



CITY OF
Port Adelaide Enfield

Biodiversity Management Plan 2016 - 2020

Background Report



This Plan has been prepared by Council staff with valued input from business and community groups, local schools, NGOs, Elected Members and State Government agencies. The research phase was assisted by SEED Consulting Services Pty Ltd.

The City of Port Adelaide Enfield acknowledges that we are in the traditional country of the Kaurna people of the Adelaide Plains. We recognise and respect their cultural heritage, beliefs and relationship with the land. We acknowledge they are of continuing importance to the Kaurna people living today.

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Figure: 1. – *Eucalyptus porosa* Woodland, Folland Park, Enfield, SA.

1.0 INTRODUCTION

1.1 Background

The City of Port Adelaide Enfield (CPAE) consists of diverse natural landscapes containing a wide range of native vegetation communities including; woodland, parkland, dune, mangrove and samphire. These communities provide habitat and resources for a broad range of flora and fauna species, including significant and threatened species listed at the State, Federal and International levels. Biodiversity maintains the critical ecosystem processes that support life within these diverse communities. Healthy, functioning ecosystems are necessary to maintain and regulate the atmosphere, climate, fresh water, soil formation, cycling of nutrients, and disposal of wastes.

More than ever these diverse communities and ecosystems need to be protected from the continuous pressure of current and future threats, including ongoing urban development and climate change.

The Port Adelaide Enfield Council State of the Environment Report (2012) recognised that preserving biodiversity is a fundamental aspect of sustainable development, and is a key concern for all levels of government, including local governments around Australia. With the current and future pressures for significant broad scale and infill development within the Port Adelaide Enfield Council area, it is acknowledged that areas of biodiversity should be valued and appropriate management regimes be implemented to ensure that these areas are preserved and enhanced wherever practical.

The Council's State of the Environment Report 2012 included the following specific recommendations with regard to biodiversity management priorities –

- Collaborate with other neighbouring Councils and State Government agencies to support integrated biodiversity land management practices.
- Council to liaise with key agencies to ensure local climate change vulnerability assessments (IVAs) are undertaken.
- Develop biodiversity management plans for site-specific natural sites in accordance with Council's Strategic Biodiversity Management Plan.
- Council to incorporate opportunities for biodiversity enhancement through the establishment of indigenous drought-tolerant vegetation in verges and reserves where practical, in accordance with Council's Urban Landscape Guidelines.

- Undertake detailed flora and fauna surveys and ecological assessments of natural areas to ascertain baseline information and guide future revegetation or development.
- Review Biodiversity Plan in line with strategic actions, and develop a framework and guideline document.
- Develop partnerships with volunteer groups in the management of natural areas.
- Review the application of Council's Development Plan and planning policy in relation to using the Plan's biodiversity protection principles in development assessment. Undertake information or training as required.
- Council to be fully engaged with the State Government in the Master planning process for Gillman, to ensure optimal protection and improvement of the highly significant ecological assets of the area, and related commercial and cultural values.
- Consult with the Department for Environment, Water, and Natural Resources regarding the future of the vacant land at E.A. Carlson Reserve. Propose that appropriate zoning is applied and a management plan prepared to facilitate its inclusion in the Open Space management regime.
- Council to engage with the State Government from the early stages in the planning for the Northern Expressway through Gillman, in order to highlight the significant biodiversity and other assets to be protected and enhanced in key coastal areas.

This Biodiversity Management Plan supports the above recommended actions, and also supports the following goals and objectives contained in Council's City Plan 2030.

1.2 Purpose of Council's Biodiversity Management Plan

The purpose of Biodiversity Management Planning is to develop strategies to enhance biodiversity in the Council, by sustaining current biodiversity values, building reliance in the face of climate change and providing opportunities to support ecosystem functions for the longer term. The Biodiversity Management Plan strategies need to be underpinned by scientific knowledge, citizen science information and activities, and ongoing monitoring to assess trends and outcomes.

The Biodiversity Management Plan's main function is to provide Council's officers with a scheduled program to manage biodiversity at Council-wide level - in conjunction with other agencies and the community. Each strategy in the action plan specifies key activities, tasks, responsible personnel, timelines and required resources.

The objectives of the Biodiversity Management Plan are:

- To monitor, map and analyse biodiversity condition to inform decision making
- To manage Council's public open space to maintain, restore & enhance biodiversity value
- Develop partnerships to respond to changes in land use development and climate change

1.3 What is Biodiversity?

Biodiversity (or biological diversity) is the variety of life and its composition, structure and function, at a range of scales (Noss 1990). Within this broad definition, four interconnected levels of diversity are commonly recognised - genetic diversity, species diversity, ecosystem diversity and landscape diversity. Three levels of organisation are considered in the Biodiversity Management Plan:

- **Composition** (the different elements of a system e.g. species)
- **Structure** (the physical organisation of a system e.g. local habitat complexity or landscape pattern)
- **Function** (ecological and evolutionary processes e.g. gene flow, disturbances, and nutrient cycling).



Figure 2: - Mixed *Halosarcia* spp., *Sclerostegia* spp., *Atriplex paludosa* ssp., *Sarcocornia* app. Low shrubland, Barker Inlet Wetland. City of Port Adelaide Enfield.

1.4 Why is Biodiversity Important?

In the Port Adelaide Enfield area, biodiversity is most prevalent in coastal, woodland, and estuarial ecosystems. An ecosystem refers to the complex networks formed by the interaction of animals and plants with each other and with their surrounding physical environment. Many different species live in the Council area, and each one is connected uniquely in some form of relationship with another. Direct impacts on one species may have a detrimental effect on another. Biodiversity conservation therefore needs to focus on protecting ecosystems, habitats, and associations of species, as well as single species.

In urban landscapes that are required to meet multiple planning and management objectives (e.g. housing, industry, recreation), the benefits of maintaining biodiversity include the provision of a range of important ecosystem services. Ecosystem services are “*the conditions and processes by which natural ecosystems, and the species that make them up, sustain and fulfil human life*” (Daily 1997). Examples of these services include water filtration, nutrient recycling, waste assimilation and disposal, carbon dioxide sequestration, support for commercial enterprises (e.g. fishing and tourism), and flood mitigation. In addition to these biophysical benefits, natural landscape components such as open space areas in urban landscapes are important for public wellbeing, by providing opportunities for recreation and aesthetic stimulation (Maller *et al.* 2005).

The loss of biodiversity and its negative effects on ecosystem services in urban landscapes therefore negatively impacts on the environmental, cultural and economic sustainability of a region (Millennium Ecosystem Assessment 2005).

2.0 THE STUDY AREA

2.1 Pre-European Landscape

Prior to European settlement, the native vegetation in the greater Adelaide region consisted of mixed open eucalypt woodland associations, grasslands, and coastal vegetation communities such as samphire flats, mangroves and swamplands (Kraehenbuehl 1996). Within the current Port Adelaide Enfield Council boundary, eight broad vegetation associations predominated, encompassing a range of vegetation, soil and landscape types (Table 1; Figure 5).

Table 1: Description and cover of Pre-European vegetation associations (regions) across the Port Adelaide Enfield Council area, after Kraehenbuehl (1996).

Region	Vegetation association	Soil description	Landscape description
Region 3	<i>Eucalyptus leucoxylon</i> Woodland	Black earth, red brown earth, terra rossa	Footslopes of Winsor Gardens & Klemzig
Region 4	<i>Eucalyptus camaldulensis</i> , <i>E. leucoxylon</i> Woodland.	Alluvial soils	Watercourse along Torrens river and Dry Creek
Region 7	<i>Eucalyptus porosa</i> Woodland	Brown Solinized soil, terra rossa, black earth	Plains – eastern part of the City
Region 15	<i>Melaleuca halmaturorum</i> ssp. <i>Halmaturorum</i> Low woodland	Estuarine mud and sands	Watercourse (Port River & Patawalonga)
Region 16	<i>Avicennia marina</i> Low woodland	Estuarine mud and sands	Tidal flats
Region 18	<i>Olearia axillaris</i> , <i>Acacia longifolia</i> var. <i>sophorae</i> Open heath	Dune sand	Coastal dunes
Region 19	Mixed <i>Halosarcia</i> spp., <i>Sclerostegia</i> spp. <i>Atriplex paludosa</i> ssp., <i>Sarcocornia</i> spp. Low shrubland.	Estuarine mud and sands	Tidal flats
Region 21	<i>Stipa</i> spp., <i>Danthonia</i> spp. Grassland	Red brown earths (red brown clay to red brown sandy clay).	Plains

Prior to European settlement, there was a high number and diversity of native flora and fauna within the Adelaide plains. As a biological entity, Adelaide is unique among Australian capital cities, as it is positioned between the hills and the sea, isolating it from other regions.

Before 1836, the Adelaide plains supported approximately 1,130 species of native vascular plants, approximately 290 species of birds (including migratory and nomadic species), 40 species of mammals, 56 species of reptiles, 7 species of amphibians, 11 species of freshwater fish, and tens of thousands of species of invertebrates.

Only around 12% of the original vegetation remains in the Adelaide metropolitan area today (as defined by the Development Act, 1993). In the Adelaide plains area studied by Kraehenbuehl, this figure drops to around 4% including the mangroves, and less than 2% without them (Daniels & Tait (eds) 2005).

Other changes to the landscape since European settlement include loss of the following species:-

- 89 (7.5%) plant species;
 - 2 (3%) reptiles;
 - 21 (7%) birds; and
 - 20 (50%) mammals
- (Daniels & Tait (eds) 2005).

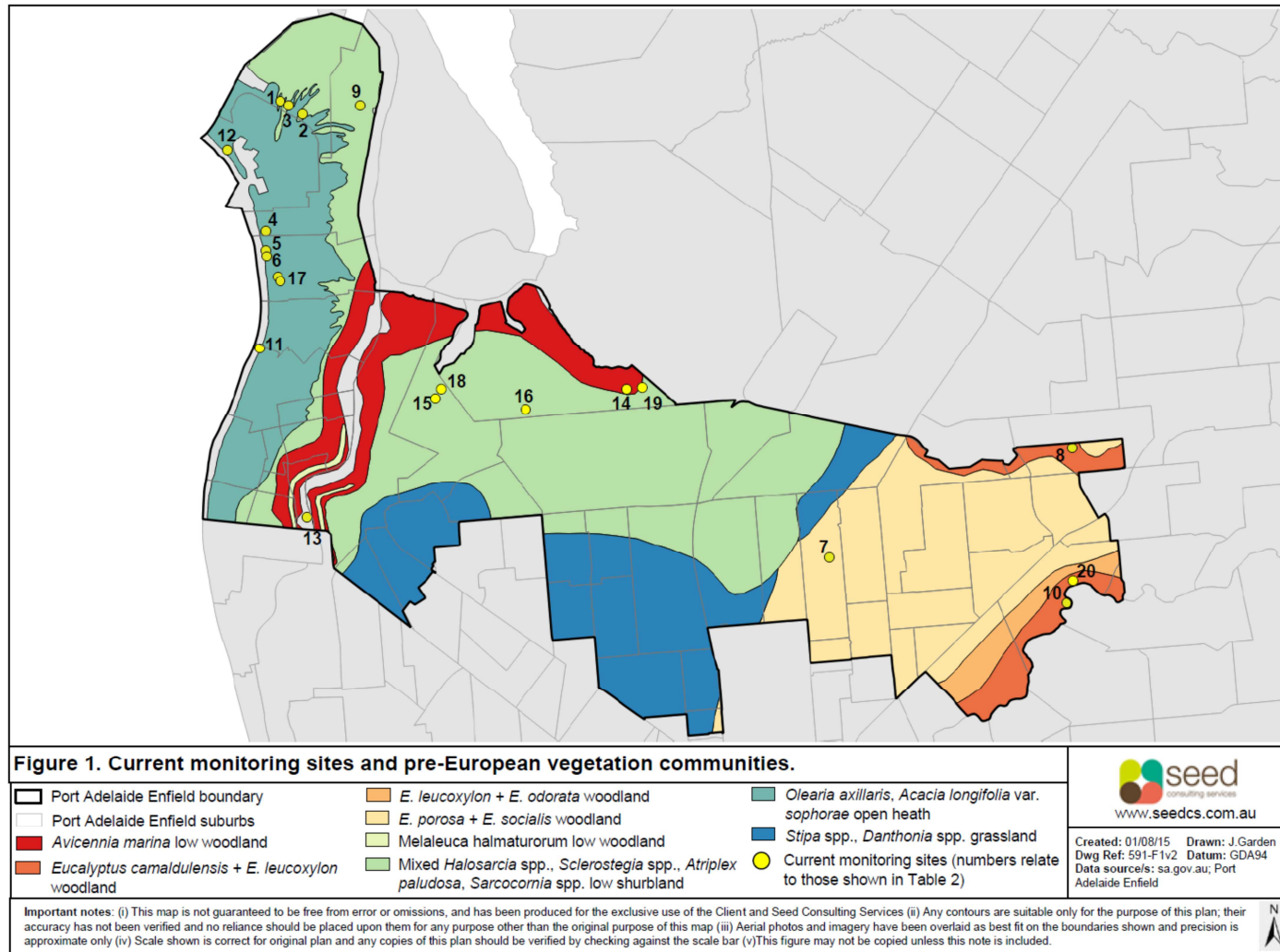


Figure 3: – *Eucalyptus porosa* Woodland, Folland Park, Enfield.



Figure 4: - *Eucalyptus camaldulensis*, *Eucalyptus leucoxylon* Woodland, River Torrens, Linear Park, City of Port Adelaide Enfield.

Figure 5: Forests & Woodlands of the Adelaide Plains in 1836 (Source: Rural Solutions 2008)



2.2 The Current Landscape

The City of Port Adelaide Enfield covers an area of 91.7 square kilometres and has a population of 120,427 people (2013). The City is a historically rich metropolitan area, located between unique and significant natural features including diverse coastal, estuary and land-based ecosystems and habitats.

2.3 i-Tree Canopy Cover Landscape Assessment

An i-tree canopy assessment was undertaken by SEED Consulting Services to determine the City's canopy coverage for twelve different land cover classes (Figure 21). 1035 randomly located points were surveyed across the City giving a 95% confidence level and 3.05% confidence interval. Each point was classified as one of twelve land cover classes. The classifications conducted were based on 2010 satellite imagery and 2015 aerial imagery to enable an analysis of change over time. With regard to percentage canopy cover in the region, the contribution of each suburb to the overall region's canopy cover percentage was also calculated and mapped.

The canopy cover across the region increased marginally between 2010 and 2015 (10.2% to 10.5%), with most of this canopy occurring over pervious surfaces. Nearly half of the region in 2015 was covered by impervious (hard covered) surfaces (47.9%), which is a slight increase from 2010 (47.2%). The amount of bare ground in the region decreased by just over 5% between 2010 and 2015, whilst the amount of non-sporting grass cover increased by 4% (9.9% to 13.9%). Available planting space (bare ground plus grass-other) decreased by 1% between 2010 and 2015, likely due to conversion of some bare ground to 'grass-other' and impervious surfaces.

On the coast and beaches, there is 1.4% coverage by dune vegetation, and 1.9% by wetland vegetation (not including mangroves, which are included as 'tree-pervious' in this analysis and cover just over 1% of the region.) Just over 2% of the coastal area is effectively water (SEED Consulting, 2015).

In 2015, Dry Creek was classified as the suburb contributing the highest percentage of canopy cover to the overall canopy cover per cent; 18 suburbs were classified as having no contribution to the region's overall canopy cover percentage. This does not mean that there is no vegetation present in those suburbs, but rather the percentage cover of the vegetation is low relative to the points classified. Dry Creek was also classified as the suburb contributing the highest percentage of relative space for planting opportunities (i.e. Bare ground & grass-other) to the overall region's planting opportunity percentage.

The 'random selection point' methodology used within the region in 2010 and 2015 resulted in no points occurring within Dernancourt, due mainly to the relatively small area of this suburb. An independent assessment was therefore undertaken, and 10 random points hosen within this suburb, which indicates it is relatively green - however, there are still a number of planting opportunities (20% canopy cover, 30% impervious surfaces, 20% planting space, 20% wetland vegetation, 10% water).

Based on canopy cover (tree-impervious & tree-pervious) in the region in 2010 and 2015, broad benefit valuations were calculated as part of i-tree Canopy outputs (summarised in figure 22). The valuations are inherently broad given that i-tree Canopy does not distinguish between different tree species or sizes (as the i-Tree Assessment software is capable of achieving). It is important to note that i-tree Canopy is based on American metrics based on California i-tree assessments, which offers the closest American climate analogue to South Australia. In considering this, the data should be interpreted here as an approximate relative valuation only; valuations adapted for Australian conditions may vary, but are still likely to be in the same order of magnitude.

Table 2: Significant open space areas in the City of Port Adelaide Enfield

Significant open space area	Type of open space *	Vegetation region
Dry Creek	L	Region 4
River Torrens Linear Park	L	Region 4
Folland Park	N	Region 7
Roy Amer Reserve	P	Region 7
Barker Inlet	N/C	Region 16
Mangrove Park	N/C	Region 16
Biodiversity Park	N	Region 18
Largs Bay	N/F	Region 18
North Haven	N/F	Region 18
R.B. Connolly Reserve	N/P	Region 18
Semaphore south	N/F	Region 18
Taperoo	N/F	Region 18
Magazine Creek Wetlands	W	Region 19
Mutton Cove	N/C	Region 19
Outer Harbour	N/F	Region 19
Range Wetlands	W	Region 19

*N = natural area, F = foreshore, L = linear park, P = park, C = coastal, W = wetland

Since European settlement, much of the indigenous vegetation of the Port Adelaide Enfield region has been cleared and replaced with urban and industrial development. Today, existing vegetation fragments are typically small and highly modified by past and current management practices. This change in land use, combined with other threats such as competition from and displacement by exotic plants and pest animals, has significantly reduced the extent and condition of all of the major vegetation associations that originally occurred in the region. For example, the mallee box (*Eucalyptus porosa*) woodlands, which once formed a major part of the native vegetation, have all but disappeared from the Adelaide plains. The rapid and extensive decline of this and other vegetation associations has led to the local extinction of some indigenous flora and fauna species and the decline in range and abundance of many other species (Paton et al. 1994; Tait et al. 2005).

However, some significant areas of these vegetation associations exist in various states of modification within the Port Adelaide Enfield Council area, particularly in coastal regions (Table 1; Figure 5). These areas of natural and semi-natural open space are particularly valuable for maintaining biodiversity and ecological character in the predominantly urban and industrial environments, as highlighted in the Council's State of the Environment Report (City of Port Adelaide Enfield 2012).



Figure 6: Painted Dragon *Ctenophorus pictus* found at Largs Bay Dunes



Figure 7: *Thysanotus juncifolius* Rush Fringe-lily, City of Port Adelaide Enfield.

3.0 PREPARING THE PLAN

The City of Port Adelaide Enfield consists of a diverse mix of native vegetation communities including; woodland, parkland, dune, mangrove and samphire. These communities provide habitat and foraging resources for a wide range of flora and fauna species, including significant and threatened species, however, face a number of current and future threats including ongoing urban development and climate change.

With these current and future pressures, together with increasing levels of urbanisation, the Council's *State of the Environment Report (2012)* recognised that preserving biodiversity is a fundamental aspect of sustainable development, and implementing monitoring and appropriate management regimes in areas of biodiversity value were identified as critical actions for creating resilient natural open space landscapes. In response, Council initiated the development of the Biodiversity Management Plan 2016 – 2020.

The planning supports the recommended actions included in Council's *State of the Environment Report 2012*, and also supports the following objectives contained in Council's **City Plan 2030**.

The output from the Biodiversity Management Plan will also help to address the key challenges, objectives and principles outlined in the *30 Year Plan for Greater Adelaide*. For example, increasing population and urbanisation, as well as climate change impacts, are recognised in the Plan as key challenges for Greater Adelaide. Actions to addressing these challenges are categorised under three key objectives:

- Maintain and improve liveability;
- Increase competitiveness; and
- Drive sustainability and resilience to climate change.

The key stages in the preparation of the Biodiversity Management Plan 2016 - 2020 have included:-

3.1 Stage 1&2 – Biodiversity Research Report

Planning and preparing a Biodiversity Research Report, which involved the below research elements:

- Biodiversity Management Plan 2009 – 2014 Review and Gaps Analysis
- Biodiversity Condition status and opportunities for Improvements.

(Further details found from p. 67 to 81 and technical information in Appendix: 1.)

3.2 Stage 3 – Review of key legislation, policy and plans

Involved undertaking a review of the key legislation, policy and plans (Local, State and Federal) in relation to Biodiversity Management, to identify links and partnership opportunities or non-compliance.

3.3 Stage 4 – Consultation with key stakeholders

Consultation with key agency and stakeholder groups that influence and contribute to biodiversity management within the Council boundary. Workshops were held during September 2015 with Government and Non-government groups.

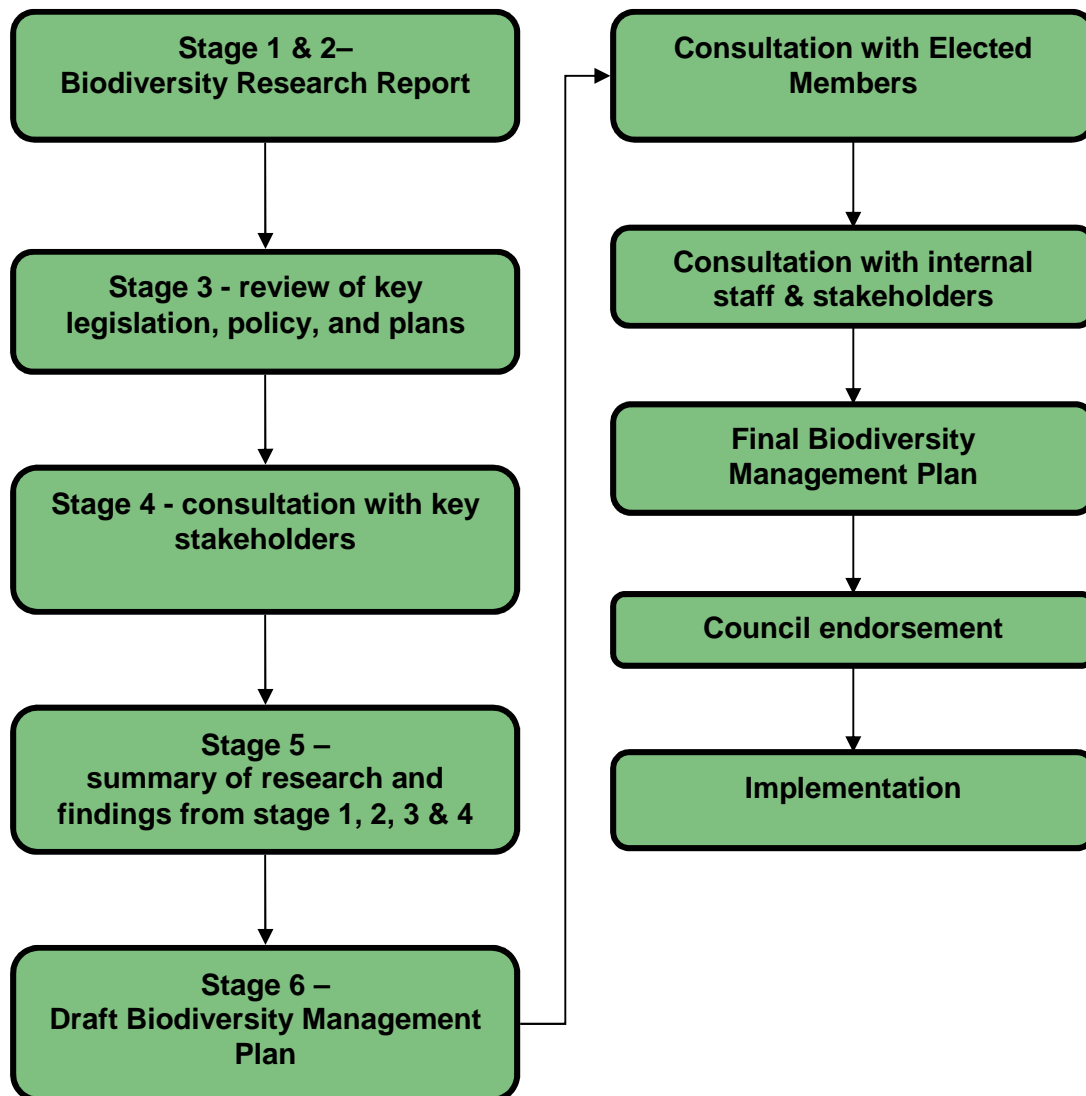


Figure 8: *Avicennia marina* Low woodland, Port Adelaide River, City of Port Adelaide Enfield.

3.4 Stage 5 – Preparation of Biodiversity Management Plan 2016 - 2020

Development of a four year prioritised work program and budget, to be reflected in Council's Section Plans.

Figure 9: Process for preparation of the Biodiversity Management Plan



4.0 Biodiversity Research Design

4.1 Stages 1 and 2 – Biodiversity Research Report

Stages 1 and 2 of the Biodiversity Management Plan (desktop analysis and fieldwork) provide background information to underpin the preparation of the Biodiversity Management Plan. The research provides some specific biodiversity insight into the City's current biodiversity status and management mechanisms in place, and provides recommendations for management in line with the most up-to-date principles of urban ecology. More specifically, the objectives of Stages 1 and 2 were to:

- Review of the relevant literature, studies and systems that exist regarding biodiversity
- Determine where gaps have emerged in the current Biodiversity Management Plan
- Identify and undertake monitoring in new biodiversity monitoring sites that could assist in providing a more comprehensive understanding of particular ecosystems within the City.
- Provide recommendations for key habitat areas from across Council to improve biodiversity value and reduce the likelihood of threats.

Details of Stages 1 and 2 generated maps and tables are included within the Technical Information (Appendix 1.) - however, the following is a summary of the key findings of that body of research.

4.2 Stages 1 and 2 - Methodology for new monitoring sites

Selection of new monitoring sites

The Summary recommended three new monitoring sites (Table 3; Figure 5). These were new locations for the Bushland Condition Monitoring (BCM) setup (see 4.3 below), conducted as part of this project, and will be considered as part of Council's existing mapping and biodiversity monitoring activities. Site selection was based on areas of specific conservation and/or revegetation/restoration value for biodiversity. Consideration was also given to improving representation of mapped pre-European vegetation communities. The selected sites represent two stormwater wetland areas and one riparian (river) area. The details of each site are included below at Table 3.

Table 3: New monitoring site - general ecosystem type and representative pre-European vegetation community. (see figure 5. For mapped locations of sites)

Region no.	Name	Ecosystem Type	Pre-European Vegetation Community
18	Magazine Creek Wetlands	Wetland	Mixed <i>Halosarcia</i> spp., <i>Sclerostegia</i> spp., <i>Atriplex paludosa</i> , <i>Sarcocornia</i> spp., low shrubland
19	Barker Inlet Wetlands	Wetland	Mixed <i>Halosarcia</i> spp., <i>Sclerostegia</i> spp., <i>Atriplex paludosa</i> , <i>Sarcocornia</i> spp., low shrubland community
20	Lagonda Drive	Riparian	<i>Eucalyptus camaldulensis</i> + <i>E. leucosylon</i> woodland

4.3 Monitoring techniques

The previous Biodiversity Management Plan included the use of the Nature Conservation Society of Australia Bushland Condition Monitoring (BCM) Framework. To maintain consistency with the Council's existing monitoring site survey protocol, the BCM method (Croft et al., 2005) was applied to flora and fauna surveys at each of the new sites by SEED Consulting Services.

These methods were primarily developed for monitoring remnant bushland areas and revegetation projects in rural / undisturbed settings - certain details collected are therefore potentially misleading when applied to highly disturbed, managed, and often created, vegetation patches in urbanised areas. However, the BCM method focuses primarily on collecting information about vegetation communities, cover and diversity, as well as threats/disturbances - with methods for detecting *fauna* diversity severely lacking, being based only on incidental observations. Nonetheless, the method provides a consistent process for assessing and monitoring vegetation within sites, and so formed the basis of the method used to survey the new monitoring sites. In order to capture a better representation of fauna diversity at sites, whilst still maintaining a rapid, low-effort assessment framework, some additional fauna survey techniques were undertaken, including the standardised bird census and Anabat (bats) recording (SEED Consulting, 2015).

Survey techniques for evaluating water quality are also absent from the BCM methods. Given the three new monitoring sites were located within close proximity to water (either wetland or riverine), there was an opportunity to take water samples from the water body/ies closest to each site. Samples were taken at approximately 2-3m from the water's edge using a dipping bottle and three samples were taken at each location (SEED Consulting, 2015).

4.4 Surveying limitations

Flora and fauna findings from the surveys conducted as part of this project were limited by a number of factors outlined below, which need to be considered when referring to findings from these surveys.

4.5 Time of year

Flora and fauna surveys are ideally conducted during spring/early summer when species are most active and able to be detected. The timing constraints of the research meant that surveys were conducted in the middle of winter. The lower temperatures and shorter daylight hours characteristic of winter in South Australia limited the number of flora and fauna species able to be detected, as:

- resident species are less active in the cold weather (e.g. micro-bats often enter a state of hibernation called torpor);
- the majority of migratory species are absent;
- it is the off-season for fruiting/flowering for the majority of plants; and
- certain plants only emerge in spring/summer (e.g. some orchids).

Follow-up surveys at each site in mid-spring are recommended to supplement this survey.

4.6 Time and resources

Surveys conducted for the first time at sites are ideally conducted over a minimum of three consecutive nights, and incorporate more detailed survey techniques (e.g. trapping, spotlighting, call playback). Sample replicate sites within a specific location/ecosystem types are also being established in order to better represent biodiversity occurrence.

The time and resources available for this project, together with three sites being selected for survey, constrained the longevity and survey techniques able to be applied at each site. As a result, the two wetland sites, which were located within 7km of each other, were surveyed over two consecutive nights using a subset of 'rapid assessment' techniques. However, the Lagonda Drive site, being located approximately 15km from the Barker Inlet Wetlands site, could only be surveyed over a single night using rapid assessment techniques.

4.7 Urban matrix

The land-use surrounding vegetated areas, together with the land-use history, influence the biodiversity, condition, and biodiversity threats within sites. All monitoring sites are located within a highly urbanised matrix, with a long history of habitat clearing and urban Development, and varying degrees of public access and use. The chosen sites are also actively managed by Port Adelaide Enfield Council, with revegetation, access infrastructure, and weed clearing/control activities being apparent at each site. These

factors will substantially influence the vegetation condition, biodiversity threats, and diversity of species at sites (including the native: exotic species ratio).

5.0 RESULTS FROM RESEARCH REPORT

The below table summarises the main findings from the BCM indicator condition scores and additional fauna surveys and water monitoring results conducted at each of the new survey sites, for the Magazine Creek Wetlands, Barker Inlet Wetlands and Lagonda Drive sites. Further information can be found in the Technical Information (Appendix: 1).

5.1 BCM indicator scores

Table 4: BCM indicator condition scores for the 3 new selected monitoring sites.

Date	BCM Flora Indicator Scores														9. Fauna list	10. Bushland degradation
	1. Species diversity	2. Weed abundance and threat	3a. Structural diversity: ground cover	3b. Structural diversity: plant life forms	4. Regeneration (trees)	5 & 6. Tree health: dieback	5 & 6. Tree health: lerp damage	5 & 6. Tree health: mistletoe infestation	5 & 6. Tree habitat	5 & 6. Tree hollow	5 & 6. Fallen logs and trees	7. Feral animal abundance	8. Total grazing pressure			
Magazine Creek wetlands																
24 July, 2015	4	12	4	4	n/a - no trees or fallen logs							22	0	Yes	n/a	
Barker Inlet wetlands																
24 July, 2015	13	12	3	4	1	0	0	0	1	0	0	33	0	Yes	n/a	
Lagonda Drive																
24 July, 2015	18	43	3	11	1	3.2	2.2	0	10	1	0	0	0	Yes	n/a	

Indicator condition score colour codes:

Very poor or Very high risk	Poor or High risk	Moderate	Good or Minimal risk	Excellent or No risk
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Table 5: Summary of biodiversity ratings at each assessment site.

Box 1. Interpretation of indicators

The **Diversity** indicator is a measure of species richness (number of species) of native plants found within each assessment site. This is one of the most commonly used ecological indicators, but should not be used by itself as an indicator for 'biodiversity'. Native plant species vary naturally between vegetation communities. For example health grassland is typically less diverse than forest with a dense understorey. The rating in table 3 is weighted to account for these structural differences.

The **Weeds** indicator is a measure of the abundance (cover) and threat posed by different weed species found within each assessment site. Weeds are prevalent in open space throughout the council and in many cases outnumber native species. Many of the assessment sites also contain weeds of significant environmental concern (e.g. Boxthorn, Bridal Creeper). These 'red alert' species invade natural ecosystems and compete with and displace native plants and other biodiversity. They can reproduce and disperse rapidly to colonise large areas, particularly following disturbance, and they provide sub-optimal habitat for native fauna.

The **Cover** indicator is a reflection of the area of groundcover within each assessment site. This includes leaf litter, moss, lichen, liverworts and microphytic crusts exposed rocks and native and vegetative ground cover. Ground cover is important for the overall vegetation structure. High ground cover is beneficial for soil functions such as erosion control and nutrient cycling and provides habitat for ground-dwelling organisms (e.g. invertebrates) which in turn provide food for other native fauna.

The **Structure** indicator reflects the structural diversity (layers of vegetation) within each assessment site. Layers range from mat or groundcover and herbs, to grasses and tussocks, shrubs, vines and trees. In natural vegetation systems, high structural diversity is typically associated with high fauna diversity. This is because structurally diverse habitats (e.g. multi-layered forests) provide more habitat opportunities for a wider range of different organisms, compared to structurally simple vegetation (e.g. single species grasslands or plantations). In forest and woodland vegetation communities, senescent trees provide habitat for animals from fallen limbs and hollows.

The **Pest** indicator is the measure of the number and abundance of feral animals (or their signs such as dung, tracks etc.) observed in each assessment site. Pest animals can have significant negative impacts on biodiversity. Direct impacts include destruction on native plants, particular juveniles, by herbivores such as hares and rabbits, and soil disturbance which may exacerbate weed problems. Pests may also spread the seeds of invasive weed species from surrounding areas. For example foxes and starlings consume olive seeds and then move throughout the landscape spreading the seeds.

The **Degradation** indicator is a measure of the bushland degradation risk or the degree of exposure of the assessment site to degrading impacts from surrounding areas. As a general rule vegetation patches that are small, narrow and isolated from other vegetation are more likely to suffer degradation. The type of management of surrounding areas also affects biodiversity values. A combination of the sites and landscape factors is used to calculate degradation risk.

(Source: Collard.S & Mabarrack.A., *The City of Port Adelaide Enfield Biodiversity Management Plan: Stage 1 – Research and issues paper*, Rural Solutions, August 2008.)

5.2 Fauna species

A total of 31 native and 26 exotic vertebrate fauna species were detected across the three sites (see Table:10-12, page 72-75 for bird species). The highest diversity of both native and exotic species was detected at the Magazine Creek wetlands site (Whicker Rd), closely followed by the Barker Inlet wetlands site - these two sites also had the most similar composition of species. Birds were the most diverse taxonomic group identified, and included Federally listed critically endangered species. A number of additional migratory birds species are also expected to occur (or are known to occur from previous surveys) within the two wetland sites during the spring/summer seasons. Of particular conservation importance, are the numbers of Federally threatened species, which may occur in these sites (see Table: 10-13 SEED Consulting, 2015).

In addition, three micro-bat species were detected during the survey period, though at least five other species may be expected to be detected across the sites if surveyed during the spring/summer seasons (Terry Reardon, pers. comm. 2015):-

- Gould's wattled bat (*Chalinolobus gouldii*)
- Southern free-tailed bat (*Mormopterus planiceps*)
- White-striped free-tail bat (*Austronomus australis*)

Similarly, a number of reptile species (geckos, skinks, snakes, dragons, and blind snakes) are also expected to occur at the sites (Kellogg Brown & Root Pty Ltd , 2011), though none were detected during this survey period.

5.3 Water quality

Water samples were taken at the Barker Inlet wetlands and Magazine Creek wetlands sites. Samples from Magazine Creek wetlands showed conductivity readings of 3,320µScm and total dissolved solids readings of 1,800mg/L, compared to those at Barker Inlet wetlands, which showed conductivity of 28,800µScm and total dissolved solids of 18,000mg/L. 'Conductivity' is an indicator of the presence of solids and sediments in water. The results indicate that the water quality at Barker Inlet Wetland is more loaded with sediment than Magazine Creek. This could be due to greater disturbance of the soils beneath the water, and/or greater input of sediment pollution from stormwater and other sources flowing into the wetlands.

Three macro-invertebrates belonging to the *Ostracoda*, *Daphnia*, and *Amphipoda* (likely) sub-classes were observed in the samples from Magazine Creek wetlands. No macro-invertebrates were detected in water samples taken from Barker Inlet wetlands. It was not possible to safely access the River Torrens to take samples at Lagonda Drive (SEED Consulting, 2015).

5.4 Area limits to the Biodiversity Management Plan

The biodiversity of coastal areas is particularly rich and dynamic as they interlink marine and land-based ecosystems, including estuarine and wetland areas. Local marine biodiversity is described in detail in Council's *State of the Environment Report 2012*. However, the responsibility for management of marine waters is with State Government agencies including the Department of Environment, Water and Natural Resources (DEWNR), the Department of Primary Industries and the Department of Planning, Transport and Infrastructure, among others. Council has stewardship over Council's public open space areas only, including some coastal areas where Council has a 'care and control' role to the low watermark. This Plan focuses on those areas of management over which Council has responsibility, predominantly related to land-based biodiversity.

In relation to the coastal ecosystems outside of Council's boundary, the State program that has most implications for Council is the Adelaide Dolphin Sanctuary Act 2005, and the Adelaide Dolphin Sanctuary Management Plan. Council was a key driver and participant in assisting the State Government to establish the Sanctuary, and Council supports its implementation. The dolphin population of the Adelaide metropolitan coastal area is a valuable indicator of the health of the overall marine environment, as well as being an iconic natural asset of the area, engaging people in enjoying and learning about the natural world. Further information on the Port Adelaide Dolphins and the Sanctuary is available at:

<http://www.naturalresources.sa.gov.au/adelaidemtloftyranges/coast-and-marine/dolphin-sanctuary>

While not having direct responsibility for management of marine areas, Council assists in sponsoring valuable work of the Sanctuary staff and ADS Action Group volunteers to stage the annual Dolphin Day community event, which aims to raise awareness of the dolphins and the Sanctuary, increase community participation in the Sanctuary's activities, and promote the environmental importance of the sanctuary.

Coastal Management Responsibility

The Coast Protection Board was formed in 1972 with the proclamation of the [Coast Protection Act 1972](#) (the Act). The functions of the Coast Protection Board (as stated in the Act) are to:

- protect the coast from erosion, damage, deterioration, pollution and misuse
- restore any part of the coast that has been subjected to erosion, damage, deterioration, pollution or misuse
- develop any part of the coast aesthetically, or to improve it for those who use and enjoy it with assistance from Local Government and AMLR NRM.
- manage, maintain and develop those coast facilities that the Board is responsible for
- report to the Minister where required

- carry out, or be involved in, research into the protection, restoration or development of the coast.

Under the Act the Board has the power to:

- carry out works
- remove sand
- acquire coastal land, with the approval of the Minister
- deal with its land, with the approval of the Minister
- enter land (any member of the Board or an authorised person).

This Biodiversity Management Plan acknowledges the importance of the below neighbouring regional systems:

- the Barker Inlet-St Kilda Aquatic Reserve declared under the *Fisheries Management Act 2007* is managed by the Department of Primary Industries and Regions (PIRSA);
- the Torrens Island Conservation Park declared under the *National Parks and Wildlife Act 1972* is managed by DEWNR with support from community groups. The rest of the island is managed by a variety of government, non-government and private organisations.; and
- in the broader seascape, the Upper Gulf St Vincent Marine Park declared under the *Marine Parks Act 2007* is managed by DEWNR.

A summary of recommendations from the Research phase :-

- Addressing key threatening processes;
- Incorporating measurable targets in *Plan* strategies and implementing an adaptive monitoring and evaluation strategy to assess the *Plan's* progress;
- Ensuring consistency in monitoring of existing bushland monitoring sites and adding additional sites as well as expanded survey approaches;
- Monitoring climate change variables; and
- Improving metadata and creating additional, spatial dataset to facilitate decision-making and track actions and outcomes.

5.5 Stage 3 - Review of key legislation, policy, and plans

There is a wide range of legislation, strategies, and policies that apply to biodiversity conservation at the international, national, state and local level including the following:

TYPE	DETAILS
City of Port Adelaide Enfield	
Plans/strategies	Environment Strategy for a Sustainable City 2009-2014 (City of Port Adelaide Enfield, 2009a)
	Biodiversity Management Plan 2009-2014 (City of Port Adelaide Enfield, 2009B)
	Strategy Report: Open Space Plan 2013
	State of the Environment Report 2012
Consultant reports/management plans	Barker Inlet, Magazine Creek and Range Wetlands: Management and Maintenance Plans; Spill Contingency Plans; Existing vegetation Condition and Supplementary Planting (Eco Management Services, 2011)
	Port River-Barker Inlet Sea Wall Upgrade. Assessment of Environmental Effects and Upgrade Options (Tonkin Consulting and Eco Management Services, 2013)
	Dry Creek Management Plan (EBS, 2011a)
	Coastal Management Plan for the Largs Bay Dunes (EBS, 2012a)
	Coastal Management Plan for North Haven Dunes (EBS, 2011b)
	Coastal Management Plan for Osborne Dunes (EBS, 2011c)
	Coastal Management Plan for Semaphore Dunes (EBS, 2011d)
	Coastal Management Plan for Taperoo Dunes (EBS, 2011e)
	Environmental Management Plan, Mutton Cove, South Australia (Cook & Coleman, 2003)
	Mangrove Cove Management Plan and monitoring program (Delta)
	White Hollow Reserve Management Plan (EBS, 2013a)
	Folland Park Management Plan (Bellette, 1993)
	Monitoring report: Assessment Site 4 – Taperoo Dunes (Rural Solutions SA; EBS, 2012)

TYPE	DETAILS
City of Port Adelaide Enfield	
	Monitoring report: Assessment Site 8 – Dry Creek (Rural Solutions SA; EBS, 2013)
	Monitoring report: Assessment Site 9 – Mutton Cove (Rural Solutions SA, 2008)
	Monitoring report: Assessment Site 10 – Pitman Park (Rural Solutions SA, 2011)
	Monitoring report: Assessment Site 11 – Semaphore Dunes (EBS, 2012b)
	Monitoring report: Assessment Site 12 – North Haven (EBS, 2013b)
	Monitoring report: Assessment Site 13 – Mangrove Cove (Delta Environmental Consulting, 2014)
	Monitoring report: Assessment Site 14 – Barker Inlet Wetlands Bird Monitoring (Bird SA, 2014a)
	Monitoring report: Assessment Site 15 – Magazine Creek Wetlands Bird Monitoring (Bird SA, 2014b)
	Monitoring report: Assessment Site 17 – Semaphore Dunes (EBS, 2012b)
Databases	PAE digital biodiversity mapping system (GIS)
Government reports	Adelaide and Mt Lofty Ranges NRM Regional Species Conservation Assessment Project. Phase 1: Regional Species Status Assessments (Gillam & Urban, 2014)
Plans	Metropolitan Adelaide and Northern Coastal Action Plan (Caton, et al., 2009a;b)
	River Torrens Linear Park – Eastern Section Draft Management Plan (URPS, EBS, Tonkin, Swanbury Penglase, 2011)
Consultant reports	Adelaide and Mt. Lofty Ranges NRM Board: Shorebird Conservation & Management (Coleman & Cook, 2009)
	Shorebird Population within Gulf St Vincent: July 2011 to June 2012 Annual Report (Purnell, et al., 2012)
	AdaptWest: Environment and Open Space Research Paper (URPS, SEED Consulting Services and AECOM, 2015)
	Western Adelaide Region Climate Change Adaptation Plan – Stage 1 (SKM, 2013)
State	
Legislation	<i>National Parks and Wildlife Act 1972</i>
	<i>Natural Resources Management Act 2004</i>
	<i>Native Vegetation Act 1991</i>
Plans	Adelaide Dolphin Sanctuary Management Plan 2008 (Department for Environment and Heritage, 2008)
	Biodiversity Park Management Plan (EBS)
	Torrens Island Biodiversity Action Plan September 2013
	Metropolitan and Northern Coastal Action Plan 2013 Caton et al
	Water for Good Plan and WSUD policy.
Consultant reports	Northern Connector Project Impact Report. Technical Report No. 3: Flora (EBS, 2011f)
	Northern Connector Project Impact Report. Technical Report No. 4: Flora (EBS, 2011g)

TYPE	DETAILS
Federal	
Legislation	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
Plans	Wildlife Conservation Plan for Migratory Shorebirds (Department of the Environment, 2015)
Databases	EPBC Act Protected matters search Tool (PMST) (Department of Environment, 2013) Atlas of Living Australia database (ALA (ALA, n, d.))
International	
Agreements	Japan-Australia Migratory Bird Agreement (JAMBA) (Commonwealth of Australia, 1995a)
	China-Australia Migratory Bird Agreement (CAMBA) (Commonwealth of Australia, 1995b)
	Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) (Commonwealth of Australia, 2007)
	Convention on the Conservation of Migratory Species of Wild Animals (CMS; also known as the Bonn Convention (Bonn))(UNEP/CMS Secretariat, 2015)
	Ramsar Convention on Wetlands (RAMSAR) (The RAMSAR Convention Secretariat, 2014)
	Agreement on the Conservation of Albatrosses and Petrels (ACAP) (ACAP, 2015) East Asian-Australasian Flyway Partnership (EAAFP) (East Asian-Australasian Flyway Partnership, 2015)

This broad legislative and policy framework is designed to address those activities that cause damage to biodiversity, and also provide a platform for governments to develop programs and projects to research, monitor, manage, regulate, and improve the State's biodiversity assets.

5.6 International Context

Australia is a signatory to a range of international agreements and treaties, and where these may apply within the Council area, the Council ensures that its management takes consideration of these agreements. The most significant treaties in this regard are the Japan, Korea, and China Australia Migratory Bird Agreements which protect seven northern hemisphere bird species that take up residence in the Port Adelaide Barker Inlet Wetlands during the spring and summer months as part of the species' migratory and breeding cycles (Kellogg B and Root Pty. Ltd 2003).

The Japan Australia Migratory Bird Agreement, the Korean, and the China Australia Migratory Bird Agreements provide for cooperation between the national governments to manage and protect migratory birds, birds in danger of extinction, and the management and protection of relevant environments. The agreements require each country to respond appropriately to preserve and enhance the environment of birds protected under the provisions of the agreements.

In 2015 the State Government confirmed its commitment to these agreements through the development of the Adelaide International Bird Sanctuary that extends 60km along the stretch of coast from the Port Adelaide Barker Inlet to Port Parham. The Sanctuary will be a very significant area that aims to not only protect migratory birds, but will also preserve and protect coastal ecosystems which are critical for sustaining water quality in

Gulf St. Vincent. In 2016 Council is directly involved in the planning for the Adelaide International Bird Sanctuary, with DEWNR , adjacent Councils, and the community.

5.7 National Context

Under the *Environment Protection and Biodiversity Conservation Act 1999* certain procedures must be taken into consideration by Council, State Government or private developers undertaking capital works, where the works have the potential to impact on certain elements described in the Act, such as impacts on significant habitats or species, including migratory species.

A number of studies however have also noted the need to focus on restoring habitats at a landscape scale and ensuring that attention is directed not just to threatened species, but rather to threatened communities (City of Norwood, Payneham & St. Peters 2006).

There are a range of national policies and programs regarding biodiversity, which all levels of government must consider. Some of the national programs include community or non-government organisation (NGO) funding programs, which local government may be able to access directly or can collaborate with local groups to access for project delivery.

Most recently, the Commonwealth Government has developed the *Green Army Program*. The aim of the *Green Army Program* is to provide opportunities for young Australians aged 17-24 years to gain experience in environmental and heritage conservation fields and explore careers in conservation management, while participating in projects that generate benefits for the environment.

5.8 South Australian Context

The SA Native Vegetation Act 1991 is the primary tool for protecting and enhancing native vegetation throughout South Australia. The Native Vegetation Act applies in the metropolitan area only with respect to areas designated as being within Metropolitan Open Space (MOSS) Zones in a Council's Development Plan, or where clearance would cause significant harm to the Adelaide Dolphin Sanctuary or nature reserves such as *Forest Park* at Gepps Cross, and pockets along Dry Creek Valley View, and the River Torrens, which fall predominantly within and adjacent to Port Adelaide Enfield Council.

The Development Act 1993 also includes provision for the protection of biodiversity in the local area. The main development activities that can affect biodiversity include land division, change of land use, and building works.

A purpose of the Natural Resources Management Act 2004 is to assist in the achievement of ecologically sustainable development and natural resource management in the State. The Act establishes Natural Resource Management Boards throughout the State that are guided by the State Natural Resources Management Plan 2014-15 to

2023-24. Each regional Board also develops its own Plan and investment strategy. Port Adelaide Enfield Council falls within the Adelaide and Mt Lofty Ranges (AMLR) Natural Resource Management Board region, and works closely with the Board and its staff on a range of programs and projects (Ref. www.amlrnrm.sa.gov.au). The AMLR NRM management plan sets out the following 2028 targets for the region (in relation to the local context):-

- The region will have the system capacity to harvest up to 35 GL of storm water and 50 GL of wastewater per annum.
- Aquatic ecosystems and groundwater condition is maintained or improved
- All water resources used within sustainable yield
- Condition and function of ecosystems (terrestrial, riparian) recovered from current levels
- Improvement in conservation prospects of native species (terrestrial, aquatic, marine) from current levels
- Land based impacts on coastal, estuarine and marine processes reduced from current levels
- Halt the decline of sea grass, reef and other coast, estuarine and marine habitats, and a trend towards restoration
- All coast, estuarine and marine water resources meet water quality guidelines to protect defined environmental values
- Increased participation in natural resources management activities by 20%

The Department of Environment, Water and Natural Resources (DEWNR) have prepared a strategy “No Species Loss - A Nature Conservation Strategy for South Australia 2007-2017”, to contribute to natural resource management. DEWNR aims to halt species decline through the implementation of a number of goals and targets, including:-

- Protection of 80% of South Australia’s regional ecosystems;
- Management of threats to biodiversity;
- Identification of ecological communities in decline;
- Decline in threatened species and ecological communities is halted;

- Recovery Plans implemented for 100% of South Australia's endangered and vulnerable threatened species.

The strategies and management commitments developed for the Port Adelaide Enfield Biodiversity Management Plan 2015-2020 are consistent with the goals and targets contained within the Nature Conservation Strategy for South Australia, the Adelaide and Mt Lofty Ranges Natural Resource Management Plan, and other relevant regional and State plans.

5.9 Local Context

Commitment to biodiversity conservation features strongly in the Port Adelaide Enfield Corporate Plan 2011-2016 and Open Space Plan 2013. The Council's State of the Environment Report 2012 highlights the importance of developing Council's biodiversity management capacity to ensure all natural public open space areas are managed in a sustainable manner in order to protect against pressures such as development and other human or climate-induced impacts. Council will develop management plans for all areas of conservation significance under its stewardship in order to identify the issues and pressures in these vulnerable areas, and put in place site-specific management, conservation and rehabilitation plans to ensure their long-term viability.

The Port Adelaide Enfield State of Environment Report 2012 recommended implementation by Council of four key biodiversity actions, including:

- Collaborate with other neighbouring Councils and State Government agencies to support integrated biodiversity land management practices
- Council to liaise with key agencies to ensure local climate change vulnerability assessments are undertaken
- Undertake detailed flora and fauna surveys and ecological assessments of natural areas to ascertain baseline information and guide future revegetation or development
- Develop partnerships with volunteer groups in the management of natural areas.

Refer to the [City of Port Adelaide Enfield State of the Environment Report 2012](#) for more information.



Figure 10: - Conservation volunteers working at Magazine Creek Wetlands, Whicker Road Gillman (City of Port Adelaide Enfield)

6.0 Stage 4 - findings from consultation with key stakeholders

Stage 4 of the preparation of the Biodiversity Management Plan included consultation with key stakeholders that influence and contribute to biodiversity management within the Council region. Two workshops and a range of phone conversations were held during June to September, with Government and Non-government groups including:

Government Organisations

- Department for Environment, Water and Natural Resources (DEWNR)
- Adelaide and Mt Lofty Ranges Natural Resources Management Board (AMLR NRM)
- Department of Planning, Transport and Infrastructure (DPTI)
- Renewal SA (Major government land owner in the Council area)

- Tea Tree Gully Council
- Salisbury Council
- Charles Sturt Council

Non – Government Organisations

- Friends of Dry Creek
- Trees for Life
- Portside Christian School
- Friends of Mutton Cove Conservation Reserve
- Port Adelaide Residents Environment Protection Group
- Conservation Volunteers Australia

Each organisation was asked to provide their perspective and experience in relation to:

- Current or future research that would assist in ongoing biodiversity management within the City
- Key local issues of relevance.
- Relevant institutional management plans and strategies, in order to ensure alignment and co-ordination of effort and direction across levels of government.
- Current and future funding directions and partnership opportunities.

The feedback from key stakeholders is summarised below:-

- A priority focus should be on communicating, networking and sharing knowledge to help promote and achieve biodiversity management actions across multiple organisational boundaries. A particular focus should be on improving communication with the local Councils, the Adelaide and Mount Lofty Ranges Natural Resource Management Board (AMLR NRM), the Department of Environment, Water and Natural Resources (DEWNR) and education institutions.

Key topics of discussion could include:

- Sharing knowledge in regards to migratory shorebirds and Dry Creek corridor management, and BCM sites.

- State Government agencies communication in regards to new native and exotic pest control/management methods.
 - State government to establish partnerships to undertake research and monitoring of climate change impacts (e.g. sea level rise) in order to inform adaptation and management decisions for the long term.
 - Establish clear and open communication links with the Northern Connector Transport Corridor Project in order to work together to reduce impacts on biodiversity as a result of the development works and ongoing use and maintenance of the infrastructure.
 - Establish communication links, a shared vision, and agreed management actions with Renewal SA for on-going management of Biodiversity Park and with DEWNR and AMLR NRM for on-going management and monitoring of Mutton Cove. (Key sites on the Lefevre Peninsula)
- Additional monitoring sites should be considered for addition into the Council's existing BCM monitoring sites program. Doing so will assist in building a more comprehensive understanding of the current biodiversity, and evaluating the success of management actions.
 - All biodiversity management actions should carefully consider the impacts of actions on ecosystems occurring adjacent to the Council region and in the broader landscape and seascape. In particular, the impacts of terrestrial and aquatic management actions on adjacent marine and island areas and biodiversity must be considered (e.g. Inner Port, Barker Inlet, Outer Harbor, Torrens Island and Gulf St Vincent)
 - In addition to the BCM sites, it is recommended that other possible avenues for future research could include - vegetation re-establishment and retreat opportunities for coastal and estuarine vegetation communities, "living shorelines" as an option for addressing levee bank stabilisation (especially at and near Mutton Cove), and monitoring of threatened coastal and migratory species along sand dunes and in wetland areas (e.g. Red-capped plovers *Charadrius ruficapillus*, at Semaphore beach)

6.0 Stage 5 – Biodiversity Management Plan

Stages 1 – 4 of the Biodiversity Management Plan provided the research to inform the development of the final Biodiversity Management Plan, including the articulation of aims, strategies, and a program to prepare specific action plans to maintain and enhance biodiversity assets. The Plan includes a prioritised and costed activities program for a 4 year period, to enable budgets to be designed to implement the Plan.

The Biodiversity Management Plan strategies have been developed to align with Local, State and Commonwealth strategic plans, policy and legislation, so as to facilitate maximum on-ground partnership and funding collaboration opportunities.

The Plan will be reviewed within 2 years, and any changes made will be included in the Corporate Plan and Section Plan reviews.



Figure 11: Council wetlands Ranger undertaking plant identification, Barker Inlet Wetland, City of Port Adelaide Enfield.

7.0 BIODIVERSITY – KEY ISSUES and INFORMATION

7.1 Biodiversity Assets

7.1.1 Remnant vegetation

The remaining original vegetation in the Council area consists of large mature River Red Gums, SA Blue Gums, *Eucalyptus porosa* woodland, low shrub land, and open heath. The remnant River Red Gums and SA Blue Gums are along the Torrens Linear Park and Dry Creek reserves. The last remaining *Eucalyptus porosa* woodland is located in Enfield, at a protected Council and community-managed reserve known as Folland Park, where the density of the trees is reminiscent of pre-European settlement. Low Shrub land is scattered throughout the Council area, however good condition examples are on the Lefevre Peninsula at Biodiversity Park, and remnants of open heath are along the Lefevre Peninsula coast stretching from Semaphore to Outer Harbour.

Since European settlement, much of the indigenous vegetation of the Adelaide region has been cleared and replaced with urban and industrial development. Today, original vegetation fragments are typically small and highly modified.

Folland Park is one of a few conservation reserves owned by the Council that has been specifically managed to retain and protect its remnant vegetation. The reserve is 3.5 hectares in area and is one of the few areas remaining in metropolitan Adelaide containing vegetation that grew prior to European settlement. The reserve named after the early settler Charles French Folland is protected by a heritage agreement. The National Trust's Significant Tree Register lists remnant trees and habitats of Folland Park as being of outstanding historic significance (Bellette 1993).

Mutton Cove, a gazetted State Government Nature Reserve, is located on the eastern coast of the Lefevre Peninsula. The coastal / estuarine zone has been rehabilitated to its original function of a tidal mangrove and samphire environment, supported by a dedicated Management Plan. However, the levee bank is at serious risk of collapsing, which would cause detrimental impacts by allowing flooding in the reserve, "suffocating" the successful establishment of mixed *Halosarcia spp.* habitat. The local community has been very active and successful in managing and advocating for the site's protection over many years. It is very important ecologically as the last remaining significant area of samphire and mangrove woodland on the Lefevre Peninsula.

There is another small inter-tidal pocket at Mangrove Cove in the Inner Port harbour at Newport, which contains some important species including the heliotrope moth. This area is managed by Council with significant and valuable input from the adjacent school community.

The Commonwealth Government's *Environment Protection and Biodiversity Conservation Act (1999)* identifies the Lefevre Peninsula remnant vegetation and stormwater estuarial wetlands located at Gillman and Dry Creek as important migratory bird habitat, whereby a number of migratory birds are listed under international agreements (Refer to Table: 10-13 Migratory/other bird list).

7.1.2 Regulated and Significant Trees

The *South Australian Development Act 1993* provides for the protection of large and mature trees in the urban landscape, on both private and public land. The Act requires that permission be obtained from local Councils by anyone wishing to remove trees that are recognised as "Regulated and Significant Trees" pursuant to the definition within the Act. A similar requirement exists for proposals to undertake any activity, which may potentially affect the health of the tree. The legislation states that:-

A regulated tree is any tree in metropolitan Adelaide with a trunk circumference of 2.0 metres or more (measured at a point 1.0 metre above natural ground level). In the case of trees with multiple trunks, regulated trees are those with trunks having a total circumference of 2.0 metres or more and an average circumference of 625 millimetres or more (measured at a point 1.0 metre above natural ground level).

A number of tree species are exempt from regulated tree controls, either through their location or their species. To find out about the species exempt from this regulation and other details about the protecting regulated and significant Trees controls, see the State Government [Regulated and Significant Trees web page](#).

The Port Adelaide Enfield (City) Development Plan *regulated* tree Objective states:-

1. The conservation of regulated trees that provide important aesthetic and/or environmental benefit.
2. Development in balance with preserving regulated trees that demonstrate one or more of the following attributes:
 - (a) significantly contributes to the character or visual amenity of the locality
 - (b) indigenous to the locality
 - (c) a rare or endangered species
 - (d) an important habitat for native fauna.

The Port Adelaide Enfield (City) Development Plan *significant* tree Objective states:-

1. The conservation of significant trees, in Metropolitan Adelaide, that provides important aesthetic and environmental benefit.
2. The conservation of significant trees in balance with achieving appropriate development.

The Development Plan outlines the important value of 'Significant trees' and 'Regulated trees' as defined in the Act, and also contains strong objectives in relation to the protection of native vegetation generally. However, the Development Plan does not specify principles of development control ('conditions') in relation to biodiversity offset requirements and guidelines that would be highly desirable when there is development that requires the removal of regulated and significant trees. The State's 2016 review of the Greater Adelaide 30 year Plan proposes to increase the tree canopy by minimum of 30% across the urban area of metropolitan Adelaide by 2045. This can only be achieved if developers (small and large) take on the responsibility to replace trees using appropriate biodiversity offset guidelines to be set out by the State Government, in consultation with Local Government. A priority of this Plan is to establish a Council 'Tree assessment and Offset Guideline' for assisting in ensuring development that complements the local biodiversity value (refer to Action 3.1.3), and to achieve the required urban canopy targets.



Figure 12: *Eucalyptus porosa*, Folland Park, Enfield, SA.

7.1.3 Street and Reserve Trees

The City of Port Adelaide Enfield contains 831 kilometres of roads (including arterial roads) and a total of 323 open space parks & reserves, most of which have trees, landscaping, or other plantings to reflect local character. Local roads and associated assets including footpaths, street vegetation and reserve plants are managed by the Council, while most major arterial roads are managed by the SA Department of Planning, Transport, and Infrastructure, with Council support. Suburban streets have a particular set of issues and constraints with regard to the planting of suitable vegetation, additional to those issues that apply to reserves or vacant areas, and present a greater number of constraints in relation to addressing biodiversity. These issues include –

- traffic use, with associated safety and road maintenance requirements;
- the placement of essential services under and above roads and footpaths, such as gas, electricity, cable, sewer, and water pipelines;
- the use for pedestrians and cyclists who require a high level of surface safety and access;
- proximity to private houses and businesses, which can restrict the type of trees used in a street;
- the use of trees which minimise public health impacts, particularly allergies;
- the need to consider costs to the ratepayer of Council's streetscape management and maintenance;
- the increasing density of residential areas, and loss of public street space for tree planting

To manage these issues, the CPAE has specific Local Government tree management guidelines and a Street Tree Policy in place, which considers built form containment, road's associated infrastructure, and the urban landscape character.

However, even within these constraints, many benefits may be gained from ensuring that streets in the suburban environment add as much as possible to the overall values of biodiversity and amenity. Council's aim is to maximise biodiversity benefits wherever possible within the urban environment, both through its own practices and by promoting and guiding native vegetation plantations in new private developments, as part of the development assessment process.

7.1.4 Suburban Gardens

Private suburban gardens equate to a significant proportion of the total Council area. Suburban gardens provide great opportunities for both the habitation and breeding of birds, insects, amphibians and reptiles and also allow for movement between larger open space areas such as reserves and nature parks.

There are great benefits in developing gardens that attract native wildlife, minimise weed distribution, conserve water, and prevent the threat to local native species. A very valuable website developed by the South Australian Government specifies how residents can develop a garden that attracts wildlife and supports composition, structure and function of biodiversity – [Adelaide Gardens Planting Guide](#)

The size and diversity of the Council area means that the City contains a wide range of soil types and micro-climates. These include coastal sandy areas in the west, to the clay environments of the foothills in the east. It is valuable for each household to identify which are the most appropriate flora species to plant in the particular neighbourhood. This will maximise biodiversity and ensure that the species used will survive and thrive in that particular area.

7.1.5 Fauna and Flora

Over the last four years, Council has undertaken Bushland Condition Monitoring (BCM) once a year at seven biodiversity sites, varying from coastal landscapes in the west, to wetlands and to woodlands in the east. The majority of sites' diversity is rated as being in 'poor' to 'good condition'. The 'poor' category indicates low species diversity, high weed abundance, low structural complexity and high degradation risk from the surrounding landscape, and the 'good' condition is rated higher (refer to definitions in Table 5. for more information). Significant potential exists for expanding and enhancing biodiversity value in open space across the Council area by expanding the existing remnant vegetation open space areas wherever possible.

The BCM monitoring reports over the years have built a comprehensive list of flora species located at four sites, and can be viewed in Table 12 from page 78 - 81.

Overall, there have been 177 flora species recorded within 10 monitoring sites, where 71 species are classified as exotic; including State declared weed species. A number of recorded species are of conservation significance in the Southern Mount Lofty Ranges region including *Acacia ligulata*, *Callitris preissii*, *Eucalyptus porosa*, *Lawrenzia squamata*, *Lomandra effusa*, *Maireana enchylaenoides*, *Poranthera ericoides*, *Sonchus megalocarpus* and *Vittadinia blackii*.

The coastal mangrove and wetland communities in the CPAE region provide important, limited habitat for fish nurseries and important feeding grounds to the resident dolphin population and for wading and migratory birds. Many of the birds are listed as 'significant', not only under State and Federal legislation, but also under a range of international biodiversity agreements (see Table: 10-13 for more details).

- At least 54 bird species are listed under International bird agreements – 37 designated as 'known to occur', 9 are 'likely to occur', and 8 'may occur' in the CPAE region;
- At least 54 bird species are listed as migratory under the EPBC Act – 36 'known to occur', 11 are 'likely to occur', and 7 'may occur'; and
- At least 56 bird species are listed marine (ocean going) species under the EPBC Act – 39 'known to occur', 9 are 'likely to occur', and 8 may occur.

Some of these migratory birds such as the Red Necked Stint fly thousands of kilometres each year from the northern hemisphere to feed and roost at the Gillman and Barker Inlet Wetlands and along the coast of St. Vincent Gulf as far as Thompson Beach. Numbers of migratory bird species are declining due to a combination of factors, predominantly the loss of coastal wetland habitats globally which is reducing bird numbers substantially, and also due to the effects of climate change in affecting seasonal migratory bird patterns (OZ Coast, 2008).

The State Government has recently gazetted large areas of land along the coast from Port Adelaide to Thompson beach known as the [Adelaide International Bird Sanctuary](#) to protect coastal habitat for migratory birds that travel from Siberia, Alaska and Korea. Each summer the coastal mud flats and saltmarsh habitats host up to 27,000 shorebirds, with 12 species classified as internationally significant.

Many of the coastal sand dunes such as Taperoo Dunes, North Haven Dunes and Biodiversity Park (Lefevre Peninsula) contain regionally significant populations of two reptile species, *Ctenophorus pictus* (Painted Dragon) and *Pogona barbata* (Bearded Dragon) as well as a number of other reptile species. Common reptiles including shingle-back lizards, blue tongue lizards, small skinks and eastern brown snakes have been recorded.

Several common local bat species were sighted at Magazine, Barker Inlet Wetland and Lagonda Drive Torrens including, Gould's wattled bat, Southern free-tailed bat and White-striped free-tail bat (SEED Consulting 2015) - however the population distribution is uncertain.

The Council understands that a population of Bitterbush Blue Butterfly (*Theclinessthes albocincta*) exists on the northern Lefevre Peninsula and nearby at Torrens Island. Butterfly species have specific food requirements and losses of particular plant species can lead to the loss of a butterfly species. The Bitterbush Blue Butterfly relies on the native plant *Adriana klotzschii* (Coast Bitterbush) as a caterpillar food plant. However, urban sprawl has seen the butterfly's distribution reduced to only a few isolated populations. *Adriana klotzschii* would have originally occurred in the sand dunes along the metropolitan coast, including those in the City of Port Adelaide Enfield.

7.1.6 Existing areas undergoing revegetation projects

The Council's largest revegetation projects have occurred along the beach coastal dunes from Semaphore South to North Haven. The Council has carried out revegetation works extensively with 20,000 indigenous plants planted annually along this coastline since winter 2004. These projects have enhanced the coastline of Lefevre Peninsula, and have opened up further opportunities to increase vegetation links along the coast and inland to provide biodiversity linkages for birds, particularly smaller species such as Wrens. This will increase the overall biodiversity value of the reserves.

Council, with the assistance from Conservation Volunteers Australia programs in accordance with site-specific Council Management Plans, has undertaken a number of aquatic planting days with the aim of improving the water quality in some of these shallow basins. There are a number of opportunities for the Council, along with community groups, to carry out revegetation works, maintenance activities, and monitoring along the coast and in some reserves such as Dry Creek Linear Park and Torrens Linear Park where there are already remnant native corridors established.

All biodiversity revegetation programs will be undertaken in accordance with the [City's Open Space Strategy 2013](#) strategic directions.



Figure 13: Purple Swamphen *Porphyrio porphyrio*



Figure 14: Shingle Back Lizard *Trachydosaurus rugosus*



Figure 15: Mangrove *Avicennia marina*



Figure 16: Eastern long-necked tortoises
Chelodina longicollis

7.2 Major Threats to Biodiversity Values

7.2.1 Environmental Weeds

An 'environmental weed' is a non-indigenous species that adversely affects the habitats that they invade, ecologically and economically. Weeds are spread predominantly by vehicles, bikes, pedestrians, birds, foxes and other animals, as well as wind and water.

Overall, the urban development pressures in Port Adelaide Enfield, as elsewhere, contribute to exacerbating the 'edge effect' around existing areas of open space. The 'edge effect' is the impact on an ecosystem of the side-by-side location of contrasting environments. The greater the exposed 'edge' boundary at the perimeter of an open space, the greater the risk of degradation to the more fragile ecosystem. Long and linear reserves are therefore impacted more from the edge effect than circular reserves with the same area. The edge effects include:

- Weed invasion
- Wind penetration, and
- Air temperature increase at the perimeter

Disturbance, habitat loss and fragmentation due to urbanisation, for example, will likely be exacerbated by climate change. The edge affected areas are favourable for weed establishment and compete with and displace native species, and can negatively affect habitat value for native fauna. Furthermore, these species are likely to displace native species before they are able to adapt or evolve capabilities to persist in changing climatic conditions.

Activities that are considered to address key threatening processes include:

- Community group engagement to identify areas threatened by illegal activities.
- Species distribution modelling to identify high risk species, groups and/or communities under climate change (including decliner/increaser species and species shifting in/out of the region).
- Climate Change Refugia modelling to identify priority locations within the region for protection, revegetation and/or rehabilitation.

A large number of weed species are currently prevalent across the Port Adelaide Enfield area. The table 6 below lists the 'priority' weeds that require active management. A regional approach to managing these species (e.g. based on mapping and eradication across the landscape) is preferable to a site-by-site approach. In developing this Plan, consultations have highlighted the opportunity and interest from surrounding Councils to improve collaboration across borders to implement weed eradication and maintenance programmes in the future.

Table 6: List of declared weed species that need to be controlled in the Council area.

Species name	Common name
<i>Euphorbia paralias</i>	Sea spurge
<i>Euphorbia terracina</i>	False Caper
<i>Juncus acutus</i>	Spiny rush
<i>Lycium ferocissimum</i>	African Boxthorn
<i>Olea europaea</i>	Olive
<i>Oxalis pes-caprea</i>	Soursob
<i>Pennisetum clandestinum</i>	Kikuyu
<i>Phalaris aquatica</i>	Phalaris
<i>Trachyandra divaricata</i>	Dune Onion weed
<i>Rosa canina</i>	Dog Rose
<i>Salix sp.</i>	Willow
<i>Asparagus asparagoides</i>	Bridal Creeper
<i>Opuntia sp.</i>	Prickly Pear

7.2.2 Exotic marine species - *Caulerpa taxifolia*

There are several exotic marine species (plant and micro-animal) that have settled in the coastal waters of West Lakes, and the Port River and Barker Inlet areas, introduced by a range of means including release of ballast water from ships. The most critical of these pests currently is *Caulerpa taxifolia* (and a related species *Caulerpa Racemosa*) which is a Mediterranean species that has invaded the Port River, Barker Inlet, and adjacent coastal waters. It is a common aquarium plant, and is thought to have been introduced initially into West Lakes via the disposal of water from a home aquarium. The plant has spread rapidly through the entire Port Waterway system, and is an example of the extreme care required when disposing of exotic species of any kind into the environment.

Caulerpa taxifolia is a bright green alga (seaweed) with main stems that can grow 3 metres long, with up to 200 fronds. The weed can regenerate and start a new colony from a plant fragment as small as 1 square centimetre (PIRSA), and is also thought to be able to spread and reproduce via spores. It is very invasive, grows rapidly and is a serious threat to native sea grass meadows and bottom-dwelling communities, threatening fish breeding and feeding grounds. Pieces of the seaweed can survive out of water for up to two weeks. This means that pieces of the weed entangled in boat trailers, anchors and fishing gear can be transported between bays and waterways (PIRSA).

The [Department of Primary Industries and Resources of South Australia](#) (PIRSA) are managing the control of *Caulerpa taxifolia*. A ban on river floor anchoring by boats in the Port River and Barker Inlet is also in place, which aims to minimise the breakup and distribution of the plants. Council's *State of the Environment Report 2012* provides further information on this and other aspects of coastal biodiversity and its current pressures.

7.2.3 Introduced animals and insects

Council has identified three species (including the European Red Fox and Feral Cat) out of the eleven priority invasive species known in Australia, that create the most damage to habitats at a national scale. These species harmfully affect native fauna through competition for food and shelter, or through predation.

Council is required to report the sightings of weed and pest species to the State agencies, to ensure appropriate management regimes can be implemented where required.

7.2.4 Foxes

Foxes (*Vulpes vulpes*) are introduced predators that prey on native animals. Foxes cost the Australian economy millions of dollars annually. Foxes are highly adaptable and most abundant in urban areas where food is freely available, and have had a devastating effect on the smaller native species of mammals, birds and reptiles. Foxes are also placing pressure on the remaining populations of threatened species, such as the Brushtail Possum.

Due to the largely residential character of the Council area where domestic dogs and cats are present, the use of fox baiting programs to reduce and control fox numbers is not a viable option. The CPAE in partnership with volunteer programs in the last two years have undertaken fox den surveys at the North Haven dunes, however Council currently has no safe means of eradicating the dens. Currently dens are reported to be present at the following Council-managed sites:

- Folland Park, Enfield
- R B Connelly Reserve, North Haven
- Magazine, Barker Inlet & Range Wetlands
- Coastal Dunes
- Biodiversity Park (Lefevre Peninsula)

The public are encouraged to report any fox den sightings to Council. To find out more information about fox control you can visit the [Department of Primary Industries and Resources of South Australia](#) website.

7.2.5 Dogs

Domestic dogs (*Canis familiaris*) can have a significant impact on biodiversity through predation, disturbance of habitat and fauna (including birds on beaches), and the contribution of their faeces to water pollution. Dog faeces and other organic material entering waterways contribute to excess nitrogen and phosphorus levels. This nutrient excess increases aquatic plant growth which chokes waterways and leads to large fluctuations in dissolved oxygen levels, threatening fish and other animals in the water body. Unmanaged dog faeces may be washed directly into watercourses or may enter via the stormwater system after rains.

The spread of pathogens and parasites (e.g. hydatids) to humans is also a potential risk when dog faeces remain in public parks. Dog owners should therefore be aware of these impacts and collect and dispose of dog faeces correctly as specified in the CPAE Council's By Law 5.

These policies mentioned in By Law 5 are also critical in restricting dogs from:

- Digging up vegetation in biodiversity sensitive areas, including beaches and ;
- Chasing or disturbing native flora or fauna.

The CPAE has installed dog waste bag dispensers at reserves, parks and gardens throughout the Council area to enable users of the parks to dispose of the dog waste appropriately.

7.2.6 Cats

Cats (*Felis catus*), both feral and domestic, are introduced predators, which prey on a large range of native fauna. The feral cat occurs in most habitats across Australia. It has caused the extinction of some species on islands and contributed to the disappearance of many ground-dwelling birds and mammals on the mainland (DEWHA, 2007).

Feral or stray cats can carry diseases such as toxoplasmosis and sarcosporidiosis which can be transmitted to and cause serious illness and death in native wildlife, stock and humans (Dickman, C. 1996). South Australia has the highest abundance of feral cat numbers in Australia (Department of the Environment, 2008).

Owners of domestic cats can minimise the impact of the pets on local native fauna by responsibly restricting the animal's movement, particularly at night when cats naturally hunt. Options include restricting cats to indoor areas or the installation of appropriately designed outdoor enclosures.

7.2.7 Human Impacts

The impacts of un-managed human settlement on the natural environment are extensive and long term. Large or intensive human settlements inevitably apply pressure on biodiversity at global and local level by a range of activities, including:

- the introduction and distribution of pests and pollution;
- accelerating climate change, and

- creating the major loss or fragmentation of habitat through land clearing or development.

At a local level, humans can affect biodiversity in parks and reserves by a range of recreational activities, if not well managed. Even passive activities such as walking and bike riding can cause soil erosion and weed migration, particularly near waterways. Other localised human impacts include:

- Illegal rubbish dumping on reserves, potentially polluting soil and waterways in catchments;
- Illegal dumping of green garden waste, spreading exotic plant species into native habitats;
- Seeds and cuttings from exotic garden plants escaping into native habitats and becoming serious environmental weeds;
- Pollution including sediments and heavy metals accumulating in waterways and the sea from stormwater run-off.

Activities such as walking and riding in sensitive areas can be managed by the creation of dedicated trails and tracks, bikeways etc. such as the beachside 'Coastal Way', which allows the public to enjoy and value the natural environment while facilitating the protection of unique natural landscapes.



Figure 17: Largs Bay walking and cycling path - section of the Coastal way (City of Port Adelaide Enfield)

7.2.8 Climate Change

Climate Change caused by increasing concentrations of greenhouse gases in the atmosphere has impacts on vegetation germination, establishment, growth and regeneration. Some species, including numerous invasive species will benefit from increasing carbon dioxide concentrations, which in turn increases the pressure from pest plants on native and remnant vegetation. Changes in temperature, rainfall and evaporation are likely to have impacts on the composition of communities, population mixes within species and the timing of activities of organisms, such as flowering of plants (Bardsley, 2006).

The below Table 7 includes the current climate change variables used for the Western Region's Integrated Vulnerability Assessment (City of Charles Sturt, City of West Torrens and City of Port Adelaide Enfield)

Table 7: Climate variables used by the Western Region Integrated Vulnerability Assessment.

Climate Variable	Description
Temperature increases: Winter-spring	An increase in average annual temperatures of up to 2°C (1-2.5°C) is projected in winter and 2°C (1-3°C) in spring across the Region by 2070.
Temperature increases: Summer-autumn	An increase in average annual temperatures of up to 2°C (1-3°C) is projected in summer-autumn across the region by 2070.
Rainfall Reduction: Winter-spring	Average winter rainfall predicted to decrease by up to 20% (5-20%) and spring rainfall by up to 20% (10-40%) below 1990 levels by 2070.
Rainfall reduction: Summer-autumn	Average summer rainfall predicted to decrease by up to 10% (2 to 10%) and autumn by up to 5% (2 to 10%) below 1990 levels by 2070.
Sea level rise	Global mean sea level rise for 2046-2065 relative to 1986-2005 could be 0.26 m for more moderate emissions outlooks an up to 0.48 m by 2081-2100.
Sea surface temperatures	By 2046-2065 warming of the ocean could result in a 1.4°C in global sea surface temperatures under a medium emissions outlook relative to 1986-2005 and a 1.8-2.2°C rise by 2081-2100.
Increased ocean acidity	Projections for decreasing p H range from 0.06 to 0.32 p H units by 2100, with a best estimate more likely to be in the order of a 0.2 p H unit decrease.
Increased heatwave frequency and intensity	Sequences of three or more consecutive day with average temperatures at least 32°C are projected to increase from 1 to 20 years under the baseline period to one in every 3-5 years under a low emissions scenario in 2070 and every year under a high emissions scenario by 2070.
Increased intensity of rainfall	Climate models suggest that for each degree of global warming, extreme daily rainfall may increase by 7%.

(Refer Adapt West (2014) *Identifying climate variables for use by the Integrated Vulnerability Assessment for the Western Adelaide Region* and SKM (2013) *Western Adelaide Region Climate Change Adaptation Plan - Stage 1* for more information).

In particular, the City of Port Adelaide Enfield's, coastal wetlands (e.g. samphire and mangrove systems) will be directly affected by rising sea levels. The Lefevre Peninsula and adjacent low lying landforms have been identified as an area of potential risk from rising sea level and storm surges associated with climate change. Unless properly accommodated and planned for, rising sea levels have the potential to adversely influence the functions of natural marine and coastal ecosystems in the area. In many cases, natural systems may be constrained by abutting coastal infrastructure and human modifications to hydrology and landforms. In estuarine and mangrove areas in particular, it will be necessary to ensure the provision of adequate buffers or accretion zones so that future development does not become a barrier to the movement of species landwards.

In the woodland vegetation remnants in the eastern section of the Council area, existing habitat fragmentation may be a significant barrier to the movement of plant and animal species between remnant vegetation patches. As predicted by current models, the climate is predicted to become warmer and dryer leading to a shift of species to dryer semi-arid environments.

Estuaries are likely to be affected by a number of climatic and hydrologic variables that influence both freshwater and marine systems. Surface ocean acidity (pH) is predicted to increase significantly by the end of the century, and in estuaries there may be other natural and anthropogenic processes (e.g. additional nutrient inputs, acidic river inputs) that compound pH problems (Scientific Working Group, 2011). Strong correlations between salinity and fish assemblages have also been found. The data suggest that with climate change some species may become extinct. Others may be outside their optimum environmental conditions and whether they can adapt will depend on their life cycle, and changes to coastal currents. Changes to estuarine morphology and closure are likely in wave-dominated estuaries and deltas thereby impacting fish species that move into or through estuaries. For more information about estuary and marine biodiversity and the various activities undertaken to protect these ecosystems refer to [Marine Parks](#).

As part of this Plan, Council will consider monitoring terrestrial micro-climates, with a focus on temperature, establishing key climate change monitoring sites or temperature monitoring points located in different land cover types (mangrove/samphire, dune vegetation, bushland vegetation, open parkland and built area). This information could be used to:

- Examine, quantify and clearly communicate relationships between micro-climate temperature trends, distance to coast/hills, land cover type, and biodiversity;
- Investigate the influence of green infrastructure on temperatures, which will help advocate (and leverage funding for) increasing 'green infrastructure';
- Identify relationships between micro-climate temperature trends and regional and state level climate data; and
- Link to the Western Adelaide regional adaptation plan and climate change adaptation pathways, providing important information for informing key decision points where a choice between different adaptation options is required (i.e. understanding when key thresholds are triggered). (SEED, 2015).

7.2.9 Planning of stormwater assets to support biodiversity

The CPAE has an extensive network of stormwater drainage channels that transport stormwater from catchments in and beyond the City to waterways and the coast. As part of the preparation program of the newly mandated Stormwater Management Plans, Council is assessing opportunities to improve the capacity of major stormwater channels to add to water quality improvements, and where possible, to add biodiversity corridor value and improve water infiltration by progressively making some channels more permeable in parts. At the same time, it is important to ensure that any strategy does not add to flood risk in existing areas.

In new large-scale developments, Council is promoting strongly and supporting the use of 'Water Sensitive Urban Design' principles by developers, which includes wherever possible the use of stormwater management techniques and designs that support biodiversity, including the use of wetlands and water-sensitive landscapes and plantings.

7.2.10 Development of vacant areas

Species of plants are under increasing threat by current new urban developments in Australia. This is in addition to the many species already on the edge of survival over the last century.

The Port Adelaide Enfield Council area is an unusual Council area in that, although a metropolitan urban Council, it still contains significant areas of undeveloped or vacant land. They are located predominantly in the eastern and northern sections of the Lefevre Peninsula and the large coastal tracts of land at Gillman and Dry Creek. (Refer to Figure 5: Natural Area Region 19).

This is due to –

- (a) the European settlement history of the area, which established parts of the Council area as industrial and port-focused land uses and operations to service the greater Adelaide region,
- (b) its natural characteristics which included, in its original state, large areas of marsh, mangrove, and floodplain land along the coast and Port Adelaide River, and
- (c) some of this topography and related ecosystems remaining relatively intact, while some have been transformed significantly by various past land reclamation and engineering projects.

Due to these ‘constraints’, development of the land in these more marginal areas has not been cost effective or strategically valuable – until now. The ongoing growth and expansion of Adelaide and its need for effective economic and physical infrastructure to support that growth, has increasingly brought these vacant areas to the attention of the State’s land use planners, and has made development of the areas more commercially viable.

From a biodiversity perspective, these areas are important in that by default they have retained some significant vegetation and other natural features of the original landscape of the area. This provides a unique opportunity (and challenge) to ensure that as development occurs, maximum protection is provided to significant habitats and linkages. In this Plan, Council will consider developing practical biodiversity asset guidelines in liaison with State Government, for developers to utilise to encourage them to investigate alternative means of reducing their corporate environmental footprint where ever possible (refer to action 3.1.3 for more information).

The Council requests prospective private developers (and advocates major State Government agencies proposing development) to include the requirement for a vegetation or biodiversity survey and assessment, in order to ensure that any significant or valuable species or habitats that occur in the area are identified and managed appropriately as part of the development of the land. The State Planning authority also

requires in most cases comprehensive environmental impact assessments for major projects in undeveloped areas.

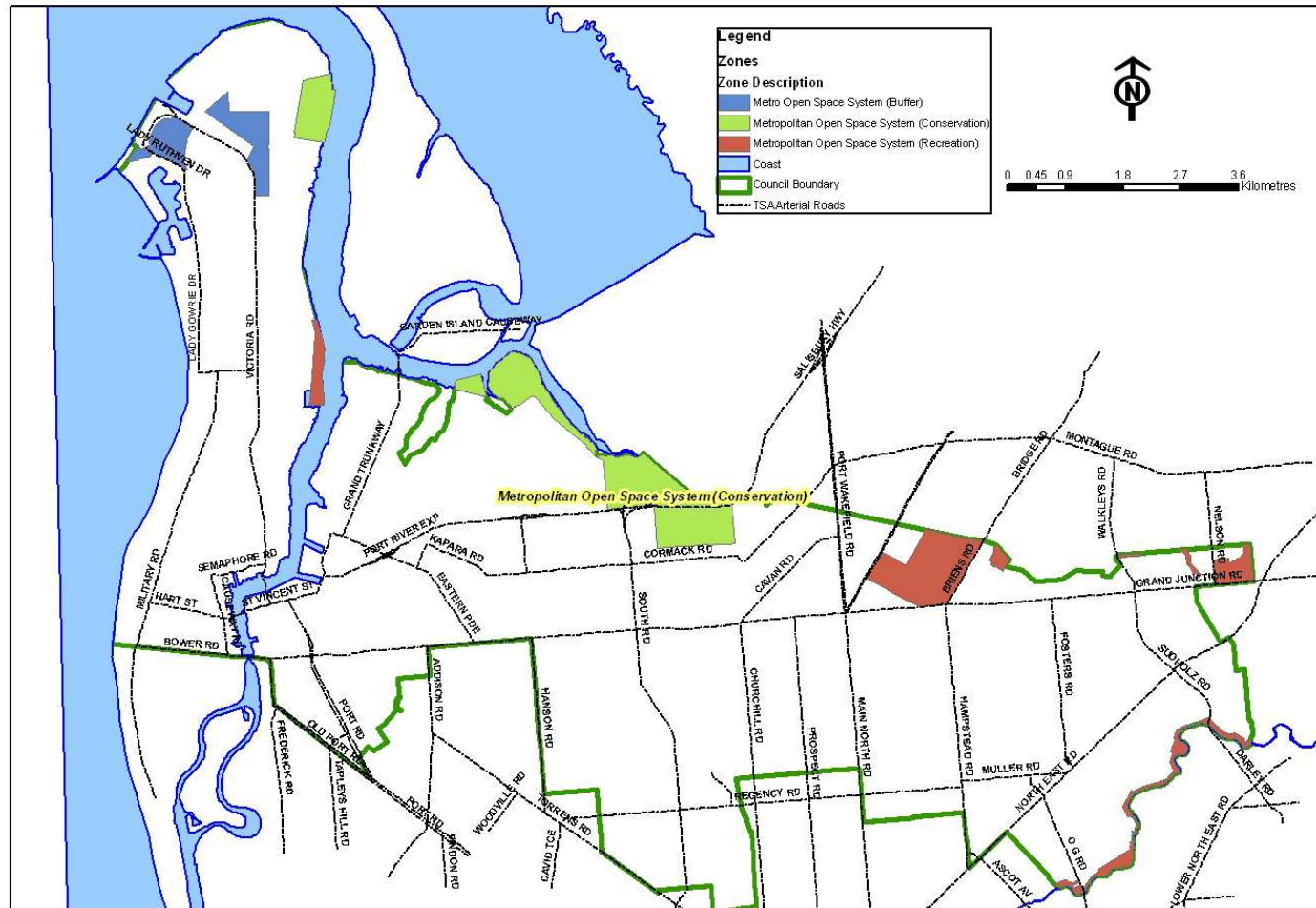
In some cases, development in previously vacant areas may also trigger the requirement for the prospective developer to assess the potential impacts of a development proposal on biological species of national or international significance. This impact assessment is administered under the Commonwealth Government's legislation – the *Environment Protection and Biodiversity Conservation Act 1999*. An example of this process is in relation to bird species that are listed as protected under international migratory bird agreements.

Some areas of vacant open space in the City are set aside under the State Government's *Metropolitan Open Space System* (MOSS). These are designated areas fully protected from most types of development under State and local legislation. In some cases, these areas are specifically set aside in order to protect local 'conservation' values or assets, such as the Gillman mangrove areas and some other areas protected under the SA Native Vegetation Act 1991. (See Figure 19 map location of particular MOSS zones and figure 20 map of Native Vegetation zones covered under the act in PAE).



Figure 18: Natural rehabilitation of Mangroves within Barker Inlet Wetlands, City of Port Adelaide Enfield.

Figure 19: (MOSS) Metropolitan Open Space System zones in Port Adelaide Enfield Council



Biodiversity Management Plan 2016 - 2020 Part 1: Background Report



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ABBREVIATIONS

AMLR NRM Board	-	Adelaide and Mount Lofty Ranges National Resources Management Board
DEWNR		Department of Environment, Water and Natural Resources
DPTI	-	Department of Planning, Transport and Infrastructure
MOSS	-	Metropolitan Open Space System
NGO	-	Non-Government Organisation
BMMH	-	Biodiversity Management Mitigation Hierarchy
CPAE	-	City of Port Adelaide Enfield

Glossary of terms

Aesthetic means landscape with a sense of beauty, pleasant to the visual eye.

Amphibians means (class Amphibia), such as frogs, toads, salamanders, newts, and gymnophiona, are cold-blooded animals that metamorphose from a juvenile, water-breathing form to an adult, air-breathing form.

Anthropogenic means affects processes or materials that are derived from human activities, as opposed to those occurring in natural environments without human influence.

Biodiversity means the variability among living organisms from all sources (including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part) and includes diversity within and between species and the diversity of ecosystems.

Degradation means any significant decline in the quality of natural resources or natural integrity of a place or the viability of an ecosystem, caused directly or indirectly by human activities.

Glossary of terms

Enhancement means the introduction of additional organisms, genotypes, species or elements of habitat or geodiversity to those that naturally exist in a place.

Ecosystem means a dynamic complex of organisms and their non-living environment, interacting as a functional unit.

Estuary means a semi-enclosed coastal body of water with one or more freshwater rivers or streams flowing into it, and with a free connection to the open sea.

Geodatabase is short for geographic database, and is the core geographic information model to organize GIS data into thematic layers and spatial representations. The geodatabase is a comprehensive series of application logic and tools for accessing and managing GIS data.

Habitat means the structural environments where an organism lives for all or part of its life, including environments once occupied (continuously, periodically or occasionally) by an organism or group of organisms, and into which organisms of that kind have the potential to be reinstated.

Hydrology means the study of the movement, distribution, and quality of water, and addresses both the hydrologic cycle and water resources.

Indigenous (or local native) species means a species that occurs at a place within its historically known natural range and that forms part of the natural biodiversity of a place.

Maintenance means the continuous protective care of the biodiversity and geodiversity of a place.

Modification means altering a place to suit proposed uses that are compatible with the natural significance of the place.

Monitoring means ongoing review, evaluation and assessment to detect changes in the natural integrity of a place, with reference to a baseline condition.

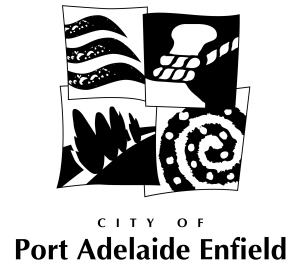
Protection means taking care of a place by managing impacts to ensure that natural significance is retained.

Restoration means returning existing habitats to a known past state or to an approximation of the natural condition by repairing degradation, by removing introduced species or by reinstatement.

Species diversity means the variety of species in a place.

Sustainability means in a general sense the capacity to maintain a certain process or state indefinitely. The concept of sustainability applies to all aspects of life on Earth and is commonly defined within ecological, social and economic contexts.

Understorey means level of vegetation situated under the midstorey vegetation layer. In woodlands, the understorey normally comprises low shrubs under 1 metre high, groundcovers and grasses.



Biodiversity Management Plan 2016 - 2020

Appendix 1: Technical Information and consultation report

Current Bushland Condition Monitoring (BCM) Sites located in the City of Port Adelaide Enfield

Table 8: Summary of type and regularity of surveys conducted at monitoring sites in the PAE region.

Relevant management plans are also shown. Survey types: BCM = bushland condition monitoring; FL = flora; FA = fauna; BIRD = bird survey only; VEGMPG = vegetation mapping from aerial imagery. Regularity of surveys is indicated by the years in which surveys were conducted.

MONITORING SITE		SURVEY TYPE					MANAGEMENT PLAN
No	NAME	BCM	FL	FA	BIRD	VEGMPG	
1	Biodiversity Park (site 1)	2008	-	-	-	-	- (not managed by PAE)
2	Biodiversity Park (site 2)	2008	-	-	-	-	- (not managed by PAE)
3	Biodiversity Park (site 3)	2008	-	-	-	-	- (not managed by PAE)
4	Taperoo Dunes (site 1)	2008 to 2012	-	-	-	-	Coastal Management Plan for Osborne Dunes (2012)
5	Taperoo Dunes (site 2)	2008 to 2012	-	-	-	-	Coastal Management Plan for Taperoo Dunes (2012)
6	Taperoo Dunes (site 3)	2008 to 2012	-	-	-	-	Coastal Management Plan for Taperoo Dunes (2012)
7	Folland Park	2008	1993	1993	-	-	Folland Park Management Plan (1993)
8	Dry Creek	2008 to 2013	-	-	-	-	Dry Creek Management Plan (2011)
9	Mutton Cove	2008	2009	2009	2010 to 2011	-	- (not managed by PAE)
10	Pitman Park	2008 to 2011	-	-	-	-	River Torrens Linear Park – Eastern Section: Draft Management Plan (2011)
11	Semaphore Dunes	2009 - 2013	-	-	-	-	Coastal Management Plan for Largs Bay Dunes (2012)
12	North Haven Dunes	2009 to 2013	-	-	-	-	Coastal Management Plan for North Haven Dunes (2012)
13	Mangrove Cove	-	-	-	2010 to 2014	2002, 2011, 2014	-

Table 9: (continued) Current Bushland Condition Monitoring Sites located in the City Of Port Adelaide Enfield

MONITORING SITE			SURVEY TYPE				MANAGEMENT PLAN
No	NAME	BCM	FL	FA	BIRD	VEGMPG	
14	Barker Inlet Wetlands	-	-	-	2012 to 2014	-	Barker Inlet, Magazine Creek and Range Wetlands Management and Maintenance Plans, Spill Contingency Plans, Existing Vegetation Condition and Supplementary Planting (2011)
15	Magazine Wetlands	-	-	-	2012 to 2014	-	As above
16	Range Wetlands	-	-	-	-	-	As above
17	White Hollow Reserve (sites 1 & 2)	2014	-	-	-	-	White Hollow Reserve Management Plan (2013)
18*	Magazine Creek Wetlands	2015	-	2015	2015	-	-
19*	Barker Inlet Wetlands 2	2015	-	2015	2015	-	-
20*	Lagonda Drive	2015	-	2015	2015	-	-

* New monitoring sites surveyed as part of Stage 2 of this Biodiversity Research Report project.

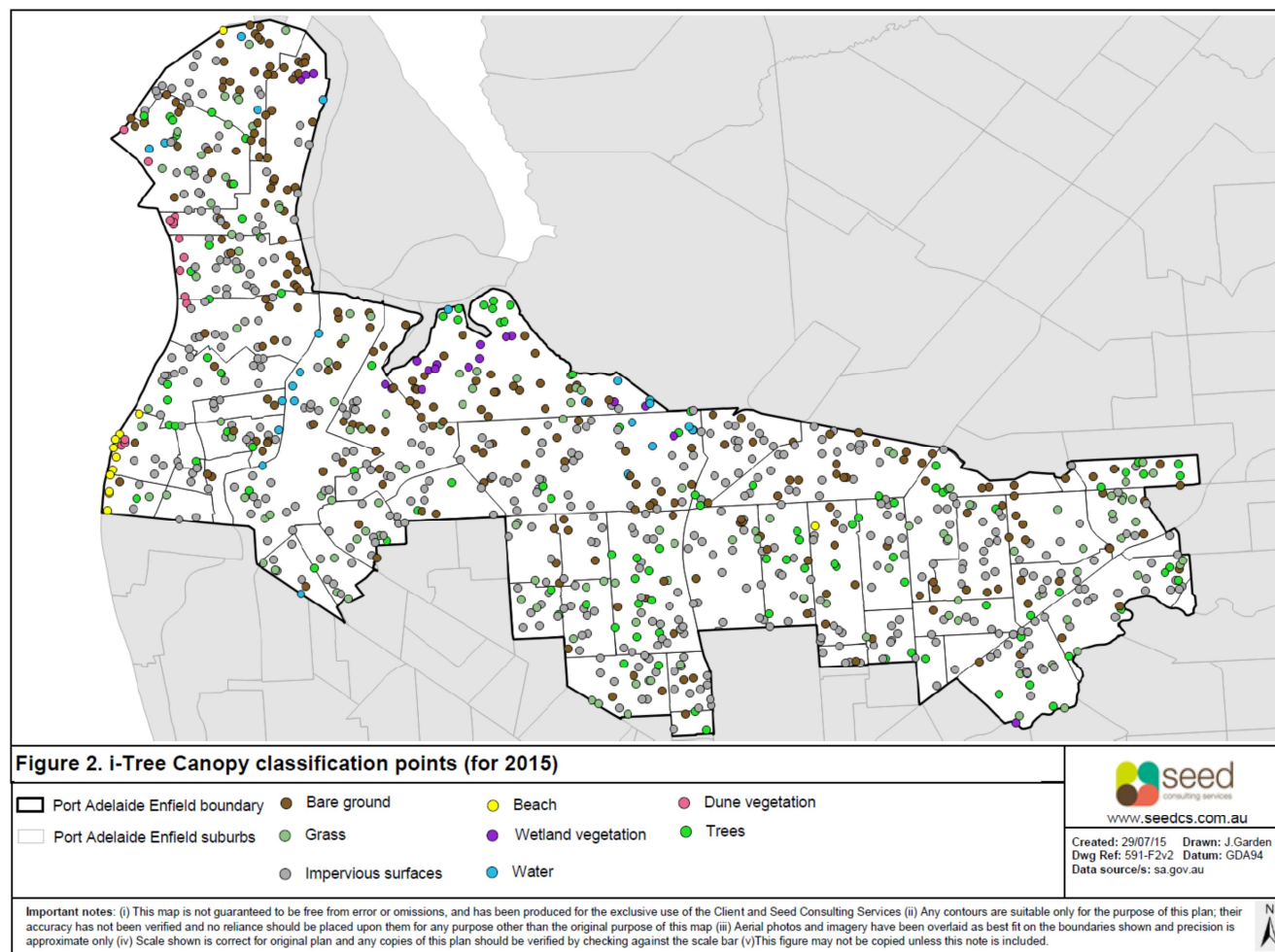


Figure 21: i-Tree Canopy classification points

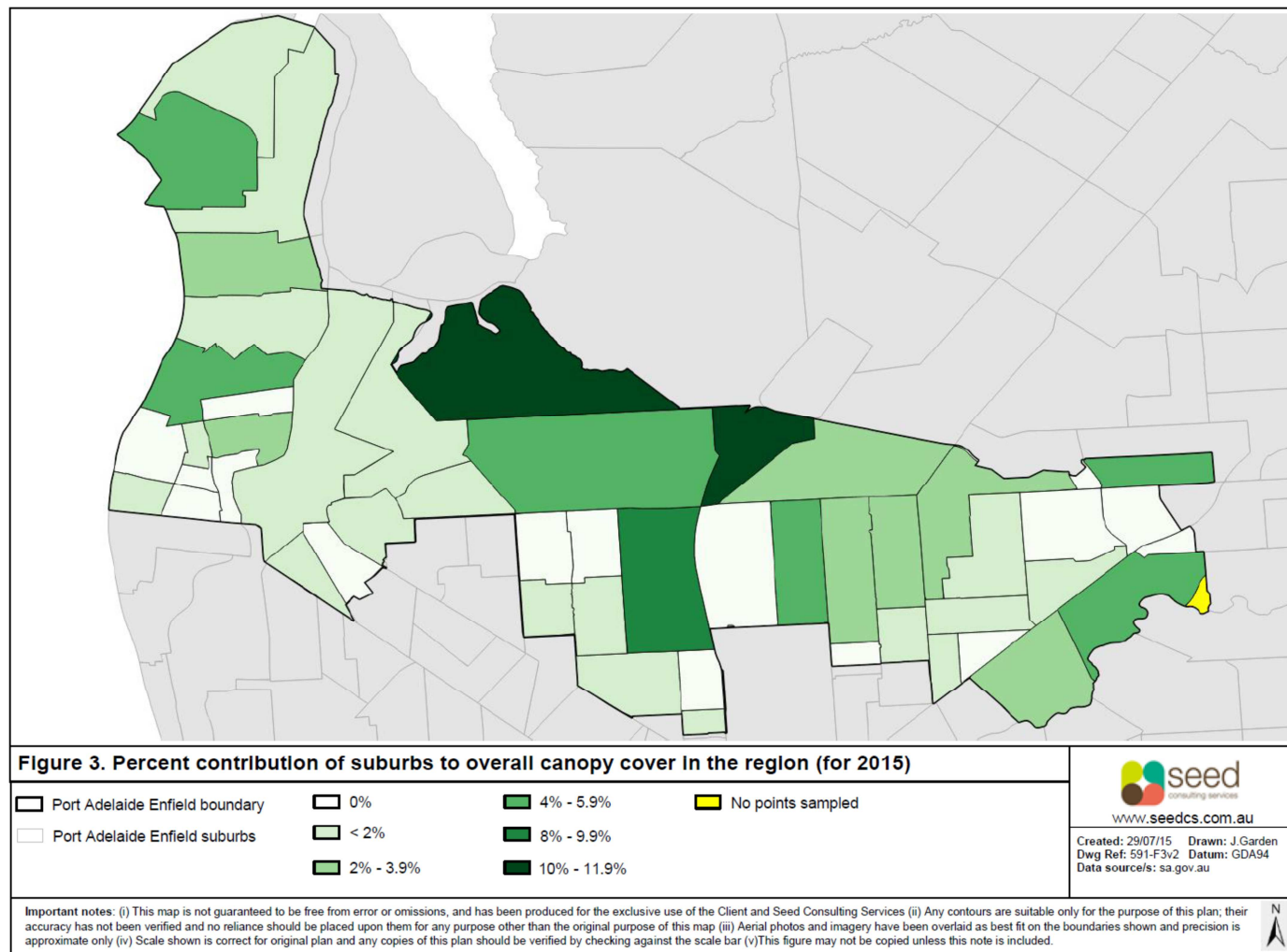


Figure 22: Per cent contribution of suburbs to overall canopy cover in the region - for 2015.

Table 10: List of significant native bird species reported in the Port Adelaide Enfield region

Significant native bird species reported in the Port Adelaide Enfield region and which may occur in the Lagonda Drive, Barker Inlet wetlands and/or Magazine Creek wetlands sites. The following list is not considered to be comprehensive. Species listed are based on searches of databases² and available reports.³ Species are listed alphabetically within major taxonomic groups (birds, mammals, reptiles, sharks, fishes, plants). For each species the following information is provided: scientific and common names; conservation status at Federal (F), State (S), and regional/local (R/L) levels (CE = critically endangered; E = endangered, NT – near threatened; T = threatened; R = rare; V = vulnerable); relevant migratory designation under the EPBC Act's other matters of national environmental significance (MNES) (species may be identified as wetland, marine or terrestrial migrants); whether the species is listed as a marine species under the EPBC Act Other MNES (Y = yes); any relevant listing under International agreements (A = ACAP, B = Bonn Convention, C = CAMBA, E = EEAFF; J = JAMBA, R = ROKAMBA; and the species' likelihood of occurrence. An asterisk (*) next to an International agreement letter indicates the species is listed as threatened by that agreement. A dash (-) indicates information is not relevant or available.

Species shown in bold were detected during the current surveys at one or more of the three survey sites.

		Status			EPBC Other MNES		
Scientific Name	Common Name	F	S	R/L	Listed Migratory	Listed Marine	International Agreements
BIRDS							
<i>Acanthiza iredalei rosinae</i>	Slender-billed thornbill	-	V	V	-	-	-
<i>Acanthiza pusilla</i>	Brown thornbill	-	-	V	-	-	-
<i>Acanthorhynchus tenuirostris</i>	Eastern spinebill	-	-	R	-	-	-
<i>Acrocephalus australis</i>	Australian reed-warbler	-	-	R	-	-	-
<i>Actitis hypoleucos</i>	Common sandpiper	-	R	E	Wetlands	Y	C; J; R

² Commonwealth of Australia (2013). Protected Matters Search Tool. <http://www.environment.gov.au/epbc/pmst/> (accessed July 2105); ALA (n.d.) Atlas of Living Australia. <http://www.ala.org.au> (accessed July 2015);

³ AdaptWest (2014) Environment and Open Space Research Paper. A report prepared for City of Port Adelaide Enfield, City of Charles Sturt and City of West Torrens; Gillam, S, and Urban, R (2014) Regional Species Conservation Assessment Project, Phase 1 Report: Regional Species Status Assessments, Adelaide and Mount Lofty Ranges NRM Region. Department of Environment, Water and Natural Resources, South Australia; SKM (2013) Western Adelaide Region Climate Change Adaptation Plan - Stage 1. Sinclair Knight Merz, South Australia; City of Port Adelaide Enfield (2008) Biodiversity Management Plan 2009-2014. City of Port Adelaide Enfield, South Australia; Existing council monitoring site reports.

Table 10 continued: List of significant native bird species reported in the Port Adelaide Enfield region.

Scientific Name	Common Name	Status			EPBC Other MNES		
		F	S	R/L	Listed Migratory	Listed Marine	International Agreements
<i>Anas rhynchotis</i>	Australasian shoveler	-	R	NT	-	-	-
<i>Anhinga novaehollandiae</i>	Australasian darter	-	R	V	-	-	-
<i>Apus pacificus</i>	Fork-tailed swift	-	-	R	Marine	Y	C; J; R
<i>Aquila audax</i>	Wedge-tailed eagle	-	-	V	-	-	-
<i>Ardea alba</i>	Great egret	-	-	-	Wetlands	Y	C; J
<i>Ardea ibis</i>	Cattle egret	-	R	V	Wetlands	Y	C; J
<i>Ardea intermedia</i>	Intermediate egret	-	R	-	-	-	-
<i>Arenaria interpres</i>	Ruddy turnstone	-	R	E	Wetlands	Y	C; J; R
<i>Biziura lobata</i>	Musk duck	-	R	R	-	-	-
<i>Botaurus poiciloptilus</i>	Australasian bittern	E	V	CE	-	-	-
<i>Cacatua galerita</i>	Sulphur-crested cockatoo	-	-	R	-	-	-
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	-	-	-	Wetlands	Y	C; J; R
<i>Calidris alba</i>	Sanderling	-	R	-	Wetlands	Y	C; J; R
<i>Calidris canutus</i>	Red knot	-	-	-	Wetlands	Y	C; E; J; R
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	-	CE	Wetlands	Y	C; E; J; R
<i>Calidris melanotos</i>	Pectoral sandpiper	-	R	R	Wetlands	Y	J; R
<i>Calidris ruficollis</i>	Red-necked stint	-	-	-	Wetlands	Y	C; J; R
<i>Calidris subminuta</i>	Long-toed stint	-	R	R	Wetlands	Y	C; J; R
<i>Calidris tenuirostris</i>	Great knot	-	R	R	Wetlands	Y	C; E*; J; R
<i>Cereopsis novaehollandiae</i>	Cape Barren goose	-	R	R	-	-	-
<i>Charadrius bicinctus</i>	Double-banded plover	-	-	R	Wetlands	Y	-
<i>Charadrius leschenaultii</i>	Greater sand plover	-	R	-	Wetlands	Y	C; J; R
<i>Charadrius mongolus</i>	Lesser sand plover	-	R	V	Wetlands	Y	C; J; R
<i>Charadrius ruficapillus</i>	Red-capped plover	-	-	E	-	Y	-
<i>Charadrius veredus</i>	Oriental plover	-	-	-	Wetlands	Y	R

Table 10 continued : List of significant native bird species reported in the Port Adelaide Enfield region.

Scientific Name	Common Name	Status			EPBC Other MNES		
		F	S	R/L	Listed Migratory	Listed Marine	International Agreements
<i>Cheramoeca leucosernus</i>	White-backed swallow	-	-	R	-	-	-
<i>Chrysococcyx lucidus</i>	Shining bronze-cuckoo	-	-	R	-	-	-
<i>Cinclosoma punctatum anachoreta</i>	Spotted quail-thrush (Mt Lofty Ranges)	CE	E	-	-	-	-
<i>Circus approximans</i>	Swamp harrier	-	-	E	-	-	-
<i>Cisticola exilis</i>	Golden-headed cisticola	-	-	V	-	-	-
<i>Cladorhynchus leucocephalus</i>	Banded stilt	-	V	V	-	-	-
<i>Corvus coronoides</i>	Australian raven	-	-	V	-	-	-
<i>Coturnix ypsilophora</i>	Brown quail	-	V	V	-	-	-
<i>Diomedea epomophora epomophora</i>	Royal albatross (southern ssp.)	V	V	-	Marine	Y	A; B
<i>Diomedea epomophora sanfordi</i>	Royal albatross (northern ssp.)	E	E	-	Marine	Y	A; B
<i>Diomedea exulans</i>	Wandering albatross	V	V	-	Marine	Y	A; B; J
<i>Diomedea exulans antipodensis</i>	Antipodean albatross	V	-	-	Marine	Y	A; B
<i>Diomedea exulans exulans</i>	Tristan albatross	E	-	-	Marine	Y	A; B
<i>Egretta garzetta</i>	Little egret	-	R	-	-	-	-
<i>Egretta sacra</i>	Eastern reef egret	-	R	CE	-	-	C
<i>Epthianura albifrons</i>	White-fronted chat	-	-	R	-	-	-
<i>Falco peregrinus</i>	Peregrine falcon	-	R	E	-	-	-
<i>Falco subniger</i>	Black falcon	-	-	R	-	-	-
<i>Falcunculus frontatus</i>	Crested shrike-tit	-	R	E	-	-	-
<i>Gallinago hardwickii</i>	Latham's snipe	-	R	E	Wetland	Y	B; C; J; R
<i>Gallinago megala</i>	Swinhoe's snipe	-	-	-	Wetland	Y	C; J; R
<i>Gallinago stenura</i>	Pin-tailed snipe	-	-	-	Wetland	Y	C; R
<i>Gallirallus philippensis</i>	Buff-banded rail	-	-	V	-	-	-
<i>Geopelia cuneata</i>	Diamond dove	-	-	R	-	-	-

Table 10 continued: List of significant native bird species reported in the Port Adelaide Enfield region

Scientific Name	Common Name	Status			EPBC Other MNES		
		F	S	R/L	Listed Migratory	Listed Marine	International Agreements
<i>Geopelia placida</i>	Peaceful dove	-	-	V	-	-	-
<i>Haematopus fuliginosus</i>	Sooty oystercatcher	-	R	E	-	-	-
<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle	-	E	E	Terrestrial	Y	C
<i>Haliastur sphenurus</i>	Whistling kite	-	-	E	-	-	-
<i>Himantopus himantopus</i>	Black-winged stilt	-	-	-	-	Y	-
<i>Hirundapus caudacutus</i>	White-throated needletail	-	-	CE	-	-	C; R
<i>Lalage tricolor</i>	White-winged triller	-	-	R	-	-	-
<i>Larus dominicanus</i>	Kelp gull	-	R	-	-	-	-
<i>Larus pacificus</i>	Pacific gull	-	-	U	-	-	-
<i>Lewinia pectoralis</i>	Lewin's rail	-	V	E	-	-	-
<i>Limicola falcinellus</i>	Broad-billed sandpiper	-	-	-	Wetlands	Y	C; J; R
<i>Limosa lapponica</i>	Bar-tailed godwit	-	R	-	Wetlands	Y	C; J; R
<i>Limosa limosa</i>	Black-tailed godwit	-	R	-	Wetlands	Y	C; E; J; R
<i>Macronectes giganteus</i>	Southern giant-petrel	E	V	-	Marine	Y	A
<i>Macronectes halli</i>	Northern giant-petrel	V	-	-	Marine	Y	A
<i>Malacorhynchus membranaceus</i>	Pink-eared duck	-	-	R	-	-	-
<i>Malurus cyaneus</i>	Superb fairy-wren	-	-	R	-	-	-
<i>Malurus leucopterus</i>	White-winged fairy-wren	-	-	CE	-	-	-
<i>Melithreptus lunatus</i>	White-naped honeyeater	-	-	R	-	-	-
<i>Melopsittacus undulata</i>	Budgerigar	-	-	R	-	-	-
<i>Merops ornatus</i>	Rainbow bee-eater	-	-	R	Terrestrial	Y	-
<i>Myiagra cyanoleuca</i>	Satin flycatcher	-	E	-	Terrestrial	Y	-
<i>Neophema chrysogaster</i>	Orange-bellied parrot	CE	E	CE	-	Y	-
<i>Neophema chrysostoma</i>	Blue-winged parrot	-	V	V	-	-	-
<i>Neophema elegans</i>	Elegant parrot	-	R	R	-	-	-

Table 11: Combined flora species detected at the three monitoring sites.

Status: LC = least concern; R/L = regionally/locally threatened; * = exotic species; D = declared weed species; U = unknown.

Scientific Name	Common Name	Status	Monitoring Site		
			MC	BI	LD
<i>Acacia ligulata</i>	Coastal wattle	R/L		✓	
<i>Acacia paradoxa</i>	Kangaroo thorn	LC			✓
<i>Acetosella vulgaris</i>	Sorrel	*			✓
<i>Allium triquetrum</i>	Three-cornered garlic	D			✓
<i>Anagallis arvensis</i>	Pimpernel	*			✓
<i>Atriplex paludosa</i>	Marsh saltbush	R/L		✓	
<i>Avicennia marina</i>	Grey mangrove	LC		✓	
<i>Callistemon sieberi</i>	River bottlebrush	R/L			✓
<i>Callistemon rugulosus</i>	Scarlet bottlebrush	LC			✓
<i>Chloris truncate</i>	Windmill grass	LC			✓
<i>Cyperus vaginatus</i>	Stiff flat-sedge	LC			✓
<i>Enchylaena tomentosa</i>	Ruby saltbush	LC		✓	
<i>Eucalyptus camaldulensis</i>	River red gum	R/L			✓
<i>Ficinia nodosa</i>	Knobby club-rush	LC			✓
<i>Fraxinus augustifolia</i>	Desert ash	D			✓
<i>Fumaria capreolata</i>	White flower fumitory	*			✓
Fungi sp.1	Fungi sp.1 (Plate 1a, Appendix C)	U			✓
Fungi sp. 2	Fungi sp.2 (Plate 1b, Appendix C)	U			✓
Fungi sp. 3 (likely <i>Scleroderma cepa</i>)	Fungi sp.3 (Plate 1c, Appendix C)	LC			✓
Fungi sp. 4	Fungi sp.4 (Plate 1d, Appendix C)	U			✓
<i>Galenia pubescens</i>	Coastal galenia	*		✓	
<i>Galium aparine</i>	Stickyweed	*			✓
<i>Hedera helix</i>	Ivy	D			✓
<i>Hypochaeris radicata</i>	Deep-rooted cat's ear	*			✓
<i>Ixodia achillaeoides</i>	Coast ixodia	LC			✓

Table 11: (continued) Combined flora species detected in the three monitoring sites.

Scientific Name	Common Name	Status	Monitoring Site		
			MC	BI	LD
<i>Lolium multiflorum</i>	Annual ryegrass	*	✓	✓	✓
<i>Marrubium vulgare</i>	Horehound	D			✓
<i>Medicago</i> sp.	Medic (clover)	*	✓	✓	✓
<i>Melaleuca</i> sp.	Likely <i>M. brevifolia</i>	LC		✓	
<i>Melaleuca</i> sp.	Likely <i>M. halmaturorum</i>	R/L?			✓
<i>Nitraria billardierei</i>	Nitre bush	R/L	✓		
<i>Olea europaea</i>	Olive	D			✓
<i>Oxalis pes-caprae</i>	Soursob	D	✓	✓	✓
<i>Pennisetum clandestinum</i>	Kikuyu	*			✓
<i>Persicaria decipiens</i>	Slender knotweed	LC			✓
<i>Phalaris</i> sp.	Grass sp.	D			✓
<i>Phlebopus marginatus</i>	Salmon gum mushroom	LC			✓
<i>Phragmites australis</i>	Common reed	LC			✓
<i>Piptatherum miliaceum</i>	Smilo grass	*			✓
<i>Plantago lanceolata</i>	Lamb's tongue	*			✓
<i>Poa annua</i>	Wintergrass	*	✓	✓	
<i>Rhamnus alaternus</i>	Buckthorn	D			✓
<i>Salix</i> sp.	Willow sp.	D			✓
<i>Sarcocornia quinqueflora</i>	Beaded samphire	R/L		✓	
<i>Sonchus oleraceus</i>	Annual sow-thistle	*		✓	✓
<i>Taraxacum officinale</i>	Dandelion	*			✓
<i>Tecticornia halocnemoides</i>	Grey samphire	R/L		✓	
<i>Tecticornia arbuscula</i>	Shrubby samphire	R/L		✓	
<i>Typha domingensis</i>	Narrow-leaf bull rush	LC			✓
Unknown grass sp.1	Grass sp.1 (Plate 1a, Appendix B)	U	✓	✓	
Unknown grass sp. 2	Grass sp.2 (Plate 1b, Appendix B)	U		✓	
Unknown herb	Liverwort	LC			✓
Unknown deciduous	Potentially <i>Betula</i> sp. (birch)	*			✓
Unknown saltbush	Saltbush sp.1 (see Plate 1c, Appendix B)	U		✓	
Unknown samphire	Samphire sp.1 (Plate 1d, Appendix B)	U	✓	✓	
Unknown moss	Moss sp.1 (Plate 1b, Appendix A)	U	✓		
Unknown saltbush	Saltbush sp.1 (Plate 1c, Appendix A)	U	✓		
<i>Vicia sativa</i>	Vetch	*		✓	✓
<i>Vinca major</i>	Periwinkle	D			✓

Table 12: List of flora species 2009 - 2013 (excluding 3 new BCM sites, Magazine Creek, Barker Inlet Wetlands and Lagonda Dr)

	Scientific name	Common name	Conservation status		Location			
			State	National	Dry Creek	North Haven	Semaphore	Taperoo/Osborne
	<i>Acacia argyrophylla</i>	Silver Mulga-bush			1,2,3,4,5			
	<i>Acacia cyclops</i>	Western Coastal Wattle						1,2,3,4,5
	<i>Acacia ligulata</i>	Umbrella Bush					1,2,3,4	
	<i>Acacia longifolia ssp.</i>	Sallow Wattle					5	5
	<i>Acacia longifolia ssp. sophorae</i>	Coastal Wattle					1,2,3,4	1,2,4
	<i>Acacia pycnantha</i>	Golden Wattle			1,3,4,5			
	<i>Acacia salicina</i>	Willow Wattle			1,2,3,4,5			
	<i>Actites megalocarpus</i>	Coast Sow-thistle					5	
	<i>Adriana quadripartita</i>	Coast Bitter-bush					1,2,3,4,5	
	<i>Atriplex cinerea</i>	Coast Saltbush					1,2,3,4,5	
	<i>Atriplex paludosa ssp.</i>	Marsh Saltbush					4	
	<i>Bromus sp.</i>	Brome			2			5
	<i>Carpobrotus rossii</i>	Native Pigface				1,2,3,4,5	1,2,3,4,5	1,2,3,4,5
	<i>Dianella revoluta var.</i>					5	5	5
	<i>Dianella revoluta var. revoluta</i>	Black-anther Flax-lily					1,2,3,4	1,2,3,4
	<i>Disphyma crassifolium ssp. clavellatum</i>	Round-leaf Pigface				2,3,4	4	
	<i>Einadia sp.</i>							5
	<i>Enchylaena tomentosa var.</i>	Ruby Saltbush				5		
	<i>Enchylaena tomentosa var. tomentosa</i>	Ruby Saltbush				1,2,3	1,2,4	
	<i>Eragrostis sp.</i>	Love-grass			1,2,4			
	<i>Eucalyptus camaldulensis ssp.</i>	River Red Gum			1,2,3,4,5			
	<i>Eucalyptus porosa</i>	Mallee Box			1,2,3,4,5			
	<i>Ficinia nodosa</i>	Knobby Club-rush				1,2,3,4,5	1,2,3,4,5	

Table 12 contd: List of flora species 2009 - 2013 (excluding 3 new BCM sites, Magazine Creek, Barker Inlet Wetlands and Lagonda Dr)

	Scientific name	Common name	Conservation status		Location			
			State	National	Dry Creek	North Haven	Semaphore	Taperoo/Osborne
	<i>Frankenia sp.</i>	Sea-heath					5	
	<i>Halgania sp.</i>	Blue-flower					5	
	<i>Helichrysum leucopsidium</i>	Satin Everlasting					5	
	<i>Hordeum distichon/vulgare</i>				5			
	<i>Hordeum glaucum/leporinum</i>				3,4			
	<i>Kennedia prostrata</i>	Scarlet Runner					5	
	<i>Malva preissiana</i>	Australian Hollyhock			3			
	<i>Malvaceae sp.</i>				2			
	<i>Myoporum insulare</i>	Common Boobialla				1,2,3,4,5		1,2,3,4,5
	<i>Nitraria billardierei</i>	Nitre-bush						1,2,3,4
	<i>Olearia axillaris</i>	Coast Daisy-bush					1,2,3,4,5	
	<i>Pelargonium australe</i>	Austral Stork's-bill					1,2,3,4	
	<i>Phragmites australis</i>	Common Reed			1,2,3,4			
	<i>Rhagodia candolleana ssp.</i>	Sea-berry Saltbush				5	5	5
	<i>Rhagodia candolleana ssp. candolleana</i>	Sea-berry Saltbush				2,3,4	1,2,3,4	3,4
	<i>Rytidosperma caespitosum</i>	Wallaby Grass			3,4,5			
	<i>Scaevola calendulacea</i>	Dune Fanflower	V				5	
	<i>Scaevola crassifolia</i>	Cushion Fanflower					2,3,4	
	<i>Senecio odoratus</i>	Scented Groundsel			1			
	<i>Senecio pinnatifolius var. lanceolatus</i>	Variable Groundsel				1,2,3,4,5	1,2,3,4,5	2,3,4,5
	<i>Spinifex hirsutus</i>	Rolling Spinifex				4	1,2,3,4,5	
	<i>Tecticornia halocnemoides ssp.</i>	Grey Samphire						1
	<i>Tetragonia implexicoma</i>	Bower Spinach						1,2,3,4,5
	<i>Threlkeldia diffusa</i>	Coast Bonefruit				1,2,3,4,5	1,2,3,4	
*	<i>Acacia saligna</i>	Golden Wreath Wattle			2,4			
*	<i>Ammophila arenaria</i>	Marram Grass				1,2,3,5	1,2,3,5	4
*	<i>Atriplex prostrata</i>	Creeping Saltbush					1,2	
*	<i>Avena barbata</i>	Bearded Oat			5	5		5

Table 12 contd: List of flora species 2009 - 2013 (excluding 3 BCM sites, Magazine Creek, Barker Inlet Wetlands and Lagonda Dr)

	Scientific name	Common name	Conservation status		Location			
			State	National	Dry Creek	North Haven	Semaphore	Taperoo/Osborne
*	<i>Avena barbata/fatua</i>	Wild Oat			1,2,3,4	1,2,3,4		1,2,3,4
*	<i>Brassica tournefortii</i>	Wild Tumip				1,2,3,4,5	,2,3	3,4
*	<i>Bromus catharticus</i>	Prairie Grass			1,3,4,5			
*	<i>Bromus diandrus</i>	Great Brome				4		
*	<i>Cakile maritima ssp. maritima</i>	Two-horned Sea Rocket				1,2,4,5	1,2,4,5	1,2,4
*	<i>Cenchrus clandestinus</i>	Kikuyu			1,2,3,4,5			
*	<i>Conyza bonariensis</i>	Flax-leaf Fleabane					,2,3	
*	<i>Cynodon dactylon var. dactylon</i>	Couch					2	
*	<i>Ehrharta longiflora</i>	Annual Veldt Grass			5			
*	<i>Euphorbia helioscopia</i>	Sun Spurge				1,2,3,4,		1,2,3,4
*	<i>Euphorbia paralias</i>	Sea Spurge				5	1,2,3,5	5
*	<i>Foeniculum vulgare</i>	Fennel			2,3,4,5			
*	<i>Fraxinus angustifolia ssp. angustifolia</i>	Desert Ash			5			
*	<i>Fumaria capreolata</i>	White-flower Fumitory			1,2,4			
*	<i>Fumaria sp.</i>	Fumitory			5			
*	<i>Galenia pubescens var. pubescens</i>	Coastal Galenia			1,2,3,4,5	1,2,3,4,5	1,2,3,4,	1,2,3,4,5
*	<i>Hypochaeris radicata</i>	Rough Cat's Ear			1,2,3,4			
*	<i>Lagurus ovatus</i>	Hare's Tail Grass				1,2,3,4,5		
*	<i>Lolium sp.</i>	Ryegrass						5
*	<i>Medicago polymorpha var. polymorpha</i>	Burr-medic					2,4	
*	<i>Mesembryanthemum crystallinum</i>	Common Iceplant				1,2,3,4	1,2,4	1,4
*	<i>Mesembryanthemum sp.</i>	Iceplant				5		5
*	<i>Olea europaea ssp.</i>	Olive			5			
*	<i>Phalaris aquatica</i>	Phalaris			1,2,3,4,5			
*	<i>Phoenix canariensis</i>	Canary Island Palm			1,2,4,			
*	<i>Phoenix dactylifera</i>	Date Palm			5			
*	<i>Piptatherum miliaceum</i>	Rice Millet			1,2,3,4,5			
*	<i>Plantago lanceolata var.</i>	Ribwort			5			

Table 12 contd List of flora species 2009 - 2013 (excluding 3 BCM sites, Magazine Creek, Barker Inlet Wetlands and Lagonda Dr)

	Scientific name	Common name	Conservation status		Location			
			State	National	Dry Creek	North Haven	Semaphore	Taperoo/Osborne
*	<i>Rapistrum rugosum ssp. rugosum</i>	Turnip Weed			1, 2 ,			
*	<i>Reichardia tingitana</i>	False Sowthistle				1, 2, 3, 4 ,	1, 2, 3, 4 ,	1, 2, 3 , 4
*	<i>Ricinus communis</i>	Castor Oil Plant			3			
*	<i>Scabiosa atropurpurea</i>	Pincushion			2, 3, 4, 5			
*	<i>Sisymbrium erysimoides</i>	Smooth Mustard						5
*	<i>Sonchus oleraceus</i>	Common Sow-thistle			2, 3, 4, 5	5	5	5
*	<i>Taraxacum officinale</i>	Dandelion			5			
*	<i>Thinopyrum elongatum</i>	Tall Wheat-grass			1 4, 5			
*	<i>Trachyantra divaricata</i>					1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5
*	<i>Tropaeolum majus</i>	Nasturtium			1, 2, 3, 4, 5			
*	<i>Vulpia fasciculata</i>	Sand Fescue			5	1, 2, 3, 4, 5	1, 2, 4, 5	1, 2, 3, 4

*denotes exotic or non-local species

- 1 = observed during the 2009 monitoring period
- 2 = observed during the 2010 monitoring period
- 3 = observed during the 2011 monitoring period
- 4 = observed during the 2012 monitoring period
- 5 = observed during the 2013 monitoring period

Conservation Status Codes

X = Extinct/Presumed extinct: not located despite thorough searching of all known and likely habitats; known to have been eliminated by the loss of localised population(s); or not recorded for more than 50 years from an area where substantial habitat modification has occurred.

E = Endangered: rare and in danger of becoming extinct in the wild.

T = Threatened: likely to be either Endangered or Vulnerable but insufficient data for a more precise assessment.

V = Vulnerable: rare and at risk from potential threats or long-term threats which could cause the species to become endangered in the future.

K = Uncertain: likely to be either Threatened or Rare but insufficient data for a more precise assessment.

R = Rare: has a low overall frequency of occurrence (may be locally common with a very restricted distribution or may be scattered sparsely over a wider area). Not currently exposed to significant threats, but warrants monitoring and protective measures to prevent reduction of population sizes.

U = Uncommon: less common species of interest but not rare enough to warrant special protective measures.

N = Not of particular significance/Common (also indicated by a blank entry)

DRAFT Biodiversity Management Plan - Summary of final consultation comments

The Council provided a two week final consultation period from the 11th May to the 25th May 2016 to provide comment on the Draft Biodiversity Management Plan. On the 19th May 2016 Council provided a presentation on the Draft Plan at the Port Adelaide Environment Forum, where they also had an opportunity to provide comment on the Plan. Below includes a summary of the main comments indicated by the Adelaide Mt.Lofty Rangers NRM, Port Adelaide Residents Environment Protection Group and Port Adelaide Environment Forum:

The below table includes Consultation comments and associated replied comments from the City of Port Adelaide Enfield:

Stakeholder comments	PAE reply comments
It is recommended that tangible targets are embedded to enable monitoring and evaluation. This will support progress towards achieving the stated objectives of the draft Plan.	Have included targets: Target 1: BCM Biodiversity ecosystem ratings for (terrestrial, riparian and coastal sites) are maintained or improved from current 2015 levels. Target 2: Improvement in conservation prospects for native flora and fauna (coastal, terrestrial and aquatic) from current levels. Target 3: Increase participation in community natural resources management activities by 80% from current levels.
It is recommended that the draft Plan acknowledge the State Government's Water for Good Plan and Water Sensitive Urban Design (WSUD) policy. This will provide Council with the opportunity to fully incorporate WSUD and green infrastructure objectives that incorporate positive biodiversity outcomes.	The Water for Good Plan and WSUD policy has been referenced in Biodiversity Plan-Background Report (pg.31)
As the City of Port Adelaide Enfield is in the Metropolitan Adelaide subregion, the draft Plan should consider and align with the subregion's key priorities.	The Plan has included AMLR NRM Sub-regional priorities (pg.4)
Include the 'Torrens Island Biodiversity Action Plan September 2013' and 'Metropolitan and Northern Coastal Action Plan 2013 Caton et al' in Plan.	The Plan has referenced the associated Plans in Background Report (pg.31)
Council should share; Site-specific management plans, Monitoring reports, climate change monitoring data, biodiversity registers to the community via a dedicated webpage.	The Plan has indicated that all information will be included on PAE webpage or another appropriate website (strategy 1.2.3, 1.1.2).

Stakeholder comments	PAE Comments
Involve volunteer groups in i-tree programs by collecting on-ground information.	Volunteer groups included as a stakeholder in i-tree program (strategy 1.1.2, 1.1.3).
It is recommended as a minimum that the Council should list all areas of recognised biodiversity, Management responsibility and other relevant information would be a welcome addition.	Council has provided a list of biodiversity management sites (pg.15)
It is Recommended that Council include activity in the Plan to develop a publicly accessible register allowing residents to register areas of significant urban biodiversity.	Council has provided task in Strategy 1. (pg.22, 1.2.5)
Include Community groups in Plan as Stakeholders with community engagement activities, reviewing management plans and monitoring programs	The Plan has been updated to include community stakeholders in all of the relevant activities.
It is recommended that the Plan be revised when the Climate Change Adaptation Plan is finalised.	Included a task under Strategy 3, 3.2.3 Council review of biodiversity plan to reflect and incorporate findings of Climate Change Adaptation Plan
Council consider forming a biodiversity liaison group with local community groups and agencies to share knowledge and assist in revising management plans.	Included in task 2.2.4, 2.2.5, 2.1.2 and 2.1.3 under Strategy 2.
Recommend to develop a publicly available significant tree removal register, allowing the approved removal of significant trees and their location to be tracked over time.	Council has considered the recommendation of a publicly available register and has determined that an internal tree register should be developed as a first priority.
2.3.4 (pg.23) Council is encouraged to incorporate management activities as well as monitoring. Additionally AMLR NRM and Birdlife Australia should be listed as Stakeholders.	Have updated accordingly
The draft Plan does not highlight the significant role mangrove habitat provides as a fish nursery and important feeding ground to the resident dolphin population. It is recommended that this is included under Strategy 2.	Have updated accordingly
In 2.3.4 (pg.28) Red-Capped plovers are neither a threatened nor a migratory species	Have updated accordingly
In 2.1.3 (pg.24) Spending \$20K a year to update the plan seems like planning for planning's sake.	The \$20K budget will be allocated at the end of a four year period to review the Plan rather than annually.
Pg.9 "Biodiversity Management Priorities" this section is confusing.	The layout has been changed to identify the priorities more clearly
Pg.4-5. Executive summary should include the three management plan strategies.	Have updated accordingly