LOCAL BIODIVERSITY STUDY

FOR THE CITY OF PERTH

Prepared by the Claise Brook Catchment Group Inc

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Local Biodiversity Study for the City of Perth

This report presents the views of the Claise Brook Catchment Group Inc for the consideration of the City of Perth.

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Executive Summary

Perth City, located on the Swan Coastal Plain, is one of the most bio-diverse cities in the world with a wide variety of plants and animals, many of which occur no-where else in the world. Since 2001, the WA Local Government Association (WALGA), through the Perth Biodiversity Project (PBP), has provided assistance to metropolitan councils wishing to develop strategies to conserve the biodiversity within their area. Although no remnant bushland remains in the city, the Claise Brook Catchment Group, a community based environmental group working within the inner city, considers that planning for conservation and enhancement of biodiversity will be of benefit within the City of Perth.

The study documents the natural and cultural assets of the city, which include the natural landforms, geology and soil, the riverside setting and indigenous flora and fauna as well as the cultural values. General principles on protecting and enhancing biodiversity are discussed with primary importance given to protecting and restoring indigenous flora, fauna and landforms.

The study recognises that the city's greatest natural assets are the Swan River and Kings Park. Improving the habitat value of the foreshore parks, and better linking Heirisson Island to Kings Park are important priorities to enhance biodiversity. However all landscaped areas are of value including landscaping on private land as a setting around buildings.

While many parks are heritage listed, and some contain few indigenous species of plants, some parks planted almost exclusively with exotic species are supporting a wide variety of fauna. General assumptions about what species are suitable for 'heritage' plantings are challenged.

Indigenous flora and fauna has been widely used as a decoration for buildings such as in stained glass windows, carvings and plasterwork, and as the emblem for many city organisations including schools, clubs and businesses showing the cultural importance of native flora and fauna.

Recommendations

The study identifies that protecting and enhancing biodiversity within the city could achieve multiple benefits. Key proposals include:

- Restoring indigenous vegetation to Heirisson Island to create an area of natural beauty and provide a uniquely Western Australian setting for complementary uses.
- Developing a linear native flora park along the northern perimeter of Langley Park adjacent to Terrace Road, which would add visual interest and provide a shaded walkway connecting the city to Point Fraser and Heirisson Island.
- Restoring the river foreshore, particularly around East Perth, where it is urgently needed as erosion and couch grass threaten remnant native vegetation.

- Linking landscaped areas by creating “greenways” along the railway line and roads to increase the biodiversity value of individual patches, with the most important “greenway” being along the river foreshore.
- Recognising two “green belts” to facilitate the enhancement of all landscaping within these areas to improve biodiversity value. The approach would be to develop cooperative initiatives between the City of Perth and government, commercial and private building owners and tenants of these areas to increase the use of native flora and replacement of exotic flora in landscaping within the “green belt” areas.
- A greater use of indigenous vegetation in landscaping and as street trees to achieve multiple outcomes including reduced water consumption, improved surface and ground water quality as well as added visual interest to public landscaping.
- Developing demonstration gardens, particularly in high visibility locations. Information about indigenous culture and the State’s unique local flora would add interest for locals as well as interstate and overseas visitors.
- Policy and management change to incorporate consideration of biodiversity into the design and management of landscaped areas.

Finally, the study urges greater consideration being given to including appropriate habitat areas for the black swan along the city’s foreshore. The black swan has been the emblem of Perth since early settlement and has been widely used to represent “Perth” as the logo for schools, businesses and clubs in the city. It is still the first choice as an emblem for any new endeavour forming in the city today. Along the river foreshore and foreshore parks, accommodating swans while providing for the needs of the growing city is possible. A strategy should be developed to ensure that current plans for foreshore development do not relegate the black swan to other parts of the Swan River, leaving the swan to be remembered in the city’s emblem alone.

1 Introduction

In 2006/2007 the Claise Brook Catchment Group received funding from the City of Perth to undertake a Local Biodiversity Study for Perth City and make recommendations to inform the development of a Local Biodiversity Strategy and action plan for the City of Perth.

This Local Biodiversity Study identifies and prioritises opportunities to protect and enhance biodiversity within the City of Perth through policy, management practices, on-ground works, community involvement and other means. Opportunities to link isolated patches of habitat and connect Kings Park to the river foreshore and through the city to other regional habitat areas are identified.

The methodology used was based on that developed by the Perth Biodiversity Project for assessing biodiversity and preparing a Local Biodiversity Plans but modified for the inner urban location. Perth Biodiversity Project staff provided technical assistance and training.

The scope of the recommendations of this report cover the land within the City of Perth, from Crawley to East Perth, excluding Kings Park. Kings Park was not subject to detailed assessment, however is regarded as an important biodiversity asset within the city and is considered in the recommendations of the report.

The report was prepared by the Claise Brook Catchment Group for the City of Perth. Members of the catchment group and staff at the City of Perth assisted, particularly by conducting surveys of parks and reserves within the city to assess their biodiversity value.

1.1 Background

The Swan Coastal Plain has a large number of plant and animal species and Perth is one of the most bio-diverse cities in the world (Del Marco et al, 2004). Since 2001, the WA Local Government Association (WALGA), through the Perth Biodiversity Project (PBP), has provided funding and technical assistance to metropolitan councils wishing to develop strategies to conserve the biodiversity within their area.

The primary focus of the PBP has been working with outer metropolitan authorities within whose municipalities there is still substantial remnant bushland, in public and private ownership, to ensure that remaining bushland was protected through Planning Schemes and appropriate management.

The Claise Brook Catchment Group, an environmental group working within the city and inner city area, felt that planning for conservation and enhancement of biodiversity would also be of benefit within the City of Perth. The group considered that the city's natural assets, including the river foreshore, Kings Park and the possibility of greenbelts along major roads and the railway, gave some hope of enhancing biodiversity within the city. In addition, the group recognised the unique opportunity to raise awareness of biodiversity issues to people who visit or work within the city.

With the encouragement of PBP, the City of Perth provided funding to the Claise Brook Catchment group to undertake this study.

1.2 Scope of the Study

The scope of this report covers the land within the City of Perth, from Crawley to East Perth, excluding Kings Park, which although considered as part of the strategies was not subject to detailed assessment of biodiversity values, which are already well documented. This study is not restricted to areas under the direct control of the City of Perth.

The report includes recommendations that affect land in private ownership. Private land, particularly land managed by Government agencies, forms a significant part of the open areas within the city. City of Perth policies can influence the management of landscaped areas on private land which may be vital in providing links between areas of public open space. Recommendations are also made for the restoration of land which would be undertaken in partnership with other agencies, particularly State Government agencies such as the Department for Planning and Infrastructure (DPI), Landcorp, Main Roads, the Swan River Trust and the Water Corporation.

1.3 Methodology

To assist in the preparation of this report the following was undertaken:

- Desktop and field surveys of open areas within the city
- Collecting anecdotes about fauna seen in the city
- Survey of the use of native flora and fauna in art and architecture within the city
- Literature Review
- Review of Heritage Assessments (Indigenous and European)
- Promotion to encourage community involvement

1.3.1 Desktop and Field Surveys

Field surveys were undertaken of all parks and reserves within the city to assess the general vegetation structure, identify existing biodiversity assets and threatening processes which may affect the viability of these assets or hamper habitat restoration efforts.

The surveys were undertaken by volunteers from the catchment group, local residents and City of Perth staff. Participants were given training prior to doing assessments. As many of the participants were not professional botanists or environmental scientists, the group developed strategies to assist participants in completing the surveys and in identifying plants. These included providing field guides, taking photos, taking botanic samples which were labelled and pressed for later identification. Some people who joined the project part-way through did not receive training; however each team included at least 2 trained members.

A standard template was used for all field surveys so that the information collected was consistent. The template was derived from the assessment template developed by the Perth Biodiversity Project, but was significantly altered to be relevant to the type of vegetation and landscaping likely to be found within the inner city.

Information gathered during field surveys included:

- Vegetation assessment, size and type of vegetation
- Fauna observed (and known from previous visits)
- Existing habitat
- Existing or possible links to other areas
- Vegetation health
- Feral fauna (observed or known previously)
- Management infrastructure (fences, signs, barbeques, seating etc)
- Social value (observed or known from previous visits)
- Surrounding land uses and their possible impact on the site
- Weeds
- Disturbing factors and threatening processes
- Recommendations for management

Survey teams mapped the information recorded over an aerial photo of the site.

Prior to the field survey, a desktop survey was conducted to gather relevant information about park size, shape, ownership and heritage constraints.

See Appendix 11 for the desktop survey template, Appendix 12 for the field survey template and Appendix 13 for a list of survey sites and survey results and maps.

1.3.2 Collecting Anecdotes

While some information on fauna was gathered during field surveys, the group also asked that people contribute anecdotes about fauna seen in the city.

The anecdotes and supporting photos, where provided, were put onto the group's website which assisted in sharing the project more widely within the community. Anecdotes collected included sightings of indigenous fauna and feral fauna, and show the importance of natural experiences within people's experience of the city. The anecdotes collected are listed in Appendix 1.

1.3.3 Cultural Use of Local Flora and Fauna

Figure 1.1 Examples of the use of local flora and fauna

To gain an understanding of whether indigenous flora or fauna were valued by early residents of Perth, the group looked for the use of flora and fauna in early art, documents and architecture. The results were published on the group's website which resulted in further examples being sent in by members of the public. This section of the website received the greatest feedback during the project.

The group found that indigenous flora and fauna were widely used in stained glass windows, on external decorations, as the emblem for many city organisations including schools, clubs and businesses, to illustrate documents and clothing. The group found that the black swan was regarded as emblematic of Perth since early settlement and has been widely used to represent "Perth" and is still important today. Examples of the use of native flora and fauna in early art, documents, objects and building decoration are shown in Appendix 2.

1.3.4 Literature Review

Reports, surveys, strategies and other information which might be relevant to protecting biodiversity within the city were gathered with the assistance of the City of Perth.

These included City of Perth policies, management plans and reports; flora and fauna surveys from Birds Australia, Swan River Trust and Main Roads, Bush Forever and A Strategic Plan for Perth's Greenways.

A full list of documentation reviewed is presented in Appendix 3.

1.3.5 Heritage Assessments

Many of the parks and reserves within the city are valued by the indigenous community for their associations as former campsites, for mythological connections and for other reasons. A list of registered sites within the City of Perth or overlapping the city, together with a map, has been sourced from the Department of Indigenous Affairs online database and is shown in Appendix 4.

Some of the parks within the city date back to the founding of the Swan River Colony and have significance under the *Heritage of Western Australia Act 1990*, often for their non-indigenous vegetation. A list of parks on the permanent or interim State Heritage Lists is shown in Appendix 6.

Heritage Assessments and Conservation Plans were obtained to identify heritage considerations which may impact on future landscaping or habitat restoration effort.

Any changes to the landscaping or management of such areas must take into account the heritage significance. This does not necessarily mean that biodiversity cannot be a factor considered within the management, as long as it does not impact on the recognised heritage values of the site.

1.3.6 Promotion, Website and Advertising

The project was promoted in a number of ways with the primary intention of encouraging people to become involved in field surveys. People were also invited to submit anecdotes and examples of flora and fauna seen in the city.

Website: The group created a Biodiversity section on the Claise Brook Catchment Group website, www.cbcg.org.au/projects/biodiversity_strategy.htm . The section consisted of five pages covering:

- Biodiversity home page
- Field surveys
- Biodiversity in Perth (anecdotes and photos of fauna expected in the Perth area)
- Flora and fauna in art and architecture
- Tips for encouraging biodiversity at home

The website was promoted through networks, with members forwarding the web address to friends and colleagues, encouraging them to take a look. Judging from the feedback and suggestions received, this was particularly of interest to people who worked within the city and encouraged them to take a new look at their city.

Advertising: The group advertised in the local paper, The Perth Voice, running a series of advertisements during March 2007, one of which focussed on the Biodiversity project.

Figure 1.2 Advertisement in local paper

2 The City's Natural Assets

The following is a summary of the environmental setting of the City of Perth. In addition to the natural assets of geology, flora and fauna, Perth has cultural assets which may contribute to sustaining biodiversity within the city. These are explored in Section 3.

2.1 Geology and Soil

> *"The soil is entirely sand which produces a great variety of plants and herbs, very curious to the eye of the naturalist, but of little use to the agriculturalist,"* Alfred H Stone 1829
>
> *"What could our friend Frazier have been thinking of when he stated the soil to be good and the place to be well watered"* George Cathcart 1829 (Berryman, 2002)

Three main soil types are found naturally within the city: Vasse soils along the river foreshore, Herdsman soils marking the location of the former wetlands, and Karrakatta sands elsewhere.

The following section is mostly adapted from *Soils of the Swan Coastal Plain* (Bolland, 1998).

Almost all the soils of the Swan Coastal Plain are formed by material deposited by rivers and wind. The Yilgarn Block, east and south of the Darling Scarp bordering the Swan Coastal Plain, rose about 40 to 50 million years ago. Rivers and streams eroded the block with the eroded material being deposited onto the Swan Coastal Plain or washed into the sea. The eroded material formed the soils on the plain.

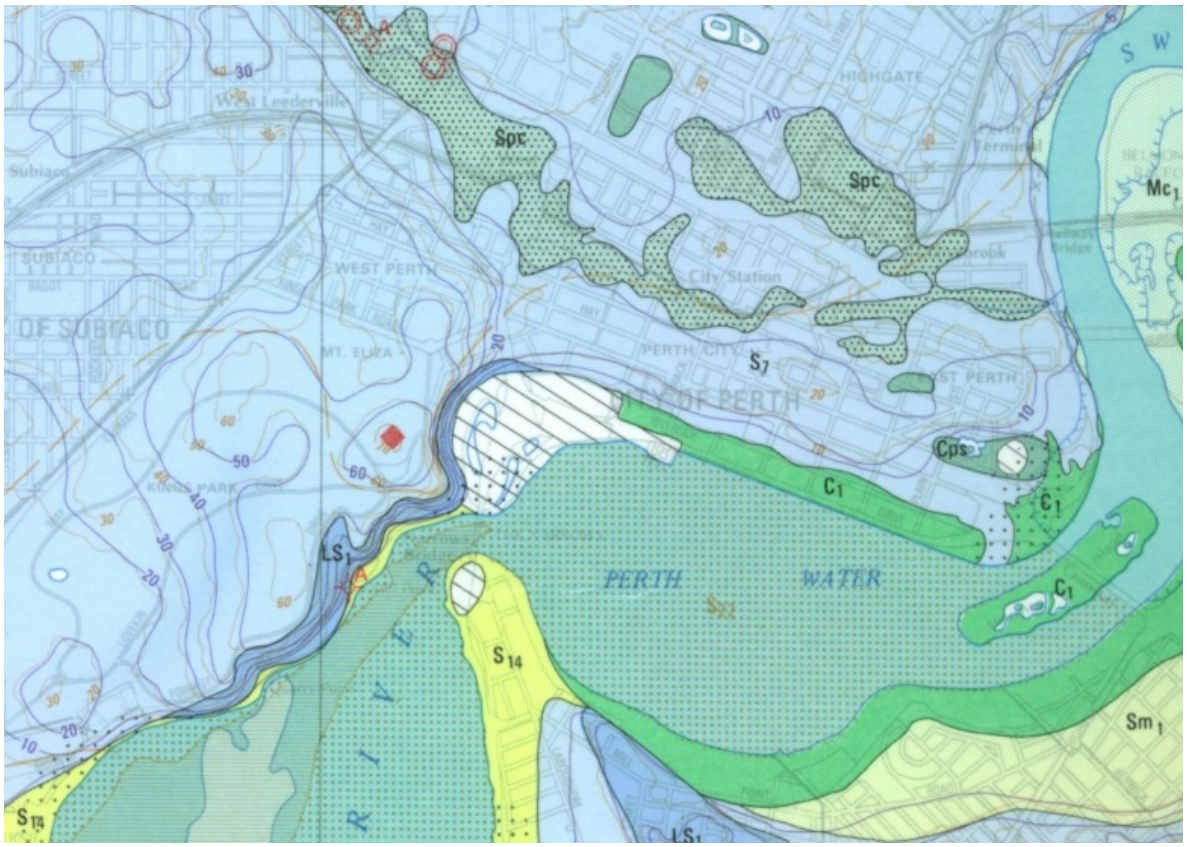
The Spearwood dune system is believed to have been formed about 40,000 years ago, and comprise red/brown, yellow and pale yellow/grey sands. The sands are coated with both iron and aluminium oxides, with the amount of iron oxide coating the sands largely responsible for the colour of the sands. The sands become less coloured as they age because the iron (and aluminium) coating the sands is leached. The paler yellow/grey sands, the grey phase of the **Karrakatta sands** comprise the main soil type found within the City of Perth.

Between the dune systems, inlets, lakes and swamps occur. The **Herdsman** soils under the swamps and lakes are rich in organic matter, being peat swamps, and have often been drained and used for vegetable production. Near the city many swamps were historically used as rubbish tips, or filled in and used for sport and recreation, or as building sites. Some areas contained clay soil, such as at Queens Gardens, which was used to manufacture bricks.

The **Vasse** soils are formed from estuarine alluvia, and are about at sea level. They are very variable soils, comprising layers of clay, shells, marine algae and coarse calcareous sand.

Some areas of the city have been subject to significant excavation and fill. The Narrows Interchange was created by filling in much of Mounts Bay within the Swan River, with fill brought in from elsewhere. The soil appears to be sandy and is not necessarily related to any "natural" soil found in the area. It is marked as "made ground" on the soil map below (Figure 2.1)

Long sections of the river foreshore were also formerly within the river and created by fill dredged from the riverbed. These are marked on the soil map as Vasse soils as they were created from the material from within the estuary/river. Heirisson Island was also filled with dredged material to create one continuous island where formerly there were several low islets.



Cps Peaty clay, dark grey and black with variable sand content of lacustrine origin – Swamp Deposit
Spc Peaty sand, dark grey and black quartz sands with variable organic content and common peat lenses, variable clay content– Swamp Deposit
S7 Sand, pale and olive yellow, medium to coarse grained, sub-angular to sub-rounded quartz, trace of feldspar, moderately sorted of residual origin – Sand derived from Tamala Limestone
C_1 Clay, mid to dark grey, soft saturated, prominent 0.2m thick oyster shell bed near surface of alluvial origin.
LS_1 Limestone, light, yellowish brown, fine to coarse grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin. Tamala Limestone
Hatched – made ground

Figure 2.1. Map of sub-surface soil types in the vicinity of the city of Perth (Gozzard, 1986)

2.1.1 Iconic Natural Landforms

Significant changes have been made to natural landforms such as the changing of the river foreshore, drainage of wetlands, and building of structures which have since disappeared such as the former canal in East Perth which assisted shipping to pass the shallows around Heirisson Island. These changes are of interest to present day city residents and visitors. The former landforms and structures can be expressed through interpretive works to add interest to the urban environment.

2.2 Flora

"There are the most beautiful flower plants for pots, of every description, handsomer than ever I saw in England." George Busby 1829 (Berryman, 2002)

The typical plant communities naturally found on the three soil types, Karrakatta, Vasse and Herdsman are described below. However outside Kings Park there is very little remnant vegetation in the City of Perth. There is a tuart tree at Point Fraser and flooded gums at Claisebrook Cove. Further surveys would be required to determine if there is any remnant vegetation on Heirisson Island. A small section of the Kings Park escarpment, behind the old Swan Brewery, contains remnant vegetation and falls within the City of Perth. It is highly significant for this reason and is the only Bush Forever site (#317) within the City of Perth.

The following vegetation descriptions are based on Powell & Emberson (1996) pp73 and describe the vegetation communities that would have naturally occurred over the soils and landforms in the City of Perth. For a fuller description based on historic photos of early Perth see Seddon (Appendix 7).

2.2.1 Karrakatta Central: Jarrah-Banksia woodland

This consists of jarrah woodland with marri on moister sites and an understorey of candle banksia, firewood banksia and common sheoak. Tuart is found on hills where limestone is nearer the surface. Kings Park is a suitable reference site to see the typical vegetation of the Karrakatta Central form.

2.2.2 Vasse – Swan Estuary

From the water's edge, samphire on mudflats, shore rush, coast saw-sedge and knotted club rush along the water's edge, then salt sheoak, freshwater paperbark and saltwater paperbark, then fringing woodland of marri, tuart and jarrah.

2.2.3 Herdsman - Wetlands

From the wettest zone, closer to water, moving outwards; sedges, freshwater paperbark, flooded gum, sometimes with tuart or marri, modong and swamp banksia, then spearwood and holly-leaf banksia.

2.2.4 Iconic Flora

The red and green kangaroo paw (mangles) features on the State emblem as well at the city of Perth emblem and is widely associated with Western Australia. The firewood banksia (*Banksia menziesii*) with its colourful flower cone, the towering trees, jarrah, marri and tuart and the vegetation of the foreshore including rushes (sedges), and Melaleuca species could also make a claim for icon status. As much of Perth's flora is unique to south-western Western Australia, it is of interest to interstate and overseas visitors, particularly in the flowering season.

2.3 Fauna

"In those days the water-front, where the Esplanade is now, was a field of mud. I have seen natives there in dozens, spearing cobblers"
Perth in my Boyhood –Mr. James Kennedy 1927

"there are plenty of wild ducks, wigeons, black swans, parrots, cockatoos, parakeets and quails – all good eating; fine emus, than which I never tasted anything more delicious. Kangaroo and kangaroo rats, both excellent eating; fish in abundance, and we all agree that we never met with such excellent fish before."
P.H. Dod 1829 (Berryman, 2002)

The fauna that was present when Perth was founded is well known from settlers' diaries and letters home. There is also a display case at the WA Museum showing the mammals which could be found in and around Perth, although many of were fast disappearing by the time the display was mounted in the early 20th Century.

Many birds are still common, although the changes to the foreshore and the dredging of the shallow areas of Perth Water reduced the feeding and roosting areas for many species. Most mammals are no longer found within the city apart from possibly the native rat, bats and dolphins in the river. The aquatic fauna within the river has changed markedly. Current residents, who grew up

in the city recall catching crabs in Mounts Bay at the foot of Jacob's Ladder. Prawning probably disappeared from the city with the filling in of the foreshore in the 1920s.

Information on existing fauna within the city is based on observations and some fauna surveys (mainly of birds). It is understood that one of Perth's universities surveys Heirisson Island annually, however this information could not be obtained. Fauna observed during field surveys is shown in Appendix 8.

2.3.1 Birds

Birds are the most frequently observed native fauna within urban areas, and appear to have survived urbanisation better than other fauna. However they have been significantly impacted by urbanisation and the species which are now common are those which have been able to adapt to living in human settlements. These include the silver gull, raven and sacred ibis.

Figure 2.2
Ravens do well around human settlements.

The changes to the river foreshore has significantly affected the range of bird species in this area. Remaining common birds are the cormorants (pied, black and little black), darter, pelican and nankeen night heron. Black ducks, coots, moorhens and grebes are regularly found in wetlands throughout the city. Other species of waterbird, including wood ducks (maned geese) and mountain ducks make seasonal appearances.

A pair of osprey are often sighted above the river around East Perth and off Point Fraser, however it is likely that they nest elsewhere (up or downriver).

Surveys of Point Fraser in 2005 recorded 30 species of bird, two of which, the Common Sandpiper and the Musk Duck are of conservation significance (Gole, 2006). This number compares with 66 species of bird recorded at Baigup Reserve upriver and 66 species at the Waterford Foreshore Conservation Reserve across the river in South Perth. It can be expected that the number of bird species at Point Fraser will increase over time, with the return of natural habitat values, however the size of the site will be a limiting factor.

Anecdotes from CBCG members and City of Perth staff also recorded owls, seen occasionally such as roosting deep with in a tree in the courtyard of the museum and in a tree in Royal St East Perth.

In winter, flooded parks such as Langley Park and Trinity Reserve can attract large flocks of birds such as Black Swans, Pied Oystercatchers and seagulls.

Figure 2.3. Pied Oystercatchers and Silver Gulls on flooded Trinity Reserve in winter 2007.

Within parks, common birds include the Singing Honeyeater, Wattlebirds, Willie Wagtail and Magpie Lark. Brown Honeyeaters are also seen and the naturalised Turtle-doves (laughing and spotted) are common. Anecdotally members noticed that the variety of species within a park correlated with the complexity of the vegetation; parks with trees over lawn having less variety of bird species than parks with low and high shrubs and a variety of trees. Even parks with mainly exotic vegetation, but with a variety of vegetation forms, such as Queens Gardens had more species of birds than parks with less variety in the vegetation.

Surveys within the Hamilton Interchange during 1997 recorded 38 species of bird comprised of 23 bushbirds, 12 waterfowl and 3 shorebirds. Two species, the Rainbow Bee-eater and the Great Egret, are listed under the CAMBA and JAMBA international treaties for migrating birds. The Rainbow Bee-eater was observed using the embankments for nesting. (Cannella, 1997). As the Hamilton Interchange is an area managed by Main Roads primarily for managing stormwater runoff and providing irrigation water for the Narrows Interchange, these birds, particularly the nesting birds are at risk of disturbance and also at risk of poor water quality and algal blooms within the interchange lakes. This was anecdotally recorded during the field surveys. Around the northern lake, where in previous years members had observed a variety of species of waterfowl, including young birds, during the field survey in March 2007, the surveyors recorded only 3 species of waterfowl and considered that breeding would be unlikely to occur. The surveyors noted that vegetation had been damaged to provide vehicular access to drainage pipes which may have disturbed fauna.

2.3.2 Mammals

Only two native mammals were reported to have been observed, Dolphins within the river, seen off Point Fraser and near Claisebrook Cove. A person also reported seeing a native water rat (Rakali / *Hydromys chrysogaster)* at the river's edge near Trinity College. While the observation was only fleeting and may be considered doubtful, water rats have been observed upriver near Mt Lawley and are present on the Canning River.

It is possible there are bats within the city. Members have observed bats at nearby Hyde Park. The likely species is not known at this time.

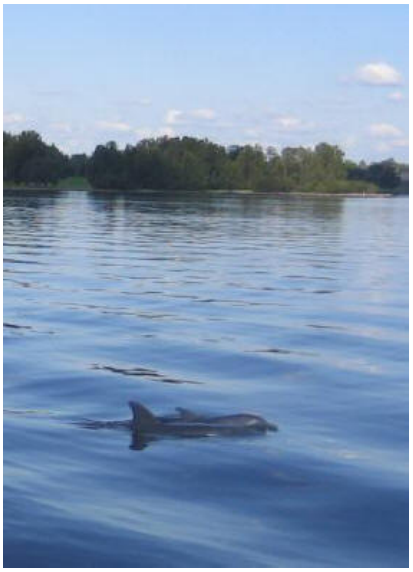


Figure 2.4 Dolphin in the Swan River near Point Fraser.

2.3.3 Aquatic Fauna

It is expected that some aquatic fauna are in the water bodies at Point Fraser, Queens Gardens, the Narrows Interchange Lakes, Hamilton Interchange Lakes, the lake above Claisebrook Cove and Lake Vasto (Ozone Reserve). However no aquatic surveys have been conducted of these waterbodies to provide this information.

The variety and type of species of macro-invertebrate fauna can be used as an indication of the health of a water body and therefore it would be worthwhile gathering this information on an annual basis. Local schools may be interested in participating during the annual 'snapshot' coordinated by Ribbons of Blue each year during Spring although there may be safety issues with sampling water bodies with known water qualities issues such as the Narrows and Hamilton Interchange lakes.

2.3.4 Reptiles and Amphibians

Perth as a city had more species of reptile than any city of the world. Unfortunately, with urbanisation, many species are no longer found within the metropolitan area; however reptiles and amphibians are still common, though often overlooked within the city.

Most houses within Perth have a fence skink *Cryptoblepharus plagiocephalus* on a fence, tree or power pole near their home. Less often seen but quite common in backyards of older suburbs is the marbled gecko *Phyllodactylus marmoratus*, an attractive small gecko with incredibly soft skin. Marbled geckos forage at night and are sometimes seen by residents when watering at night. They like to hide between the layers of material (fencing sheets, old pots) so are often inadvertently thrown out during verge rubbish collections. Marbled geckos are likely to occur in the backyards of remaining older residences and perhaps less likely to be found in the newer houses with minimal gardens.

Other species including legless lizards and sand swimmers may occur in the area.

Frogs may occur along the river and in some lakes, although the form of many of the lakes, with hard edging, would not support the natural breeding cycle of native frogs. Recording frogs is relatively easy simply by noting distinctive frog calls during the breeding seasons. Local residents may be interested in assisting in a survey. A record of which frogs are present, with estimated numbers at different seasons is useful information. If there is a concern that frog numbers may have fallen or frogs disappeared from an area, observations from previous years can indicate if frogs have been present at that season in previous years.

Long-necked Turtles (*Chelodina oblonga)* were observed in 1997 at the Hamilton Interchange (Cannella, 1997) and in the creek channel above Claisebrook Cove (resting on a turtle sculpture!). City of Perth staff said they had been seen previously in the Narrows Interchange lakes. They may occur in other lakes.

2.3.5 Other Fauna

Insects and spiders are common throughout the city and were observed during field surveys. A study comparing type and variety of species to vegetation would be of interest. Other studies have found that as the number of indigenous species of vegetation decrease, to be replaced by exotic species, the variety of insect species reduces (Darryl Hardie, pers comm.). Exotic species tend to favour fewer insect species, often those regarded as ‘pests’. About one third of insect species feed on rotting and dead material such as fallen branches, dead wood, dead animals. The desire to keep parks in an attractive state means that fallen branches, older trees, fallen leaves and rotting wood is often removed. While it is not feasible to change these practices in the more formal city parks like Queens Gardens and Stirling Gardens, in the more remote areas such as the Hamilton Interchange, it may be possible to manage the area to allow fallen branches to remain, although fire, maintenance and safety risks would have to be assessed.

2.3.6 Perceptions of Fauna

When involving the community in biodiversity projects, it sometimes takes a while for people to appreciate that a tree covered in insects is equivalent to a full larder for birds, rather than a problem which requires to be dealt with (usually by the application of pesticide). It is not always apparent to the casual observer that a singing honeyeater eats insects as often as nectar.

Termite nests are something that people particularly fear, considering that it increases the risk of termite attack of nearby buildings.

Species such as water rats are also not necessarily appreciated, partly because people assume it is a feral rat, but also because of a general dislike of rodents and concerns they will ‘get into the roof’. Some people are similarly concerned about bats, and therefore it may be better to hide nesting boxes for bats rather than draw attention to them.

Involving people in fauna surveys and plantings can change their perceptions over time and even lead to them retaining old trees and fallen branches within parks and their own gardens as they appreciate their ecological value.

2.3.7 Feral Animals

A number of feral animals were observed during surveys and otherwise reported to the group, from large flocks of rainbow lorikeets and corellas to foxes. Areas with a large proportion of exotic vegetation appeared to favour the feral species, the noise of rainbow lorikeets in the Indian Coral Trees (*Erythrina)* at Parliament House was very noticeable on several visits and also in palms along Mounts Bay Road and at Queens Gardens.

Figure 2.5 Rainbow Lorikeets, which have bred from cage escapees, are becoming common in Perth

Control of feral animals through removal of the animals is unlikely to be successful as they will quickly recolonise from outside areas and also unlikely to be supported by the public. The removal of vegetation, such as palm trees, which supports feral animals is therefore the best approach to reducing their numbers.

The use of artificial substitutes like nesting boxes can also support feral animals such as honeybees and rainbow lorikeets which occupy the boxes to the exclusion of native species. If nesting boxes are used, a program of regular monitoring and removal of bees should be undertaken. Removal of nesting rainbow lorikeets with young animals may be controversial so a policy on how this will be managed should be agreed to (with public consultation) prior to nesting boxes being installed. See http://www.birdsaustralia.com.au/infosheets/info5.html in Appendix 9 for more information on using nesting boxes appropriately.

2.3.8 Iconic Fauna

"The black swans sail up and down the river most majestically in parties of fifty or more"
Diary of Anne Whatley during the floods of 1830 (Berryman, 2002)

The Black Swan was regarded as the emblem of the Swan River colony from the earliest times, although the Black Swan's natural range extends across southern Australia. The Black Swan is the emblem for hundreds of Western Australian clubs, businesses from the West Australia Club on St Georges Terrace, established in 1893 until as recently as the Western Force logo unveiled in 2005. Also see Appendix 6 and www.cbcg.org.au/biodiversity/flora_and_fauna_in_city_art.htm

In 2000, a report was prepared for the Water and Rivers Commission on the possibility of providing appropriate habitat for the Black Swan to bring it back to the Swan River. (ATA Environmental, 2000). The report investigated several sites around Perth City to improve Swan habitat including in Mounts Bay and East Perth. While these sites did not rate as highly as sites elsewhere on the river, the significant value to the city to encourage the return of Black Swans to areas frequented by overseas visitors suggests that the reports recommendations should be re-investigated, particularly as both East Perth and Mounts Bay will be redeveloped in the coming years.

Figure 2.6 Black Swans currently use the sandy beaches in Mounts Bay. Changes to this area could make it more attractive to Swans or could see swans lost from the area entirely.

3 The City's Cultural Assets

It is not only the natural assets of soil, water, flora and fauna which contribute to the biodiversity within the city, but also the cultural assets; the value that natural areas and green spaces hold for the Perth community.

3.1 Indigenous Heritage

There are a number of sites within the City of Perth of significance to Aboriginal people and registered with the Department of Indigenous Affairs. Works which involve disturbing the ground at any of these sites, such as restoring a gentle slope and indigenous vegetation to the river foreshore, may require consultation and Section 18 clearance under the Aboriginal Heritage Act 1972. As the types of works recommended by this report involve the protection of remaining indigenous flora and restoration of indigenous vegetation and landforms, such proposals are likely to be supported by the Aboriginal community.

Of particular relevance is the proposed Indigenous Heritage Trail which will link Heirisson Island to Kings Park along the river foreshore. The protection of biodiversity through creating a Greenway link along the foreshore will complement and enrich the experience of walking the Trail.

The implications of heritage listing are discussed in Section 5.2.1. A full list of registered sites is shown in Appendix 4.

3.2 European Heritage

A number of the city's Parks and Reserves are recognised as having heritage significance and are listed on the State Heritage List and/or the City of Perth's Municipal Heritage List.

A full list of parks on the permanent or interim State Heritage List is shown in Appendix 6. The implications of heritage listing discussed in Section 5.2.2.

It is significant that incorporating parks within and around the city was of importance from the early days of settlement. This has resulted in a city which has been called "A Garden City" where in addition to a '*mosaic of open spaces within the city itself, many public buildings which have survived from the early twentieth century still stand in garden settings (ie St George's Cathedral, Perth Railway Station, Parliament House)*'. (Richards, 1982)

There is a risk that the value of landscaping around buildings is not recognised and is lost in the face of security concerns or development priorities.

3.3 The Impact of Urban Development on Biodiversity

Apart from the general effect of loss of vegetation due to dense urban development, probably the most significant impact on biodiversity in the city was caused by the dredging of Perth Water and the filling in of the shallow river foreshore, subsequently planted with rows of exotic trees and

palms lining newly created roads. Widespread foreshore infill was planned from the early 1900s and commenced in the 1920s, extending to the South Perth side of Perth Water, Heirisson Island and East Perth. However it was prefaced by much earlier infill to create the Esplanade Parade Ground in the shallow ground between the long jetties which reached into the river to service boats bringing cargo and passengers from Fremantle.

The historical importance of the river shallows as fish breeding grounds is now generally understood and in fact early settlers observed that the river margins were a good place to spear cobblers and catch crabs and prawns. What was less widely understood was the importance of such areas in the broader ecology of the river for processing and recycling nutrients (Malcolm Robb, pers comm.).

The dredging of Perth Water to deepen it for boating has had a significant impact on one highly visible species of fauna, the Black Swan. Black Swans used to be common on Perth water where the shallow waters and adjacent land provided ideal food and shelter for the birds. Black Swans feed in shallow water, eating aquatic plants to a depth of the length of their neck. Deepening Perth Water put any aquatic plants which still managed to grow in the deeper water, out of reach and forced the Swans to go elsewhere.

4 How to Protect and Enhance Biodiversity

The primary aim must be first to protect existing biodiversity and secondly to take actions to enhance biodiversity. This applies to both native flora and fauna, and includes aquatic fauna.

Actions may include general environmental improvement such as improvement to water quality, as a degraded or polluted environment will impact negatively on native fauna and flora.

While actions may vary, depending on the species at risk, some general principles can be followed.

4.1 General Principles

1 Protect any indigenous flora, fauna and natural landforms.

It is of primary importance to identify existing indigenous vegetation, especially any which may be remnant or have colonised the area naturally and protect from any threats. Threats could include being overgrown by weeds or the risk of damage or being removed.

Similarly natural landforms should be identified and protected from threats such as erosion.

2 Revegetate with indigenous species.

Indigenous species of plant are more likely to provide food, shelter and other needs of native fauna. Exotic species are also often likely to favour feral fauna (i.e. rainbow lorikeets and palm trees).

3 Provide all vegetation layers from groundcovers, low, medium and high shrubs to small, medium and tall trees.

Providing all vegetation layers in plantings provides a greater diversity of habitat and is more likely to encourage a wider range of species from small lizards and insects, which will be food for larger animals. Smaller birds require the shelter of dense shrubs as protection from larger predators.

This recommendation can be provided even in parks which due to heritage requirements cannot accommodate indigenous flora.

4 Create vegetated links (Greenways) between areas to increase their effectiveness.

Providing vegetation links between parks and reserves has been shown to increase the effectiveness of the individual reserve to provide food and shelter. Links allow species to colonise new areas, or re-colonise. In an urban area, links primarily benefit mobile species such as birds, however it is possible for frogs to travel quite a distance to colonise water bodies.

5 Obtain information through botanic and fauna surveys. Monitor the success of any works undertaken.

Ongoing surveys may bring to light previously unknown species of valuable flora or fauna, or unrecognised threats. Surveys will also provide useful information about natural seasonal variations. Ongoing surveys are important to ensure that changes are achieving outcomes.

6 Educate and involve the community so that community understanding and support is high.

Some of the recommendations of this report may result in changes to the management and appearance of public areas which will impact on city residents and visitors. If the reasons behind the changes are well understood within the community, they are more likely to be supported. Some recommendations also require the community to change their behaviour. There are also opportunities for the community to support the initiatives in the public domain by changing the landscaping on private land.

7 Only use artificial replacements like nesting boxes where there is clear evidence they will be beneficial.

In general it will always be more valuable to restore natural areas and increase the planting of indigenous species to improve habitat than provide artificial replacements. Simple replacements such as a nesting box1 provides only one aspect of the natural environment. They also risk being used by feral species. For similar reasons, artificial food sources are not recommended.

Occasionally a native species will feed on exotic species and care should be taken to ensure that other more appropriate food sources are available before removal of the exotic species (if that is proposed). An example is Carnaby's cockatoo which feeds on the large seed of some species of pine tree as most of the vegetation it would naturally feed on is no longer available within the city.

[1] See http://www.birdsaustralia.com.au/infosheets/info5.html on using nesting boxes appropriately.

4.2 Revegetation and Local Provenance

When revegetating, local species suitable to the soil type should be selected where possible. The soil map and soil types listed above should be matched to a reliable authority when selecting suitable species for revegetation. Static species lists are not provided in this report as more species are becoming available as nurseries propagate more local species.

Within a species, characteristics can alter over geographic area in response to specific environments. While local species are the species which originally grew within the area, local plants may be propagated from stock from elsewhere within the region, and therefore may display some genetic variation to the original vegetation.

“Local provenance” are plants which have been propagated from collections from locations as close geographically and in terms of habitat as practicable to the location where the propagated plants are to be planted. The practice of collecting seeds from remnant vegetation within the same area (and the same soil type), and propagating seedlings to be planted back into the same or nearby areas with the same soil type is consistent with the concept of local provenance.

There appears to be very little remnant vegetation remaining within the City of Perth, although further botanic surveys may uncover some, however the plant stock of Kings Park is a wonderful source for local provenance seedlings, particularly for revegetation on higher ground (Karrakatta soils).

In some planting there may be a desire to use some hybrid species which have a longer flowering period, larger flowers or some other primarily aesthetic feature. This would be acceptable in limited areas such as in more formal garden beds.

In general when planting, the following principles should be applied in this order:

1. Choose local provenance species, suitable to the soil type.
2. Choose local species, suitable to the soil type.
3. Choose species from South-west Western Australia.
4. Choose Western Australian species.
5. Use hybrid WA plants to meet particular aesthetic requirements.
6. Use plants from elsewhere in Australia to meet particular requirements.

5 Results

5.1 Field Survey Results

Field surveys were undertaken of most open landscaped areas within the City of Perth including land not under the control of the City of Perth such as around Parliament House, Dumas House and the East Perth Cemetery. The only areas not surveyed were Government House gardens, the gardens of Bishop's See, which could not be accessed due to building works, and the Esplanade, which was partly a construction zone during the period.

The desktop and field surveys are shown in Appendix 13. Each field survey concludes with the recommendations of the survey team. While some recommendations do not relate specifically to biodiversity, they may be of interest to City of Perth Parks staff and landscapers.

While the field surveys have informed the recommendations, issues which were common to a number of parks and reserves are discussed below.

5.1.1 Weed Control

In many parks there was a recognised need to control weeds, however whether a plant is considered a threat which requires controlling may vary depending on the situation. Couch grass overgrowing indigenous sedges at the river's edge is a serious threat, however it is accepted that couch is likely to be present in many parks and would not always be regarded as a weed that requires control or removal.

For some weeds, careful species identification may be required. *Typha orientalis* at the outlet of the Claisebrook drain is an exotic weed, however *Typha domengensis* at the same location would be a valued indigenous species. They are difficult to tell apart without close inspection.

Whether a 'weed' species is a threat and therefore requiring control must also be assessed. The *Typha spp* at the Claisebrook drain outlet could be come a serious problem if it spreads, however this is unlikely given its location.

In general it is important to first assess the level of threat of the weed, and then prepare a strategy for long-term eradication and control. If the strategy indicates that eradication or long-term control will be impossible or infeasible, then reassessment may be necessary.

5.1.2 Remnant Vegetation

During the field surveys, members came across indigenous species which could possibly be remnants of original vegetation. While at first thought, it may seem unlikely, it is possible that vegetation could have remained within an urban centre for over 175 years.

Possible remnant vegetation found during surveys include grass trees within the Hamilton Interchange and in the forecourt of Main Roads' Don Aitken Centre; Flooded gums *Eucalyptus*

rudis at Claisebrook Cove and Wellington Square (noting that flooded gums were known to be used in plantings such as at the East Perth Cemetery); a Tuart tree at Point Fraser and Marri trees in Victoria gardens and the Bush Forever sites on the Kings Park escarpment.

The potential for growing seedlings from locally sourced seed-stock as well as the intrinsic value of remnant plants makes it worthwhile investigating this further.

5.1.3 More Variety of Species and Forms

In a number of parks it was considered that a greater variety of plants would add visual interest while also improving the habitat value of the plantings.

In the more formal parks, such as Russell Square, Stirling Gardens and Harold Boas Gardens, a greater use of native plants would add colour, interest and variety. This would be particularly worthwhile in areas frequented by tourists. It was considered that this would not compromise the heritage value of such areas.

Some parks with mainly trees over grass, would benefit from underplanting and creating garden beds around and under the trees. In a park like Wellington Square, the garden beds could reflect the location of former wetlands.

5.1.4 Creating Links

Some parks within the city are isolated from other green spaces by roads, buildings and infrastructure. However outside the city centre, most roads retain green verges with street trees and sometimes underplanting (or the possibility of underplanting). The importance of street trees and trees on private property as a link between green spaces is clear to anyone observing the movement of birds through an urban area. During surveys, participants noted where vegetation between parks and reserves could be enhanced to provide better links between reserves, increasing their individual habitat value.

5.1.5 A Garden City on the Swan River

Through the surveys, the group's members and City of Perth staff rediscovered the city. It was discovered that many of the parks contained more of interest than first suspected and participants explored parks that some had not known existed.

The members' observation that parks and landscaped open space extended throughout the city, even in unexpected places along road and rail transport corridors is reflected in the recognition of Perth as 'A Garden City' from 1902 to the present day. (Richards, 1982)

The field surveys reinforced the recognition that the city's greatest natural assets are the Swan River and Kings Park. Improving the habitat value of the foreshore, and better linking Heirisson Island to Kings Park were seen as important priorities. However the value of all landscaped areas was recognised including the importance of maintaining a proportion of landscaping on private land as a setting around buildings.

5.2 Cultural Heritage

Heritage considerations could been seen as a major impediment to biodiversity within the city. Many changes following urban development have resulted in an environment which is sterile in an environmental sense. Also many of the city's more historic parks featuring primarily exotic vegetation. However that there are so many parks within and around the city is a significant feature of the city. In addition Perth also does not have a history of building on the river foreshore, the river was never industrialised apart from a few individual industries, such as breweries located on the site of springs near the edge of Mount Eliza (Kings Park). The city therefore has a lot of existing open space, especially along the foreshore. In recent years, the recognition of sites of importance to Indigenous culture, particularly along the foreshore and at former campsites and springs, will complement any changes to support biodiversity, based as they both are on valuing and restoring indigenous flora and landforms.

5.2.1 Indigenous Heritage

The abundant springs along the city's foreshore, one remembered now in the name Spring St, were once camping places for Aboriginal people. Early camps have been recorded in the grounds of Government House, near the Esplanade, at the former Emu Brewery, at Bishop's See and near the ABC studios. Camps at East Perth near Claise Brook continued to be used well into the 20th Century. Kings Park is also recognised as significant for mythological and ceremonial reasons. Many of these recorded sites are within or close to present day parks and reserves. A list of registered sites within the City of Perth or overlapping the city together with a map has been sourced from the Department of Indigenous Affairs online database and is shown in Appendix 4.

Restoring Indigenous Heritage values to an area is likely to be consistent with supporting biodiversity values through the restoration, or at the least incorporation of indigenous vegetation and landforms to the landscaping.

Indigenous Culture has become a feature of the annual Australia Day celebrations on the Swan River Foreshore with the music, dance and displays held in the Supreme Court Gardens. The City of Perth has also given in principle support [2] to the development of the Enrich Walk Trail, a trail of Noongar heritage sites, with artwork, information plaques and interpretive signage, to be created along Perth's central foreshore area in a plan by the Department of Indigenous Affairs in partnership with the City of Perth, to showcase Perth's Indigenous history.

The ENRICH trail will include sites of value to Noongar culture, including Heirisson Island, Point Fraser, the Supreme Court Gardens, Barrack Square, Mt Eliza and Kings Park. Such a trail would reinforce the opportunity for a focus on indigenous plantings along the foreshore to better link Kings Park to Heirisson Island and beyond. It is envisaged that the trail would create tourism opportunities within the city.

[2] General Purposes Committee, 28 February 2006

See Appendix 5 for examples of Indigenous culture being celebrated within the City of Perth.

Figure 5.1 Festival of Perth Opening Event 2006. Participants followed the Enrich Walk Trail from Heirisson Island to Kings Park.

5.2.2 European Heritage

The broad changes to the city and the impact on biodiversity has been discussed in Section 3.3.

The general principles of replacing exotic species with native vegetation, to provide habitat for native fauna and remove species more favourable to feral fauna, may not always be consistent with the heritage values of some parks. However Harold Boas Gardens is an example of how significant changes can be made to the planting within a park, including species selection, without necessarily affecting its essential 'heritage' character. Historian Oline Richards has observed that it is in the nature of gardens that they are constantly changing. She argues that it is the relationship between the parks and Perth society which should be maintained rather than rigid maintenance of exact species and plantings. (Richards, 1982)

Some parks planted almost exclusively with exotic species are supporting a wide variety of fauna. The field survey for Queens Gardens listed 45 different animals, not all of which were observed on the day, but were known from previous visits. This was the most recorded for any site. Queens Gardens contains permanent water and also has a complex vegetation structure with low and medium shrubs through to tall trees present which both contribute to its habitat value.

Parks staff recommended at several sites that plantings in garden beds could be more interesting visually, and more waterwise, if native plants were incorporated in the plantings (Note however that for waterwise plantings, all plants within the area must have similar watering requirements, so that watering can be reduced).

General assumptions about 'heritage' plantings should also be challenged. For example many people believe that only exotic trees are suitable for 'heritage' streets, however early horticulturalists used whichever plants that suited their needs and could be propagated. The Battye

library has a photograph of tree-lined Bennett St, East Perth which shows the street lined with planted flooded gums *Eucalyptus rudis*.[3] This species was also planted in the East Perth Cemetery and Stirling Gardens (where one solitary tree remains). Peppermint *Agonis flexuosa* was also a popular native tree used as a street tree and in gardens. With its weeping habit, the peppermint was considered a suitable substitute for the more traditional weeping willow at the East Perth Cemetery.

Decisions on appropriate tree selections are required to avoid the long-term environmental and health problems being experienced within Perth and elsewhere in the world. The autumn leaf-fall from soft-leaved exotic deciduous trees is having an ongoing and cumulative affect on the water quality of waterways within the Swan River catchment. Widely used street trees, such as the deciduous London Plane, are also now considered to be major contributors to urban allergens in European cities. Continuing to plant such species because of their reliable growth habits may be considered irresponsible by future generations.

In summary ways of improving the habitat value of the heritage listed parks include:

- Provide more vegetation layers including mid level shrubs.
- Use more native plants in garden beds.
- Question the widespread use of species which are either of little value or attract feral fauna, such as Cotton palms on Riverside Drive.
- Challenge assumptions that 'heritage' means exotic plants must be used. Early gardeners did use native plants where available (flooded gums, peppermints).
- Phase out exotics where they are doing environmental harm, such as deciduous trees affecting stormwater, palms encouraging lorikeets at the expense of 28 parrots, London plane trees increasing levels of allergens.

5.3 Landscaping Requirements

Landscaping within the city environment must meet a number of requirements including being attractive throughout the year, low-maintenance, hardy and waterwise. In some locations vegetation is at risk of trampling or vandalism. Heat reflected from roads and hard surfaces can be a problem. Maintaining open sightlines may be important for safety. The following sections address how these considerations can be incorporated into landscaping plans.

5.3.1 Safety

The WA Planning Commission has released guidelines on designing a safe urban environment. The guidelines were developed in response to very clear evidence that poorly designed public spaces could contribute measurably to the incidence of crime. (WAPC, 2006)

[3] Photo 009621d Bennett Street, Perth 1894

An important element of good urban design is increasing surveillance and maintaining clear sightlines. Criminal activity is less likely to occur if all spaces are overlooked and criminals have the perception that their activities may be viewed.

Unfortunately landscaping runs the risk of being severely restricted if the guidelines are interpreted too severely. Maintaining sightlines requires no visual barriers, including vegetation, between about 0.5m from the ground to eye height (~1.5m). Careful plant selection and pruning can accommodate attractive landscaping while maintaining sightlines. In the example below, groundcovers and low shrubs are planted beneath small trees. If necessary, the trees can be pruned to remove low branches and maintain open sightlines between knee and head height. A person walking down the street can see there is no-one hiding behind the landscaping and be assured of their safety. The few plants which are taller (the two grass trees on the right) are not bulky enough to create a safety concern. To reduce maintenance, plants chosen for the lower level should have a natural height not exceeding 0.3-0.5m. The taller vegetation should have a natural tree form (foliage in canopy well above the base) rather than a shrub form (many branches and low foliage).

Figure 5.2 Landscaping in the City of Perth which meets WAPC *Designing Out Crime* guidelines.

5.3.2 Water Consumption

With our drying climate, it is becoming increasingly important that landscaping, on both public and private land, has reduced requirements for additional inputs in the way of water and fertiliser. The City of Perth has joined the ICLEI initiative and is striving to reduce water consumption throughout the city.

Landscaped areas can be significant water consumers. In Perth homes, gardens can account for 60% of a household's scheme water use. While local government is more likely to be using groundwater supplies to irrigate landscaping, groundwater is still a valuable resource which needs to be conserved, particularly in a city where 60% of the scheme water supply comes from groundwater.

While the solution may appear to be to reduce the vegetation within landscaped areas and increase paving, the resulting increase in paved surfaces could measurably increase temperatures resulting in greater energy and water consumption as air-conditioning systems work harder to maintain comfortable temperatures in cars and buildings.

The alternative approach is to phase out high water use plants and replace with plants which are adapted to Perth's Mediterranean climate. The area was fully vegetated prior to settlement and in fact supported one of the greatest diversities of plant life found on Earth so there is a wide variety of local species to choose from to meet current landscaping requirements.

The desire for attractive landscaping year-round does mean that some watering may be required during summer months, however this can be minimised and restricted to highly visible locations.

5.3.3 Aesthetics

With thousands of species to choose from, there is no reason why native Australian plants cannot fulfil the landscaping requirements which have previously been met by exotic plants. The problem is that many exotic plants used in gardening have been in cultivation for hundreds of years, and hardy, long-flowering, compact varieties have been selected over that time.

Nurserymen working in Western Australia are fulfilling the same function, selecting suitable forms of native plants which have the characteristics to perform well within urban landscaping. New varieties become available each year and these should be trialled by local government.

Interstate and overseas visitors are interested in seeing what is special about Western Australia, and our flora is something which is unique in the world. Using it within landscaping in prominent locations throughout the city will be of interest to visitors.

Figure 5.3 Western Australia plants are attractive, hardy and waterwise, displaying a variety of forms which are unique in the world.

5.3.4 Maintenance

With aesthetic and safety requirements, maintenance of landscaping can take considerable staff time. Careful selection of plants however can reduce the required maintenance.

In the landscaping at Piazza Nanni, which was replanted with WA natives in 2005, plants were selected which had a compact growing habit and a size at maturity which was appropriate for the design. Most of the plants chosen should require little or no pruning as they will not outgrow their position in the garden (Piazza Nanni Sustainable Landscape, 2007).

As the pruning and care of WA plants can differ from exotics, regular and ongoing training should be provided to grounds staff so that plants are pruned appropriately.

5.3.5 Stress tolerance

Hardy plants may be required for situations that provide extra stresses. This can include particularly hot locations such as where heat is reflected from roads and dark surfaces, where there is occasional trampling of vegetation or where there is a likelihood of vandalism. For example it may be unwise to plant grass trees near nightclubs or event venues where large numbers of people congregate.

It is recommended that a list of suitable species be developed and plants which are particularly hardy or suitable for challenging situations be identified.

5.4 Greenways

In 199, Alan Tingay and Associates were commissioned to study the potential for 'Greenway' corridors to link remaining bushland and freshwater habitats. The value of vegetated links to address the fragmentation of remaining vegetation is now generally recognised. Priority was given to Greenways along foreshore areas, between wetlands and links between large areas of bushland. (Alan Tingay and Associates, 1997)

Since that report a number of adjacent local authorities have prepared "greening" plans including an assessment of providing 'Greenway' links through their local areas. In 2002 the Western Suburbs Councils (WESROC) commissioned Ecoscape to prepare the *Western Suburbs Greening Plan* and in 2004 Syrinx prepared a *Habitat Report* for the Town of Vincent.

During the field surveys, surveyors were asked to identify possible vegetated links between the survey site and adjacent areas.

5.4.1 Regional Greenways

Tingay's report shows 3 possible regional Greenway links through the City of Perth.

Link 24 is an important link along the entire length of river foreshore, including around Heirisson Island. This link has the potential to link to Kings Park and the city's foreshore to areas upstream, downstream and across the river. As Perth's river foreshore has traditionally been undeveloped and fully open to public access there this good potential for think link to be realised, subject to an new approach to landscaping in some sections particularly along Riverside Drive.

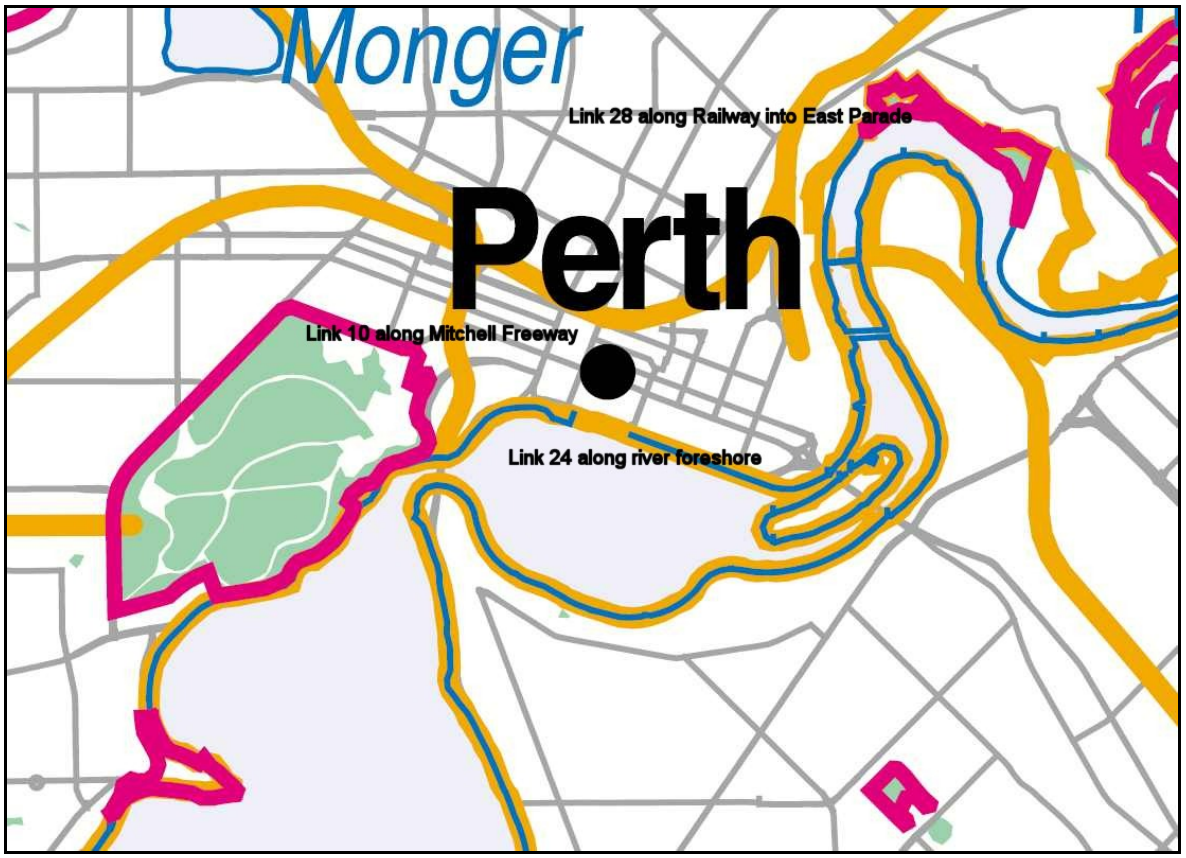
However proposed link 24 could be constrained by proposed foreshore developments on Mounts Bay (Landcorp), at the Perth Concert Hall (City of Perth) and in East Perth (EPRA).

Compact nodal development such as at Barrack Square and the proposed development at Point Fraser should not compromise this Greenway link as both are set within a landscape setting and of limited size. The previous development at Claisebrook Cove was set back from the river's edge therefore not compromising a Greenway link. These developments should be considered as a model for any future foreshore development if the river foreshore is to be enhanced and retained as a regional ecological link through the city.

Link 10 is a link north from the Narrows Bridge along the northern road/rail transport corridor. This link has the potential to be realised and would link the city, river and Kings Park to Lake Monger and areas further north. Within the city, there already exist several significant green spaces along and adjacent to this corridor including (from south to north) the Narrows Interchange, Parliament House and the Hamilton Interchange.

Link 28 is along the rail transport corridor to the north-east of the city between East Perth and Midland. While Tingay's report shows link 28 leaving the rail corridor, continuing a short distance along East Parade and terminating in East Perth, a survey of the railway line through the city indicates that the existing vegetation along the railway line could be enhanced to join link 28 to link

10. This however depends on existing vegetation being valued, retained and enhanced. Recent works as part of the Northbridge Link have already seen many large trees in the former Entertainment Centre carpark removed. Concept plans prepared by EPRA did not show replacement vegetation in this area, with the only major landscaping proposed being street trees on Wellington Street.



Yellow – Possible greenway links; Pink – Bush Forever sites; Blue – Swan River foreshore. Annotated detail of map from Bush Forever (2000)

Figure 5.4 Greenway links through Perth city.

5.4.2 Local Greenways

As discussed above it is considered that it would be possible to provide a vegetated link along the railway line through the city to connect links 28 and 10.

In addition during field surveys, members identified possible links between surveys sites. When considering these at the completion of the surveys, the links clustered at the eastern and western ends of the city. It was considered that rather than identify specific links, it would be more beneficial to broadly encourage 'greening' throughout these zones.

The first green zone identified through field surveys was a zone through East Perth, in a radius fanning out from Heirisson Island, connecting the river foreshore and Ozone Reserve through Queens Gardens, Wellington Square to Claisebrook Cove and the East Perth Cemetery.

The second zone connects Kings Park to the City via Dumas House, the Old Observatory, Parliament House, the Mitchell Freeway down through Bishop's See, the Narrows Interchange to the river foreshore.

These green zones will not only enhance biodiversity but also improve aesthetics and create an area of interest with a greater sense of place for the benefit of people within the city.

5.4.3 Community Involvement

The creation and enhancement of Greenways, requires the development of appropriate policies to ensure that the value of existing vegetation along a Greenway is recognised and protected and that new development incorporates appropriate landscaping.

However there is also potential for involvement of the community who are responsible for the type of landscaping on private land. Raising awareness within the Perth community about biodiversity generally and the benefits of landscaping with local plants through information, gardening workshops, tours and other methods has the potential, in time, to greatly enhance the habitat value of landscaping in public spaces through the greater use of native plants in landscaping on private land.

Figure 5.5 Community members who are involved through plantings and tours are better custodians of their local area.

5.5 Impact of Future Major Projects

Several proposed major projects have the potential to impact on existing vegetated areas.

Along the river foreshore a number of major developments are proposed, in Mounts Bay between Barrack Square and the Narrows Bridge, between the Concert Hall and the river, at Point Fraser and upstream of the Causeway in East Perth.

5.5.1 Mounts Bay

Landcorp, on behalf of the State Government of Western Australia, is currently investigating the feasibility of developing the Mounts Bay foreshore and preparing a business case for the

consideration of the State Government.[4] Early concepts have shown development spread along the foreshore from Barrack Square towards the Narrows Bridge.

Various sampling indicates that Mounts Bay has elevated nutrient and pollutant levels which are exacerbated by poor tidal flushing. Poor water quality also affects water bodies within the catchment including the lakes within the Narrows and Hamilton Interchanges. Poor water quality impacts on biodiversity as water bodies are less able to support a diverse range of species and healthy ecology. Poor water quality also impacts on human health, of concern in an area that is rapidly becoming another densely populated residential hub within the city.

Development along the foreshore also risks future development of a viable Greenway link along this section of the foreshore.

To enhance biodiversity it is essential that development is concentrated in nodes along the river, so that native landscaping can occur in between to provide linkages. To protect biodiversity it is also important that water quality issues are addressed as part of or prior to any development.

5.5.2 Concert Hall Precinct

In late 2007 the City of Perth released a Masterplan for a Performing Arts Precinct centred around the Perth Concert Hall, encompassing the Terrace Road carpark through to the Swan River foreshore.

The Masterplan seeks to improve the connection between the city and the foreshore while respecting the surrounding civic domain, which includes the Supreme Court Gardens, Stirling Gardens and Government House (with extensive gardens).

The Masterplan proposes new performance and rehearsal spaces and a lyric theatre around a lake which would also function as an irrigation lake to enable the city to extend the foreshore areas currently irrigated by the waters of Lake Vasto.

The proposal as presented runs the risk of disconnecting Langley Park from the riverside parks further west (Supreme Court Gardens and The Esplanade). Improved east-west landscaping links should be considered, without compromising the design, to maintain linkages along the foreshore.

This may be an example of foreshore development which is at odds with providing an ecological linkage along the river. The value of Perth's foreshore as a natural corridor may lie in its lack of development. The foreshore is currently fully landscaped and open to public access, with buildings being only a minor feature, either small in extent and fulfilling a specific function or clustered together at the old port (Barrack Square). While the proposal replaces a carpark, which could be argued to be an inappropriate use for such high value riverfront land, the carpark is at least landscaped and provides a landscape link between Langley Park and Supreme Court Gardens.

[4] www.perthwaterfront.com.au

5.5.3 Point Fraser and Heirisson Island

At Point Fraser, the City of Perth has developed a landscape which restores the indigenous flora of the area, a natural river's edge, a wetland which also treats the stormwater from the eastern end of the city together with boardwalks, interpretive works, a playground and recreation facilities. A commercial site will allow the future development of a restaurant.

Point Fraser is a very good example of foreshore restoration/development. Facilities for visitors have been incorporated without compromising environmental benefits, the indigenous landscaping is attractive and well maintained, human access is allowed on clearly defined paths and boardwalks, the commercial development is concentrated in two nodes and will not interrupt foreshore access.

The City is currently considering future uses for Heirisson Island. An outdoor sculpture park has been proposed for the islands and a concept prepared. [5]

Heirisson Island's location within the Swan River and proximity to foreshore parks including Point Fraser and Ozone Reserve provides an opportunity to provide a high-quality natural environment to give people in the city a chance to experience a natural riverine environment close to the city in contrast to the bushland environment at Kings Park. This would complement a sculpture park and would provide a uniquely Western Australian setting for sculptures.

Heirisson Island is currently home to a small group of Western Grey kangaroos, which are kept enclosed on the south-west half of the island. Although the location may not be entirely appropriate for such large fauna, it is clear from reading traveller's comments online that the experience of viewing wildlife in a semi-natural state within walking distance of the city is greatly valued by visitors. There are also benefits from raising public awareness and appreciation of native fauna.

5.5.4 Riverside, East Perth

The East Perth Redevelopment Authority has planning control over the area of East Perth upstream of the Causeway with one kilometre of river foreshore. The Gateway Masterplan proposes a '*bustling, vibrant community with a range of entertainment, commercial and residential developments that take advantage of the Gateway's* [6] *unique location*'.

The Masterplan recognises the area's '*natural riverine ecology'*. [7] The vision states the intention to '*respect and utilise the riverine environment through landscape rehabilitation including boardwalks, jetties and sensitive tourist and residential development'* [8]

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[5] See www.sculptureontheswan.com.au

[6] the Gateway, also previously known as the Eastern Gateway is now referred to as Riverside.

[7] EPRA Gateway Masterplan "A wide range of possible landscape experiences have been introduced, from the natural riverine ecology, to formal civic spaces. A significant opportunity exists for collaboration with key stakeholders in the re-creation and enhancement of riverine environments." page 5

Specifically in regards to the '7 River front' the Masterplan outlines "*A sequence of landscaped spaces, from riverside parkland to boardwalks and inlets, will provide a range of recreational, educational and interpretive opportunities along the riverfront. An attraction of the area is the natural protection from strong afternoon breezes. Stakeholder participation in design and implementation of riverine works is expected and encouraged. The riverfront changes will complement the City of Perth's Ozone Reserve improvements on the southern side of the Causeway*." And "*Paper-bark trees and reed-beds by the water will be protected and extended to enhance the area's natural beauty*." [9]

The Masterplan shows Trinity Reserve, the land between Trinity College and the Causeway having a development node on one side of a created inlet, with the edge of the southern side of the inlet forming a natural edge planted with indigenous vegetation.[10]

Further upriver, development of the existing Gloucestor Park into a residential zone, again around a created inlet, is proposed. Both of these development nodes will extend to the river's edge, which is a departure from previous development on the Swan River which is generally setback from the river. This is in conflict and will constrain future strengthening of the proposed foreshore Greenway. This may not be the case if the development could be setback from the river, or restricted in extent, so that substantial landscaping can occur around the development and on the riverbanks.

5.6 Impact of Current Policies and Strategies

Existing policies and projects of the City of Perth and State Government Agencies have the potential to impact in biodiversity, either positively or negatively.

A full list of documents with brief comments is provided in Appendix 3.

5.6.1 City of Perth Planning Policies

The City of Perth's City Planning Scheme No.2 and supporting Precinct Policies recognise the existing landscaping within and around the city.

5.6.2 City of Perth Strategies

A number of studies have been done over the years in regards to the river foreshore and adjacent parklands (The Esplanade, Langley Park etc). While the studies recognise '*the foreshore is the city's front garden'* [11] in general it is the aesthetic and recreational values of the open space, rather than any natural values, which are given prominence. The current Foreshore Action Plan (1999)

[8] EPRA Gateway Masterplan page 9

[9] EPRA Gateway Masterplan page 17

[10] The inlet is currently being reviewed. It is likely that the southern side will be built on. (May 2008)

[11] Central Perth Foreshore Study 1985

broadly aims to maintain public access along the foreshore and improve connections between the city and foreshore. There are no actions relating to any natural values of the areas.

In regards to landscaping, a strategy drafted in 1995 recommended that landscaping, especially tree planting in streets and public open space should aim to create a predominantly Western Australian character. The plan also proposed 'strategic green corridors' along the freeway and railway reserves including the Narrows Interchange and Bunning Lakes (within the Hamilton Interchange). This strategy was not adopted by Council.

A Public Places Enhancement Strategy is currently being prepared but was not available for comment.

5.6.3 Swan River Trust Policies

In late 2007 the Swan River Trust released the Draft Foreshore Management Strategy for public comment. The Strategy identifies the condition of the foreshore, makes recommendations and identifies priority areas for funding. Priority (which determines funding) is given to unstable or eroded foreshores and areas with remnant vegetation. As the proposed Strategy does not recognise areas where indigenous vegetation could potentially be restored, such as has occurred at Point Fraser, but is focussed on protecting areas of existing native vegetation, possible restoration of natural foreshores within the City of Perth is not catered for in this strategy.

6 Recommendations

6.1 Type A: Major Projects

6.1.1 Heirisson Island

Heirisson Island is an island within the Swan River between East Perth and Victoria Park, accessed by the Causeway Bridge. The island is a single regularised island that was created by joining several low lying natural islands that previously existed in the area where the Swan River changed from a river to an estuary.

The island is bisected by the Causeway bridge. The south-western section of the island contains some lakes and low-lying saline swampy areas. The north-east section contains a river inlet. Otherwise the islands are low undulating sandy hills planted with grass and trees.

The islands were replanted extensively during the 1970s with some local but mainly eastern states species of trees. It is possible (although unlikely) that some remnant vegetation remains in the vicinity of the saline wetlands.

Heirisson Island's location within the Swan River and proximity to foreshore parks including Point Fraser and Ozone Reserve provides an opportunity to provide a high-quality natural environment to give people in the city a chance to experience a natural riverine environment close to the city in contrast to the bushland environment at Kings Park. This would complement other uses such as a sculpture park, providing a uniquely Western Australian setting for the sculptures. The island represents an opportunity to not only undertake landscaping with local plants, but to restore vegetation structure and habitat values in selected areas. Several rehabilitation nodes could be densely planted at areas where they will provide maximum benefit for providing habitat for fauna.

Recommendation 1: Create an area of natural beauty and habitat on Heirisson Island, as an area for city residents and visitors to experience and learn about Australian flora and fauna. Restore indigenous vegetation to the island, choosing species suitable for the saline environment.

6.1.2 Linear Foreshore Park

The City of Perth is probably unique in having a river foreshore which is undeveloped and remains fully open to public access. In the vicinity of Langley Park however, the area is dominated by open grassed areas and roads. There is little shade for pedestrians or visual interest for passers by. At each end, the city contains well-landscaped attractive areas of interest to visitors.

A linear park of indigenous species would provide a shaded walkway connecting the city to Point Fraser and Heirisson Island. The park would also mark the former river's edge and could be part of the Indigenous Heritage Trail. It would showcase Western Australian native plants and could include informative signs on species names and values.

Recommendation 2: Create a linear park of indigenous plant species along the northern perimeter of Langley Park adjacent to Terrace Road.

6.1.3 Foreshore Restoration

Much of the river foreshore was created following dredging operations which saw the river shallows filled in with material dredged from the river. The indigenous vegetation was largely lost through this operation and the resulting foreshore was subject to erosion, which had previously been controlled through the roots of vegetation holding the soil together.

For most of the length of Perth Water and extending to Matilda Bay, erosion was controlled by the construction of limestone retaining walls. Elsewhere rubble was included in the fill material in an attempt to reduce erosion. The rubble has since been exposed as the foreshore has eroded and is particularly visible around East Perth. Sedges, paperbarks (Melauca spp) and other indigenous vegetation has re-colonised the foreshore and in some areas a natural foreshore and some sandy beaches have formed.

Much of the indigenous foreshore vegetation is severely impacted by weed, particularly grass and this requires urgent attention. Grass is less successful as an edging plant, tending to suffer from erosion below the waterline creating unstable, dangerous banks.

More recently a natural foreshore edge has been restored at Point Fraser where instead of the usual hard wall edge a deep bed of sedges has been planted into a framework of branches (brushmattress). The brushmattress stabilises the soil until the sedges become established. This type of edging significantly increases the capacity of the foreshore to provide habitat for shore-dwelling birds and aquatic biota.

Recommendation 3: Develop a plan to protect the remaining lengths of natural foreshore and indigenous vegetation and to restore a natural edge to as much of the remaining foreshore as possible, particularly focussing on East Perth between Claisebrook Cove and the Causeway. In partnership with the Swan River Trust develop a plan to fund the works over a ten year period.

6.1.4 Hamilton Interchange Restoration

At the Hamilton Interchange there are three water bodies, one under the control of the Water Corporation and the others under Main Roads Western Australia. One water body is a compensating basin on the Mounts Bay Main Drain and the others provide water for reticulation and lake recharge in the Narrows Interchange.

There are considerable opportunities to improve the landscaping and habitat value in the area and make changes to improve water quality. Improving water quality would not only benefit the water bodies in the Hamilton Interchange but also the Narrows Interchange, since water is pumped from the Hamilton Sumps to the Narrows Interchange western lake prior to being used for reticulation. The location on the Mitchell Freeway between Lake Monger and the city makes this an important

area for providing a 'green' connection heading north out of the city on the proposed Greenway Link 10. (Alan Tingay and Associates, 1997)

Recommendation 4: In partnership with Main Roads and the Water Corporation, prepare an improvement plan for the Hamilton Interchange to improve water quality and improve habitat links between the city and areas to the north.

6.1.5 Demonstration Gardens

The City can be a leader in demonstrating that landscaping using indigenous plants can be attractive, easy to maintain, with environmental and social benefits while also having minimal off-site environmental impacts.

Demonstration 'gardens' in high profile locations can be used to inspire and educate landscapers and gardeners. Information should be provided on site and through a website and through workshops and tours.

An example is the sustainable landscaping at Piazza Nanni with signage directing visitors to a website for further information on species selection and maintenance. Piazza Nanni has been used in Sustainable Landscaping courses for local government staff.

Recommendation 5: Develop demonstration landscaping areas in prominent locations to inspire and educate landscapers and gardeners.

6.2 Type B – Policy

6.2.1 Foreshore Vegetation

The City of Perth is responsible for maintaining almost 12 kilometres of foreshore and adjacent parkland (including Heirisson Island). While different parks have their own character, a more uniform planting policy in the vicinity of the foreshore would unify the area visually. Adopting a policy to use only indigenous species of plants for new and replacement plantings within a specified distance of the foreshore would have environmental benefits for the Swan River due to reduced watering and fertiliser requirements. Over time the creation of a continuous corridor of indigenous species along the foreshore would facilitate the spread of native fauna.

Recommendation 6: Adopt a policy to use only local species for new and replacement plantings within 50m of the Swan River.

Along the foreshore in front of the city, particularly through Langley Park, The Esplanade and adjacent to Riverside Drive, some open space is required for public events. However there may be areas which are currently open grass or grass and trees which could accommodate more varied planting without compromising function.

Recommendation 7: Investigate what land is required along the city's foreshore for public events to identify which areas could accommodate more varied landscaping to increase low and medium level shrubs and a range of tree species and sizes.

6.2.2 Fostering Greenways

In 1998, Tingay and Associates prepared a Greenways strategy for the greater Perth metropolitan area. The strategy identified possible 'green' corridors through the urban area to link naturally vegetated areas to enable fauna to move between remnant islands of vegetation.

The possible greenways identified within Perth city were along the river foreshore and along major rail and freeway transport corridors. Vegetated links along these greenways would connect the city along the river up and downstream and north and west to areas and major open space including Lake Monger and Herdsman Lake.

If the City adopts a policy requiring the maintenance and extension of vegetation within the identified greenways, this will ensure that future development doesn't compromise existing landscaping.

Recommendation 8: Develop and adopt a policy recognising the greenway corridors identified in Tingay 1998 and requiring that the proposed greenway corridors be reflected in strategic and planning policies and management plans and referred to when assessing development applications.

6.2.3 Green Zones

During the field surveys, members identified two zones within the city where existing landscaped areas in public and private ownership could be enhanced through additional plantings to create "green zones'. Landscaping with indigenous plants benefits more than biodiversity. Such landscaping has lower fertiliser and water requirements, resulting in surface and ground water quality improvements. Utilising unique Western Australian plants can also create areas of outstanding beauty and interest with a clear sense of being within Western Australia.

It is envisaged that the green zones would not only enhance biodiversity but also improve aesthetics and create an area of interest with a greater sense of place for the benefit of people within the city.

The first green zone identified through field surveys was a zone through East Perth, in a radius fanning out from Heirisson Island, connecting the river foreshore and Ozone Reserve through Queens Gardens, Wellington Square to Claisebrook Cove and the East Perth Cemetery.

The second zone connects Kings Park to the City via Dumas House, the Old Observatory, Parliament House, the Mitchell Freeway down through Bishop's See, the Narrows Interchange to the river foreshore.

Recommendation 9: Develop and adopt a policy recognising two green zones in the city, with supporting policies to facilitate a greater use of indigenous plants within landscaping (subject to heritage requirements) and strengthening connections between landscaped areas. Provide incentives to increase the use of native plantings in existing landscaping on private land.

6.2.4 Sustainable Landscaping Policy

The removal of indigenous vegetation and the use of exotic species in landscaping has significantly impacted on floral and faunal biodiversity within the city. Exotic species are also more likely to encourage feral animal species. Other environmental impacts of using exotic species can include increased requirements for water and fertiliser and worsening water quality which also leads to reduced biodiversity within the aquatic environment of receiving waters.

A sustainable landscaping policy should be adopted by the City to reduce the environmental impact of public and private landscaping. The policy will require landscapers to primarily use indigenous species and avoid deciduous plants, unless there is a clear function and environmental value in their use (noting that deciduous plants should not be used in locations where leaf-fall can affect stormwater quality). Such a policy will, in time, have a number of significant environmental benefits.

Recommendation 10: Adopt a policy to require all landscaping (public and private) to use a minimum percentage of Western Australian species, preferably local species for new and replacement plantings (suggested minimum 70% generally and 90% in identified 'green zones'). Deciduous trees may be used only where there is a demonstrated requirement for summer shade and winter sun. Deciduous trees may not be used where the leaves will affect stormwater quality.

6.2.5 Water Sensitive Urban Design

Ensure more living spaces are incorporated into urban development by developing policies which require WSUD to be incorporated into urban developments, including features such as 'living carparks' which incorporate a greater proportion of landscaping including within carbays, green roofs and the use of indigenous flora.

Recommendation 11: Develop WSUD policies for urban development to restore natural water flows and increase the use of local native plants and natural systems within developments.

6.3 Type C – Data Collection and Further Investigation

6.3.1 Botanic Survey

The field surveys identified that there may be some remaining indigenous trees and plants within the City. That these could survive over 178 years of urban settlement gives them great value and they should be protected. Initially a survey should be undertaken to identify whether any remnant vegetation exists, and this would require historical research in addition to a proper botanic survey.

Recommendation 12: Undertake historical research and a botanic survey to identify if any remnant vegetation remains within the City of Perth.

Places to be investigated include:

- Main Roads forecourt planting – grass tree
- Wellington Square – flooded gums
- Claisebrook Cove – flooded gums
- Point Fraser – tuart
- Victoria Gardens – marri
- Heirisson Island – esp vegetation around saline wetlands
- Kings Park escarpment – Bush Forever site
- Matilda Bay – foreshore
- Hamilton Interchange – grass tree

6.3.2 Bringing back the Swans

The black swan is iconic of the City of Perth. It features in the City's emblem and in the emblem and logos for many clubs, businesses, schools and organisations either based in the city or which were originally located within the city. It also appears as a decoration on buildings and also on tourist memorabilia representing Perth. Black swans are eagerly sought out by visitors to Perth.

The black swan used to be common on Perth Water and upstream of Heirisson Island, but changes to the foreshore and dredging to increase the depth for boating reduced the available habitat (both food and shelter) suitable for Black Swans.

In 2000, the Water and Rivers Commission had a report prepared on the possibility of bringing swans back to the Swan River. Given the swan's uniqueness within the world and its association with the city of Perth and the number of proposals for major foreshore development in the city from East Perth to the Causeway, it would be worthwhile re-investigating the recommendations of the report to see if Black Swan habitat could be accommodated in foreshore developments. (Also see Claise Brook Catchment Group submission to Landcorp on Perth Waterfront)

Recommendation 13: Re-investigate the recommendations of the 2000 report *Bringing back the Swans* to see if opportunities exist to provide for the habitat needs of Black Swans as part of current and proposed foreshore developments around the city.

6.4 Type D – Management Practices

6.4.1 Weed Management

The field surveys indicated that many reserves contain weeds which are threatening indigenous vegetation either through smothering or through replacement. However plants which are regarded as a problem weed generally within Western Australia may not be causing a problem in some parks but be an intended part of the park's vegetation. Therefore weed management needs to first identify whether weeds are present and secondly whether they are causing a problem or whether there is any benefit from controlling or removing the identified 'weed'.

Careful species identification is sometimes required as indigenous species and exotic 'weed' species can sometimes be similar in appearance (eg *Typha orientalis and T. domengensis*).

However in some areas, such as along the river foreshore and lake edges (Narrows Interchange), indigenous vegetation is at high risk of being smothered by grasses and management strategies are considered a high priority.

Recommendation 14: Prepare a weed management strategy to identify problem weeds, assess the risk and identify methods to remove or manage problem weeds with particular attention to protecting indigenous vegetation, foreshore and lakes edges. For each park, list problem weeds and control actions.

6.4.2 Trial New Species in Garden Beds and Planters

In a number of parks, the City's horticultural staff suggested that new varieties of native plants, now becoming available through nurseries, could be trialled to add colour, interest and variety to garden beds. Informative signage could add interest by providing information about the species being used. Plantings in highly visible locations including at Barrack Square, along Riverside Drive and in the City's malls could demonstrate the spectacular nature of Western Australian plants.

Plantings could be coordinated with major events within the city such as the Kings Park Wildflower Show in Spring.

Recommendation 15: Trial new species of Western Australian plants in garden beds to add colour and variety. Consider informative signage to explain to visitors the unique characteristics and environmental benefits of using WA plants.

6.4.3 Increase Understorey Plantings

Some of the parks surveyed contain primarily trees over grass. While this is probably low maintenance and reduces security concerns by maintaining generally open views at ground level, it does not provide adequate shelter for smaller species of birds.

> **Recommendation 16:** Create garden beds under trees, planted with lower shrubs and groundcovers, where grass is not required for sporting or other existing pursuits in the park.

Parks include Trinity Reserve, Wellington Square and Russell Square.

6.4.4 Extend Point Fraser-style Landscaping

Extending the type of landscaping and variety of species used at Point Fraser to adjacent areas would add visual interest as well as increase the habitat value of the eastern end of the city. This is already occurring with plantings at the Adelaide Tce end of Ozone Reserve.

> **Recommendation 17:** Increase variety of species planted at Ozone Reserve, Trinity Reserve, roadway islands to extend planting theme of Point Fraser and increase the habitat area.

6.4.5 Western Australian Trees as Street Trees

More varieties of Western Australian trees are becoming available from nurseries. These should be trialled for their suitability as street trees. Consideration should be given to replacing aging and unsuitable species such as Coral trees (*Erythrina*) and Cotton palms.

Exotic species are often the first choice for urban areas, however a historic photo of Bennett St, East Perth in the collection of the Battye Library[12] shows that this street used to be lined by flooded gums (*Eucalyptus rudis*).

> **Recommendation 18:** Prepare a list of Western Australian trees which may be suitable as street trees and trial these in streets throughout the city.

6.4.6 Prepare and Publish Suitable Plant List

As more local species become available from nurseries, develop a list of suitable landscaping plants for use internally by Parks and Landscaping staff and also for the general public. The list should be revised annually and published on the City of Perth website. The list should identify whether the species is local, South-West WA, WA or hybrid. Information on form, size at maturity, flower colour and flowering season should be included. The list should indicate which soil types the species is suitable for and recommended maintenance required to maintain the plant in good

[12] Photo 009621d Bennett Street, Perth 1894

appearance. Plants with useful characteristics, such as being particularly hardy, able to withstand hot conditions, such as receiving reflected heat from hard surfaces or can recover from trampling should be indicated. The location of good examples of the species would be useful for members of the public as well as staff.

Recommendation 19: Prepare a list of suitable landscaping plants for use by City of Perth staff and the public. Publish the list on the City of Perth website and review annually.

6.5 Type E – Community Involvement and Awareness

6.5.1 Fostering Community Involvement

Involving the community in measures to protect and enhance biodiversity within the city is critical to the overall success of the separate initiatives proposed within this report.

The community within the city includes long-term residents, short-term visitors, people who work in the city, companies based in the city, government agencies, members of the indigenous community, schools and churches.

Making the community aware of the initiatives proposed is the first step to gaining understanding and then support. In time people can be encouraged to volunteer to undertake fauna surveys of local parks, assist in plantings, form 'Friends of' groups to protect their local area, raise funds through their workplace and use indigenous plants in landscaping on private property, extending the 'value' of indigenous plantings in public places.

The City of Perth can facilitate community involvement through providing information about biodiversity within the city, workshops on landscaping with local plants, incentives to change landscaping, coordinating community involvement in fauna surveys and assisting the formation of 'Friends of" groups. Corporate clients could be involved through 'adopting' a local green space with staff involved in planting, care and workplace fund-raising. The value of creating an entity to receive tax-deductible donations in support of protecting biodiversity within the city should be investigated.

A garden competition for residents and commercial properties with sustainable landscaping is another method of providing an incentive and reward. This could include the encouragement of 'green roof' gardens within the city.

Information on why it is harmful to feed wildlife should be prepared and distributed in a variety of means including signage, brochures and website. City of Perth staff, particularly rangers, customer service and volunteer guides should receive training on why feeding is detrimental to the health of wildlife. Hotels, tour guides and schools should be targeted to receive information and training. The emphasis should be on providing an explanation of why feeding wildlife is harmful rather than only reinforcing bans on the activity.

Recommendation 20: Prepare a community engagement strategy to explain the biodiversity values within Perth City and how the city community can assist in protecting and enhancing the city's biodiversity. Identify opportunities to promote biodiversity within the city.

6.5.2 Promotion

Promote the benefits of native plants to tourists and visitors to the city through landscaping, interpretive works, information, heritage trails, Heirisson Island, Kings Park Wildflower Festival. Using the theme of biodiversity linked through different places and events throughout the city will reinforce the message that the City is a leader in environmental management.

Recommendation 21: Promote Perth's unique floral and faunal biodiversity to city residents, workers and visitors through information, interpretive works, tours, events and cross-promotion. Ensure that landscaping in prominent and well-visited locations features Western Australia's unique flora.

6.5.3 Education

Ongoing training of horticultural staff, landscapers, city residents and anyone involved in making decisions about landscaping is required to ensure that landscapes using native plants perform well both aesthetically and environmentally.

Recommendation 22: Educate landscapers and gardeners in using indigenous species.

6.6 Type F – Park Specific Suggestions

6.6.1 Wellington Square

Wellington Square contains flooded gums and paperbarks which although they may not be remnant, are suitable to the location which was formerly a wetland which drained into Claise Brook. The lower lying areas of the park are often inundated in winter. The current landscaping of primarily trees over grass, while low maintenance, could be greatly improved with more understorey plantings.

Recommendation 23: Create garden beds under trees planted with a variety of groundcovers, low and medium shrubs and small trees. Choose species which can withstand inundation in the areas which become flooded in winter. Use the garden beds to mark out the edges of the former wetland. Consult with the indigenous community on design, plant selection and interpretive works.

6.6.2 Ozone Reserve

The thickly planted shelter belts along the Adelaide Tce side of Ozone Reserve were some of the most attractive plantings in the city that were seen during the field surveys. In some sections the plantings are less successful, possibly due to soil conditions.

Around the lakes and towards Plain St a much narrower range of species is used and is limited primarily to low shrubs. Members considered the area around the lakes would be more visually interesting if a wider variety of forms and species were planted. This would also provide better habitat for a wider range of animals.

The area is visited by people living or staying in the city as well as people who work in nearby offices. Interpretive information about biodiversity, including an explanation of why it is harmful to feed wildlife would be worthwhile.

Recommendation 24: At Ozone Reserve increase the variety and form of species planted, particularly around the lakes.

6.6.3 East Perth Cemetery

The north-east corner of the East Perth Cemetery (outside the fence) was identified as an area which could benefit from improved landscaping.

Recommendation 25: Create a garden bed in the north-east corner of the East Perth Cemetery (outside the fence) as a place for local residents to sit and observe wildlife.

7 Conclusion

This study has found that Perth City's natural assets of river foreshore, parks and reserves and proximity to Kings Park provide an opportunity to provide for biodiversity within and around a major capital city.

The city's greatest natural assets are the Swan River and Kings Park. Improving the habitat value of the foreshore parks, and better linking Heirisson Island to Kings Park are important priorities to enhance biodiversity. However all landscaped areas are of value including landscaping on private land as a setting around buildings.

While many parks are heritage listed, and some contain few indigenous species of plants, some parks planted almost exclusively with exotic species are supporting a wide variety of fauna. General assumptions about what species are suitable for 'heritage' plantings can be challenged.

Indigenous flora and fauna has been widely used as a decoration for buildings such as in stained glass windows, carvings and plasterwork, and as the emblem for many city organisations including schools, clubs and businesses showing the cultural importance of native flora and fauna.

The study identifies that protecting and enhancing biodiversity within the city could achieve multiple benefits. Key proposals include:

- Restoring indigenous vegetation to Heirisson Island to create an area of natural beauty and provide a uniquely Western Australian setting for complementary uses.
- Developing a linear native flora park along the northern perimeter of Langley Park adjacent to Terrace Road, which would add visual interest and provide a shaded walkway connecting the city to Point Fraser and Heirisson Island.
- Restoring the river foreshore, particularly around East Perth, where it is urgently needed as erosion and couch grass threaten remnant native vegetation.
- Linking landscaped areas by creating "greenways" along the railway line and roads to increase the biodiversity value of individual patches, with the most important "greenway" being along the river foreshore.
- Recognising two "green belts" to facilitate the enhancement of all landscaping within these areas to improve biodiversity value. The approach would be to develop cooperative initiatives between the City of Perth and government, commercial and private building owners and tenants of these areas to increase the use of native flora and replacement of exotic flora in landscaping within the "green belt" areas.
- A greater use of indigenous vegetation in landscaping and as street trees to achieve multiple outcomes including reduced water consumption, improved surface and ground water quality as well as added visual interest to public landscaping.

- Developing demonstration gardens, particularly in high visibility locations. Information about indigenous culture and the State's unique local flora would add interest for locals as well as interstate and overseas visitors.
- Policy and management change to incorporate consideration of biodiversity into the design and management of landscaped areas.

Finally, the study urges greater consideration being given to including appropriate habitat areas for the black swan along the city's foreshore. The black swan has been the emblem of Perth since early settlement and has been widely used to represent "Perth" as the logo for schools, businesses and clubs in the city. It is still the first choice as an emblem for any new endeavour forming in the city today. Along the river foreshore and foreshore parks, accommodating swans while providing for the needs of the growing city is possible. A strategy should be developed to ensure that current plans for foreshore development do not relegate the black swan to other parts of the Swan River, leaving the swan to be remembered in the city's emblem alone.

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