Mal's Ecological
&
Environmental **Services**
PTY. **LTD.**

Consulting in Ecological Management
and Restoration
ACN 166 603 345
ABN 791 666 033 45

Fauna survey of Balcombe Estuary Reserves Mount Martha

Final Report

Prepared for Balcombe Estuary Reserves Group Mt Martha Inc.

28th September 2019

FAUNA SURVEY OF BALCOMBE ESTUARY RESERVES, MOUNT MARTHA, 28TH SEPTEMBER 2019

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Profiles Front Page

Top to bottom:

- The estuary mouth opened revealing the algae beds.
- Great Egret and cormorants roosting in the estuary.
- Balcombe Creek
- Balcombe Creek Estuary
- Black Bream in creek
- Great Egret and cormorants rossting in the estuary

All other images through-out this report were photographed within the study site or the surrounding area and are Copy-right M. Legg 2019.

Executive Summary

Mal's Ecological & Environmental Services PTY. LTD. was commissioned by the Balcombe Estuary Reserves Group Mt Martha Inc. (BERG MM) to conduct a vertebrate fauna survey within the Balcombe Estuary Reserves, Mount Martha (from Nepean Highway to Port Phillip Bay). The study site is approximately 50 hectares in size. Habitat within includes: Balcombe Creek, its estuary & tributaries, remnant patches of woodland on either side, and scrub, and the reserves are surrounded by urban development, with The Briars located to the east, Mount Martha Park to the south and foreshore reserves located north & south. The area has a maritime climate with wet moist winters and dry warm summers.

Eight identified Ecological Vegetation Classes are present with five listed as endangered and one as vulnerable within the Gippsland Plains Bioregion. The reserves are also part of the Devilbend Reservoir to Port Phillip Bay Biolink. The presence of threatened or endangered EVCs and flora and fauna species, means the reserves are of State Significance.

Fauna surveys and mapping were undertaken from August 2018 to July 2019 with emphasis on:-

- obtaining base line data on all vertebrate fauna species,
- obtaining population densities of birds, amphibians, nocturnal fauna & feral species,
- conducting Fauna Environmental Indicator Species (FEIS) assessments of remnant Broad Vegetation Communities within the reserves,
- discussions on biodiversity issues and
- listing recommendations to help manage the site in order to protect and enhance its biodiversity values into the future.

Key ecological values

The field study identified key ecological values in the reserve and is as follows:-

- 108 species of native fauna and ten species of introduced fauna were recorded during this current survey comprising:-
    - 14 species of fish, of which one is an introduced species
    - six species of amphibians.
    - eleven reptile species comprising one species of tortoise, eight of lizards and two of snakes.
    - 70 species of birds, of which four species are introduced.
    - 17 species of mammals, of which five species are introduced.

- One fish species detected (Dwarf Galaxias) is listed on the EPBC ACT as Vulnerable and one species of bird (White throated Needletail) is listed as Internationally Migratory under the EPBC Act.

- Eleven State Significant species were recorded including three listed under the state *Flora and Fauna Guarantee Act 1988* (FFG Act) as threatened.

- A further 16 species recorded are considered to be of Regional Significance and five species recorded are considered to be of High Local Significance.

- Due to large population and habitat losses across the Mornington Peninsula the remaining native fauna recorded within the reserves can be considered to be of Local Significance.

Government legislation and policy

Key biodiversity legislation and policy is summarised in Table A below.

Table A: Key biodiversity legislation and policy

Legislation / Policy	Relevant ecological feature on site
EPBC Act	Habitat for Nationally threatened fauna species and migratory bird species
FFG Act	Study area provides habitat for two FFG listed fauna species
Planning & Environmental Act	Possible future vegetation to be removed during weeding practices and fire protection measures
CaLP Act	No noxious weed species recorded

Internationally migratatory and State significant fauna species identified during this assessment within the reserve.

The International Migratory, National and State significant fauna species identified during this assessment are listed in Table B below.

Table B: Significant fauna species identified within the reserves

Species name	Area of value within the study site
EPBC Act listed species and Internationally Migratory bird species	
Dwarf Galaxias	Balcombe Creek
White-throated Needletail	Coastal and foothill updrafts provide conditions for feeding
FFG Act/ DSE Advisory List species	
Dwarf Galaxias	Balcombe Creek
Southern Toadlet	Sites that become inundated with early summer rains
Common Long-necked Tortoise	Balcombe Creek & estuary
Glossy Grass Skink	Swamp Scrub and associated plant communities
Pied Cormorant	Balcombe Estuary
Lewin's Rail	Along the banks of the estuary and creek
Nankeen Night Heron	Swamp Scrub thickets, estuary and creek
Great Egret	Balcombe Estuary
Royal Spoonbill	Balcombe Estuary
Pacific Gull	Coastal areas adjacent to Balcombe Estuary
White-throated Needletail	Coastal and foothill areas provide updrafts for feeding

Aims and Objectives

The brief for this project was to identify the vertebrate fauna within the Balcombe Estuary Reserves.

The outcomes of the study will inform the reserves' managers in:-

- sustaining the significant & common fauna and their habitats (as detected in this survey) and identifying possible impacts or risks.
- developing and implementing a monitoring program for endangered and threatened fauna species within the reserves.

- Identifying and implementing methods to enhance or restore significant fauna habitats.

Study limitations

The field survey was conducted during a 12 month period which included all seasons of the year. However there are a number of reasons why not all vertebrate species may have been detected at the site including low individual local species populations, migration, predation of native species by native & introduced fauna and variable seasonal conditions. The reserves are densely vegetated in some areas and this may have reduced the detection of faunal species and population densities.

Vegetation

The vegetation and associated habitat of the reserves and greater area are today highly modified and fragmented, a result of intense urbanization of the area over the last 50 years and earlier historical changes to the Mount Martha vegetation following European settlement. The native vegetation within the study area has partial connectivity with broader areas of vegetation in the greater area, remnant vegetation on private and public land and remnant vegetation along roadsides.

The study site supports eight Ecological Vegetation Classes (EVC's), as shown in the table below.

Table C: EVC's and their status within the reserves.

EVC No	EVC's	Status within Bioregion	Current distribution within the study site
002	Coast Banksia Woodland	Vulnerable	Confined to the western end of the estuary
048	Heathy Woodland	Least Concern	Raised areas that retain sandy soils
053_61	Freshwater Swamp Scrub	Endangered	Along the creek at the eastern half of the reserve
053_62	Estuarine Swamp Scrub	Endangered	Around the estuary
083	Swamp Riparian Woodland	Endangered	Along parts of the upper creek where Swamp Gum dominates
175	Grassy Woodland	Endangered	Sections of the northern slopes that retain clay soils
821	Tall Marsh	No listing	Shallow areas of the estuary
937	Swampy Woodland	Endangered	Sites around the old soccer oval

The quality of vegetation within the EVCs is generally of medium to high standard, with large areas being weeded over the last couple of decades.

Fauna survey methods

Methods, undertaken in accordance with permit conditions, included:-

- identifying appropriate habitat,
- mapping all vertebrate fauna species,
- active searching,
- scat analysis,
- digging analysis,

- deploying Color bond tiles,
- conducting spotlight walks,
- Anabat 2 Bat Detector,
- vocalization identification,
- deploying motion-censored cameras, -and
- FEIS assessments.

Conclusion and Recommendations

The reserves contain a wide range of terrestrial and arboreal habitats across a large range of EVC's that are assessed as endangered or vulnerable within the bio-region. The reserves also support significant indigenous fauna species listed under Commonwealth and State biodiversity acts.

Overarching recommendation: Collectively, the Balcombe Estuary Reserves are of State Significance and their continued protection should accordingly be of high priority.

Priority recommendations to help protect and maintain the reserve's diverse habitats and fauna species:

1. Habitat protection: Maintain and increase crucial indigenous habitats through-out the reserves and continue to remove habitat-changing weeds through-out.
2. Eucalypt habitat: Plant out 1,000 Manna Gums and 1,000 Swamp Gums to establish essential Eucalypt habitats.
3. Nesting boxes: Install nesting boxes for listed key species using the design drawings included within this report and following the recommended locations/density of installation. Deploy additional habitat logs through-out.
4. Pest animal control: Implement pest animal control programs with specific frequencies to control foxes, cats rabbits and rodents.
5. Environmental monitoring: Develop and implement a longitudinal environmental monitoring program, informed by the results of this study, -that captures changes to species diversity and abundance in response to variable seasonal conditions, particularly for endangered and threatened species.

Action is required on a number of fronts to achieve these five priority recommendations:

- Fauna surveys: Continue to conduct fauna surveys every ten years and on a yearly basis monitor population density fluctuations in threatened fauna, FEIS's and feral fauna.
- Pest control: Continue to carry out integrated, on-going pest animal control programs through-out the reserves and surrounding catchment, targeting:
  - *Common Myna,
  - *Common Blackbird,
  - *Common Starling,
  - *Red Fox,
  - *Feral Cat,
  - *European Rabbit and
  - *Black Rat.

- In particular *Red Fox, *Feral Cat and *Black Rat must be controlled within the reserves and surrounding landscape.
    - Red Foxes: Deploy leg-hold traps during four control pulses annually. Control pulses to be conducted during each season. Fox dens to be located in late winter to early spring and fumigated.
    - *Feral Cats: Target every four months during three control pulses per annum, using cage traps baited with KFC or sardines.
    - *Black Rats: Target twice per year, in autumn and spring, using baited cage traps.
- Legislative recommendations: Recommendations for fauna species contained in Action Plans and Recovery Plans under the EPBC Act 1999 and the FFG Act 1988 should be implemented within the reserves and surrounding bushland, including the surrounding catchment on both public and private land.
- Significant fauna management: To maintain the significant fauna within the reserves the managers must adopt the significant fauna management requirements set out in Appendix 4 of this report.
- Maintaining and increasing habitat: To maintain and increase crucial indigenous habitats.
    - Continue to conduct weeding in sections and span the process over a staged period.
    - Start from the good areas and work outwards and control invading weeds on the edges.
    - Only remove woody weeds during the non-bird breeding season.
    - Leave if Eastern Yellow Robins or other birds are nesting.
    - Allow natural regeneration to occur.
    - If ringtail possum dreys or bird nests occur in weeds then ring-bark with-out poisoning and follow-up after a year.
- Nesting boxes: Continue to deploy and monitor a fauna nesting box program.
- Logs & hollows: Continue to retain and deploy additional terrestrial habitat logs with hollows through-out different habitats.

Contents

1.0 INTRODUCTION

Malcolm Legg from Mal's Ecological & Environmental Services PTY. LTD. (MEES) was commissioned by Balcombe Estuary Reserves Group Mt Martha Inc. (BERG MM) to conduct a fauna survey of Balcombe Estuary Reserves, Mt Martha (from Nepean Highway to the mouth of the estuary at Port Phillip Bay). The study was conducted between August 2018 and July 2019.

This report provides:

- Information on fauna habitats,
- endangered and threatened fauna species locations within the study site,
- lists of fauna detected within the study site by methods outlined in the method section of this report,
- results of fish trap deployment, Color-bond tile deployment, monthly bird surveys, spotlight walks, Anabat 2 Bat Detector surveys, motion-censored camera deployment, Fauna Environmental Indicator Species (FEIS's) assessments, fauna diggings assessments and scat assessments,
- discussions on fauna species, bio-diversity issues, monitoring and feral management, and
- recommendations to ensure that fauna biodiversity values are maintained.

1.1 Project background

The scope of works proposed by MEES and BERG MM included the following:

- a review of fauna databases at the site,
- targeted fauna surveys using various methods,
- to obtain baseline data on fauna species and their population densities, and
- write a comprehensive report on the project.

This report aims to:

- Guide the maintenance and enhancement of the site's known significant fauna values.
- assess all fieldwork data and information,
- discuss indigenous and feral fauna detected at the site,
- discuss fauna not detected during survey period,
- discuss results from this survey and previous surveys,
- provide recommendations to ensure the site's significant biodiversity values are maintained, and
- develope a monitoring program of FEIS's and other threatened fauna species within the site.

1.2 Study site

Balcombe Estuary Reserves are located at the mouth of Balcombe Creek in Mount Martha, which is within the Mornington Peninsula Shire and Victoria (Melways reference number 144 K11). It is also a part of the western biolink that runs from Devilbend Reservoir to Port Phillip Bay and falls within the Gippsland Plains Bioregion (DNRE 1997). The reserves are approximately 50 hectares in size. They consist of Balcombe Creek, its estuary & tributaries, and remnant patches of woodland on either side, surrounded by urban development, with The Briars located to the east, Mount Martha Park to the south and foreshore reserves located north & south. The area has a maritime climate with wet moist winters and dry warm summers.

Map 1 Location of the study site within Mt Martha.

1.2.1 Ecological Vegetation Class/ Habitats

Eight Ecological Vegetation Classes (EVCs) were identified within the study site. Of these, five are listed as 'endangered', one is listed as 'vulnerable' and another is listed as 'least concerned' within the Gippsland Plains Bioregion. These EVCs contains different habitats which provide homes for a diversity of fauna species. The EVCs are of medium to high quality, depending on previous weeding works. The EVCs identified during the survey period and their status is shown in the table below.

TABLE 1: EVCs and their status within the reserves

EVC No	EVCs	Status within Bioregion	Current distribution within the study site
002	Coast Banksia Woodland	Vulnerable	Confined to the western end of the estuary.
048	Heathy Woodland	Least Concern	Raised areas that retain sandy soils.
053_61	Freshwater Swamp Scrub	Endangered	Along the creek at the eastern half of the reserves.
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821	Tall Marsh	No listing	Shallow areas of the estuary
937	Swampy Woodland	Endangered	Sites around the old soccer oval.

EVC Freshwater Swamp Scrub photographed along the banks of the creek. Photos M. Legg, 2019.

Map 2: Aerial of Balcombe Estuary Reserves.

1.3 Geology

Geologically the reserves are made up of two formation origins (Geological Survey of Victoria 1967):

- Both sides of the estuary & creek are derived from Baxter & Ferruginous Sandstone, consisting of sand & sandy clay with occasional gravels. This formation was formed in the Pliocene period of the Tertiary era. These soils are typically well drained and drier.
- The damper soils along the creek & estuary are derived from swamp, stream & younger fluviatile deposits consisting of clay, silt, and sand which are often peaty. This formation was formed in the Recent period of the Quaternary era.

1.4 History

The reserves fall within the traditional lands of the Aboriginal territory of the Boonwurrong clan of the Kulin Nation. Prior and post European settlement the site was and is an important area to the Boonwurrong people, with high cultural evidence found through-out. Similar evidence of past aboriginal occupation is scattered through-out the Mornington Peninsula in the form of midens and tool artifacts (Adam Magennis MPS Cultural Heritage Officer).

In the late 1700's and early 1800's Port Phillip Bay was discovered by Europeans and the area was settled soon after.

From the mid-1800's the Mornington Peninsula was cleared of its indigenous vegetation from the ridges down to the coast and pastures were created through-out. More recent indigenous vegetation has returned to 18% and weeds have colonized at most sites.

The following are extracts from historical records of the fauna that used to occur in the area (between Moorooduc Quarry and Arthur's Seat) during the 1800's and early to mid-1900's:

Cavill (1986, p. 39) recounts the wildlife around her property (immediately to the east of Moorooduc Quarry) in the 1930's:

> "Koalas grunted all night, wombats, kangaroos, wallabies, possums, echidnas, bush and water rats, flying foxes and bandicoots were abundant and tame."

Cavill (pers. comm.) has noted the decline in occurrence of vertebrates living around the Moorooduc Quarry. Of the mammals, Quolls, Southern Brown Bandicoots and Eastern Grey

Kangaroos lasted until around the 1940's while the Common Wombat remained until twenty years later. As recently as twenty years ago, Mrs Cavill recalls Koalas, Sugar Gliders and Agile Antechinus as abundant, although their numbers have since declined dramatically. She believes the Black Wallaby was still present until 1984. Two species of pygmy possum (Feathertail Glider and possibly the Eastern Pygmy Possum) were also thought to have lived in the vicinity.

Wheelwright (1979) whose 'wanderings' all occurred within sixty-five kilometers of Melbourne was one of the first naturalists to write about (and shoot so many of) the region's fauna. He records Dingos "lying up generally in thick patches of tea-tree…" (p. 35) and being common in thick forests, deeply scrubbed gullies, in belts of timber bordering the large plains and in patches of tea-tree on the plains themselves." (p35). Wheelwright also describes many of the species noted by Cavill – Common Wombats, Koalas, the two possums, Sugar Gliders, Feathertail Glider, Bandicoots (two species), Short-beaked Echidnas, Eastern Water Rat and various smaller bush animals, such as field-mice and rats.

In the 1850s Wheelwright also observed a "Kangaroo Rat" which was "common throughout the bush" and which was "excellent eating". This species described by Wheelwright is almost certainly the Long-nosed Potoroo.

Interestingly Wheelwright never observed Platypus in the "Westernport district", although he found it common in the "Yarra and many of the streams to the north and east of Melbourne" (p.52).

Wheelwright also shot both species of quolls. He found the Spotted-tail Quolls rare, but the Eastern Quolls to be "one of the commonest of all bush animals" (p.48). He found Eastern Quolls especially common in the belts of timber around swamps.

Kenyon (1930), reporting on the work and travels of Dr Edmond Charles Hobson, an early Victorian naturalist, quotes from Hobson's 1837 notes:

> "The forests between Melbourne and Arthurs Seat teem with life. The large Kangaroos may be seen in flocks of three hundred or four hundred, and some measure nearly eight feet in height."

He goes on to say that the Southern Brown Bandicoot, Common Wombat, Eastern Quoll, Common Brushtail Possum and Common Ringtail Possum were very numerous.

Hobson's 1837 records comment on a number of birds including the Brolga and the Australian Bustard which were common but have now disappeared from the Greater Melbourne region. They are now listed as vulnerable and endangered in Victoria.

Extracts from Tuck 1971

> The numbers of kangaroos must have been enormous. "Kangaroos were formerly so plentiful that they resembled flocks of sheep. At Sandy Point they erected yards for a big kangaroo drive. Messrs. Clark, White, Benton and others got 1500 in the first
>
> drive. Stakes seven foot high were driven into the ground and interwoven with ti-tree. In the last drive they got 800 kangaroos. On the plain they were in thousands, as also were possums. Bandicoots and goannas were also very numerous." (Tuck, 1971, p. 10).

Also,

> "The place was full of wild animals – wild cats, kangaroos, possums, snakes, emus and everything…" (Tuck, 1971, p.10)

Historical records indicate that by the 1860's ducks were almost shot out on the Port Phillip Bay side of the Mornington Peninsula, and that excessive hunting and drainage of their habitat had reduced numbers dramatically.

The photos below portray some of the species that would have occurred 160 years ago, prior to European settlement.

The Spot-tailed Quoll and the Dingo are now extinct within the Gippsland Plain Bio-region, M. Legg 2010.

Tasmanian Pademelon is now extinct on mainland Australia and Long-nosed Potaroo range has been reduced to French Island, M. Legg 2011.

2.0 METHODS

2.1 Existing information

2.1.1 Desktop Assessment

The following resources and databases were reviewed as part of the desktop assessment:

- DSE's Advisory List of Threatened Vertebrate Fauna 2013
- EPBC Act Protected Matters Search Tool (DEWHA 2010.

Two previous fauna surveys of the reserves have been conducted:

- Legg. M. (April 1999) *Fauna Survey and Management Prescriptions for Balcombe Estuary, Mt Martha*. Mals Ecological & Environmental Services PTY LTD.

- Legg. M. (August 2008) *Fauna Survey and Management Recommendations for Balcombe Creek Estuary, Mt Martha From Nepean Highway to Port Phillip Bay August 2007 to August 2008*. Mals Ecological & Environmental Services PTY LTD.

2.2 New information

Fauna surveys were carried out using the following methods:

- Fish were sampled by site, scoop net and bait trap deployment.
- Amphibians were identified by listening to male vocal calls during day and spotlight walks.
- Reptiles were sampled by hand-capture, under Color-bond tiles, randomly searching and turning over logs and debris.
- Birds were visually & call identified during daytime and spotlight walks. Population densities for each species were also recorded for each month.
- Mammals were identified by sampling on motion-sensor cameras, identifying diggings & scats and during spotlight & day walks.
- Nocturnal fauna were identified whilst conducting four spotlight walks.
- During spotlight walks microbats were recorded on the Anabat 2 Bat Detector and identified using specialized software.

2.2.1 Further detail of some of these fauna survey techniques:

AMPHIBIAN CALL IDENTIFICATION

Amphibians were identified by listening to male vocal calls during spotlight and day walks. Some species were also identified by turning over logs or debris near water bodies.

RANDOM SEARCHING FOR REPTILES

Reptiles were identified by turning over fallen logs, within leaf-litter or by observing and identifying basking species.

COLOR BOND TILES

Ten Color-bond tiles (consist of a sheet of Color-bond measuring c. 30x20cm) were deployed in intact understory through-out the reserves. In the morning of a sunny day as the tile heats up it attracts small reptiles to warm themselves beneath. The tile is turned over in the morning revealing the species, then placed back as it was.

VISUAL BIRD DETECTING

Birds were identified by walking through the site, listening to calls or looking through binoculars and identifying individuals. Bird species population densities were counted each month of the survey. Nocturnal birds were identified by calls and sight during spotlight walks.

SCAT ANALYSIS

Indigenous and feral fauna scats were analyzed to determine species and what feral predators had been preying on.

SPOTLIGHTING

Spotlighting was conducted over four nights during mild weather conditions and during some of the pre full & new moon cycles of 2018-19.

ANABAT 2 BAT DETECTOR

Micro bats omit echo-location while flying around at night. Each species has a different call frequency and thus their calls are detected and recorded on the Anabat 2 Bat Detector. The calls are down-loaded on to computer and analyzed using specialized software to determine species.

MOTION-SENSOR CAMERAS

Motion sensor cameras are designed to capture in photos or video fauna that passes through the camera's range either at night (infra-red) or during daylight (color). The images

are stored within the camera on SD cards. Four 'Digital Scouting/trail Cameras were deployed at four sites from March to June 2019.

All cameras were configured similarly using the low sensitivity setting and were switched onto photos only.

2.3 Limitations

The field survey was conducted between August 2018 and July 2019 (12 months) which is normally an optimal period to assess all species that usually utilize a study site. However there are a number of reasons why not all vertebrate species may have been detected at the site including low individual local species populations, migration, predation of native species by native & introduced fauna and variable seasonal conditions. Parts of the reserve are densely vegetated and this may have reduced the detection of faunal species and population densities.

2.4 Data handling and storage

Listings of all fauna taxa detected throughout this assessment, within the reserves have been submitted to the DELWP, Nicholson Street, and recorded on the Biodiversity Atlas of Victoria for future reference.

2.5 Mapping

Fauna surveys were conducted through-out the entire reserves which were also traversed by foot during several field trips from August 2018 to July 2019. During this time, fauna surveys were undertaken throughout the different habitats within the site. Dedicated searches for rare or threatened fauna species were also made during fieldwork. Fauna surveys were conducted by Malcolm Legg.

2.6 Rapid assessment tool using Fauna Environmental Indicator Species (FEISs) to measure the health of an ecosystem.

A rapid assessment tool to measure health of fauna diversity has been developed by Malcolm Legg in an attempt to gauge the level of ecosystem health through fauna species diversity. This considers two aspects:

1. The five phases of extinction since European settlement – five broad categories of extinction based on a benchmark of what fauna were present prior to European settlement

2. Indicator species which provide a benchmark for a particular habitat type

This tool is still in the development phase, and has not undergone rigorous testing. It has not been developed using detailed academic study nor received peer review. Therefore, it should be used with some caution. However, as there is no other easy-to-use assessment tools (to the author's knowledge), this tool is presented for interpretation of results and for rapid assessment of the health of bush land for the fauna species diversity. There are many rapid assessment tools developed by DSE and other organizations to measure the health of native vegetation, habitat, creeks and rivers. However few tools exist to measure fauna species diversity or aspects of 'ecological processes'.

The FEIS assessment criteria are discussed and listed in Appendix 3.

3.0 RESULTS

3.1 Fauna identified within the study site

During this assessment 118 species of vertebrate fauna were recorded within the reserves. Of these, 108 species are native and ten species introduced.

3.1.1 Fish

During this survey 14 species of fish were recorded within the study site (Appendix 1), of which one species is introduced. Fish were mainly found within the estuary and creek.

3.1.1 Amphibians

During this survey six species of amphibians were recorded within the study site (Appendix 1), mainly within the woodlands or near the estuary and creek.

3.1.2 Reptiles

During this survey eleven species of reptiles were recorded within the reserves: a tortoise, eight species of lizard, and two species of snake (Appendix 1). There appears to be a medium diversity of reptiles within different habitats throughout the reserves.

3.1.3 Birds

Within the reserves 70 species of birds were recorded during this survey (Appendix 1). 66 of these are native species and four species are introduced. Wetland birds are found in the estuary and creek, woodland birds dominate the woodlands, while common open-country birds dominated the open and outer perimeter of the reserves and surrounding urban area.

3.1.4 Mammals

During this survey 17 species of mammals were recorded within the reserves (Appendix 1) of which five species are introduced. There appears to be a medium diversity of terrestrial and a high diversity of arboreal mammals still inhabiting the study site.

3.2 Fauna sampling results.

3.2.1 Fish Trap results

The table below lists the results from the deployment of Fish traps in the estuary and creek.

TABLE 2: Fauna observed during fish trap deployment within the reserves July 2019

Species	Date	Number sampled	Area sampled
Estuary Fauna			
Black Bream	08-10-18	22	Observed.
Mullet sps	30-01-19	10+	Observed.
Flat-headed Gudgeon	21-05-19	22	Scoop net on edges of estuary.
Blue-spot Goby	21-05-19	3	Scoop net on edges of estuary.
Bridled Goby	21-05-19	6	Scoop net on edges of estuary.
Greenback	21-05-19	2	Scoop net on edges of estuary.
Smooth Toadfish	08-10-19	7	Mouth of estuary.
Long-finned Goby	21-05-19	4	Scoop net on edges of estuary.
Creek Fauna			
Short-finned Eel	08-10-18	2	Fish trap 2.
Common Galaxias	08-10-18	14	Fish trap 1.
	09-10-18	3	Fish trap 2.
Spotted Galaxias	09-10-18	2	Fish trap 1.
Dwarf Galaxias	08-10-19	3	Fish trap 1.
*Mosquitofish	08-10-19	20	Fish trap 5.

3.2.2 Bird species and population density results

TABLE 3: Bird species and population densities detected for each month throughout the reserves, August 2018 to July 2019. 'B' denotes when each species bred

SPECIES	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
	2018					2019						
Darter											1	
Pied Cormorant						4	3	2	2			2
Little Pied Cormorant	2		2			3	2	2	4	15	7	2
Great Cormorant			2									
Little Black Cormorant	2								12	37	12	
Hoary-headed Grebe	2											
Pacific Black Duck	4			2						12	9	6
Chestnut Teal	12	4	12	2	2	6			4	17	18	4
Australian Wood Duck										22	6	
Lewin's Rail		2	2B	2B	2B	2B						
Dusky Moorhen	8	8	10B	6B	6B	6B				12	17	12
Purple Swamphen	4	6	6B	6B	6B	8B	6B			10		6
Eurasian Coot										34		
Nankeen Night Heron								1				
White-faced Heron	2	2B	2B	2B	2B	2B	3	3				
Great Egret				2				1	2	4	2	
Australian White Ibis	20+	10+										
Straw-necked Ibis		20+										
Royal Spoonbill			2									
Masked Lapwing											6	
Silver Gull	17	26	48	50+	60+	15			2	80+	16	6
Pacific Gull	2							2	3	4	1	
Wedge-tailed Eagle	2											

SPECIES	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
	2018					2019						
Brown Goshawk	2											
*Spotted Turtle-dove	12	16	16	20	28	22	24	24	22	6	8	8
Yellow-tailed Black-Cockatoo	12									4		
Galah	12					4		6		7	4	5
Little Corella										30+	30+	20+
Sulphur-crested Cockatoo				3	6	4	5	6	6	6	4	5
Rainbow Lorikeet	25	16	35	6	35	40	40	40	40	16	16	30
Australian King Parrot						4	4	2				
Musk Lorikeet				4	16	20	16	10			3	
Crimson Rosellas	4							3		7		
Eastern Rosella	6	6	14B	8B	10B	12B	12	12	8	8	8	8
Fantail Cuckoo			4									
Shining Bronze-Cuckoo			4B	4B								
Tawny Frogmouth											3	
White-throated Needletail							10+					
Laughing Kookaburra	4	4B	4B	6B	6B	6B	6	6	10	9	8	8
Superb Fairy-wren	60	60B	60B	60B	85B	90B	88	85	84	82	80	80
Spotted Pardalote			10	6				25	40		10	20
White-browed Scrub-wren	60	55B	56B	50B	80B	80B	80	80	80	78	76	74
Brown Thornbill	70	90B	70B	70B	95B	100B	96	95	92	88	88	86
Striated Thornbill						6						
Red Wattlebird	10	24B	24B	16B	20B	14B	14	14	24	12	8	12
Little Wattlebird	10	12B	12B	12B	6B	6B	8	10	10	10		
Noisy Miner	16	20	18B	20B	24B	26B	26	25	26	26	22	20
Yellow-faced Honeyeater		20	12B	8B	8B	6B				8		6
White-plumed Honeyeater		4										
Brown-headed Honeyeater									8			
White-napped Honeyeater									6			
New Holland Honeyeater	6	8B	8B	10B	12B	12B	12	10		14	12	6
Eastern Spinebill			4B	4B	8B	4						6
Eastern Yellow Robin	10	12B	12B	12B	16B	16B	16	16	14	14	12	12
Grey Shrike-thrush	8	8B	8B	8B	10B	10B	10	8	8	8	8	8
Golden Whistler		8B	8B	10B	12B	12B	12	8	6			
Rufous Whistler			10B	14B	14B	16B	8					
Grey Fantail	6	26B	28B	36B	36B	38B	32	26	12	6	6	5
Magpie-lark	4	6B	6B	8B	8B	10B	10	8	8	4	8	6
Black-faced Cuckoo-shrike		4										
Grey Butcherbird	6	8B	10B	10B	12B	12B	12	10	10	10	10	10
Australian Magpie	4	8B	10B	12B	12B	12B	16	20	16	17	16	15
Pied Currawong			2									
Australian Raven	8	8	16	4	6	6	12	16	12	9	12	10
Little Raven	3	4	4					5		4	3	
Welcome Swallow		14	6B	6B	6B	6B	10	10				
Silvereye		16B	40B	50B	35B	30B	26	20	15	16	8	15
*Common Blackbird	14B	16B	18B	22B	26B	22+B	22	20	22	12	13	12
*Common Myna	10+	10+	10+	16	20			10		6	6	8
*Common Starling	20+	20+	20+	16	20				10+	12	8	6

3.2.3 Elliot Trap results

Fauna usually sampled in Elliot traps were sampled by other methods, outlined in section 2.2.1

3.2.4 Pitfall trap results

No pitfall trap lines were deployed within the reserves as interference from the public was inevitable. Fauna usually sampled in pitfall traps were sampled by other methods, outlined in section 2.2.1.

3.2.5 Color-bond tile results

The table below lists the results from the deployment of ten Color-bond tiles.

TABLE 4: Fauna sampled under Color-bond tiles deployed in the reserves, November 2018 to April 2019

Species	Date	Number sampled	Area sampled
Reptiles			
Eastern Three-lined Skink	10-12-18	2	Color-bond tile 5.
	11-02-19	1	Color-bond tile 5.
Southern Water Skink	10-12-18	1	Color-bond tile 7.
Garden Skink	10-12-18	2	Color-bond tile 3.
	11-02-19	1	Color-bond tile 3.
	24-04-19	3	Color-bond tile 9.
Delicate Skink	24-04-19	1	Color-bond tile 4.
Metallic Skink	24-04-19	1	Color-bond tile 10.
Glossy Grass Skink	10-12-18	1	Color-bond tile 8.
	24-04-19	2	Color-bond tile 8.
Weasel Skink	11-02-19	2	Color-bond tile 6.
	24-04-19	1	Color-bond tile 2.
Blotched Blue-tongue	24-04-19	1 juv.	Color-bond tile 1.
White-lipped Snake	10-12-18	1	Color-bond tile 4.

3.2.6 Spotlight walk results

Four spotlight walks were conducted within the reserves during this fauna assessment: the results are shown in the table below.

TABLE 5: Fauna observed during spotlighting in the reserves, September 2018 to June 2019

Species	Date	Number sampled	Area sampled
Amphibians			
Common Froglet	17-09-18	50+	Wet areas
	10-12-18	100+	As above.
	03-06-19	80+	As above.
Southern Brown Tree Frog	17-09-18	40+	As above.
	10-12-18	20+	As above.
	14-03-19	10+	As above.
	03-06-19	10+	As above.
Verreaux's Tree Frog	17-09-18	20+	As above.
	10-12-18	10+	As above.
	03-06-19	4	As above.
Birds			
Australian Wood Duck	03-06-19	20+	Woodlands & estuary.
Nankeen Night Heron	14-03-19	1 juv.	Swamp scrub along creek.
Masked Lapwing	03-06-19	4	Estuary.
Tawny Frogmouth	17-09-18	3	Woodlands.

Species	Date	Number sampled	Area sampled
Tawny Frogmouth cont.	10-12-18	3	As above.
	03-06-19	4	As above.
Mammals			
Common Brushtail Possum	17-09-18	12	Woodlands
	10-12-18	8	As above.
	03-06-19	8	As above.
	03-06-19	8	As above.
Sugar Glider	17-09-18	6	As above.
	10-12-18	8	As above.
	14-03-19	10	As above.
	03-06-19	8	As above.
Common Ringtail Possum	17-09-18	20+	As above.
	10-12-18	30+	As above.
	14-03-19	20+	As above.
	03-06-19	20+	As above.
White-striped Free-tail Bat	10-12-18	24	As above.
	14-03-19	16	As above.
Other Microbat species	17-09-18	4 species	As above.
	10-12-18	5 species	As above.
	14-03-19	3 species	As above.
	03-06-19	3 species	As above.
*Red Fox	17-09-18	2	As above.
	10-12-18	1	As above.
	14-03-19	3	As above.
	03-06-19	2	Through-out.
*Feral Cat	17-09-18	1	As above.
	14-03-19	2	As above.

3.2.7 Anabat 2 Bat Detector results

The Anabat 2 Bat detector was deployed during four spotlight walks within the reserves: the results are displayed in the table below.

TABLE 6: Micro bats recorded on the Anabat 2 Bat Detector through-out the reserves, September 2018 to June 2019.

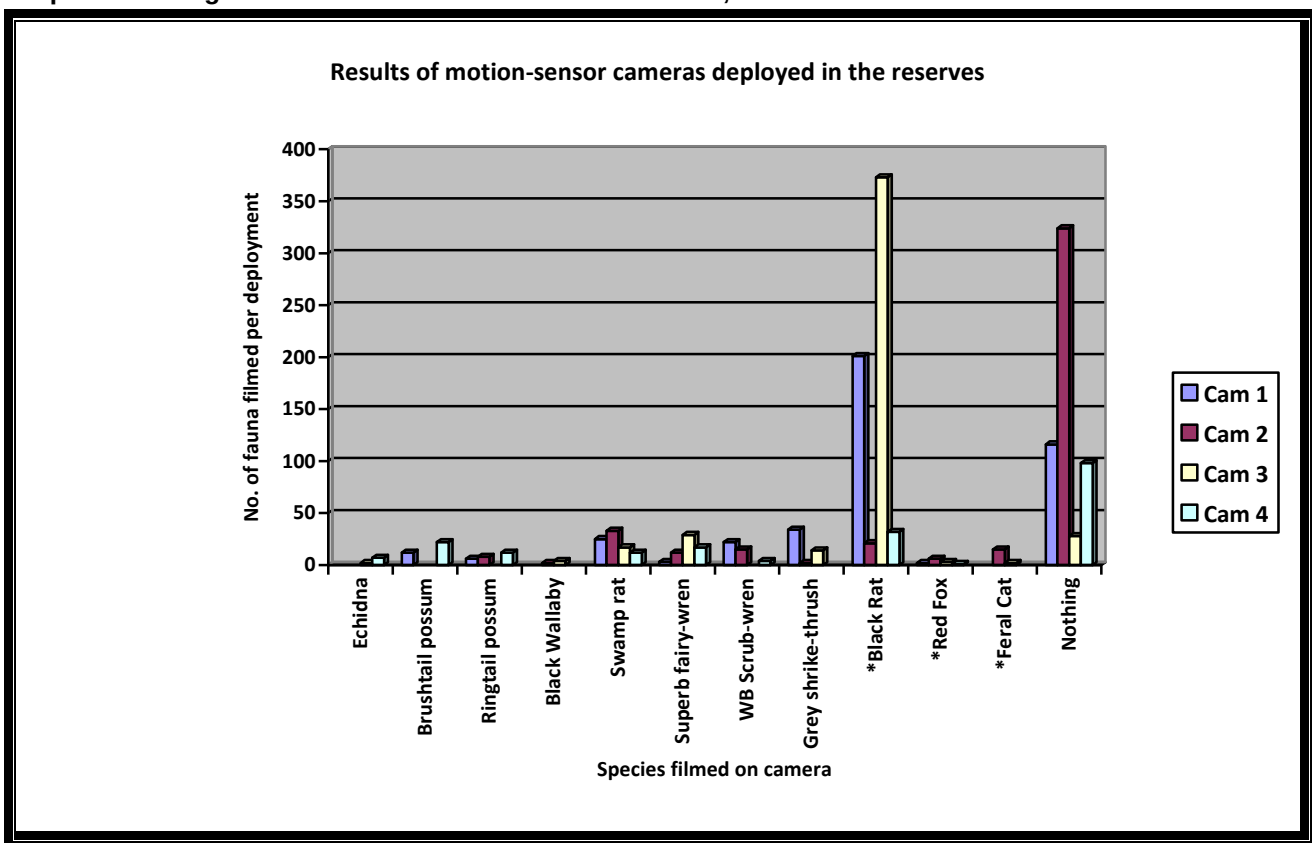
Species	Date	Number of calls recorded	Area Observed
White-striped Freetail Bat	10-12-18	24	Through-out woodlands.
	14-03-19	16	As above.
Gould's Wattled Bat	17-09-18	36	As above.
	10-12-18	54	As above.
	14-03-19	39	As above.
Gould's Wattled Bat	03-06-19	24	As above.
Lesser Long-eared Bat	14-03-19	12	As above.
	03-06-19	19	As above.
Large Forest Bat	17-09-18	18	As above.
	10-12-18	14	As above.
	14-03-19	9	As above.
Little Forest Bat	17-09-18	44	As above.
	10-12-18	38	As above.

Species	Date	Number of calls recorded	Area Observed
Little Forest Bat cont.	14-03-19	35	As above.
	03-06-19	39	As above.

3.2.8 Digital Scouting/trail camera results

Throughout the reserves four motion-sensor cameras were deployed between March and June 2019: The results are in the table below.

Graph 1: Scout-guard camera results within the reserves, March to June 2019



3.2.9 Current status of Broad Vegetation Class ecosystems within the reserves using FEIS rapid assessment tool

The FEIS rapid assessment tool was applied to reserves, and the tables below show the results, listing the FEISs that still occur and the species that have disappeared within Broad Vegetation Classes across the site. Each Broad Vegetation Class is also given a rating from 1 to 5 depending on loss of FEISs: this score shows the extinction phase the site is currently experiencing.

3.2.9.1 FEIS assessment of woodlands

TABLE 7: FEIS Assessment of BVT 'woodlands' within the reserves.

Decapod Crustaceans	Reptiles	Birds	Mammals	No. Of FEIS's present and extinction phase
Engaeus sp Red writing indicates species that have either disappeared or become extinct within the reserves.	Tree Dragon Whites Skink Southern Water Skink Eastern three-lined Skink Delicate Skink McCoy's Skink Southern Grass Skink Blotched Blue-tongue or Common Blue-tongue White-lipped Snake	Painted Button Quail Buff-banded Rail Southern Boobook Powerful Owl Eastern Rosella Crimson Rosella Sacred Kingfisher Varied Sitella White-throated Treecreeper White-eared Honeyeater Brown-headed Honeyeater Crescent Honeyeater New Holland Honeyeater Pink Robin Eastern Yellow Robin Crested Shrike-tit Grey Shrike Thrush Golden Whistler Rufous Whistler Rufous Fantail Grey Fantail Satin Flycatcher Grey Currawong Mistletoebird Stubble Quail Brush Bronzewing	Short-beaked Echidna Agile Antechinus White-footed Dunnart Southern Brown Bandicoot Long-nosed Bandicoot Sugar Glider Feathertail Glider Black Wallaby Sothern Forest Bat Large Forest Bat Swamp Rat	26 of the 47 FEIS's have disappeared from woodlands within the reserves. 44.6% of FEIS's still remain, which indicates a phase 3 extinction rate within the woodlands through-out the reserves.

3.2.9.2 FEIS assessment of scrub (wet areas)

TABLE 8: FEIS assessment of BBT 'wet scrub' within the reserves.

Decapod Crustaceans, Amphibians and Reptiles	Birds	Mammals	No. Of FEIS's present and extinction phase
Engaeus sps Victorian Smooth Froglet Southern Toadlet Swamp Skink Southern Water Skink Glossy Grass Skink Southern Grass Skink Blotched Blue-tongue Red writing indicates species that have disappeared from the reserves.	Lewin's Rail Buff-banded Rail Nankeen Night Heron Brush Bronzewing Eastern Rosella Sacred Kingfisher Southern Emu-wren Crescent Honeyeater New Holland Honeyeater Eastern Yellow Robin Grey Shrike Thrush Golden Whistler Rufous Whistler Grey Fantail Rufous Fantail Grey Currawong	Short-beaked Echidna Agile Antechinus Dusky Antechinus Southern Brown Bandicoot Long-nosed Bandicoot Black Wallaby Water Rat Large Forest Bat Swamp Rat	15 of the 32 FEIS's have disappeared from the reserves. 46.8% of FEIS's still remain which indicates a phase 3 extinction rate within the Swamp Scrub through-out the reserves.

3.2.9.3 FEIS assessment of wetlands and swamps

TABLE 9: FEIS Assessment of BVT 'wetlands and swamps' within the reserves.

Decapod Crustaceans & Fish	Amphibians	Reptiles	Birds	Mammals	No. of FEIS's present and extinction phase
Engaeus sp Spotted Galaxias Dwarf Galaxias Red writing indicates species that have either disappeared or become extinct within the reserves.	Victorian Smooth Froglet Southern Toadlet Growling Grass Frog	Common Long-necked Tortoise Swamp Skink Metallic Skink Glossy Grass Skink	Lewin's Rail Buff-banded Rail Baillons Crake Spotless Crake Australasian Bittern Nankeen Night Heron Great Egret Royal Spoonbill Southern Emu-wren White-fronted Chat Clamorous Reed Warbler	White-footed Dunnart Southern Brown Bandicoot Black Wallaby Water Rat Swamp Rat	13 of the 26 FEIS's have disappeared from the wetlands and swamps within the reserves. 50% of FEIS's still remain which indicates a phase 3 extinction rate within the wetlands and swamps through-out the reserves.

3.2.9.4 FEIS assessment of riparian zones

TABLE 10: FEIS Assessment of BVT 'riparian zones' within the reserves.

Decapod Crustaceans & Fish	Reptiles	Birds	Mammals	No. of FEIS's present and extinction phase
Engaeus sp Spotted Galaxias Broad-finned Galaxias Red writing indicates species that have either disappeared or become extinct within the reserves. .	Swamp Skink Southern Water Skink Delicate Skink Glossy Grass Skink Southern Grass Skink Blotched Blue-tongue White-lipped Snake	Lewin's Rail Buff-banded Rail Baillons Crake Spotless Crake Nankeen Night Heron Royal Spoonbill Great Egret Southern Boobook Powerful Owl Eastern Rosella Crimson Rosella Sacred Kingfisher White-throated Treecreeper Varied Sitella White-eared Honeyeater Brown-headed Honeyeater Crescent Honeyeater New Holland Honeyeater Pink Robin Eastern Yellow Robin Crested Shrike-tit Grey Shrike Thrush Golden Whistler Rufous Whistler Grey Fantail Rufous Fantail Satin Flycatcher Grey Currawong Clamorous Reed Warbler Mistletoebird	Short-beaked Echidna Agile Antechinus Dusky Antechinus Long-nosed Bandicoot Sugar Glider Feathertail Glider Black Wallaby Water Rat Southern Forest Bat Large Forest Bat Swamp Rat	26 of the 51 FEIS's have disappeared from the riparian zones within the reserves. 50.9% of FEIS's still remain which indicates a phase 3 extinction rate along the Riparian Zones through-out the reserves.

3.2.9.5 FEIS assessment of creeks

TABLE 11: FEIS Assessment of BVT 'creeks' within the reserves.

Decapod Crustaceans & Fish	Amphibians	Reptiles	Birds	Mammals	No. of FEIS's present and extinction phase
Engaeus sp Spotted Galaxias Broad-finned Galaxias Dwarf Galaxias	Growling Grass Frog Red writing indicates species that have either disappeared or become extinct within the reserves.	Common Long-necked Tortoise	Royal Spoonbill Great Egret	Water Rat	Three of the 9 FEIS's has disappeared from creeks within the reserves. 66.7% of FEIS's still remain which indicates a phase 2 extinction rate within the creeks through-out the creek.

4.0 SIGNIFICANT FAUNA

One nationally significant species listed under the *Environment Protection and Biodiversity Act 1999* was detected during this survey. Another species detected is listed as internationally migratory under the EPBC Act. Eleven state significant species were recorded, three of which are listed under the *Flora and Fauna Guarantee Act 1988* as threatened. In addition, a further 16 species recorded are considered to be of regional significance and five species recorded are considered to be of high local significance. Due to large population and habitat losses within the local area (Mornington Peninsula Shire) the remaining native fauna can be considered to be of local significance levels.

4.1 Faunal significance within the study site.

On the basis of significant species detected during this assessment, which are either listed on the EPBC Act or as state or regionally significant fauna species, along with five EVCs that are listed as endangered within the Gippsland Plains Bioregion, the reserves can be considered to be State significance.

4.2 Habitat significance

The reserves and their unique range of habitats support a reasonably high diversity of vertebrate fauna species and population densities including several bird species. In addition the indigenous treed communities support a high diversity of arboreal mammals and many species of avifauna that are now threatened within the Gippsland Plains Bioregion. It also represents some bird species that have disappeared from several bushland sites across the Mornington Peninsula. The ground vegetation supports a high diversity of terrestrial fauna and scrub-dwelling avifauna whose population densities are usually greatly reduced when confronted with high population densities of *Red Fox and *Feral Cats across other parts of the Peninsula.

4.3 Defining significant species

Fauna within the reserves were classed according to their high local, regional, State and National significant levels. As lists of regionally and locally significant fauna aren't available from relevant government authorities, those significant taxa were assessed by the author from his previous records within the bioregion and the Mornington Peninsula.

4.4 Significant fauna detected throughout the reserves during this assessment.

Key to defining significant species

Signif	**Significant/status of species is designated by:**
N	**National**
S	**State**
R	**Regional**
HL	**High Local**
DSE	**Threatened Vertebrate Fauna in Victoria-2013 (DSE 2013)**
DEPI	**Department of Environment & Primary Industries**
FFG	***Flora and Fauna Guaranteed Act 1988***
ActPl	**Action Plan approved by Environmental Australia**
EPBC	***Environment Protection and Biodiversity Conservation Act 1999***
TR	**International Treaties, C=China (CAMBA) and J=Japan (JAMBA).**
Cen	**critically endangered**
End	**endangered**
Vul	**vulnerable**
LR	**lower risk-near threatened**
NT	**Near Threatened**
DD	**data deficient**
Ls	**Listed**
M	**Migratory under the EPBC Act**
Un	**Uncommon**
MC	**Moderately Common**
LC	**Locally Common**
C	**Common**

TABLE12: Significant fauna detected throughout the reserves during this assessment.

Common Name	Scientific Name	Signif	DELWP	FFG	ActPl	EPBC	TR	Optimal period to survey for
Fish								
Spotted Galaxias	*Galaxias truttaceus*	R	Un					All year.
Dwarf Galaxias	*Galaxiella pusilla*	N	En	Ls	Yes	Vul		All year.
Southern Pygmy Perch	*Nannoperca australis*	R	Un					All year.
Amphibians								
Southern Toadlet	*Pseudophryne semimarmorata*	S	Vul					Autumn
Reptiles								
Common Long-necked Tortoise	*Chelodinia longicollis*	S	DD					Spring/summer
Southern Water Skink	*Eulamprus tympanum*	R	MC					Spring/summer
Delicate Skink	*Lampropholis delicata*	R	Un					Spring
Metallic Skink	*Carinascincus metallicus*	R	MC					Summer/autumn
Glossy Grass Skink	*Pseudemoia rawlinsoni*	S	Vul					Spring/summer
Weasel Skink	*Saproscincus mustellina*	R	MC					Spring/summer
Blotched Blue-tongue	*Tiliqua nigrolutea*	R	MC					Spring/summer
White-lipped Snake	*Drysdalia coronoides*	R	MC					Spring/summer
Birds								
Darter	*Anhinga melanogaster*	R	Un					All year.
Pied Cormorant	*Phalacrocorax varius*	S	NT					All year.
Lewin's Rail	*Rallus pectoralis*	S	Vul	Ls	Yes			All year.
Nankeen Night Heron	*Nycticorax caledonicus*	S	NT					All year.
Great Egret	*Ardea alba*	S	Vul	Ls	Yes			All year.
Royal Spoonbill	*Platalea regia*	S	NT					All year.
Pacific Gull	*Larus pacificus*	S	NT					All year.
Wedge-tailed Eagle	*Aquila audax*	HL	MC					All year.
Musk Lorikeet	*Glossopsitta concinna*	HL	MC			M		Sum/aut
Australian King Parrot	*Alisterus scapularis*	HL	MC					Spring

Common Name	Scientific Name	Signif	DELWP	FFG	ActPl	EPBC	TR	Optimal period to survey for
White-throated Needletail	*Hirundapus caudacutus*	S	Vul			M	Jamba	Sum/aut
Striated Thornbill	*Acanthiza lineata*	R	Un					All year.
Brown-headed Honeyeater	*Melithreptus brevirostris*	R	Un					All year.
White-napped Honeyeater	*Melithreptus lunatus*	HL	MC					All year.
Rufous Whistler	*Pachycephala rufiventris*	HL	MC					Spring/summer
Mammals								
Sugar Glider	*Petaurus breviceps*	R	MC					Spring to autumn
Koala	*Phascolarctos cinereus*	R	MC					All year.
Black Wallaby	*Wallabia bicolor*	R	MC					All year.
Micro bats occurring through-out.	*Tadarida, Chalinolobus & Vespadelus sps.*	R	C					Summer/autumn
Swamp Rat	*Rattus lutreolus*	R	C					All year

5.0 DISSCUSSION

5.1 Indigenous fauna

5.1.1 Fish

Fish populations within the creek appear to be at healthy levels. In spring 2018 several Black Bream were observed in the creek along with large healthy populations of Common Galaxias. During autumn 2019 Short-finned Eel populations greatly increased at the mouth of the estuary until the mouth opened in early June. The occasional Spotted Galaxias, Dwarf Galaxias, Southern Pygmy Perch and the introduced *Mosquitofish were sampled in bait traps under the bridge at Nepean Highway.

Estuarine fish populations appear to be healthy and consist of bottom dwelling predatory fish such as Flat-headed Gudgeon, Blue-spot Goby, Bridled Goby, Greenback Flounder, and Long-finned Goby. Other predatory fish within the estuary include Yellow-eyed Mullet, Black Bream and Smooth Toadfish.

Black Bream in the creek, spring 2018.

Common Galaxias sampled in bait trap and released into creek.

5.1.2 Amphibians

Large sized population densities of Common Froglet, Spotted Marsh Frog and Southern Brown Tree Frog were found to occur throughout the reserves and especially in inundated areas. The occasional Southern Bullfrog and Verreaux's Tree Frog were heard calling during spotlight walks or observed jumping through the understorey.

The State significant Southern Toadlet was heard calling in autumn 2019 and was found to occur at sites that become inundated after early winter rains. Populations appear to be at stable levels.

Rarer species which weren't sampled during this survey and are probably extinct within the area include: Victorian Smooth Froglet, Haswell's Froglet and Growling Grass Frog. It is unlikely that future surveys within the reserves would identify these species.

5.1.3 Reptiles

During the assessment period reptile species and population densities appeared to be at a medium to high diversity with recent local extinctions occurring in the reserves of some species such-as: Tree Dragon, Common Scaly-footed Legless Lizard and Tiger Snake.

An occasional Common Long-necked Tortoise was observed surfacing in the creek or estuary. The diversity of reptile species that still remain can be attributed to reasonably high quality understorey habitats with terrestrial habitat logs present, especially where areas are dominated by a grassy, sedgy or heathy understorey. Such habitats provide a variety of homes for reptile species. Within these habitats the majority of the overstorey habitat-changing weeds have been eradicated. The Skink family was the largest representation of the reptile family found in the survey, with eight species recorded. The reptiles identified during this assessment period and their habitats are discussed below.

Skinks identified within the reserves include: Eastern Three-lined Skink, Southern Water Skink, Delicate Skink, Garden Skink, Metallic Skink, Glossy Grass Skink, Weasel Skink and Blotched Blue-tongue. All species of skinks are terrestrial and feed on a variety of insects and fruits. The two species of snake identified are: Lowland Copperhead and White-lipped Snake. Both appear to be at low-medium population densities.

5.1.4 Birds

A high diversity of birds inhabits the reserves. They can be divided into three categories:

- wetland birds
- woodland birds
- Introduced birds

Wetland birds

During this assessment the wetland bird species identified throughout the reserves were mainly observed either feeding or roosting in the estuary and creek. Occasional species such as the Straw-necked Ibis were observed flying overhead. Cormorant and duck species were regularly observed in the estuary or roosting on fallen trees within the creek. One Darter was observed in June 2019 while the Lewin's Rail was occasionally heard calling along the

banks of the creek and estuary. Other water fowl species which appear to be reasonably common include: Dusky Moorhen, Purple Swamphen and Eurasian Coot.

Typical wader birds of the estuary include: Nankeen Night Heron, White-faced Heron, Great Egret, Australian White Ibis and Royal Spoonbill. All of these species are at low population densities within the reserves. Occasional Pacific Gull and Masked Lapwing were observed in the estuary or flying along the coast. The Silver Gull was high in population numbers on the estuary especially during the months leading up to summer and again in May 2019 before the mouth opened.

Great Egret and Cormorants roosting in the estuary after the mouth opened.

Woodland birds

Several species of woodland birds were found to inhabit the woodlands, scrub and understories found through-out the reserves: these are discussed below.

The occasional Wedge-tailed Eagle was observed flying overhead with the nearest known nest site slightly north of Devilbend Reservoir. The Brown Goshawk was occasionally observed hunting other birds within the woodlands.

Small flocks of Yellow-tailed Black Cockatoos were observed feeding on pine cone seeds, banksia cone seeds and she-oke seeds through-out the reserves. Small to medium-sized flocks of Galahs, Little Corella and Sulphur-crested Cockatoos were regularly seen flying overhead or feeding on seed either in trees or on the ground. Flocks of Rainbow Lorikeets

visited the reserves regularly and breed within tree hollows. Smallish flocks of Musk Lorikeet visited the reserves during the warmer months and were observed feeding on eucalypt blossoms. The occasional Australian King Parrot was seen feeding on seeds. Medium sized flocks of Eastern Rosella and occasional Crimson Rosella are breeding residents within the reserves or adjacent private properties, as adequate tree hollows still exist throughout. However the breeding hollows are becoming scarce.

Migratory birds within Australasia arrived in the reserves during spring & autumn including: Fantail Cuckoo, Shining Bronze-Cuckoo, Rufous Whistler, Grey Fantail, Black-faced Cuckoo-shrike, Welcome Swallow and Silvereye. The majority of these species arrive in spring or summer to breed and leave for New Guinea and northern or eastern Australia during autumn. After breeding and during autumn the Silvereye migrates from Tasmania back to the mainland especially to the Frankston and Mornington Peninsula areas. The cuckoos are parasitic, laying their eggs in the nests of honeyeaters, finches, wrens & thornbills. They migrate to Eastern Australia or New Guinea after breeding.

During spotlight walks Tawny Frogmouths were identified within the woodlands, usually perched on a tree limb while hunting for prey. They are breeding residents within the reserves and greater area.

During early autumn small flocks of internationally migratory White-throated Needletail were seen flying over the reserves on high thermals and feeding on insects. Breeding pairs of Kookaburras were occasionally encountered throughout the reserves and are breeding residents in old-growth tree hollows within the greater area.

Superb Fairy-wren and White-browed Scrubwren were found in high population densities in understories through-out the reserves. Spotted Pardalote and Brown Thornbill are common permanent breeding residents of the reserves' thickets, undergrowth and canopies, while the striated Thornbill was an occasional visitor.

Nine species of honeyeaters were recorded in the reserves, mainly in the woodlands where they were seen feeding on insects and nectar from the various flowering plant. They were the Red Wattlebird, Little Wattlebird, Noisy Miner, Yellow-faced Honeyeater, White-plumed Honeyeater, Brown-headed Honeyeater, White-naped Honeyeater, New Holland Honeyeater and Eastern Spinebill. They range from common to rare breeding residents, with some species staying all year round while others migrate to other parts of eastern and south-eastern Australia after breeding. The Wattlebirds and Noisy Miners are large dominating birds who chase away essential smaller leaf-gleaning birds. This phenomenon can contribute in the die-back of eucalypt trees.

Eastern Yellow Robin, Grey Shrike Thrush and Golden Whistler are reasonably common breeding residents within the reserves and can often be heard calling or seen feeding on insects.

Common open country birds such as the Magpie-lark, Grey Butcherbird, Australian Magpie, Australian Raven and Little Raven range from common to rare breeding residents or visitors to the reserve. Some species are regularly fed by surrounding residents. The Pied Currawong was observed in October 2019 near the soccer oval and is a rare vagrant to the peninsula.

Introduced birds

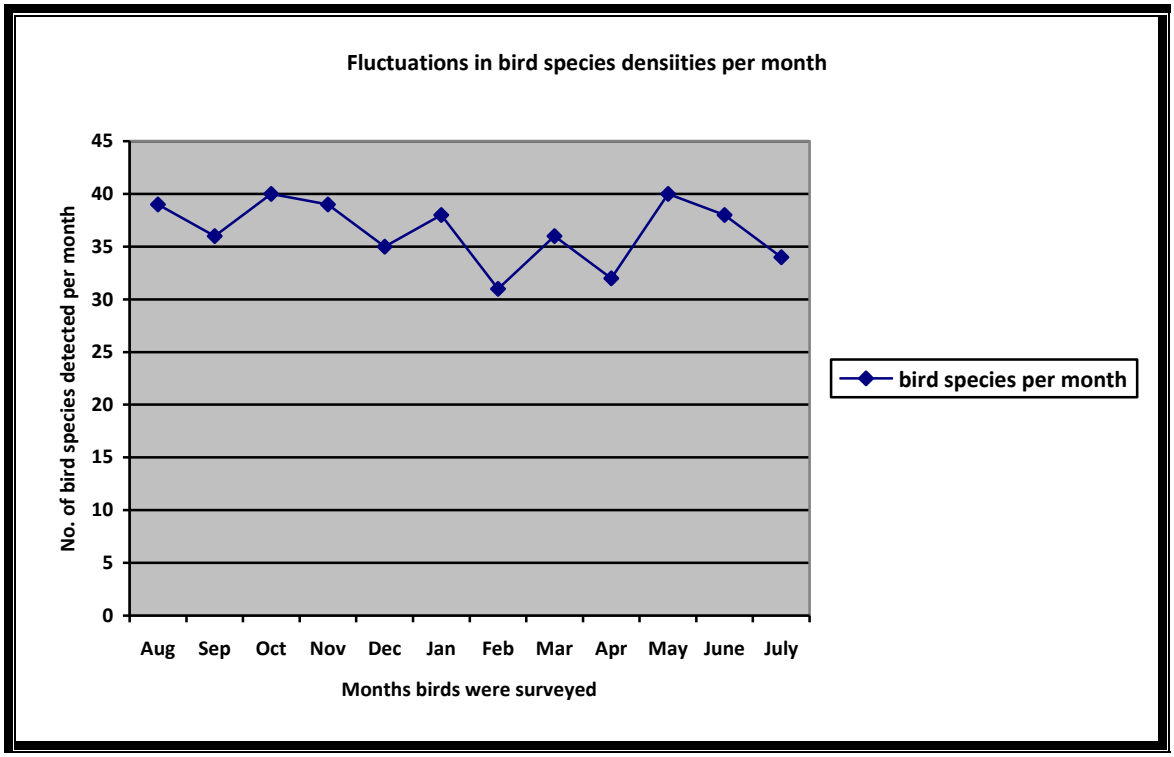
The introduced *Spotted Turtle-Dove appears to be relatively common and a breeding resident throughout the reserves, surrounding residential homes and greater area. They are extremely competitive towards the rarer Common Bronzewing for territory and food. The *Common Blackbird is common throughout the reserves and is a prolific breeder and spreader of noxious and environmental weed seed. Both the *Common Starling and *Common Myna are common species of the greater area, depriving native birds and mammals of nesting tree hollows. They will also utilize nearby human habitation to roost and the reserves' tree hollows to breed within.

5.1.4.1 Comparisons of bird species diversity per month

Results shown in the graph below indicate that bird species diversity within the reserves was the lowest in February at 31 species, and in April 32 species. Bird species diversity peaked at 40 species during October and May. This can be attributed to spring breeding periods when bird species increase and during autumn when roaming bird species of the greater area enter the reserves to feed.

The graphs below display the fluctuations in bird species diversity within the reserves month by month across the survey period.

Graph 1: Fluctuations in bird species diversity within the reserves and over the 12 month period of this assessment.



5.1.5 Mammals

The mammal species diversity within the reserves is at a medium level, with the populations of many of those species declining. However most micro-bat species still appear to be at reasonable population levels. Several species were found to be absent including: Agile Antechinus, Dusky Antechinus, Southern Brown Bandicoot, Feathertail Glider, Eastern Pygmy Possum, Common Wombat, Eastern Grey Kangaroo, Eastern Water Rat and New Holland Mouse. Some of these species still occur in bushland areas within the greater area especially nearby at The Briars. However others have become extinct within Mornington Peninsula or population densities are at alarmingly low numbers. The mammals recorded during this survey are discussed below.

Marsupials

The occasional Short-beaked Echidna was observed searching for food, and diggings were commonly encountered. Nocturnal possums include the Common Brushtail Possum and Common Ringtail Possum, which were observed during spotlight walks through the reserves feeding in the canopy or heard calling when disturbed. Juvenile possums were seen in summer and autumn. The ringtail possum population is larger than that of the brushtail possum. However the populations of both species appear to be declining when comparing previous surveys. Recent dramatic population crashes have been experienced during

prolonged heat waves. Both species occupy tree hollows within the reserves. However ringtails will also build dreys which are occasionally found through-out.

During spotlight walks medium-sized colonies of Sugar Gliders were found through-out the reserves' woodlands, especially where old-growth hollows and wattle species are present. They are hollow-dependent and old-growth trees with appropriate hollows are essential for their survival. The deployment of additional nesting boxes will help to increase the over-all population.

One Koala was observed in late October near the soccer oval. The populations within the area appear to be at low numbers. Additional feed trees (Manna Gum & Swamp Gum) need to be planted to sustain future Koala populations.

Black Wallaby populations are at very low levels with only two individuals observed during the project time frame.

Placental Mammals

Four nights of recording micro-bat echolocation calls formed part of this study. Micro-bats were seen on warm nights flying past the light beam of a torch while catching and eating insects in flight. The species identified include White-striped Freetail Bat, Gould's Wattled Bat, Lesser Long-eared Bat, Large Forest Bat and Little Forest Bat. Future micro-bat recordings could result in further species identification, as some species are common one month and then absent the next. All species of micro-bats that occur within the reserves are hollow dependent, nocturnal, and eat three times their body weight in insects each night. This makes them very important around urban and agricultural areas. During the colder months of the year they shut down and hibernate within tree hollows or under bark, venturing out only as climatic conditions become warmer. Microbat roosting boxes have been deployed within the reserves and are helping to sustain the over-all population densities.

Swamp Rat populations appear to be high in the reserves occurring where there are dense grassy & sedgy understories. They occupy sites that do not become inundated with water and have a dense understorey of sedges and other graminoids. Underneath this vegetation they excavate runways and build nest chambers at the end of burrows up to one metre long. These are apparent throughout their distribution within this area. They feed on a variety of rhizomes, seeds and other various vegetation matters from the local graminoids.

5.2 Introduced mammals

Introduced rodents

The occasional *House Mouse was found under fallen timber within the reserves. Populations appear to peak during late summer and autumn. They probably provide a large food source for predatory fauna and probably impact on some species in various ways, usually by spreading parasites and disease to small mammals and displacing other fauna.

*Black Rats appear to be relatively common through-out most habitats and were regularly filmed on motion-sensor cameras. *Black Rats impact on fauna in various ways: they spread parasites and disease to small mammals, displaces hollow-dependant and hollow-breeding fauna, and probably takes a large proportion of food items that are essential for the survival of threatened mammal species.

Control is usually difficult but further investigation into the feasibility of *Black Rat control is warranted. The most appropriate method is to use baited cage traps.

*European Rabbit

Occasional individuals still occur around the soccer oval but no other evidence was observed in other parts of the reserves. Eradication of this small population is highly recommended.

*Feral Cat

*Feral and domestic cats were occasionally observed during field work and the concentration of cats within the reserves and surrounding areas is contributing to the loss of terrestrial fauna and small bird species. During this assessment the author noted low population densities of some lizard species which can be attributed to high predation from cats. Cats could have also contributed to the recent loss of fauna species such as the Tree Dragon within the reserves. Refer to section 6 for management recommendations for control of cat populations.

*Red Fox

The occasional *Red Fox was observed or heard squabbling in the reserves during day and night field work. Other forms of evidence included foot prints and scats. This large and efficient predator can cause large scale destruction of various fauna species, with a major effect on their population densities, to bring about local extinctions of threatened fauna species. Within the greater area foxes have probably caused the local extinction of several mammal species including the nationally endangered Southern Brown Bandicoot. On-going and integrated *Red Fox control programs need to continue. This will help to maintain

important terrestrial fauna species and their population densities. Refer to section 6 for management recommendations for control of foxes.

5.3 Habitat-changing weeds

Habitat-changing weeds are a serious problem for habitat-specific fauna species as they quickly invade and kill off vital habitats, changing their structure and eroding ecosystem functionality, diversity and health.

Over the last decade or so many of the habitat-changing weeds have been removed from the reserves with the occasion outbreak occurring. The largest concern is the invasion of Coast Tea tree into sites that retain sandy soils, where the majority of other vegetation has died leaving something like a mono-culture. Future weed invasions that could be of concern if management isn't continued would come from the following species: *Sweet Pittosporum, *Boneseed, *Sallow Wattle, *Coast Tea Tree, *Smilax, *Blue-bell Creeper, *English Blackberry, several weedy grasses and a host of surrounding garden plants.

5.4 Habitats

A high diversity of EVC's occurs within the reserves, which appear to retain a reasonable biodiversity rating. The woodlands within the reserve retain some old-growth trees with important breeding and roosting hollows. However many of the eucalypt species have died or are senescing which will cause a decline of essential breeding hollows over the next decades. The swamp scrub communities form important habitats, especially for some threatened species, and are a feeding ground for many small bird species.

Other habitats within the reserves include the estuary and creek which provide habitats for aquatic fauna species and a host of wetland bird species. Patches of Austral Bracken support feeding and breeding habitats for small semi-terrestrial bird species such as populations of Superb Fairy-wren and White-browed Scrubwren.

Several terrestrial habitat logs have been retained, which provide homes and food source for many terrestrial species.

Over the decades there has been a recorded decrease in sea grasses growing within the estuary. This has led to a loss of sea grass eating bird species such as Black Swan and some duck species. Sea grass decline has been associated with sedimentation from unmade roads & road gutters that is also causing filling in of the estuary: with high nutrients entering the system from the hinterland, and with prolonged droughts. This year when the estuary

mouth opened in early June 2019 it revealed that green algae were thriving and very little sea grass (see photo below).

The estuary mouth opened up in early June 2019 revealing green algae beds.

Important habitats which are situated adjacent to the reserves, or within the surrounding area and are of importance for faunal movement & recruitment include: The Briars, Devilbend Reservoir, Mount Martha Park, Sunshine Reserve, foreshore reserves, smaller Council reserves, and on some private properties.

5.5 Bio-link and significance rating of the reserves

The reserves are an important refuge for remaining native fauna within the area and are acting as a partial biolink within the Mornington Peninsula area. MPS and Landcare have established a major biolink from Devilbend Reservoir through to the coast which includes the reserve and The Briars. This will allow future movement and recruitment along the biolink.

The reserves also have partial connections to the adjoining foreshore reserves which extend around Port Phillip Bay. The reaches of Balcombe Creek are well vegetated and are a major biolink from the head waters in the northern peninsula to the mouth at Port Phillip Bay.

These biolinks help to provide stop overs, recruitment and corridors of movement for a host of fauna species that remain within the greater area (especially woodland bird and mammal

species). Private property owners within proposed biolink routes could be encouraged to fence off and plant indigenous plants to help complement the biolinks.

The high bio-diversity site rating of the area, along with threatened fauna species occurring at a National, State & Regional levels and the EVCs which are listed as endangered & vulnerable within the Gippsland Plains Bio region rates the reserves and surrounding indigenous vegetation as a State significant site.

5.6 Key biodiversity issues

5.6.1 Relative importance of key habitats

The reserves and surrounding bushland sites are part of the 18% of remaining bushland found within the Mornington Peninsula Shire. Such sites help to connect surrounding bushland with remnant vegetation along roadsides, creeks, vegetation on adjacent private properties and on public reserves. These are some of the last remaining largish patches of remnant indigenous vegetation within the greater area. Such sites are extremely important for the large diversity of fauna species that remain in the greater area and provide some of the last remaining habitat as so much of the peninsula has been cleared in the past (around 82%).

The important faunal habitats must be allowed to flourish and increase not only within the environs of the reserves but in the surrounding landscape as it provides important habitat for threatened and common fauna species. This requires on-going weeding of any serious habitat-changing weed outbreaks that occur or might enter the reserves.

5.6.2 Planting gum trees through-out the reserve

Due to a range of factors within the greater area, the majority of the indigenous gum trees within the reserves have died or are in the process of dying. Habitat-specific bird species such as the White-eared Honeyeater, Brown-headed Honeyeater and White-naped Honeyeater that utilize gum trees as a feeding or breeding source are present around the soccer oval but not within other areas of the reserves. This is because Swamp Gums are present around the oval but are rare in other areas of the reserves, and this section is also adjacent to The Briars, which connects as a biolink and allows many species to move to this section of the reserves.

Koalas are becoming scarce within the greater area which can be attributed to the loss of essential Manna Gums and Swamp Gums through-out the reserves. The decline in arboreal mammals can also be attributed to this loss of gum trees.

The ideal scenario would be over the next couple of years to plant over a 1,000 Manna Gums and a 1,000 Swamp Gums through-out the reserves in improve future essential and critical gum tree habitats.

5.7 FEIS assessments

During this study the Broad Vegetation Types (BVT) woodlands, scrub, wetlands & swamps, riparian zones and creeks were assessed within the reserves using the FEIS rapid assessment tool. This is an assessment of habitat-specific fauna species that quickly disappear when their habitat changes at a rapid rate. The assessments within the reserves indicated that 44.6% of FEISs were present within woodlands, 46.8% of FEISs were present within scrub, 50% of FEISs were present within wetlands & swamps, 50.9% of FEISs were present within riparian zones and 66.7% of FEISs were present within creeks. This indicates phase 3 extinction rates of FEISs found to occur in all Broad Vegetation Types assessed within the reserves apart from creeks, which was a stage 2 extinction rate.

Assessments indicted that old-growth trees with tree hollows were rare and terrestrial logs with small hollows are present within the reserves. On-going and integrated pest animal control programs need to continue within the reserve. The construction and deployment of fauna nesting boxes has occurred in the past. However additional nesting boxes need to be erected for the following species: Australian Wood Duck, rosellas, owls, kookaburras and Sugar Gliders (refer to section 5.11 of this report).

5.8 Future survey work

Future fauna surveys every ten years are warranted to determine:

- the fluctuations within fauna populations and species diversity,
- if species have disappeared from the reserves or if new species have arrived, and
- whether the recommendations in this report have contributed to an increase or decrease in fauna diversity and population densities.

Yearly on-going monitoring of threatened fauna species & feral predators needs to commence at the end of this survey period in order to determine future population fluctuations and possible extinctions which have & could occur within the reserves & surrounding areas.

5.9 Climate change

Predicted global warming could see future rising temperatures and prolonged periods of drought, and the reserves could lose several species of flora & fauna. Large losses of flora & fauna populations, especially those that are exposed directly to the elements, could also occur. This occurred during the 2008/2009 summer, the 2013-14 summer and the 2018-19 summer where large-scale loss of possum populations occurred within the bio-region. Future rising temperatures will also cause severe drought along with large intense fires which were experienced during the recent drought. The EVCs within the reserves could change from woodlands to grasslands. These factors will also result in the large-scale loss of fauna species and population densities.

5.10 Monitoring threatened fauna and their population densities within the reserves

A threatened fauna monitoring program within the reserves needs to be developed to measure increases or decreases in population densities. Monitoring of threatened species is important as these are the species that quickly disappear when adverse elements are causing a decline in the health of a natural ecosystem such as: severe habitat-changing weed invasion, high feral predation, and intense urban development of surrounding landscapes, where only small unconnected patches of remnant bushland remains. The monitoring program should involve the following species displayed within the table below:

TABLE 13- Threatened fauna species to be monitored within the reserves' Broad Vegetation Type's

Species	Woodlands	Scrub (wet)	Wetlands & Swamps	Riparian Zones	Creeks	Season to survey for
Spotted Galaxias				**Yes**	**Yes**	All year.
Dwarf Galaxias				**Yes**	**Yes**	All year.
Southern Pygmy Perch				**Yes**	**Yes**	All year.
Southern Toadlet		**Yes**				Autumn
Common Long-necked Tortoise			**Yes**	**Yes**	**Yes**	Spring/summer
Southern Water Skink	**Yes**	**Yes**		**Yes**		Spring/summer
Delicate Skink	**Yes**			**Yes**		Spring
Metallic Skink	**Yes**	**Yes**		**Yes**		Summer/autumn
Glossy Grass Skink		**Yes**		**Yes**		Spring/summer
Weasel Skink	**Yes**			**Yes**		Spring/summer
Blotched Blue-tongue	**Yes**	**Yes**		**Yes**		Spring/summer
White-lipped Snake	**Yes**			**Yes**		Spring/summer
Darter			**Yes**	**Yes**	**Yes**	All year.
Pied Cormorant			**Yes**	**Yes**	**Yes**	All year.
Lewin's Rail		**Yes**	**Yes**	**Yes**	**Yes**	All year.

Species	Woodlands	Scrub (wet)	Wetlands & Swamps	Riparian Zones	Creeks	Season to survey for
Nankeen Night Heron		Yes	Yes	Yes	Yes	All year.
Great Egret			Yes	Yes	Yes	All year.
Royal Spoonbill			Yes	Yes	Yes	All year.
Pacific Gull			Yes			All year.
Wedge-tailed Eagle	Yes			Yes		All year.
Musk Lorikeet	Yes	Yes				Summer/autumn
Australian King Parrot	Yes			Yes		All year
White-throated Needletail	Yes					Summer/autumn
Striated Thornbill	Yes	Yes		Yes		All year.
Brown-headed Honeyeater	Yes			Yes		All year.
White-napped Honeyeater	Yes			Yes		All year.
Rufous Whistler		Yes		Yes		Spring/summer
Sugar Glider	Yes			Yes		Spring to autumn
Koala	Yes			Yes		All year.
Black Wallaby	Yes	Yes		Yes		All year.
Micro bats occurring through-out.	Yes			Yes		Summer/autumn
Swamp Rat	Yes	Yes		Yes		All year

5.11 Installation and monitoring of fauna nesting boxes

Previously fauna nesting boxes have been erected within the reserves, of which majority are for microbats. Additional boxes need to be deployed for the following habitat-specific fauna species: Australian Wood Duck, Yellow-tailed Black-Cockatoo, Eastern Rosella, Southern Boobook Owl, Laughing Kookaburra and Sugar Glider. This will help to compensate for the lack of tree hollows in most areas. Deploying nesting boxes for fauna allows additional breeding & roosting sites and an easy way to monitor population densities of such species. Motion-sensor cameras can be mounted a metre away from the nesting boxes to establish when individuals take up residency and to measure population densities per box.

5.12 Comparing fauna surveys

During the 1999 fauna survey 119 species of fauna (110 species indigenous and nine species introduced) were identified within the reserves. During the 2008 assessment 122 species of fauna (112 species indigenous and ten species introduced) were identified. During this assessment 118 species of fauna (108 indigenous and ten introduced) were identified. This indicates a 3.3% decrease in identified fauna species during this survey compared to the 2008 survey and a 0.8% decrease in identified fauna species during this survey and the 1999 survey. Refer to Appendix 2 for new fauna species to the reserves and species that have disappeared between this assessment and the previous two assessments. It is important to note that several extinctions have occurred in the reserves since the

1990's. These include important habitat-specific species such as: Small-mouthed Hardyhead, Tommy Rough, Growling Grass Frog, Tree Dragon, Common Scaly-foot Legless Lizard, Tiger Snake, Eastern Small-eyed Snake, Australian Pelican, Black Swan, some duck species, Little Egret, Yellow-billed Spoonbill, Latham's Snipe, Painted Button-quail, Sharp-tailed Sandpiper, Black-fronted Dotterel, Black-shouldered Kite, Australian Hobby, Common Bronzewing, Swift Parrot, Southern Boobook, Sacred Kingfisher, Varied Sitella, White-throated Treecreeper, Striated Pardalote, Yellow-rumped Thornbill, Bell Miner, White-eared Honeyeater, Yellow-tufted Honeyeater, Crescent Honeyeater, Rose Robin, Pink Robin, Flame Robin, Scarlet Robin, Crested Shrike-tit, Rufous Fantail, Willie Wagtail, Satin Flycatcher, Dusky Woodswallow, Tree Martin, Fairy Martin, Clamorous Reed Warbler, Little Grassbird, Golden-headed Cisticola, Grey Currawong, Red-browed Finch, Mistletoebird, Bassian Thrush, Agile Antechinus, Feathertail Glider and Eastern Water Rat. Many of the fauna species identified above have slipped into a regional significance rating as populations have crashed through-out the Gippsland Plain Bioregion over the last two or so decades (M. Legg fld. obs.).

6.0 RECOMMENDATIONS

These recommendations are intended to help the reserves' managers to manage the flora and fauna appropriately and in accordance with flora and fauna requirements.

Priority recommendations to help protect and maintain the reserve's diverse habitats and fauna species:

1. Habitat protection: Maintain and increase crucial indigenous habitats through-out the reserves and continue to remove habitat-changing weeds through-out.
2. Eucalypt habitat: Plant out 1,000 Manna Gums and 1,000 Swamp Gums to establish essential Eucalypt habitats.
3. Nesting boxes: Install nesting boxes for listed key species using the design drawings included within this report and following the recommended locations/density of installation. Deploy additional habitat logs through-out.
4. Pest animal control: Implement pest animal control programs with specific frequencies to control foxes, cats rabbits and rodents.
5. Environmental monitoring: Develop and implement a longitudinal environmental monitoring program, informed by the results of this study, -that captures changes to species diversity and abundance in response to variable seasonal conditions, particularly for endangered and threatened species.

Action is required on a number of fronts to achieve these five priority recommendations:

- Fauna surveys: Continue to conduct fauna surveys every ten years and on a yearly basis monitor population density fluctuations in threatened fauna, FEIS's and feral fauna.

- Pest control: Continue to carry out integrated, on-going pest animal control programs through-out the reserves and surrounding catchment, targeting:
  - *Common Myna,
  - *Common Blackbird,
  - *Common Starling,
  - *Red Fox,
  - *Feral Cat,
  - *European Rabbit and
  - *Black Rat.
- In particular *Red Fox, *Feral Cat and *Black Rat must be controlled within the reserves and surrounding landscape.

  - Red Foxes: Deploy leg-hold traps during four control pulses annually. Control pulses to be conducted during each season. Fox dens to be located in late winter to early spring and fumigated.
  - *Feral Cats: Target every four months during three control pulses per annum, using cage traps baited with KFC or sardines.
  - *Black Rats: Target twice per year, in autumn and spring, using baited cage traps.

- Legislative recommendations: Recommendations for fauna species contained in Action Plans and Recovery Plans under the EPBC Act 1999 and the FFG Act 1988 should be implemented within the reserves and surrounding bushland, including the surrounding catchment on both public and private land.
- Significant fauna management: To maintain the significant fauna within the reserves the managers must adopt the significant fauna management requirements set out in Appendix 4 of this report.
- Maintaining and increasing habitat: To maintain and increase crucial indigenous habitats.
  - Continue to conduct weeding in sections and span the process over a staged period.
  - Start from the good areas and work outwards and control invading weeds on the edges.
  - Only remove woody weeds during the non-bird breeding season.
  - Leave if Eastern Yellow Robins or other birds are nesting.
  - Allow natural regeneration to occur.
  - If ringtail possum dreys or bird nests occur in weeds then ring-bark with-out poisoning and follow-up after a year.
- Nesting boxes: Continue to deploy and monitor a fauna nesting box program.
- Logs & hollows: Continue to retain and deploy additional terrestrial habitat logs with hollows through-out different habitats.

7.0 RELEVANT POLICY AND LEGISLATION

The following section explores relevant policy and legislation pertaining to biodiversity from the National level through to the Regional level. It provides a short overview of the policies in context of the findings of this study.

7.1 National

7.1.1 Environment Protection & Biodiversity Conservation Act 1999

The EPBC Act is the principle piece of federal legislation that aims to guide a variety of planning processes or other actions with regard to any matters listed under the Act. Under the Act species and communities can be listed as threatened. Fauna can also be listed as migratory. One fauna species (Dwarf Galaxias) identified within the reserve is listed under the EPBC Act as threatened or endangered.

7.2 International

7.2.1 International migratory bird agreements

Several bird species recorded within the Mornington Peninsula are listed as 'migratory' under several bird agreements. These include:

- CAMBA (China-Australia Migratory Bird Agreement 1986)
- JAMBA (Japan-Australia Migratory Bird Agreement 1974)
- ROKAMBA (Republic of Korea-Australia Migratory Bird Agreement 2006)

The Convention on Migratory Species or Bonn Convention, includes birds listed under the agreement on the Conservation of Albatrosses and Petrels (ACAP) 2006.

Internationally migratory birds are also listed as 'migratory' under the Federal Government's EPBC Act 1999. Internationally migratory species detected during this survey include: White-throated Needletail. The locations of internationally migratory bird White-throated Needletail is located on map 3.

7.3 State

7.3.1 Victoria's Native Vegetation Management Framework

The objective of the Native Vegetation Management Framework is the retention and management of native vegetation (DNRE 2002:13). According to the DSE (2002:14) the goal of native vegetation management in Victoria is to achieve:

A reversal, across the entire landscape, of the long-term decline in the extent and quality of native vegetation, leading to a Net Gain.

Four individual actions to achieve the above goal are outlined in the DNRE's (2002:14) Framework. These are:

- active improvement of the quality of existing vegetation;
- avoidance or minimization of further permanent losses through clearing;
- strategic increase in the cover of native vegetation through revegetation; and
- the flexibility that is required to support landholders as they move towards more sustainable land use.

7.3.2 Flora and Fauna Guarantee Act 1988 Guarantee Act

The Flora and Fauna Guarantee Act 1988 (FFG Act) was legislated to ensure the continued survival of all Victorian species of flora and fauna and all Victorian communities of plants and animals.

Protected Flora

Protected Flora species include all species listed as threatened, all species that belong to communities listed as threatened and plants requiring protection for other reasons.

Potentially Threatening Processes

Schedule three of the FFG Act lists numerous Potentially Threatening Processes. These processes have been identified as a threat to the survival of one or more species of flora or fauna or a community. A number of threatening processes operate across Victoria and across all land tenures while some are specific to a defined locality.

A number of the Potentially Threatening Processes are, or could be, operating within the reserve. These include:

- collection of native orchids,
- habitat fragmentation as a threatening process in Victoria
- loss of hollow-bearing trees
- predation of native wildlife by the cat Felis catus
- predation of native wildlife by the introduced Red Fox Vulpes vulpes
- reduction in biomass and biodiversity of native vegetation through grazing by the *European Rabbit Oryctolagus cuniculus
- spread of Pittosporum undulatum in areas outside its natural range
- the invasion of native vegetation by environmental weeds.
- inappropriate fire regimes causing disruption to sustainable ecosystem processes and resultant loss of biodiversity,
- the introduction and spread of the Large Earth Bumblebee *Bombus terrestris* into Victorian terrestrial environments,
- use of Phytophthora-infected gravel in construction of roads, bridges and reservoirs.

Three fauna species identified (Dwarf Galaxias, Lewin's Rail and Great Egret) during this assessment are listed under the FFG Act 1988 as threatened.

7.3.3 Catchment and Land Protection Act

The study site supports some weeds that are declared noxious under the Catchment and Land Protection Act 1994 (CLP Act). Plants occurring on this list are known to or have the potential to result in detrimental environmental or economic impact.

Under the CLP Act declared noxious weeds are categorized into four groups depending on their known and potential impact and specific circumstances for each region. These categories are:

- State Prohibited Weeds (S);
- Regionally Prohibited Weeds (P);
- Regionally Controlled Weeds I; and
- Restricted Weeds

State Prohibited Weeds are either currently absent in Victoria or are restricted enough to be eradicated. The Victorian Government is responsible for their control.

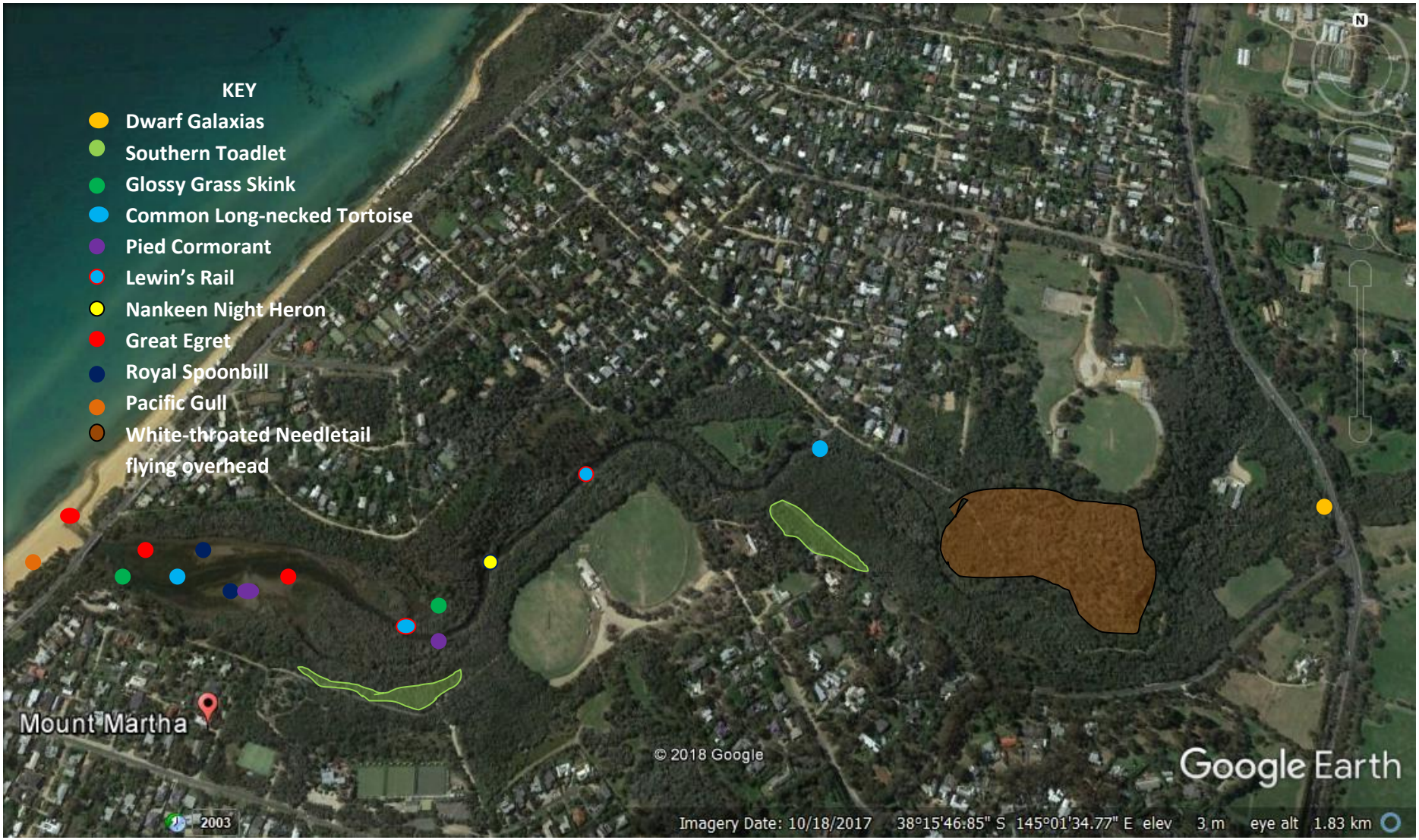
Regionally Prohibited Weeds in the Mornington Peninsula Catchment area are not necessarily widespread but have the potential to become widespread. It is expected that weeds that meet this criterion can be eradicated from the region. Regionally controlled weeds are usually widespread but it's important to prevent further spread.

Restricted Weeds occur in other states and are considered to be a serious threat to primary production, crown land, the environment and or community health if they were traded in Victoria. No weeds are currently listed as Restricted Weeds.

7.3.4 Species listed on DSE's Advisory List of Threatened Vertebrate Fauna in Victoria, 2013.

Within the reserves there are eleven fauna species listed on the Advisory List of Threatened Vertebrate Fauna in Victoria – 2013 (DSE 2013). See map 3 on following page, for coverage within the reserve of the following recorded fauna species Dwarf Galaxias, Southern Toadlet, Common Long-necked Tortoise, Glossy Grass Skink, Pied Cormorant, Lewin's Rail, Nankeen Night Heron, Great Egret, Royal Spoonbill, Pacific Gull, White-throated Needletail

Map 3: Locations of National & State significant fauna species



7.4 Regional

7.4.1 The Frankston, Mornington Peninsula and Western Port Biosphere Reserve Charter

The conservation functions of the charter include;

- The conservation of ecosystems and species
- The enhancement of ecosystems and biological values
- At the core of the Biosphere charter is the principle of nature conservation.

7.4.2 Regionally-significant species

Regional significance is often difficult to determine, however, an attempt at defining regionally significant species has been made. Within the Gippsland Plain Bio-region 115 fauna species are considered to be regionally significant according to three sets of criteria. Within the reserve 16 species of regional significance were recorded.

7.4.3 Port Phillip and Western Port Regional Catchment Strategy

The Port Phillip and Western Port Regional Catchment Strategy (Port Phillip and Western Port CMA 2004) is a broad policy document providing strategic direction in land, water and biodiversity management with the aim of increasing the protection of bays and waterways. The reserves fall within the region covered by this plan.

The reserves and surrounding remnant vegetation represent a unique 'catchment asset' within the region by providing substantial habitat and bio-links for flora & fauna of regional, & state significance.

7.4.4 Port Phillip and Western Port Vegetation Management Plan

The Port Phillip and Western Port Native Vegetation Plan (Port Phillip and Western Port CMA 2006) establishes a strategic and coordinated approach to native vegetation within the CMA area. Its primary function is to provide guidance and context for native vegetation management in the region.

8.0 REFERENCES

Brunner, H. (2000). *Fauna Survey of Paratea Reserve Frankston.*

Cogger, H.G. (2000). *Reptiles and Amphibians of Australia* (Sixth Edition). New Holland Publishers Pty Ltd, Sydney, N.S.W.

DSE 2013. *Advisory List of Threatened Vertebrate Fauna in Victoria-2013.* Department of Sustainability and Environment, Victoria.

Fairbridge, D, SMEC (June 2011). *Flora and Fauna Assessments of Natural Reserves in Frankston.*

Hero. J., Littlejohn, M., & Marantelli, M. (1991). *Frogwatch Field Guide to Victorian Frogs.* Dept. Of Conservation and Environment, Melbourne.

Jenkins, R. And Bartell, R. (1980). *A Field Guide to Reptiles of the Australian High Country*. Inkata Press Pty Ltd, Melbourne.

Legg. M. (April 1999) *Fauna Survey and Management Prescriptions for Balcombe Estuary, Mt Martha*. Mals Ecological & Environmental Services PTY LTD.

Legg. M. (August 2008) *Fauna Survey and Management Recommendations for Balcombe Creek Estuary, Mt Martha From Nepean Highway to Port Phillip Bay August 2007 to August 2008*. Mals Ecological & Environmental Services PTY LTD.

Menkhorst, W. (1996). *Mammals of Victoria*. Oxford University Press. Victoria, 1996.

Port Phillip and Westernport Catchment and Land Protection Board. *Draft Port Phillip and Westernport Native vegetation Plan.* August, 2000.

Simpson, K. And Day, N. (1999). *Field Guide to the Birds of Australia…* (Sixth Edition). Penguin Books Australia.

Strahan, R. (1998). *The Mammals of Australia* (Revised Edition). New Holland Publishers Pty Ltd, Sydney.

Yugovic, J. Oct. 2002. Mornington Peninsula Ecological Vegetation Class Profiles. Biosis Research.

Appendix 1- Fauna species detected during this survey within Balcombe Estuary Reserves, Mt Martha.

Fauna taxa detected throughout study site during the survey by Malcolm Legg of Mal's Ecological & Environment Services PTY. LTD. All fauna was detected throughout the study site between August 2018 and July 2019.

Codes for status within the reserve and Victoria:

*	introduced species
VU	Vulnerable in Victoria (DSE 2013)
EN	Endangered in Victoria (DSE 2013) or Australia (EPBC Act 1999)
NT	Near threatened in Victoria (DSE 2013)
L	listed as threatened under FFG Act 1988
I	Invalid or ineligible under FFG Act 1988

KEY-Significance/status of species:

N	National
S	State
R	Regional
HL	High Local
L	Local
*	Introduced

Type of record:

h	Heard
s	Seen
I	Incidental (scats, feathers etc.)
t	Trapped/handheld
a	recorded on Anabat 2 Bat Detector
v	Filmed on Scout-guard Camera
B	Breeding residential bird

TABLE 14. Fish results

Scientific Name	Common Name	Conservation status within the reserves.	Type of record
Anguilla australis	Short-fined Eel	Common	Lts
Galaxias maculatus	Common Galaxias	Common	Lts
Galaxias truttaceus	Spotted Galaxias	Uncommon	Rt
Galaxiella pusilla	Dwarf Galaxias	Rare	Nt
Nannoperca australis	Southern Pygmy perch	Rare	Rt
Philypnodon grandiceps	Flat-headed Gudgeon	Uncommon	Lt
Aldrichetta forsteri	Yellow-eyed Mullet	Common	Lts
Pseudogobius olorum	Blue-spot Goby	Rare	Lt
Acanthopagrus butcheri	Black Bream	Common	Lts
Arenigobius bifrenatus	Bridled Goby	Rare	Lt
Rhombosolea tapirina	Greenback	Uncommon	Lt
Tetractenos glaber	Smooth Toadfish	Common	Lts
Favonigobius lateralis	Long-finned Goby	Uncommon	Lt
**Gambusia affinis*	*Mosquitofish	Rare	t

TABLE 15. Amphibian results

Scientific Name	Common Name	Conservation status within the reserves.	Type of record
Crinia signifera	Common Froglet	Common	Lhs
Pseudophryne semimarmorata	Southern Toadlet	Uncommon	Shs
Limnodynastes dumerilii	Southern Bullfrog	Uncommon	Lhs
Limnodynastes tasmaniensis	Spotted Marsh Frog	Uncommon	Lhs
Litoria ewingii	Southern Brown Tree Frog	Common	Lhs
Litoria verreauxii	Verreaux's Tree Frog	Uncommon	Lhs

TABLE 16. Reptile results

Scientific Name	Common Name	Conservation status within the reserves.	Type of record
TORTOISES			
Chelodinia longicollis	Common Long-necked Tortoise	Rare	Ss
LIZARDS			
Acritoscincus duperreyi	Eastern Three-lined Skink	Uncommon	Lst
Eulamprus tympanum	Southern Water Skink	Rare	Rt
Lampropholis delicata	Delicate Skink	Rare	Rt
Lampropholis guichenoti	Garden Skink	Uncommon	Lst
Carinascincus metallicus	Metallic Skink	Uncommon	Rt
Pseudemoia rawlinsoni	Glossy Grass Skink	Uncommon	St
Saproscincus mustelinus	Weasel Skink	Common	Rst
Tiliqua nigrolutea	Blotched Blue-tongue	Uncommon	Rst
Austrelaps superbus	Lowland Copperhead	Uncommon	Ls
Drysdalia coronoides	White-lipped Snake	Uncommon	Rst

TABLE 17. Wetland bird results

Scientific Name	Common Name	Conservation status within the reserves.	Type of record
Anhinga melanogaster	Darter	Rare	Rhs
Phalacrocorax varius	Pied Cormorant	Rare	Shs
Phalacrocorax melanoleucos	Little Pied Cormorant	Common at times	Lhs
Phalacrocorax carbo	Great Cormorant	Rare	Lhs
Phalacrocorax sulcirostris	Little Black Cormorant	Common at times	Lhs
Poliocephalus poliocephalus	Hoary-headed Grebe	Rare	Lhs
Anas superciliosa	Pacific Black Duck	Uncommon	Lhs
Anas castanea	Chestnut Teal	Common at times	Lhs
Chenonetta jubata	Australian Wood Duck	Uncommon	Lhs
Rallus pectoralis	Lewin's Rail	Rare	Shs
Gallinuta tenebrosa	Dusky Moorhen	Common	Lhs
Porphyrio porphyrio	Purple Swamphen	Uncommon	Lhs
Fulica atra	Eurasian Coot	Uncommon	Lhs
Nycticorax caledonicus	Nankeen Night Heron	Rare	Shs
Egretta novaehollandiae	White-faced Heron	Rare	Lhs
Ardea alba	Great Egret	Rare	Shs
Threskiornis molucca	Australian White Ibis	Uncommon	Lhs
Threskiornis spinicollis	Straw-necked Ibis	Uncommon	Lhs
Platalea regia	Royal Spoonbill	Rare	Shs
Vanellus miles	Masked Lapwing	Rare	Lhs
Larus novaehollandiae	Silver Gull	Common to abundant	Lhs
Larus pacificus	Pacific Gull	Rare	Shs

TABLE 18. Woodland bird results

Scientific Name	Common name	Conservation status within the reserves.	Type of record
Aquila audax	Wedge-tailed Eagle	Rare	HLhs
Accipiter fasciatus	Brown Goshawk	Rare	Lhs
**Streptopelia chinensis*	Spotted Turtle-Dove	Common	hs
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	Uncommon	HLhs
Eolophus roseicapillus	Galah	Uncommon	Lhs
Cacatua sanguinea	Little Corella	Common	Lhs
Cacatua galerita	Sulphur-crested Cockatoo	Uncommon	Lhs
Trichoglossus haematodus	Rainbow Lorikeet	Common	Lhs
Glossopsitta concinna	Musk Lorikeet	Uncommon	HLhs
Alisterus scapularis	Australian King Parrot	Rare	HLhs
Platycercus elegans	Crimson Rosella	Uncommon	Lhs
Platycercus eximius	Eastern Rosella	Uncommon	Lhs
Cacomantis flabelliformis	Fantail Cuckoo	Uncommon	Lhs
Chalcites lucidus	Shining Bronze-Cuckoo	Uncommon	Lhs
Podargus strigoides	Tawny Frogmouth	Uncommon	Lhs
Hirundapus caudacutus	White-throated Needletail	Rare	Shs
Dacelo novaehollandiae	Laughing Kookaburra	Uncommon	Lhs
Malurus cyaneus	Superb Fairy-wren	Common	Lhs
Pardalotus punctatus	Spotted Pardalote	Common	Lhs
Sericornis frontalis	White-browed Scrubwren	Common	Lhs
Acanthiza pusilla	Brown Thornbill	Common	Lhs
Acanthiza lineata	Striated Thornbill	Rare	Rhs
Anthochaera carunculata	Red Wattlebird	Common	Lhs
Anthochaera chrysoptera	Little Wattlebird	Common	Lhs
Manorina melanocephala	Noisy Miner	Common	Lhs
Lichenostomus chrysops	Yellow-faced Honeyeater	Uncommon	Lhs
Lichenostomus penicillatus	White-plumed Honeyeater	Rare	Lhs
Melithreptus brevirostris	Brown-headed Honeyeater	Rare	Rhs
Melithreptus lunatus	White-napped Honeyeater	Rare	HLhs
Phylidonyris novaehollandiae	New Holland Honeyeater	Common	Lhs
Acanthorhynchus tenuirostris	Eastern Spinebill	Uncommon	Lhs
Eopsaltria australis	Eastern Yellow Robin	Uncommon	Rhs
Colluricincla harmonica	Grey Shrike Thrush	Uncommon	Lhs
Pachycephala pectoralis	Golden Whistler	Uncommon	Lhs
Pachycephala rufiventris	Rufous Whistler	Uncommon	HLhs
Rhipidura fuliginosa	Grey Fantail	Common	Lhs
Grallina cyanoleura	Magpie-lark	Uncommon	Lhs
Coracina novaehollandiae	Black-faced Cuckoo-shrike	Rare	Lhs
Cracticus torquatus	Grey Butcherbird	Uncommon	Lhs
Gymnorhina tibicen	Australian Magpie	Common	Lhs
Strepera graculina	Pied Currawong	Rare vagrant	Lhs
Corvus coronoides	Australian Raven	Common	Lhs
Corvus mellori	Little Raven	Uncommon	Lhs
Hirundo neoxena	Welcome Swallow	Common	Lhs
Zosterops lateralis	Silvereye	Common	Lhs
**Turdus merula*	Common Blackbird	Common	hs
**Sturnus vulgaris*	Common Starling	Common	hs
**Acridotheres tristis*	Common Myna	Common	hs

TABLE 19. Mammal results

Scientific Name	Common Name	Conservation status within the reserves.	Type of record
MARSUPIALS			
Tachyglossus aculeatus	Short-beaked Echidna	Rare	Lhs
Trichosurus vulpecula	Common Brushtail Possum	Uncommon	Lhs
Petaurus breviceps	Sugar Glider	Uncommon	Rhs
Pseudocheirus peregrinus	Common Ringtail Possum	Common	Lhs
Phascolarctos cinereus	Koala	Rare	Rhs
Wallabia bicolor	Black Wallaby	Rare	Rhs
PLACENTAL MAMMALS			
MICROBATS			
Tadarida australis	White-striped Freetail Bat	Uncommon	Ra
Chalinolobus gouldii	Gould's Wattled Bat	Common	Ra
Nyctophilus geoffreyi	Lesser Long-eared Bat	Rare	Ra
Vespadelus darlingtoni	Large Forest Bat	Uncommon	Ra
Vespadelus vulturnus	Little Forest Bat	Common	Ra
RODENTS			
Rattus lutreolus ssp. Lutreolus	Swamp Rat	Common	Rtlv
INTRODUCED MAMMALS			
**Rattus rattus*	Black Rat	Common	tv
**Mus musculus*	House Mouse	Uncommon	tv
* Oryctolagus cuniculus	European Rabbit	Rare	s
**Vulpes vulpes*	Red Fox	Common	s
**Felis catus*	Feral Cat	Common	s
** Denotes introduced species*			

Appendix 2 Previous and present fauna survey results for Balcombe Estuary Reserve.

TABLE 20: Fauna taxa detected throughout the reserves during this fauna assessment, 2008 fauna survey, 1999 fauna survey and DELWP's Atlas of Victorian Wildlife records. By Malcolm Legg of Mal's Eco. & Enviro. Services PTY LTD.

Scientific Name	Common Name	This survey 2019	August 2008 fauna survey	1999 fauna survey	DELWP's Atlas of Victorian Wildlife (AVW), July 2013 edition	Comments
Fish						
Anguilla australis	Short-finned Eel	C	C	Yes	Yes	Many observed at estuary mouth before it opened.
Galaxias brevipinnis	Broad-finned Galaxias			Yes	Yes	Found further up-stream near Nepean Highway bridge.
Galaxias truttaceus	Spotted Galaxias	Un	Un	Yes	Yes	Found further up-stream near Nepean Highway bridge.
Galaxias maculatus	Common Galaxias	C	C	Yes	Yes	Common fish found through-out.
Galaxiella pusilla	Dwarf Galaxias	R		Yes	Yes	Found further up-stream near Nepean Highway bridge.
Nannoperca australis	Southern Pygmy Perch	R	Un	Yes	Yes	Found further up-stream near Nepean Highway bridge.
Philypnodon grandiceps	Flat-headed Gudgeon	Un	Un	Yes	Yes	Estuarine fish.
Aldrichetta forsteri	Yellow-eyed Mullet	C	Un	Yes	Yes	Estuarine fish.
Atherinosoma microstoma	Small-mouthed Hardyhead			Yes	Yes	Last recorded in 1999.
Pseudogobius olorum	Blue-spot Goby	R	Un	Yes	Yes	Estuarine fish.
Arripis georgianus	Tommy Rough			Yes	Yes	Last recorded in 1999.
Acanthopagrus butcheri	Black Bream	C	Un	Yes	Yes	Estuarine fish found in large numbers during spring.
Arenigobius bifrenatus	Bridled Goby	R	Un	Yes	Yes	Estuarine fish.
Rhombosolea tapirina	Greenback	Un		Yes	Yes	Estuarine fish.
Tetractenos glaber	Smooth Toadfish	C	Un	Yes	Yes	Estuarine fish.
Favonigobius lateralis	Long-finned Goby	Un		Yes	Yes	Estuarine fish.

Scientific Name	Common Name	This survey	August 2008 fauna survey	1999 fauna survey	DELWP's Atlas of Victorian Wildlife (AVW), July 2013 edition	Comments
**Gambusia affinis*	*Mosquitofish	R	Un	Yes	Yes	Found further up-stream near Nepean Highway bridge.
Amphibians						
Crinia signifera	Common Froglet	C	C	Yes	Yes	Common through-out.
Pseudophryne semimarmorata	Southern Toadlet	Un	C	Yes	Yes	Found in areas that become inundated during winter rains.
Limnodynastes dumerilii insularis	Southern Bullfrog	Un	Un	Yes	Yes	Found through-out.
Limnodynastes tasmaniensis	Spotted Marsh Frog	Un	Un	Yes	Yes	Wet areas of freshwater.
Litoria ewingii	Southern Brown Tree Frog	C	C	Yes	Yes	Populations appear to be viable within the reserves
Litoria raniformis	Growling Grass Frog				Yes	Last detected in 1994.
Litoria verreauxii	Verreaux's Tree Frog	Un	C	Yes	Yes	Populations are at average levels.
Reptiles						
Chelodinia longicollis	Common Long-necked Tortoise	R	Un		Yes	Occasionally observed in creek and estuary.
Amphibilorus muricatus	Tree Dragon				Yes	Last detected in 1994.
Bassiana duperreyi	Eastern Three-lined Skink	Un	Un	Yes	Yes	Occurs on sandy soils.
Eulamprus tympanum	Southern Water Skink	R	R	Yes	Yes	Rare and found along the banks of the creek.
Lampropholis delicata	Delicate Skink	R	Un	Yes	Yes	Occurs through-out.
Lampropholis guichenoti	Garden Skink	Un	C	Yes	Yes	Populations appear to be viable within the reserves.
Carinascincus metallicus	Metallic Skink	Un	Un		Yes	Occurs around the edges of the estuary.
Pseudemoia rawlinsoni	Glossy Grass Skink	Un	Un		Yes	Occurs in micro-climates under vegetation along the estuary and creek.
Saproscincus mustelinus	Weasel Skink	C	Un	Yes	Yes	Populations appear to be viable within the reserves.
Tiliqua nigrolutea	Blotched Blue-tongue Lizard	Un	C	Yes	Yes	Populations are becoming at low levels.
Pygopus lepidopodus	Common Scaly-foot Legless Lizard				Yes	Last detected in 1995.
Austrelaps superbus	Lowland Copperhead	Un	Un	Yes	Yes	Occurs through-out.
Drysdalia coronoides	White-lipped Snake	Un	Un		Yes	Occurs where grassy habitats occur with fallen limbs.
Notechis scutatus	Tiger Snake				Yes	Last detected in 1970.
Rhinoplocephalus nigrescens	Eastern Small-eyed Snake				Yes	Last detected in 1970.

Scientific Name	Common Name	This survey	August 2008 fauna survey	1999 fauna survey	DELWP's Atlas of Victorian Wildlife (AVW), July 2013 edition	Comments
Birds						
Eudyptula minor novaehollandiae	Little Penguin				Yes	Last detected in 1989.
Macronectes giganteus	Southern Giant Petrel				Yes	Last detected in 1975.
Puffinus gavial	Fluttering Shearwater				Yes	Last detected in 1989.
Pelecanus conspicillatus	Australian Pelican		R	Yes	Yes	Last detected in 2008.
Morus serrator	Australasian Gannet		Un		Yes	Last detected in 1989.
Anhinga melanogaster	Darter	R			Yes	A male observed in June 2019 diving for fish.
Phalacrocorax varius	Pied Cormorant	R	Un	Yes	Yes	Usually observed roosting or diving for fish.
Phalacrocorax melanoleucos	Little Pied Cormorant	C	C	Yes	Yes	Usually observed roosting or diving for fish.
Phalacrocorax carbo	Great Cormorant	R	R	Yes	Yes	Usually observed roosting or diving for fish.
Phalacrocorax sulcirostris	Little Black Cormorant	C	Un	Yes	Yes	Usually observed roosting or diving for fish.
Poliocephalus poliocephalus	Hoary-headed Grebe	R		Yes	Yes	Observed in the estuary.
Tachybaptus novaehollandiae	Australasian Grebe		Un	Yes	Yes	Last recorded in 2008.
Cygnus atratus	Black Swam			Yes	Yes	Last recorded in 1999.
Anas superciliosa	Pacific Black Duck	Un	Un	Yes	Yes	Usually observed on the estuary.
Anas gracilis	Grey Teal			Yes	Yes	Last recorded in 1999.
Anas castanea	Chestnut Teal	C	Un	Yes	Yes	Usually observed on the estuary.
Anas rhynchotis	Australasian Shoveller			Yes	Yes	Last recorded in 1999.
Aythya australis	Hardhead			Yes	Yes	Last recorded in 1999.
Chenonetta jubata	Australain Wood Duck	Un	Un	Yes	Yes	Observed on the estuary and breeds in tree hollows.
Rallus pectoralis	Lewin's Rail	R	R		Yes	Observed along the estuary and creek edges.
Gallinuta tenebrosa	Dusky Moorhen	C	C	Yes	Yes	Common bird of the estuary.
Porphyrio porphyrio	Purple Swamphen	Un	Un	Yes	Yes	Uncommon bird of the estuary.
Fulica atra	Eurasian Coot	Un		Yes	Yes	Occasionally observed on the estuary.
Ardea pacifica	White-necked Heron		R		Yes	Last recorded in 2008.
Egretta novaehollandiae	White-faced Heron	R	Un	Yes	Yes	Usually observed feeding in the estuary.
Ardea ibis	Cattle Egret				Yes	Last detected in 1994.
Ardea alba	Great Egret	R	R	Yes	Yes	Usually observed feeding in the estuary.

Scientific Name	Common Name	This survey	August 2008 fauna survey	1999 fauna survey	DELWP's Atlas of Victorian Wildlife (AVW), July 2013 edition	Comments
Egretta garzetta	Little Egret				Yes	Last detected in 1989.
Nycticorax caledonicus	Nankeen Night Heron	R	R	Yes	Yes	One observed feeding along the banks of the upper estuary.
Threskiornis molucca	Australian White Ibis	Un	C	Yes	Yes	Observed flying overhead and feeding in the estuary.
Threskiornis spinicollis	Straw-necked Ibis	Un	C	Yes	Yes	Observed flying overhead.
Platalea regia	Royal Spoonbill	R	R	Yes	Yes	Usually observed feeding in the estuary.
Platalea flavipes	Yellow-billed Spoonbill		Un	Yes	Yes	Last recorded in 2008.
Gallinago hardwickii	Latham's Snipe		R		Yes	Last recorded in 2008.
Calidris acuminata	Sharp-tailed Sandpiper				Yes	Last detected in 1994.
Vanellus miles	Masked Lapwing	R	Un	Yes	Yes	Populations are at a low level.
Elseyomis melanops	Black-fronted Dotterel				Yes	Last detected in 1994.
Larus novaehollandiae	Silver Gull	C	Un	Yes	Yes	At times it is the most common bird on the estuary.
Larus pacificus	Pacific Gull	R	Un	Yes	Yes	Observed roosting at the mouth of the estuary.
Sterna bergii	Crested Tern		Un	Yes	Yes	Usually observed adjacent to estuary mouth diving for fish in Port Phillip Bay.
Turnix varia	Painted Button-quail				Yes	Last detected in 1994.
Elanus axillaris	Black-shouldered Kite		Un		Yes	Last detected in 2008.
Aquila audax	Wedge-tailed Eagle	R			Yes	Observed flying overhead.
Accipiter fasciatus	Brown Goshawk	C	Un		Yes	Observed in the woodlands.
Circus approximans	Swamp Harrier		R		Yes	Usually observed flying over the estuary. Last detected in 2008.
Falco longipennis	Australian Hobby				Yes	Last detected in 1994.
**Streptopelia chinensis*	Spotted Turtle-Dove	C	C	Yes	Yes	Mainly occurs on the urban edges of the reserves.
Phaps chalcoptera	Common Bronzewing		Un	Yes	Yes	Last detected in 2008.
Ocyphaps lophotes	Crested Pigeon		R		Yes	Last detected in 2008.
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	Un			Yes	Small flocks usually observed feeding on pine cone seeds.
Eolophus roseicapillus	Galah	Un	Un	Yes	Yes	Observed flying overhead.
Cacatua sanguinea	Little Corella	C			Yes	Observed flying overhead.

Scientific Name	Common Name	This survey	August 2008 fauna survey	1999 fauna survey	DELWP's Atlas of Victorian Wildlife (AVW), July 2013 edition	Comments
Cacatua galerita	Sulphur-crested Cockatoo	Un	C	Yes	Yes	Observed flying overhead.
Trichoglossus haematodus	Rainbow Lorikeet	C	C	Yes	Yes	Common bird found through-out.
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet				Yes	Last detected in 1987.
Glossopsitta concinna	Musk Lorikeet	Un	C		Yes	Observed flying overhead and feeding in banksias.
Lathamus discolor	Swift Parrot				Yes	Last detected in 1994.
Alisterus scapularis	Australian King Parrot	R			Yes	Occasionally observed within the reserves.
Platycercus elegans	Crimson Rosella	Un		Yes	Yes	Occasionally observed within the reserves.
Platycercus eximius	Eastern Rosella	Un	C	Yes	Yes	Populations appear to be viable within the reserves.
Cuculus pallidus	Pallid Cuckoo				Yes	Last detected in 1998.
Cacomantis flabelliformis	Fantail Cuckoo	Un	Un		Yes	Occasionally observed within the reserves.
Chalcites basalis	Horsfield's Bronze-Cuckoo		R		Yes	Last detected in 2008.
Chalcites lucidus	Shining Bronze-Cuckoo	Un	R		Yes	Occasionally observed within the reserves.
Ninox novaeseelandiae	Southern Boobook		R		Yes	Last detected in 2008.
Podargus strigoides	Tawny Frogmouth	Un	Un	Yes	Yes	Populations becoming at low levels within the reserves.
Hirundapus caudacutus	White-throated Needletail	R	C		Yes	Observed flying overhead.
Dacelo novaehollandiae	Laughing Kookaburra	Un	C	Yes	Yes	Usually observed within the woodlands.
Todiramphus sanctus	Sacred Kingfisher				Yes	Last detected in 1994.
Daphoenositta chrysoptera	Varied Sitella				Yes	Last detected in 1994.
Cormobates leucophaeus	White-throated Treecreeper				Yes	Last detected in 1994.
Malurus cyaneus	Superb Fairy-wren	C	C	Yes	Yes	Common species of the undergrowth.
Pardalotus punctatus	Spotted Pardalote	C	C	Yes	Yes	Observed through-out the woodlands.
Pardalotus striatus	Striated Pardalote		Un		Yes	Last detected in 2008.
Sericornis frontalis	White-browed Scrubwren	C	C	Yes	Yes	Common species of the undergrowth.
Acanthiza pusilla	Brown Thornbill	C	C	Yes	Yes	Common species of the undergrowth and canopy.
Acanthiza chrysorrhoa	Yellow-rumped Thornbill				Yes	Last detected in 1994.
Acanthiza lineata	Striated Thornbill	R			Yes	Last detected in 1994.
Anthochaera carunculata	Red Wattlebird	C	C	Yes	Yes	Observed feeding through-out woodlands.

Scientific Name	Common Name	This survey	August 2008 fauna survey	1999 fauna survey	DELWP's Atlas of Victorian Wildlife (AVW), July 2013 edition	Comments
Anthochaera chrysoptera	Little Wattlebird	C	C	Yes	Yes	Observed feeding through-out woodlands.
Manorina melanophrys	Bell Miner			Yes	Yes	Last detected in 1999.
Manorina melanocephala	Noisy Miner	C	C	Yes	Yes	Common on the fringes.
Lichenostomus chrysops	Yellow-faced Honeyeater	Un	C	Yes	Yes	Observed in the woodlands.
Lichenostomus leucotis	White-eared Honeyeater		Un		Yes	Last detected in 2008.
Lichenostomus melanops	Yellow-tufted Honeyeater				Yes	Last detected in 1994.
Lichenostomus penicillatus	White-plumed Honeyeater	R		Yes	Yes	Rare visitor of the woodlands.
Melithreptus brevirostris	Brown-headed Honeyeater	R		Yes	Yes	Rare visitor of the woodlands around the soccer oval.
Melithreptus lunatus	White-napped Honeyeater	R	Un	Yes	Yes	Rare visitor of the woodlands around the soccer oval.
Phylidonyris pyrrhoptera	Crescent Honeyeater				Yes	Last detected in 1994.
Phylidonyris novaehollandiae	New Holland Honeyeater	C	C	Yes	Yes	Observed feeding through-out woodlands.
Acanthorhynchus tenuirostris	Eastern Spinebill	Un	Un	Yes	Yes	Observed feeding through-out woodlands.
Epthianura albifrons	White-fronted Chat				Yes	Last detected in 1994.
Petroica rosea	Rose Robin				Yes	Last detected in 1994.
Petrocia rodinogaster	Pink Robin				Yes	Last detected in 1994.
Petrocia phoenicea	Flame Robin		R		Yes	Last detected in 2008.
Petrocia multicolor	Scarlet Robin				Yes	Last detected in 1994.
Eopsaltria australis	Eastern Yellow Robin	Un	Un	Yes	Yes	Observed through-out.
Falcunculus frontatus	Crested Shrike-tit			Yes	Yes	Last detected in 1999.
Colluricincla harmonica	Grey Shrike Thrush	Un	C	Yes	Yes	Observed through-out woodlands.
Pachycephala pectoralis	Golden Whistler	Un	Un	Yes	Yes	Observed through-out woodlands.
Pachycephala rufiventris	Rufous Whistler	Un	Un	Yes	Yes	Observed along the estuary and creek.
Rhipidura fuliginosa	Grey Fantail	C	C	Yes	Yes	Common through-out.
Rhipidura rufifrons	Rufous Fantail				Yes	Last detected in 1994.
Rhipidura leucophrys	Willy Wagtail		Un	Yes	Yes	Last detected in 2008.
Myiagra cyanoleuca	Satin Flycatcher				Yes	Last detected in 1994.
Grallina cyanoleura	Magpie-lark	Un	C		Yes	Populations appear to be viable within the reserves.
Oriolus sagittatus	Olive-backed Oriole			Yes	Yes	Migratory vagrant. Last detected in 1999.

Scientific Name	Common Name	This survey	August 2008 fauna survey	1999 fauna survey	DELWP's Atlas of Victorian Wildlife (AVW), July 2013 edition	Comments
Coracina novaehollandiae	Black-faced Cuckoo-shrike	R	Un	Yes	Yes	Occasionally observed in the woodlands.
Artamus cyanopterus	Dusky Woodswallow			Yes	Yes	Last detected in 1999.
Cracticus torquatus	Grey Butcherbird	Un	C	Yes	Yes	Populations appear to be viable within the reserves.
Gymnorhina tibicen	Australian Magpie	C	C	Yes	Yes	Populations appear to be viable within the reserves.
Strepera graculina	Pied Currawong	R			Yes	Rare vagrant.
Corvus coronoides	Australian Raven	C	C	Yes	Yes	Populations appear to be viable within the reserves.
Corvus mellori	Little Raven	Un	C	Yes	Yes	Populations appear to be viable within the reserves.
Hirundo neoxena	Welcome Swallow	C	C	Yes	Yes	Populations appear to be viable within the reserves.
Hirundo nigricans	Tree Martin				Yes	Last detected in 1994.
Hirundo ariel	Fairy Martin				Yes	Last detected in 1994.
Anthus novaeseelandiae	Richard's Pipit				Yes	Last detected in 1994.
Acrocephalus stentoreus	Clamorous Reed Warbler				Yes	Last detected in 1988.
Megalurus gramineus	Little Grassbird			Yes	Yes	Last detected in 1999.
Cisticola exilis	Golden-headed Cisticola				Yes	Last detected in 1994.
**Carduelis carduelis*	European Goldfinch				Yes	Last detected in 1994.
* *Carduelis chloris*	European Greenfinch				Yes	Last detected in 1994.
Neochmia temporalis	Red-browed Finch		C	Yes	Yes	Last detected in 2008.
Dicaeum hirundinaceum	Mistletoebird		R		Yes	Last detected in 2008.
Zosterops lateralis	Silvereye	C	C	Yes	Yes	Populations appear to be viable within the reserves.
Zoothera lunulata	Bassian Thrush				Yes	Last detected in 1994.
**Turdus merula*	Common Blackbird	C	C	Yes	Yes	Populations appear to be viable within the reserves.
**Sturnus vulgaris*	Common Starling	C	C	Yes	Yes	Populations appear to be viable within the reserves.
**Acridotheres tristis*	Common Myna	C	C	Yes	Yes	Populations appear to be viable within the reserves.
Mammals					Yes	
Tachyglossus aculeatus	Short-beaked Echidna	R	C	Yes	Yes	Becoming rare within the reserves.
Antechinus agilis	Agile Antechinus			Yes	Yes	Last detected in 1999.
Phascolarctos cinereus	Koala	R	R	Yes	Yes	Very rare within the reserve and through-out the greater area.

Scientific Name	Common Name	This survey	August 2008 fauna survey	1999 fauna survey	DELWP's Atlas of Victorian Wildlife (AVW), July 2013 edition	Comments
Trichosurus vulpecula	Common Brushtail Possum	Un	Un	Yes	Yes	Populations appear to be decreasing within the reserves.
Petaurus breviceps	Sugar Glider	Un	Un	Yes	Yes	Populations appear to be decreasing within the reserves.
Acrobates pygmaeus	Feathertail Glider			Yes	Yes	Last detected in 1999.
Pseudocheirus peregrinus	Common Ringtail Possum	C	C	Yes	Yes	Populations appear to be viable within the reserves
Wallabia bicolor	Black Wallaby	R	R		Yes	Becoming very rare within the reserves.
Tadarida australis	White-striped Freetail Bat	Un	Un		Yes	Populations appear to be viable within the reserves
Chalinolobus gouldii	Gould's Wattled Bat	C	C	Yes	Yes	Populations appear to be viable within the reserve.
Nyctophilus geoffroyi	Lesser Long-eared Bat	R	Un		Yes	Populations at a low level within the reserves.
Vespadelus darlingtoni	Large Forest Bat	Un	Un	Yes	Yes	Populations at a low level within the reserves.
Vespadelus vulturnus	Little Forest Bat	C	Un	Yes	Yes	Populations appear to be viable within the reserves.
Rattus lutreolus ssp. Lutreolus	Swamp Rat	C	C	Yes	Yes	Common within the reserves.
**Mus musculus*	House Mouse	Un	C	Yes	Yes	Populations appear to be viable within the reserves.
**Rattus rattus*	Black Rat	C	C	Yes	Yes	Populations appear to be viable within the reserves
**Rattus norvegicus*	Brown Rat			Yes	Yes	Last detected in 1999.
* *Oryctolagus cuniculus*	European Rabbit	R	Un	Yes	Yes	Populations appear to be decreasing within the reserves.
**Vulpes vulpes*	Red Fox	C	C	Yes	Yes	Populations appear to be viable within the reserves
Felis catus	Feral Cat	C	C	Yes	Yes	Populations appear to be viable within the reserves
Total number of fauna species recorded		**118**	**122**	**119**		

KEY for the above table

R = Rare **BW = Beach Washed**

Yes = fauna species Identified during previous surveys **A = Abundant**

Un = Uncommon

C = Common

APPENDIX 3: FEIS Assessment criteria

PHASES OF EXTINCTIONS

Different extinction levels are occurring on each allotment of remaining remnant native vegetation through-out the Mornington Peninsula, Frankston City, Western Port catchment and bio-region. This is based on the extinction rate of fauna species (in the past and at present) within remaining bush land sites. Factors that determine extinction of fauna species within remaining bush land sites include:

Size of remaining bush land, status of bush land health, amount of weed invasion, status of feral populations, status of native fauna populations, whether the site has bio-links, the determined future of the site and whether the site has tree hollows and fallen hollow logs. A large healthy parcel of vegetation with bio-links will have a high species diversity, where-as a small isolated parcel of vegetation with no bio-links will have a very low diversity of fauna species.

Each ecosystem within remaining native vegetation allotments can be categorized into the following processes of fauna extinctions, all of which are associated with post-European settlement disturbance of the past and or present. These processes are explained in the '5 phases of extinction' which are based on fauna data collected and collaborated from over 500 sites on the Mornington Peninsula, 50 sites within Frankston City and other significant sites within the sub-bioregion which have had fauna surveys conducted by the author Malcolm Legg in the last 15 years.

FIRST PHASE

In the first phase of extinction the land has been cleared and only a few large and several small areas of indigenous bush remain. These areas have mostly been set aside for national parks and large foreshore reserves (Western Port side) which retain most species (especially if feral works and weeding have been conducted) apart from larger carnivores (which have been replaced by foxes and cats) and a few habitat specific species which are now extinct: Tree Goanna, Emu, Spot-tailed Quoll, Eastern Quoll, Common Wombat, etc. Several threatened species in phase two are still moderately common in this phase and most to all FEISs (80% to 100%) still remain and are present in low to high population densities. Such examples within the area include: Mornington Peninsula National Park, Point Nepean National Park, Devilbend Reservoir, Westernport coastal bio-link from Tooradin to Flinders, Pines Flora and Fauna Reserve, Langwarrin Fauna and Flora Reserve, and Quail Island. 80% to 100% of FEISs still remain.

MANAGEMENT

- Conduct pest animal control programs.
- Conduct habitat changing weed control programs.
- Monitor threatened or endangered fauna species and their population densities.
- Monitor FEISs.
- Prevent the site from slipping into second and third extinction phases.

SECOND PHASE

The second phase usually occurs in large bush land areas that have been set aside for state parks, regional reserves and remaining large bush patches on private land. Usually between 10% and 20% of fauna species have become extinct or disappeared and several species are either endangered or threatened at various levels. Around 60% to 80% of FEISs are present in this phase and at reasonable densities. Examples within the area include: Arthur's Seat State Park, Peninsula Gardens Bushland Reserve, Mt Eliza Regional Park, Mt Martha Regional Park, Warringine Park, Tootgarook Swamp and Edithvale & Seaford Wetlands.

MANAGEMENT

- Conduct pest animal control programs.
- Conduct habitat changing weed control programs.
- Monitor threatened or endangered fauna species and their population densities.
- Monitor FEISs.
- If old growth trees with hollows are rare then install roosting and breeding boxes for hollow dependant species and monitor.
- Deploy additional terrestrial habitat logs with hollows for terrestrial species.
- Connect site with other surrounding bushland sites via biolinks.
- Prevent the site from slipping into third or fourth extinction phases.

THIRD PHASE

Phase 3 usually occurs in small to medium-sized Parks Victoria reserves, some foreshore reserves (Port Phillip Bay side), council reserves that retain good habitat, and smaller patches on private land. Most of these sites have weed infestations which have killed off essential understorey including the overstorey of old-growth eucalypts with hollows and feral fauna dominates. Several species are threatened at a regional and local level. Some state significant species still remain and possibly one or two nationally threatened species.

Several FEISs have disappeared and the health of the ecosystem is usually poor and failing. Some examples include rural roadsides, large urban bushland reserves usually over five hectares, small rural allotments usually under ten hectares and on private property which

are less than ten hectares in size with some remnant bush land. 40% to 60% of FEISs still remain.

MANAGEMENT

- Conduct habitat changing weed control programs.
- Yearly monitor threatened or endangered fauna species and their population densities.
- Monitor FEISs.
- Retain old growth trees with hollows whether dead or alive and within the surrounding landscape.
- Introduce Common Myna and Common Starling control programs within the reserve and surrounding landscape.
- If old growth trees with hollows are rare then install roosting and breeding boxes for hollow dependant species and monitor.
- Deploy additional terrestrial habitat logs with hollows for terrestrial species.
- Connect site with other surrounding bushland sites via biolinks.
- Install vermin proof fence around the outer boundary with small gates to allow the movement of terrestrial species in and out of the reserve,
- Conduct pest animal control programs within and outside the fence.
- Control visitor management by only doing guided walks.
- Educate surrounding property owners to keep their pets within their property and not in the reserve. Prevent domestic pets from entering the reserve.
- Look at reintroducing endangered or extinct fauna back into the vermin proof reserve,
- Prevent the site from slipping into fourth or fifth extinction phases.

FOURTH PHASE

Phase 4 extinction rate can usually be associated with urbanization or highly degraded remnant rural sites. The only indigenous habitat that remains is a few isolated pockets along creeks, drainage lines and small shire reserves. The majority of these sites are highly degraded and facing extinction in the final stages. 20% to 30% of fauna species remains but several are quickly depleted by domestic cats, dogs and vermin. 20% to 40% of FEISs still remain and several FEISs have become extinct or disappeared. However a low percentage of significant species could still remain. Noisy Miners dominate on the fringes and chase smaller essential insect gleaming birds away.

MANAGEMENT

- Only put resources into the site if it is along a creek or has reasonable connectivity.
- Conduct habitat changing weed control programs.

- Yearly monitor threatened or endangered fauna species and their population densities.
- Monitor FEISs.
- Retain old growth trees with hollows whether dead or alive and within the surrounding landscape.
- Introduce Common Myna and Common Starling control programs within the reserve and surrounding landscape.
- If old growth trees with hollows are rare then Install roosting and breeding boxes for hollow dependant species and monitor.
- Deploy additional terrestrial habitat logs with hollows for terrestrial species.
- Connect site with other surrounding bushland sites via biolinks.
- Install vermin proof fence around the outer boundary with small gates to allow the movement of terrestrial species in and out of the reserve,
- Conduct pest animal control programs within and outside the fence.
- Control visitor management by only doing guided walks.
- Educate surrounding property owners to keep their pets within their property and not in the reserve. Prevent domestic pets from entering the reserve.
- Look at reintroducing endangered or extinct fauna back into the vermin proof reserve,
- Prevent the site from slipping into a fifth extinction phase.

FIFTH PHASE

The fifth and final phase can be associated with suburbanization and rural allotments that have been 100% cleared of native vegetation, replanted with pine or conifer rows and European plants around the house. 90% to 100% of all fauna species have become extinct or disappeared apart from a few common species and introduced fauna species thrive. New vegetation planted within urban areas is usually exotic or non-indigenous and attracts exotic species and out of balanced native bird species. All significant and most FEISs have disappeared or become extinct with 0% to 20% of FEISs still remaining.

MANAGEMENT

- All resources should be invested into the other four extinction phases as it is usually too late or no possibility of rehabilitating the site or expecting extinct species to return into the site.

FAUNA ENVIRONMENTAL INDICATOR SPECIES (FEIS'S)

How do we measure the health of ecosystems within remaining bush land sites in-order to be able to categorize each bush land site into the above five extinction phases? This can be achieved by assessing each site and determining how many FEISs remain. FEISs are a

justification for the health of a particular ecosystem and are thus categorized using habitat specific fauna species which quickly disappear from an ecosystem which has been or continues to be altered by humans. These processes occur due to lack-of or changed management practices of pre 1750 Australia and includes weed invasion, lack of appropriate fire regimes, clearing practices, high predation by introduced predators, displacement by introduced fauna etc.

The author has determined which FEISs fit into each broad vegetation community that still exists within the Mornington Peninsula, Frankston City on and around Western Port catchment.

FEISs and EVCs that fit into Broad Vegetation Types & Assessment Tables

TABLE 21- EVCs that fit into Broad Vegetation Types (BVT)

EVC's Broad Types → Vegetation ↓	CBW	DSH-rW	SH	CSM	LF	RS	RF	H-rFF	DF	HW	SS	ESS	SRW	PGW	SW	MS	CDS	CHS	CTG	CH-rW	GW	BGS	AH	BW	DH	DHW	CAS	S-zCS	CDG
Forest					Y		Y	Y	Y																				
Woodland	Y	Y								Y			Y							Y						Y			
Scrub (coastal)																	Y	Y				Y					Y	Y	
Scrub (Wet sites)						Y					Y	Y																	
Grassland														Y					Y			Y							Y
Heathland			Y																						Y				
Drainagelines											Y																		
Riparian Zone						Y					Y		Y							Y			Y						
Creeks																							Y	Y					
Coastal				Y								Y				Y	Y	Y	Y			Y		Y			Y	Y	Y
Wetlands & Swamps														Y	Y								Y	Y					
Salt Marsh				Y																									
Mangroves																Y													

KEY to EVC's

CBW-Coast Banksia Woodland, DSH-rW-Damp Sands Herb-rich Woodland, SH-Sand Heathland, CSM-Coastal Salt Marsh, LF-Lowland Forest, RS-Riparian Scrub, RF-Riparian Forest, H-rFF-Herb-rich Foothill Forest, DF-Damp Forest, HW-H
Woodland, PGW-Plains Grassy Wetland, SW-Sedge Wetland, MS-Mangrove Shrubland, CDS- Coastal Dune Scrub, CHS-Coastal Headland Scrub, CTG-Coastal Tussock Grassland, CH-rW-Creekline Herb-rich Woodland, GW-Grassy Woodla
Damp Heathland, DHW-Damp Heathy Woodland, CAS-Coastal Alkaline Scrub, S-zCS-Spray-zone Coastal Shrubland, CDG-Coastal Dune Grassland, GW-Gully Woodland and SW-Swampy Woodland.

FEISs within broad vegetation types

Key to FEISs within broad vegetation types

RF –Rain Forest, F –Forest, W- Woodland, GL –Grassland, Sco –Coastal Scrub, SWA- Scrub in wet areas, H –Heath, DL –Drainage lines,
RZ –Riparian Zone, C –Creeks, Co –Coastal, WL&S –Wetlands and Swamps, M&S –Mangroves and Salt Mash and HR-Habitat Requirements

TABLE 22: FEISs of broad vegetation communities.

FEIS's and seasons to survey for FEIS's	RF	F	W	GL	Sco	SWA	H	DL	RZ	C	Co	WL&S	M & S	HR
DECAPOD CRUSTACEANS														
Engaeus sps. (All)	Y	Y	Y			Y		Y	Y	Y		Y		Damp & wet areas.
Helograspsus sp (All)													Y	Coastal Salt Marsh.
FISH														
Spotted Galaxias (All)								Y	Y	Y		Y		Lower reaches of creeks.
Broad-finned Galaxias (All)								Y	Y	Y				Upper reaches of creek.
Dwarf Galaxias (All)										Y		Y		Swampy parts of creek.
AMPHIBIANS														
Victorian Smooth Froglet (Autumn)						Y		Y				Y		Dry swampy sites which are inundated i
Southern Toadlet (Autumn)						Y		Y				Y		Dry swampy sites which are inundated i
Growling Grass Frog (November to January)										Y		Y		Deep fresh water with reeds.
REPTILES														
Common Long-necked Tortoise (All)								Y		Y		Y		Fresh-water bodies.
Tree Dragon (Spring till autumn)			Y	Y	Y		Y				Y			Dry vegetation & fallen timber with holl
Swamp Skink (Spring)						Y		Y	Y			Y	Y	Wet sites with Decapod. Crustacean bu
Southern Water Skink (Spring)	Y	Y	Y			Y			Y		Y			Riparian and coastal veg. with high raint
Whites Skink (Spring)			Y	Y	Y		Y				Y			Dry vegetation & fallen timber with holl
Eastern Three-lined Skink (Spring)			Y	Y	Y		Y				Y			Sedgy and grassy understorey.
Delicate Skink (Spring)		Y	Y	Y			Y		Y					Sedgy & grassy understorey & fallen hol
McCoy's Skink (Autumn & winter)	Y	Y	Y											Grassy understorey with fallen hollow lo
Metallic Skink (Autumn)					Y			Y			Y	Y		Grassy understorey & fallen hollow logs
Glossy Grass Skink (Spring)						Y		Y	Y			Y		Slightly elevated veg. around wetland e
Southern Grass Skink (Autumn)			Y	Y		Y			Y				Y	Grassy understorey & fallen hollow logs
Blotched Blue-tongue (Spring)		Y	Y	Y	Y	Y	Y	Y	Y					Sedgy & grassy understorey & fallen hol
Common Blue-tongue (Spring)			Y	Y	Y						Y			Sedgy & grassy understorey & fallen hol
White-lipped Snake (Spring)		Y	Y	Y	Y			Y	Y		Y			Sedgy & grassy understorey & fallen hol
BIRDS														
Painted Button Quail (Autumn)			Y	Y	Y		Y							Sedgy & grassy understoreys.
Red-capped Plover (Spring)											Y			Coastal with washed up seaweed.
Lewin's Rail (Spring)						Y		Y	Y			Y	Y	Grassy & sedgy understory along creeks
Buff-banded Rail (Spring)			Y	Y		Y		Y	Y			Y	Y	Grassy & sedgy understory along creeks
Baillons Crake (Spring)									Y			Y		Sedges and reeds around wetlands.
Spotless Crake (Spring)												Y		Sedges and reeds around wetlands.

Brown-headed Honeyeater (Spring)		Y	Y					Y	Y					Forests and woodlands.
Crescent Honeyeater (Spring)			Y		Y	Y		Y	Y					Coastal scrub and scrub along water cou
New Holland Honeyeater (Spring)		Y	Y		Y	Y	Y		Y					Forests, woodlands and scrub.
White-fronted Chat (Spring)												Y	Y	Edges of wetlands and Coastal Salt Mars
Pink Robin (Spring)	Y	Y	Y					Y	Y					Forests and woodlands.
Eastern Yellow Robin (Spring)	Y	Y	Y		Y	Y	Y	Y	Y		Y			Forests, woodlands and scrub.
Crested Shrike-tit (Winter & spring)		Y	Y				Y	Y	Y					Trunks of gums along water courses.
Grey Shrike-thrush (All)	Y	Y	Y		Y	Y	Y	Y	Y					Forests, woodlands and scrub.
Golden Whistler (Spring)		Y	Y		Y	Y		Y	Y					Forests, woodlands and scrub.
Rufous Whistler (Spring)		Y	Y		Y	Y		Y	Y					Forests, woodlands and scrub along wat
Grey Fantail (All)	Y	Y	Y		Y	Y	Y	Y	Y					Forests, woodlands and scrub.
Rufous Fantail (Spring and autumn)	Y	Y	Y			Y		Y	Y					Gullies of Forest and woodlands (higher
Satin Flycatcher (Spring till early autumn)	Y	Y	Y						Y					Forests and woodlands.
Grey Currawong (Spring)	Y	Y	Y			Y		Y	Y					Forests and woodlands.
Mistletoebird (Spring and autumn)		Y	Y		Y			Y	Y					Forests, woodlands and scrub.
Stubble Quail (Spring)			Y	Y	Y		Y							Scrub, grasslands and intact understorie
Brush Bronzewing (Spring)			Y	Y		Y	Y							Grasslands and intact understories.
Clamorous Reed Warbler (late spring to summer)									Y			Y		Common Reed etc to nest in.
Golden=headed Cisticola				Y										Tall grasses, indigenous or exotic.
Little Grassbird				Y										Tall grasses, indigenous or exotic.
Great Egret								Y	Y	Y		Y	Y	Open wet areas to feed and mangroves
MAMMALS														
Short-beaked Echidna (Spring to autumn)	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y			Intact understories and fallen logs with
Agile Antechinus (Winter & spring)	Y	Y	Y		Y	Y		Y	Y					Forests, woodlands & scrub with tree ho
Dusky Antechinus (Winter & spring)	Y	Y				Y	Y	Y	Y		Y			Forests, with intact understory & fallen
White-footed Dunnart (August till October)			Y	Y	Y		Y				Y	Y		Coastal woodlands, scrub & grasslands,
Southern Brown Bandicoot (Winter to autumn)		Y	Y	Y	Y	Y	Y	Y				Y	Y	Grassy & heathy woodlands with unders
Long-nosed Bandicoot (Winter & spring)	Y	Y	Y	Y	Y	Y		Y	Y		Y			Coastal woodlands, scrub & grasslands.
Sugar Glider (Spring till autumn)	Y	Y	Y					Y	Y					Forests & woodlands with tree hollows.
Feathertail Glider (Spring)	Y	Y	Y					Y	Y					Forests & woodlands with tree hollows.
Black Wallaby (All)	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Forests. Woodlands, scrub and grasslan
Water Rat (Spring till autumn)					Y	Y		Y	Y	Y	Y	Y	Y	Water bodies including coastal.
Southern Forest Bat (Spring till autumn)	Y	Y	Y					Y	Y					Forests and woodlands with tree hollow
Large Forest Bat (Spring till autumn)	Y	Y	Y		Y	Y		Y	Y					Forests and woodlands with tree hollow
Swamp Rat (All)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y		Most habitats with intact understories.
Totals	**26**	**38**	**47**	**21**	**32**	**33**	**21**	**43**	**51**	**10**	**21**	**26**	**17**	

Assessment Table for habitat structure and composition of Broad Vegetation Classes Assessed

NAME OF SITE-
LOCATION-
SIZE OF SITE-
HABITAT-

TABLE 23: Evaluating the health of ecosystems by using the presence of habitat structure and composition of site to be assessed

Broad vegetation classes to be assessed at site	% of FEIS's present in each BVC	Old Growth trees (% present per hectare)	Middlestorey (% present)	.Understorey (% present)	Fallen logs (% present per hectare)	Feral control program, (type deployed)	Presence of habitat changing weeds (% present) and main species	Connectivity or bio-link

Assessment Table for habitat structure and composition of Creeks and still water bodies

NAME OF SITE-
LOCATION-
LENGTH OF CREEK-
STRUCTURE- Includes dams, lakes, estuaries, drainage-lines and creeks.

TABLE 24: Evaluating the health of ecosystems by using the presence of habitat structure and composition of water bodies to be assessed.

Creek or water-body-type	% of in-stream logs present	Percentage of aquatic plants present	Presence of in-stream macro-invertebrates High species diversity Medium species diversity Low species diversity	Presence of streamline vegetation along or around the water body.	Presence of old-growth trees alive or dead, with breeding hollows or roosting sites, and still standing either in or on the edge of water body.	Feral control program, (type deployed)	Connectivity or b link
Upper reaches							
Middle reaches							
Lower reaches							
Estuary							
Still water body including dams and lakes.							

APPENDIX 4: Threatened Fauna Management & Recommendations

TABLE 25: Significant fauna, their habitat requirements and management actions.

Species	Habitat Requirements	Management Actions
Spotted Galaxias	Lower and middle reaches of creeks	Keep creek free from sediments, pollutants and nutrients.
Dwarf Galaxias	Upper reaches of creeks, but area occasionally washed down-stream.	Keep creek free from sediments, pollutants and nutrients.
Southern Pygmy perch	Upper and middle reaches of creeks, but area occasionally washed down-stream.	Keep creek free from sediments, pollutants and nutrients.
Common Long-necked Tortoise	Occurs in water bodies including creeks, swamps, dams and estuaries.	Keep creek free from sediments, pollutants and nutrients.
Southern Water Skink	Terrestrial dwelling species found where intact understorey and fallen habitat logs occurs.	Retain and increase terrestrial logs and grassy understorey. Continue to control habitat changing weeds and vermin.
Delicate Skink	Terrestrial dwelling species found amongst fallen timber and leaf-litter where intact understorey occurs.	Retain and increase terrestrial logs and grassy understorey. Continue and control habitat changing weeds and vermin.
Metallic Skink	Terrestrial dwelling species found amongst fallen timber and leaf-litter where intact understorey occurs.	Retain and increase terrestrial logs and grassy understorey. Continue and control habitat changing weeds and vermin.
Glossy Grass Skink	Terrestrial dwelling species found in micro-habitats under the understorey vegetation.	Retain and increase terrestrial logs and grassy understorey. Continue and control habitat changing weeds and vermin.
Weasel Skink	Shade hugging species found amongst fallen timber and leaf-litter where intact understorey occurs.	Retain and increase habitat logs, leaf-litter and grassy understorey. Continue to control habitat changing weeds and vermin.
Blotched Blue-tongue	Large terrestrial dwelling skink species found where intact understoreys occur. Omnivore in choice of food.	Retain and increase indigenous understorey and habitat logs throughout. Continue to control vermin and habitat changing weeds.
White-lipped Snake	Occurs in intact understorey habitats.	Retain and increase indigenous understorey and habitat logs throughout. Continue to control vermin and habitat changing weeds.
Darter	Wetland species rarely seen on the peninsula.	Keep creek free from sediments, pollutants and nutrients. Retain roosting trunks that stick out of the water.
Pied Cormorant	Wetland species usually observed in the estuary.	Keep creek free from sediments, pollutants and nutrients. Retain roosting trunks that stick out of the water.
Lewin's Rail	Occurs along the banks of the creek and estuary that retain dense vegetation.	Keep creek free from sediments, pollutants and nutrients. Retain dense vegetation along the creek and estuary.
Nankeen Night Heron	Occurs along the banks of the creek and within the estuary that retain dense vegetation.	Keep creek free from sediments, pollutants and nutrients. Retain dense vegetation along the creek and estuary especially paperbark and Common Reed thickets.
Great Egret	Wader bird of the estuary.	Keep estuary free from sediments, pollutants and nutrients. Retain dense vegetation along the banks estuary especially paperbark and Common Reed thickets.
Royal Spoonbill	Wader bird of the estuary.	Keep estuary free from sediments, pollutants and nutrients. Retain dense vegetation along the banks estuary especially paperbark and Common Reed thickets.
Pacific Gull	Coastal bird foraging along the bay.	No management required within reserves.

Species	Habitat Requirements	Management Actions
Wedge-tailed Eagle	Largest bird of prey only observed flying overhead.	No management required within reserve.
Australian King Parrot	Large parrot requiring long hollows to breed within	Maintain and increase habitat free of habitat changing weeds and vermin.
Musk Lorikeet	Migrates to the peninsula during late summer-autumn to feed on various flowering eucalypts at the time.	Protect and maintain woodland free of habitat changing weeds.
White-throated Needletail	Occurs in the summer-autumn period where it migrates from Northern Asia. Aerial, usually over coastal and mountainous areas on the peninsula and flies with flickering strokes, then long-winged raking glides and slow turns.	No management required.
Striated Thornbill	Forager of gum canopies	Protect and maintain woodland free of habitat changing weeds and plant additional gums.
Brown-headed Honeyeater	Forager of gum canopies	Protect and maintain woodland free of habitat changing weeds and plant additional gums.
White-napped Honeyeater	Forager of gum canopies	Protect and maintain woodland free of habitat changing weeds and plant additional gums.
Rufous Whistler	Migratory and riparian breeding bird	Protect and maintain riparian zone free of habitat changing weeds and plant additional gums.
Sugar Glider	Requires old-growth tree hollows where they form a den with up to 12 individuals occupying. Prefers large wattles to feed on the sap.	Maintain woodlands free of habitat changing weeds and die-back. Plant additional gums. Control foxes, cats, *Common Starlings and *Common Myna populations.
Koala	Eucalypt specific mammal that feeds upon Manna Gum and Swamp Gum.	Maintain woodlands free of habitat changing weeds and die-back. Plant additional gums. Control fox and cat populations.
Black Wallaby	Solitary in nature requiring dense thickets to rest in.	Maintain habitats free from habitat changing weeds.
Micro bat species occurring through-out the reserves.	Utilize tree hollows, loose bark, adjacent buildings and sheds as roost sites. Feeds on insects at night.	Retain, maintain and restore habitat. Implement a bat-box program using a variety of designs. Control habitat changing weeds and vermin. Plant additional eucalypts.
Swamp Rat	Prefers areas of dense undercover e.g. low-lying vegetation and heaths that don't become inundated. Feeds on seeds and rhizomes and excavates runways and burrows. After fire, habitat is not usually suitable for some years.	Protect areas that have intact habitats and understoreys. Continue to control vermin and weeds.

Map 5: Locations of fauna sampling sites