PRACTICAL ECOLOGY
ecological restoration & consulting

City of Yarra
Biodiversity Health Survey
2014-2016

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Prepared for the City of Yarra

CITY OF YaRRA

City of Yarra Biodiversity Health Survey 2014-2016

January 2017

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1. INTRODUCTION

Practical Ecology Pty Ltd (Practical Ecology) was commissioned by the City of Yarra to undertake a Biodiversity Health Survey. This survey aimed to establishing baseline data on the biodiversity values of open space areas within the municipality that are managed by the City of Yarra and provide a system for the ongoing monitoring of biodiversity health within these areas. The findings of this study will also contribute towards future Council planning in relation to the management of biodiversity.

The methods employed as part of this study and the associated survey effort were based on the scope of works proposed by the City of Yarra in their project brief, and the fee proposal subsequently prepared by Practical Ecology. These methods in initially included database interrogation and a literature review. This was subsequently followed by a process for the determination of the open space reserve areas within which various survey techniques aimed at sampling the biodiversity values within these areas would subsequently be undertaken. Further details on project methodology is provided in Section 2 of this report.

A total of 30 open space reserves with an area generally greater than 0.5 ha were assessed as part of this study. An additional 10 'Pocket Parks', deemed to be those with an area less than 0.5 ha were also assessed, along with a series of 12 Streetscapes. An important aspect of this study was the inclusion of areas that were not typically considered associated with the presence of indigenous flora and fauna species in other studies completed within the City of Yarra. These include the European-style gardens and parklands which dominate much of the City of Yarra. As this report shows, such areas provide important habitat for common indigenous fauna species in such an urban context and also providing important links between areas of higher quality habitat quality, such as the Yarra River corridor.

1.1 Aims

This aims of this study are to:

- undertake a background review of available biodiversity information including, but not limited to, the Victorian Biodiversity Atlas (VBA), Department of Environment, Land, Water and Planning (DELWP) Biodiversity Interactive Mapping, the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Protected Matters Search Tool, the Birdlife Australia Database, the Australian Platypus Conservancy Database, Council-held data, and other relevant literature

- collate and analyse information from the background review (which was also used as a means to determine which open space areas and streetscapes across the municipality would be the focus of on-ground surveys)

- within designated open space areas and pocket parks subject to further assessment;

  - undertake native vegetation mapping and condition assessments, including Ecological Vegetation Class (EVC) identification and Habitat Hectare Assessments where deemed necessary
  - gather reserve based information on weeds
  - undertake quadrat surveys
  - undertake a fauna habitat values assessment
  - conduct diurnal and nocturnal bird surveys based on the Birdlife Australia preferred survey method
  - conduct frog and reptile surveys
  - conduct microbat surveys using a bat detector, as well as remote camera surveys
- as part of Streetscape Assessments
  - determine the tree species present, and
  - review the bird species likely to use these trees for foraging and nesting, and
  - record bird species incidentally observed during the course of the assessment
- map the location of the biodiversity values present within each open space area assessed, including but not limited to:
  - EVC and Habitat Zones
  - Vegetation type and fauna habitat values,
  - Location of monitoring sites (quadrats, transects and defined search areas (e.g. bird census), and
  - Records of significant species
- provide recommendations for areas where restoration or other improvement works could be undertaken and further biodiversity surveys, particularly in regards to monitoring of threatened flora and fauna species populations.

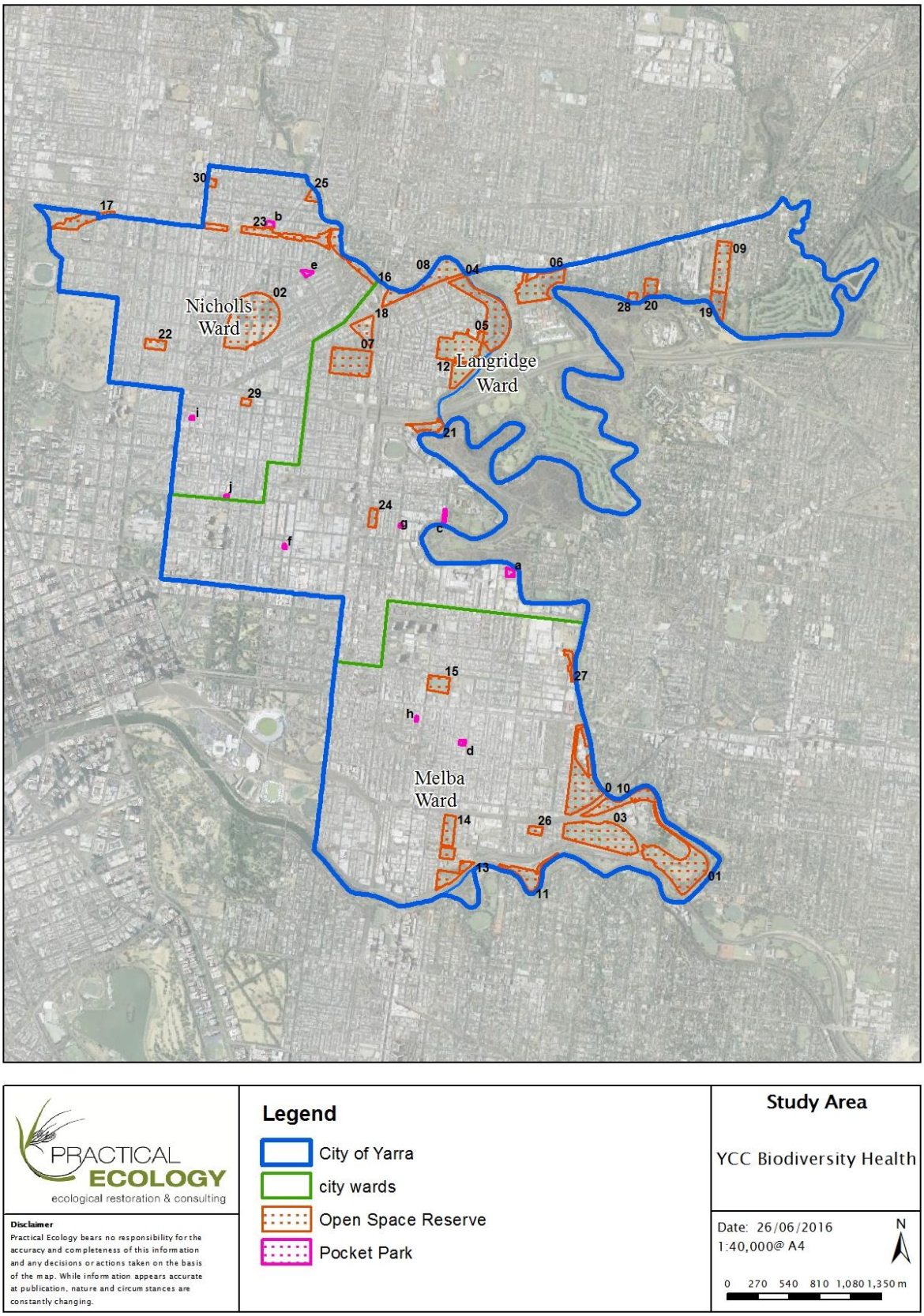
1.2 Study area

While the City of Yarra is deemed the overarching 'study area' covered by this investigation, on-ground surveys took place at selected open space areas managed by the City of Yarra and along various streets that occur across the municipality. As is discussed in Section 2 below, a process of site selection took place prior to on-ground surveys to ensure that these took place within areas that would provide a representative sample of the biodiversity values across the municipality.

Provided below is information on the City of Yarra as a whole, and subsequently the areas of open space managed by the City of Yarra that were the focus of this study. The extent of the municipality study area and reserves sampled in the Biodiversity Health Survey are shown in Map 1 below including the 30 Open Space Reserves and 10 Pocket Parks. An overview map and reserve details are provided in Map 1 and Map 5 (APPENDIX 1).

See Table 1 for cross-referencing of park codes in Map 1 and also Map 5 for a more detailed overview.

Map 1. Survey Area



1.2.1 The City of Yarra

The City of Yarra is an inner metropolitan municipality located approximately 2 km east of the Melbourne General Post Office at its closest point. It was created in June 1994 following a merge of the former councils of Collingwood, Richmond, Fitzroy (including North Carlton), and Northcote (Alphington and Fairfield, south of Heidelberg Road only).

The City of Yarra occupies 19.5 square kilometres and includes the suburbs of Abbotsford, Burnley, Clifton Hill, Collingwood, Cremorne, Fitzroy, North Carlton, North Fitzroy, Princes Hill and Richmond. Parts of Alphington and Fairfield, south of Heidelberg Road, are also included. The location of these suburbs are shown in Map 1. The council area is divided into three wards, Nicholls Ward, Langridge Ward, and Melba Ward (Map 1)

The Yarra River defines the majority of the southern and eastern City of Yarra municipal boundaries (Map 1). The lower reaches of the Darebin Creek delineates the remainder of the eastern boundary around Alphington. Within the vicinity of Rushall Train Station, the northern municipal boundary follows the Merri Creek. Sections of Heidelberg Road, May Street and Park Street also form the northern boundary. To the west, Nicholson Street and Punt Road, along with the roads surrounding the Melbourne General Cemetery define the boundary between the City of Yarra and the adjacent City of Melbourne local government area that occurs immediately east.

Over time, the industrial focus of the City of Yarra has shifted to a more residential and retail mix as the population of Melbourne and demand for inner city living has increased. As a result, many former factories have now been converted into highly sought after warehouse and studio apartments. As of March 2015, the estimated residential population of Yarra was 86,506 with more than more than 33,500 households present (City of Yarra 2015 – website accessed 12/05/2015).

1.2.2 Geology and Topography

There are sites of geological and geomorphological significance along the Merri Creek and Yarra River through the City of Yarra, including one site of State significance and four sites of regional significance (King 1988) .

The majority of Yarra's topography is gently undulating, characteristic of the western basalt plains. Subtle changes in topography are evident at Richmond Hill, where the elevation facilitates views across to the Dandenong Ranges and the Melbourne CBD. The land form in Princes Hill and Carlton North is also slightly elevated with views towards the CBD. The central area of Fitzroy near Gore Street and George Street are elevated enough to also enable views, in this case toward the east over Collingwood and to the Dandenong Ranges. Areas of Fairfield and Alphington have views over the Yarra River valley (Biosis: Hill 2001: Design 2006).

The waterway corridors provide the most significant change in topography across the City of Yarra, with areas of the Darebin Creek, Merri Creek and Yarra River deeply incised in nature at various locations.

1.2.3 Bioregions

The City of Yarra is located at the junction of two Bioregions: the Victorian Volcanic Plain and the Gippsland Plain Bioregions. The majority of the municipality is located within the Victorian Volcanic Plain which characterises the undulating basalt plains and heavy basalt-derived soils that extend further into western Victoria. The Gippsland Plain Bioregion is a more extensive system extending to the south-east of the City. There are outcrops of this Silurian based geology in the north-west and south-eastern parts of Yarra.

1.2.4 City of Yarra Open Space Areas

According to the *Yarra Open Space Strategy* (Design 2006), the City of Yarra has a total of is 235 ha of open space that is useable and accessible, with an additional 75.4 ha of open space available on a fee paying basis. Much of this land is however part of the regional park network along the municipalities waterways which is managed by Parks Victoria for access by people from across Melbourne and beyond.

While some highly urbanised areas of the municipality have almost no open space (Collingwood, Cremorne and North Richmond), other areas are renowned for their large historical gardens, such as Edinburgh and Darling Gardens, located in North Fitzroy and Clifton Hill respectively (Design 2006: Pittle and Kern 1998).

The linear open space reserves along the Merri Creek and Yarra River are also highly valued by residents of Yarra and wider metropolitan Melbourne for their recreational and nature conservation values. It was these areas, as well as railways across the City of Yarra, that were targeted as part of the survey of flora (vascular plants) and fauna (birds, reptiles, frogs) completed by Biosis in 2001 (Biosis: Hill 2001).

The City of Yarra itself is responsible for the management of a number of open space areas across the municipality. This includes a total of 94 open space reserves or parks that cover over 157 ha These City of Yarra managed open space reserves range from approximately 24 ha (Kevin Bartlett Reserve in Burnley) to less than 0.1 ha. These smaller reserves include those such as Chestnut Street Reserve (Chestnut Street, Cremone) and Glow Weave Reserve (Young Street, Fitzroy). The City of Yarra managed reserves are distributed across the municipality, with the majority of larger Council managed reserves located along the Yarra River corridor.

1.2.5 City of Yarra Open Space and Streetscapes subject to on-ground survey

The scope of works proposed by the City of Yarra in their project brief included specifications for the on-ground survey of Council managed open space that included:

- 30 open space reserves, which were deemed to be these with an area generally greater than 0.5 ha (Map 5; Table 1)
- 10 ‘Pocket Parks’, deemed to be those with an area less than 0.5 ha (Map 5; Table 1), and

- 12 Streetscapes, defined as continuous linear corridors of roadside vegetation approximately 100 m in length (Table 2).

The process of site selection that took place to determine the locations of these on-ground surveys is detailed in Section 2 of this report. The final list of sites subject to on-ground surveys as part of this study are listed in Table 1 and Table 2 below.

Table 1. Open Space Reserves and Pocket Parks subject to survey

Open Space Type	Open Space Identifier	Name	Area (ha)	Location
Open Space Reserves	1	Kevin Bartlett Reserve	24.25	Burnley
	2	Edinburgh Gardens	17.04	Fitzroy North
	3	Burnley Golf Course	12.63	Burnley
	4	Hall Reserve	11.02	Clifton Hill
	5	Quarries Park	8.06	Clifton Hill
	6	Fairfield Park	7.41	Fairfield
	7	Darling Gardens	7.23	Clifton Hill
	8	Coulson Reserve / Knott Reserve	7.18	Clifton Hill
	9	Alphington Park	5.50	Alphington
	10	Circus Site	4.76	Burnley
	11	Loys Paddock	3.17	Burnley
	12	Ramsden Street Reserve	2.86	Clifton Hill
	13	McConchie Reserve	2.82	Richmond
	14	Barkly Gardens and Alan Bain Reserve	3.82 (in total)	Richmond
	15	Citizens Park	2.47	Richmond
	16	Rushall Recreation Reserve	2.61 (in total)	Fitzroy North
	17	Harry Gallagher Reserve	2.38	Princes Hill
	18	Mayors Park	2.38	Clifton Hill
	19	Alphington Park Wetland	2.25	Alphington
	20	Coate Park	1.58	Alphington
	21	Dights Falls Park	1.53	Abbotsford
	22	Curtain Square	1.45	Carlton North
	23	Park Street Reserve, Thomas Kidney Reserve, Janet Millman Reserve	3.62 (in total)	Fitzroy North
	24	Gahan Reserve	1.03	Abbotsford
	25	Bundara Street Reserve	0.91	Fitzroy North
	26	Golden Square Park	0.82	Burnley
	27	Annettes Place	0.76	Richmond
	28	Rudder Grange	0.54	Alphington
	29	Smith Reserve	0.46	Fitzroy
	30	Langdon Reserve	0.43	Fitzroy North
Pocket Parks	A	Flockhart Reserve	0.41	Abbotsford
	B	Holden Byrne Park	0.32	Fitzroy North
	C	Clarke Street Park	0.27	Abbotsford
	D	Dame Mellie Melba Park	0.21	Richmond
	E	Edwards Place	0.12	Fitzroy North
	F	Cambridge Park	0.10	Collingwood
	G	Browns Reserve	0.09	Abbotsford

Open Space Type	Open Space Identifier	Name	Area (ha)	Location
	H	Alexander Reserve	0.08	Richmond
	I	Garryowen Park	0.12	Fitzroy
	J	Whitlam Place	0.11	Fitzroy

Table 2. Streetscape Details

Number	Street Scape	Suburb	Group	Direction	Trees
1	Pigdon Street	Carlton North	1	east-west	native
2	Pigdon Street	Princes Hill	1	east-west	exotic
5	Mark Street	Fitzroy North	2	north-south	native
6	Kneen Street	Fitzroy North	2	north-south	exotic
7	Heidelberg Road	Clifton Hill	3	east-west	native
8	Heidelberg Road	Clifton Hill	3	east-west	exotic
9	Hoddle Street	Abbotsford	4	north-south	exotic
10	Hoddle Street	Abbotsford	4	north-south	native
12	Highett Street	Richmond	5	east-west	exotic
13	Murphy Street	Richmond	5	east-west	native
14	Bendigo Street	Richmond	6	north-south	exotic
15	Stawell Street	Richmond	6	north-south	native

2. METHODS

The background review of existing information that took place as part of this study focussed on information available on the biodiversity values within the City of Yarra or the immediate surrounds (up to 5 km from municipal boundaries; Map 6).

A partial review of such available information, such as previous EVC mapping within Biosis (2001) and database records from the VBA, was undertaken prior to the on-ground surveys undertaken as part of this study. This initial review formed part of the process of site selection as is detailed in Section 2.2 below.

Additional information sources were reviewed throughout the duration of the study and particularly during the course of report preparation. Some of these are also listed below where specifically relevant to the City of Yarra or the vegetation and habitat within it. This list is not exhaustive however given that additional literature and information was reviewed as part of report preparation. All other information sources referenced within this report are detailed in Section 6: References.

2.1 Desktop Analysis

2.1.1 Database Records

Ecological databases searches were undertaken in 2015 and covered a broad range of information on flora and fauna values. Existing information within a five kilometre radius around the City of Yarra municipal boundary was collated (Map 6).

Flora and Fauna Biodiversity Searches were undertaken in January 2015 using all the available tools and datasets available at that time. Datasets and searches included the:

- Victorian Biodiversity Atlas
- Biodiversity Interactive Mapping (Department of Environment, Land, Water and Planning)
- Atlas of Living Australia
- Birdlife Australia Database
- Australia's Virtual Herbarium
- Fungimap
- Climatewatch
- iNaturalist

- Eremaea eBird
- BowerBird
- Melbourne Water databases
- Australian Platypus Conservancy Database
- Council-held data

Major sources of records came from the Victorian Biodiversity Atlas, Atlas of Living Australia (as a whole), Australia's Virtual Herbarium, and Birdlife Australia. Numerous other sources and datasets (over 20) were accessed through the Atlas of Living Australia portal.

The definition of flora broadly encompassed vascular and non-vascular plants, fungi, algae, diatoms, and amoeba. Fauna encompassed all vertebrate and invertebrate taxa.

2.1.2 Biodiversity mapping and other values

The distribution of biodiversity and habitat values across the City of Yarra was also informed by the following information resources:

- Ecological Vegetation Class (EVC) mapping (DELWP)
- Council street tree directory
- Tree density maps (DELWP model version 4.1)
- Aerial photography

DELWP mapping (DELWP 2015b:d) and information on relevant EVC Benchmarks (DELWP 2015c) were also consulted as an indication of the vegetation and flora present.

2.1.3 Literature

The following literature was reviewed for biodiversity values information:

- 'Stage 2 of the Natural Heritage Study of the City of Yarra, Victoria' by Biosis (Biosis: Hill 2001)
- 'Weed Management and Vegetation Assessment: Lower Yarra River (Dights Falls to Church Street), Melbourne, Victoria' by Biosis (Yugovic 2001b)
- 'The Vegetation of Yarra Bend Park' by Beardsell (Beardsell 2003)
- 'Yarra Open Space Strategy' by Thompson Berril Landscape Design (in association with Environment & Land Management) (Design 2006)

- 'Urban Wildlife Management Plan' – City of Yarra by Ecology Australia (2009)
- Pittle, L. and Kern, L. 1998, Elms and remnant indigenous vegetation in the City of Yarra. Report prepared for Yarra City Council (Pittle and Kern 1998)

Other previous studies Biosis (1999), Biosis (2001a), Biosis (2001b), Beardsell (2003), (Yugovic 2001a), Thompson Berril Landscape Design (2006) and Ecology Australia (Marr and Renowden 2009) were also reviewed.

2.2 Mapping

Geographical positioning data collection in the field for the purposes of map display was carried out with a handheld GPS device. This was used for identifying areas of different habitat types, animal sightings, and trap locations. Determination of actual locations, on the maps provided, was undertaken using a combination of GPS and ground-truthing with aerial/satellite imagery. Survey maps were digitised and produced using ArcView ArcGIS (version 10.1).

2.3 Selection of Sites for on-ground Surveys

As the City of Yarra is responsible for the management of 94 open space reserves and parks across the municipality, a process for the selection of candidate sites formed part of the City of Yarra brief for this study, and the fee proposal subsequently prepared by Practical Ecology. This process aimed to define the 30 Open Space Reserves, 10 Pocket Parks and 12 Streetscapes requiring on-ground survey.

As mentioned above, this process of site selection took place after an initial review of background information and its collation in GIS. The information sources reviewed as part of this process, and presented on maps subsequently prepared specifically for site selection purposes, included:

- the boundaries of the open space reserves managed by the City of Yarra, as made available through Councils GIS department;
- the distribution of EVCs mapped across the municipality in Biosis (2001) and again made available to Practical Ecology through Councils GIS department;
- database records from the VBA, with a particular emphasis on significant flora and fauna species listed at a State or National level; and
- data made available from Melbourne Water, particularly in relation to significant amphibian species.

The site selection maps prepared and associated data formed the basis of discussions at a 'Survey Design Meeting' that took place in mid-December 2014. In attendance at this meeting were Michelle Savona and Austin O'Malley of Practical Ecology and Craig McGrath and Craig Lupton of Yarra City Council. At this time, a review of data gathered was undertaken and a list of the 30 Open

Space Reserves to be assessed finalised. The 10 Pocket Parks to be assessed was refined in the weeks following this meeting.

It was identified through the course of selection of the Open Space Reserves and Pocket Parks in late 2014, that only 35 of the candidate sites were of a size greater than 0.5 ha that would warrant their assessment as Open Space Reserves, as opposed to Pocket Parks. Consequently, Smith Reserve at 0.46 ha and Langdon Reserve at 0.43 were to be assessed as Open Space Reserves.

2.3.1 Pocket Parks

A Pocket Park for the purposes of this study was considered: 'a planted landscape which includes a mixture of ornamental trees, lawns and shrubs' but may include some native species. While some of the Pocket Parks within the City of Yarra contain remnant trees patches of native vegetation that would be representative of local EVCs (and thus, Habitat Zones) were not present. For this study, pocket parks with at least one dominant mature tree were selected.

The habitat and vegetation classification and mapping system applied to Pocket Parks was largely the same as for Open Space Reserves with only two additional habitat attributes collected: for pocket parks an estimate of total log length and canopy cover. This approach ensured survey consistency across the municipality within the areas of open space subject to assessment.

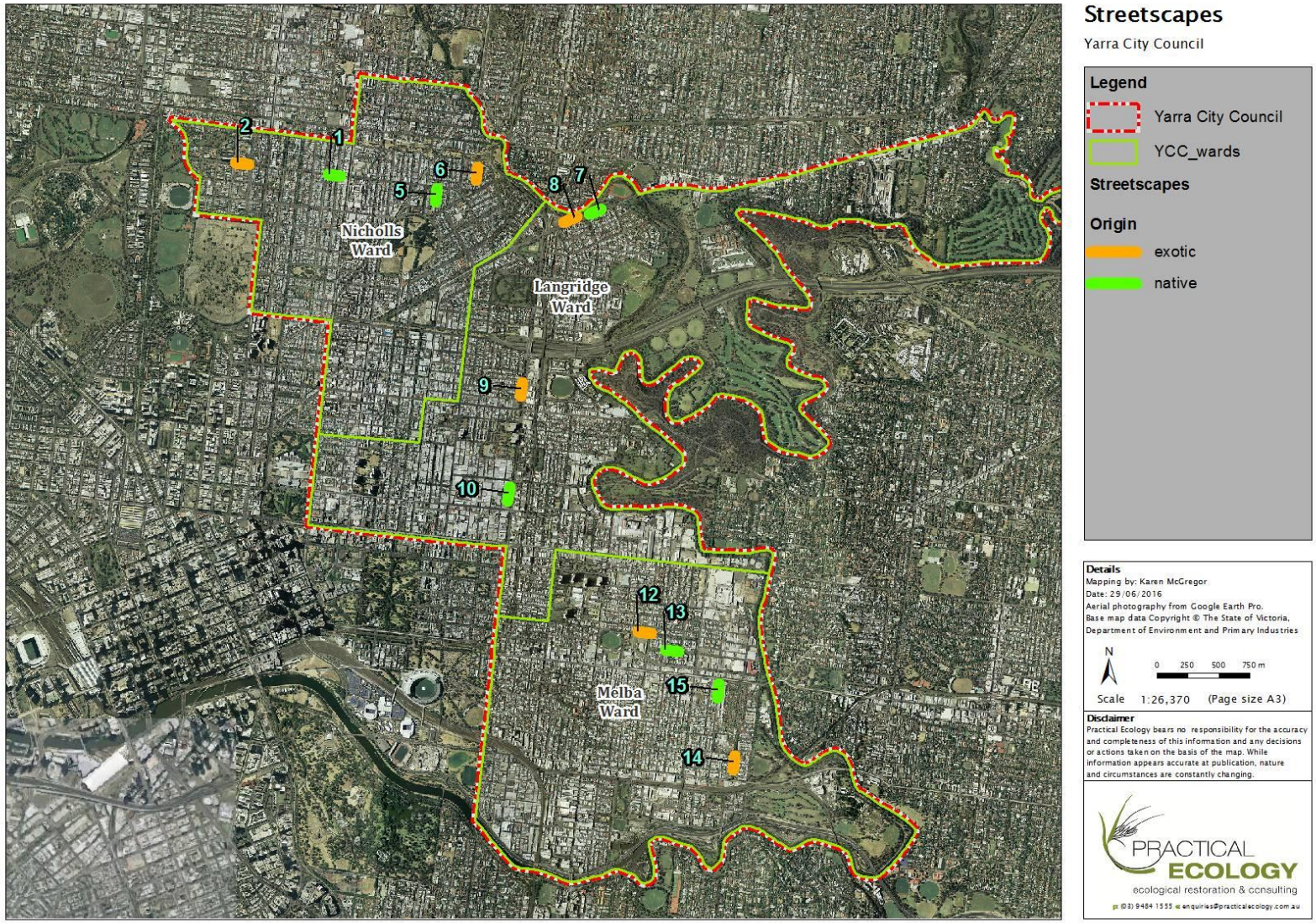
2.3.2 Streetscapes

Streetscapes were selected to allow comparison of native versus exotic streetscapes and east-west versus north-south running streets. In total, 12 Streetscapes were selected composed of 6 pairs of Streetscapes located in proximity, composed on one exotic streetscape and one exotic. Pairs were selected to be facing the same direction either north-south or east-west. Two Streetscapes were located within each council ward area (Table 2; Map 2).

The selection of Streetscapes was informed by inventory of street trees (LIDAR based) across the City of Yarra in 2015, associated street tree inventories, aerial maps, and field assessments.

For each Streetscape, the species and location of each tree was assessed and mapped along with the general habitat attributes for fauna provided by different species and cultivars of trees. This included the habitat features of hollows (presence/absence), fissures (score 1-3), bark (score 1-3), presence of nests, and the bird species likely to utilise each tree species. The original location was derived from LIDAR data and further refined using aerial imagery and site surveys.

Map 2. Streetscape assessments



2.4 Field Surveys

2.4.1 Vegetation Type and Habitat Mapping

Vegetation and habitat types across the Open Space Reserves and Pocket Parks were classified into different types to facilitate collection of data. The first level of classification was 'land cover' which assigned habitat zones to one of 6 categories (bushland, canopy, and lawns, garden beds, open water, or unvegetated). The second tier of classification was more detailed and contained numerous categories largely describing the type of vegetation within each zone. Zone were mapped based on this second tier of classification (Table 3).

A total of 11 categories were applied during this study to classify the Vegetation and Habitat Types observed across the Open Space Reserves and Pocket Parks assessed. These categories and their definitions are presented in Table 25 (APPENDIX 4). This approach to classifying all Vegetation and Habitat Types across each site aimed to ensure that the contribution these features make to habitat across the municipality, even where they are not representative of indigenous or native vegetation, is not overlooked and considered as part of the overall health of biodiversity across the City of Yarra.

Some of these categories (Habitat Zone and Scattered Indigenous Trees) and their definitions were broadly consistent with current methods used throughout Victoria for planning purposes and therefore aimed to assist the City of Yarra in identifying where policies, such as the Biodiversity Assessment Guidelines (DEPI 2013b) as referred to under Clause 52.17 of the Yarra Planning Scheme, may come into effect. This is particularly pertinent for areas identified as 'Habitat Zones' or areas of 'scattered Indigenous Trees' as any proposed removal of such native vegetation may be subject to specific reporting and offsetting requirements under Clause 52.17.

The categorisation of Vegetation and Habitat Types across all 30 Open Space Reserves was undertaken as part of fieldwork completed in early-January 2015. For Pocket Parks, this process took place in March 2015. Assessment of Habitat Zones was undertaken according to DELWP guidelines (DELWP 2015a: DEPI 2013a: 2014b).

Table 3. Categories used to classify Vegetation and Habitat Types

Vegetation and Habitat Type	Definition	Additional Comments
Habitat Zone	Areas of vegetation consistent with the DELWP definition of remnant patch, such that *at least 25% of the total perennial understorey plant cover is native*	• Inclusive of areas of remnant vegetation as well as revegetation, where such revegetation was predominantly locally indigenous species. Revegetation needed to be aiming to replicate an EVC and be diverse, otherwise it was considered an Indigenous Garden Bed (see below). • Data collection included the delimitation of Habitat Zones based on their origin as predominantly revegetation or remnant, or a combination of remnant vegetation and revegetation. • Data collection during the process of determining Vegetation and Habitat Types also aimed to document the EVC that the Habitat Zone represented. Habitat Hectare assessments for each Habitat Zone were undertaken in spring 2015. The process of EVC identification and Habitat Hectare assessments are detailed in Section 2.4.2 below.
Habitat Zones (Canopy Only)	Areas of vegetation consistent with the DELWP definition of remnant patch, where there were three or more native canopy trees where the canopy foliage cover is at least 20% of the area	• Canopy tree further defined as a canopy tree is a mature tree that is greater than 3m in height and 80% of a mature canopy height based on the relevant Ecological Vegetation Class benchmark and is normally found in the upper layer of a vegetation type as per (DELWP 2015a) • Inclusive of areas of revegetation, with delineation of this Habitat Zone type also done so on the basis of whether vegetation was remnant, part of revegetation works or both. • As above, the process of EVC identification and Habitat Hectare assessments within these areas is detailed in Section 2.4.2 below.
Scattered indigenous trees and/or shrubs in patches	Areas where indigenous trees or shrubs are present but the understorey cover is less than 25% or there are less than 3 canopy trees present in the group with a cover less than 20%.	• Within these areas, the understory was predominantly exotic or non-indigenous species and the polygon recorded may have included non-indigenous trees and shrubs in between indigenous species.

Vegetation and Habitat Type	Definition	Additional Comments
Scattered Native trees	Areas where non-indigenous native trees are dominant over a non-indigenous understorey (i.e. less than 25% indigenous plant cover)	• In most cases, would include species such as Spotted Gum *#Corymbia maculata* or Southern Mahogany #*Eucalyptus botryoides* over an understorey dominated by exotic species and in most cases open lawn areas.
Mix of Exotic, Indigenous and Native trees	Area with a mix of scattered trees of different origins, with no one group being clearly more dominant than another, over a non-indigenous understorey (i.e. less than 25% indigenous plant cover).	• A suite of trees of exotic, native and/or indigenous origin present as a canopy normally over a mown lawn or mulched beds.
Exotic Groundstorey Vegetation	Areas where the vegetation consists of groundstorey only and the cover of indigenous species in the groundstorey is less than 25%.	• Inclusive of open lawn areas such as sporting ovals, picnic areas, lawn areas, golf course greens etc. • May include some scattered indigenous species, such as Wallaby Grass *Rytidosperma* spp. however the cover of these less than 25%
Exotic Trees in Patches	Areas that are dominated by a cover of exotic trees	• Included reserves such as Edinburgh Gardens where exotic trees occur over lawn • Areas that have exotic trees across them that are separated by gaps of lawn also generally mapped as a larger polygon of this vegetation and habitat type • Again may include some scattered indigenous species (trees and groundstorey) however the cover of these is low.
Indigenous Garden Beds	Garden beds and other areas of similar vegetation that are dominated by planted indigenous vegetation	• Such vegetation was not deemed representative of a Habitat Zone due to limited size of the zone and species composition whereby they were generally dominated by one or two species, such as Mat-rush *Lomandra* spp. or Tussock Grass *Poa* spp. that had been planted. • The total cover of indigenous species greater than 50% of total vegetation cover.
Native Garden Beds	Garden beds and other areas of similar vegetation that are dominated by planted native (non-indigenous) vegetation	• Not representative of an EVC nor indigenous • Native cover greater than 50% of total vegetation cover, however may include some scattered indigenous plants.

Vegetation and Habitat Type	Definition	Additional Comments
Exotic Garden Beds	Garden beds and others areas of similar vegetation that are dominated by exotic understorey and mid-storey vegetation	• Exotic cover greater than 50% of total vegetation cover • Included garden beds within formal parkland areas that may include roses and other ornamentals plantings. • May also include some indigenous and non-indigenous native species. .
Unvegetated/Other Areas	Unvegetated areas where built infrastructure or open water occurs	• Includes roads, buildings and paths that establish gaps between the categories of Vegetation and Habitat Types listed above but still occur within the parcel boundary of the Open Space Reserve or Pocket Park subject to assessment

2.4.2 Ecological Vegetation Classes and Quality Assessments

As detailed in Table 3 above in regards to Habitat Zones, data collection focussed on determining Vegetation and Habitat Types that took place in early-January 2015 also aimed to document the EVC that the Habitat Zone represented. This was further refined during the Habitat Hectare assessments completed within identified areas of Habitat Zone that subsequently took place in Spring 2015.

EVC Identification

Ecological Vegetation Classes (EVCs) are a method for the systematic organisation of plant communities into common types that occur in similar environmental conditions throughout Victoria. Each vegetation type is identified on the basis of its floristic composition (the plant species present), vegetation structure (woodland, grassland, saltmarsh), landform (gully, foothill, plain) and environmental characteristics (soil type, climate).

Various information sources were reviewed as part of the process of EVC identification. This included EVC mapping by the DELWP (DELWP 2015c) such as EVC benchmark descriptions and information available within various reports and documents. Reports included Beardsell (2003), given the detailed descriptions provided of the EVC present across the Merri Creek and Yarra River within Yarra Bend Park (Beardsell 2003: Beardsell and Beardsell 1999). The information on EVCs within Biosis (2001) was however seminal to this process given that this 2001 report identified vegetation communities in the waterways and railway corridors across the City of Yarra itself, and built the previous documentation of EVC (Biosis 1999) based on DELWP modelling (Anon 1999).

Habitat Hectare Assessments

Habitat hectare assessments were used to determine the condition of the Habitat Zones in the context of the local area and the Victorian Volcanic Plain or Gippsland Plain Bioregions.

The habitat hectare method involves making visual and quantitative assessments on various characteristics of native vegetation according to established criteria that are set against an optimum benchmark. This process aims to establish the significance of native vegetation through an objective and repeatable methodology using working documents (benchmark data and score sheets) that are uniformly applied across Victoria. The Habitat Hectare Assessments undertaken as part of this study were based on the methodology outlined in *Vegetation Quality Assessment Manual-Guidelines for Applying the Habitat Hectares Scoring Method* (DSE 2004a:b).

In summary, this process begins with the identification of the EVC as outlined above. Each EVC has a benchmark of optimal values which are found on DSE's website (DSE 2009b). Site assessments are undertaken using the DSE *Vegetation Quality Field Assessment Sheet* (Version 1.3 October 2004) from DSE. Further to the site condition criteria, the habitat hectare process also requires an assessment of the site in a landscape context (DSE 2004b).

If a site meets or exceeds all benchmark criteria it will receive a total score of 100, which is a total of the above condition and landscape scores in pristine undisturbed condition. However, in many cases in the urban-influenced ecosystems in the Melbourne area, sites receive a score less than 60, due to their relatively high level of modification. The final habitat score is presented as a percentage and then converted to a score out of 1.00.

2.4.3 Flora

Assessments of flora species were initially made during fieldwork that was completed in between January and May 2015. During this time, categorisation and mapping of Vegetation and Habitat Types took place and general information on flora species was documented. This included reserve-based information on weeds. For sites within which Habitat Zones were identified, this was followed up by further identification of flora species during the completion of Habitat Hectare Assessments and Quadrat Surveys between September and October 2015.

Flora lists were compiled for each Habitat Zone assessed (59) and for 16 flora quadrats established across a number of reserves (Table 4). Locations of flora quadrats and habitat zones are shown in Map 8 APPENDIX 1.

A summary of the information gathered pertaining to flora within the Open Space Reserves and Pocket Parks that were assessed is provided in Table 4 below. Further details on individuals flora quadrats in provided in Table 26 (APPENDIX 4).

Table 4. Methods applied to collect information on flora species

Method	Detail
Collection of general documentation of flora species	• General information on flora species across Open Space Reserves and Pocket Parks documented throughout the course of fieldwork in these areas that was undertaken between January and May 2015, and for those sites with Habitat Zones again during September to October 2015. • Note that only general observations of flora species were made within reserves that did not contain Habitat Zones in order to develop a site description for such reserves. This was based on incidental observations of dominant flora species and in such cases a defined list for the reserve was not recorded. • Searches for significant flora species, including EPBC listed flora, were also made during general inspections of all reserves and the completion of Habitat Hectare Assessments where applicable. This included searches for significant flora species detected on database searches. Additional information on weeds was also collected in reserves that did not contain Habitat Zones where they contained woody or high biomass weeds as described below (see below).
Reserve based information on weeds	• For all Open Space Reserves and Pocket Parks, regardless of whether Habitat Zones were present or not, reserve based information on weeds was collected. • Data collection pertaining to weeds focussed on woody or high biomass weeds with a high invasive habit and impact on indigenous flora and/or flora such as Wandering Jew or Blackberry. • For these weeds, an infestation was considered to generally only include areas that have a projective foliage cover ≥25% due to one weed species. The size of infestations recorded was also largely limited to those with a minimum size of 5 X 5 m or 25 m2. • For infestations that were recorded, the actual projective foliage cover of the infestation was documented. This was based on the following categories: 0-25%, 26-50%, 51-75% or 76-100%. • A weed severity rating was applied to the weeds recorded in according with the definitions in Lorimer (2006). These were as follows: ○ VS = 'Very Serious': Currently becoming denser and/or more widespread, to the extent that the vegetation's current value for indigenous flora or fauna is expected to suffer a very serious reduction within the next few years if new measures are not introduced to

<table>
<tr><th>Method</th><th>Detail</th></tr>
<tr><td></td><td>control this species. This excludes weeds that have already done such damage but are no longer actively and very seriously replacing the remaining indigenous flora and fauna;
○ S = 'Serious': Seriously diminishing the vegetation's future value for indigenous flora or fauna by either causing active deterioration or preventing ecological recovery, or else likely to become very serious (as defined above) within 5-10 years if preventative action is not taken;
○ M = 'Moderate': Causing significant (but not serious) diminution of the vegetation's value for indigenous flora or fauna by either: (a) causing active deterioration or preventing ecological recovery; or (b) having a strong chance of becoming serious (as defined above);
○ I = 'Insignificant': Not representing any significant ecological threat, e.g. weeds that are expected not to spread beyond the edges of paths and tracks.
The overall weed cover present in each Habitat Zone was also recorded. .</td></tr>
<tr><td>Habitat Hectare Assessment Lifeform Checklists</td><td>• Within Habitat Zones the flora species identified in the process of undertaking a Habitat Hectare assessment were recorded. This included indigenous and weed species.
• This information was recorded on Lifeform Checklists that, among other things, also serve to assist in the determination of an understorey score for the particular Habitat Zone.</td></tr>
<tr><td>Quadrat Surveys</td><td>• Quadrat surveys were undertaken at a total of 16 location across the Open Space Reserves assessed.
• Each quadrat was permanently marked with capped steel pickets in two corners and mapped using a hand-held GPS or PDA. Quadrats were 20 x 20 m in size with the exception of three locations in which the Habitat Zone/EVC could not accommodate this size and an alternate dimension and size was used to the maximum feasible of 400 m^2 where practicable. See Table 26 (APPENDIX 4) for further details.
• These quadrats were located in sites that facilitated sampling across the EVCs that were identified across the City of Yarra within the reserves assessed.
• Quadrats were all located in defined Habitat Zones within which Habitat Hectare Assessments were also undertaken. Data on the various habitat score components from the Habitat Hectare Assessment undertaken for a particular location is therefore applicable to each quadrat.
• A detailed flora survey within each quadrat was also completed according to a modified version of the Braun-Blanquette system from 1951, described in Specht (1981):
<table>
<tr><th>Cover value</th><th>Cover of foliage</th><th>Number of individuals</th></tr>
<tr><td>+</td><td><5%</td><td>Few (less than 10)</td></tr>
<tr><td>1</td><td><5%</td><td>Many (more than 10)</td></tr>
<tr><td>2</td><td>5 – 25%</td><td>Any number</td></tr>
<tr><td>3</td><td>25 – 50%</td><td>Any number</td></tr>
<tr><td>4</td><td>50 – 75%</td><td>Any number</td></tr>
<tr><td>5</td><td>75 – 100%</td><td>Any number</td></tr>
</table></td></tr>
</table>

Plant Identification

Species that could not be identified in the field were recorded to the nearest possible family or genera. These were then collected as per the protocols associated with Practical Ecology's Flora and Fauna Guarantee (FFG) Act 1988 permit (No. 10006484) for the collection of plant material. In order to assist in the identification of some flora, major features of the specimens were collected where possible, including leaves, parts of branches, fruit and/or flowers. The following resources were referred to in flora identification and taxonomy (Foreman and Walsh 1993: Ross and Walsh 2003).

Limitations of Flora Survey

The information regarding flora species gathered during fieldwork for this project is not considered to be conclusive, as limitations may have resulted in some species remaining undetected. These limitations are outlined below:

- the time that could be devoted to fieldwork at each site was limited by the budget allocated to the project;
    - while every effort was made to accurately document the species present across each site, budget constraints limited the effort the detail to which a flora survey as part of this project could be undertaken;
    - not all non-indigenous or exotic trees and shrubs that had been planted, or planted species within revegetation beds were recorded;
    - not all species were identified to species level, with some identified only to genus;
- within each study site, flora surveys were undertaken over a relatively short period and can only be considered indicative of a point in time assessment of a particular site;
    - as plants flower and set seed at different times of year, and during the peak spring survey period, the total suite of flora present at each site would not have been recorded;
    - it is expected that several species that can only be observed for a limited period of time in late Winter and early Spring may not have been recorded during the present assessment. This is particularly the case for lily and orchid species, as the absence of identifiable characteristics such as flowers makes identification to species level difficult. Surveys at different times of the year at each site would most likely yield additional species. These include species from the Poaceae, Liliaceae, Orchidaceae and Asteraceae families;
- searches for significant species documented within previous reports and documents was only undertaken in areas where such reports clearly indicated the location of such species
    - searches for these species within the vicinity of previous observations were made during general site inspections and the completion of habitat hectare assessments;
- while the flora list that was compiled is considered comprehensive for the timing allocated and the time of year it was undertaken, there is no doubt that further flora surveying would reveal more species.

2.4.4 Fauna

Fauna Habitat Values Assessment

Fauna habitat values assessments were undertaken within each of the Open Space Reserves and Pocket Parks that were assessed. These assessments were undertaken within each of the areas identified as being representative as one of the Vegetation and Habitat Types listed in Table 3 above.

These fauna habitat values assessments aimed to document the habitat features within each Open Space Reserve or Pocket Park and their distribution across it. The process also facilitated documentation of any apparent management issues relating to fauna habitat or populations.

Fauna Habitat Values Assessment Categories

Within each of the Vegetation and Habitat Types identified within a particular reserve, the same area was assessed in regards to the presence of the following fauna habitat types (Table 3; Table 25, APPENDIX 4):

- Hollow density;
- Leaf/organic matter (% cover)
- Rocky (or similar) habitat (% cover)
- Tall groundcover and origin (% cover grasses or herbs >10cm height; ratio exotic/native)
- Shrub density
- Waterbodies/drainage lines/nest boxes and other artificial structures; and
- Other (potentially site specific) fauna habitat requirements and management issues.

Further details on each of these fauna habitat types is provided below.

Information pertaining to the extent of coverage that was recorded for each of these fauna habitat types is also provided in more detail below. For all fauna habitat types with the exception of hollows, cover of these components was deemed to range from 0%, which represented no coverage, through to 100%, which was representative of the presence of a particular fauna habitat type across an entire Vegetation or Habitat Type. For example, within a single Habitat Zone, a pile of rocks may have been deemed to cover 20% of the entire Habitat Zone while shrubby midstorey habitat (shrubs 1-4 metres in height) may have been present throughout the same Habitat Zone (thus, 91 - 100 % coverage).

Leaf/Organic litter

Leaf litter and fallen bark and wood/branches from eucalypts and other canopy and midstorey species provide good microhabitats for a range of invertebrates, reptiles and also for small mammals. Areas where leaf-litter and other organic matter were present were recorded within each of the Vegetation and Habitat Types identified within a particular reserve. The coverage of this habitat type throughout each of these areas was then estimated and placed into one of the percentage cover ranges outlined in Table 5 below.

Table 5. Data collected in relation to leaf/organic litter

Habitat Feature	Leaf/organic litter cover
Data Collected	Percentage cover of leaf/organic litter based on the following ranges: • < 1 % • 1-5 % • 6-10 % • 11-20 % • continued at 10% intervals through to 100 %

Rocks

Areas of rocks, as well as rubble or rubbish piles with a similar spatial structure, provide shelter within the groundstorey for ground-dwelling fauna, particularly reptiles, amphibians and some mammals (Jellinek et al. 2004). The presence or absence of this habitat tends to dictate whether these fauna are present or not, often in conjunction with the quality and extent of understorey/groundcover vegetation (see category below). Certain skink species, such as the White's Skink *Egernia whitii*, prefer continuous bushland habitat with sufficient rocky shelter.

The coverage of rocky or similar habitat throughout each Vegetation and Habitat Type identified within a particular reserve was estimated and placed into one of the percentage cover ranges outlined in Table 6 below.

Table 6. Data collected in relation to rocky (or similar) habitat

Habitat Feature	Rocky cover (exposed rocks only)
Data Collected	Percentage cover of rocky or similar habitat based on the following ranges: • < 1 % • 1-5 % • 6-10 % • 11-20 % • continued at 10% intervals through to 100 %

Tall Groundstorey

In a study of common skinks, habitat structure complexity was observed to influence species abundance and diversity more than habitat fragmentation or edge effects. In addition, increasing

cover of exotic plants (or higher ratio of exotic to native species) may also have a negative influence on fauna species abundance and richness (Jellinek et al. 2004).

The above research findings were integrated into the City of Yarra fauna habitat assessment. Local landscape features that have a positive influence on lizard abundance and species richness include a higher percentage of ground cover and organic litter cover, particularly with medium to high cover - in Jellinek *et al.* 2004, where coverage was aggregated as below: 0-25% (low), 25-75% (medium), and 75-100% (high).

The cover of tall groundstorey vegetation (>10 cm height) was used as a surrogate for this structural complexity as the variation across areas in actual groundcover density was not anticipated to be great or provide a great deal more information.

The proportion of indigenous groundcover is also predicted to have a strong influence on the quality of habitat for indigenous ground dwelling fauna. Consequently, the ratio of exotic to native species groundcover was also incorporated.

These two habitat characteristics were assessed within each habitat zone according to a categorical range and % value for the ratio of exotic to native species and total groundcover cover respectively as shown in Table 7 below.

Table 7. Data collected in relation to grassy herbaceous groundstorey

Habitat Feature	Grassy/Herbaceous groundstorey	
Data Collected: Information on exotic versus native groundstorey	**Nil**	• No grassy ground cover or <0.1 m
	Low	• Mostly, or all, exotic grasses/herbs (0.1-1.5 m)
	Medium	• 50-50 ratio exotic : native species (0.1-1.5 m)
	High	• Mostly native species (0.1-1.5 m)
Data Collected: % cover of grassy/herbaceous groundstorey	Percentage cover of grassy/herbaceous groundstorey based on the following: • < 1 % • 1-5 % • 6-10 % • 11-20 % • continued at 10% intervals through to 100 %	

Shrubby understorey

Parsons *et al.* (2008) determined that shrub density has a greater influence on the presence of Superb Fairy-wrens in urbanised areas than remnant patch size. Superb Fairy-wrens appear to be edge-specialists, with a preference for habitat with dense shrubs surrounding grassy areas (Parsons et al. 2008). Given the influence shrubby understorey/midstorey can have on the presence of fauna, data regarding this fauna habitat type was also collected.

The coverage of shrubby understorey/midstorey throughout each Vegetation and Habitat Type identified within a particular reserve was estimated and placed into one of the percentage cover ranges outlined in Table 8 below.

Table 8. Data collected in relation to shrub cover

Habitat Feature	Shrub density	
Data Collected	**Nil**	• No shrubby understorey/midstorey
	Low	• Sparse, open area with patchy distribution of shrubby understorey between 1-4 m
	Medium	• Moderate density of shrub understorey between 1-4 m
	High	• Dense shrubby understorey between 1-4 m

Hollow Abundance

Tree hollows provide important habitat to a wide range of fauna, particularly birds, arboreal mammals, microbats and some reptiles. To assess the quality of each area assessed across a particular Open Space Reserve or Pocket Park, the categories below were applied in relation to the presence of hollow-bearing trees.

These were derived from general requirements for hollow-bearing trees and associated habitat which in turn were based on habitat preferences, territory (i.e. home range) and body sizes of hollow-dependent fauna.

As entrance size of hollows largely determines the level of utilisation by differing fauna species (Gibbons & Lindenmayer 2002), size categories used for this study were based on the size of fauna (birds, possums, and microbats) that were deemed likely to use these habitats within the City of Yarra's reserves. It should be noted that while the entrance dimensions of some hollows may be smaller than 5 cm, they can represent important habitat for microbats (Churchill 2008) and other fauna which are relatively mobile between patches of vegetation, such as smaller parrots (Churchill 2008: Gibbons and Lindenmayer 2002).

Rather than determining a 'coverage' (as a percentage) of this habitat type throughout a particular Vegetation or Habitat Type within a reserve however, the number of hollows of two different size classes was estimated. Table 9 below outlines the data collected in relation to hollows.

Table 9. Data collected in relation to tree hollows

Habitat Feature	Hollows
Data Collected	Estimate of the number of hollows: • < 5cm in diameter present • > 5cm in diameter present

Significant habitat trees

Over the course of the 2014-2016 BHS fieldwork, observations of significant indigenous habitat trees were recorded in each habitat zone and as incidental observations across all reserves. Trees were considered significant if they qualified as Large Old Trees under the Habitat Hectare method, were large dead stags, or supported a number of hollows.

Significant habitat trees can also include Australian native or exotic trees if they provide a relatively high proportion of shelter (hollows or canopy to nest in) or food resources (flowers, fruits, seeds, and insects) for fauna in the local environment. The level of food resources can be related to tree size with larger trees providing greater canopy extent, food resources, and shelter opportunities such as hollows or canopy for nesting in. Some large trees across open space reserves and council land are captured within the City of Yarra Significant Tree Register. An indication of where other significant trees may be present is inferred in this study from a recent vegetation remote sensing study using LIDAR (Light Detection and Ranging) which uses light from a pulsed laser on an aircraft to measure the height of vegetation. From the resulting database of tree locations, point locations of trees estimated to be greater than 15 m in height are also used to infer the potential location of additional significant trees across both public and private land in the City of Yarra.

Collectively, all trees are important within a landscape through the contribution to total canopy cover. Total landscape habitat cover has been shown to have a strong influence on bird abundance, diversity, and species composition. The relative cover of eucalypt and exotic trees also influences bird community structure, with eucalyptus forest birds more likely to persist where a eucalypt canopy is present and a unique urban bird community where exotic trees dominate. Gaps in forest canopy and habitat connectivity can also have a strong influence of fauna persistence within an urban matrix (Chace and Walsh 2006: Fischer and Lindenmayer 2007: Radford et al. 2005: Tremblay and St Clair 2011).

Waterbodies/drainage lines and other artificial structures

Wetter habitat, in particular waterbodies such as ponds, dams, and wet depressions, but also drainage lines, wetlands and creeks, provide critical habitat for amphibians, waterbirds and some reptiles.

Nest boxes and other artificial structures are also considered in their likelihood to provide support to fauna, and where present were recorded.

Where observed, the presence of waterbodies/drainage lines and other artificial structures was noted throughout the course of fieldwork and completion of the fauna habitat values assessment undertaken. For each of these habitat types the presence of such habitat was noted and a brief description of feature and its likelihood to support fauna documented.

2.4.5 Fauna Surveys

General Techniques

Fauna surveys were carried out using the methods summarised below, with each method outlined in further detail, below this list:

- Birds were identified by sight and their calls, during timed bird surveys, during spotlight walks (with the use of call playback), and as incidental observations;

- Amphibians were surveyed by listening to vocal calls during spotlight walks (call playback was also used to elicit a response at this time) and during the day to identify each species heard;

- Reptiles were identified by sight as part of hand capture during active searching under leaf-litter, logs, rocks, rubbish (i.e., sheets of tin etc.), or as incidental observations.

- Microbats were detected using AnaBat™ SD2 and AnaBat™ Express bat detectors (both developed by Titley™ Scientific) which record bat echolocation calls. Species identified was subsequently undertaken using software that plots the frequency and time of their calls.

- Other bats were detected by sight or their audible calls during spotlighting, or as incidental observations

- Mammals and birds were also surveyed by the use of remote, motion-sensitive infra-red cameras deployed within selected reserves.

Further detail of these fauna survey techniques is provided below and a checklist of survey methods employed across each open space reserve provided in Table 10 below. Table 10 below provides a summary of the Open Space Reserves and Pocket Parks that were subject to the various fauna survey techniques completed as part of this project.

Locations of all the above listed fauna surveys and census areas are shown in Map 7 APPENDIX 1. Bird census areas are shown in Map 3 below.

Diurnal bird surveys were undertaken in all of the Pocket Parks that were subject to assessment as part of this study; no other fauna survey techniques were proposed for Pocket Parks. For the Open Space Reserves, the location within which the various fauna survey techniques were undertaken was determined using the following:

- the documentation of potential fauna survey locations during initial mapping of Vegetation and Habitat Types across each Open Space Reserve that took place in January 2015, which also included a system of priority ranking of suitable sites;

- consideration of the need to include wetland and riparian environments in regards to the bird, amphibian and microbat surveys;

- consideration of the potential vandalism of equipment to be left in the field for extended periods, including infrared cameras and bat detectors;

- the desire to ensure that fauna surveys were spread across the municipality and sampled a variety of parks and reserves, from those dominated by bushland, to larger historical gardens, such as Edinburgh Gardens; and

- efficiency during the completion of fieldwork by making attempts to undertake multiple survey types within the same reserve.

Table 10. Summary of the reserves subject to various fauna survey techniques. Shaded cells and tick marks indicate the use of a survey technique within a reserve.

Open Space Type	Open Space ID	Name	Diurnal Bird Survey	Nocturnal Bird Survey	Frog Survey	Reptile Survey	Bat Recorder	Camera Survey
Open Space Reserves	0	Kevin Bartlett Reserve	✓	✓	✓		✓	
	1	Burnley Park	✓	✓			✓	
	2	Edinburgh Gardens	✓	✓			✓	
	4	Hall Reserve	✓	✓	✓	✓	✓	✓
	7	Darling Gardens	✓	✓			✓	
	13	McConchie Reserve	✓	✓	✓		✓	
	11	Loys Paddock	✓	✓			✓	✓
	15	Citizens Park	✓	✓				
	16	Rushall Recreation Reserve	✓	✓		✓		✓
	17	Harry Gallagher Reserve	✓	✓				
	19	Alphington Park Wetland	✓	✓	✓	✓	✓	✓
	21	Dights Falls Park	✓	✓	✓	✓	✓	
	23	Park Street Reserves	✓	✓				
	25	Bundara Street Reserve	✓	✓		✓	✓	
	27	Annettes Place	✓	✓			✓	
	28	Rudder Grange	✓	✓			✓	
Pocket Parks	A	Flockhart Reserve	✓					
	B	Holden Byrne Park	✓					
	C	Clarke Street Park	✓					
	D	Dame Mellie Melba Park	✓					
	E	Edwards Place	✓					
	F	Cambridge Park	✓					
	G	Browns Reserve	✓					
	H	Alexander Reserve	✓					
	I	Garryowen Park	✓					
	J	Whitlam Place	✓					

Bird Surveys

Bird surveys were undertaken using the BirdLife Australia preferred survey method, which is a 2 hectare area surveyed for 20 minutes. Where a 2 hectare area was not achievable (e.g. most pocket parks) the minimum survey area was 0.2 hectares. This area was defined and mapped for use as part of potential future monitoring of bird populations. The survey captured data for all bird species sighted or confidently identified from calls.

Bird census areas are shown below in Map 3.

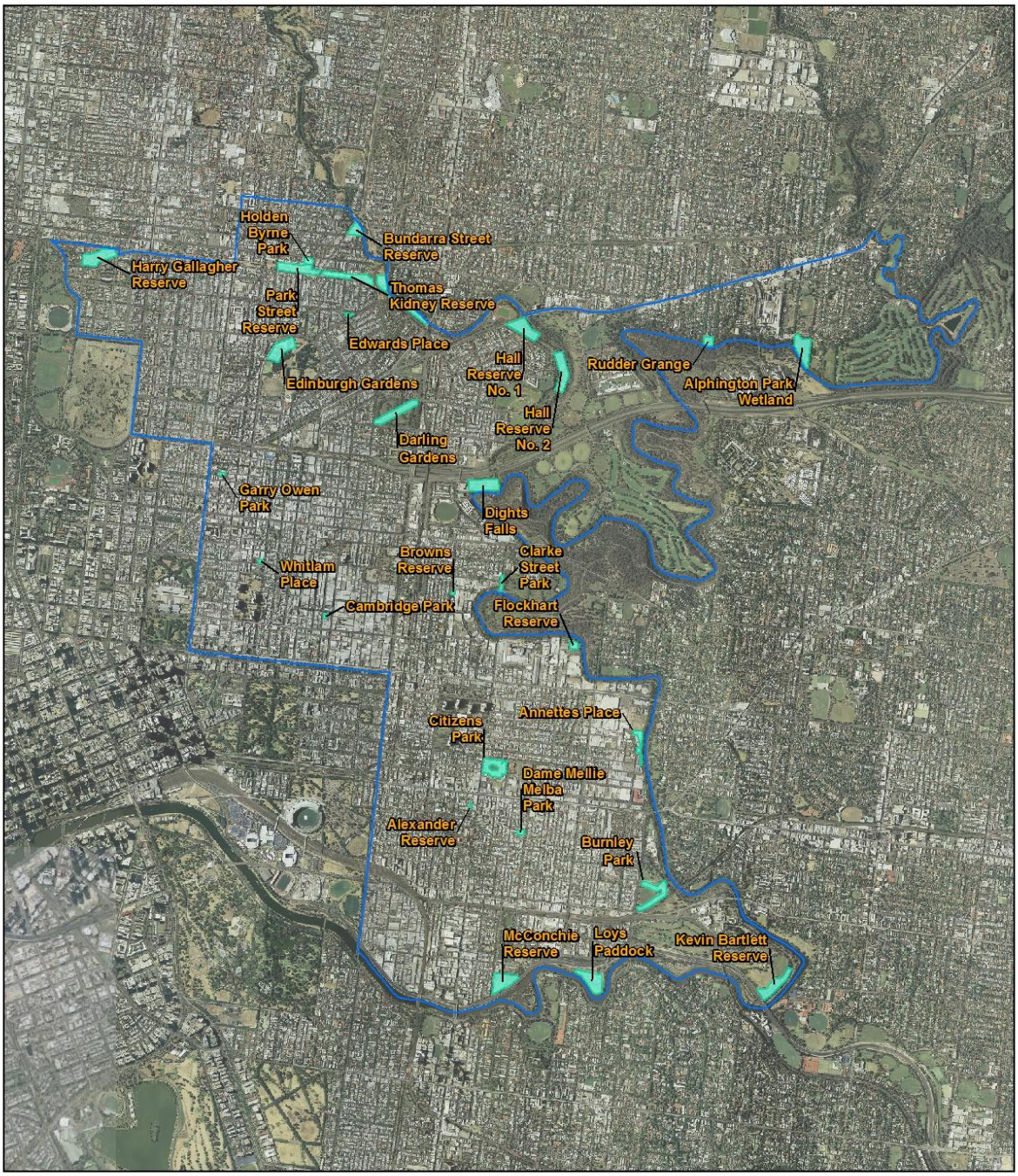
Based on the assumption that there were eight EVCs across the municipality, as outlined in Hill and Kimber (2001), a total of 16 diurnal surveys were conducted using the above method (see Map 3 below for locations of census areas and associated reserves). Surveys were undertaken between the hours of 07:00 and 09:00 (or within 3 hours of dawn as appropriate to season). This ensured that two separate examples of each EVC across the open space areas to be assessed were subject to these morning bird surveys. The season of surveys was identified prior to commencement to ensure standardisation across survey areas.

As a number of the EVCs present across the municipality were found to be associated with wetland and riparian environments, the location of the proposed bird surveys outlined above also aimed to ensure that bird species, that have an affinity with wetland and riparian areas, were also captured as part of the bird surveys. Consequently, of the 16 survey sites to be selected, two wetland sites and two riparian sites were included to ensure this. All selected reserves had one bird census area with the exception of Halls Reserve where two census areas were established. Due to the large size of the reserve and diverse habitat, two census areas were considered optimal to capture the full range of fauna present.

Nocturnal surveys for birds were based on spotlighting and the use of call-playback for species such as Powerful Owl and cryptic waterbirds, such as the Australasian Bittern and Baillon's Crake. They were undertaken at the same locations as the diurnal bird surveys mentioned above, which included at the two wetland sites and two riparian sites. Each survey was of one hour in duration, taking place between 21:30 and 00:00 (midnight); located within defined survey areas, to allow repeat monitoring at future dates. Note that spotlighting undertaken at this time also recorded other species observed, such as possums, rabbits, foxes, and roosting diurnal birds. Counts of each species were recorded.

Note that only one diurnal and one nocturnal bird/arboreal mammal survey was undertaken at each of the 16 sites to be assessed, as part of the bird surveys. Given the nature of this study, it was assumed that these sites will provide ideal reference sites across the open space areas to be monitored into the future.

Map 3. Locations of bird census areas across the City of Yarra Open Space Reserves



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Disclaimer
Practical Ecology bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of the map. While information appears accurate at publication, nature and circumstances are constantly changing.

Legend

City of Yarra boundary

bird census areas

Bird Census Areas

YCC BHS

Date: 17/01/2017
1:40,000@ A4

N

0 270 540 810 1,080 1,350 m

Amphibian Surveys

Frog surveys incorporated call playback, spotlighting and active searching during summer. These were undertaken in conjunction with the nocturnal bird surveys mentioned above and were at the same wetland and riparian sites selected as part of the bird surveys. Each survey has a duration of 30 minutes. The two wetland sites and two riparian sites selected for the bird surveys were synonymous with those selected as part of the frog surveys undertaken.

Reptile Surveys

Reptile surveys were focussed along the Merri Parklands and incorporated active searching within four distinct habitat types. Optimal search sites were identified during habitat mapping for each reserve such as rock outcrops, stream banks, rocky escarpments, and woodlands.

Active searches for reptiles were undertaken for a period of 30 minutes at each of five locations (Map 7, APPENDIX 1). Searches were undertaken in summer under optimal warm sunny conditions when animals would be expected to be active or basking.

Microbat Surveys

Microbats were surveyed for within one representative site for each EVC and at a minimum of four water bodies. As outlined in Hill and Kimber (2001), a total of eight EVCs have been documented within the City of Yarra. Based on this, a total of twelve sites were targeted for microbat surveys.

Surveys for microbats were undertaken using AnaBat® SD1 and AnaBat® Express bat detectors (Figure 1). These electronic devices detect and record the ultrasonic calls of microbats used for hunting their insect prey (like sonar) and interactions with other bats ('social calls'). Feeding calls or 'buzzes' are distinctive among species allowing each to be recognised by eye by trained experts using a reference dataset of calls

The AnaBat Express unit was deployed in a protective case while the SD1 unit was installed within a purpose-built nest-box. At each reserve, a detector was deployed at height (>3m) in a suitable tree. The detector microphone of each unit was positioned to be facing open areas (0-45° angle depending on height of unit and surrounding land slope) likely to be flyways or foraging areas for microbats (e.g. over small waterbodies).

Data collected was analysed and identified by an expert in this field (Rob Gration of EcoAerial P/L) and a list of bat species determined for each site.

Figure 1. From Left: a wildlife camera, ANABAT SD1 microbat recorder and nestbox

Remote Camera Surveys

Remote camera surveys were based upon the deployment of remote infrared fauna monitoring camera traps (Scoutguard®, and Reconyx® 'Hyperfire HC500'). Camera traps were deployed in native vegetation at four locations across the municipality that contained the largest areas of contiguous native vegetation (and confirmed with Yarra City Council). These cameras were left out for three continuous weeks at each of these locations to specifically target mammals (using an appropriate bait mix). Each camera trap was checked and re-baited mid-deployment (Figure 1).

Photographs taken were then analysed by an in-house zoologist, to identify the species present within each of the sites assessed. The relative frequency of each species captured on camera was calculated to provide an indication of species abundance.

2.4.6 Limitations

There were various limitations associated with data collected as part of this project with regard to the vegetation types and EVCs identified across the sites assessed. These limitations were:

- the time that could be devoted to fieldwork at each site was limited by the budget allocated to the project;
    - while every effort was made to accurately categorise the vegetation present within a particular site, it was not, for example, possible in some cases to break Habitat Zones down into smaller areas;
    - the same score was applied to multiple Habitat Zones within a particular site where the vegetation appeared to be of similar quality.

- the City of Yarra occurs across two Bioregions, Victorian Volcanic Plains and Gippsland Plain, and where sites occurred on or close to this boundary, the vegetation was generally assessed according to the bioregion mapped by DSE (2010) in conjunction with an assessment of on-ground conditions;

With regard to the completion of Habitat Hectare assessments it should be noted that while the data provided results in a Habitat Score for a particular patch of vegetation, consideration needs to be given to other factors before an overall Conservation Significance of a patch can be determined. Conservation Significance not only depends on the habitat hectare score and the conservation status, but needs to also take into account other biodiversity attributes such as the presence of significant species or the site's significance. While assessment of the potential presence of significant fauna species within a patch, or its location within a DSE Biosite, was beyond the scope of this project, it needs to be considered when assessing Conservation Significance.

2.5 Data Management and Analysis

Information on the habitat categories outlined above was gathered in the field using hand-held Trimble Nautiz PDAs.

A GIS geodatabase was first created to record the habitat assessment criteria discussed above. A data entry form, specifically formulated for the Yarra Biodiversity Health Survey study by Practical Ecology was also uploaded to the PDAs, to facilitate greater consistency and accuracy in data collection. Using this method, data on incidental fauna observations, fauna habitat and potential issues, was entered directly in association with hand-drawn zones on hard-copy maps, which were later digitised for maps of each reserve, and the confirmed pocket parks and streetscapes.

GIS Databases

The following key GIS databases were generated by this project:

- Monitoring site locations - bird census areas, fauna survey points, flora quadrats, Streetscapes.
- Vegetation Type and Habitat Quality (VTHQ)
- Ecological Vegetation Classes (contained within the VTHQ layer)
- Streetscapes – tree census and habitat attributes
- Significant Habitat Trees
- Significant Weed Infestations and Pest Animal Sightings

Spreadsheet Databases

A number of important outputs of the project include detailed results of surveys which can be queried and maintained by council officers for managing biodiversity assets. These datasets can be added to and improved on for future management and monitoring activities. Core spreadsheet datasets include:

- Vegetation & Flora spreadsheet ('YCC_BH_Flora_data.xlsx'):
    - Flora species lists (Habitat Zones) and abundances (quadrats)
    - Weed severity rating (Table 4)
    - Habitat Zone % weed cover (incl. 'high threat' weed species)
    - Habitat Hectare assessments

- Fauna databases
    - Detailed database with results of all 2014-2016 fauna surveys
    - Database search results (+130,000 records)

Results of both the 2014-2016 BHS census and database searches are combined in a single spreadsheet/Geospatial database.

2.6 Taxonomy and Permits

Fauna nomenclature used in this report is in accordance with the Victorian Biodiversity Atlas Taxa List (DEPI 2014c). Reference was made to several sources of literature on animal taxonomy and biology (Cogger 2014: Hero et al. 1991: Higgins 1999: Higgins and Davies 1996: Higgins and Peter 2002a:b: Higgins et al. 2006: Higgins et al. 2001: Marchant and Higgins 1990: Marchant and Higgins 1993a: Marchant and Higgins 1993b: Menkhorst and Knight 2001: Natural Learning 1994).

Flora taxonomy used in this report is in accordance with the Victorian Biodiversity Atlas Taxa List (DEPI 2014c).

3. BIODIVERSITY ASSESSMENT RESULTS

3.1 Introduction

This section provides the summarised results of the 2014-2016 City of Yarra Biodiversity Health Survey including biodiversity searches, habitat mapping and assessments, and flora and fauna surveys.

3.2 Land Cover & Habitat Mapping

3.2.1 Land Cover and Vegetation Type Mapping

Across all council reserves, 288 zones were mapped and assessed for land cover and vegetation type. Each zoned was assigned a land cover and vegetation type to characterise each zone according to general biodiversity and habitat values.

Results of land cover and habitat mapping undertaken across Open Space Reserves and Pocket Parks as contained within a GIS database associated with this project's outputs. Examples of habitat mapping results are provided for a selection of reserves in the following section.

Figure 2 shows the relative cover of each land cover types across the council reserve system. This is further broken down for comparison between Open Space Reserves and Pocket Parks in Figure 3 and Figure 4. Lawns and canopy cover were the dominant cover types across all council reserves follows by bushland and garden beds. Collectively canopy and bushland accounted for over half of land cover, categories likely to provide significant habitat for fauna species. Over 27 hectares of bushland and 58 hectares of canopy were mapped.

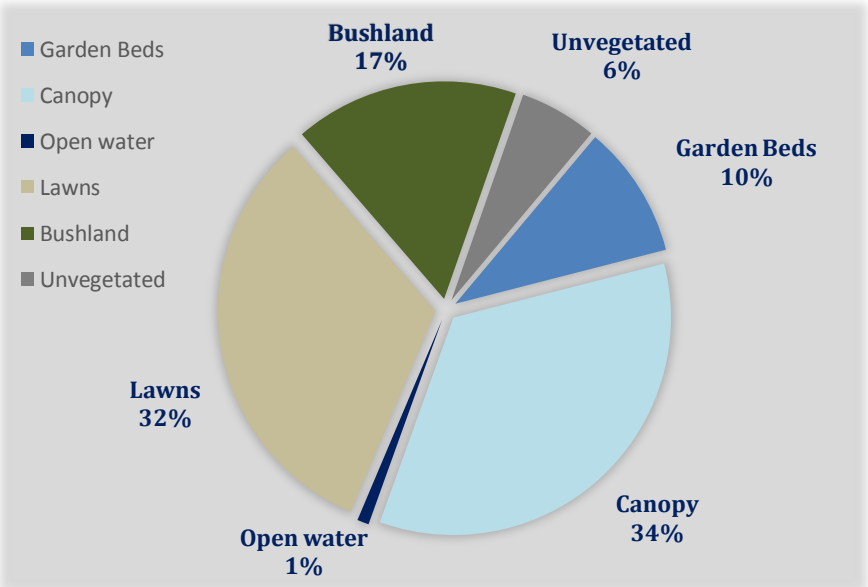


Figure 2. Land cover type cover across the reserve system

Land cover proportions did not vary greatly between Open Space Reserves and Pocket Parks although Pocket Parks supported a higher % of garden beds and canopy (Figure 3 and Figure 4). Open Space Reserves also supported a much higher average proportion of bushland compared to Pocket Parks.

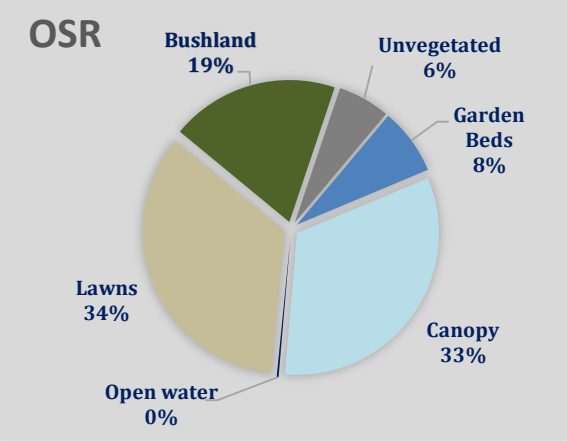


Figure 3. Land cover types across Open Space Reserves (OPR)

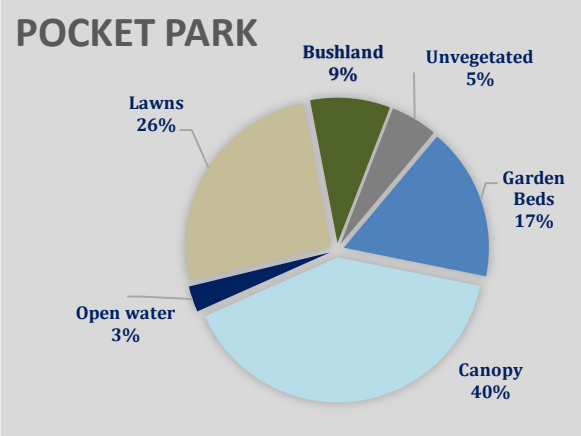


Figure 4. Land cover types across Pocket Parks (PP).

Figure 5 below shows the average % cover of different vegetation types across all reserves. Exotic vegetation types accounted for over half the average reserve land cover. Indigenous vegetation accounted for over 20% of average reserve area taking both understorey and scattered trees into account. Indigenous garden beds generally accounted for a larger proportion of reserve area than exotic garden beds.

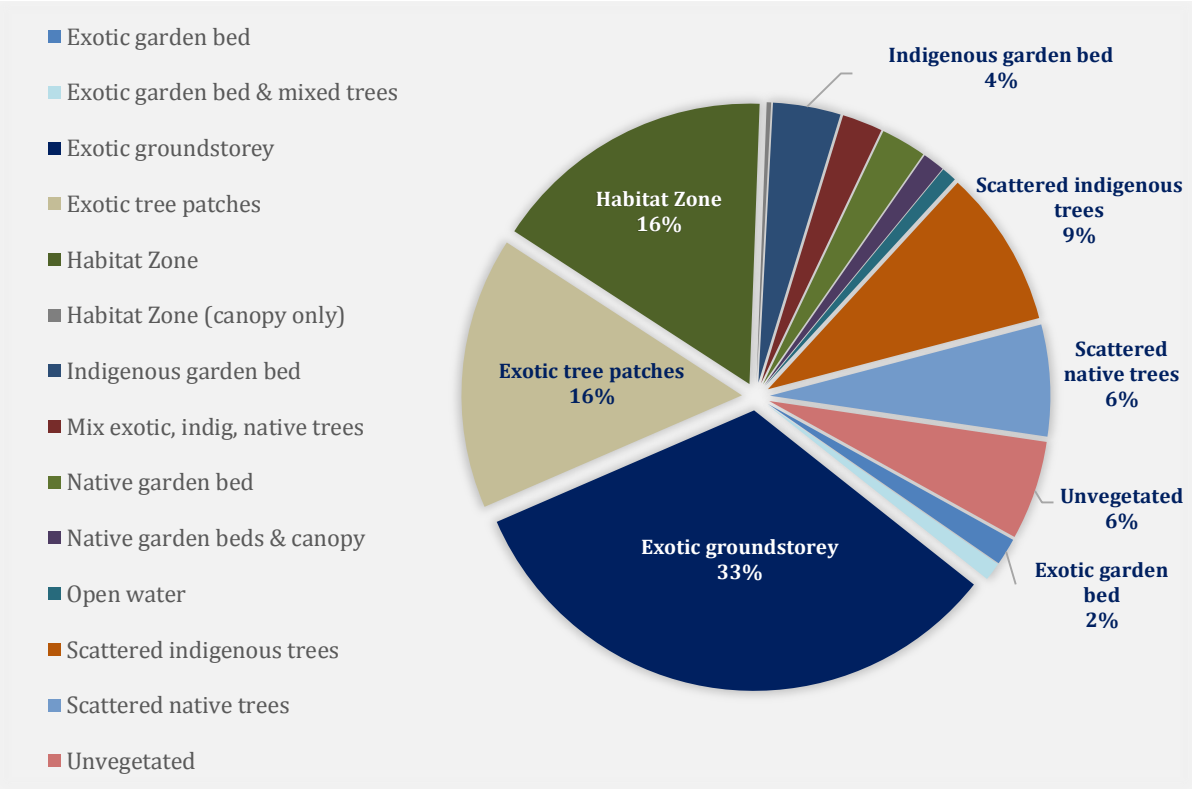


Figure 5. Vegetation type cover across the reserve system

3.2.2 Habitat Attribute Assessments

Of the 288 habitat zones mapped, 233 were valid for assessment of habitat attributes being not 'open water' or 'unvegetated'. The habitat attributes of litter and grassy herbaceous cover accounted for a moderate average proportion of reserve area within the range of 15-20% and this was similar between OS and PP reserves. Grassy herbaceous cover was similar between exotic and native flora. Rock cover and shrub was sparse across most reserves accounting for between 1% and 10% of average reserve area. Pocket Parks in generally had lower levels of habitat features than Open Space Reserves. The total reserve area with habitat features (Figure 6) showed similar patterns as for the average across all reserves (Figure 5).

Overview maps of habitat attributes are provided in APPENDIX 1 Map 13 to Map 17.

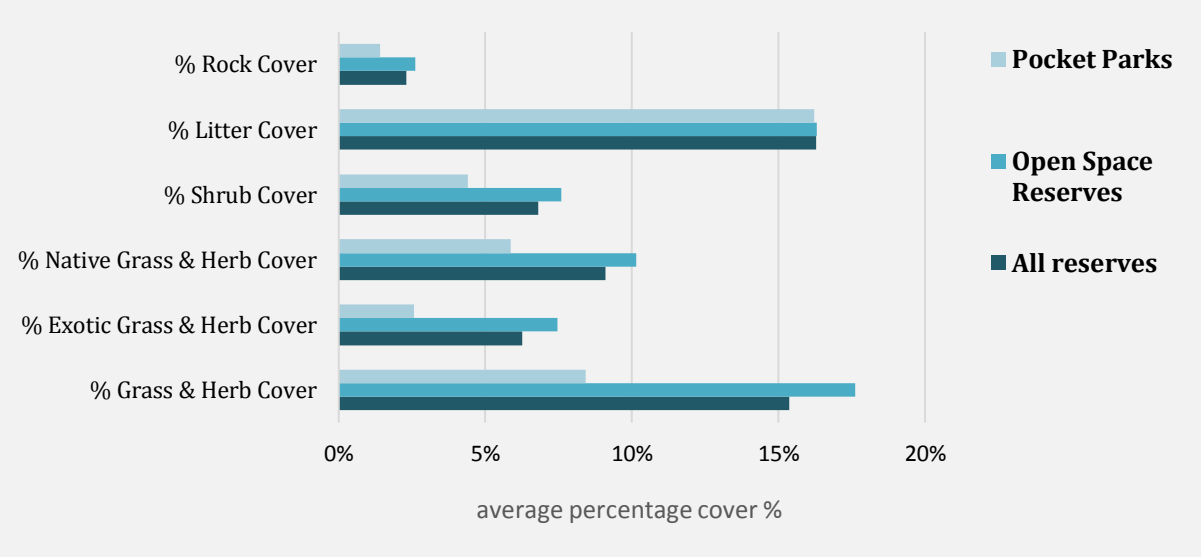


Figure 6. Average habitat attribute values across all YCC reserves

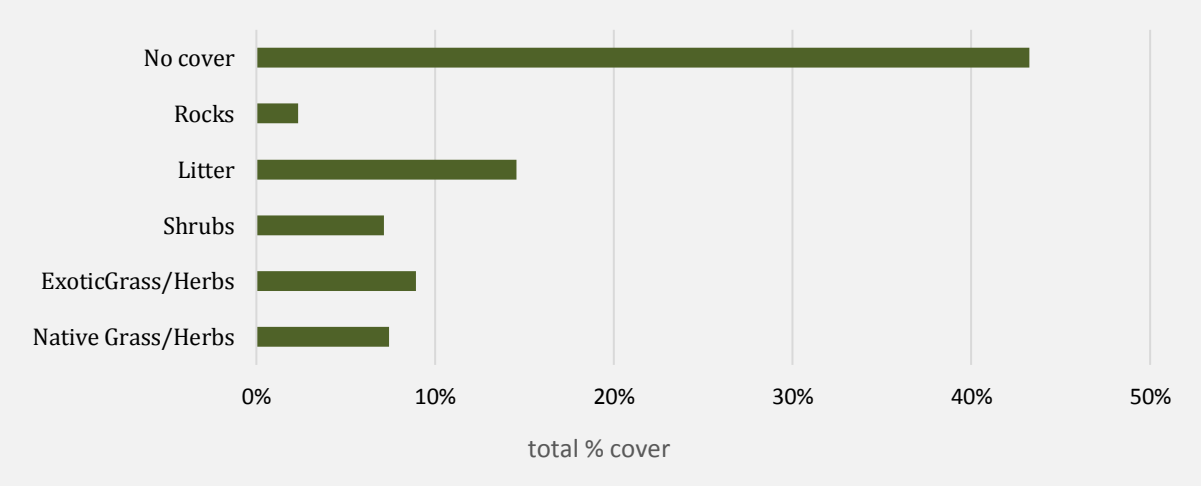


Figure 7. Total percentage cover % of habitat features across the YCC reserve system

There was considerable differences between individual reserves in habitat attributes (Table 11). Generally, reserves with bushland areas such as Alphington Park Wetland, Hall Reserve, and Rudder Grange had much higher habitat attributes than more urbanised parks such as Darling Gardens and those with a principle focus on active recreation such as Citizens Park.

Table 11. Total % projective cover of habitat attributes in each reserve

Reserve	% Grass & Herb Cover	% Exotic Grass & Herb Cover	% Native Grass & Herb Cover	% Shrub Cover	% Litter Cover	% Rock Cover
Alphington Park	4%	1%	2%	4%	12%	0%
Alphington Park Wetland	49%	25%	25%	20%	52%	5%
Annettes Place	32%	16%	17%	10%	28%	2%
Barkly Gardens and Alan Bain Rese	0%	0%	0%	6%	0%	0%
Bundara Street Reserve	35%	13%	21%	32%	38%	0%
Burnley Golf Course	20%	20%	1%	11%	6%	0%
Burnley Park	20%	8%	12%	13%	20%	1%
Circus Site	13%	6%	6%	3%	16%	18%
Citizens Park	0%	0%	0%	0%	6%	0%
Coate Park	38%	7%	30%	14%	23%	11%
Coulson Reserve / Knott Reserve	23%	21%	2%	6%	17%	8%
Curtain Square	3%	2%	2%	1%	4%	0%
Darling Gardens	0%	0%	0%	0%	10%	0%
Dights Falls Park	19%	4%	14%	11%	21%	8%
Edinburgh Gardens	1%	0%	1%	0%	5%	0%
Fairfield Park	12%	11%	0%	3%	5%	1%
Gahan Reserve	4%	4%	0%	1%	4%	0%
Golden Square Park	2%	2%	0%	0%	18%	0%
Hall Reserve	43%	37%	6%	15%	34%	7%
Harry Gallagher Reserve	7%	0%	7%	2%	6%	0%
Kevin Bartlett Reserve	20%	3%	18%	9%	16%	1%
Langdon Reserve	0%	0%	0%	0%	2%	0%
Loys Paddock	36%	21%	15%	20%	33%	5%
Mayors Park	1%	0%	1%	0%	13%	0%
McConchie Reserve	28%	15%	14%	8%	14%	0%
Park Street Linear Reserves	12%	1%	12%	6%	15%	1%
Ramsden Street Reserve	6%	0%	6%	3%	7%	0%
Rudder Grange	57%	1%	57%	16%	39%	8%
Rushall Recreation Reserve	49%	12%	37%	16%	28%	2%
Smith Reserve	0%	0%	0%	0%	0%	0%
The Quarries Park	12%	2%	9%	5%	12%	0%
Ben Alexander Reserve	16%	5%	12%	6%	26%	0%
Browns Reserve	5%	0%	5%	0%	11%	2%
Cambridge Park	2%	1%	1%	3%	9%	0%
Clarke Street Park	31%	12%	19%	7%	12%	1%
Dame Mellie Melba Park	0%	0%	0%	11%	13%	4%
Edwards Place	12%	6%	6%	4%	21%	2%
Flockhart Reserve	9%	0%	9%	6%	30%	3%
Garry Owen Park	0%	0%	0%	1%	16%	0%
Holden Byrne Park	2%	2%	1%	3%	9%	1%
Whitlam Place	7%	0%	7%	3%	16%	0%
Average	15.37%	6.27%	9.11%	6.81%	16.29%	2.31%

Table 11 shows results of habitat attributes assessments across each mapped zone and averaged for each reserve. Habitat attributes include the % cover of grassy and herbaceous cover, shrub cover, and litter and rock cover.

3.3 Vegetation Communities

Overall six Ecological Vegetation Classes were recorded across the surveyed Open Space Reserves. These were:

- Aquatic Herbland – 0.74 ha
- Escarpment Shrubland – 5.85 ha
- Floodplain Riparian Woodland – 1.95 ha
- Plains Grassy Woodland – 8.09
- Riparian Woodland – 10.6 ha
- Tall Marsh – 0.05 ha

An overview of EVC distribution is shown in Map 4. All EVCs were located within the Victorian Volcanic Plains (VVP) Bioregion.

Figure shows the relative % cover and total area of each EVC across the City of Yarra. Riparian Woodland and Plains Grassy Woodland accounted for over half of the indigenous vegetation across the municipality. Small areas of Aquatic Herbland and Tall Marsh has restricted occurrences to a few reserves, notably Alphington Wetland and McConchie Reserve.

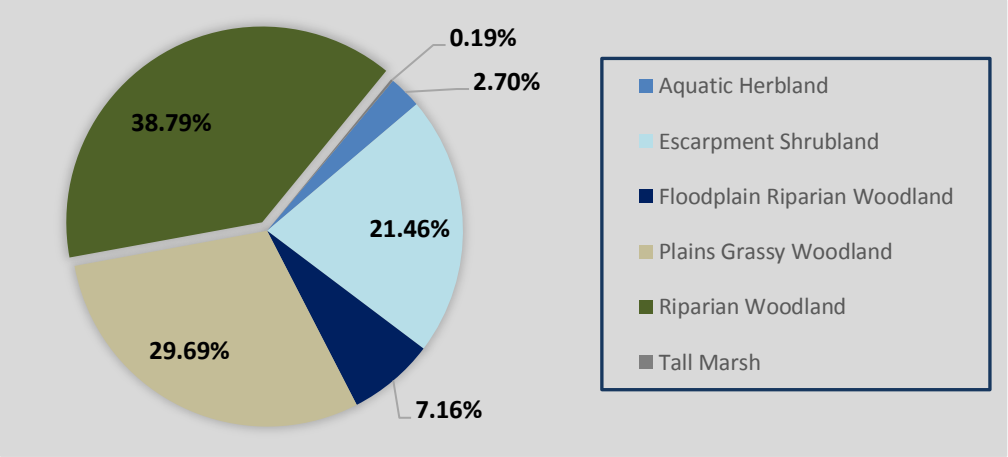


Figure 8. Relative EVC cover across the City of Yarra

Map 4. Ecological Vegetation Community distribution across the City of Yarra

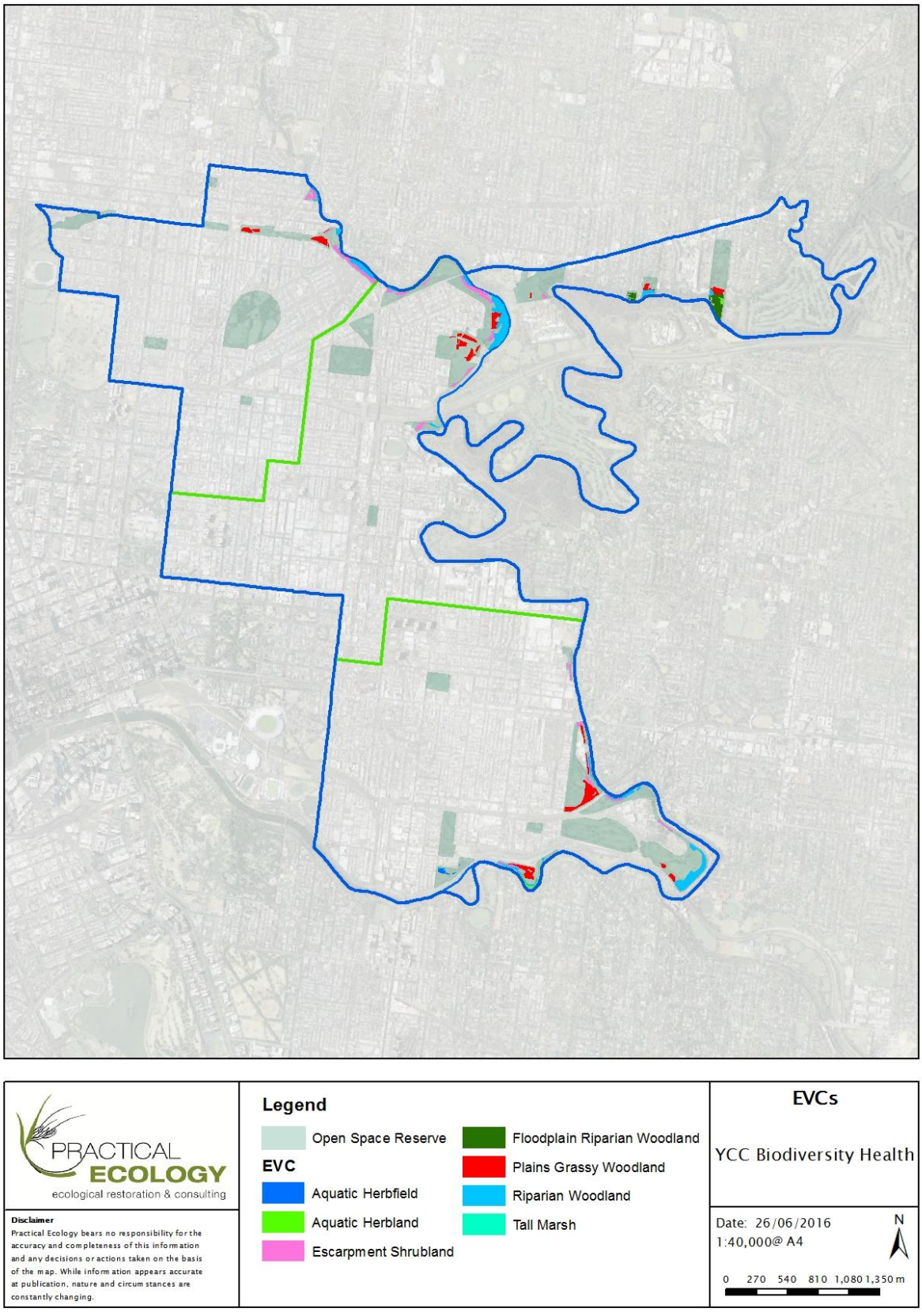


Table 12 shows details of Ecological Vegetation Communities (EVCs) mapped in each reserve including total area of coverage.

Alphington Park Wetland and Loys Paddock supported the greatest diversity of EVCs (4) followed by Kevin Bartlett Reserve, Burnley Park, and McConchie Reserve each supporting three unique EVCs (Table 12). Hall Reserve supported the greatest extent of indigenous vegetation communities (6.14 ha), followed by Kevin Bartlett Reserve (3.54 ha), Alphington Park Wetland (2.16 ha) Loys Paddock (2.10 ha).

Table 12. EVCs across council reserves and area extent (ha)

Park	Area (ha)	Park	Area (ha)
Alphington Park	**0.24**	**Hall Reserve**	**6.14**
Plains Grassy Woodland	0.24	Escarpment Shrubland	1.36
		Plains Grassy Woodland	0.75
Alphington Park Wetland	**2.16**	Riparian Woodland	4.03
Aquatic Herbland	0.15		
Floodplain Riparian Woodland	1.58	**Kevin Bartlett Reserve**	**3.54**
Plains Grassy Woodland	0.27	Escarpment Shrubland	0.21
Riparian Woodland	0.16	Plains Grassy Woodland	0.37
		Riparian Woodland	2.97
Annettes Place	**0.23**		
Escarpment Shrubland	0.23	**Loys Paddock**	**2.10**
		Aquatic Herbland	0.26
Bundara Street Reserve	**0.69**	Escarpment Shrubland	0.24
Escarpment Shrubland	0.49	Plains Grassy Woodland	1.06
Riparian Woodland	0.20	Riparian Woodland	0.54
Burnley Park	**3.26**	**McConchie Reserve**	**0.42**
Escarpment Shrubland	0.57	Aquatic Herbland	0.32
Plains Grassy Woodland	2.34	Riparian Woodland	0.05
Riparian Woodland	0.36	Tall Marsh	0.05
Circus Site	**0.69**	**Park Street Linear Reserves**	**1.27**
Escarpment Shrubland	0.25	Escarpment Shrubland	0.09
Riparian Woodland	0.44	Plains Grassy Woodland	1.18
Clarke Street Park	**0.04**	**Ramsden Street Reserve**	**0.32**
Floodplain Riparian Woodland	0.04	Escarpment Shrubland	0.32
Coate Park	**0.73**	**Rudder Grange**	**0.34**
Plains Grassy Woodland	0.27	Floodplain Riparian Woodland	0.34
Riparian Woodland	0.46		
		Rushall Recreation Reserve	**2.34**
Coulson Reserve / Knott Reserve	**0.58**	Escarpment Shrubland	1.20
Escarpment Shrubland	0.48	Riparian Woodland	1.14
Riparian Woodland	0.10		
		Quarries Park	**1.54**
Dights Falls Park	**0.47**	Plains Grassy Woodland	1.54
Escarpment Shrubland	0.32		
Riparian Woodland	0.15		
Fairfield Park	**0.16**		
Escarpment Shrubland	0.09		
Plains Grassy Woodland	0.07		
Plains Grassy Woodland	0.07		

3.4 Habitat Zones and Habitat Hectare Assessments

A total of 59 habitat zones were mapped and assessed according to DELWP guidelines. Areas of indigenous bushland qualifying as 'Habitat Zones' totalled 27.25 hectares in area. The reserves with the greatest number of habitat zones were Burnley Park (6), Hall Reserve (5), Alphington Park Wetland (5), Rushall Recreation Reserve (5), Park Street Linear Reserves (4), and Coulson Reserve / Knott Reserve (4).

Figure 9 shows the average score for habitat attributes across council reserves using DELWPs 'Vegetation Quality Field Assessment' technique. The 'Landscape Context' score was also determined as part of assessments and represents a combined assessment of the HZ 'patch' size, the proximity to large 'core' habitat patches (>50 ha in size), and amount of bushland within the immediate surrounding landscape. Greater values represent higher quality vegetation. The maximum score (pristine bushland) for each category is also shown for comparison (grey bars).

Compared to pristine bushland the average habitat zone scored particularly poorly in the categories of Large Old Trees (LOTs), weed cover, recruitment, and logs. Understorey, organic litter, and canopy cover scores are what would be expected levels of condition within urban bushland remnants while the 'Landscape Context' reflects the urban nature of the study area.

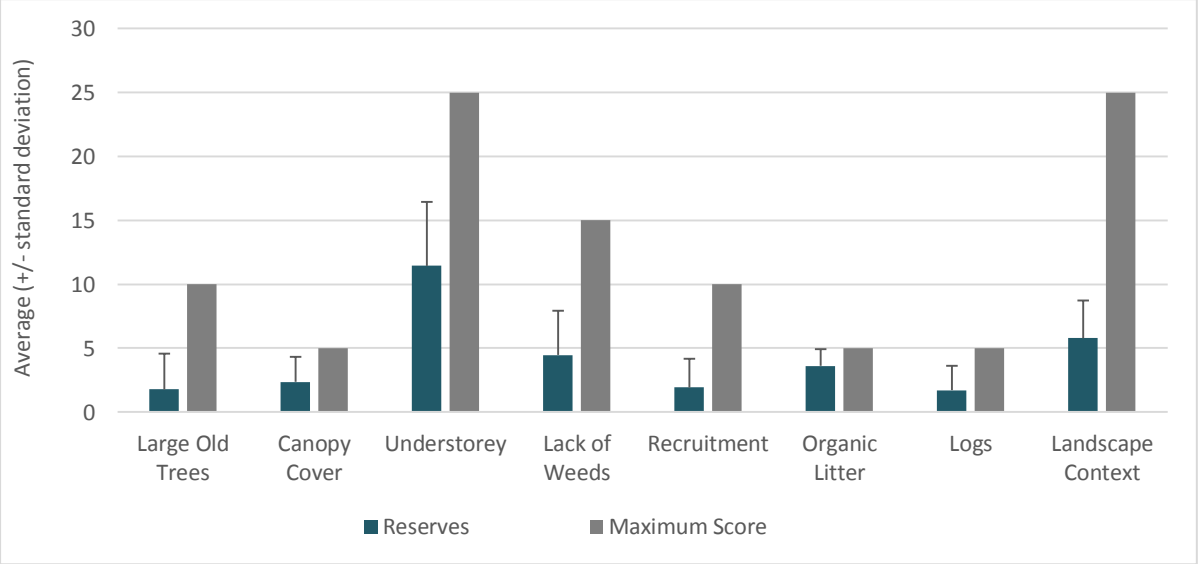


Figure 9. Average 'Site Condition' and 'Landscape Context' scores across all Habitat Zones

3.5 Streetscape Assessments

Twelve Streetscapes were determined and assessed according to methods outlined above, composed of 6 native/exotic pairs. Due to the restricted occurrence of native street trees across the municipality, not all of the 'native' Streetscapes are composed of native only trees. However, in all cases, native trees account for >80% of trees. Overall, the satisfactory distribution and composition of Streetscapes were identified and assessed to allow a robust comparisons of exotic versus native Streetscapes.

In total 248 street trees were mapped and assessed and entered into a geospatial dataset. Dominant street trees were *London Planetree (76/30%), Yellow Gum (30/12%), and Spotted Gum (26/11%) (Figure 10).

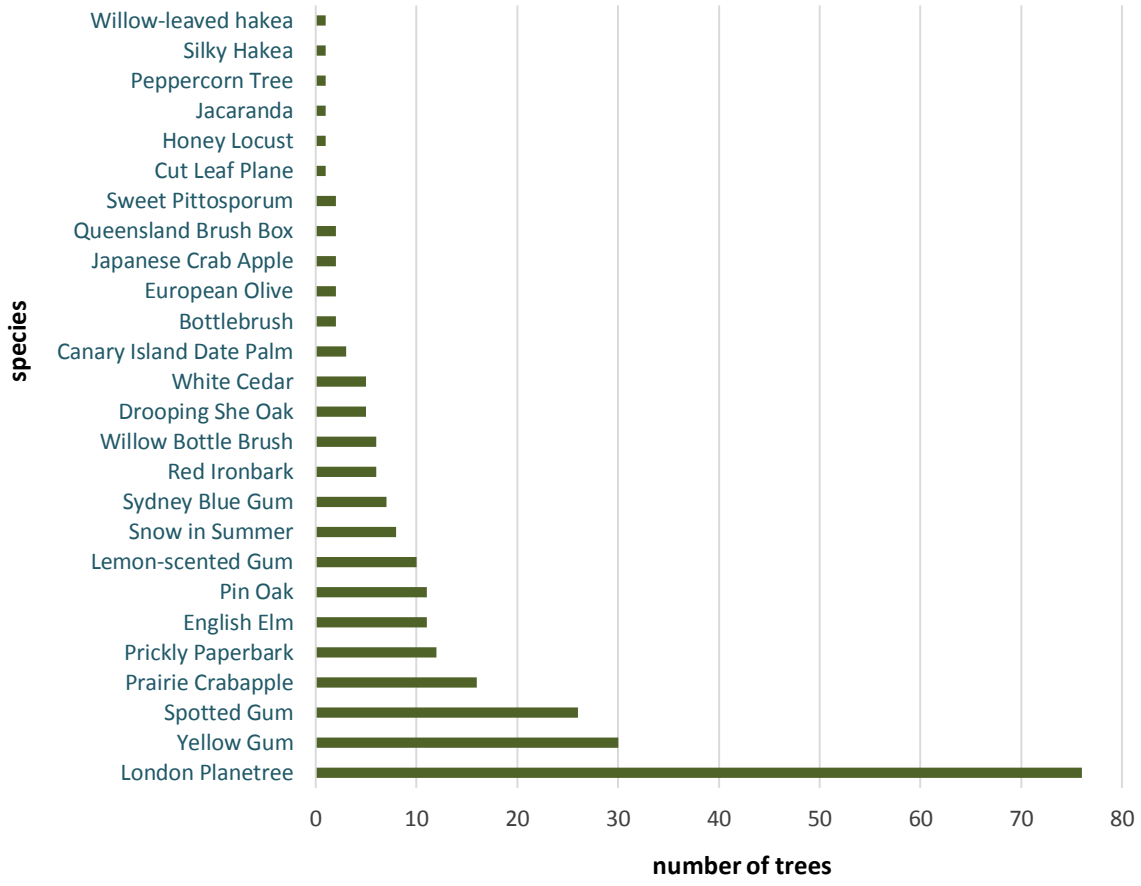


Figure 10. Tree species composition across all Streetscapes

Fissures were more abundant across native trees than exotic trees with an average score of 1 versus 0.5 respectively. Similarly, bark abundance was higher across native trees (score of 1.6) than exotic trees (score of 1.1). However, hollows were more abundant across exotic trees than natives, largely due to the older average age of exotic trees and lower frequency and slower rate of hollow formation in some of the native trees species (i.e. *Corymbia* sp. and *E. sideroxylon*) compared to exotic elms and oaks.

3.6 Flora Biodiversity Overview

Biodiversity Databases

Flora biodiversity searches of existing datasets were undertaken in January 2015. Datasets and searches included the:

- Atlas of Living Australia (ALA)
- Department of Environment and Primary Industries (DEPI) Victorian Biodiversity Atlas (VBA)
- Australia's Virtual Herbarium
- Fungimap
- Climatewatch
- iNaturalist
- Yarra City Council-held data

Samples of these biodiversity searches are presented as a native flora (Table 21) species list including significant species results in APPENDIX 2 below. Significant species are those listed as state threatened under the Victorian FFG Act or Victorian DEPI Advisory list, nationally threatened under the Commonwealth EPBC Act, or as a listed migratory species under the EPBC Act or international treaties.

Flora Surveys 2014-2016

In the below sections, results of biodiversity searches are combined with flora records obtained during 2014-2016 undertaken by Practical Ecology. Flora records were made during the process of completing lifeform checklists for habitat zones, quadrat surveys, and incidental observations. The results are discussed individually below the following summary of flora diversity and composition across the City of Yarra and surrounds.

Flora species recorded during the 2014-2016 surveys are provided below in Table 23 (APPENDIX 3)

3.6.1 Flora Diversity and Taxon Composition

Over 20,000 flora records were obtained through biodiversity databases searches and field surveys for the City of Yarra and surrounds (with 5 kilometers). A total of 2753 taxa have been recorded to at least 7 broad taxonomic groups. Flowering plants (angiosperms) dominated flora records accounting for over 80% of species and 90% of records. Within the angiosperms, dicots accounted for 63% of taxa and monocots (e.g. grasses and lilies) for 21% (see Figure 11 below).

The remaining species diversity was accounted for mostly by fungi (9%), followed by Mosses, Hornworts and Liverworts (3%), and with amoebas, ferns, algae, and gymnosperms making up the remaining 6% of taxa. This composition of different flora groups was again reflected in the relative number of records observed within the study area (Figure 12).

Figure 11 below shows the composition of floristic taxon diversity across the City of Yarra and surrounds. Numbers of taxa belonging to each group are shown. Figure 12 illustrates the proportional abundance of each taxonomic group based on observations. Numbers represent the total number of observations for each taxonomic group.

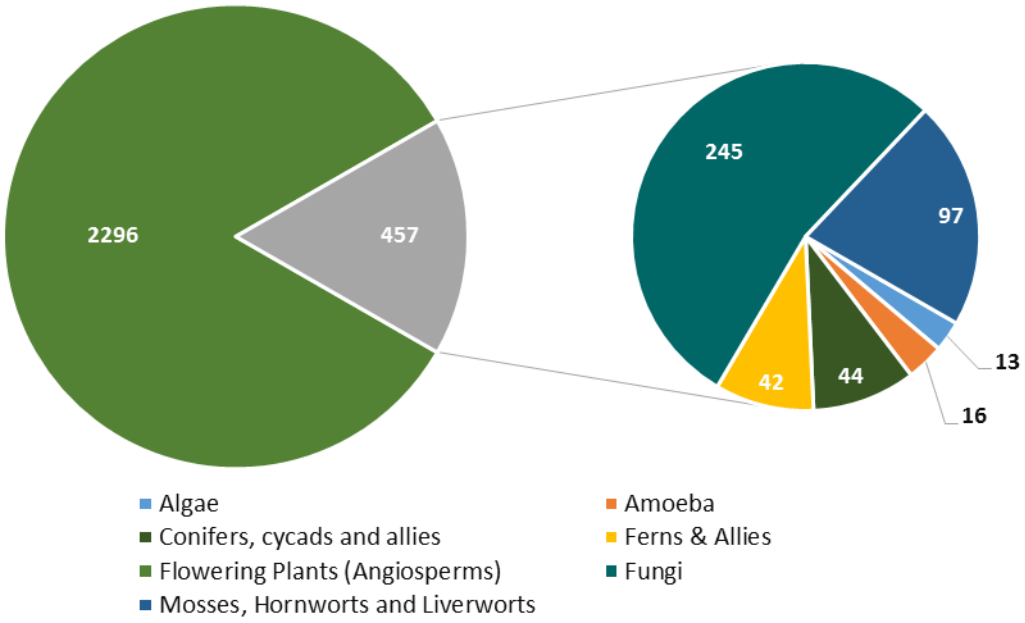


Figure 11. Flora species diversity by taxonomic group

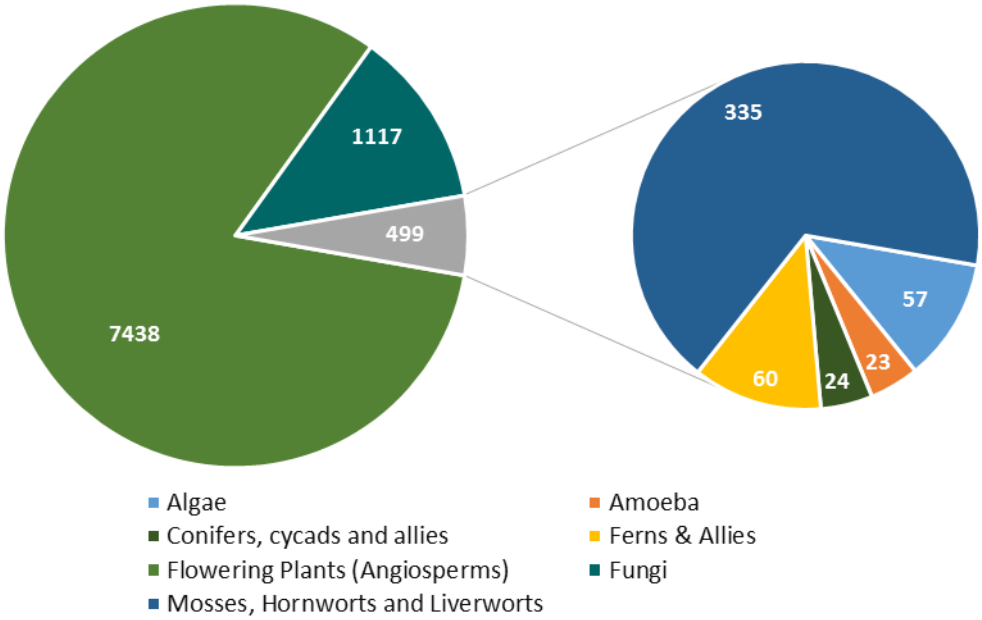


Figure 12. Number of flora records by taxonomic group

Within the City of Yarra, 961 taxa have been recorded from 5374 records. A total of 3670 flora records were found for council reserves included in this survey representing 604 taxa. Of these, approximately half (275 taxa) were indigenous.

Flora species diversity and abundance was similarly evenly divided amongst indigenous and exotic taxa in the surrounding 5 km area (Figure 13). A smaller number of naturalised natives were also recorded. A total of 603 species were recorded within council reserves composed of 275 indigenous flora, 307 exotic, and 19 naturalised natives. Some of the databases (VBA) have a bias against records for cultivars, naturalised native, and exotic garden species records which may skew the results somewhat towards the native spectrum. However, this likely reflects the relative proportions of native versus exotic species and records across council reserves.

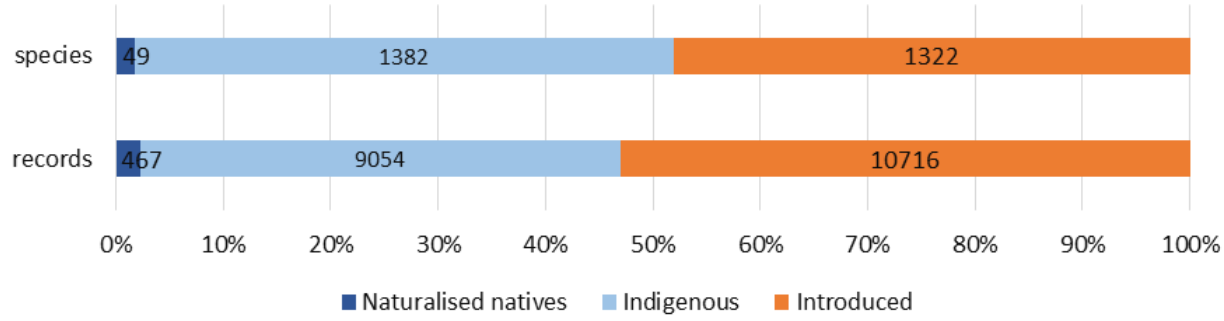


Figure 13. Composition of flora origin

3.6.2 Flora Surveys 2014-2016

New flora species records were made during the completion of Habitat Zone lifeforms checklists for each of 59 zones and in establishing 16 flora quadrats across several council reserves.

A total of 3174 new flora records were made in the 2014-2016 surveys. As database searches revealed only 498 flora records for council reserves, this amounts to a substantial increase in flora records for the council reserve system.

New records were composed of 211 introduced flora species, 209 indigenous, and 20 naturalised native species. Of these 430 species, 389 were detected across habitat zones (2673 records) and 223 within quadrats (499 records). These proportions recorded in these surveys reflect the results and proportions of indigenous versus exotic flora species in the wider council area and surrounds.

3.7 Fauna Biodiversity Overview

3.7.1 Biodiversity Databases

Fauna biodiversity searches of existing datasets were undertaken in January 2015. Datasets and searches included the:

- Department of Environment and Primary Industries (DEPI) Victorian Biodiversity Atlas (VBA)

- Birdlife Australia Database
- Atlas of Living Australia (ALA)
- Australian Platypus Conservancy Database
- Melbourne Water databases
- Yarra City Council-held data

All searches included all areas within the City of Yarra and surrounding land within a 5km radius of the municipality's boundary. Major sources of records were the VBA, Birdlife, and ALA datasets.

The results of these searches are presented as native fauna species lists (Table 22) in APPENDIX 2 listed according to fauna groups including significant species. Significant fauna species records within 5 km of the City of Yarra are illustrated in Map 10. Significant species are those listed as state threatened under the Victorian FFG Act or Victorian DEPI Advisory list, nationally threatened under the Commonwealth EPBC Act, or as a listed migratory species under the EPBC Act or international treaties.

Fauna Surveys 2014-2016

In the below sections, results of biodiversity searches are combined with fauna records obtained during 2014-2016 surveys undertaken by Practical Ecology. Fauna records were made through a comprehensive series of general and targeted fauna survey methods including:

- 2 ha 20 minute bird census surveys
- Nocturnal spotlighting surveys for nocturnal birds and mammals
- AnaBat deployment for microbats
- Wildlife cameras for ground fauna
- Call playback and active searches for frogs
- Active reptile searches
- Incidental records over the course of surveys

The results of these surveys are discussed separately below the following summary of fauna diversity and composition across the City of Yarra and surrounds. Detailed tabulated results are provided in Table 24 below in APPENDIX 3.

3.7.2 Fauna Diversity and Taxon Composition

Over 240,000 fauna records were obtained through biodiversity databases searches and field surveys for the City of Yarra and surrounds (with 5 kilometres). Within the City of Yarra there were 32,842 fauna records and within council reserves 12,130 records.

In total, 1341 species have been recorded within 5 kilometres of the City of Yarra. Of these 534 species have been recorded within the City of Yarra, while 278 species have been observed within council reserves surveyed as part of the 2014-2016 biodiversity census.

Birds, insects, and invertebrates combined dominated species richness within the broader landscape study area, accounting for over 70% of species. Other major fauna groups by species richness were fish, molluscs, and crustaceans. Taxonomic groups accounting for less than 5% of the species richness were mammals, amphibians, and reptiles. Within the City of Yarra, patterns of species richness amongst taxonomic groups was similar, although birds, aquatic invertebrates and mammals accounted for a greater relative diversity. Reptiles and amphibians accounted for smaller numbers of species and records (Figure 14, Figure 14, and Figure 16). Birds accounted for the vast majority of vertebrate fauna diversity along with individual fauna observations, equating to 92% and 96% of all fauna sightings within the City of Yarra and the surrounding landscape respectively. Patterns in other fauna group observations were similar between the surrounding landscape and the City of Yarra. Generally, these results reflect the relative biodiversity of different fauna groups in south-eastern Australia at a local level.

The relative abundance of each fauna group (Figure 16), however, is strongly influenced by observational bias. Although numbers of observations for each fauna group may in part reflect the high abundance of birds within urban landscapes, for the larger part, it reflects the relative intensity of sampling undertaken for each fauna group and the associated dominance of sampling being undertaken for birds and conversely the paucity of sampling being undertaken for other taxonomic groups. In other words, birds are conspicuous and large numbers of observers are suitable keen and skilled to identify and record birds while there are few individuals actively sampling other fauna groups such as invertebrates and insects. Nonetheless, a large proportion of vertebrate fauna diversity and abundance within the City of Yarra and surrounds is accounted for by birds while a significant additional diversity is comprised by a diversity of different invertebrate groups.

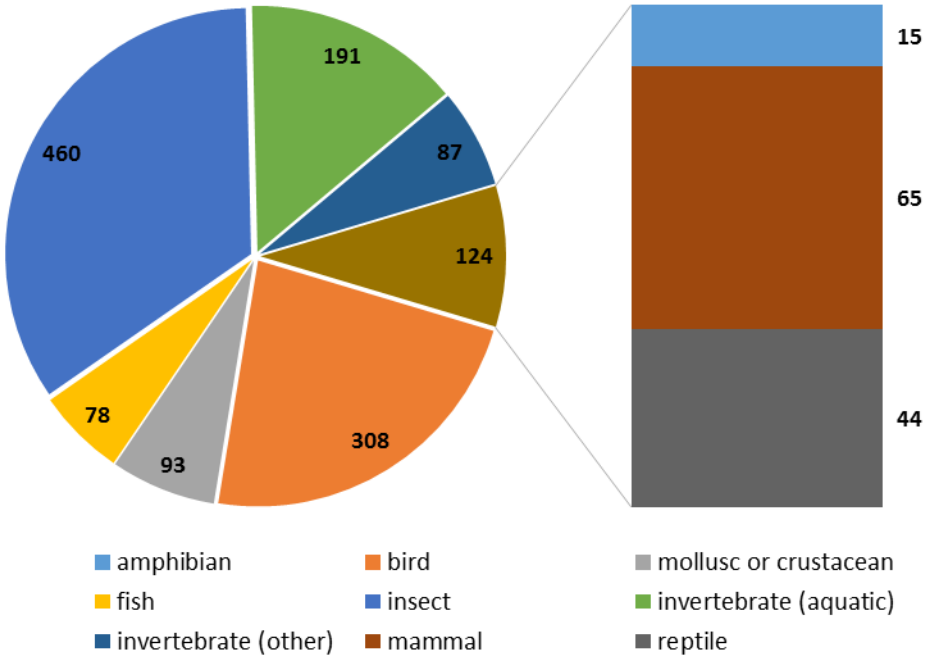


Figure 14. Fauna species richness by taxonomic group, City of Yarra and surrounds (5 km)

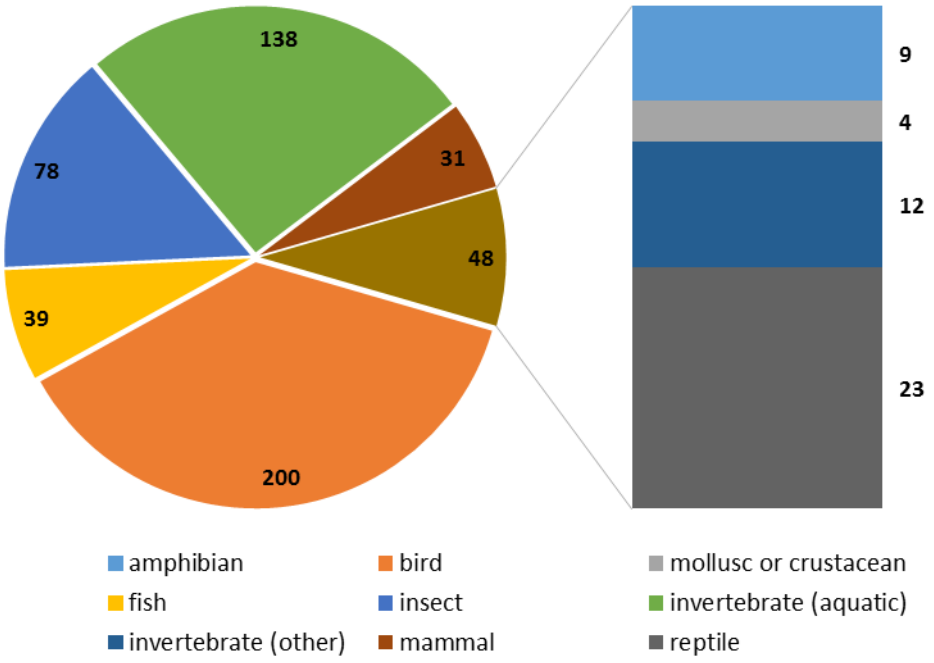


Figure 15. Fauna species richness by taxonomic group within the City of Yarra

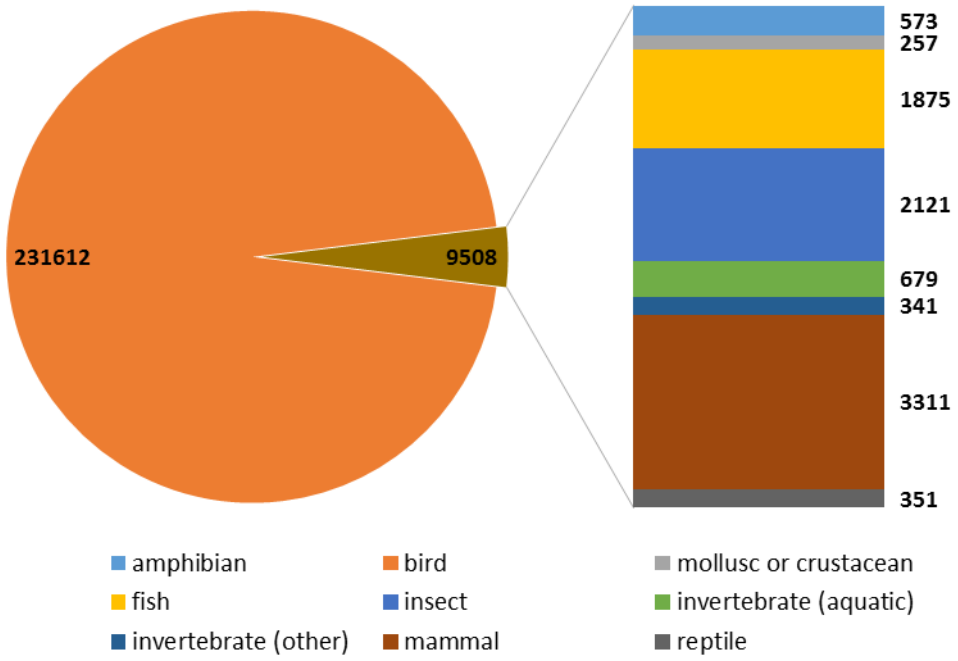


Figure 16. Relative % of fauna group records within the City of Yarra and surrounds (5 km)

Native animals dominated fauna diversity and abundance within both the City of Yarra and surrounding landscape accounting for over 90% of species and 80% of all animal sightings.

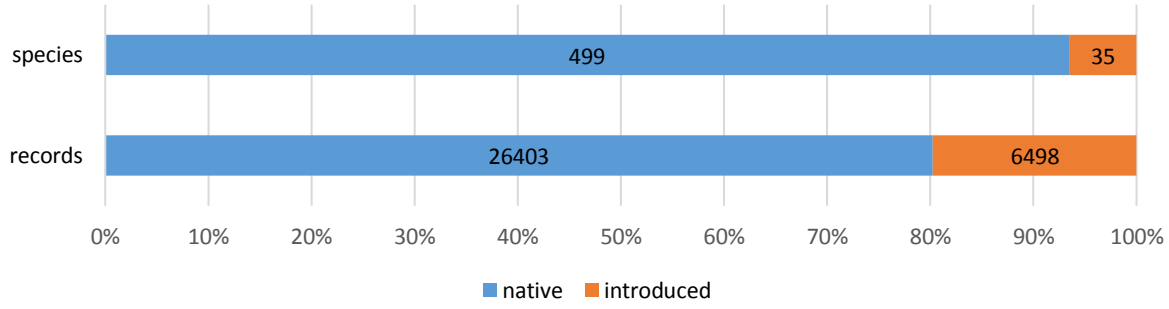


Figure 17. Proportion of native and introduced fauna species in the City of Yarra

3.8 Fauna Surveys 2014-2016

A comprehensive fauna census was undertaken in 2014-2016 utilising a range of survey techniques to detect vertebrate fauna species.

In total, 953 new fauna observations were made over the course of the Biodiversity Health Survey.

The majority of records were for bird and mammals species, with smaller numbers of records for reptiles, amphibians, invertebrates, and fish (Figure 18).

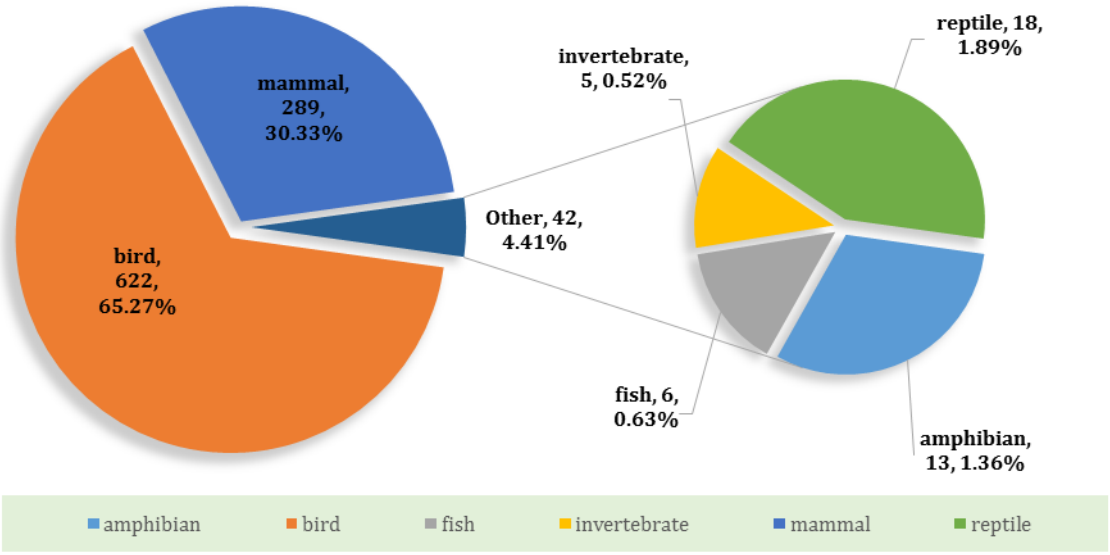


Figure 18. Fauna taxon composition across all 2014-2016 BHS observations

The following sections report on the results of specific targeted fauna surveys undertaken during the 20150-2016 census.

3.8.1 Bird Census

A diversity of bird species were detected even in small pocket parks although larger reserves supported a slightly higher diversity on average (Table 13). The greatest diversity of birds was observed at Dights Falls Park. Bundara Street Reserve, Hall Reserve, McConchie Reserve, and Kevin Bartlett Reserve all recorded a high diversity of birds. Refer to Map 3 above for census areas and Map 5 (APPENDIX 1) for further information on reserve location.

Table 13. Bird diversity and abundance results for each pocket park and open space reserve

Park	Type	No. Species	No. Birds	Park Area (ha)	Survey Area (ha)
Browns Reserve	Pocket Park	6	14	0.09	0.09
Cambridge Park	Pocket Park	6	3	0.1	0.1
Clarke Street Park	Pocket Park	10	12	0.27	0.27
Dame Nellie Melba Park	Pocket Park	2	3	0.21	0.21
Edwardes Place	Pocket Park	5	12	0.12	0.12
Flockhart Reserve	Pocket Park	10	15	0.41	0.41
Garryowen Park	Pocket Park	5	10	0.08	0.08
Holden-Byrne Park	Pocket Park	5	9	0.32	0.32

Park	Type	No. Species	No. Birds	Park Area (ha)	Survey Area (ha)
Whitlam Place	Pocket Park	5	5	0.1	0.1
Alphington Park Wetland	Reserve	9	26	2.25	2
Annette's Place	Reserve	6	11	0.76	2
Bundara Street Reserve	Reserve	13	33	0.91	2
Citizens' Park	Reserve	7	90	2.47	2
Darling Gardens	Reserve	6	22	7.23	2
Dights Falls Park	Reserve	17	51	1.53	2
Edinburgh Gardens	Reserve	10	46	17.04	2
Hall Reserve (01)	Reserve	5	22	11.02	2
Hall Reserve (02)	Reserve	15	37	11.02	2
Harry Gallagher	Reserve	11	81	2.38	2
Kevin Bartlett Reserve	Reserve	12	57	24.25	2
Loys Paddock	Reserve	8	44	3.17	2
McConchie Reserve	Reserve	14	22	2.82	2
Rudder Grange	Reserve	8	53	0.54	2
Rushall Recreation Reserve	Reserve	11	42	2.61	2
Thomas Kidney Reserve	Reserve	10	115	3.62	2
Total		**44**	**835**		

The average number of bird species observed in pocket parks and open space reserves did not differ greatly (Figure 19). However, the average abundance of animals did differ considerably, with over four times the abundance of birds observed in reserves. Bird species diversity tracked somewhat with area up to 10 hectares but a number of outliers were also observed suggesting area is not the only predictor of bird diversity. Diversity generally tracked with park area (Figure 20).

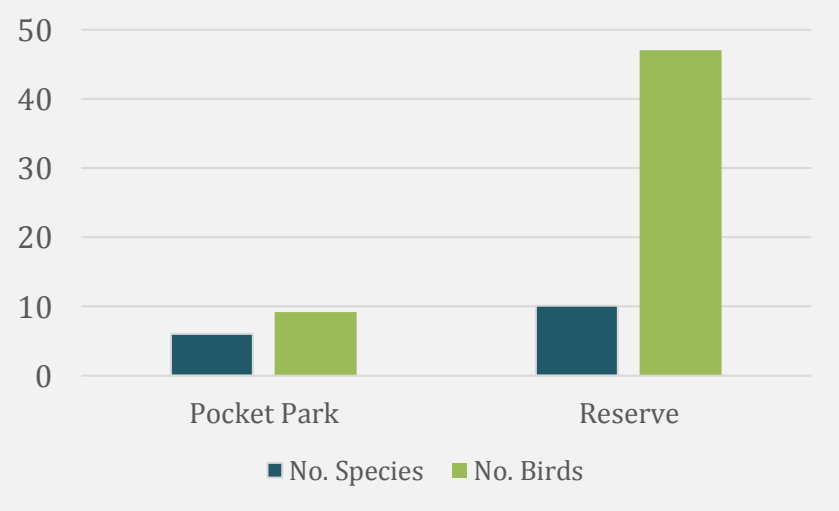


Figure 19. Total bird species diversity and abundance parks and Open Space Reserves

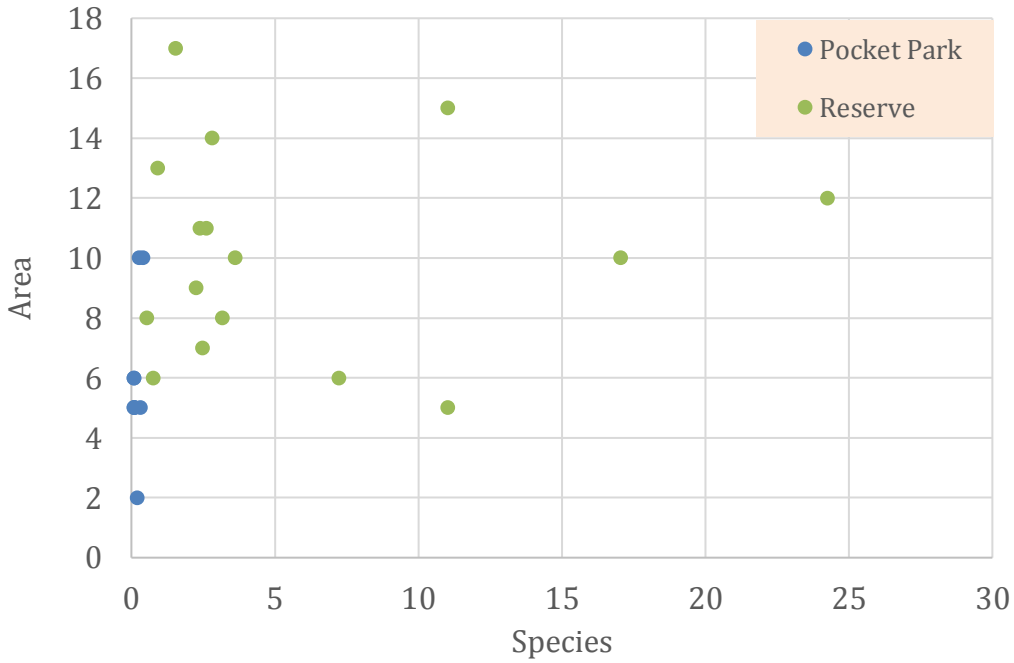


Figure 20. Relationship between species diversity and reserve area (hectares)

Bird species abundance and diversity across Council land varied across the surveyed reserves and pocket parks (Table 14). More common native species included the Australian Magpie, Noisy Miner, Red Wattlebird, Rainbow Lorikeet, Silver Gull, Magpie-lark, and Galah. Common introduced bird species included Spotted Turtle-dove*, Common Myna*, Rock Dove*, and Common Starling*. The Common Myna* and Rock Dove* accounted for a large number of individual bird species observed, while the Rainbow Lorikeet was the most abundant native bird species by a considerable margin.

Table 14. Total abundance for each bird species and Open Space Reserve combination, each species' (right) and reserve' (bottom) relative (%) contribution to the total number of observations, and total numbers of observations in each reserve (bottom). * *denotes introduced species*.

Species \ Site	Alphington Park Wetland	Annette's Place	Browns Reserve	Bundara Street Reserve	Cambridge Park	Citizens' Park	Clarke Street Park	Dame Nellie Melba Park	Darling Gardens	Dights Falls Park	Edinburgh Gardens	Edwardes Place	Flockhart Reserve	Garryowen Park	Hall Reserve (01)	Hall Reserve (02)	Harry Gallagher	Holden-Byrne Park	Kevin Bartlett Reserve	Loys Paddock	McConchie Reserve	Rudder Grange	Rushall Recreation Reserve	Thomas Kidney Reserve	Whitlam Place	% of Total Observations
Australian Magpie	1	1			1	2	3	1	4		2		3			1	5	2	5	5	1	2	5			5.3
Bell Miner										1																0.1
Black-faced Cuckoo-shrike																1										0.1
Chestnut Teal																							1			0.1
Common Bronzewing																							1			0.1
Common Myna*	1		2	1		20				3	6		1	4			28		10	6	1	1	15	13	2	13.7
Common Starling*						5				2											2			2		1.3
Crested Pigeon											2					1	3		2		1			3		1.4
Dusky Moorhen	1			3																	3		2			1.1
Eastern Rosella													1			4										0.6
Eastern Spinebill																2										0.2
Eurasian Coot				2																						0.2
European Blackbird*		1		1			2							1	1	1										0.8
Galah			2														14		2							2.2
Grey Butcherbird				1					1		1		1			1										0.6
Grey Fantail										1																0.1

Species \ Site	Alphington Park Wetland	Annette's Place	Browns Reserve	Bundara Street Reserve	Cambridge Park	Citizens' Park	Clarke Street Park	Dame Nellie Melba Park	Darling Gardens	Dights Falls Park	Edinburgh Gardens	Edwardes Place	Flockhart Reserve	Garryowen Park	Hall Reserve (01)	Hall Reserve (02)	Harry Gallagher	Holden-Byrne Park	Kevin Bartlett Reserve	Loys Paddock	McConchie Reserve	Rudder Grange	Rushall Recreation Reserve	Thomas Kidney Reserve	Whitlam Place	% of Total Observations
House Sparrow*																				2						0.2
Laughing Kookaburra							1																			0.1
Little Black Cormorant																						1				0.1
Little Corella																				7						0.8
Little Pied Cormorant																					1		1			0.2
Little Raven				1							11	3				1	3		2			1				2.6
Little Wattlebird	2																		1		2	2		1		1.0
Magpie-lark		1	4			3			6	1	3					1	1		2		2			1		3.0
Noisy Miner	7	3		1			1		3	16			3		2	4	2	3	10	12	3	4		3		9.2
Pacific Black Duck	9																						2			1.3
Pied Currawong	3										4						1	1	6				2			2.0
Purple Swamphen				5																	1					0.7
Rainbow Lorikeet	1		4	4	1				7	3	13	6	4	3	16	15	13	1	10	6		40		17		19.6
Red Wattlebird			1	8			1	2	1	2	2	2	1	1	1	1	6			4	2	2	10	3		6.0
Red-browed Finch										2																0.2
Rock Dove*		3		2		50	1			2	2	1							4					70	2	16.4
Rufous Fantail										1																0.1
Sacred Ibis										2																0.2
Silver Gull						5												2			1			2	1	1.3

Species \ Site	Alphington Park Wetland	Annette's Place	Browns Reserve	Bundara Street Reserve	Cambridge Park	Citizens' Park	Clarke Street Park	Dame Nellie Melba Park	Darling Gardens	Dights Falls Park	Edinburgh Gardens	Edwardes Place	Flockhart Reserve	Garryowen Park	Hall Reserve (01)	Hall Reserve (02)	Harry Gallagher	Holden-Byrne Park	Kevin Bartlett Reserve	Loys Paddock	McConchie Reserve	Rudder Grange	Rushall Recreation Reserve	Thomas Kidney Reserve	Whitlam Place	% of Total Observations
Spotted Pardalote																										0.0
Spotted Turtle-dove*			1			5	1			2				1		1	5						2			2.2
Striated Thornbill				3											2	2										0.8
Superb Fairy-wren							1			6						1										1.0
Welcome Swallow		2								2									3		1					1.0
White-browed Scrubwren				1																						0.1
White-faced Heron	1																									0.1
White-plumed Honeyeater					1					5			1							2	1		1			1.3
Willie Wagtail							1																			0.1
No. Observations	26	11	14	33	3	90	12	3	22	51	46	12	15	10	22	37	81	9	57	44	22	53	42	115	5	835
% of Total	3	1	2	4	0	11	1	0	3	6	6	1	2	1	3	4	10	1	7	5	3	6	5	14	1	

3.8.2 Reptile and Amphibian Surveys

Few species of reptiles and amphibians were detected during intensive active searches on council land selected based on the best quality habitat (Table 15). Five species of amphibians and two species of reptiles were observed during census surveys. An additional three species of reptiles were observed incidentally outside of the active searches.

Reptile diversity is likely higher than suggested but numbers are likely low and difficult to detect. Once-off surveys can return variable results depending on the specific environmental conditions at the time of survey. High numbers of cats and foxes in urban areas combined with limited habitat features can substantially reduce the diversity of reptiles. The considerable number of additional species detected as incidental sightings for reptiles demonstrate this likely higher diversity although abundance is likely to be low and variable.

Additional incidental records were made of Common Blue-tongued Lizard (2), Eastern Brown Snake (1), Eastern Water Dragon, and Tiger Snake (4) during the course of the 2014-2016 biodiversity census.

Table 15. Reptile and amphibian census results with numbers of individuals

	Alphington Park Wetland	Bundara Street Reserve	Bundara Street Reserve	Burnley Park	Circus Site	Dights Falls Park	Hall Reserve	Kevin Bartlett Reserve	Loys Paddock	McConchie Reserve	Rudder Grange	Rushall Recreation Reserve	Grand Total
Frogs													
Common Froglet	7					5	1			1	1		15
Southern Brown Tree Frog							1	1			1		3
Southern Bullfrog (ssp. unknown)	1												1
Striped Marsh Frog	1												1
Verreaux's Tree Frog											1		1
Reptiles													0
Garden Skink	1	1				5	3						10
Weasel Skink							2						2
Common Blue-tongued Lizard													0
Incidental Records													0
Eastern Brown Snake			1	1			2						4
Garden Skink							1						1
Lampropholis sp.												2	2
Skink sp.							2						2
Tiger Snake	2				2		1		1				6
Water Dragon				1									1
Grand Total	12	1	1	2	2	10	13	1	1	1	3	2	33

3.8.3 Wildlife Cameras

Results from wildlife camera surveys are what you expect from an urbanised landscape (Table 16). Wildlife cameras are best for detecting ground-dwelling animals, particularly mammals. This group is substantially reduced in diversity and abundance in urban landscapes. The low abundance and quality of ground habitat and poor habitat connectivity severally impacts mammalian populations and other terrestrial ground-dwelling fauna such as reptiles and amphibians,

However, we have found cameras are also quite successful in detecting wetland bird species. The Buff-banded Rail detected at Hall Reserve was a surprising find and illustrates that Council reserves may support more species than one would expect.

Table 16. Results of wildlife camera surveys

Species	Day	Night	Total	%	Locations
*Black Rat	0	49	49	43.8%	all
Buff-banded Rail	2	0	2	1.8%	Hall Reserve
Common Brushtail Possum	0	18	18	16.1%	Hall Reserve & Rushall Reserve
*Common Myna	1	0	1	0.9%	Alphington Park Wetland
*Dog	1	0	1	0.9%	Hall Reserve
Grey Currawong	4	0	4	3.6%	Alphington Park Wetland
*Human	2	0	2	1.8%	Hall Reserve & Alphington Park Wetland
Magpie-lark	10	0	10	8.9%	Hall Reserve & Alphington Park Wetland
*Red Fox	3	22	25	22.3%	all
Grand Total	23	89	112		

3.8.4 Microbat Surveys

A great diversity of bat species were recorded by AnaBat detectors (Table 17). Seven species of microbat and one species of megabat ('fruit-bat') were recorded during field surveys with numerous species recorded at each census site. Bats account for over 50% of the native mammal species detected within the municipality (8 out of 15 species) and of mammalian diversity within urban landscapes.

The White-striped Freetail Bat *Tadarida australis* was the commonly encountered species across reserves sampled while Long-eared bats were less frequently detected. Potential records of the Yellow-bellied Sheathtail Bat *Saccolaimus flaviventis* are significant observations for this species which is rarely detected. All reserves sampled had one or more bat species recorded during the census period.

Table 17. Results of microbat surveys

Row Labels	Alphington Park Wetland	Burnley Park	Hall Reserve (02)	Dights Falls Park	Hall Reserve (01)	Annette's Place	Darling Gardens	Edinburgh Gardens	Loys Paddock	McConchie Reserve	Rudder Grange	Kevin Bartlett Reserve	Bundara Street Reserve	Harry Gallagher	Park Street Linear [illegible]	Rushall Recreation [illegible]	Grand Total
Chocolate Wattled Bat	X	X	X	X	X		X		X				X				8
Forest Bat sp	X	X	X	X	X	X	X	X	X			X	X				11
Goulds Wattled Bat / Mormopterus sp	X	X	X		X			X		X	X						7
Gould's Wattled Bat	X	X	X	X	X	X	X	X	X	X		X					11
Grey-headed Flying-fox			X	X		X	X	X			X			X	X	X	9
Large Forest Bat	X	X	X	X													4
Little Forest Bat	X	X	X	X	X		X	X	X	X		X	X				11
Long-eared bats						X				X	X						3
Microbat (Unknown sp)		X			X						X						3
Southern Freetail Bat	X	X	X			X				X							5
White-striped Freetail Bat	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	20
Yellow-bellied Sheathtail Bat	X	X	X														3
Grand Total	#	#	#	7	7	6	6	6	6	6	5	4	3	2	2	2	95

3.9 Significant Species Populations

3.9.1 Significant Flora

Database searches revealed 113 'threatened' flora species as listed under the EPBC Act, FFG Act, or DEWLP advisory list potentially occurring within 5km of the City of Yarra.

The distribution of significant species records is shown in Map 9 below (APPENDIX 1).

A review of records and species distributions discounted a large number of species based mostly on occurrence outside their natural range (mostly as planted cultivars) but also reported spatial inaccuracy or lack of recent records. For example, stands of Spotted Gum *Corymbia maculata* and Giant Honey-myrtle *Melaleuca armillaris subsp. armillaris* are considered outside their natural range.

Of the remaining 18 threatened flora species recorded with 5 kilometres of the City of Yarra, seven species have been recorded within the municipality (Table 18). Only one threatened species was confirmed as present within the current census, namely Leafy Twig-sedge *Cladium procerum*.

Based on availability of habitat, years since last recorded, and total number of records within the surrounding landscape, 8 species have some potential to have isolated or single occurrences within the City of Yarra and immediate surrounds. There is some potential for isolated remnant plants or populations of Fragrant Saltbush *Rhagodia parabolica* and Rosemary Grevillea *Grevillea rosmarinifolia subsp. rosmarinifolia* although most plants are likely planted specimens. Undetected remnant threatened populations are most likely to occur along the Yarra River and Merri Creek corridors.

Table 18. Significant flora species in the City of Yarra and surrounds (5 km radius).

Common Name	Scientific Name	EPBC	FFG	VROTS	Year	Year (YYC)	Year (Reserve)	Total Records	YCC Records	Reserve Records	Likelihood occurrence	Comment
Austral Tobacco	*Nicotiana suaveolens*			r	2008	1997	1987	19	5	1	Potential	Recorded in McConchie Reserve in 1987. Requires confirmation.
Basalt Peppercress	*Lepidium hyssopifolium*	EN	L	e	1980			5			Unlikely	
Fragrant Saltbush	*Rhagodia parabolica*			r	2015	2015	2015	11	4	4	Potential	Recorded in 2015 but planted specimens only
Large-flower Crane's-bill	*Geranium sp. 1*		L	e	2010			2			Potential	
Large-headed Fireweed	*Senecio macrocarpus*	VU	L	e	2012			1			Unlikely	
Leafy Twig-sedge	*Cladium procerum*			r	2015	2015	2015	2	2	2	Present	Recorded in McConchie Reserve in 2014-2016 BH census
Matted Flax-lily	*Dianella amoena*	EN	L	e	2010			3			Potential	
Native Peppercress	*Lepidium pseudohyssopifolium*			k	2008	2003	2003	19	5	3	Potential	Recorded in Alphington Park Wetland in 2003.
Rosemary Grevillea	*Grevillea rosmarinifolia subsp. rosmarinifolia*			r	2006	2006	2006	23	10	10	Potential	Recorded in 2015 but planted specimens only
Silky Golden-tip	*Goodia pubescens*			r	1969			1			Unlikely	
Slender Bindweed	*Convolvulus angustissimus subsp. omnigracilis*			k	2006			2			Potential	
Small Golden Moths	*Diuris basaltica*	EN	L	e	2012			3			Unlikely	
Studley Park Gum	*Eucalyptus x studleyensis*			e	2006	1998		13	8		Potential	
Sunshine Diuris	*Diuris fragrantissima*	EN	L	e	2004			2			Unlikely	
Swamp Flax-lily	*Dianella callicarpa*			r	1991			8			Unlikely	
Veiled Fringe-sedge	*Fimbristylis velata*			r	1998			2			Unlikely	
Western Golden-tip	*Goodia medicaginea*			r	2010			1			Unlikely	

KEY

Conservation status under EPBC Act 1999:
EX: Extinct, CR: Critically endangered, EN: Endangered, VU: Vulnerable and CD: Conservation dependant

Conservation status under FFG Act 1988:
L: Listed, N: Nominated, X: Rejected, D: Delisted

Victorian Rare or Threatened Species (VROT) (DEPI 2014a)
x: Presumed extinct, e: Endangered, v: Vulnerable, r: rare and k: poorly known

3.9.2 Significant Fauna Species

Analysis of combined fauna records from databases searches and 2014-2016 biodiversity health census revealed 100 significant fauna species observed within 5 kilometres of the City of Yarra. Sixty-eight (84) of these species are listed as threatened at the national or state level. Twenty-four species are listed as nationally threatened under the EPBC Act and 47 are listed as threatened under the Victorian FFG Act. Another 33 species are listed as threatened under the Victorian advisory list of threatened species (Table 19).

Distribution of significant fauna records within 5 kilometres of the City of Yarra is shown in Map 10 below (APPENDIX 1).

Five nationally threatened species are likely to make use of habitat within the City of Yarra and immediately adjoining waterways and bushland. These species include the Critically Endangered Swift Parrot *Lathamus discolor*, the Endangered Macquarie Perch *Macquaria australasica* and Regent Honeyeater *Anthochaera phrygia*, and the Vulnerable Grey-headed Flying-fox *Pteropus poliocephalus* and Australian Grayling *Prototroctes maraena*.

A further fifteen state-threatened species are considered likely to make regular use of habitat within or immediately adjoining the City of Yarra. These include the Eastern Great Egret *Ardea modesta*, Azure Kingfisher *Alcedo azurea*, Nankeen Night Heron *Nycticorax caledonicus hillii*, Pied Cormorant *Phalacrocorax varius*, Hardhead *Aythya australis*, Clamorous Reed Warbler, *Acrocephalus stentoreus*, Rufous Fantail *Rhipidura rufifrons*, and Golden Perch *Macquaria ambigua*. Other threatened or migratory species recorded within the City of Yarra may also make some use of habitat on an irregular basis for migration, dispersal, and foraging.

Nearly all of the above species are restricted to aquatic environments or adjacent riparian habitats and all are likely to depend on riparian and aquatic habitats along the Yarra River, Merri Creek, and Darebin Creek corridors for foraging, dispersal, and/or migration. Stands of Yellow Gum *Eucalyptus leucoxylon*, Yellow Box *Eucalyptus melliodora*, and Mugga Ironbark *Eucalyptus sideroxylon* within the City of Yarra and adjoining areas (Yarra Bend Parklands) likely provide food resources for the Swift Parrot during its summer and winter migrations between its breeding habitat with Tasmania and summer foraging areas in south-eastern Australia.

The Grey-headed Flying-fox *Pteropus poliocephalus* has a large established population within the City of Yarra and adjoining areas and likely makes significant us of habitat resources across the council reserve system and urban environments including flowering eucalypts and fruit trees. The Nankeen Night Heron is resident at a number of locations along the Yarra River and observed on a number of occasions during the 2014-2016 census.

Table 19. Significant fauna species in the City of Yarra and surrounds (5 km radius).

Species	EPBC	FFG	VICADV	TREATY	Last Record (5 km)	Last Record City of Yarra	Records (5Km)	City Yarra Records	Likely Occurrence	Taxon Group
Arctic Jaeger				J,R	2000		4			Birds (marine)
Australasian Bittern	EN	L	en		2015		5			Birds
Australasian Shoveler			vu		2015	1966	28	1		Birds
Australian Bass		X			2014	2014	10	8	M/R	Fish
Australian Fur Seal		X			1991		1			Mammals
Australian Grayling	VU	L	vu		2014	2014	436	436	M	Fish
Australian Mudfish		L	cr		1991	1991	3	3	M	Fish
Australian Painted Snipe	VU	L	cr	C	2011		3			Birds
Azure Kingfisher			nt		2008	2007	37	8	R	Birds
Baillon's Crake		L	vu		1991		3			Birds
Barking Owl		L	en		2001	1966	3	1		Birds
Black Falcon			vu		2011	2008	14	1		Birds
Black-eared Cuckoo			nt		2013		1			Birds
Black-faced Cormorant			nt		2014		2			Birds
Black-faced Monarch				B	2010		2			Birds
Blue Petrel	VU				1981		1			Birds (marine)
Blue-billed Duck		L	en		2015	2009	46	2		Birds
Brolga		L	vu		2014		10			Birds
Brown Toadlet		L	en		2005	2005	1	1		Amphibians
Caspian Tern		L	nt	C,J	2015	1988	10	1		Birds (waders)
Cattle Egret				C,J	2015	2006	895	8	M	Birds
Clamorous Reed Warbler				B	2009	1976	286	8		Birds
Common Bent-wing Bat		L			1993		11			Bats
Common Diving-Petrel			nt		2012		7			Birds (marine)
Common Greenshank			vu	B,C,J,R	2014		5			Birds (waders)
Common Long-necked Turtle			dd		2015	2000	33	2	R	Reptiles
Common Sandpiper			vu	B,C,J,R	2007	1976	15	4		Birds (waders)
Common Tern				C,J,R	2004	1976	32	1	M	Birds (marine)
Curlew Sandpiper			en	B,C,J,R	2014	1966	7	1		Birds (waders)
Double-banded Plover				B	1999		1			Birds (waders)
Eastern Curlew			vu	B,C,J,R	2013	2013	91	90	M	Birds (waders)
Eastern Great Egret		L	vu	C,J	2016	2015	704	78	R	Birds
Emu			nt		2015		2			Birds
Fairy Prion	VU		vu		2013		4			Birds (marine)
Fairy Tern	VU	L	en		1976	1976	1	1	R	Birds (waders)
Fork-tailed Swift				C,J,R	2013		111			Birds
Freckled Duck		L	en		2015		5			Birds
Freshwater Catfish		L	en		2000		1			Fish
Glossy Grass Skink			vu		1991		2			Reptiles
Glossy Ibis			nt	B,C	1962		3			Birds
Golden Perch		X	nt		2002	1995	15010	15005	R*	Fish
Golden Sun Moth	CR	L	cr		2013		1			Invertebrates

Species	EPBC	FFG	VICADV	TREATY	Last Record (5 km)	Last Record City of Yarra	Records (5Km)	City Yarra Records	Likely Occurrence	Taxon Group
Grey Goshawk		L	vu		2016		18			Birds
Grey-headed Flying-fox	VU	L	vu		2016	2016	518607	111929	R	Bats
Growling Grass Frog	VU	L	en		2014		41			Amphibians
Hardhead			vu		2016	2013	4508	26	M	Birds
Humpback Whale	VU	L	vu	B	2013		1			Mammals
Intermediate Egret		L	en		2015	2011	11	3	R	Birds
Latham's Snipe			nt	B,C,J,R	2016	1976	40	3		Birds
Leathery Turtle	EN	L	cr	B	2011		2			Reptiles
Lewin's Rail		L	vu		2009	1957	6	1		Birds
Light-mantled Sooty Albatross		L		B	1977		1			Birds (marine)
Little Bittern		L	en		1958	1958	1	1		Birds
Little Egret		L	en		2015	2009	19	5	R	Birds
Long-footed Potoroo	EN	L	vu		2013		2			Mammals
Macquarie Perch	EN	L	en		2015	2014	134	17	R*	Fish
Magpie Goose		L	nt		1999		5			Birds
Major Mitchell's Cockatoo		L	vu		2008	1967	8	1		Birds
Marsh Sandpiper			vu	B,C,J,R	1999		4			Birds (waders)
Martin's Toadlet		L	cr		2004		1			Amphibians
Murray Cod	VU	L	vu		2015	1981	8	2		Fish
Murray Hardyhead	EN	L	cr		1989	1989	2	2		Fish
Murray River Turtle			vu		2011		2			Reptiles
Murray Spiny Crayfish		L	nt		1997		24			Crustacea
Musk Duck			vu		2015	1966	174	1		Birds
Nankeen Night Heron			nt		2016	2016	806	71	R	Birds
Orange-bellied Parrot	CR	L	cr		1999		1			Birds
Otway Bush Yabby			en		1977		1			Crustacea
Pacific Gull			nt		2015	1999	408	5	R	Birds (waders)
Pied Cormorant			nt		2016	2013	234	9	R	Birds
Plains-wanderer	VU	L	cr		1985		2			Birds
Pomarine Jaeger				C,J	1980		2			Birds (marine)
Powerful Owl		L	vu		2015	2014	436	6	R	Birds
Red Knot			en	B,C,J,R	1966	1966	1	1		Birds (waders)
Red-chested Button-quail		L	vu		2011		2			Birds
Red-necked Stint				B,C,J,R	2014	1966	9	1		Birds (waders)
Regent Honeyeater	EN	L	cr		1993	1993	18	2	M	Birds
Royal Spoonbill			nt		2016		148			Birds
Rufous Fantail				B	2015	2015	118	12	M	Birds
Satin Flycatcher				B	2014	2010	11	2	M	Birds
Sharp-tailed Sandpiper				B,C,J,R	1987	1966	4	1		Birds (waders)
Short-tailed Shearwater				J,R	2014		2			Birds (marine)
Shy Albatross	VU	L	vu		1984		1			Birds (marine)
Sooty Albatross	VU	L		B	1977		1			Birds (marine)
Sooty Oystercatcher			nt		2015		3			Birds (waders)

Species	EPBC	FFG	VICADV	TREATY	Last Record (5 km)	Last Record City of Yarra	Records (5Km)	City Yarra Records	Likely Occurrence	Taxon Group
Southern Elephant Seal	VU				1975		1			Mammals
Southern Giant-Petrel	EN	L	vu	B	1992		3			Birds (marine)
Southern Myotis			nt		1993	1993	1	1		Bats
Southern Toadlet			vu		2004		41			Amphibians
Spotted Harrier			nt		2014	1966	9	1		Birds
Striped Legless Lizard	VU	L	en		1975	1975	2	1		Reptiles
Swift Parrot	CR	L	en		2015	2012	358	23	M	Birds
Terek Sandpiper		L	en	B,C,J,R	2014		1			Birds (waders)
Turquoise Parrot		L	nt		2000		1			Birds
Tussock Skink			vu		2005		1			Reptiles
Whiskered Tern			nt		2015		74			Birds (waders)
White-faced Storm-Petrel			vu		2004		13			Birds (marine)
White-fronted Tern			nt		2004		2			Birds (waders)
White-throated Needletail			vu	C,J,R	2015	1975	342	1		Birds
Yellow-bellied Sheathtail Bat		L	dd		2016	2016	6	6	M?	Bats

KEY

Conservation status under EPBC Act 1999:
EX: Extinct, CR: Critically endangered, EN: Endangered, VU: Vulnerable and CD: Conservation dependant

Conservation status under FFG Act 1988:
L: Listed, N: Nominated, X: Rejected, D: Delisted

Victorian Rare or Threatened Species (VROT) (DSE 2009: 2013)
x: Presumed extinct, e: Endangered, v: Vulnerable, r: rare and k: poorly known

Origin
* = exotic species; # = denotes native species extended beyond natural range

Treaty
listed under a migratory treaty; B: Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II); C: China–Australia Migratory Bird Agreement; J: Japan-Australia Migratory Bird Agreement ; R: Republic of Korea-Australia Migratory Bird Agreement

Likely Occurrence in City of Yarra
R: Resident; M: migrant; *: introduced native to the City of Yarra and surrounds

3.10 Environmental Weeds and Pest Animals

Infestations of woody and high biomass weeds were recorded across the Open Space Reserves. Details of recorded infestations are given below in Table 20 and Map 11 in APPENDIX 1.

At eighteen (18) location infestation of high biomass or woody weeds were observed, mapped, and recorded. Infestations comprised of 11 weed species with the most severe infestations significantly threatening biodiversity values being those of Blackberry *Rubus fruticosus* sp. agg, Wandering Jew *Tradescantia fluminensis*, Boxthorn *Lycium ferocissimum*, and Alligator weed *Alternanthera philoxeroides*.

Table 20. Details of Weed Infestations

Park Name	Weed species	Cover	Area (m)	Severity
Circus Site	*Allocasuarina cunninghamiana*	26-50%	225	Moderate
Circus Site	*Tradescantia fluminensis*	26-50%	200	Serious
Coulson Reserve / Knott Reserve	*Lycium ferocissimum*	26-50%	750	Serious
Coulson Reserve / Knott Reserve	*Lycium ferocissimumL*	26-50%	300	Moderate
Coulson Reserve / Knott Reserve	*Opuntia spp.*	26-50%	300	Moderate
Hall Reserve	*Rubus fruticosus sp. agg*	26-50%	1000	Moderate
Kevin Bartlett Reserve	*Genista linifolia*	76-100%	25	Moderate
McConchie Reserve	*Alternanthera philoxeroides*	5-25%	25	Serious
McConchie Reserve	*Juncus acutus*	26-50%	200	Moderate
Rushall Recreation Reserve	*Fraxinus angustifolia subsp. angustifolia*	26-50%	300	Moderate
Rushall Recreation Reserve	*Fraxinus angustifolia subsp. angustifolia*	26-50%	300	Moderate
Rushall Recreation Reserve	*Rubus fruticosus sp. agg*	51-75%	30	Serious
Rushall Recreation Reserve	*Rubus fruticosus sp. agg*	51-75%	30	Serious
Rushall Recreation Reserve	*Salix x sepulcralis*	26-50%	750	Moderate
Rushall Recreation Reserve	*Salix x sepulcralis*	26-50%	750	Moderate
Rushall Recreation Reserve	*Tradescantia fluminensis*	51-75%	9	Serious
Rushall Recreation Reserve	*Tradescantia fluminensis*	51-75%	9	Serious
Rushall Recreation Reserve	*Tradescantia fluminensis*	26-50%	400	Serious

Major pest animals across the municaplity and immediate surrounds include the European Rabbit and Red Fox. Records for both species were largely confined along waterways including upper reaches of the Yarra River and Merri Creek and associated with larger expanses of open space and parkland. European Rabbits and Foxes were observed across several council reserves over the 2014-2016 census. Red Foxes are highly adapted to urban environments and densities can be very high in urbanised and industrustrial precincts with adjacent areas of open space.

3.11 Significant Habitat Trees

Significant habitat trees were recorded incidentally over the course of the 2014-2016 BHS. A focus was on large hollow-bearing native trees likely to provide significant shelter and foraging for native fauna within the City of Yarra. These results compliment an existing Significant Tree Register for the City of Yarra and the results of recent remote sensing survey (LIDAR) of canopy trees. The location of these habitat trees is shown in Map 12 below (APPENDIX 1).

A total of 82 significant habitat trees were identified over the course of the 2014-2016 BHS, all of which were eucalypts. A total of 232 trees are documented in the City of Yarra Significant Tree Register, 56 of which are Australia natives, 34 indigenous, and 142 exotic. All registered indigenous trees are River Red Gum *Eucalyptus camaldulensis* while Australian natives are largely smooth-barked gum trees. An additional 2432 trees of greater than 15m height were identified through remote sensing techniques in a separate study across public and private land within the City of Yarra, all of which have potential importance as significant habitat trees,

These trees contribute to the provision of habitat for fauna, particularly bird, mammal, and insect fauna across open space and urban spaces of the City of Yarra. While indigenous trees make the greatest contribution on a tree-by-tree basis due to indigenous fauna being adapted to readily exploit the habitat resources these species provide, both Australian natives and exotic trees also provide the larger part of habitat resources for fauna across the municipality. Both urban adapted and tolerant native fauna have learned to exploit non-indigenous food and shelter resources. Australian native trees provide suitable nectar (e.g. Tasmanian Blue gum *E. globulus* for Grey-headed Flying Foxes) and shelter for a range of fauna, while large exotic trees provide hollows (English Oak *Queues robur* in Edinburgh Gardens for possums), nesting sites (Canary Island pine *P. canariensis* for Rainbow Lorikeets, Galahs, and Little Corellas), shelter, and foraging opportunities for a range of indigenous fauna.

A large proportion of significant indigenous habitat trees within the City of Yarra were located within a few reserves. These were Burnley Park, Kevin Bartlett Reserve, Burnley Golf Course and Edinburgh Gardens. Smaller numbers of significant trees were mostly restricted to reserves along the Yarra River and Merri Creek such as Alphington Park Wetland and Fairfield Park. Extensive stands of large hollow-bearing Sugar Gums in Burnley Park and large old Indigenous River Red Gums in Kevin Bartlett Reserve are highly significant habitat resources of hollow-dependent native fauna including microbats.

Generally, large indigenous hollow-bearing trees are scarce across the municipality. Overall there a few indigenous trees as a proportion of total tree cover and where they do occur (i.e. Yellow Gum street plantings) they are young trees perhaps over a 100 hundred for developing a diversity and abundance of hollows. The diversity of hollow sizes (particularly the entrance size) is a key determinant on the diversity of different hollow-dependent species a tree can accommodate. Although a large number of hollows were recorded across the municipality during this survey, most had entrances which were either very small in size (<5cm) or very large (e.g. very large and old River Red Gums, stags, and exotic Elms or Oaks) with little variation in-between. Where they do occur, hollow-bearing trees (whether indigenous, naturalised native such as Sugar Gums, or

exotic) should be protected wherever possible as they are a key habitat resource which can take many human lifetimes and sometimes hundreds of year to replace naturally.

Many reserves across the City of Yarra such as Halls Reserve have relatively young indigenous trees likely to form hollows while a large proportion of older trees across the municipality are of species less likely to form hollows including both exotic and introduced native species. These include Mulga Ironbark, Spotted Gum, Lemon Scented Gum, and Plane Trees. Large and older Elms and Oaks also provided an abundance of hollows in reserves such as the Edinburgh Gardens and Curtain Square. Although they may provide hollows, exotic trees are less desirable than suitable indigenous species as they rarely provide a wide range of hollow sizes suitable for a diversity of native fauna and tend to be utilised by introduced and urban tolerant bird species (e.g. Rainbow Lorikeets, Galahs, and Corellas) and Brushtail Possums.

4. EXAMPLE RESULTS FOR SELECTED RESERVES

The following section provides a comprehensive summary of results for a selection of reserves representing the range of open space areas within the City of Yarra. These following examples illustrate the variety of survey techniques employed and results of surveys including mapping outputs as contained in core geospatial and spreadsheet dataset produced from the Biodiversity Health Survey.

4.1 Hall Reserve

HALL RESERVE	
General Site Description	Hall reserve comprises a long stretch of land located on the western bank of the Merri Creek directly to the south of Heidelberg Road. It includes open parkland in the north and on flatter ground at the top of the escarpment as well as vegetated slopes (some very steep) and lowlands. A concrete bicycle and walking track travels parallel to the creek and other less formal walking paths are present. A series of water treatment wetlands have also been installed and revegetated in the central portion of the reserve on the lower terraces. Other infrastructure such as sporting facilities and playground equipment are located in the south-western portion of the reserve.
Vegetation & Flora Description	The vegetation within the reserve is varied. Escarpment Shrubland is present on the steepest banks and escarpment sections, particularly in the north. Riparian Woodland is present adjacent to the creek and within its floodplain. There are also portions of Plains Grassy Woodland present on gentler slopes away from the creek. The majority of the vegetation within the reserve results from revegetation, although there may be some grassy understorey which has regenerated from a remnant seed bank. Dominant canopy trees: River Red Gums Dominant Shrubs: Black Wattle, Blackwood, Lightwood, Sweet Bursaria, Drooping She oak Vines: Narrow-leaf Clematis Dominant Ground flora: Some remnant native and planted grasses, tussocks, sedges and lilies, occasional herbs, some exotic grasses and herbs.
EVCs	Riparian Woodland (EVC 641) Escarpment Shrubland (EVC 895) Plains Grassy Woodland (EVC 55)
Significant Flora Species and/or Communities	Plains Grassy Woodland is locally valuable.
Environmental Weed Description	Desert Ash and occasional Blackberry in various locations, Olive in Habitat Zone 10, Flax-leaf Broom, Montpellier Broom and Boxthorn in Habitat Zone 3, Wandering Tradescantia in HZ9,
Significant Woody/High Biomass Weed Infestation	Blackberry **Rubus fruticosus*

Significant Flora

Common Name	Scientific Name	EPBC	FFG	VROTS	Year
Spotted Gum	*Corymbia maculata*			v	2015
River Red-gum	*Eucalyptus camaldulensis*		X		2015
Buxton Gum	*Eucalyptus crenulata*	EN	L	e	2015
Southern Blue-gum	*Eucalyptus globulus subsp. globulus*			r	2015
Rosemary Grevillea	*Grevillea rosmarinifolia*			P	2015
Giant Honey-myrtle	*Melaleuca armillaris subsp. armillaris*			r	2015
Fragrant Saltbush	*Rhagodia parabolica*			r	2015

HALL RESERVE

Significant Fauna

Species	Last Record	Number of Records	TREATY	EPBC	FFG	VICADV
Regent Honeyeater	1993	1	0	EN	L	cr
Intermediate Egret	2004	1	0	0	L	en
Hardhead	2013	1	0	0	0	vu
Blue-billed Duck	2009	1	0	0	L	en
Grey-headed Flying-fox	2016	1	0	VU	L	vu
Yellow-bellied Sheathtail Bat	2015	1	0	0	L	dd

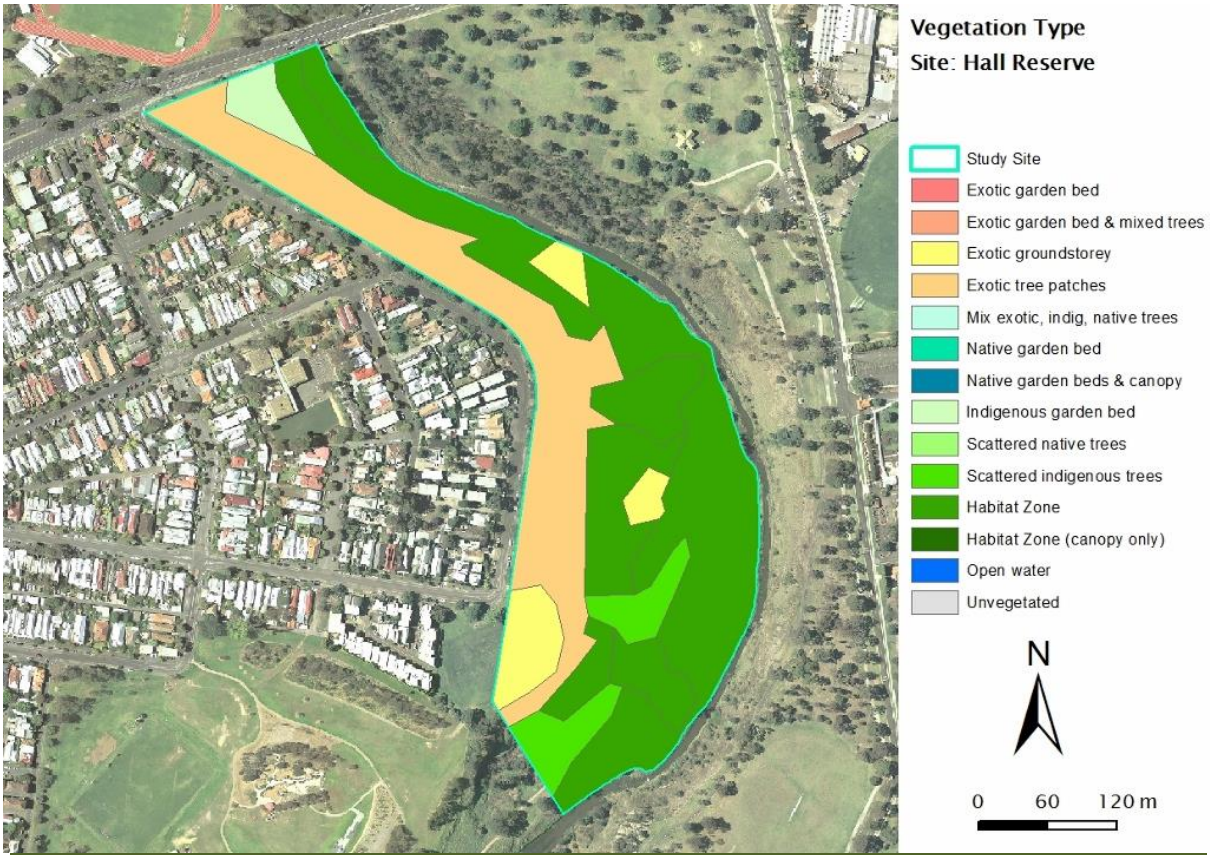
Biodiversity Health Survey 2014-2016

Diurnal Bird Survey	Yes	**Vegetation Mapping**	Yes
Nocturnal Bird Survey	Yes	**Habitat Hectare assessments**	Yes
Frog Survey	Yes	**Flora Quadrats**	Yes
Reptile Surveys	Yes	**Further Surveys**	Fungi
AnaBat	Yes		Insects, Fish
Camera Surveys	Yes		

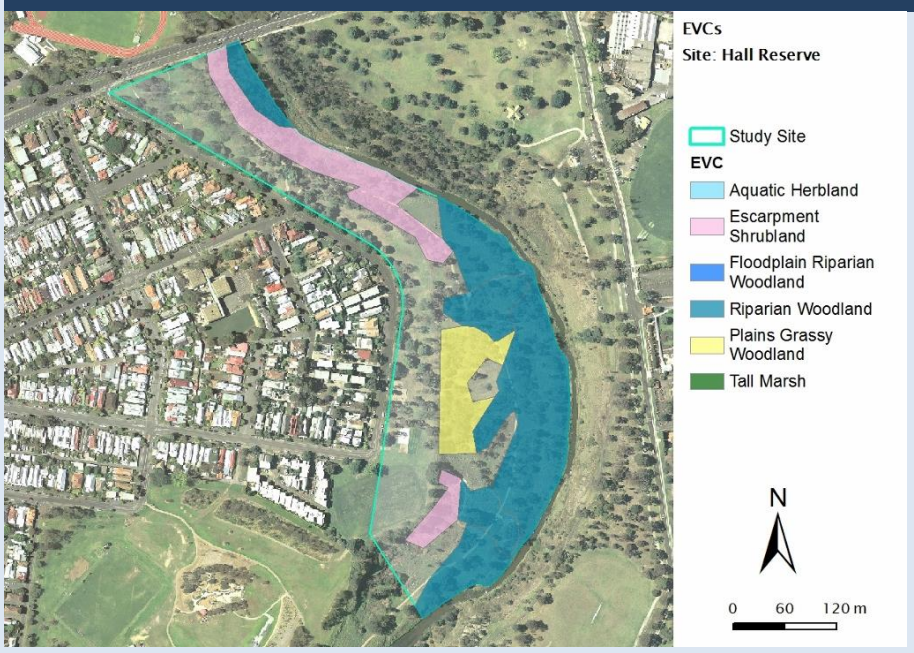
Census Locations

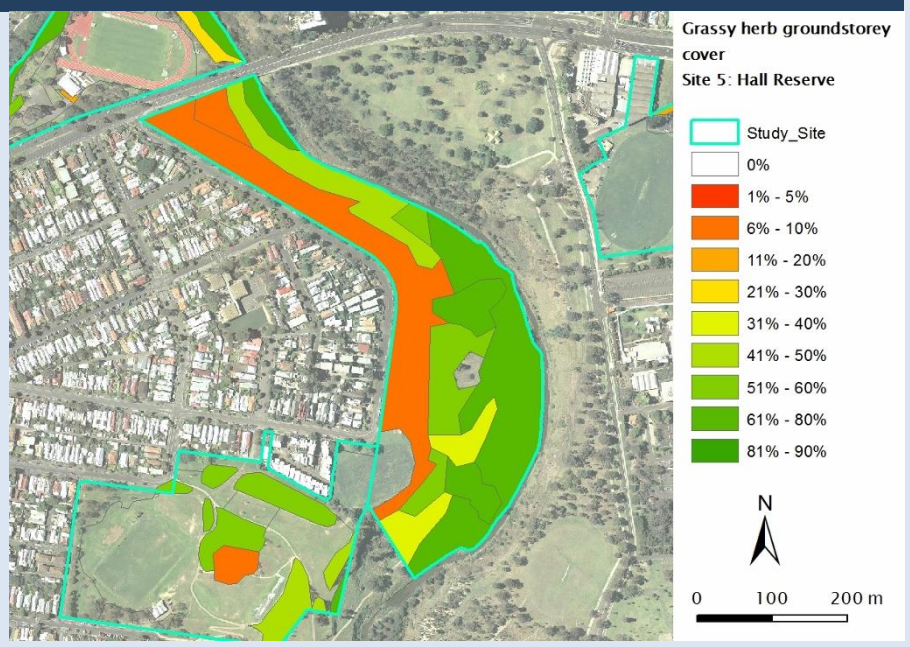
HALL RESERVE

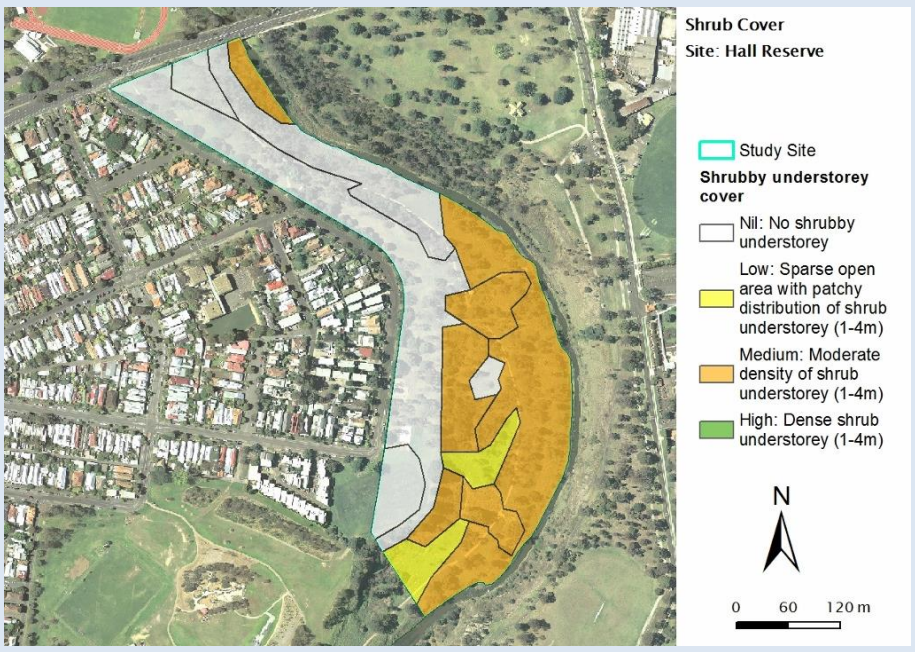
Habitat and Vegetation Mapping

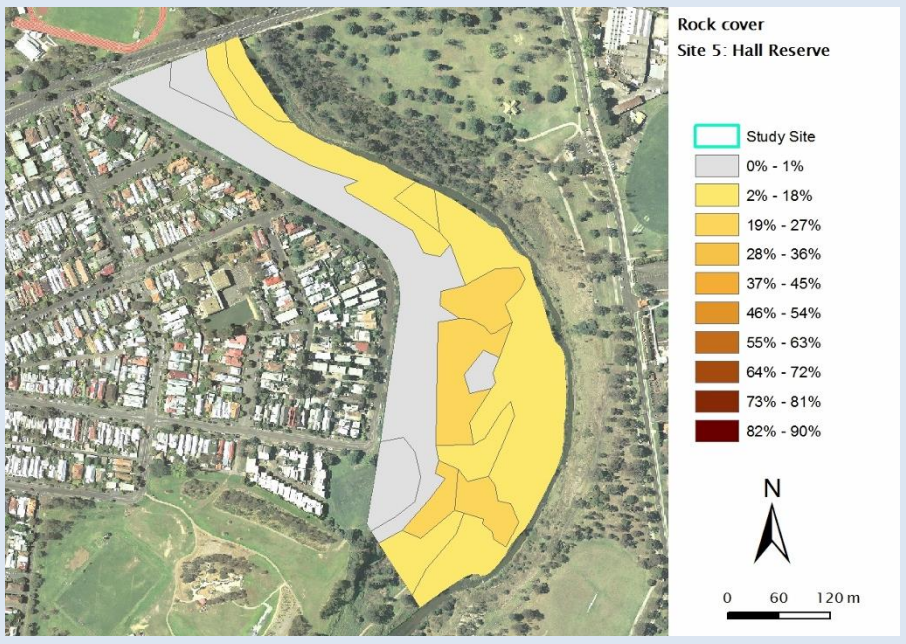


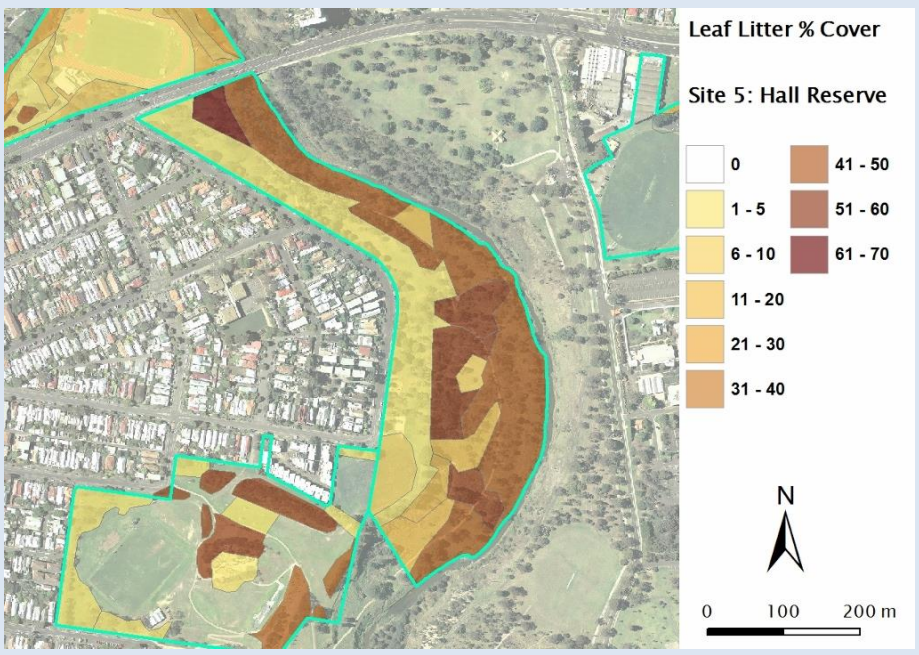
EVC and Habitat Attribute Mapping









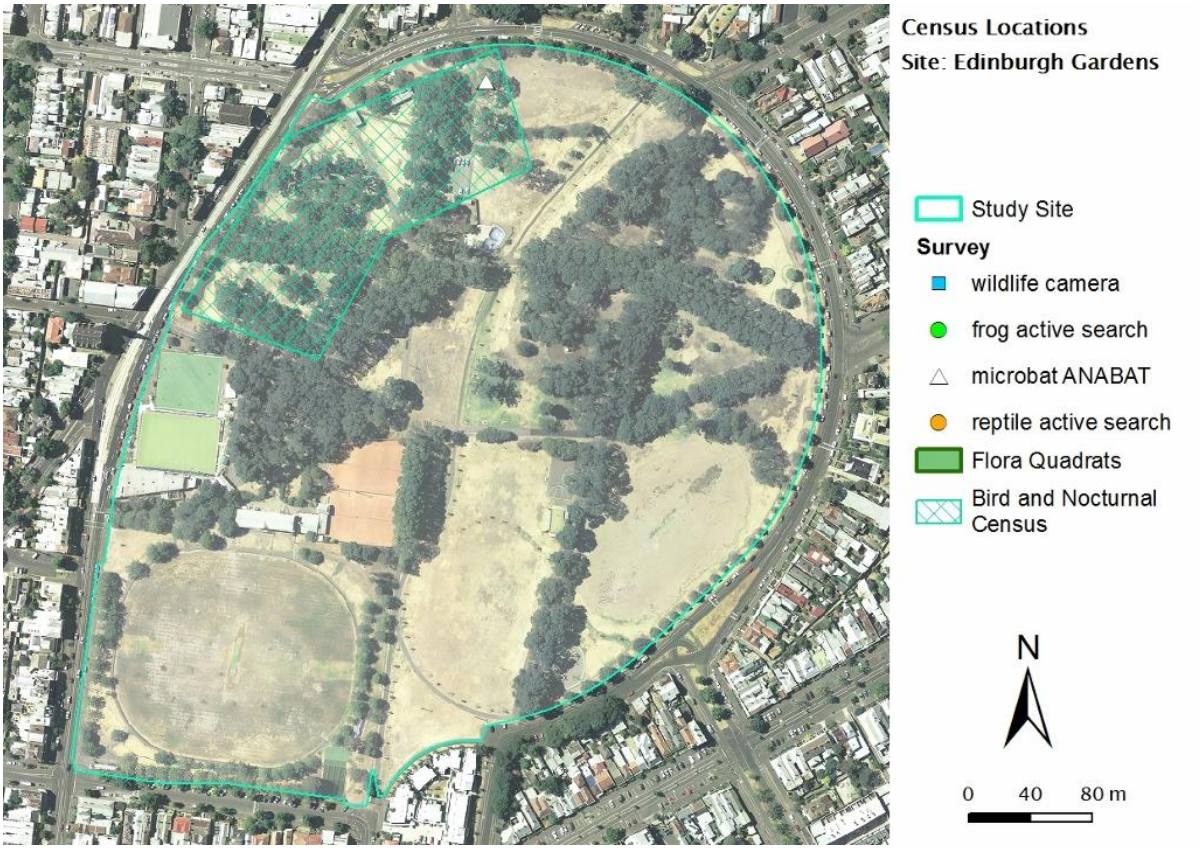


4.2 Edinburgh Gardens

Edinburgh Gardens	
General Site Description	The Edinburgh Gardens comprise a large, roughly oval-shaped area of land that was established in the late 1800's in the style of an English park. This reserve is dominated by exotic vegetation including large established exotic trees with lawn. A network of formal paths cross the space and there are a number of recreational infrastructure throughout. These include the Fitzroy football ground, two other sports grounds, the Fitzroy Bowls Club, a bandstand, toilets, a skate bowl, and a modern wetland-filter water feature, the Fitzroy Tennis Club and a large playground and pavilion. This reserve is a dog off-lead park and is heavily used by nearby residents for sporting and recreational purposes.
Vegetation & Flora Description	The vegetation within Edinburgh Gardens is typical of an urban park, consisting of large areas of lawn interspersed with exotic tree canopy and scattered indigenous and native tree species, and ornamental gardens. Large numbers of old Oak and Elm trees dominate the central and northern sections of the park. Young eucalypts have been planted along the central pathway while some scattered large old eucalypts occur acros the park, mostly in the northern section. Some very large old remnant River Red Gums occur in the north of the park along with a number of large old native Mahogany Gums Dominant canopy trees: Oaks and Elms Dominant Shrubs: nil Vines: nil Dominant Ground flora: mostly lawns composed on exotic pasture grass species.
EVCs	Nil
Significant Flora Species and/or Communities	Nil
Environmental Weed Description	Some Desert Ash, Olive trees but otherwise non-threatening weeds to values
Significant Woody/High Biomass Weed Infestation	Nil
Significant Flora	Nil
Significant Fauna	Nil
Fauna Habitat Values	There are several larger old eucalypts, oaks and elms, with many also hosting hollows, of a range of sizes. These are likely to support a wide range of urban, hollow-dependent species, such as possums, parrots/lorikeets and microbats. Large eucalypts also provide significant canopy food and nesting/resting resources for birds and bats while the large expanse of canopy provides a significant patch stepping stone in inner northern Melbourne.

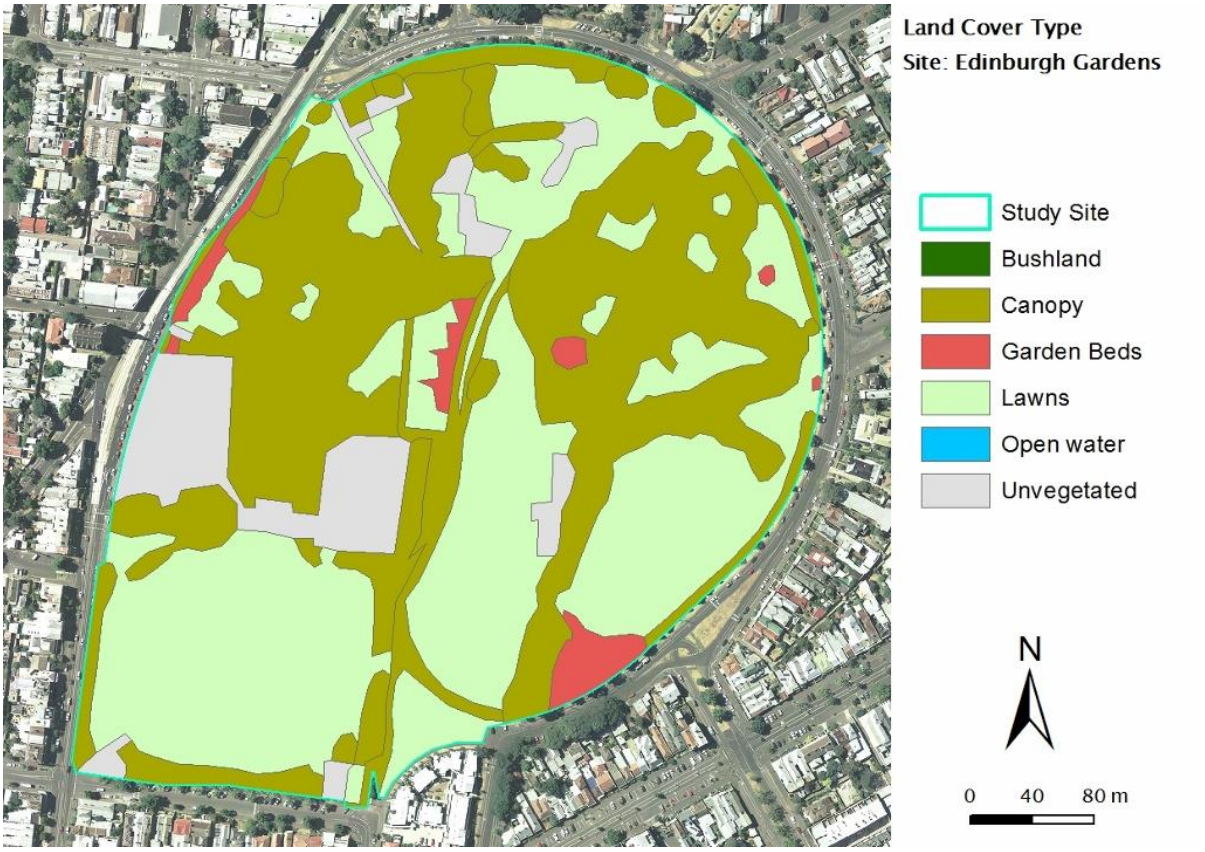
Edinburgh Gardens			
Biodiversity Health Survey 2014-2016			
Diurnal Bird Survey	Yes Yes	**Vegetation Mapping**	Yes
Nocturnal Bird Survey	Yes	**Habitat Hectare assessments**	
Frog Survey		**Flora Quadrats**	
Reptile Surveys			
AnaBat	Yes		
Camera Surveys			

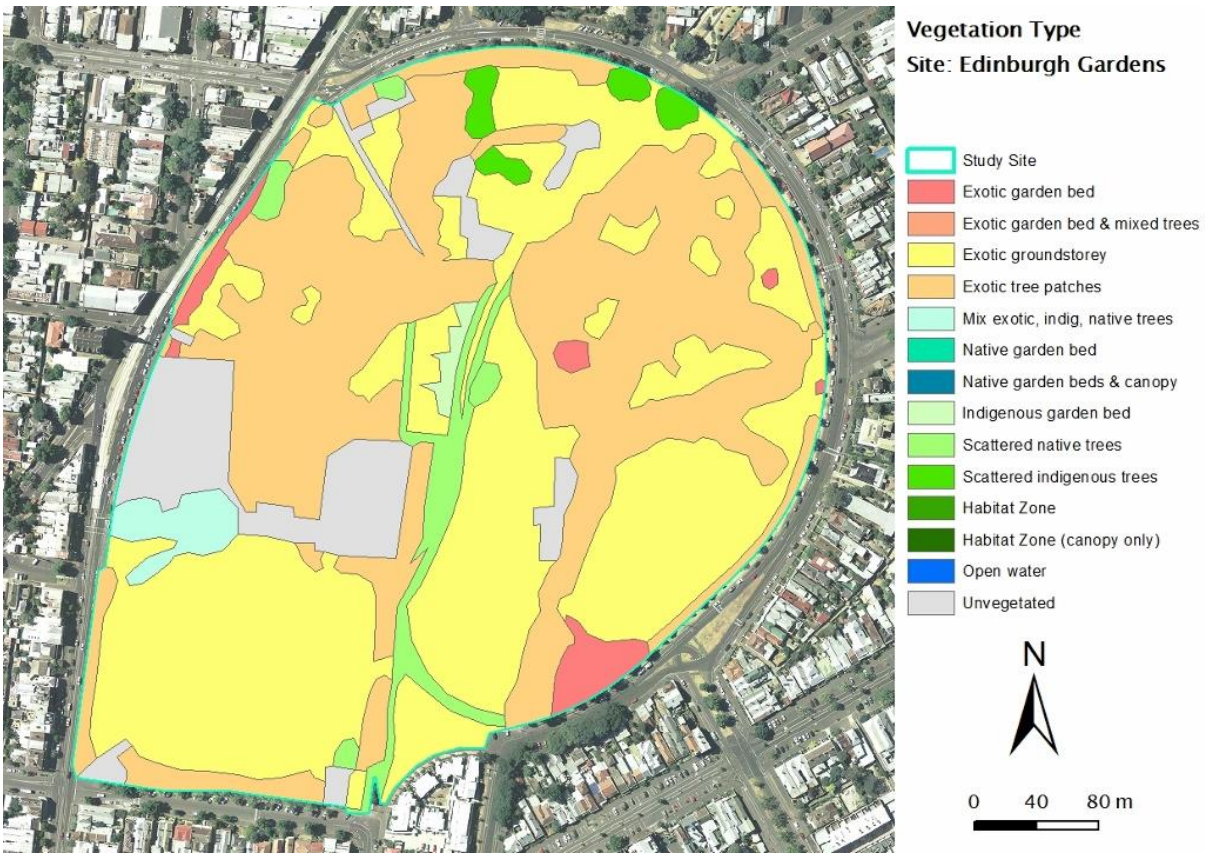
Census Locations



Edinburgh Gardens

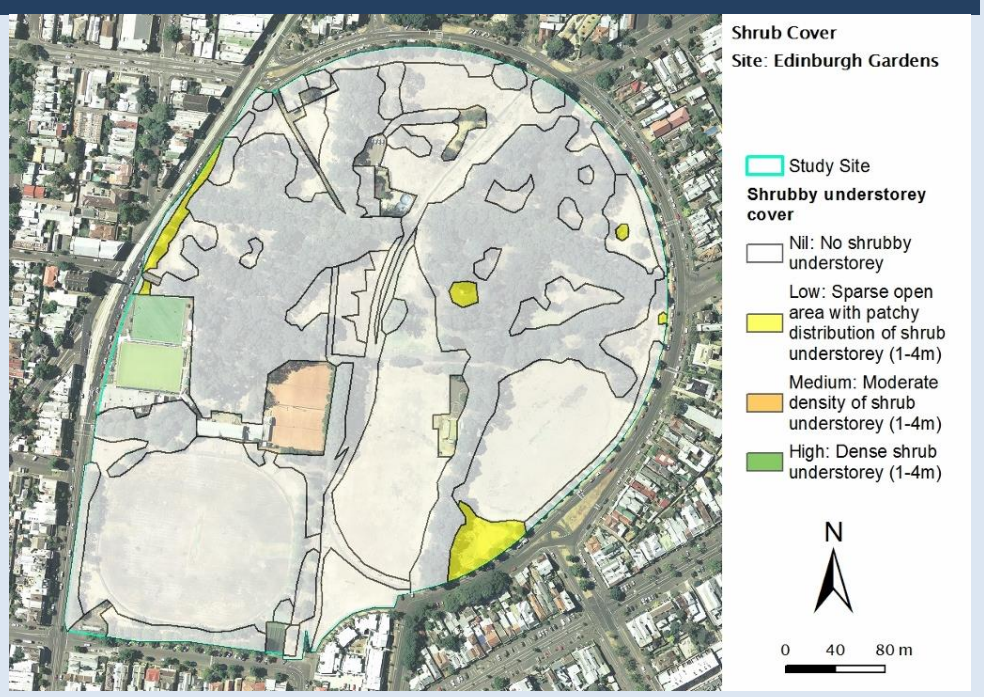
Habitat and Vegetation Mapping

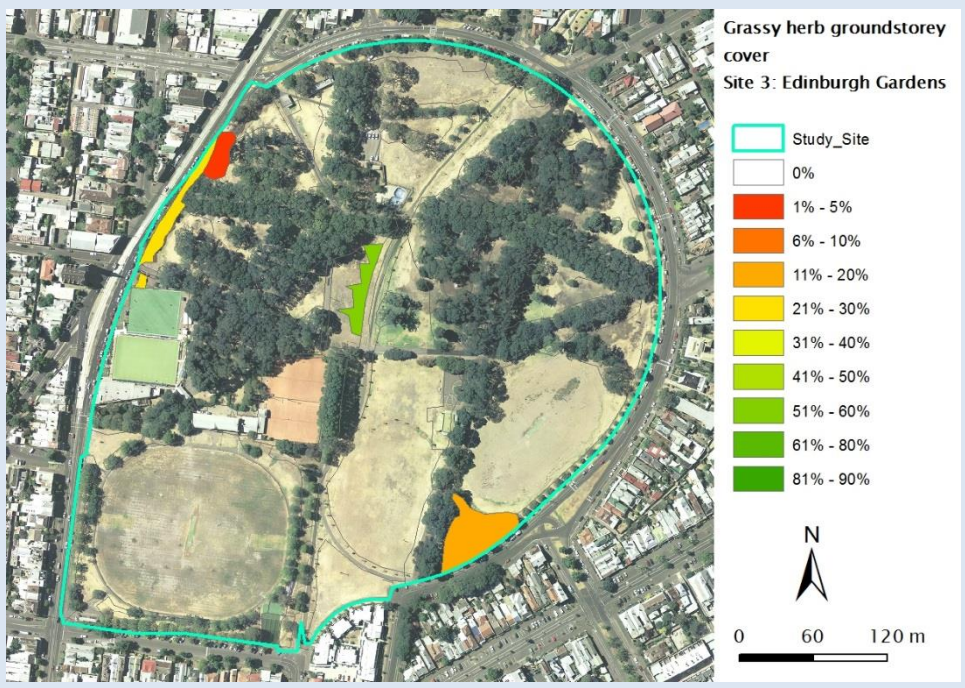


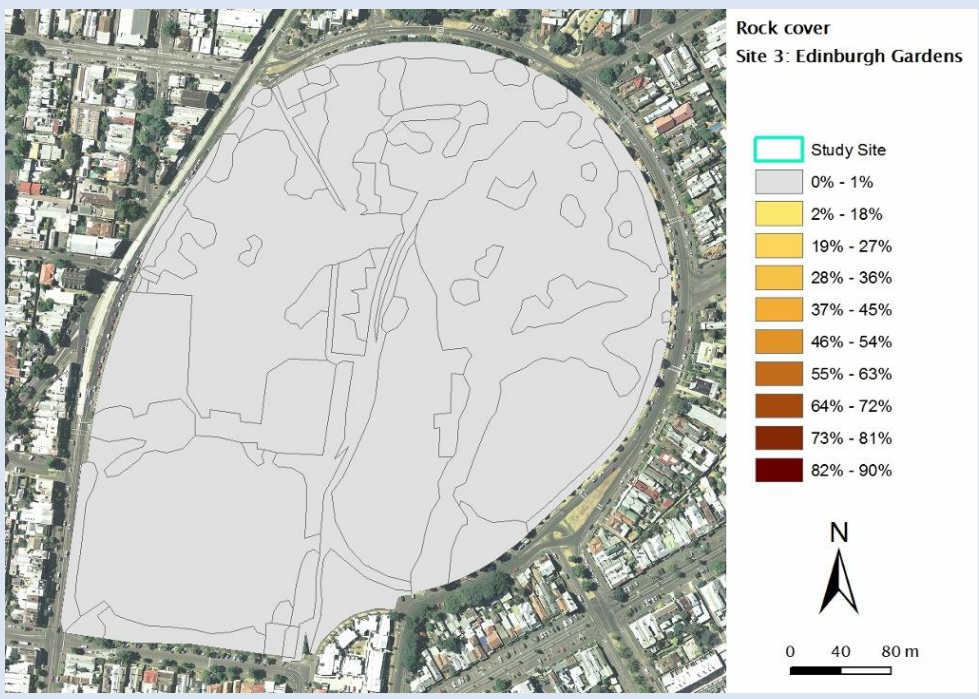


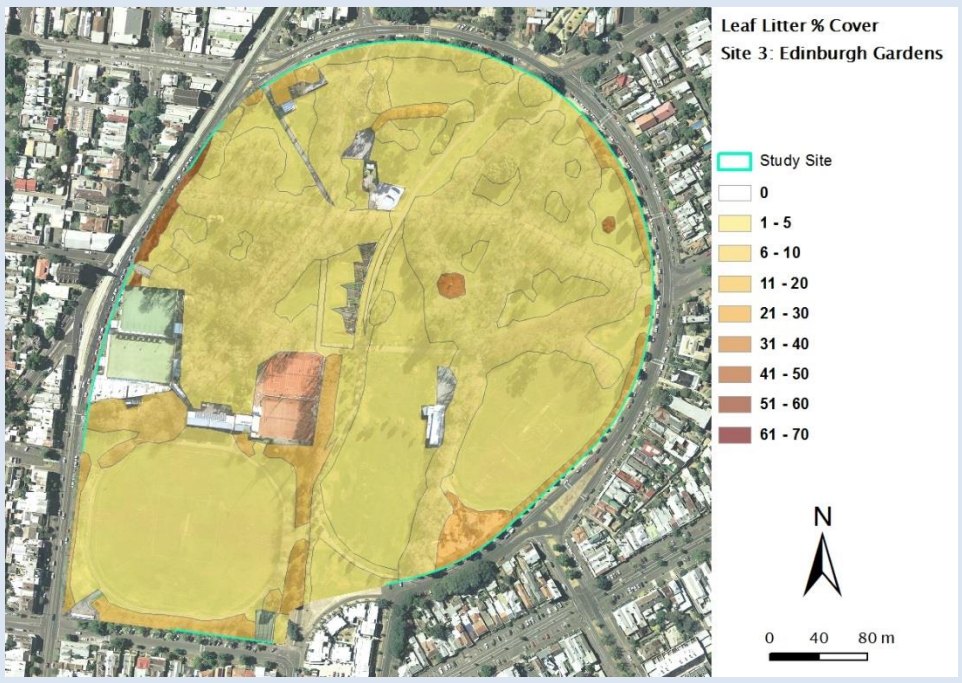
EVC and Habitat Attribute Mapping

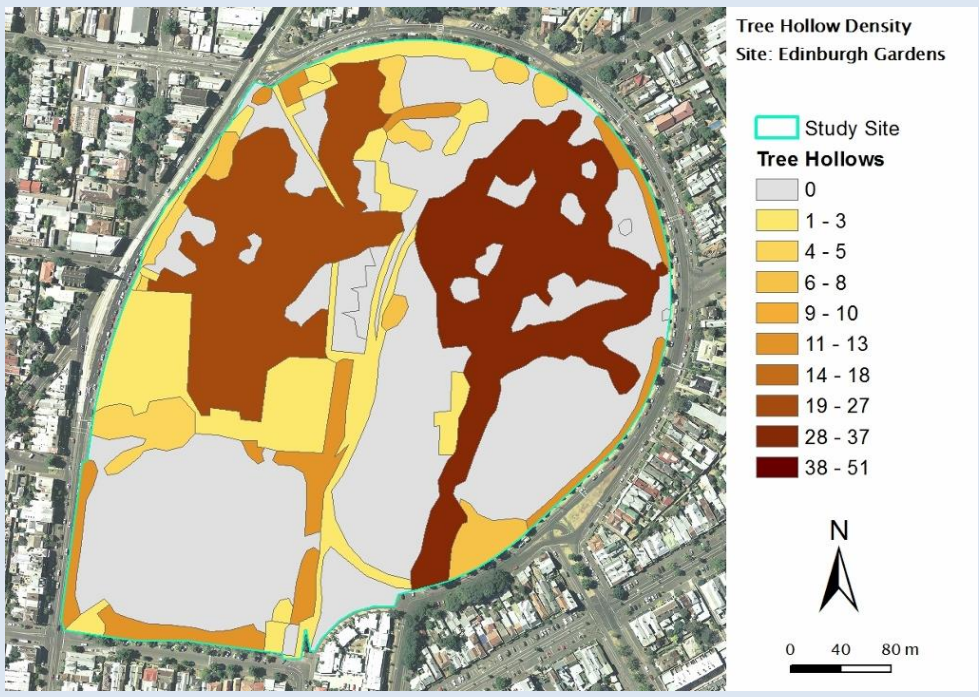
No Ecological Vegetation Class present











4.3 Alphington Wetland

Alphington Wetland	
General Site Description	Alphington Park Wetland reserve is roughly triangular shaped and sits to the east of the Yarra River. It is surrounded in almost all directions by parkland of varying types. This reserve was formerly the site of an historic swimming area and it is now used for passive recreation with gravel paths and some lawn areas interspersed between vegetated locations. This reserve includes the western half of the Alphington Wetland itself.
Vegetation & Flora Description	Vegetation within the reserve comprises mainly Floodplain Riparian Woodland and there are a large number of Large Old Trees throughout. This reserve contains one of the largest contiguous patches of vegetation (HZ1). The wetland itself supports Aquatic Herbland, the extent and composition of which alters with the season. There are also areas comprising of Plains Grassy Woodland and Riparian Woodland. The mid and understorey is largely revegetated but some regeneration is also evident. Lawned areas are interspersed throughout the indigenous patches and there are large exotic trees in the vicinity of the former swimming area. Dominant canopy trees: Eucalyptus camaldulensis Dominant lower trees: Acacia dealbata, Acacia melanoxylon, Acacia implexa Dominant Shrubs: A variety of indigenous shrubs Vines: Clematis microphylla Dominant Ground flora: Some possibly remnant *Microlaena stipoides* as well as planted tussocky indigenous grasses, sedges and lilies, mainly closer to paths. Otherwise exotic grass, namely *Ehrharta erecta*.
EVCs	Floodplain Riparian Woodland (EVC 56) Riparian Woodland (EVC 641) Plains Grassy Woodland (EVC 55) Aquatic Herbland (EVC 653)
Significant Flora Species and/or Communities	Numerous Large Old Trees Mature Red Gums (local) Wetland vegetation (local)
Environmental Weed Description	Parrot's Feather **Myriophyllum aquaticum* is present within the wetland itself.
Significant Woody/High Biomass Weed Infestation	Nil

Significant Flora

Common Name	Scientific Name	EPBC	FFG	VROTS	Year
Native Peppercress	*Lepidium pseudohyssopifolium*			k	2003

Significant Fauna

Row Labels	Last Record	Number of Records	FFG	VICADV	EPBC	TREATY
Yellow-bellied Sheathtail Bat	2015	1	0	0	L	dd

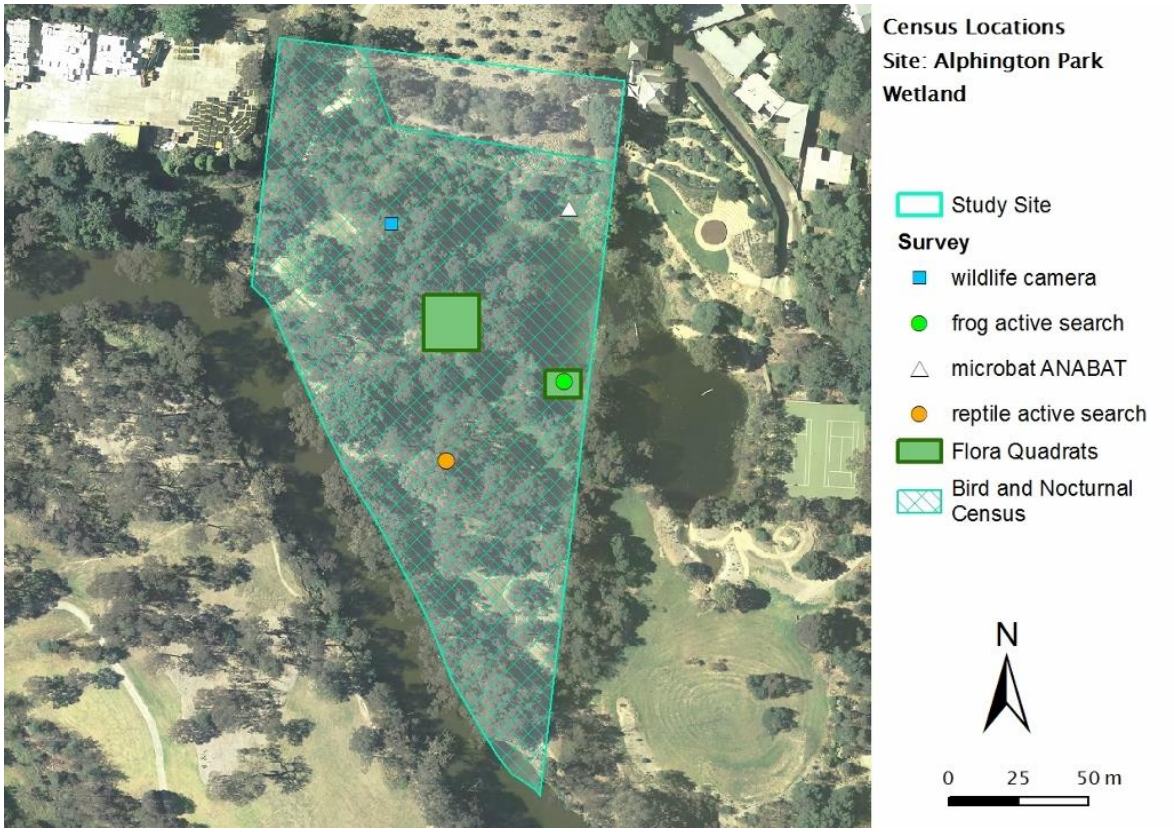
Alphington Wetland

Fauna Habitat Values	Numerous large-old River Red Gums and exotic trees provide habitat for hollow-dependent fauna including parrots, owls, possums, and potentially gliders. Sections of the reserve have a high abundance of litter and logs providing important habitat components for woodland insectivorous birds. The wetland provides foraging and breeding habitat for frogs, insects, microbats, and waterbirds. Dense areas of shore vegetation (particularly in the northern and eastern sections) provides foraging habitat for crakes, rails, and bitterns.

Biodiversity Health Survey 2014-2016

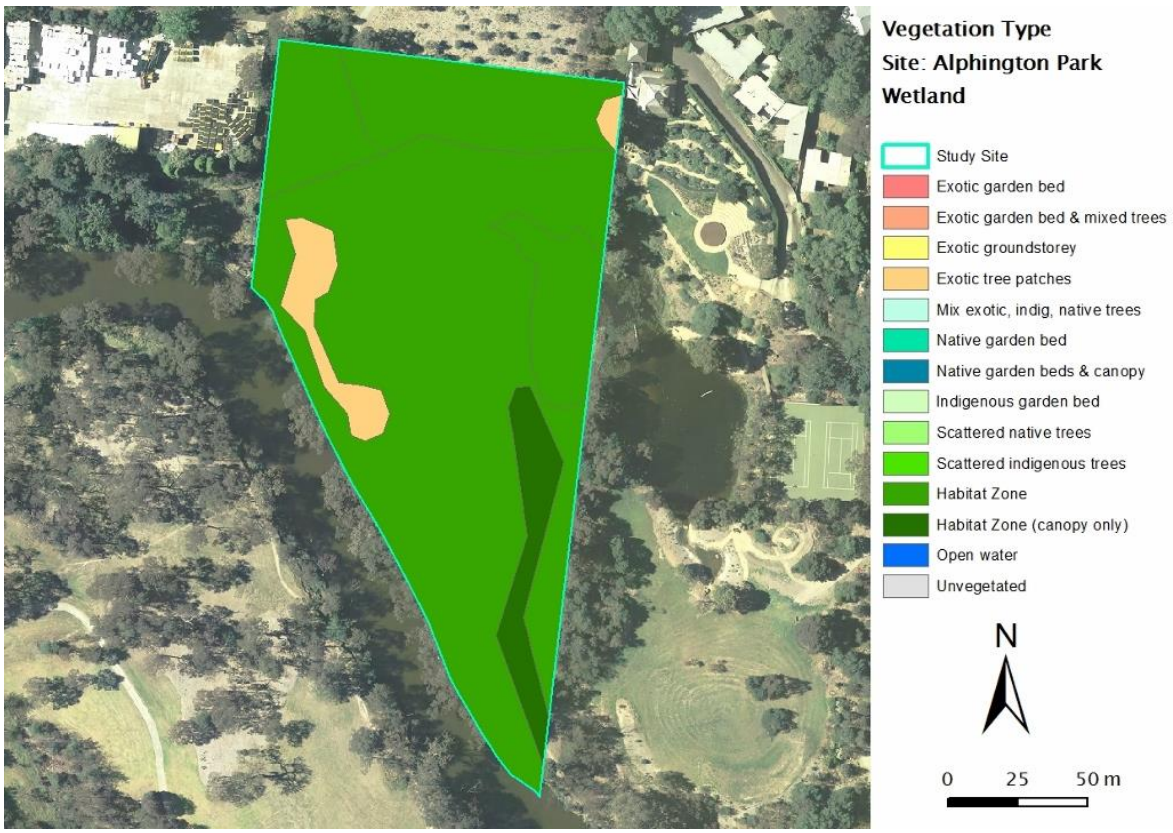
Diurnal Bird Survey	Yes	**Vegetation Mapping**	Yes
Nocturnal Bird Survey	Yes	**Habitat Hectare assessments**	Yes
Frog Survey	Yes	**Flora Quadrats**	Yes
Reptile Surveys	Yes	**Further Surveys**	Fish, Insects, Fungi
AnaBat	Yes		Frogs - repeat monitoring
Camera Surveys	Yes		Native Peppercress

Census Locations

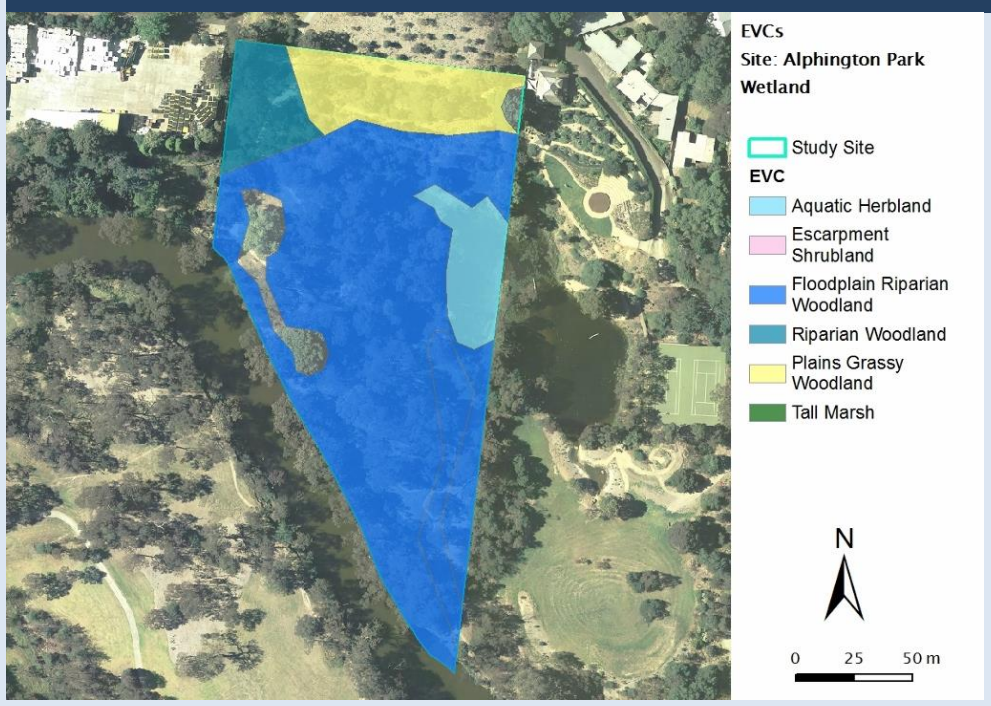


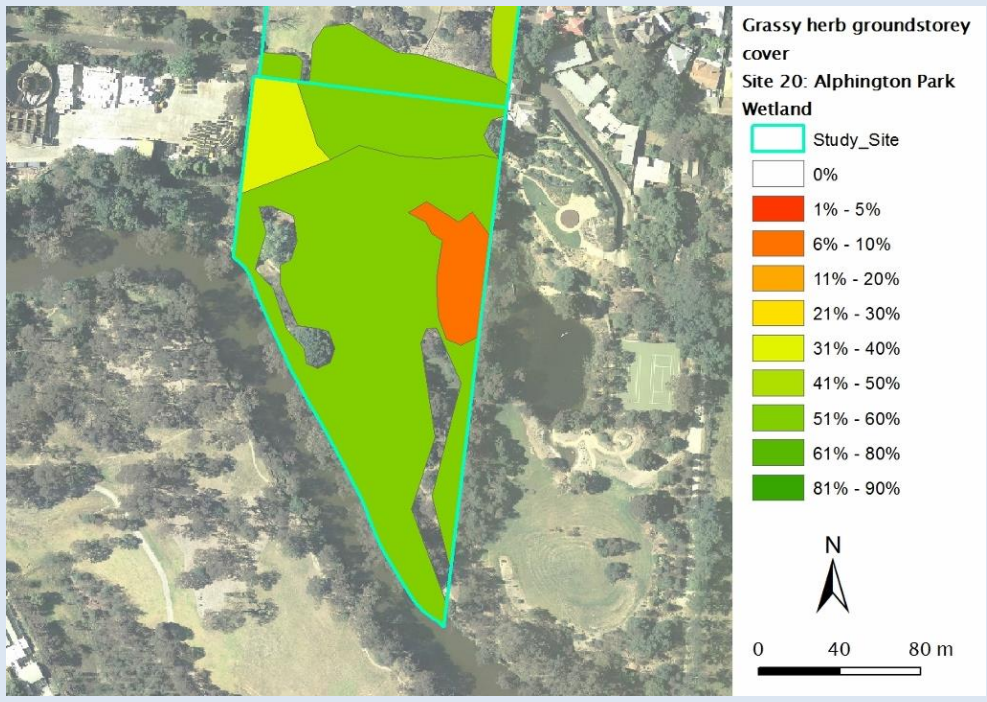
Alphington Wetland

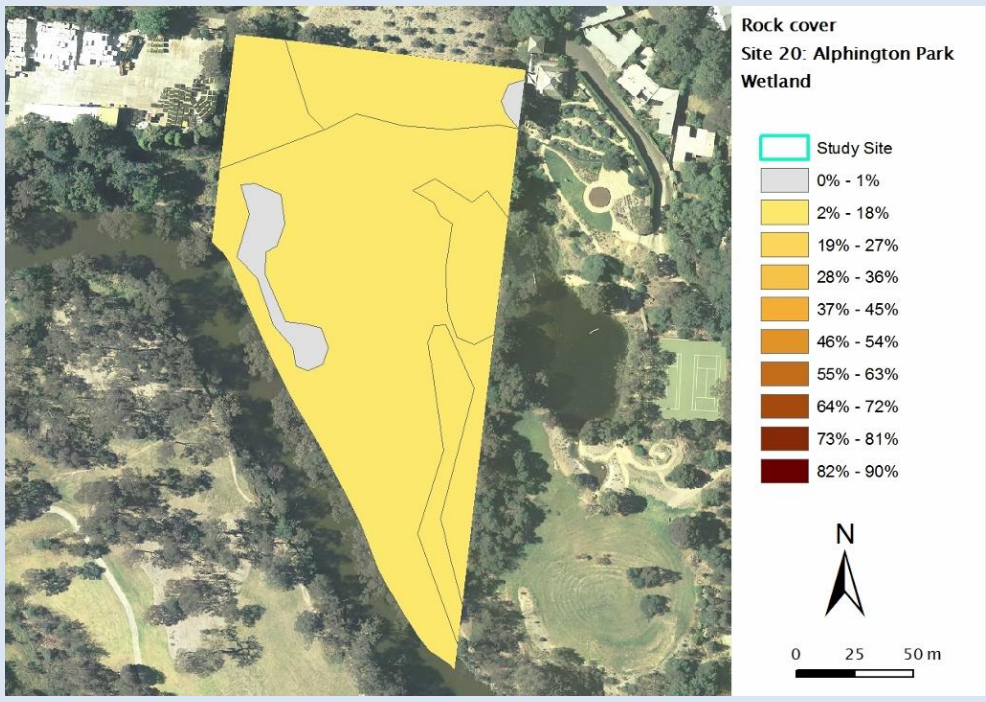
Habitat and Vegetation Mapping

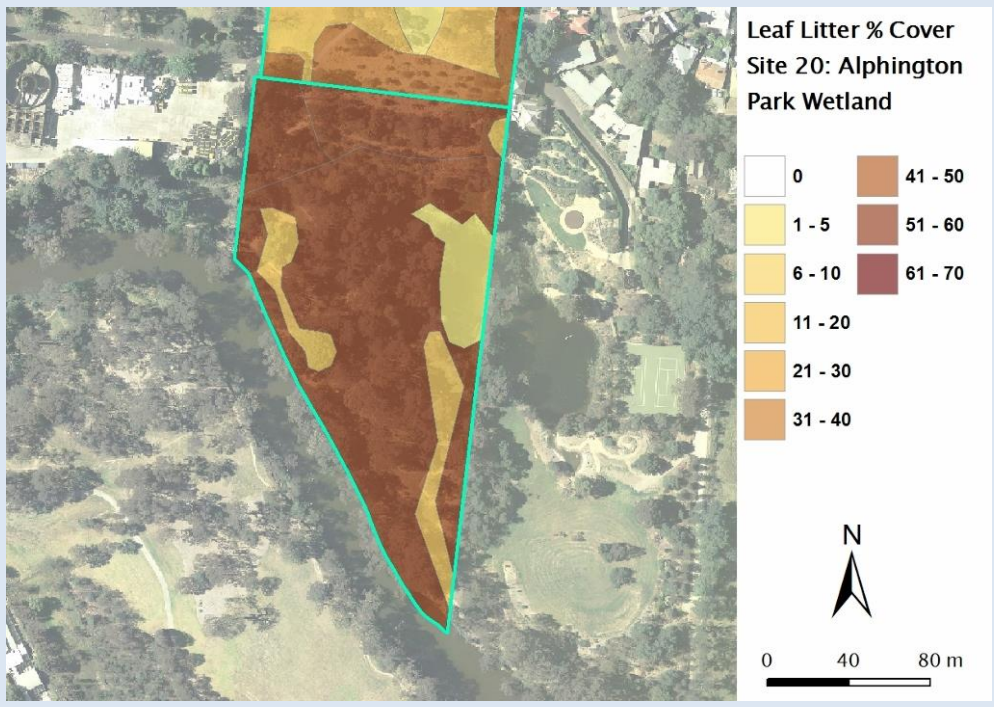


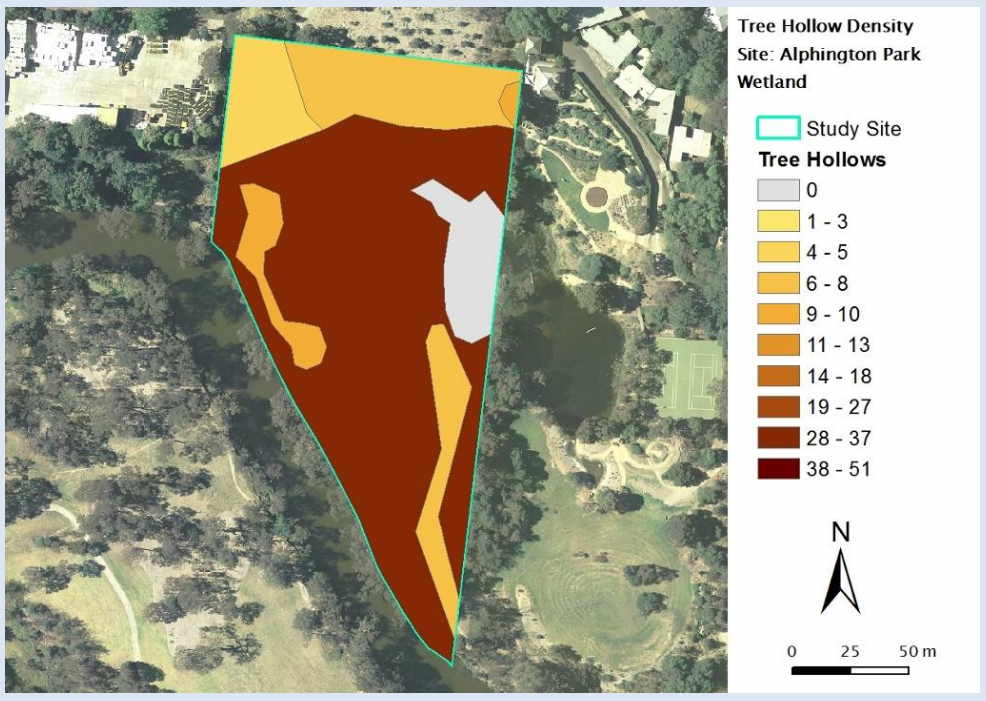
EVC and Habitat Attribute Mapping











5. RECOMMENDATIONS

An overview of key biodiversity assets and improvement works is provided, followed by recommendations for future restoration works and potential surveys.

5.1 Assets & Restoration

Critical Protection Areas and Key Biodiversity Assets

Habitat improvement works likely to have the greatest biodiversity gains, particularly for fauna, would be those along existing riparian corridors of the Merri Creek and Yarra River. Similarly, larger reserves are capable of supporting larger contiguous areas of bushland and other habitat which in turn can support a greater diversity of habitat and species.

Key Biodiversity Assets within the City of Yarra include the following critical areas of bushland and habitat:

- Large areas of bushland within Hall Reserve, Burnley Park, Kevin Bartlett Reserve, and Rushall Recreation Reserve
- Significant habitat trees (Sugar Gums and River Red Gums) in Burnley Park and Kevin Bartlett Reserve
- Wetland habitats within Alphington Park Wetland and adjacent to McConchie Reserve ('Burnley Harbour' managed by Melbourne Water)
- Faunal corridors along the Merri Creek, Yarra River, and Park Street Linear Reserves including aquatic and riparian habitats
- Urban park stepping stones and larger urban parks including Edinburgh Gardens and Darling Gardens
- All large hollow-bearing native trees within the municipality and larger canopy trees

Current Enhancement Areas/Sites

A number of reserves have been a focus of indigenous revegetation and restoration works. Notable areas include:

- Extensive groundstorey restoration at two locations within Hall Reserve, both associated with ponds and wetland areas
- Significant restoration of indigenous vegetation and indigenous canopy in Kevin Bartlett Reserve, Rushall Recreation Reserve, Dights Falls, Bundara Street Reserve, and Loys Paddock

- Wetland creation and restoration at McConchie Reserve
- Restoration works and bushland management at Alphington Park Wetland
- Protection of significant River Red Gums at Kevin Bartlett Reserve
- Groundstorey habitat improvement works and River Red Gum protection at Burnley Park
- Habitat improvement works at Quarries Park

Improvement and Restorations Works

The following improvement and restoration works are recommended for improving biodiversity health and building on existing successes:

- Continued enhancement and maintenance of bushland Rushall Recreation Reserve, Kevin Bartlett Reserve, Dights Falls, Bundara Street Reserve, and Loys Paddock
- Further enhancement and expansion of indigenous groundstorey habitat within Hall Reserve including removal of woody weeds, weed control and dense plantings of indigenous grasses and herbs. A focus on escarpment and higher (drier) slope areas first as these have fewer weed issues followed by expansion into riparian areas.
- General expansion of restoration works at the Hall Reserve, Burnley Park, Quarries Park, Coulson Reserve/Knott Reserve, and Loys Paddock,
- Increasing rock cover across most reserves with a focus on those supporting bushland and indigenous groundstorey
- Increasing leaf litter, logs, and large wood debris (in-stream, wetland, and terrestrial) in sections of urban parks and bushlands
- Further restoration of wetland habitat within Alphington Park Wetland and work toward improvements in water quality
- As required, monitor and manage pest animals (rabbits and foxes)
- Retain all hollow-bearing trees and stags

Further Research and Analysis

More insights could be gained on the information and results obtained in this Biodiversity Health Survey through further data analysis. Spatial analysis of flora and fauna records along with basic statistical analysis could reveal patterns in biodiversity values across the City of Yarra. Correlations between habitat attributes, landcover, and species composition could also be revealed.

These and other existing spatial datasets could also be used as inputs for habitat connectivity analysis to identify key fauna corridors and reserves or habitat trees which could act as stepping stones for the flow of animals across the municipality.

Community Engagement and Partnerships

There are opportunities to work further with other landholders and managers (Melbourne Water, Parks Victoria, and other councils) to connect and enhance areas of habitat between council reserves, particularly along the Merri Creek and Yarra River corridors such as between Rushall Recreation Reserve and Coulson Reserve/Knott Reserve.

Surveys and research collaborations with Universities, the Royal Botanic Garden, and friends and naturalist groups can provide long-term benefit in terms of biodiversity knowledge and management. Monitoring programs could be supported or enhanced through collaborative partnerships (see below). A similar 'Biodiversity Blitz' program to the City of Melbourne and publicised program for encouraging residents to record flora and fauna could also benefit both management of natural areas in the municipality and garner both more appreciation of biodiversity values and support for environmental works programs.

5.2 Future surveys and monitoring opportunities

Flora

Collaborative surveys coordinated with other land managers (e.g. Parks Victoria, Melbourne Water, councils etc.) could be undertaken in reserves and parklands adjacent to YCC managed reserves but managed by these other authorities, particularly along the Yarra River and Merri Creek. The same methods could be employed in this study. Such surveys would provide further information on the biodiversity values across the City of Yarra and help to identify shared biodiversity values and management objectives and initiatives.

Threatened Species

Significant flora and fauna species identified in this study as having some potential to occur within the City of Yarra reserve system could be targeted in focused searches. For flora, ideal habitats could be identified and structured targeted searches undertaken using a grid or transect system at regular spacing varied according to the size and detectability of the plant taxa being surveyed for.

Targeted surveys for significant fauna would focus on species likely to be resident or make significant use of the study area such as the Nankeen Night Heron *Nycticorax caledonicus hillii*, Eastern Great Egret *Ardea modesta*, and Azure Kingfisher *Alcedo azurea*. Many of the threatened fauna species within the City of Yarra are aquatic or aquatic dependent fauna, meaning they could be targeted together as a group. Future microbat monitoring would provide verification of

Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris* records made in this study and provide a better understanding of the species distribution and use of habitat across the City of Yarra.

A sound understanding of threatened species distributions, movements, and habitat use across the City of Yarra is crucial to managing threatening processes such as predation by foxes and cats, disturbance by domestic dogs, weed invasion, loss of hollow bearing trees, and other threatening processes as listed the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) and the commonwealth EPBC Act.

Weeds

Structured weed monitoring using a systematic approach and established plots and undertaken at regular intervals would provide valuable information of weed levels within reserves supporting significant stand of indigenous vegetation (Dights Falls, Halls Reserve, and Alphington Park Wetland). There is a current informal weed monitoring occurring but this could be further refined and form part of an ongoing biodiversity and weed management monitoring program. The City of Whitehorse undertakes regular monitoring of key bushland reserves including structured weed surveys and mapping to gauge the progress of weed management works and for use in adaptive management approach.

Fauna

The current study establishes an ideal series of fauna census areas for a number of fauna groups. This allows future surveys to occur which can be compared to the current results for tracking the progress in biodiversity improvement programs and general biodiversity values across the municipality. A number of councils (e.g. City of Whitehorse) undertake regular bi-annual bird surveys in key bushland reserves in an effort to monitor biodiversity health across the council.

Regular monitoring is important to provide a complete an reliable picture of the fauna biodiversity within an area and can provide key insights into the health of ecological systems in a way which provides time for adaptive management actions to be implemented to reduce declines in fauna populations but also to observed positive outcomes for fauna and ecosystems as a whole through biodiversity improvement works. Bird and microbat surveys are probably the best indicators fauna groups for achieving these insights as they utilise and respond to a wide range of habitat resources and attributes and play important roles in ecosystems function such as pollination, seed dispersal, and regulation of insect populations (lerps, scales, mosquitos etc.).

Fungi

Fungi are a particularly under-surveyed group of flora and little is known of fungal communities in urban areas and even of fungal communities associated with ubiquitous and widespread Australian plant species such as the River Red Gum. Fungi have key roles in healthy ecosystem function including in nutrient capture and cycling, decomposition, and in the symbiotic relationship they have with many Australian myrtaceous shrubs and trees including eucalyptus. Fungi provide these trees with critical nutrients and a much expanded root network in exchange

for providing carbohydrates to the fungi. Fungal fruit bodies also provide important winter food resources for a number of fauna.

Small scale surveys for fungi in selected flora quadrats or immediately adjacent defined search areas (20 m x 50 m) during winter would provide a baseline on fungi diversity and health. Such surveys could be coordinated with the Royal Botanic Gardens Melbourne which curates a large collection of fungi and coordinates the FungiMap project.

Reptiles

Reptiles can be cryptic and difficult to detect using active searches where populations are small or density is low or where food resources are widely spaced. This is likely the case within the City of Yarra and repeat surveys for reptiles would increase our understanding of reptiles within the area. Tile census surveys could be undertaken at key locations such as Hall Reserve, Alphington Park Wetland, Burnley Park, and Kevin Bartlett Reserve.

Fish

Although aquatic environments are largely not within the City of Yarra management area, the health of these aquatic environments have a string influence on biodiversity values and health of riparian habitat and associated fauna species. Conversely, management actions on adjacent land or environmental incidents (oil spills etc.) can have a devastating impact on aquatic environment and the flora and fauna which they support. Consequently, a knowledge of where key aquatic habitats and significant fauna species (such as fish) are located along the key corridors of the Yarra River and Merri Creek is important information for guiding works and initiatives on adjacent land both public and private.

Insects

Insects likely comprise a significant proportion of the fauna diversity with the City of Yarra. This fauna group can be used as indicators of general ecosystem health, particularly of soil and microhabitat health as they respond strongly to the diversity, structure, and health of the groundstorey vegetation.

Connectivity

Maintaining and enhancing habitat connectivity for both flora and fauna (but particularly the latter) is key to improving and safeguarding the flora and fauna within the City of Yarra and environs. The majority of flora and fauna records within the City of Yarra occur along the Merri Creek and Yarra River corridors. Other large reserves such as the Edinburgh Gardens likely play a key role as a stepping for birds, bats and other fauna across inner northern Melbourne. Large significant canopy trees also play an important role in the movement of fauna and providing food and shelter resources.

A great understanding of animal movement can be gained through the application of habitat connectivity models and associated software. These include models used in software such as CircuitScape or Connectivity Analysis Toolkit (CAT). They can predict important corridors for animal movement and associated habitat elements.

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