality, it is very important to ensure it is retained wherever possible. Development proposals that involve native vegetation removal should demonstrate that all options available to avoid and minimise impacts have been investigated and pursued before being given planning approval.

5.3 Management practices and policies

There are a number of management practices and policies that could threaten the existence of indigenous biodiversity. These include practices such as beach grooming/combing, herbicide spraying and pedestrian and dog access to name just a few.

Through consultation with various stakeholders it is pleasing to report that Council's adaptive management program ensures that serious concerns raised are proactively addressed with timely practical action from the community and local government stakeholders.

A number of historic management practices and policies that can be detrimental to environmental values are still in place. These were identified during the consultation phase and are listed in Table 11 below. Investigations into the severity of these threats and alternative options should be undertaken.

During the consultation phase of this project, it has also been reported that several initiatives, such as the Cooperative Management Advisory Committee for St Kilda breakwater, and the City of Port Phillip's Natural Heritage Charter lapsed in the current decade. Similarly, the practice of regularly inviting comment from local naturalists on open space and tree management contract specifications appears to have also declined. To make use of the local natural history knowledge within the community and improve biodiversity outcomes, strategies to enhance and protect biodiversity within the city should be based on regular dialogue with key community and government stakeholders. This has been an essential step for the development of this Background Research and Discussion Paper, and will continue to be vital as the Biodiversity Action Plan is prepared for this project.

Table 11. Historic management practices and policies that threaten biodiversity values within the City of Port Phillip, as identified by the Port Phillip EcoCentre.

Site	Existing & potential biodiversity values	Threats
Perc White Res	Local native planting in early 1980s has attracted native birds including seasonally migratory species	Current maintenance practices unknown and likely not considering biodiversity corridor value
Station Pier	Limited value	Harbours Northern Pacific Seastars
Pickles Street dunes	A range of local native dune plants established with potential for further extension	Human traffic into fenced area destabilising some areas
Middle Park beach	Relatively small areas of established dune vegetation	Annual 1-2mm sea level rise compounds influence of St Kilda breakwater on eroding this section of foreshore with implications for low-lying Middle Park properties.
St Kilda West sandspit	Extensive area of shallows providing foraging habitat for migratory waders	Off-leash dog beach
St Kilda harbour	Seagrasses	Paddle board hire accessing water through seagrass area just north of St Kilda Pier
St Kilda harbour	Rakali and Little Penguins	Tourism and marine recreation impacts such as recreational watercraft, marina pollution and fishing line entanglement
Point Ormond offshore	Sea grasses and offshore reef	Occasional renourishment of Elwood beach with potential for sands to be eroded and relocated northwards to cover seagrasses and reef off Point Ormond
Point Ormond and Elwood Tea-tree Res.	Established linear corridor of local native plantings provides for seasonally migratory birds.	Overgrown shrub layer eclipsing understorey and ground-layer microhabitats. Pest animals including foxes and black rats.
Urban streets	Optimum stormwater quality	Plastic litter not removed from nature strips before lawn-mowing increases microplastic pollution load to stormwaters and the Bay.



Site	Existing & potential biodiversity values	Threats
		Environmental weeds (Gazantias) planted in streets threaten to invade dunes.
Inland parks	Vegetation in parks potentially supports a range of birds and other fauna.	Habitat structure typically found in amenity parks favours Noisy Miners to the detriment of small to medium sized bush birds. Whole length of dead branches removed, preventing potential hollow development or nesting crook.
Urban development	Water Sensitive Urban Design (WSUD) features such as retention of permeable surfaces, providing shade, energy-efficient lighting and heating and cooling systems	Failure to implement WSUD technologies and reduce energy consumption will directly contribute to cumulative effects of climate change with negative impacts on biodiversity.

6 DETERMINING THE LOCATION FOR ECOLOGICAL FIELD SURVEYS

As part of this project, ecological field surveys are to be undertaken. These are to include vegetation surveys and terrestrial vertebrate fauna surveys in locations where the ecological values are lesser known.

A variety of somewhat ad hoc ecological surveys have been undertaken across the municipality in the past.

In addition to the past surveys, species inventories are also currently being undertaken as part of the NatureSpot program in 2019 and 2020 at:

- Te-Arai Reserve, East St Kilda
- Canterbury Forest (Canterbury Road between Fraser and Langridge Streets), Middle Park
- St Kilda Botanic Gardens, St Kilda
- Gasworks Art Park, Albert Park
- Port Melbourne Light Rail (Turner and Hester Reserves, between Bridge Street and Liardet Street), Port Melbourne
- School Park, Elwood

These data sources have been used to inform decisions on where more ecological surveys should be completed as part of this study.

6.1 Terrestrial vertebrate fauna surveys

6.1.1 Bird surveys

Bird surveys have been the most frequent and extensive form of ecological survey undertaken within the Port Phillip municipality. They have been spread across the Council with a particular focus along the foreshore, and the adjoining Westgate Park, Elsterwick Park and Royal Botanic Gardens.

Due to the extent of past bird surveys it was decided to focus on other less-surveyed vertebrate wildlife. Incidental observations of bird species will be made during the fauna surveys, the two-hectare 20-minute survey method will not be undertaken.

6.1.2 Mammal surveys

Grey-headed Flying-fox (*Pteropus poliocephalus*) surveys have regularly been undertaken at sites across the municipality and in particular at the Royal Botanic Gardens where a 'camp' for the species once existed.

Until the past year or so, microbat surveys have been relatively lacking across the municipality. A small number of Anabat detector surveys and harp trapping surveys have recently been undertaken, and more are also in progress by University of Melbourne PhD student, Julia Schiller. The focus of her study is Albert Park and Alma Park.

Other mammal records appear to primarily be incidental. Based on this, microbat surveys using Anabat acoustic recorders will be undertaken at:

- St Kilda Botanic Gardens, St Kilda
- Canterbury Forest (Canterbury Road between Fraser and Langridge Streets), Middle Park
- Elster Creek
- Elwood Canal

Further to this spotlighting, will be undertaken for Rakali at the St Kilda Breakwater.

6.1.3 Reptile and amphibian surveys

Reptile and amphibian records have been quite uncommon within the City of Port Phillip, with the Victorian Biodiversity Atlas containing just two reptile records and no frog records within the Council boundary. Additional records have been collected in the datasets provided by the EcoCentre and Frog Census app.

As such, sound recorders will be deployed for amphibian surveys at:

- St Kilda Botanic Gardens, St Kilda
- Elster Creek

An active search for reptiles will be undertaken at:

- St Kilda Botanic Gardens, St Kilda
- St Kilda Breakwater
- Elster Creek

6.2 Vegetation surveys

Relatively few vegetation surveys have been completed across the municipality, with just 22 flora surveys recorded on the VBA within the Council boundary.

In addition to these, the Foreshore and Hinterland Management Plan (Practical Ecology 2015) involved rapid surveys of 16 sites, of which six were identified as High Natural Heritage Value for their remnant indigenous flora. These included:

- Sandridge Foreshore
- First Point
- West beach
- Point Ormond
- Elwood Teatree
- Elwood Foreshore and Reserve

In addition to these, during the consultation workshop three highly modified sites were also identified as having indigenous vegetation values, primarily in the form of planted garden beds, remnant trees and/or indigenous wetland vegetation:

- The Port Melbourne Light Rail easement from Graham Street to Boundary Street.
- Elwood Canal, south of Wave Street halfway toward Foam Street – artificial concrete or bluestone channel surrounded by lawn and indigenous garden beds
- Alma Park, particularly the eastern side of the train line – remnant eucalypts with other planted exotic trees over lawn and generally exotic garden beds

Based on the occurrence of remnant native vegetation at the six sites identified in the Foreshore and Hinterland Management Plan, the vegetation surveys will still focus on these areas. If time permits the surveys will be extended out to the additional three highly modified sites for a rapid mapping of planted indigenous species.



6.3 Summary of field survey priorities

Table 12 lists the types of surveys to be undertaken at the priority sites as part of the Port Phillip Biodiversity Study and Action Plan. Figure 1 shows the location of these sites.

Table 12. Proposed location and types of ecological field surveys to be undertaken as part of the Port Phillip Biodiversity Study and Action Plan.

Site	Vegetation assessment	Floristic quadrat assessment	Rapid veg mapping	Fauna habitat assessment	Microbat Anabat survey	Spotlighting	Sound recorders	Active reptile search
Foreshore sites								
Sandridge Foreshore	✓	✓						
First Point	✓							
West Beach Dunes	✓	✓						
MO Moran Reserve	✓							
Point Ormond	✓	✓		✓	✓			
Elwood Teatree	✓	✓						
Elwood Foreshore and Reserve	✓	✓		✓	✓			
Inland sites								
Alma Park			✓					
Canterbury Forest				✓	✓			
Elwood Canal			✓	✓	✓		✓	
Port Melbourne Light Rail	✓							
St Kilda Breakwater				✓		✓		✓
St Kilda Botanical Gardens				✓	✓		✓	

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