Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Review

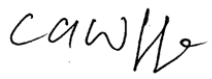
This Biodiversity Conservation Strategy will be reviewed in 2021.

Peer Review Statement:

Total Earth Care's qualified and experienced consulting ecologists undertook a review of the DRAFT Woollahra Biodiversity Conservation Strategy. This Review included, but was not limited to;

- Review of background documentation including Local Plans of Management for Woollahra's Parks and Reserves;
- A preliminary review of the DRAFT Strategy for completeness and accuracy of information;
- A site assessment to ground truth the information contain within the Strategy, more specifically;
- Field check locations of priority flora
- Undertake a search for threatened flora and fauna (and habitats) at known/mapped locations,
- Validate listed Threatened Ecological Communities and SEPP 19 Bushland across the LGA,
- Further Review of Strategy document and preparation of Assessment Report and updated mapping;
- Update of the TEC revised DRAFT Strategy based on Council review and comment to FINAL Biodiversity Conservation Strategy and Mapping.

TEC believes that its review process was thorough and data contained within the reviewed strategy is reliable and accurate. Incorporation of Council comments ensured the reviewed document is a useable resource which will achieve its aims going forward.



Callan Wharfe,
Project Officer – Ecological Consulting, Total Earth Care Pty Ltd

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

Table of Contents

Table of Contents	Page

Abbreviations and Glossary

Executive Summary

1. Introduction **1-1**

2. What is Biodiversity **2-1**

2.1. Ecosystem Services 2-2

2.2. Human Psychological Well-being 2-2

2.3. Recreational and Economic Value of Biodiversity 2-3

3. Vision and Objectives **3-1**

3.1. Vision 3-2

3.2. Guiding Principles 3-2

3.3. Objectives and Targets 3-3

4. Biodiversity Planning Framework **4-1**

4.1. Key Legislation and Planning Instruments 4-2

4.2. Local Government Plans and Policies 4-3

5. Approach **5-1**

5.1. Literature Review 5-2

5.2. Stakeholder Consultation 5-2

5.3. Data Collection and Mapping 5-2

6. Stakeholder Consultation **6-1**

6.1. Community Survey 6-2

6.2. Key Stakeholder Consultation 6-4

6.3. Coastal Zone Management Plan Consultation 6-5

7. Biodiversity in Woollahra **7-1**

7.1. Historical and Current Extent of Vegetation 7-2

7.2. Current Terrestrial Vegetation 7-4

7.3. Fauna 7-14

8. Habitat and Wildlife Corridors **8-1**

8.1. Key Habitat Areas 8-2

8.2. Locally Significant and Complementary Habitat Areas 8-2

8.3. Wildlife Corridors 8-3

9. Biodiversity Threats **9-1**

9.1. Loss of native vegetation and connectivity between habitat areas 9-2

Table of Contents		Page
9.2.	Stormwater	9-3
9.3.	Water Pollution and Debris	9-5
9.4.	Introduced flora species, weeds and diseases	9-5
9.5.	Increase in introduced animals and domestic pets	9-7
9.6.	Over-aggressive native species	9-8
9.7.	Decreased Understorey Habitat for Small Birds	9-9
9.8.	Recreational Use of Natural Areas and Associated Infrastructure	9-9
9.9.	Climate Change	9-11
9.10.	Other Threats	9-11
10. Current Biodiversity Management Practices		**10-1**
10.1.	Vegetation Management	10-2
10.2.	Stormwater Management	10-5
10.3.	Beach Cleaning / Street Sweeping	10-5
10.4.	Macrophyte planting and Streamwatch	10-5
10.5.	Environmental Education and Events	10-5
10.6.	Fox Trapping	10-5
10.7.	Cat Nuisance Policy	10-5
10.8.	Little Penguin Watch	10-6
10.9.	Walks in Woollahra	10-6
10.10.	Pool to Pond	10-6
10.11.	Summary of Current Practices and Constraints	10-6
11. Action Plan		**11-1**
11.1.	Habitat Conservation and Species Diversity	11-3
11.2.	Data Collection, Research and Monitoring	11-10
11.3.	Biodiversity Sensitive Council Operations	11-11
11.4.	Private Land Use	11-12
11.5.	Domestic/ Feral Animal Management	11-13
11.6.	Education and Awareness	11-14
11.7.	Regional Collaboration	11-16
11.8.	Funding	11-17
11.9.	Future Consideration	11-19
11.10.	Biodiversity Action Plan Summary	11-20
12. Biodiversity Monitoring Program Framework		**12-1**

Table of Contents	Page

References **13.**

Appendices

Appendix A – Planning and Policy Framework A-3

Appendix B – Current Management Plans A-10

Appendix C – Stakeholder Consultation Results A-15

Appendix D – Aeolian Soils Map A-19

Appendix E – Vegetation Type Descriptions A-20

Appendix F – Key and Local Habitat Areas A-24

Appendix G – Ecosystem Health Report Card A-29

Appendix H – Flora and Fauna List A-39

A brief summary of the content of each section is provided below:

Sections 1 to 3 provides an introduction to the Strategy, defines the concept of biodiversity, and describes the vision, guiding principles, Objectives and Targets for the Strategy

Sections 4 to 6 provide an overview of the biodiversity planning framework within which this Strategy operates, outlines the approach taken to develop this Strategy, and summarises the results of the stakeholder consultation activities.

Sections 7 to 8 provide an overview of biodiversity in Woollahra, including threatened, vulnerable and significant species, and a description of the Key, Locally Significant and Complementary Habitat Areas and Wildlife Corridors within Woollahra

Sections 9 to 10 provide a description of the threats to biodiversity in Woollahra, and outline the biodiversity management practices currently being implemented in Woollahra

Section 11 contains the Woollahra Municipal Council Biodiversity Action Plan.

Section 12 provides guidelines for a Biodiversity Monitoring Program for Woollahra Municipal Council.

Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

EXECUTIVE SUMMARY

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

Executive Summary

The Woollahra Local Government Area (LGA) covers 12 km² and is located approximately 5 km from the Sydney Central Business District. It is bounded by the Waverley LGA to the east, Randwick LGA to the south and the City of Sydney to the west (WMC 2013a).

The traditional owners of the Woollahra LGA are the Aboriginal people from the Cadigal and Birrabirragal clans. The name "Woollahra" is thought to be derived from an Aboriginal word meaning "meeting ground" (WMC 2013a).

This Biodiversity Conservation Strategy provides a vision, targets, objectives, on-ground actions and funding options for improving biodiversity management and practices across Woollahra.

Vision

The vision for Woollahra's Biodiversity is:

A high level of urban biodiversity through protected natural landscapes and systems; conserved and restored bushland areas; active wildlife corridors; clean and healthy waterways and creeks and a clean and healthy harbour

Guiding Principles

The following principles provide overall guidance for the approach to biodiversity conservation in Woollahra:

- Biodiversity is important to the physical and psychological wellbeing of its community
- Community are key stakeholders in its long-term sustainability
- Natural areas of remnant vegetation are of fundamental importance for biodiversity conservation and are irreplaceable
- Natural areas of remnant vegetation with greatest resilience have the highest priority for restoration
- A community that values biodiversity in its 'backyard' appreciates the value of biodiversity globally
- Biodiversity conservation can be integrated with other uses within an open space network
- Structural and plant species diversity is fundamental to providing habitat for small insectivorous birds and other specialist fauna species
- Management should be highly focussed on enhancing key and threatened species and controlling aggressive invasive species
- Biodiversity within urban landscapes needs on-going, pro-active protection if it is to be held in trust for future generations

Objectives and Targets

The objectives and targets were derived from stakeholder feedback, a literature review and fieldwork, and have been aligned with the overarching targets in Council's Environmental Sustainability Action Plan.

Table Ex-1. Objectives, Targets and Monitoring Mechanisms

Objective		Target	Monitoring Mechanism
1	To improve our understanding of biodiversity in Woollahra through collation of accurate data and monitoring of trends	Detailed Biodiversity baseline completed by December 2015	Biodiversity Database
2	To increase the extent, diversity and resilience of Woollahra's natural flora species and vegetation communities	75% of bushland areas are managed under an ongoing bushland restoration program by 2018	Biodiversity Database Bush Care work plan
		15% of bushland areas are fully regenerated by 2018[1]	
3	To increase the abundance, diversity and resilience of Woollahra's native fauna species	Records of habitat/ foraging of native species increase by 15% between 2015 and 2019	Biodiversity Database Council/ Community Sighting Records
4	To control and reduce the abundance of introduced animal species	Records of habitat/ foraging by introduced species decrease by 20% between 2015 and 2019	Biodiversity Database Council/ Community Sighting Records
5	To reduce the abundance of introduced flora species and weeds	15% reduction in area of infested/ completely vegetated with introduced/ weed species between 2015 and 2018	Biodiversity Database Trend Analysis / Bush Care work plan
6	To protect and enhance creek and estuary ecosystems	Creeks and waterways meet ANZECC Guidelines for Fresh and Marine Water Quality	Water Quality Monitoring Program Biodiversity Database
		Existing native vegetation buffers along all waterways maintained through to 2020.	
7	To improve the water quality and habitat value of Woollahra's foreshore and marine areas	Woollahra beaches given "Good" or "Very Good" ratings in the State of the Beaches Annual Report	Beachwatch Annual State of the Beaches Reports
8	To collaborate with the community and other organisations contributing to biodiversity conservation in Woollahra.	A range of collaborative programs implemented between 2015 and 2020	Program review
		Information sharing portal established	Information sharing portal activity
9	To increase engagement with the broader community on biodiversity	Community participation in biodiversity related projects and events increases by 25% between 2015 and 2020	Community event participation register

[1] An area that is "Fully Regenerated" is an area that only requires minimal maintenance. Major capital works/ major weed removal programs are no longer required for this area.

Approach

The Strategy was informed by a literature review, an audit of flora and flora records, reviews of relevant mapping, database searches and consultation with a range of stakeholders. Key Habitat Areas, key flora and fauna species, and wildlife corridors, which are considered crucial to the long-term survival of Woollahra's biodiversity, have been identified.

Community Consultation

An online survey was conducted through Council's website. The survey showed that:

- Vaucluse Park, Lyne Park and Trumper Park are the most popular natural areas amongst the participants
- The level of satisfaction with Councils management of the natural environment varies
- Clearance of vegetation for development and the weed invasion of bushland were considered the most significant threats
- Reducing the impact of pollution on local biodiversity and improving water quality of local catchments were considered extremely important by the highest number of participants

Consultation with key stakeholder organisations and government departments was undertaken. Issues that were raised included:

- Addressing Key Threatening Processes
- Reviewing Recovery Action Plans and Priority Action Statements
- Management of stormwater
- Habitat condition and connectivity
- Biodiversity conservation on private and public land
- Impact of community on biodiversity / education on conservation

Biodiversity in Woollahra

Despite its relatively small land area, the Woollahra landscape is remarkably diverse, comprising a range of ecosystem elements. It is estimated that Woollahra has a total of 53.8 ha of remnant vegetation (terrestrial and aquatic), representing 4.6% of its original extent. There are approximately 196 ha of non-remnant/exotic vegetation in Woollahra.

Woollahra contains the following listed[2] species:

- Sunshine Wattle *(Acacia terminalis subsp. Terminalis)*)
- Nielsen Park She-oak *(Allocasuarina portuensis*)
- Magenta Cherry *(Syzygium paniculatum*)
- Sooty Oystercatcher
- Powerful Owl
- Eastern Bentwing-bat
- Southern Myotis

[2] Listed as "Endangered" or "Vulnerable" under the Environment Protection and Biodiversity Conservation Act (1999), and/or the NSW Threatened Species Conservation Act (1995), or "Protected" under the Fisheries Management Act (1974).

- Grey-headed Flying Fox
- Seahorses, seadragons, pipehorses, ghostpipefish and seamoths (*Syngnathids*)

In addition, 28 native animal species protected under the National Parks and Wildlife Act, are recorded in Woollahra.

Habitat Areas

Areas representing known or potential habitat within Woollahra have been classified to allow prioritisation of biodiversity conservation efforts. The classifications are as follows:

- *Key Habitat Areas.* Key Habitat Areas are fundamental to the future viability of biodiversity in Woollahra. They support most of the LGA's natural vegetation and function as core foraging and breeding habitat for fauna species. The ten Key Habitat Areas are:
  - Cooper Park
  - Trumper Park
  - Woollahra Golf Club
  - Nielsen Park /Hermitage Foreshore
  - Vaucluse House
  - Parsley Bay Reserve
  - Christison Park
  - Gap Park
  - Green Point/ South Head/ Gap Bluff
  - Estuarine foreshore and Seagrass areas

- *Local Habitat Areas (Locally Significant, and Complementary Habitat Areas).* Local Habitat Areas support and enhance the ecological viability of the Key Habitat Areas. Locally Significant and Complementary Habitat Areas are generally small parks and other public open space areas managed by Council.

Wildlife Corridors

The wildlife corridors within Woollahra are mapped using the presence of open space and to a lesser extent, street trees as "stepping stones" between Key Habitat Areas.

Biodiversity Threats

Key threats to biodiversity in Woollahra include:

- Loss of native vegetation and connectivity between habitat areas
- Stormwater
- Water pollution and debris
- Introduced flora species, weeds and diseases
- Introduced animals and domestic pets
- Over-aggressive native species
- Decreased understorey for small birds
- Recreational use of natural areas and associated infrastructure
- Climate change

The Strategy

The strategy for biodiversity conservation in Woollahra is presented in section 11. Actions are grouped under the following topics:

- Habitat Conservation and Species Diversity
- Data Collection, Research and Monitoring
- Biodiversity Sensitive Council Operations
- Private Land Use
- Domestic/ Feral Animal Management
- Education and Awareness
- Regional Collaboration

Funding opportunities and future considerations are also provided in Section 11.

The biodiversity conservation actions are provided in Table E-1. The priority of the actions is illustrated using the following legend:

H	High Priority - completed by 2017 / 18
M	Medium Priority - completed by 2020 / 21
L	Low Priority - completed by 2024 / 25

No.	Action	Priority
HAB 01	Collaborate with Bushland Maintenance Team to determine options for further contributing to implementation of Biodiversity Conservation Strategy and support target monitoring and reporting	H
HAB 02	Conduct facilitated Detailed Habitat Restoration Planning exercise with bush regeneration staff for parks and reserves within Key Habitat Areas.	H
HAB 08	Identify sites that could benefit from scarification	H
HAB 12	Conduct annual assessments of seahorse populations on swimming net enclosures.	H
HAB 14	Conduct ongoing maintenance of riparian vegetation in Parsley Bay Creek	H
HAB 15	Conduct annual aquatic fauna assessments in Parsley Bay Creek and Cooper Creek	H
HAB 16	Collaborate with Sydney Water regarding reconstruction of Estuarine Coastal Saltmarsh vegetation on the lower reaches of the Rose Bay culvert.	H
HAB 17	Identify unused land that may be used for planting of native gardens and/or trees for the purposes of reducing urban heat island effect, increasing habitat, increasing permeable surfaces, and improving the amenity of unused spaces.	H
DAT 01	Implement a Biodiversity Monitoring Program. Conduct monitoring every 2 years.	H
DAT 02	Undertake a water quality monitoring program.	H
COL 02	Contact and establish process for collaborating with DPI and RMS on the management of seagrass habitat within Woollahra foreshore areas. Collate information on any programs related to monitoring seagrass populations	H
DOM 01	Parks Officer and Bush regeneration staff to inform Rangers/ Companion Animals Officer of key parks, times and offenders against dog prohibition/on leash regulations to inform prioritisation of patrols	H
DOM 02	Maintain existing cat owner engagement and education program to encourage responsible self-monitoring pet ownership.	H
DOM 03	Continue to review and improve dog prohibition signage in currently prohibited areas	H

No.	Action	Priority
DOM 04	Develop formal procedure for Council trapping of foxes when sighted in Key Habitat Areas	H
PLU 01	Prepare landscape design guide to be included in Development Assessment Guide.	H
EDU 01	Conduct an annual Biodiversity in Woollahra photography competition	H
WMC 02	Undertake review of Councils maintenance and cleaning procedures, and where possible, integrate biodiversity monitoring or conservation measures into procedures.	H
EDU 08	Develop and implement biodiversity lesson plans for schools and child cares, adaptable to suit all year levels from early childhood to year 12.	H
HAB 03	Incorporate Detailed Habitat Restoration Plans for parks and reserves within Key Habitat Areas as part of the next review and update of the Plan of Management or Masterplan.	M
HAB 04	Update relevant sections of the Plans of Management for all parks and reserves to include biodiversity conservation provisions as part of the next review and update of the Plan of Management or Masterplan.	M
HAB 05	Develop and Implement a Threatened Species Management Plan	M
HAB 06	Monitor spread of phytophora throughout Cooper Park and implement control procedures where practical	M
HAB 07	Continue monitoring of Bansksia serrata remnants in Gap and Cooper Park to determine presence of Banksia aemula	M
HAB 09	Bush regeneration staff to keep abreast of research into genetic provenance for Woollahra region, and plant known locally native species where possible	M
HAB 10	Adopt Sydney Weeds Committee Weed Incursion Plan 2010-2015 and access funding for emergency weed management as required.	M
EDU 02	Conduct bi-annual urban biodiversity information forums/ training sessions for bushcare volunteers.	M
EDU 04	Establish an online form for the community to report fauna and flora sightings, and upload photographs	M

No.	Action	Priority
EDU 06	Provide annual native garden/ habitat friendly garden workshops	M
EDU 07	Implement targeted education program for residents and landholders adjacent to Key Habitat Areas	M
WMC 01	Conduct annual workshops with indoor and outdoor staff to update Council staff on legal obligations with regard to threatened and significant biodiversity, and the relevant targets and actions contained within this Biodiversity Conservation Strategy.	M
WMC 03	Conduct internal information sessions on the relevance and use of spatial biodiversity information.	M
HAB 18	Investigate opportunities for collection of logs/ stumps/ branches removed by Park and Tree Management teams and use in the creation of habitat in bushland areas	M
HAB 11	Implement Eastern Suburbs Banksia Scrub Recovery Plan actions as appropriate for Woollahra	L
HAB 13	Conduct further ground truthing of Johnston's Lookout as a potential regeneration site to determine presence of Woody Pear and other native species.	L
COL 01	Establish a web portal for information sharing and collaboration between Council and external organisations responsible for overseeing landscape/biodiversity maintenance within Woollahra	L
COL 03	Contact and establish process for collaborating on biodiversity conservation project(s) with the Sydney Harbour Federation Trust regarding the Marine Biological Station Park and Macquarie Lightstation	L
COL 04	Contact and establish process for collaborating on biodiversity conservation project(s) with NPWS regarding SHNP (Neilsen Park, Hermitage Foreshore, Green Point, South Head, Gap Bluff)	L
COL 05	Contact and establish process for collaborating on biodiversity conservation project(s) with Sydney Living Museums regarding the management of Vaucluse House and Vaucluse Bay	L
EDU 03	Establish a demonstration small-bird friendly garden/ native bee hive and/or pond habitat at a high profile Council Reserve	L
EDU 05	Provide bi-annual biodiversity related stories to local media	L

Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

1. INTRODUCTION

1. INTRODUCTION

The Woollahra Local Government Area (LGA) covers 12 km² and is located approximately 5 km from the Sydney Central Business District. It is bounded by the Waverley LGA to the east, Randwick LGA to the south and the City of Sydney to the west (WMC 2013a).

The traditional owners of the Woollahra LGA are the Aboriginal people from the Cadigal and Birrabirragal clans. The name "Woollahra" is thought to be derived from an Aboriginal word meaning "meeting ground" (WMC 2013a).

Prior to European colonisation, Woollahra's landscape comprised of a diversity of habitat elements due to its combination of estuarine foreshore, low-lying swampy areas and exposed coastal sandstone cliff-lines. Extensive, species-rich heathlands grew on exposed ridges graduating into taller woodlands and forests on sheltered hillsides and gullies overlooking the harbour. On the alluvial flats at the heads of bays such as Rushcutters Bay and Double Bay, tall forests intermingled with smaller patches of *Livistona australis* (Cabbage Tree Palms) and other rainforest species. Paperbark swamps occurred on the peaty low lying areas stretching inland from Rose Bay (including the area currently occupied by Royal Sydney Golf Club and Woollahra Golf Club) all the way to the sand hills of Bondi (Benson and Howell, 1990).

Due to its key harbour location, Woollahra was settled relatively quickly after the establishment of the first British colony in Sydney Cove. Large areas of natural vegetation were cleared to construct defence outposts and lighthouses on the South Head peninsular and residential development elsewhere in the LGA.

Figure 1-1. View of Parsley Bay from Hopetoun Avenue, 1905

Figure 1-2. Aerial view of Rose Bay, with Royal Sydney Golf Club in foreground, Woollahra Park, portion of Point Piper and Double Bay in the far background ca. 1923

Woollahra today is a highly urbanised area comprising of commercial precincts and medium and high density residential areas. In 2011, the population of the LGA was 52,159. It is predominantly a community of families, young adults, and older people, with the population ageing at a rapid rate and a growing number of couples with children (WMC 2013a).

Today, 4.3% of the original area of terrestrial native vegetation remains. Almost all of the swampy woodlands have been filled and replaced with parks and sports fields, creek-lines have been channelised and seawalls have been constructed along much of the foreshore. Fortunately however, some high value natural areas remain in the area, many of which attract a high visitation rate from locals and tourists. The natural areas represent the largest area of foreshore bushland on the southern side of Sydney Harbour, and:

- Provide habitat for threatened and regionally significant plants and animals
- Present popular vistas of the Harbour and Sydney City skyline
- Provide opportunities for coastal walks
- Provide opportunities for boating, swimming and use of harbour beaches

Woollahra's natural areas and associated flora and fauna are of incalculable value to current and future generations and their biodiversity values should be protected and enhanced.

This Strategy provides a range of objectives and management actions for improving biodiversity conservation and management across Woollahra.

The Strategy covers native flora and fauna habitat including remnant vegetation, exotic and planted native vegetation on land managed by Council and other management authorities. The Strategy also addresses marine aquatic habitat outside of the LGA boundary on submerged land in Sydney Harbour. The contribution that private residential property makes to Woollahra's biodiversity is also considered.

A brief summary of the content of each section is provided below:

Sections 1 to 3	provide an introduction to the Strategy, defines the concept of biodiversity, and describes the vision, guiding principles, objectives and targets for the Strategy
Sections 4 to 6	provide an overview of the biodiversity planning framework within which this Strategy operates, outlines the approach taken to develop this Strategy, and summarises the results of the stakeholder consultation activities.
Sections 7 to 8	provide an overview of biodiversity in Woollahra, including threatened, vulnerable and significant species, and a description of the Key, Locally Significant and Complementary Habitat Areas and Wildlife Corridors within Woollahra
Sections 9 to 10	provide a description of the threats to biodiversity in Woollahra, and outline the biodiversity management practices currently being implemented in Woollahra
Section 11	contains the Woollahra Municipal Council Biodiversity Action Plan.
Section 12	provides guidelines for a Biodiversity Monitoring Program for Woollahra Municipal Council.

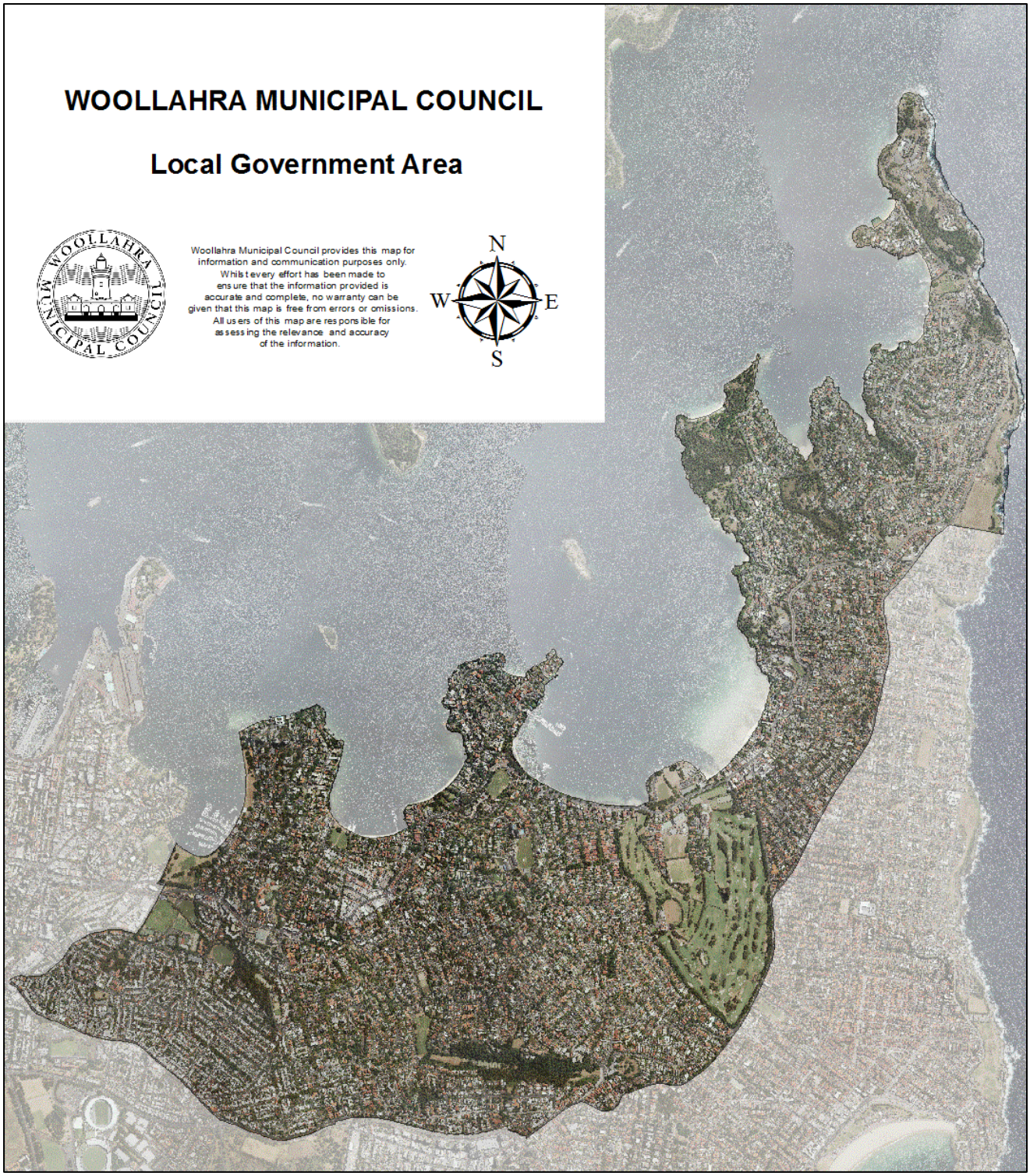


Figure 1-3. Woollahra Local Government Area

Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

2. WHAT IS BIODIVERSITY?

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

2. What is Biodiversity?

Biodiversity or biological diversity is defined as:

"The variety of all living things, including plants, animals and micro-organisms, the genes they contain, and the ecosystems of which they form a part. It is not static, but is constantly changing. It is increased by genetic change and evolutionary processes and reduced by processes such as habitat degradation, population decline, and extinction."

(Taken from National Strategy for the Conservation of Australia's Biological Diversity (Department of Environment (then DEST) 1996)

The concept of biodiversity emphasises the interconnectedness and interdependence of all life on earth and can be considered at three levels:

- Genetic diversity - the variety of genetic information that is contained in all living things and that varies within and between the populations of organisms making up single species or wider groups
- Species diversity - the variety of species on earth
- Ecosystem diversity - the variety of the earth's habitats, ecosystems and ecological processes

2.1 Ecosystem Services

Urban biodiversity contributes significantly to the quality of life for urban dwellers by providing a range of ecosystem services. Ecosystem services are defined as the physical, cultural, spiritual and economic benefits people derive from ecosystems. Examples of how urban biodiversity can provide ecosystem services to the residents of Woollahra include (Pearson et al 2007):

- **Carbon sequestration:** urban trees remove carbon dioxide from the air and act as a sink by storing carbon in their biomass
- **Air pollution removal:** in particular ozone, nitrogen dioxide and sulphur dioxide by large street trees and other vegetation
- **Microclimate regulation:** vegetation and waterway areas reduce the heat island effect; trees also keep cities warmer in winter by blocking wind and reducing wind speed
- **Flood regulation:** vegetated areas can store large quantities of water and slow water movement, thus reducing flood damage
- **Noise abatement:** vegetation belts act as barriers for traffic noise along roads
- **Recreational values:** natural areas are highly valued for opportunities to play and exercise
- **Aesthetic values:** natural areas provide attractive surroundings, increase property values, promote tourism, and may even shape the cultural identity of urban localities
- **Educational values:** easily accessible natural areas provide numerous opportunities for nature study, research and environmental education through field trips and excursions.

2.2 Human Psychological Well-being

Urban biodiversity is important for the mental health and wellbeing of city dwellers. International research (Fuller et al 2007) has shown that interaction with the natural environment contributes to a range of measurable positive benefits at individual and society levels including:

- General health
- Increased social interaction
- Management of mental fatigue
- Opportunities for reflection

Figure 2-1. Nielsen Park, Vaucluse

2.3 Recreational and Economic Value of Biodiversity

The natural environment has recreational value for many Australians. In 2008, 18 per cent of all domestic overnight trips in Australia included a nature activity, such as visiting a national park, botanical garden or wildlife park, bushwalking, whale watching, scuba diving and snorkelling. Visitors to Australia are also attracted to the natural environment; 65 per cent of tourists that visited Australia in 2008 participated in one or more of the above nature activities. Nature-based visitors also stay almost twice the length of time on average than other international visitors, and spend 80 per cent of international visitor dollars (ABS 2013).

Figure 2-2. Camp Cove, Watsons Bay

Both international and Australian visitors flock to sites around the harbour such as Nielsen Park, Gap Park, and Rose Bay. These sites provide spectacular scenery and recreational opportunities in the form of coastal walking tracks, beaches and boating. The sites are also excellent foreshore vantage points for significant Sydney events such as the New Year's Eve fireworks, the Sydney to Hobart yacht race start, bringing considerable value to the local economy.

Local businesses including boat hire, fishing shops, kiosks and restaurants benefit from high visitation throughout the year. Property values with harbour and coastline views are highly valued; 13 per cent of Sydneysiders who live in the area surrounding the harbour make up 22 per cent of the total household income of the city (Bens, 2011).

Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

3. VISION AND OBJECTIVES

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

3. Vision and Objectives

3.1.1 Vision

The vision for Biodiversity in Woollahra is:

A high level of urban biodiversity through protected natural landscapes and systems; conserved and restored bushland areas; active wildlife corridors; clean and healthy waterways and creeks and a clean and healthy harbour

The vision for biodiversity in Woollahra is based on the strategic goals within 'Woollahra 2025', Woollahra's Community Strategic Plan. Many of the aspects included in visions expressed by community members during the consultation exercises for the Strategy (see section 6) align with this vision.

3.1.2 Guiding Principles

The following principles provide overall guidance for the approach to biodiversity conservation in Woollahra:

- Biodiversity is important to the physical and psychological wellbeing of its community
- Community are key stakeholders in its long-term sustainability
- Natural areas of remnant vegetation are of fundamental importance for biodiversity conservation and are irreplaceable
- Natural areas of remnant vegetation with greatest resilience have the highest priority for restoration
- A community that values biodiversity in its 'backyard' appreciates the value of biodiversity globally
- Biodiversity conservation can be integrated with other uses within an open space network
- Structural and plant species diversity is fundamental to providing habitat for small insectivorous birds and other specialist fauna species

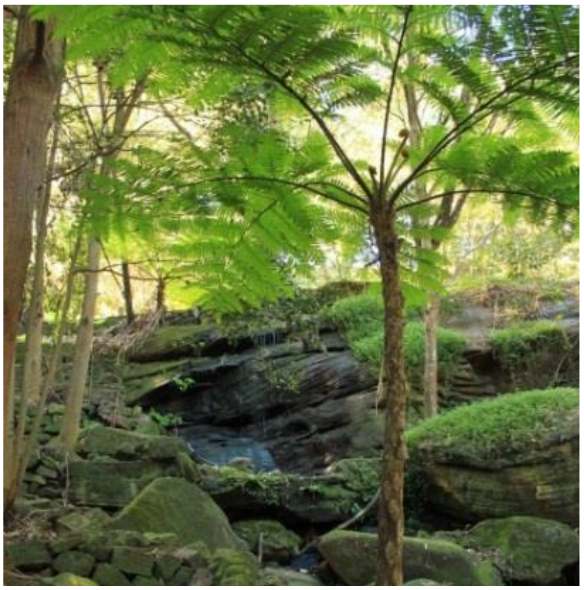


Figure 3-1. Cooper Park, Bellevue Hill

- Management should be highly focussed on enhancing key and threatened species and controlling aggressive invasive species
- Biodiversity within urban landscapes needs on-going, pro-active protection if it is to be held in trust for future generations

3.1.3 Objectives and Targets

The following objectives and corresponding targets were derived from stakeholder feedback, a literature review and fieldwork and have been aligned with overarching targets in Council's Environmental Sustainability Action Plan.

Table 3-1. Objectives, Targets and Monitoring Mechanisms

Objective		Target	Monitoring Mechanism
1	To improve our understanding of biodiversity in Woollahra through collation of accurate data and monitoring of trends	Detailed Biodiversity baseline completed by December 2015	Biodiversity Database
2	To increase the extent, diversity and resilience of Woollahra's natural flora species and vegetation communities	75% of bushland areas are managed under an ongoing bushland restoration program by 2018	Biodiversity Database Bush Care work plan
		15% of bushland areas are fully regenerated by 2018[1]	
3	To increase the abundance, diversity and resilience of Woollahra's native fauna species	Records of habitat/ foraging of native species increase by 15% between 2015 and 2019	Biodiversity Database Council/ Community Sighting Records
4	To control and reduce the abundance of introduced animal species	Records of habitat/ foraging by introduced species decrease by 20% between 2015 and 2019	Biodiversity Database Council/ Community Sighting Records
5	To reduce the abundance of introduced flora species and weeds	15% reduction in area of infested/ completely vegetated with introduced/ weed species between 2015 and 2018	Biodiversity Database Trend Analysis / Bush Care work plan
6	To protect and enhance creek and estuary ecosystems	Creeks and waterways meet ANZECC Guidelines for Fresh and Marine Water Quality	Water Quality Monitoring Program Biodiversity Database
		Existing native vegetation buffers along all waterways maintained through to 2020.	
7	To improve the water quality and habitat value of Woollahra's foreshore and marine areas	Woollahra beaches given "Good" or "Very Good" ratings in the State of the Beaches Annual Report	Beachwatch Annual State of the Beaches Reports
8	To collaborate with the community and other organisations contributing to biodiversity conservation in Woollahra.	A range of collaborative programs implemented between 2015 and 2020	Program review
		Information sharing portal established	Information sharing portal activity
9	To increase engagement with the broader community on biodiversity	Community participation in biodiversity related projects and events increases by 25% between 2015 and 2020	Community event participation register

[1] An area that is "Fully Regenerated" is an area that only requires minimal maintenance. Major capital works/ major weed removal programs are no longer required for this area.

Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

4. BIODIVERSITY PLANNING FRAMEWORK

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

4. Biodiversity Planning Framework

A comprehensive international, national and regional planning and policy framework is available to assist local government in biodiversity management.

4.1 Key Legislation and Planning Instruments

The following section outlines the key legislation and planning instruments relevant to biodiversity conservation in Woollahra. Figure 4-1 provides a summary of the elements within the biodiversity planning framework at the international, national, state and local levels. Relevant Federal and State Government legislation is summarised in Appendix A. Local Government Plans and Policies are explained in more detail in the following section.

International	• Rio Declaration on Environment and Development 1992 • International Convention on Biological Diversity 1992 • United Nations Framework Convention on Climate Change • Agenda 21 • Ramsar Convention on Wetlands • Japan-Australia Migratory Bird Agreement (JAMBA) • China-Australia Migratory Bird Agreement (CAMBA) • Bonn Convention
National	• Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) • Intergovernmental Agreement on the Environment 1992 • Australia's National Biodiversity Conservation Strategy 2010-2030 • National Local Government Biodiversity Strategy 1998
State	• NSW Environmental Planning and Assessment Act 1979 (EP&A Act) • National Parks and Wildlife Act 1974 (NPW Act) • NSW Threatened Species Conservation Act 1995 (TSCA) • State Environmental Planning Policy 19 – Bushland in Urban Areas (SEPP 19) • NSW Fisheries Management Act 1994 (FMA) • NSW Noxious Weeds Act 1993 • NSW Crown Lands Act 1989 (CL Act) • NSW Water Management Act 2000 (WM Act) • NSW Local Government Act 1993 (LG Act) • Threatened Species Recovery Plans • NSW Draft Biodiversity Strategy 2010-2015 • NSW Saving Our Species Program • Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005
Local	• Woollahra 2025 • Woollahra's Delivery Program and Operational Plan (DPOP) • Woollahra Local Environment Plan • Woollahra Development Control Plan (DRAFT) • Environmental Sustainability Action Plan • Woollahra Council Parks Plans of Management • **Woollahra Biodiversity Conservation Strategy (this Strategy)**

Figure 4-1. Biodiversity Planning Framework – International, National, State and Local instruments

4.2 Local Government Plans and Policies

4.2.1 Woollahra 2025

Woollahra 2025 is Council's key strategic planning document, adopted by Council in June 2013. It presents a long term vision for Woollahra and is structured around five broad interrelated themes, each of which is supported by a range of goals and strategies. There are two goals with five underpinning strategies under *'A Healthy Environment'*, which are relevant to this Strategy.

Goal 7: Protecting our Environment
- 7.1: Protect natural landscapes systems and biodiversity
- 7.2: Preserve and restore bushland areas and create wildlife corridor plantings
- 7.3: Support cleaner, healthier waterways including improved water quality and healthy water catchments, creeks and harbour

Goal 8: Sustainable Use of Resources
- 8.1: Reduce greenhouse emissions and ecological footprint
- 8.2: Monitor and strategically manage environmental risk and impacts of climate change

4.2.2 Woollahra's Delivery Program and Operational Plan (DPOP)

Woollahra's Delivery Program 2013 to 2017 and annual Operational Plans describe how Council will work with the community to achieve priorities and actions and meet community needs and expectations in a sustainable manner. The DPOP is reviewed, developed & publicly exhibited yearly.

4.2.3 Woollahra Local Environment Plan 2014

The Woollahra LEP 2014 has been approved by the Minister for Planning and was published on the NSW Legislation website on 23 January 2015. The new LEP commenced on 23 May 2015.

The WLEP 2014 is consistent with the NSW Government's Standard Instrument template and provides updated planning controls to guide future land use and development across the LGA.

The particular aims of the Plan that relate to the conservation of Woollahra's natural environment are:

- to conserve the built and natural environmental heritage of Woollahra (Part 1, 1.2, 2f)
- to protect the amenity and natural environment of the area of Woollahra (Part 1, 1.2, 2g)
- to protect and promote public access to and along the foreshores (Part 1, 1.2, 2h
- to promote ecologically sustainable development (Part 1, 1.2, 2k)

The Woollahra LEP 2014 has applied eleven different land-use zones clarifying the role and function of the zone and what land uses are permissible (with or without consent) or prohibited. Each of Council's Key Habitat Areas (explained further in section 3.6) are classified as either environmental protection zones or recreation zones. The objectives for each zone are listed in Appendix A.

Table 4-1. LEP Classifications in Woollahra

LEP Classification	Areas within Woollahra
E1 National Parks and Nature Reserves	Sydney Harbour National Park, including Nielsen Park and South Head
E2 Environmental Conservation	Land with high conservation value outside National Parks and Nature Reserves in the inter-tidal zone in the north-east corner of Vaucluse and Watsons Bay. This includes the coastal boundary of Christison Park and Gap Park
RE1 Public Recreation	Council parks and reserves, including Cooper Park, Parsley Bay Reserve, Vaucluse House and Strickland House.
RE2 Private Recreation	Privately owned recreation land such as Royal Sydney Golf Club

4.2.4 Development Control Plan

A Development Control Plan (DCP) contains detailed planning controls. It must be in the form of a written statement and may include supporting maps, diagrams and other materials. The DRAFT Comprehensive DCP to cover the entire LGA was in preparation at the time of writing this Strategy.

4.2.5 Environmental Sustainability Action Plan

In 2013, the Woollahra Environmental Sustainability Action Plan (ESAP) was adopted by Council. The ESAP provides the strategic direction for sustainability in Woollahra, and details Council's targets and commitments to initiatives related to each of the five priority action areas. The sustainability targets within the ESAP are based on the objectives set out in the Council's Community Strategic Plan, Woollahra 2025. The five priority action areas outlined in the ESAP are Energy and Emissions, Water, Biodiversity, Waste and Transport.

4.2.6 Woollahra Council Parks Plans of Management

Plans of Management are prepared for Council parks to guide Council in the planning, use and management of the area. Plans of management are prescribed in the Local Government Act 1993 (s 36, clause 3A). According to the Act, a plan of management for community land must identify the following (s 36, clause 3A):

a) the category of the land,
b) the objectives and performance targets of the plan with respect to the land,

c) the means by which the council proposes to achieve the plan's objectives and performance targets,
d) the manner in which the council proposes to assess its performance with respect to the plan's objectives and performance targets, and may require the prior approval of the council to the carrying out of any specified activity on the land.

A brief description of the Plans of Management for each of Councils parks is provided in Appendix B**.**

Woollahra Municipal Council

Biodiversity Conservation Strategy 2015 - 2025

5. APPROACH

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

5. Approach

This section outlines the approach and methodologies used in the preparation of this Strategy.

5.1 Literature Review

A broad review of literature on the current and historic extent of natural vegetation types, flora and fauna species, biodiversity threats and management issues was conducted. Planning documents and Plans of Management were evaluated to identify current measures and constraints in biodiversity conservation.

5.2 Stakeholder Consultation

The following key stakeholders were approached to contribute to the Strategy:

- Woollahra residents
- Key Council management planning and technical staff
- Council bushland staff and bushcare volunteers
- Neighbouring Council staff
- Government agencies and golf course managers

The objective of stage one of the consultation process was to raise awareness about the Strategy, gather information, and identify values and priorities held by stakeholders. The following consultation methods and techniques were used:

- An online community survey (via Council's website) seeking feedback from residents on community values and concerns regarding biodiversity conservation in Woollahra
- Two workshops for Council staff that included a presentation, mapped information, open discussion, and written surveys
- Survey emailed to neighbouring Councils and government agencies informing the organisation about the Strategy and seeking feedback on biodiversity conservation issues that should be addressed by the Strategy

Stage two of the consultation phase involved a meeting attended by Council parks and bushcare staff to gather feedback on preliminary mapping, and advice on key management issues and preferred management actions for Woollahra. Further internal consultation was also conducted on the draft strategy before finalisation.

5.3 Data Collection and Mapping

A desktop review was used to gain an overview of the current level of biodiversity and an insight into Woollahra's historical biodiversity status. This was supported by a targeted field survey component.

5.3.1 Flora and Fauna Records

Collated species lists of current and historic flora and fauna records for Woollahra were used and added to throughout the project. The species lists used the Woollahra Council Flora and Fauna list 1995 as a base which was augmented with records from the NSW Office of Environment and Heritage BioNet database and records from various reports including Council Plans of Management, and the Management Plan for Sydney Harbour National Park (OEH 2012), and information from the Bush Regeneration Team. It is noted that the flora species database may include native species from previous plantings that potentially spread into bushland.

Figure 5-1. Eastern Water Dragon, Parsley Bay, Vaucluse

The historical species lists used a combination of earlier BioNet records and flora information from Benson (2011), Benson and Howell (1990) and fauna information from OEH (2012).

5.3.2 Vegetation Mapping

Vegetation mapping was created using the following information sources:

- OEH Plant Community Type Classification vegetation mapping (OEH, 2013a (then DECC, 2009) 1:25,000
- Targeted field surveys undertaken for this Strategy validating the presence/absence of endangered ecological communities and listed species. Field surveys were conducted by experienced ecological consultants in February 2013. As part of the independent peer review undertaken in 2014, additional field surveys were carried out in May 2014
- Eco Logical Australia mapping derived from field work for the Cooper Park Vegetation Management Plan (Eco Logical Australia, 2010)
- The distribution of plant communities (excluding seagrass and mangroves) at the time of European settlement was

Figure 5-2. Gap Park, Watsons Bay

based on mapping from Taken for Granted: The bushland of Sydney and its suburbs (Benson and Howell 1990). These areas of historic plant communities were compared against current vegetation community classifications to estimate the loss in extent of vegetation communities since European settlement

- Mapping of mangroves and seagrasses undertaken as part of the Woollahra Coastal Zone Management Plan Stage 1 by Cardno (2013). This mapping was compared against the OEH Plant Community Type Classifications (OEH, 2013a (then DECC 2009) to estimate the change in the extent of these vegetation types since 2009
- Mapping of vegetation protected under State Environment Planning Policy (SEPP) 19 – Bushland in Urban Areas was based on the remnant vegetation community mapping (see Figure 7-10 and Figure 7-11) and field surveys
- Detailed location information on the area where Eastern Suburbs Banksia Scrub was being reconstructed within the Royal Sydney Golf Course supplied by Royal Sydney Golf Course staff

Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

6. STAKEHOLDER CONSULTATION

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

6. STAKEHOLDER CONSULTATION

The following section summarises the feedback received from stakeholders during the consultation process.

6.1 Community Survey

An online survey was conducted through Councils website. The survey was advertised in a media release and via email to bushcare volunteers and recipients of Council's environmental newsletter with hard copies placed in the public library, Council Chambers and Rose Bay RSL. The number of participants in the survey was very low (10 respondents). As such, the results are not representative of the views held by the residents of Woollahra. Appendix C contains a summary of the results of the online community survey.

Community consultation was also carried out during the preparation of the Coastal Zone Management Plan Stage 1. Resident and non-resident respondents were asked to select issues or aspects that they felt were important. The survey had 55 participants, of these 37 were residents and 18 were non-residents. Appendix C contains a summary of the results of this aspect of the survey.

6.2 Key Stakeholder Consultation

Consultation with key stakeholder organisations was undertaken. Completed surveys were received from the following key stakeholders:

- NSW Office of Environment and Heritage
- NSW National Parks and Wildlife Service
- Sydney Metropolitan Catchment Management Authority (now Greater Sydney Local Land Services)
- Department of Primary Industries (NSW Fisheries)
- Centennial Park and Moore Park Trust
- Department of Defence

With regard to the issues to be addressed in the Biodiversity Conservation Strategy, the key stakeholders provided the following feedback:

- Key Threatening Processes that are relevant to Woollahra should be addressed.
- Information contained within the Rapid Fauna Habitat Assessment of Sydney Metropolitan CMA, the Draft Vegetation Mapping for the Sydney Metropolitan CMA and OEH's Bionet portal should be utilised.
- Recovery plans and Priority Action Statements that relate to threatened species occurring on Council managed land should be reviewed.
- Council have the opportunity to play a greater role in educating residents with regard to living with wildlife (e.g. Magpies, Koels, Flying Foxes).
- An action(s) to manage the impact of stormwater draining from Council managed lands into Sydney Harbour National Park (in particular the Hermitage Foreshore) and Sydney Harbour should be included.
- Habitat condition and connectivity should be a focus; Council should identify corridors, priority remnants/ local biodiversity hotspots.

- Council should link with neighbouring LGAs to ensure consistency and alignment.
- The Strategy should cover both public and private lands and include biodiversity conservation measures in planning instruments.
- Council should address the impact that members of the public have on local areas, and recognise the important role that education plays in ensuring the public are aware of the conservation values associated with different areas within the local precinct.

This feedback has been incorporated where possible into the development of this Strategy.

Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

7. BIODIVERSITY IN WOOLLAHRA

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

7. BIODIVERSITY IN WOOLLAHRA

Despite its relatively small land area, Woollahra's landscape is remarkably diverse, comprising of the following ecosystem elements:

- Intertidal estuarine areas
- Rock platforms
- Seagrass meadows
- Sandy harbour beaches
- Sheltered wooded sandstone slopes and gullies feeding into narrow harbour coves
- Exposed sandstone coastal heaths on headlands and cliff-lines
- Small freshwater creek-lines and ponds within parks and bushland reserves

Figure 7-1. Cooper Park, Bellevue Hill

- A significant tidal creek flowing into Rose Bay
- Established gardens with significant botanic heritage values comprising a mixture of planted native and exotic trees

7.1 Historical and Current Extent of Vegetation (Flora)

Historically, the most extensive vegetation types in the Woollahra LGA were sandstone heathland, followed by sandstone woodland/forest. The estimated historic distribution of vegetation is shown in Figure 7-2. More information on the vegetation types is provided in Appendix E.

An estimated 4.3% of Woollahra's original pre-1750[1] vegetation now remains. Such a significant loss in the extent of remnant vegetation has likely had a significant impact on biodiversity. Accordingly, conservation of all remaining remnant vegetation is warranted.

Eastern Suburbs Banksia Scrub (ESBS) which once occurred on wind-blown sands within Woollahra (estimated 150 ha) is now locally extinct. This is reflected across Sydney's eastern suburbs where only small remnants of this once extensive vegetation type survive at La Perouse, Eastlakes and Centennial Park (Benson and Howell 1990).

[1] Pre1750 vegetation is modelled vegetation cover used to represent vegetation pre-European settlement. The year 1750 has been widely adopted as the reference point for comparison of pre-European vegetation with subsequent extent of Australian vegetation (Australian State of the Environment Committee, 2011).

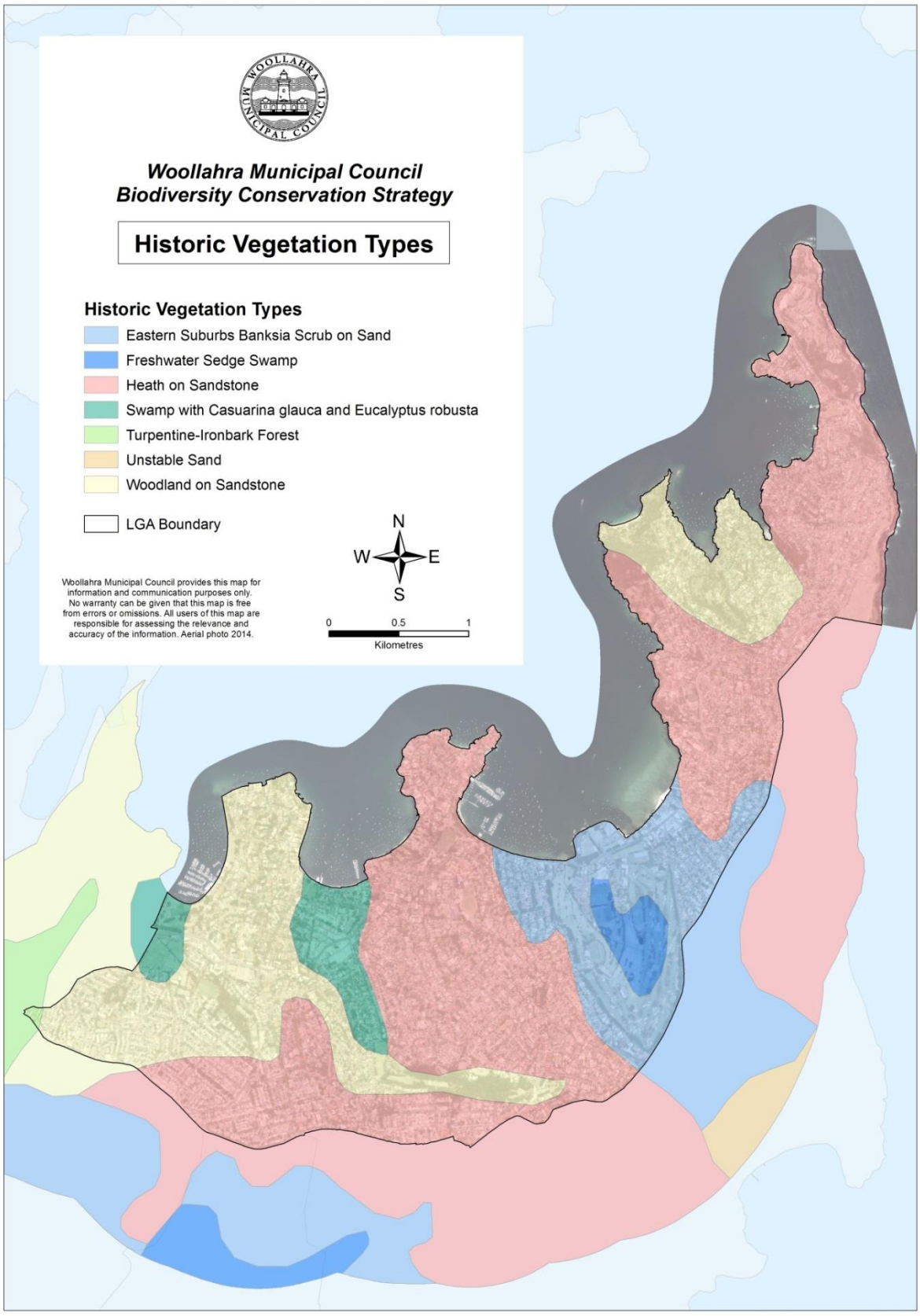


Figure 7-2. Historical Terrestrial Vegetation Extent

Figure 7-3 illustrates the reduction in terrestrial vegetation cover since European settlement. Of the estimated historical extent, 48.8 hectares (4.3%) of terrestrial remnant vegetation remains, with 24.64 hectares of this vegetation being classified as SEPP 19[2] Bushland. Within Woollahra, there is 196 Ha of non-remnant vegetation, which includes revegetated bushland, native and non-native bushland, gardens and trees. These vegetation communities are mapped in Figure 7-10.

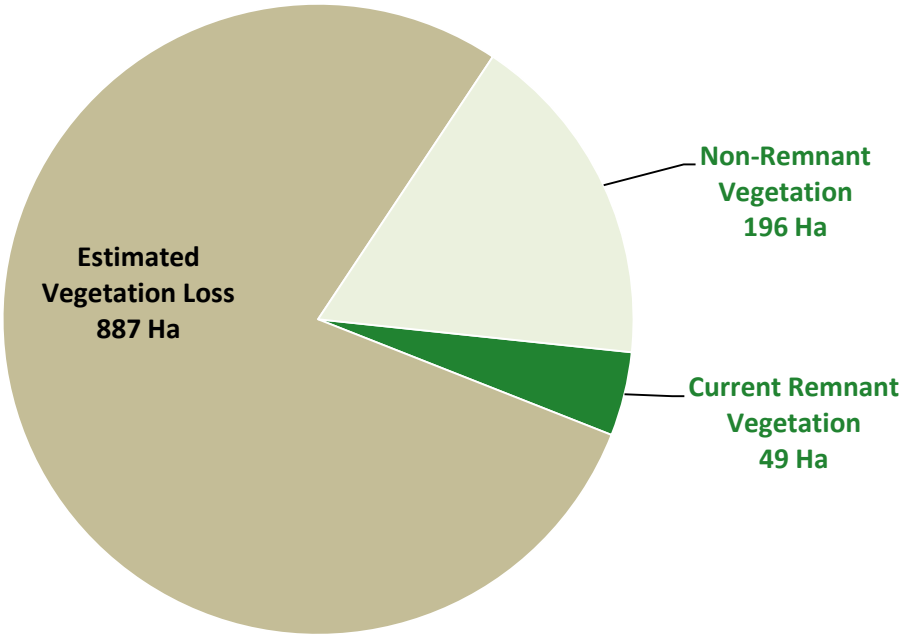


Figure 7-3. Estimated lost and remaining vegetation

7.2 Current Terrestrial Vegetation

Coastal Sandstone Foreshores Forest and Coastal Headland Banskia Heath are the predominant vegetation types, covering 47.1 hectares (96.5% of current remnant vegetation) (Figure 7-4).

[2] SEPP 19 Bushland – Bushland that complies with the criteria for bushland as set out in State Environmental Planning Policy NO 19 – Bushland in Urban Areas – Reg 4. See section 7.2.1

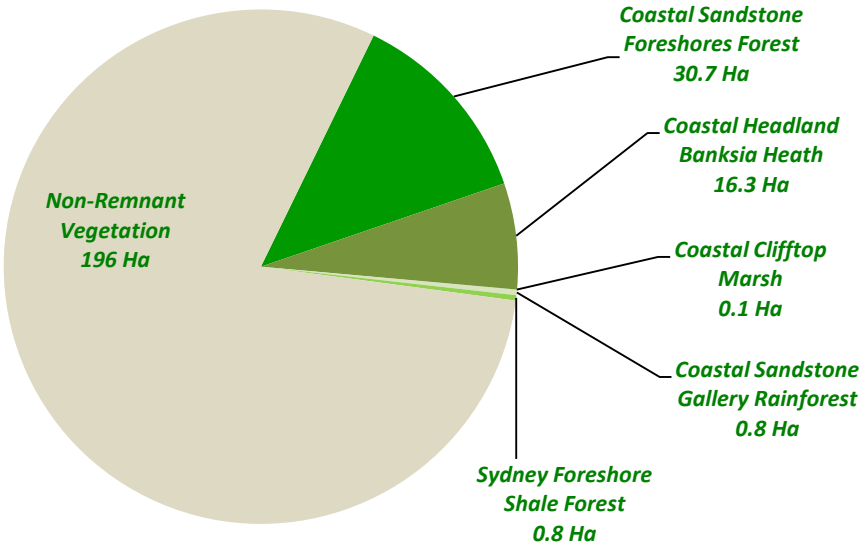


Figure 7-4. Current Vegetation Types (OEH Plant Community Type Classifications[3] and non-remnant vegetation)

7.2.1 SEPP 19 Bushland

The State Environmental Planning Policy (SEPP) 19 - Bushland in Urban Areas provides special protection to bushland occurring on land zoned public open space and land adjoining public open space. The definition of bushland under the SEPP is "land on which there is vegetation which is either a remainder of the natural vegetation of the land or, if altered, is still representative of the structure and floristics of the natural vegetation".

This definition is generally consistent with all mapped remnant vegetation types in Woollahra. Accordingly 24.64 ha of SEPP 19 bushland has been mapped within the LGA. This figure does not include NPWS land which is protected under the National Parks and Wildlife Act 1974.

7.2.2 Listed Flora

Acacia terminalis subsp. t*erminalis* (Sunshine Wattle), and *Allocasuarina portuensis* (Nielsen Park She-oak) listed as Endangered under the TSC Act and EPBC Act, and *Syzygium paniculatum* (Magenta Cherry) listed as Endangered under the TSC Act and Vulnerable under the EPBC Act, are present in Woollahra.

Acacia terminalis subsp. t*erminalis* (Sunshine Wattle) was found to occur in Cooper Park, Parsley Bay Reserve and Nielsen Park. There are records of the species occurring in Gap Park and HMAS Watson; however, these records were not able to be verified during the

Figure 7-5. *Acacia terminalis subsp terminalis* (Sunshine Wattle)

[3] Source: OEH, 2013a. The Native Vegetation of the Sydney Metropolitan Area Volume 1: Technical Report, Version 2.0, Office of Environment and Heritage, 2013.

development of this Strategy due to access restrictions.

Allocasuarina portuensis (Nielsen Park She-oak) was discovered at Nielsen Park in 1986. At that time the total known population was 10 individual plants which have since died out. The existing population of approximately 90 plants at Nielsen Park is from propagated material (OEH, 2012). Nielsen Park She-oak translocation sites have also been established at Vaucluse House and Gap Park. Sydney Harbour National Park (SHNP) is working in partnership with the Sydney Living Museums and Council to manage these populations. Several Nielsen Park She-oaks were planted at Gap Bluff, however the planting site is now considered inappropriate in terms of habitat type, soil disturbance and range; in the event of their senescence these trees will not be replaced (OEH 2012).

Syzygium paniculatum (Magenta Cherry) has been recorded at Cooper Park, Trumper Park, Parsley Bay Reserve, and Vaucluse House. While the origins of these individuals may be of question, the species has been recorded in the Wildlife Atlas (Bionet) as late as 2007 within the adjoining LGA (City of Sydney), and as such, OEH recommend that management for this species should reflect its threatened species listing despite its potential unnatural origin (Pers Comms via Email, OEH 2014). In areas where both *Syzygium paniculatum* and *Acacia terminalis subsp terminalis* occur in the same area e.g. Parsley Bay Reserve, Total Earth Care (Pers Comms via Email, Total Earth Care, 2014) recommend managing the habitat preferentially for the Acacia over management for the Syzygium as there is no doubt regarding the legitimacy of the natural occurrence of the *Acacia Terminalis subsp Terminalis*. Management practices for the two species differ considerably. If management of the *Acacia Terminalis subsp Terminalis* is likely to damage the Syzygium, Council will need to apply for a s91 licence to undertake the management regime.

There are also historical Council records of *Callistemon linearifolius* (Netted Bottlebrush) (listed as a Vulnerable Species under TSCA) at Gap Park, however the species cannot be currently located (pers. comm. Woollahra Bush Regeneration Staff, 2013). Potential habitat for this plant may still exist in the form of a soil seed bank. It is possible that active management including weed control and scarification may encourage germination of Netted Bottlebrush in areas of sandstone heathland/woodland vegetation that are currently degraded and senescent but have good recovery potential.

7.2.3 Regionally Significant Flora

Coastal Freshwater Swamp Forest
Melaleuca quinquenervia (Paperbark Trees) comprising of almost 1000 individual trees were planted on the Golf Course between 1950 and 1965 and more recently. Because these trees reflect the original vegetation, the planted areas have been identified as a separate category as they do not conform to “reconstructed” vegetation type as they comprise of only one species.

A small stand of *Melaleuca Quinquenervia* (Paperbark Trees) occurs within a swale of an old intermittent creek channel on the north-eastern boundary of the Golf Course; a previous study counted 200 individuals in good condition (Landarc 1991). This grove of *Melaleuca quinquenervia* appear to be mature, and are present in 1943 aerial mapping; however there is uncertainty around whether they are remnant.
Melaleuca quinquenervia is a component of various freshwater and riparian communities within the Sydney basin, however as they do not occur with any other species it is not possible to determine which vegetation community these individuals would have been part of.

In 2014, Total Earth Care surveyed the site and stated that whether they are remnant is uncertain. Additionally their occurrence as being associated with a 'floodplain' is questionable. This grove of *Melaleuca quinquenervia* does not legally confirm to any Threatened Ecological Community, or Endangered Ecological Community. The stand is listed on Council's significant tree register.

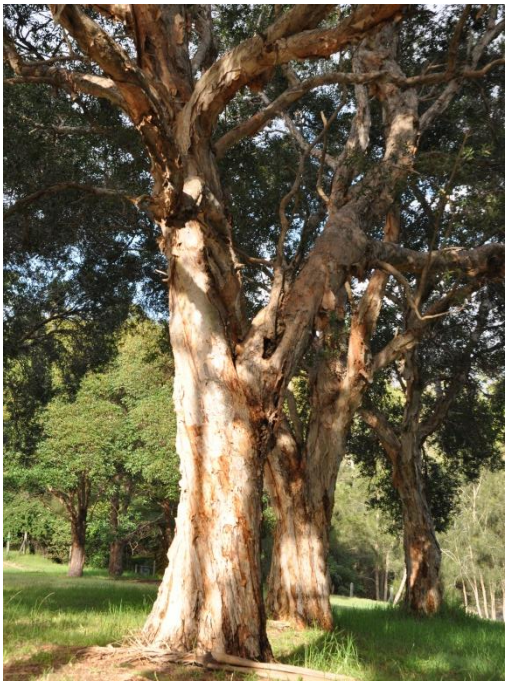


Figure 7-6. *Melaleuca quinquenervia* (Paperbark), Vaucluse Bay

Figure 7-10 illustrates the current native and non-native vegetation mapped within Woollahra.

Seven regionally significant species are present in Woollahra. Six of these species are considered significant based on some feature such as unusual distribution, general uncommonness in the region, disjunct occurrences or at near limits of range (Benson 2011). The *Gompholobium grandiflorum* (Large Wedge Pea) has not been recorded in SHNP since 1950 and has possibly become locally extinct.

Table 7-1. Threatened and Significant Flora

Scientific name	Common name	Regional significance	TSC Act	EPBC Act	Location
Acacia terminalis subsp. *terminalis*	Sunshine Wattle		E	E	Cooper Park, Nielsen Park, Parsley Bay Reserve, Gap Park, Gap Bluff, HMAS Watson
Allocasuarina portuensis	Nielsen Park She-oak		E	E	Nielsen Park, Gap Bluff
Syzygium Paniculatum	Magenta Cherry		E	V	Cooper Park, Trumper Park, Parsley Bay Reserve, Vaucluse House
Pimelea curviflora var. *curviflora*			V	V	South Head (but requires confirmation)
Chordifex dimorphus	Scrambling Sedge	✓			Gap Park, Gap Bluff
Eucalyptus obstans	Port Jackson Mallee	✓			Gap Park, Nielsen Park
Melaleuca hypericifolia	Hillock Bush	✓			Gap Park, Gap Bluff
Gompholobium grandiflorum	Large Wedge Pea	✓✓			No location recorded
Hibbertia nitida		✓			No location recorded
Rulingia hermanniifolia	Wrinkled Kerrawang	✓			Nielsen Park, Gap Park
Styphelia spp.		✓			Nielsen Park

TSC Act/ EPBC Act: E Endangered Species V: Vulnerable Species
✓: Regionally Significant in SHNP (Benson 2011)
✓✓: Potentially locally extinct in SHNP (Benson 2011)

Rare and Locally Extinct Flora

There are 39 rare or potentially locally extinct plant species in Woollahra. This list has been assembled from a combination of BioNet records dated older than 20 years, and historical records from South Head, Nielsen Park and the Domain (Benson 2011). The species considered rare or locally extinct have not been recorded on the BioNet database for more than 20 years. A table of rare and locally extinct flora species is provided in Appendix H.

Coastal Freshwater Swamp Marsh

Six patches of coastal saltmarsh covering a total area of 80 m² were recorded, but not mapped, in an assessment of saltmarsh in Parramatta River and Sydney Harbour carried out in 2007 (Kelleway et. al. 2007). They were assessed to be in poor condition and located at Rose Bay Park, Hermit Bay, Milk Beach, north of Milk Beach, Vaucluse Bay and Parsley Bay (Cardno 2013). Due to the small area and poor condition of this vegetation, these areas have not been identified as an endangered ecological community.

7.2.4 Non Remnant Vegetation

In a highly urbanised area such as Woollahra, where there are few remaining remnant vegetation patches, areas of non-remnant vegetation are valuable as foraging and shelter habitat and potentially function as "stepping stones" assisting fauna movement between remnant vegetation patches.

Figure 7-7. *Ficus Macrophylla* (Moreton Bay Fig), Rushcutters Bay

There are approximately 196 ha of non-remnant/exotic vegetation in Woollahra. This includes established park plantings, native revegetation, weedy thickets, street trees and private gardens.

Planted vegetation at Royal Sydney Golf Club comprises a mixture of species from the endangered ecological community *Eastern Suburbs Banksia Scrub,* which once occurred on the site. This reconstructed vegetation is not protected under the TSC Act. Eastern Suburbs Banksia Scrub (ESBS) generally forms a sclerophyllous heath or scrub community. Some remnants contain small patches of woodland, low forest or limited wetter areas, depending on site topography and hydrology (NSW Scientific Committee 2002, Benson & Howell, 1990a; 1990b; and 1994 in Natural Heritage Trust, 2004).

The ESBS community is similar to the more widespread coastal heath communities of the eastern seaboard but can be distinguished by the following characteristics:

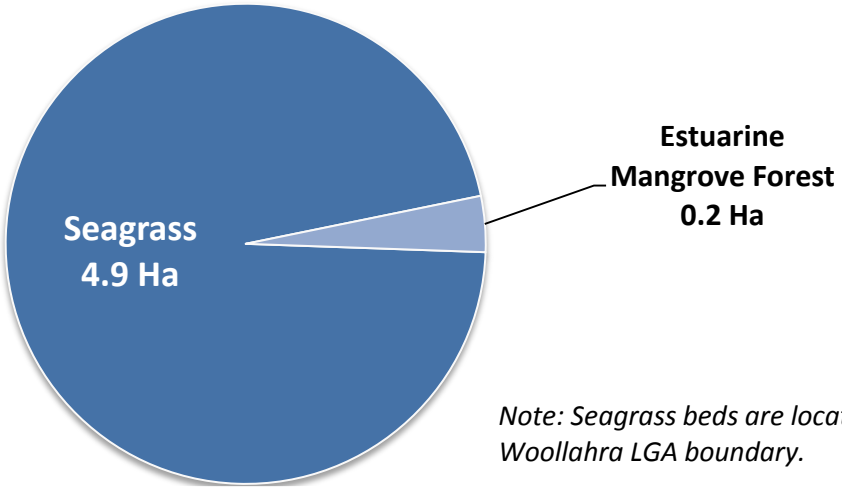
- ESBS occurs on disjunct patches of nutrient poor aeolian (wind-blown) dune sand; and
- Coastal heath occurs on soils derived from sandstone, Holocene marine sands (Benson & Howell 1994), or on aeolian sands of younger age than those of ESBS (NSW Scientific Committee 2002).

There has been very little research conducted on the soil seed bank ecology of ESBS, however Lesak (2000) observed that species germinated from samples of soil taken from an ESBS site that were not present as standing vegetation at the donor site, indicating that a soil seed bank for ESBS does exist. Identification of Aeolian soils in Cooper Park may indicate that a seed bank may exist, and that regeneration of ESBS is feasible. Appendix D contains a map showing the Sydney soil landscape showing presence of Aeolian Soils in Woollahra.

7.2.5 Current Estuarine/Aquatic Vegetation

The Woollahra marine flora database contains 13 species, including 3 seagrass species and 10 algal species. Slightly more than five hectares of estuarine/ aquatic vegetation has been mapped along the Woollahra coastline.

Figure 7-8 shows the relative proportion of this area covered by seagrass and estuarine mangrove. The majority of the estuarine/ aqautic vegetation is seagrass beds (Figure 7-9). Less than 13% of aquatic remnant vegetation remains.



Note: Seagrass beds are located outside of the Woollahra LGA boundary.

Figure 7-8. Current Estuarine/ Aquatic Vegetation Types

Figure 7-9. Examples of seagrass beds observed during the 2013 seagrass survey (Source: Cardno, 2013)

Posidonia Australis (seagrass) population

A number of small patches of Seagrass Meadows comprising of pure stands of the species *Posidonia australis* or stands of *Posidonia australis* mixed with other seagrass species conform to the endangered population: *Posidonia australis in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW)* protected under the Fisheries Management Act 1994 (Kelleway et al 2007).

Table 7-2 . Posidonia Australis (seagrass) population

Vegetation Type	Classification	Current Area (Ha)	NSW TSCA/ NSW FM	Location
Posidonia australis seagrass populations	Endangered Population	0.36	*Posidonia australis in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW)*	Watsons Bay off Nielsen Park, Hermitage Foreshore Track

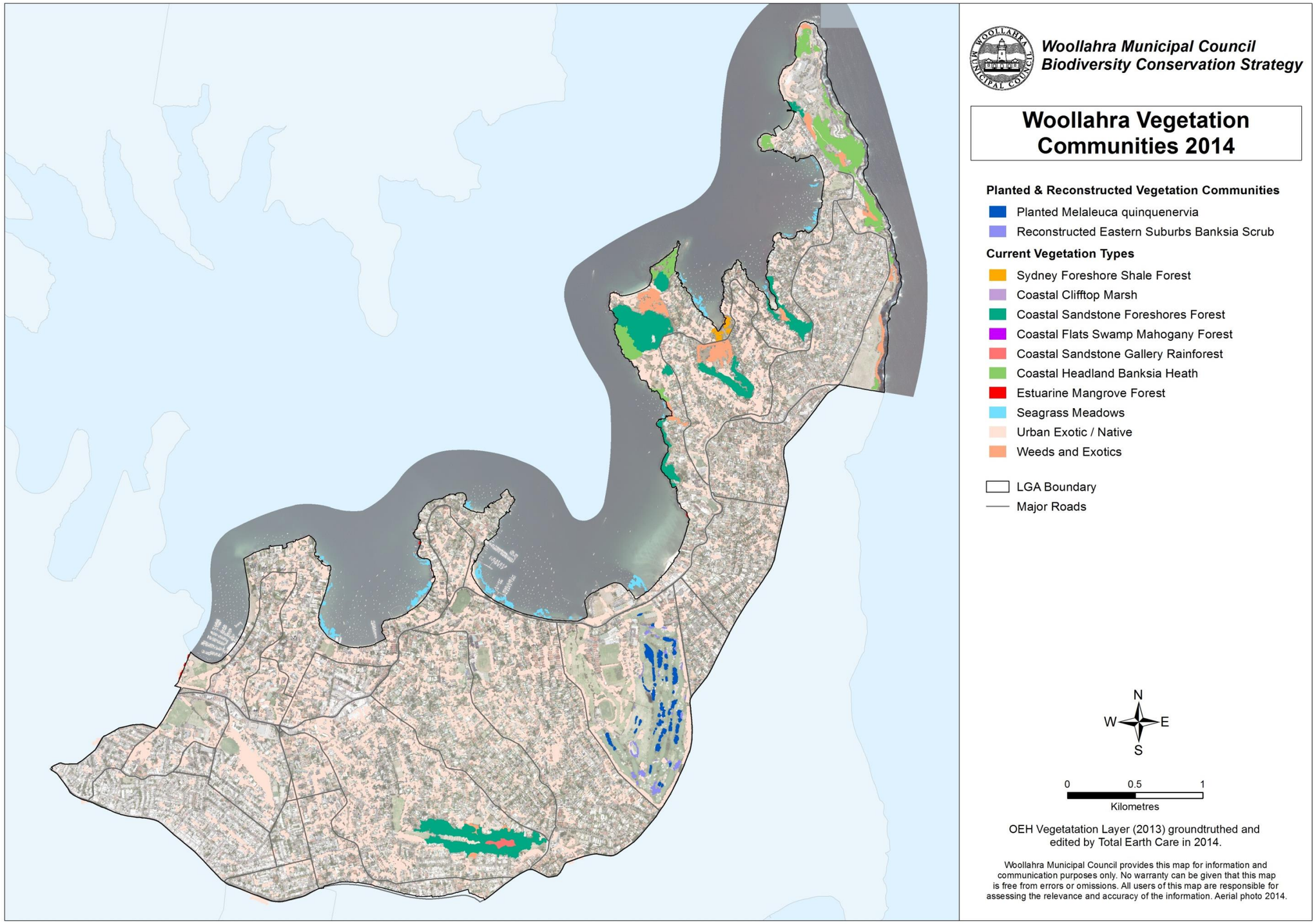
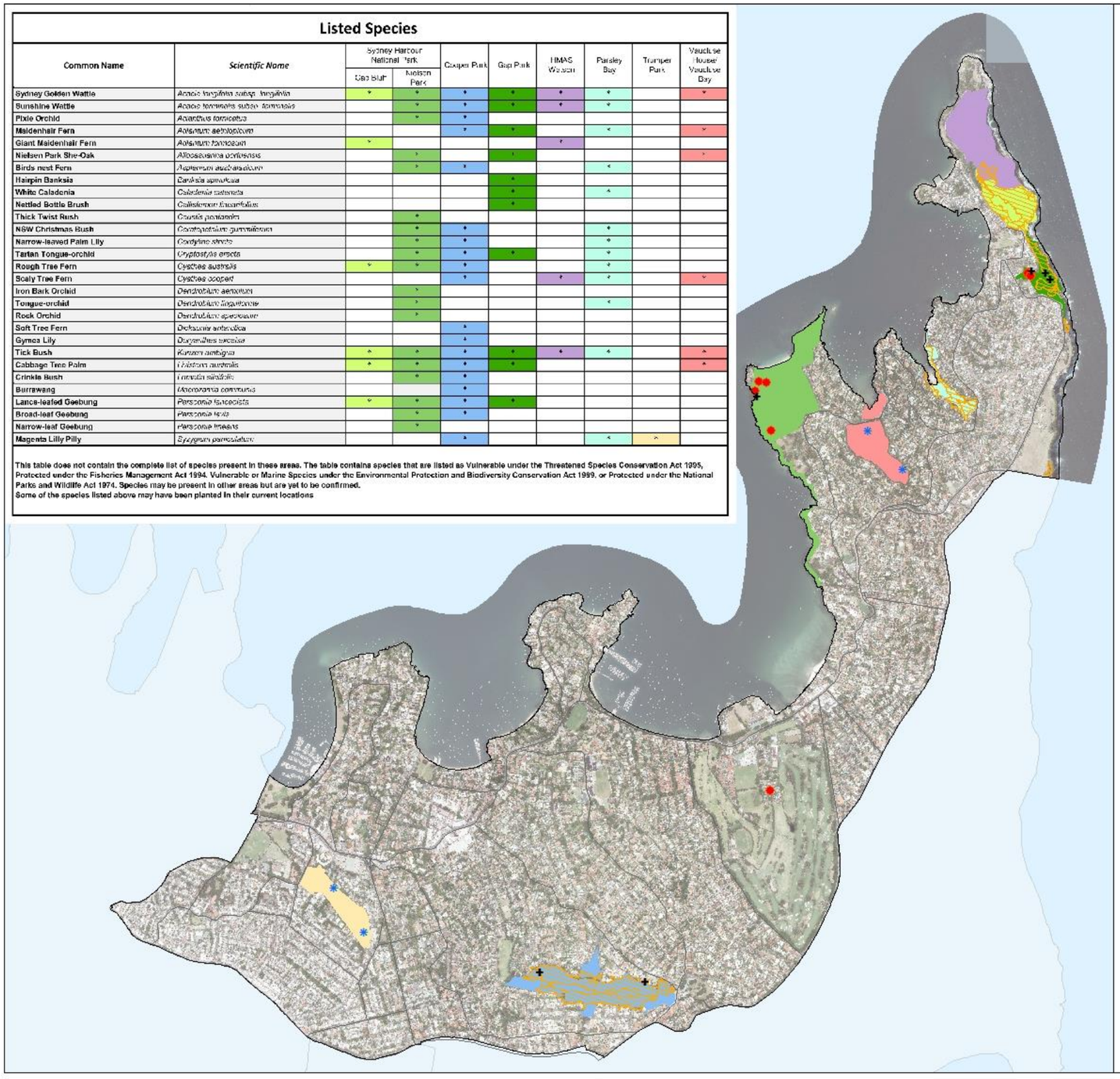


Figure 7-10. Woollahra Vegetation Communities

Listed Species

Common Name	*Scientific Name*	Sydney Harbour National Park: Gap Bluff	Sydney Harbour National Park: Nielsen Park	Cooper Park	Gap Park	HMAS Watson	Parsley Bay	Trumper Park	Vaucluse House/ Vaucluse Bay
Sydney Golden Wattle	*Acacia longifolia subsp. longifolia*	*	*	*	*	*	*		*
Sunshine Wattle	*Acacia terminalis subsp. terminalis*		*	*	*	*	*		
Pixie Orchid	*Acianthus fornicatus*		*	*					
Maidenhair Fern	*Adiantum aethiopicum*			*	*		*		*
Giant Maidenhair Fern	*Adiantum formosum*	*				*			
Nielsen Park She-Oak	*Allocasuarina portuensis*				*				*
Birds nest Fern	*Asplenium australasicum*		*	*			*		
Hairpin Banksia	*Banksia spinulosa*				*				
White Caladenia	*Caladenia catenata*				*		*		
Nettled Bottle Brush	*Callistemon linearifolius*				*				
Thick Twist Rush	*Caustis pentandra*		*						
NSW Christmas Bush	*Ceratopetalum gummiferum*		*	*			*		
Narrow-leaved Palm Lily	*Cordyline stricta*		*	*			*		
Tartan Tongue-orchid	*Cryptostylis erecta*		*	*	*		*		
Rough Tree Fern	*Cyathea australis*	*	*	*			*		
Scaly Tree Fern	*Cyathea cooperi*			*		*	*		*
Iron Bark Orchid	*Dendrobium aemulum*		*						
Tongue-orchid	*Dendrobium linguiforme*		*				*		
Rock Orchid	*Dendrobium speciosum*		*						
Soft Tree Fern	*Dicksonia antarctica*			*					
Gymea Lily	*Doryanthes excelsa*			*					
Tick Bush	*Kunzea ambigua*	*	*	*	*	*	*		*
Cabbage Tree Palm	*Livistona australis*	*	*	*	*				*
Crinkle Bush	*Lomatia silaifolia*		*	*					
Burrawang	*Macrozamia communis*			*					
Lance-leafed Geebung	*Persoonia lanceolata*	*	*	*	*				
Broad-leaf Geebung	*Persoonia levis*		*	*					
Narrow-leaf Geebung	*Persoonia linearis*		*						
Magenta Lilly Pilly	*Syzygium paniculatum*			*			*	*	

This table does not contain the complete list of species present in these areas. The table contains species that are listed as Vulnerable under the Threatened Species Conservation Act 1995, Protected under the Fisheries Management Act 1994, Vulnerable or Marine Species under the Environmental Protection and Biodiversity Conservation Act 1999, or Protected under the National Parks and Wildlife Act 1974. Species may be present in other areas but are yet to be confirmed.
Some of the species listed above may have been planted in their current locations



Woollahra Municipal Council
Biodiversity Conservation Strategy

Listed Flora

Endangered Flora Species

- \+ Acacia terminalis subsp terminalis (Sunshine Wattle)
- ● Allocasuarina portuensis (Neilsen Park She-Oak) [planted]
- ✱ Syzygium paniculatum (Magenta Cherry) [planted]

Parks Where Species Reported

- Gap Bluff (Sydney Harbour National Park)
- Nielsen Park (Sydney Harbour National Park)
- Cooper Park
- Gap Park
- HMAS Watson
- Parsley Bay Reserve
- Trumper Park
- Vaucluse Park

- LGA Boundary
- SEPP19 Bushland

N
W E
S

0 0.5 1
Kilometres

Figure 7-11. Listed Flora

7.3 Fauna

For an urbanised LGA in close proximity to a major CBD, Woollahra supports a diverse range of native fauna. This is due in part to the diversity of remaining habitats which include coastline, harbour estuary and bushland. Artificial or modified habitats such as constructed ponds on golf courses, established garden plantings, sandstone retaining walls, and piped watercourse channels are also used by local fauna for foraging and shelter.

Terrestrial Fauna

A filtered search of the NSW OEH BioNet database (Accessed 2014) and Council records identified at least 70 invertebrate species and 150 vertebrate animal species that have been recorded over the past 20 years, including:

- 6 frog species
- 22 reptile species including 1 turtle species, 17 lizard species and 4 snake species
- 94 bird species and 6 introduced bird species
- 12 native mammal species including possums, bats, flying foxes and native rats
- Introduced species: 6 birds, 7 mammals 1 fish

Figure 7-12. Yellow-tailed Black Cockatoo, Cooper Park, Bellevue Hill

Birds are the most diverse and significant assemblage. Small birds are considered critical to local biodiversity, and appear to be rapidly declining in diversity and abundance in the LGA. Weedy thickets currently provide significant habitat for small birds and other fauna. Clearing of these areas should be staged to avoid complete removal of the habitat from the area.

Invertebrates

A survey was conducted by University of New South Wales students on 9 September 2011. The aims of the research were to survey the diversity of invertebrate fauna within Neilsen Park, and contrast the fauna in areas with differing history of fire. The students identified 342 morphospecies from 3 phyla and over 20 orders of terrestrial invertebrates. The samples were dominated by arthropods, with a high diversity of spiders, true bugs and humenopterans (ants, bees and wasps) (UNSW, 2011).

Marine Fauna

Sydney Harbour is one of the most biologically diverse harbours in the world. It is home to approximately 3,600 species of invertebrates, including dozens of Australian endemic species, and over 570 species of fish (SIMS, 2012). This figure can be put into perspective when compared with 540 species of fish recorded from the Mediterranean Sea.

Woollahra's marine fauna database contains 11 fauna species (nine chordate species, one mollusc, and one echinoderm species). The marine database is based on two limited studies undertaken in the area (The Ecology Lab, 2008 and Cardno, 2013), and as such may not accurately reflect the complete range of marine fauna species. Fauna records of the Sydney Harbour collected by the Australian Museum since the 1860s contain records of crustaceans, molluscs, polychaetes, echinoderms and fishes, totalling over 3000 species across the whole harbour (Hutchings et al, 2010). The high species richness of Sydney Harbour could be contributed to significant tidal flushing and the high diversity of habitats present. Hutchings et al, (2010) indicates that the Woollahra harbour foreshore area contains a highly diverse marine environment with a high potential for future species discovery.

Figure 7-13. Hingebeah Shrimp taken in Sydney Harbour, Woollahra coastline. (*Source: Richard Vevers for Sydney Coastal Councils Group)*

Aquatic Macroinvertebrates

Biological water quality assessment of Parsley Bay Creek, Cooper Creek and Rose Bay Creeks was carried out by Biotrack in Spring 2004 and Autumn 2005.Biotrack (2005a) found that while Parsley Creek and Cooper Creek are not in ideal condition, they are typical of streams running through urban environments. It was noted that management intervention could improve the condition of both streams. The assessments[4] indicated a 'moderately impaired' macroinvertebrate community, consisting of mostly tolerant taxa, sensitive to poor water quality and degraded habitats. These results are typical of small, primarily first order, catchments in urban settings.

7.3.1 Threatened and Significant Fauna

Threatened and significant fauna in Woollahra include a number of species of bird and microbat, syngnathids (seahorses), the Little Penguin and a lizard species (Table 7-3 and Figure 7-14).

[4] SIGNAL2: Stream Invertebrate Grade Number Average Level scores are a simple index given to streams indicating water quality. AUSRIVAS is a modelling tool which compares macroinvertebrates collected at a 'test' site to macroinvertebrates collected at a selection of reference sites.6

Table 7-3. Threatened and Significant Fauna

Common name	Scientific Name	Regionally Significant	TSC ACT	FM ACT	EPBC ACT	NPWA 1974	Location
Little Penguin	*Eudyptula minor*				Ma	P	Harbour Foreshores
Sooty Oystercatcher	*Haematopus fuliginosus*		V			P	South Head and Hermitage Foreshore
Common (Eastern) Bentwing bat	*Miniopterus schreibersii oceanensis*		V			P	Habitat throughout vegetated areas of the LGA
Southern Myotis	*Myotis macropus*		V			P	Habitat within vegetated waterways throughout LGA
Powerful Owl	*Ninox strenua*		V			P	Nielsen Park, HMAS Watson and potentially other areas of remnant vegetation supporting prey species e.g. Common Ringtail Possum, birds and Grey-headed Flying Fox
Common Scaly-foot (lizard)	*Pygopus lepidopodus*	✓				P	Cooper Park, Nielsen Park
Grey-headed Flying Fox	*Pteropus poliocephalus*		V		V	P	Habitat throughout LGA, particularly areas supporting mature fig trees e.g. Rushcutters Bay Park
Greater Broad-nosed Bat	*Scoteanax rueppellii*		V			P	
New Holland Mouse	*Pseudomys novaehollandiae*					P	
Water-rat	*Hydromys chrysogaster*					P	
Red Crowned Toadlet	*Pseudophryne australis*		V			P	
Seahorse	(Syngnathidae) *Hippocampus* spp	✓		P	Ma	P	Within seaweed, seagrass and around man-made structures such as jetties or mesh nets

TSCA: V= Vulnerable Species, E= Endangered
FM Act: P = Protected
EPBCA: V= Vulnerable Species, Ma= Marine Species
NPWA: P = Protected

Little Penguin

Eudyptula minor (Little Penguin) has foraging habitat along the Woollahra foreshore. Penguins have been recently observed and photographed at McKell Park/ Darling Point and other foreshore locations. It is likely that Little Penguins seen swimming in Sydney Harbour are part of the endangered Little Penguin population at Manly Cove/ North Head[5], and/or the non-threatened population at Lion Island located in the Hawkesbury River further north. Although the Little Penguin is relatively common in the waters of southern Australia, the Manly Cove colony is the only known mainland breeding colony in NSW. Adults remain centred on their breeding colony, foraging 10 – 30 km throughout the year, although they may leave for 2 to 3 months during the breeding season (NSW NPWS, 2000). A range of nest types are utilised by the Little Penguins in Manly Cove for breeding, including burrows under sandstone rocks, overhanging vegetation, and under stairs and other foreshore structures (NSW NPWS, 2000). There may have once been suitable breeding habitat along Woollahra's harbour foreshore however no evidence of breeding has been noted along the foreshore in recent times.

Syngnathids

Syngnathids is the collective term for fish that belong to the families 'Syngnathidae', 'Solenostomidae' and 'Pegasidae' (DPI, 2013b). These unique and delicate groups of fish include seahorses, seadragons, pipefish, pipehorses, ghostpipefish and seamoths. All species within these families are now protected under the FM Act and as marine species under the Commonwealth EPBC Act. The genus 'Hippocampus' is also listed under Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

It is likely that seahorses protected under both Commonwealth and State legislation occur on the support piles of some of Woollahra's marine structures such as ocean pools and jetties (The Ecology Lab, 2008), and swimming enclosure nets. Among the biggest threats to seahorses is the loss or alteration of habitat (DPI, 2013b).

Common Scaly Foot (Lizard)

Pygopus lepidopodus (Common Scaly-foot) is a legless lizard that has been recorded as a regionally significant species in SHNP (Nielsen Park) because it has not been observed for more than 20 years (OEH 2014).

Exclusions from BioNet Wildlife Atlas

While recorded in Woollahra in the Bionet Wildlife Atlas, threatened and migratory shorebird and seabird species (with the exception of Sooty Oystercatcher) and marine mammal species have been excluded because they are considered to have no or negligible habitat within Woollahra. The *Ninox connivens* (Barking Owl), a threatened owl species has also been excluded as the record was based on an unconfirmed sighting. A 2009 record of a Spotted Tailed Quoll was also removed.

[5] The Endangered Population of Little Penguins at Manly is a legal and not a biological definition. The protection applies to nesting habitat (specifically in Manly) not foraging habitat, or the individuals. As such, individuals foraging in Woollahra are no longer considered to be part of the Endangered Population. All Little Penguins are however protected through the National Parks and Wildlife Act as a protected species, which protects most native species in Australia.

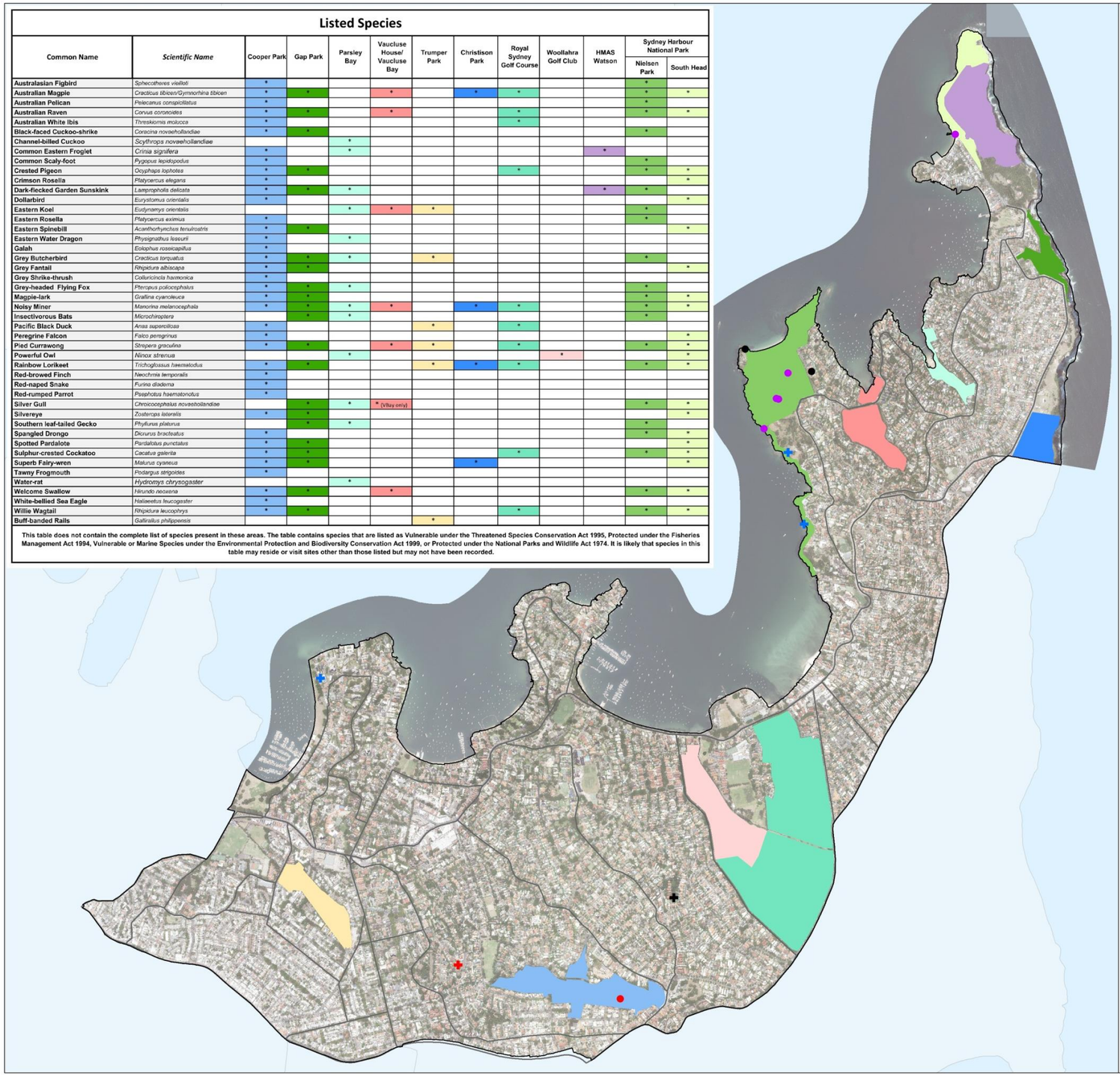
7.3.2 Potentially Locally Extinct Fauna Species

There are 23 terrestrial fauna species that have potentially become extinct within Woollahra. This list has been assembled from a combination of BioNet records from 1990 to 2014, and the Plan of Management for Sydney Harbour National Park (OEH 2013). The list of potentially locally extinct fauna species is provided in Appendix H.

Listed Species

Common Name	*Scientific Name*	Cooper Park	Gap Park	Parsley Bay	Vaucluse House/ Vaucluse Bay	Trumper Park	Christison Park	Royal Sydney Golf Course	Woollahra Golf Club	HMAS Watson	Sydney Harbour National Park	
											Nielsen Park	South Head
Australasian Figbird	*Sphecotheres viellioti*	*									*	
Australian Magpie	*Cracticus tibicen/Gymnorhina tibicen*	*	*		*		*	*			*	*
Australian Pelican	*Pelecanus conspicillatus*	*									*	
Australian Raven	*Corvus coronoides*	*	*		*			*			*	*
Australian White Ibis	*Threskiornis molucca*	*						*				
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	*	*								*	
Channel-billed Cuckoo	*Scythrops novaehollandiae*			*								
Common Eastern Froglet	*Crinia signifera*	*		*						*		
Common Scaly-foot	*Pygopus lepidopodus*	*									*	
Crested Pigeon	*Ocyphaps lophotes*	*	*					*			*	*
Crimson Rosella	*Platycercus elegans*	*										*
Dark-flecked Garden Sunskink	*Lampropholis delicata*	*	*	*						*	*	
Dollarbird	*Eurystomus orientalis*	*										*
Eastern Koel	*Eudynamys orientalis*			*	*	*					*	
Eastern Rosella	*Platycercus eximius*	*									*	
Eastern Spinebill	*Acanthorhynchus tenuirostris*	*	*									*
Eastern Water Dragon	*Physignathus lesueurii*	*		*								
Galah	*Eolophus roseicapillus*	*										
Grey Butcherbird	*Cracticus torquatus*	*	*	*		*					*	
Grey Fantail	*Rhipidura albiscapa*	*	*									*
Grey Shrike-thrush	*Colluricincla harmonica*	*										
Grey-headed Flying Fox	*Pteropus poliocephalus*	*	*	*							*	
Magpie-lark	*Grallina cyanoleuca*	*	*								*	*
Noisy Miner	*Manorina melanocephala*	*	*	*	*		*	*			*	*
Insectivorous Bats	*Microchiroptera*		*	*							*	
Pacific Black Duck	*Anas superciliosa*	*				*		*				
Peregrine Falcon	*Falco peregrinus*	*										*
Pied Currawong	*Strepera graculina*	*	*		*	*		*			*	*
Powerful Owl	*Ninox strenua*			*					*			*
Rainbow Lorikeet	*Trichoglossus haematodus*	*	*			*	*	*			*	*
Red-browed Finch	*Neochmia temporalis*	*										
Red-naped Snake	*Furina diadema*	*										
Red-rumped Parrot	*Psephotus haematonotus*	*										
Silver Gull	*Chroicocephalus novaehollandiae*		*	*	* (Vbay only)						*	*
Silvereye	*Zosterops lateralis*	*	*									*
Southern leaf-tailed Gecko	*Phyllurus platurus*		*	*							*	
Spangled Drongo	*Dicrurus bracteatus*	*									*	*
Spotted Pardalote	*Pardalotus punctatus*	*	*									*
Sulphur-crested Cockatoo	*Cacatua galerita*	*	*					*			*	*
Superb Fairy-wren	*Malurus cyaneus*	*	*				*					*
Tawny Frogmouth	*Podargus strigoides*	*										
Water-rat	*Hydromys chrysogaster*			*								
Welcome Swallow	*Hirundo neoxena*	*	*		*						*	*
White-bellied Sea Eagle	*Haliaeetus leucogaster*	*										
Willie Wagtail	*Rhipidura leucophrys*	*	*					*			*	*
Buff-banded Rails	*Gallirallus philippensis*					*						

This table does not contain the complete list of species present in these areas. The table contains species that are listed as Vulnerable under the Threatened Species Conservation Act 1995, Protected under the Fisheries Management Act 1994, Vulnerable or Marine Species under the Environmental Protection and Biodiversity Conservation Act 1999, or Protected under the National Parks and Wildlife Act 1974. It is likely that species in this table may reside or visit sites other than those listed but may not have been recorded.



Woollahra Municipal Council
Biodiversity Conservation Strategy

Listed Fauna

Selected Threatened Terrestrial Fauna

- Eastern Bentwing-bat
- Grey-headed Flying-fox
- Powerful Owl
- Sooty Oystercatcher
- Southern Myotis

Protected Marine Species

- Little Penguin

Parks Where Species Reported

- Neilsen Park (Sydney Harbour National Park)
- South Head (Sydney Harbour National Park)
- Christison Park
- Cooper Park
- Gap Park
- HMAS Watson
- Parsley Bay Reserve
- Royal Sydney Golf Links
- Trumper Park
- Vaucluse Park
- Woollahra Golf Course

LGA Boundary
Major Roads

N
W E
S

0 0.5 1
Kilometres

Figure 7-14. Listed Fauna Locations

Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

8. HABITAT AND WILDLIFE CORRIDORS

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

8. HABITAT AND WILDLIFE CORRIDORS

Areas representing known or potential habitat within Woollahra have been classified to allow prioritisation of biodiversity conservation efforts. The classifications are as follows:

- Key Habitat Areas
- Locally Significant Habitat Areas
- Complementary Habitat Areas

8.1 Key Habitat Areas

Key Habitat Areas within Woollahra have been defined as areas that have the following attributes:

- Publically accessible, and
- Opportunity for active community engagement in conservation and management

and meet one or more of the following criteria:

- Habitat for threatened/significant biodiversity
- Viable areas of remnant vegetation
- Core habitat for fauna – (this may not necessarily contain remnant vegetation and could be comprised of only exotic plant species)

Key Habitat Areas are fundamental to the future viability of biodiversity in Woollahra. They support most of the LGA's natural vegetation and function as core foraging and breeding habitat for fauna species. Restoring and enhancing Key Habitat Areas is crucial as these areas represent the last remaining extent of the LGA's original native biodiversity and have potential for natural regeneration and recruitment of flora and fauna species that are locally extinct or declining rapidly.

Importantly, Key Habitat Areas are publically accessible and provide recreational and aesthetic values which contribute to the environmental awareness and well-being of the local community and visitors.

Ten Key Habitat Areas have been identified. The areas, land managers, biodiversity and recreational values of these areas are provided in Table 8-1.

The current vegetation and historic vegetation types mapped for each Key Habitat Area are identified in Appendix E.

8.2 Locally Significant and Complementary Habitat Areas

Locally Significant and Complementary Habitat Areas support and enhance the ecological viability of the Key Habitat Areas. Locally Significant and Complementary Habitat Areas are generally small parks and other public open space areas managed by Council. Exceptions include HMAS Watson managed by the Department of Defence, Strickland House managed

by the State Property Authority, both of which support remnant vegetation and function as important buffer areas for the SHNP, and the Royal Sydney Golf Club, which contains significant stands of melaleuca quinquenervia.

54 Locally Significant and Complementary Habitat Areas have been listed against the estimated distribution of historic and current vegetation types (Appendix E) to ascertain appropriate species for revegetation that would assist in expansion of habitat and improvement of connectivity between key habitats.

8.3 Wildlife Corridors

The term "Wildlife Corridor" refers to connections between habitat areas across a landscape allowing the movement of animals and the transfer of plants through seeds and pollen. Ecological connectivity is vital to the long-term viability of native fauna species and remnant vegetation, and is recognised as one of the most effective tools available for conserving biodiversity and preparing landscapes for the impacts of climate change (Department of Environment (then DSEWPaC), 2012).

The important functions of wildlife corridors include (Smith and Smith 2009):

- Ensuring outbreeding and genetic exchange between flora and fauna populations that may otherwise become extinct in the long-term
- Allowing re-colonisation of habitat areas by fauna and flora that have become locally extinct from events such as fire, disease or poor breeding success
- Providing a route for the dispersal of young animals and a guiding pathway across an alien habitat for birds and bats including migratory and nomadic species.

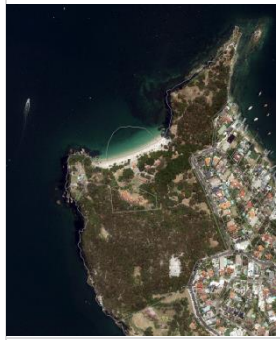
Although much of Woollahra is comprised of fragmented patches of habitat isolated by a highly urbanised environment, some connectivity between Key Habitat Areas remains and there is potential to improve and progressively restore connectivity between them by establishing wildlife corridors through selective revegetation of public open space, and changing work practices. Landscape elements that contribute to wildlife corridors in urban environments include parks, golf courses, street trees and gardens that provide habitat.

The wildlife corridors within Woollahra are mapped using the presence of open space and to a lesser extent, street trees as "stepping stones" between Key Habitat Areas (shown in Figure8-1 and Figure 8-2).

Due to the presence of barriers such as busy roads and developed infrastructure generally only birds and bats are likely to use these wildlife corridors to move between Key Habitat Areas. A number of these species are threatened and perform important ecological functions such as cross-pollination, seed dispersal and insect control.

Site	Land Manager	Area (HA)	Biodiversity/ Environmental Value	Recreational / Social Value / Economic Values
Cooper Park 	Woollahra Council	17.9	• Largest area of remnant bushland outside SHNP • Diverse habitat including sandstone and riparian forest and woodland vegetation • Contains a “naturally” constructed sandstone creekline and pool riparian habitats • Habitat for the endangered plants *Acacia terminalis* subsp. *terminalis* and *Syzygium paniculatum* • Foraging habitat for the vulnerable Grey-headed Flying Fox • Potential site for reconstruction of ESBS	• Recreational value through exposure to remnant vegetation and natural waterway within Sydney • Opportunity for environmental education and events • Amphitheatre provides space for outdoor events, with natural backdrop • Significant investment made by Council and State Government in recent years Ongoing Council investment in bush regeneration being carried out by contract, Council and volunteers

Site	Land Manager	Area (HA)	Biodiversity/ Environmental Value	Recreational / Social Value / Economic Values
Trumper Park 	Woollahra Council	6.5	• Habitat value due to the fully structured forest of many native species offering similar broad habitat values as a natural forest • Pond provide habitat value • Habitat for the endangered *Syzygium paniculatum*	• Active recreational use • Natural thoroughfare by commuters accessing Edgecliff Station • Ongoing Council investment in bush regeneration being carried out by contract, Council and volunteers
Woollahra Golf Club 	Woollahra Council	15.8	• Powerful Owl known to visit the area • Significant established plantings including native trees and trees with hollows provides habitat for a range of native birds • Rose Bay open drain traverses the golf course is wide and tidal and flushes into Rose Bay - potential to establish saltmarsh at the drain outflow adjacent to Sydney Harbour • Upstream section of drain is vegetated with riparian species providing habitat for aquatic invertebrates and a range of other fauna • Potential to link the eastern and western sections of the LGA	• Economic value associated with players fees

Site	Land Manager	Area (HA)	Biodiversity/ Environmental Value	Recreational / Social Value / Economic Values
Nielsen Park 	SHNP	20.4	• Most extensive patch of remnant vegetation in the LGA • Largest area of foreshore bushland south of Sydney Harbour • Characterised by sandstone woodland and heathland vegetation habitat on slopes, gullies and coastal headlands • Endangered plants, *Acacia terminalis* subsp. *terminalis* and *Allocasuarina portuensis* • habitat for and the vulnerable Powerful Owl and Sooty Oystercatcher and a number of regionally significant flora and fauna species • Dogs prohibited (SHNP)	• High social values due to spectacular vistas of Sydney Harbour, Sydney City and a coastal walking track • Ongoing Council investment in bush regeneration works in Nielsen Park undertaken by Bushcare volunteers since 1999, trained staff and contractors • High tourist visitation
Hermitage Foreshore 		3.5		

Site	Land Manager	Area (HA)	Biodiversity/ Environmental Value	Recreational / Social Value / Economic Values
Vaucluse House 	Sydney Living Museums	8.9	• Includes remnant sandstone woodland habitat with escarpments and creek-lines • Translocation site for *Allocasuarina portuensis* (Nielsen Park She-Oak) • Mature trees contains providing breeding habitat for bird, bat and mammal species • Relatively large patch of established garden plantings extend from the upper valley slopes to sheltered marine cove with sandy beach and intertidal rock platforms • Evidence of effective habitat management works in remnant vegetation • Habitat for the endangered *Syzygium paniculatum*	• Restaurant and venue for events such as weddings
Parsley Bay Reserve 	Woollahra Council	3.7	• Intact remnant sandstone woodland and moist forest in good condition • Habitat for the endangered plant, *Acacia terminalis* subsp. *Terminalis* and *Syzygium paniculatum* • Variety of habitat elements such as natural creek-lines, waterfall, rock-overhangs and caves • Remnant vegetation extends to sheltered marine cove with sandy beach and intertidal rock platforms potential seahorse habitat on netted swimming enclosure • Dogs prohibited	• High social values due to popularity as picnic, swimming and walking area • Economic values associated with operation of kiosk • Ongoing Council investment in bush regeneration.

Site	Land Manager	Area (HA)	Biodiversity/ Environmental Value	Recreational / Social Value / Economic Values
Christison Park 	Woollahra Council	6.2	• Native revegetation, remnant and weedy vegetation providing excellent habitat for small birds which are very active on site • Important habitat link with South Head	• High economic and social values due to spectacular sandstone cliff-lines • Trails and vistas attracting high visitation of tourists and locals
Gap Park 	Woollahra Council	4.6	• Vegetation includes remnant coastal heathland and established plantings of Queensland littoral rainforest species • Important habitat link from South Head • Habitat for the endangered plant *Acacia terminalis* subsp. *terminalis* • Dogs prohibited	• High economic and social values due to spectacular sandstone cliff-lines • Trails and vistas attracting high visitation of tourists and locals • Ongoing Council investment in bush regeneration being carried out by contract, Council and volunteers since 1981

Site	Land Manager	Area (HA)	Biodiversity/ Environmental Value	Recreational / Social Value / Economic Values
Green Point 	SHNP	1.2	• Remnant vegetation: Coastal Headland Banksia Heath • Dogs prohibited (SHNP)	• Spectacular sandstone cliff-lines • Outdoor venues (lawns/ gardens etc.) • Tourist attraction • Accommodation at Green Point Cottage
South Head 		6.7	• Records of the Sooty Oystercatcher *Haematopus fuliginosus* (Vulnerable) foraging on the rocks and foreshores • Remnant vegetation: Coastal Headland Banksia Heath, Clifftop Sedges and Grassland, and Coastal Sandstone Foreshores Forest • Note: South Head has a history of land-fill and on-going disturbance and accordingly a high level of weed invasion • Dogs prohibited	• Coastal Walks • Lookouts • Outdoor venues (lawns/ gardens etc.)
Gap Bluff 		7.6	• Remnant vegetation: Coastal Headland Banksia Heath, supplemented by a native revegetation program • Habitat for the endangered plant *Acacia terminalis* subsp. *terminalis* • Dogs prohibited	• Coastal Walks • Lookouts • Outdoor venues (lawns/ gardens etc.)

Site	Land Manager	Area (HA)	Biodiversity/ Environmental Value	Recreational / Social Value / Economic Values
Estuarine foreshore and Seagrass areas 	RMS	90.5	• Foraging habitat for Little Penguins • Seagrass ecosystems including patches of the endangered *Posidonia* seagrass populations • Habitat for a rich diversity of marine fish species including the protected seahorse	• Water based recreation opportunities such as boating, fishing, sailing, whale watching etc • Presence of cafes, restaurants, marinas, wharfs providing access for commuters and tourists

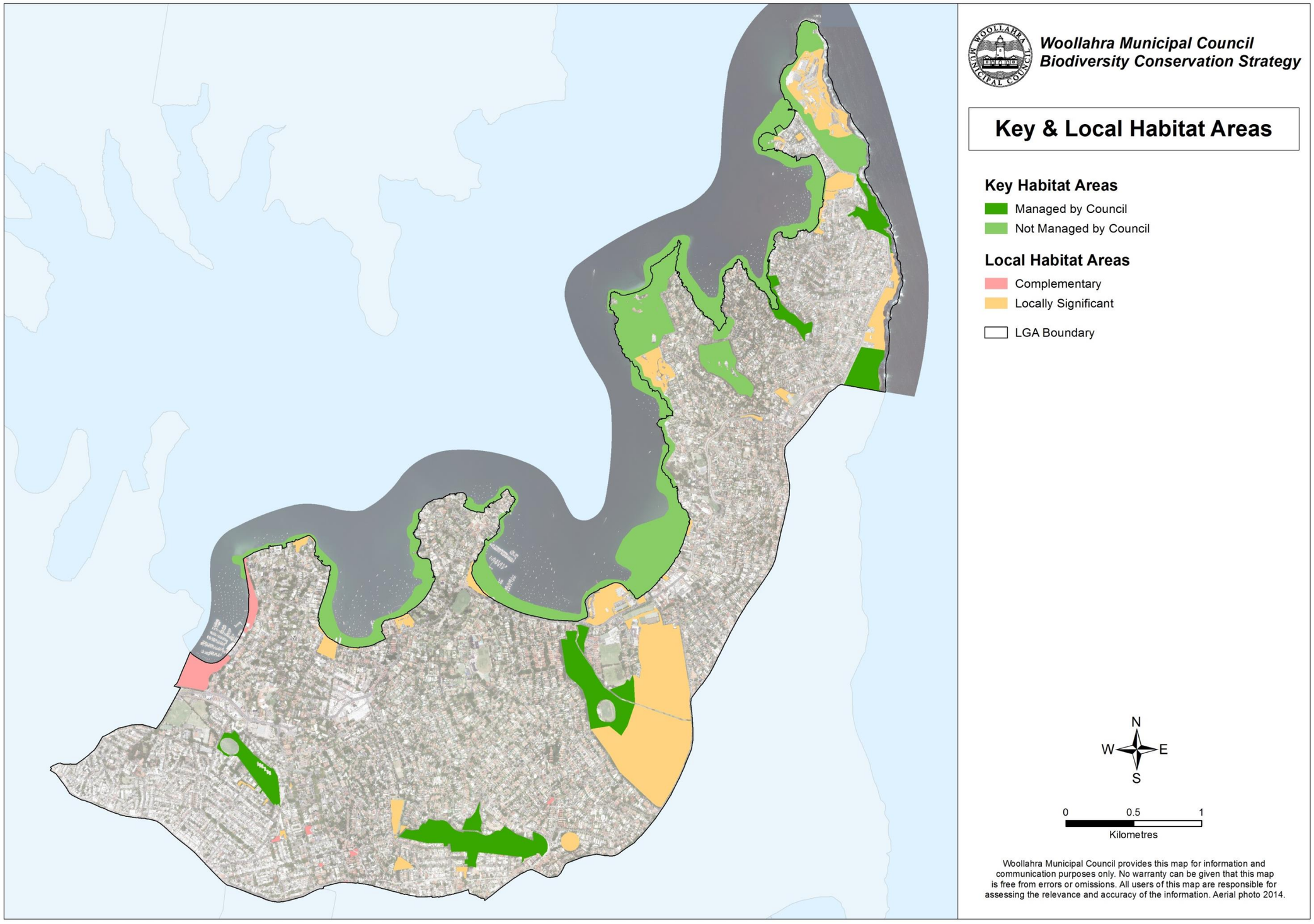


Figure 8-1. Key and Local Habitat Areas

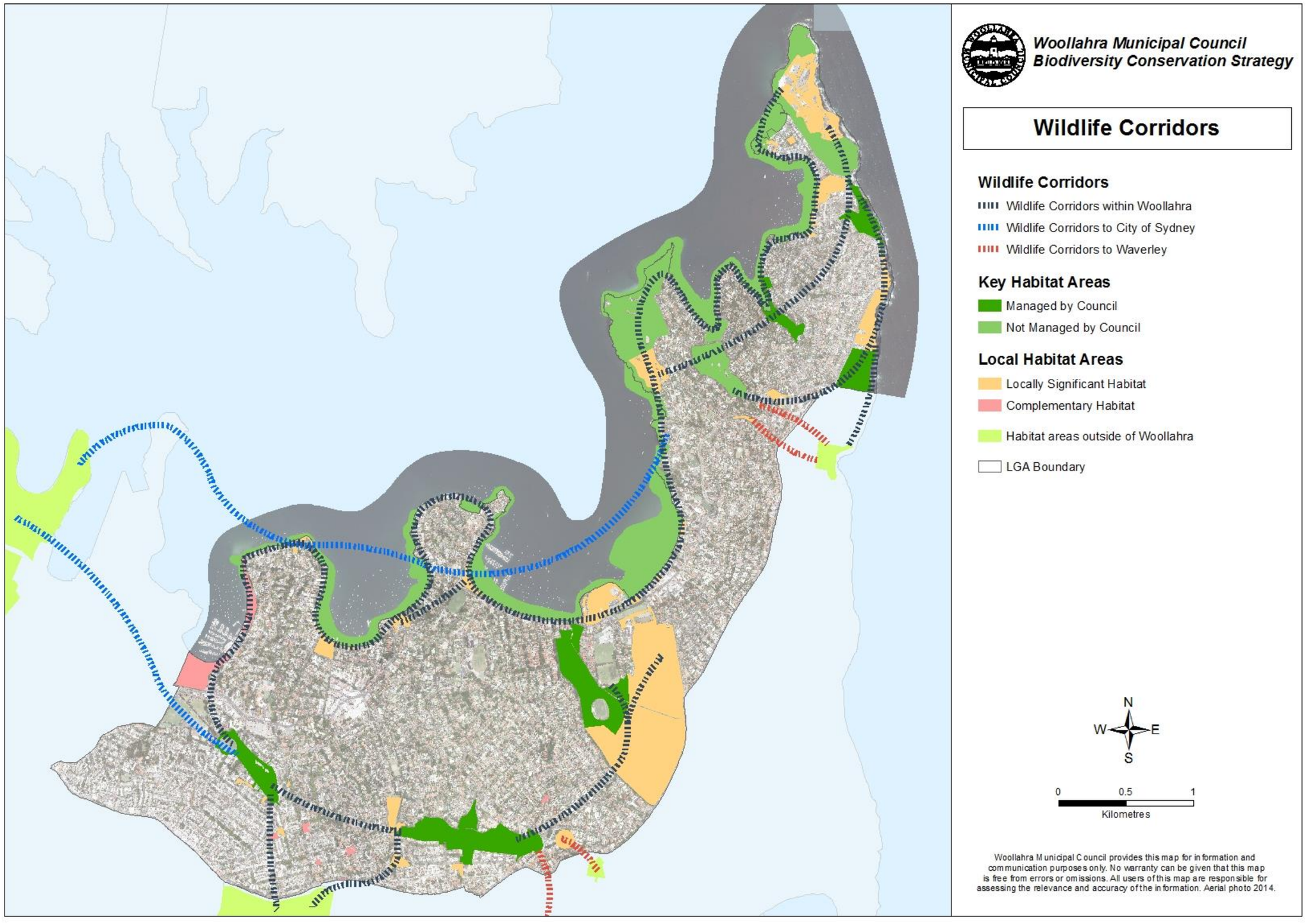


Figure 8-2. Habitat Areas and Wildlife Corridors

Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

9. BIODIVERSITY THREATS

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

9. Biodiversity Threats

Since European settlement, over 95% of Woollahra's original vegetation has been cleared and numerous native plant and animal species have become locally extinct. The LGA's remaining fragmented ecosystems are still experiencing a rapid decline in species diversity and degradation of condition from a range of threatening processes. Effectively managing these threats to halt the long-term decline of local biodiversity is crucial.

This section identifies the primary threats to Woollahra's biodiversity. Actions to manage these threats are detailed in section 11.

Key threats to biodiversity in Woollahra are listed below, and explained in more detail in the following sections:

- Loss of native vegetation and connectivity between habitat areas
- Stormwater
- Water pollution and debris
- Introduced flora species, weeds and diseases
- Introduced animals and domestic pets
- Over-aggressive native species
- Decreased understorey for small birds
- Recreational use of natural areas and associated infrastructure
- Climate change

9.1 Loss of native vegetation and connectivity between habitat areas

Encroachment

Encroachment is a specific type of habitat destruction threat. Encroachments occur on the urban interface boundary of bushland and in some cases foreshore areas and generally involve incremental vegetation clearance and degradation for various reasons such as extension of residential backyards, weed and rubbish dumping, car parking, trailers, boat storage, view enhancement, management of weeds and real or perceived bushfire risk. Bushland encroachment is a widespread threat to biodiversity in Woollahra, and is a particular issue on the boundaries of public land such as Trumper Park and Parsley Bay Reserve.

Loss of Riparian Vegetation

The removal of riparian vegetation along estuary tributaries and foreshores and subsequent replacement with reclaimed parkland, infrastructure, housing and other artificial structures such as jetties and seawalls have significantly modified estuarine foreshores. Loss of riparian vegetation can lead to bank destabilisation, loss of essential habitat and can introduce nutrients and sediments into the waterway.

Landscape Maintenance and Construction

Landscape maintenance works can result in habitat destruction and fragmentation. For example, inappropriate use of herbicide and lawnmowers and brush-cutters in habitat areas, misidentification of native plants as weeds and removal of important habitat features

such as fallen timber, rocks and hollow bearing trees. Construction works associated with new development or redevelopment can remove habitat elements which are important for urban wildlife such as long grass, dense shrubby areas (including weeds) and rock piles.

Reduced capacity for natural or imposed fire regimes
Fire regimes play a crucial role in the life cycle of local remnant vegetation by stimulating the release or germination of seeds, facilitating the establishment of seedlings by liberating resources and reducing the competition of standing vegetation (Auld and Keith 2009). It is likely that sandstone vegetation in particular is potentially impacted by a fire regime that is 'reduced' in a complex pattern of fire frequency, intensity, seasonality resulting in a long-term decrease in biodiversity values. It is possible that active management in the form of weed control and carrying out scarification may encourage germination of some of the local threatened species where there are historical records of threatened plant species. Scarification is considered more appropriate than ecological burning in Woollahra due to the small size of vegetated areas, and their proximity to developed land.

9.2 Stormwater

Water Quality
The catchment and foreshores of Woollahra are highly urbanised, which has resulted in a significant increase in hard surfaces such as roads, car parks and buildings. There are permeable areas allowing for the absorption and filtration of stormwater, and as such a larger volume of stormwater reaches the foreshores more quickly than would have prior to development of the catchment.

Management of stormwater is typically the responsibility of local councils, however, it is acknowledged that this can be difficult to achieve as stormwater infrastructure (including outlets, sections of pipes, pits and stormwater canals) are often owned and managed by a number of different stakeholders (Cardno, 2013).

Typical pollutants found in urban stormwater runoff may include gross pollutants (e.g. rubbish or leaf litter), sediments, heavy metals, nutrients, and faecal pathogens from animals and sewer overflows/leaks. The concentrations of these different pollutants will vary depending upon the specific characteristics of each catchment. Depending on the characteristics of the receiving water body, this may result in impacts on estuarine processes, resulting in siltation and sedimentation, or algal blooms due to high nutrient concentrations.

Stormwater flows are conveyed to the foreshore area by a number of tributary creeks and the stormwater drainage system. As the Woollahra catchment is highly urbanised, the majority of stormwater runoff is managed via the provision of piped drainage, overland flow paths and open channels discharging to the estuary. There are over 100 known stormwater discharge points from the LGA (WMC, 2012c).

Stormwater Pollutants include:

- Heavy metals, oils, grease from road runoff, roofing materials etc.
- Pesticides and fertilisers
- Pet and animal faeces
- Plastic debris and litter
- Sewage from sewer overflow events, leaks and illegal sewer connections
- Household chemicals and paints (if incorrectly disposed of)
- Organic material, which can result in decaying green waste taking vital oxygen away from plants, fish and other aquatic species

Key stormwater management issues related to biodiversity include:

- The development of the catchment has resulted in significant changes to the quantity and timing of delivery of stormwater runoff
- Potential for increased sedimentation and smothering of aquatic habitat by sediments discharged from stormwater outlets
- Increased nutrient levels stimulating primary productivity (e.g. algal blooms)
- Potential for sedimentary contamination, where pollutants such as heavy metals bound to sediment particles become entrained in stormwater runoff

Most of the potential sources of stormwater pollutants are diffuse sources, meaning that they cannot be tied to a specific location. This is very difficult to manage and requires a large network of stormwater treatment measures.

Damage to Seagrass Beds

Seagrass beds occur in sheltered areas and shallow waters along the harbour foreshore. Seagrass meadows serve three key ecological functions (DPI 2007):

- Provide habitat for fish and other aquatic fauna,
- Help to reduce erosion and improve water quality
- Provide a source of food for fish and other aquatic fauna

Seagrass beds are extremely fragile habitat and can be easily destroyed. They are often damaged directly by boating-related activities (mooring and driving over seagrass in shallow waters) and by dredging and reclamation. Foreshore structures such as pontoons and jetties can shade seagrass reducing photosynthesis. Stormwater outlets can cause physical scouring of seagrass beds and result in smothering of seagrasses if sediment is transported through the stormwater network (DPI 2007).

Recent research (Mcreadie et.al 2013) indicates that seagrasses are among the planet's most effective natural ecosystems for capturing and storing carbon; but if degraded, they could leak stored carbon dioxide into the atmosphere.

A 63% reduction in the extent of seagrass from 12.87 ha meadows mapped in 2009 (DECC 2009) to only 4.73 ha mapped in 2013 was identified as part of the Woollahra Coastal Zone

Management Plan – Stage 1 (Cardno 2013)[1]. Seagrasses can undergo relatively rapid fluctuations over time and can be seasonally variable as some seagrasses die back during winter and re-establish in summer, however such a significant loss over a period of five years warrants further investigation.

The most significant decline has occurred in Rose Bay where a large section of seagrass previously mapped has disappeared. The cause, or causes, of this sand accumulation, which has been occurring over the last 20 years have not been defined. Contributing factors may include sand accumulation, poor water quality and damage from boats.

A significant decrease of seagrass has also occurred in Double Bay in particular around the ferry wharf. Cardno (2013) noted filamentous algae covering the seagrass beds in Double Bay. Areas around Watsons Bay and north of Green Point have also experienced a decline to a lesser extent.

The western portion of Point Piper and the eastern side of Darling Point have also experienced some loss of seagrass. However, some areas are showing an increase in seagrass meadows, and it appears that new seagrass patches are establishing in some areas. Although it's only a small increase, a patch of seagrass has appeared at Rushcutters Bay since 2009.

In the development of the Woollahra Municipal Council Coastal Zone Management Plan – Stage 1, Cardno (2013) applied an Estuarine Health evaluation process to the study area[2]. The report card is provided in Appendix G. It should be noted that data was not available for the full length of the Woollahra coastline.

9.3 Water Pollution and Debris

In addition to urban stormwater pollution, water pollution originating in Sydney Harbour also presents a risk to aquatic flora and fauna, including:

- Fishing line and free stainless steel or alloy hooks discarded from boats, beaches, jetties etc. can remain in the aquatic environment for very long period of time, potentially killing or injuring marine life.
- Plastic debris and other litter from beach and harbour users can entangle, strangle or poison wildlife as it breaks down and is consumed.

[1] It should be noted that that mapping undertaken in 2009 was based on aerial photography while the 2013 survey was taken via boat. This difference in survey approach may account for some of the difference in area measured in 2009 and 2013. Cardno survey of seagrass populations carried out in 2013 should be used as the baseline. In-situ identification, mapping and condition assessment is preferable to aerial imagery based monitoring due to the increased level of accuracy, and the ability to monitor trends in condition e.g. epiphyte growth and boat propeller damage.

[2] This process incorporated a modified version of the report card system defined in the State of the Marine Environment Report (Zann, 1995) and those defined by Roper et al. (2011), including indicators identified by the Natural Resources Commission, as the basis for monitoring programs at the State level under the NSW Natural Resources Monitoring Evaluation and Reporting (MER) strategy

9.4 Introduced flora species, weeds and diseases

Weed invasion is a significant and pervasive threat for all of Woollahra's remnant bushland areas. The capacity of Woollahra's bushland to resist and recover from weed invasion has been compromised by a long history of disturbance, fragmentation of small areas of remaining bushland patches and urban stormwater run-off.

Weed invasion is covered by three key threatening processes listed under the Threatened Species Conservation Act 1995 which are relevant in Woollahra:

- Invasion and establishment of exotic vines and scramblers
- Invasion, establishment and spread of *Lantana camara*
- Invasion of native plant communities by exotic grasses

Freshwater aquatic weeds
Two aquatic weeds, *Alternanthera philoxeroides* (Alligator Weed) and *Ludwigia peruviana* (Water Primrose) have been identified and eradicated by Council bush-regeneration staff in Cooper Creek and Trumper Park creek. Regular monitoring for outbreaks of aquatic weeds is important because they tend to have extremely vigorous growth and can rapidly spread and destroy freshwater ecosystems.

Caulerpa Taxifolia
The highly invasive alga, *Caulerpa taxifolia* is a marine species that threatens Sydney Harbour's Seagrass Meadows. *Caulerpa taxifolia* is endemic to tropical regions including northern Australia and is listed as a Class 1 noxious species in 2001, under the NSW Fisheries Management Act 1994. It has been listed as one of the World's most 100 invasive species and impacts Seagrass Meadow ecosystems by out competing native seagrasses, reducing fish numbers, particularly seahorses, and affecting invertebrate populations due to lower oxygen levels in sediments. A 2011 survey of Port Jackson carried out by the Department of Primary Industries mapped *Caulerpa taxifolia* in four locations at Woollahra (DPI 2011). Recent marine vegetation mapping undertaken for stage 1 of the Draft Woollahra Coastal Zone Management Plan (Cardno 2013) did not however find any infestations of *Caulerpa taxifolia.* A native species of the same macroalgae, *Caulerpa filiformis* was observed and mapped at Double Bay.

Diseases
As of 2013, several diseases are threatening Sydney's tree population, including:

- Australian Honey Fungus *(Armillaria luteobubalina*)
- Plane Tree Anthracnose *(Apiognomonia veneta)*
- Cuban Laurel Thrips (*Gynaikothrips ficorum*)
- Fig Psyllid *(Mycopsylla fici)*
- Figleaf Beetle *(Poneridia australis)*
- Fusarium Wilt *(Fusiarum oxysporum)*
- Painted Apple Moth *(Teia anartoides)*
- Pink Wax Scale *(Ceroplastes rubens)*
- White Rot *(Phellinus sp.)*

- Phytophthora dieback *(Phytophthora cinnamomi)*
- Sycamore Lace Bug *(Corythucha ciliata)*
- Winter Bronzing Bug *(Thaumastocoris sp.)*
- Lantana Bug *(Aconophora compressa)*
- Myrtle Rust *(Uredo rangelii)*

The impact of pest and disease on urban bushland is likely to increase due to a range of factors including increased international travel and commodity importation, and climate change; causing increased temperatures, storm events, greater or lower rainfall events.

9.5 Increase in introduced animals and domestic pets

A number of introduced animal species prey upon native fauna in Woollahra. Biodiversity impacts associated with introduced animals relevant to Woollahra are covered by four key threatening processes listed under the Threatened Species Conservation Act 1995:

- Competition from feral honey bees (Apis mellifera)

  Breeding colonies of feral honey bees occupy large hollows in trees used by bird, possum and microbat species for shelter and breeding. Feral honeybees have also been shown to remove up to 80% of pollen and nectar from flowers resulting in the displacement of honeyeaters and native bees and impact seed set in some native plants due to inefficient transfer of pollen (NSW Scientific Committee, 2003).
- Predation by the European red fox *(Vulpes vulpes)*
- Predation by the feral cat *(Felis catus)*
- Predation by the plague minnow or mosquito fish *(Gambusia holbrooki)*

In addition to these Key Threatening Processes, the following mammalian feral pests are known to be present in Woollahra; the European Rabbit (Oryctolagus cuniculus), House mouse (Mus musculus) and Black Rat (Rattus rattus).

The results of a recent study into Common (Indian) Mynas (Lowe et al, 2011) suggest that, in southern Sydney at least, the Common (Indian) Myna does not have a significant competitive impact on native bird species. The high level of interspecific aggression that is often attributed to the Common (Indian) Myna was not evident during observations, though the reputed behavioural dominance of the Noisy Miner was clearly detected. A case of mistaken identity with the Noisy Miner, with similarities in appearance and name, is likely to have contributed to the negative perceptions of the Common (Indian) Myna. Furthermore, and contrary to the findings of other studies, there is no evidence that Common (Indian) Mynas exploit tree hollows at the expense of native cavity-nesting birds (Lowe et al, 2011). The availability of tree hollows was low in urbanised sites, and Common (Indian) Mynas were generally absent from remnant bushland habitat where the hollow-bearing trees were abundant for native species breeding; Common (Indian) Mynas primarily nested in buildings and other artificial structures, and only occasionally nested in tree hollows or other vegetation (Lowe et al, 2011).

Domestic Pets
Dogs and cats predate upon urban wildlife. Dogs can also compete with and harass native fauna, and trample native flora species. Dogs can also disturb wildlife by their scent, sounds, scratching and digging.

Unleashed dog activity in areas where unleashed dogs are not permitted under the Companion Animals Act 1998 appears to be prevalent in local bushland and foreshore areas, including harbour beaches. Problems with unleashed dogs were identified during consultation, reported in the results of the stakeholder consultation program and observed during the field inspection.

Council has prohibited dogs from the following parks, reserves and public places:

- Blackburn Gardens (Double Bay), Redleaf Pool (Double Bay), Double Bay Beach (Double Bay)
- Percival Park (Rose Bay)
- Gap Park (Watsons Bay)
- Robertson Park (Watsons Bay)
- Chiswick Gardens Reserve (Woollahra)
- McKell Park (Darling Point)
- Parsley Bay Reserve (Vaucluse)
- Nielsen Park (Vaucluse)
- Trumper Park Oval playing surface (Paddington)
- Woollahra Oval playing surface (Woollahra)
- Royal Hospital For Women Park (Paddington) (Sundays ONLY between 10am-8pm)

Dogs are permitted off leash at Steyne Park (northern end except during organised sailing events, Yarranabbe Park, Lighthouse Reserve and Rose Bay Foreshore. Dogs are permitted in other areas on-leash, and/or or at specific times.

9.6 Over-aggressive native species

Over-aggressive native birds
Small insect eating birds such as wrens, thornbills, and fantails have been especially affected by urbanisation and are now largely absent in most built-up areas. A major cause for their decline is the abundance of larger native bird such as ravens, currawongs and butcherbirds which have adapted well to urbanisation. Several of these species are voracious nest predators, preying upon small bird nestlings and eggs during the breeding season.

The Noisy Miner is a sedentary, highly aggressive honeyeater endemic to eastern Australia which has benefitted by large scale vegetation changes such as the loss of understorey vegetation. These birds are strongly implicated in the loss of small birds from cities because they aggressively exclude smaller species in competition for food resources. In November 2013, the *'Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners Manorina melanocephala'* was classified as a Key Threatening Process.

Figure 1. Introduced Indian Myna Bird (left) and native Noisy Miner Bird (right) ***(Source: Wikipedia)***

Feedback from the stakeholder consultation program indicated that removal of small bird habitat in the form of weeds was associated with the loss of *Zosterops lateralis* (Silvereyes) and *Sericornis frontalis* (White-browed Scrub Wrens) at Gap Park. Fortunately some small bird species still occur in dense shrubby areas, including weedy thickets, where there is shelter for them to escape attacks from Noisy Miners that prefer the treed lawn landscapes found in local parks.

9.7 Decreased Understorey Habitat for Small Birds

A healthy understorey of native shrubs and/or grasses is one of the most important factors in maintaining bird diversity. Native shrubs provide nesting habitat for small birds (prickly shrubs such as Needlewood are particularly favoured), and a range of food such as nectar, seed and fruit that are not always available from eucalypts (Gosper, n.d). Understorey habitat has decreased across the LGA, reducing this habitat type.

9.8 Recreational Use of Natural Areas and Associated Infrastructure

High levels of visitation by tourists and the local community and demand for recreational access places pressure on harbour-side beaches and coastal headland reserves.

The recreational and commercial uses of the Woollahra coastal zone are summarised in Table 1.

Table 1. Recreational and Commercial Uses

Recreational Uses	
• Walking, jogging and bush walking • Exercising • Cycling • Picnicking and BBQs • Tennis • Swimming • Scuba diving • Motor boating • Art groups • Sailing and windsurfing	• Paddle boarding, kayaking & canoeing • Dragon boating and outrigger canoeing • Recreational fishing (from the rock platforms or shoreline) • Bird and whale watching • Dog walking • Sightseeing and tourism • Organised team sports and group exercise
Commercial Uses	
• Tourism • Restaurants, cafes and kiosks • Public transport • Boat charters • Sporting facilities • Dog walking	• Hire of powered and non-powered watercraft • Marina operations, boat repairs and storage Equipment sales • Group fitness/personal training
Clubs	
• Sailing/yacht clubs • Outrigger canoe clubs • Paddling boarding clubs	• Tennis clubs • Rugby Union, Rugby League and Soccer Clubs • Lawn Bowls Clubs

Biodiversity impacts associated with recreational access include direct loss of habitat, in particular through trampling, erosion and sedimentation of natural waterways, littering, dispersal of weeds, introduction of the plant pathogen *Phytophthora cinnamomi*, disturbance to native fauna behaviour such as avoidance of habitat, the use of trails by foxes, cats and dogs and edge effects extending into bushland from the trail boundaries.

Mountain Biking

Mountain biking in Cooper Park has been identified as a problem in the past as it disturbs the native vegetation.

Fishing and Collection

Commercial fishing is not permitted in Sydney Harbour, although recreational fishing is a commonly observed activity. Popular rock fishing locations include McKell Park, Watsons Bay Baths, and Duff Reserve in Point Piper. There are conflicts between fishers and other recreational users due to the limited amount of space available and the perceived tendency of fishers to leave behind rubbish and/or discards from cleaning fish. The intertidal zone (the zone between the mean higher high water and mean lower low water lines is protected

within Sydney Harbour which means it is not permissible to collect intertidal animals such as cockles.

Swimming enclosure nets
While the natural habitat of seahorses in Sydney Harbour is seagrass or kelp beds, they are also commonly found on artificial structures such as jetty pylons and netted swimming enclosures. Swimming enclosure nets are subject to fouling from marine growth and rubbish and require regular cleaning and/or replacement resulting in a significant loss to seahorse habitat. Fortunately seahorse populations in Sydney Harbour tend to be seasonal with increased numbers occurring on nets during breeding time which span the warmer months (September – February) which allows major net cleaning or replacement to be planned for winter months when populations are at their lowest (Harasti et al, 2010).

9.9 Climate Change

Climate change is listed as a Key Threatening Process under the Threatened Species Conservation Act 1995 and will impose major impacts on species and ecosystems, although many of the potential impacts on ecological processes remain poorly understood (Auld and Keith 2009). The means by which global climate change could affect biodiversity include increased frequency of extreme weather events, disruption to the life cycles of flora and fauna, exposure to new pathogens and predators and loss of habitat from sea level rise (Auld and Keith 2009). Examples of the potential impact of climate change in Woollahra are sea level rise inundating harbour-side vegetation habitats and changes to distribution of seagrass meadows, and exacerbation of weed invasion through altered climate patterns.

Climate Change Impacts on Estuarine Ecology
A qualitative ecological risk assessment was undertaken by Cardno (2013) to assess the likelihood and consequences of hazards resulting from climate change impacting on the key attributes of the estuarine ecosystem. The coastal area from Shark Point to the southernmost point of Hermitage Foreshore Walk at Bayview Hill Road, including Hermit Bay and the coastal area 5 from the southernmost point of Hermitage Foreshore Walk to Rushcutters Creek (western most extent of LGA), including Rose Bay, Double Bay and part of Rushcutters Bay appear to have the greatest level of level of risk to estuarine ecosystems resulting from climate change. The complete results are provided in Appendix G.

9.10 Other Threats

Other threats to the long-term sustainability of Woollahra's biodiversity include:

- Decreased genetic diversity of flora and fauna species surviving in isolated habitat patches resulting in the reduced ability of these populations to survive disease and environmental changes
- An ageing tree canopy including mature planted species in parks and remnant species in bushland
- Illegal tree removal by foreshore residents to improve views

Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

10. CURRENT BIODIVERSITY MANAGEMENT PRACTICES

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

10. CURRENT BIODIVERSITY MANAGEMENT PRACTICES

The following section summarises the key biodiversity management practices currently being undertaken by Council.

10.1 Vegetation Management

Remnant vegetation occurs across a variety of land tenures (Figure 10-2). The remnant vegetation on Council and NPWS land is protected under legislation and managed in accordance with approved management plans. The NSW Roads and Maritime Service (NSW RMS) is responsible for the bed of Sydney Harbour and is therefore responsible for the management of mangroves and seagrass beds in accordance with the Fisheries Management Act 1994.

Bush Regeneration and Weed Removal

Council staff and volunteers currently carry out bush regeneration and weed removal works over 16.83 hectares of bushland in Woollahra. This work occurs at Cooper Park, Parsley Bay Reserve, Gap Park and Trumper Park and Harbour View Park.

Councils bush regeneration activities are also supported by volunteers from corporate groups and schools.

NSW National Park and Wildlife Service staff, bush-regeneration contractors and bushcare volunteers work within the resilient areas of Nielsen Park. Bush-regeneration contractors have worked previously within bushland areas at HMAS Watson, Vaucluse House and Cooper Park.

Figure 10-1. Bush regeneration, Harbour View Park

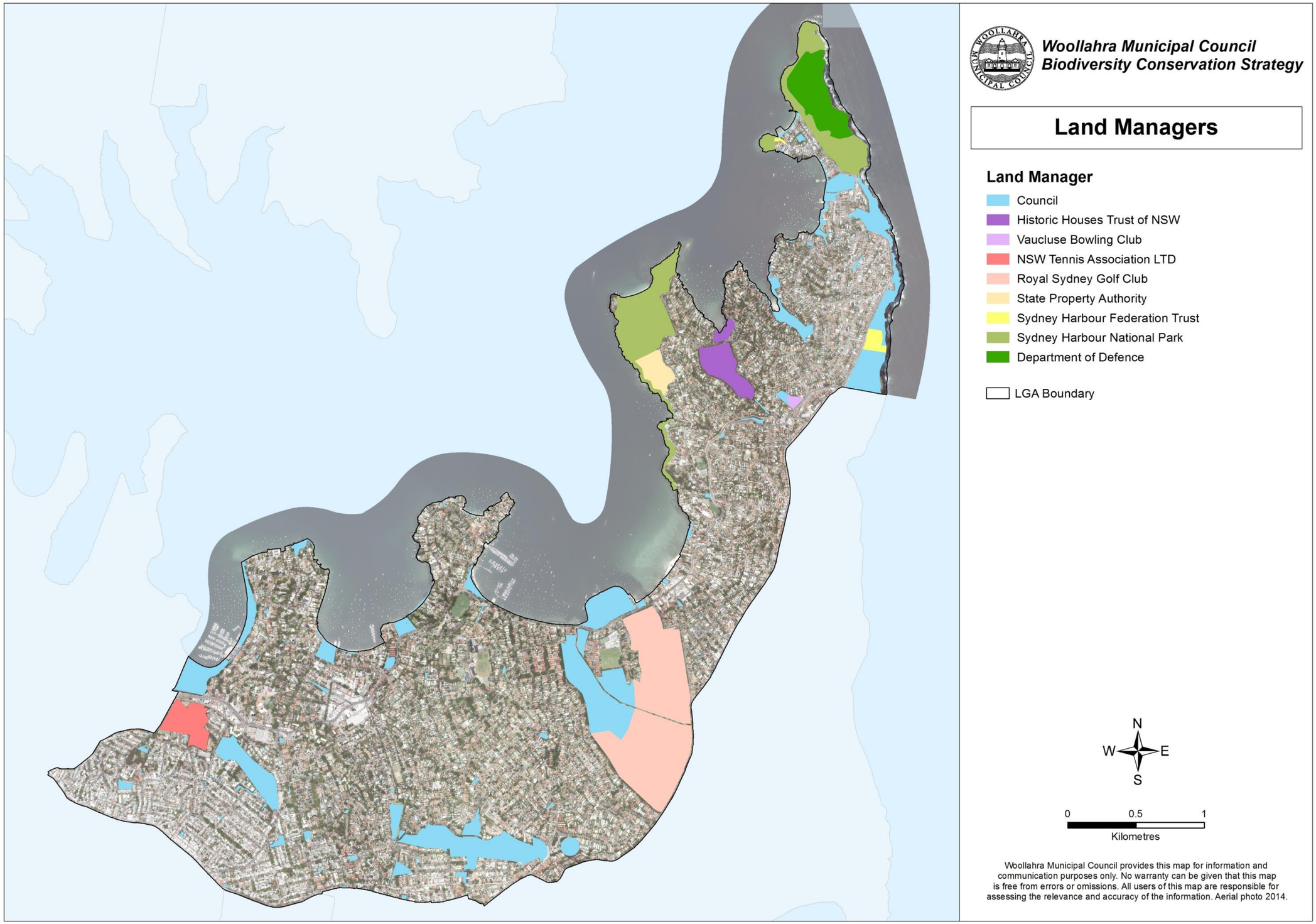


Figure 10-2. Land Management

10.2 Stormwater Management

Controls on pollutant loadings entering Sydney Harbour and creeks include Gross Pollutant Traps (GPTs) and other Stormwater Quality Improvement Devices (SQIDs) that provide pre-treatment of stormwater before it is discharged to the receiving waters. The type and volume of pollutants removed will depend upon the type of device used. Council has installed a number of devices throughout the LGA to address stormwater pollutants entering the harbour including:

- 17 Gross Pollutant Traps - The GPTs are designed to capture gross pollutants (and in some cases sediment). The majority of GPTs are checked quarterly by Council
- Trash racks (pit baskets) - The majority of the material cleaned from trash racks is organic matter (leaves, twigs and other plant matter). Organic matter represents almost half of the total tonnage in both the Double Bay and Rushcutters Bay catchments. Although trash racks were historically a popular means of capturing gross pollutants, Council has found that they are difficult to maintain. For this reason, Council has removed trash racks in recent years, and now has a preference for larger stormwater treatment structures.
- Litter Nets – Litter nets have been installed on stormwater pipes at Tingira Beach (off Vickery Avenue), Rose Bay Beach (concrete weir constructed with three netter pipes off Wunulla Road, Rose Bay Park (parallel with Rose Bay Police Station) and Lady Martin Beach. Council investigates the need for additional nets as issues arise.

Figure 10-3. Rain Garden, Rose Bay

Woollahra Council has an increasing focus on Water Sensitive Urban Design (WSUD) with a view to improved stormwater management, and particularly capturing those pollutants that are generally not targeted by GPTs and other devices. WSUD is the integration of water cycle management into urban planning and design. Implementaion sites include:

- Stormwater Harvesting in Cooper Park, Rose Bay promenade and Parsley Bay Reserve.
- Raingardens (bio retention system) which detain and naturally treat stormwater before it reaches the waterway, at O'Sullivan Road, Bellevue Hill shops, Hopetoun Avenue and Lyne Park.

10.3 Beach raking andStreet sweeping

Beach raking is conducted three times a week on publicly accessible beaches. Council also conducts street sweeping where possible.

10.4 Macrophyte planting and Streamwatch

During the Cooper Creek Sustainable Water Project, macrophytes were planted in small patches along the creek to improve natural water treatment capacity and improve water quality. Streamwatch activities have also been carried out at Cooper Park, involving community volunteers.

10.5 Environmental Education and Events

Environmental education and events carried out in recent years relevant to biodiversity management include:

- Bird watching walks and talks
- Stormwater education
- Streamwatch
- Rockpool Discovery Tours
- Snorkelling Discovery Tours
- Natural pest management in gardens (workshops)
- Gardening Network Workshop[1] 'Backyard Pollinators' (the ecology of birds, bees, bats and their role in pollinating gardens)
- Organic gardening workshops

10.6 Fox Trapping

In response to reports or complaints, Council staff carry out fox trapping on an as needs basis[2].

10.7 Cat Nuisance Policy

Council currently owns a single trap for cat trapping. This trap can be loaned to residents if they are experiencing a problem with a feral/nuisance cat. Cats can only be trapped on private property. No Council Officers are to carry out trapping.

Council has a draft procedure titled “Companion Animals – Investigation of Cat Complaints”.

[1] Delivered through the 3 Councils Project, a joint initiative between Woollahra, Waverley and Randwick Councils

[2] In 2014, the European red fox (Vulpes vulpes) was declared to be a pest in New South Wales. The Local Land Services (European Red Fox) Pest Control Order 2014 states that the Local Land Services is empowered to serve an individual eradication order in accordance with Part 10 of the Act, on any occupier or owner (other than a public authority) of controlled land requiring the occupier or owner to eradicate the pest by use of a method specified by Local Land Services in the individual eradication order. The Order does not require a change in Councils fox management program.

10.8 Little Penguin Watch

Council has an ongoing Little Penguin watch program, which provides an online portal for people to register penguin sightings along the foreshore. The program is aimed at both engaging residents and increasing Councils understanding of the penguin population in the area.

10.9 Walks in Woollahra

Council staff carry out a program of whale watching and biodiversity walks to provide an opportunity for members of the public to learn more about the flora and fauna in Woollahra and Sydney Harbour. Four of these walks are conducted each year. Bird watching walks are also conducted 1-2 times per year.

10.10 Pool to Pond

Pool owners in Woollahra who no longer wish to maintain their pool as a chlorinated swimming space are able to work with Council to convert the pool into a thriving, native pond.

Figure 10-4. Example pool to pond Conversion
(Source: Spielman)

10.11 Summary of Current Practices and Constraints

The following section outlines Councils current practices, policies and programs against the threats identified in section 9. The table also highlights some of the constraints associated with addressing these threats.

Table 10-1.Biodiversity Management – Current Practices and Constraints

Threat	Current Practices / Policies/ Programs	Constraints
Loss of Native vegetation and connectivity between habitats	– Bush regeneration/ bushcare – Tree Protection Orders – Environmental Management Zones within the LEP – Pool to Pond Program – Native Gardening Community Workshop – DRAFT Street Tree Master Plan includes measures to maintain/increase species diversity	– Significant number of parks, and small fragmented sites – Limited local native seed banks – Some Key Habitat Areas are not environmental management zones
Stormwater Water Pollution and debris	– Water Sensitive Urban Design measures (raingardens, stormwater harvesting and rainwater harvesting) and Stormwater Quality Improvement Devices (e.g. GPT, litter nets) – Stormwater water quality monitoring (hotspots) – Street sweeping and beach cleaning – Education/ engagement events – Clean Up Notice/ waste removal of illegally dumped waste – Pollution Clean Up Notice Procedure (DRAFT) – Erosion and Sediment Controls Procedure (DRAFT) – Water Pollution Sampling Procedure (DRAFT) – Water Pollution Incident Response Procedure (DRAFT)	– Diffuse sources of pollution from within and outside LGA – Highly developed catchment – Potential illegal sewer connections and sewer leaks – High cost of WSUD measure implementation and maintenance
Introduced flora species, weeds and diseases	– Bush regeneration/ bushcare including weed removal – Noxious Weeds Policy 2013 and Noxious Weeds Strategy – Weed Control in Streets, Tree Pits, and Lane Ways Procedure	– Significant number of parks, and small fragmented sites vulnerable to edge effects and transfer of weeds from adjacent gardens – Significant introduced species contained in private gardens
Introduced animals and domestic pets	– Companion Animals – Investigation of Cat Complaints Policy (DRAFT)/ Cat Trap Use Policy – Fox Trapping program (as needs basis) – Responsible Cat Ownership education – Dog prohibition and on-leash restrictions in some parks/ beaches	– Recreational users include visitors to the LGA, who would not receive Council information/education – Dog exercise areas in / adjacent to Key Habitat Areas
Over-aggressive native species / Decreased understorey for small birds	– Bush regeneration/ Bushcare	– Some understorey habitat is dominated by weeds. Removal of weeds may result in loss of habitat if not managed carefully.
Recreational use of natural areas and associated infrastructure	– Prohibition of fishing in some areas – Snorkelling and Rockpool education tours – Commercial Use Policy limiting group sizes for water sports (e.g. scuba diving, stand-up paddle boarding) – Dinghy Storage Policy – Formalised pathways on most foreshore areas	– High visitation and usage rates – Recreational users include visitors to the LGA, who would not receive Council information/education
Climate change	– Draft Climate Change Adaptation Plan – Carbon Reduction Strategy and Action Plan – Coastal Zone Management Plan Stage 1 (DRAFT)	
Decreased genetic diversity of flora and fauna species	– Trumper Park Nursery Local seed bank – Bush regeneration/ Bushcare – Management of foxes and nuisance cats and dogs on an as needs basis – DRAFT Street Tree Master Plan includes measures to maintain/increase species diversity	– Highly urbanised LGA with limited space for re-introduction of previously present flora and fauna species – Limited local native seed banks
Aging tree canopy	– Trumper Park Nursery Local seed bank – Bush regeneration/ Bushcare – Proactive Tree Pruning Procedure	– Currently no process for retention of hollows and perches on dead trees that have had canopy removed for safety reasons.
Illegal tree removal/ poisoning for creation/ preservation of views	– TPO Breaches Procedure, prescribing process for investigation into poisoning/ removal/ pruning of trees within Council's Tree Preservation Order. May result in prosecution	

Woollahra Municipal Council

Biodiversity Conservation Strategy 2015 - 2025

11. ACTION PLAN

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

11. Action Plan

The Biodiversity Conservation Action Plan has been developed to meet the objectives outlined in section 3.3 and address the threats identified in section 9. The implementation timeframe for this Plan is five years. It is recommended that this Strategy be reviewed in 2021.

The actions are categorised under the following topics:

- Habitat Conservation and Species Diversity
- Data Collection, Research and Monitoring
- Biodiversity Sensitive Council Operations
- Private Land Use
- Domestic/ Feral Animal Management
- Education and Awareness
- Regional Collaboration
- Funding
- Future Considerations

The following sections provide further explanation and notes on the actions under each category.

The priority of the actions is illustrated using the following legend:

H	High Priority - completed by 2017-2018
M	Medium Priority - completed by 2020-2021
L	Low Priority - completed by 2024-2025

Section 11.10 provides a summary of all actions, ranked in order of priority.

Section 12 provides information of the monitoring program associated with this Strategy.

11.1 Habitat Conservation and Species Diversity

In an urban landscape such as Woollahra, pro-active on-going management is required to conserve and maintain biodiversity and ecological function of fragmented remnant bushland.

Extension of habitat through revegetation where feasible and management of remnant and non-remnant vegetation as habitat for wildlife will significantly benefit local biodiversity.

Management of weedy and exotic vegetation must take into consideration impacts on biodiversity, and the habitat contribution made by these areas. For example, weedy thickets provide protective shelter for small bush birds from cats and aggressive native birds (e.g. *Manorina melanocephala* - Noisy Miners). Similarly, the numerous established plantings of Moreton Bay Figs (*Ficus macrophylla)* provide foraging and potential roosting habitat for the threatened fauna species *Pteropus poliocephalus* (Grey-headed Flying Fox) and a large number of bird species.

The following table contains each of the actions within this category, and a description or notes on the action. The complete suite of actions is contained in section 11.10.

Table 11-1. Habitat Conservation and Species Diversity– Action Summary

	Action	Description / Notes	Priority	Department /Team
HAB 1	Collaborate with Bushland Maintenance Team to determine options for further contributing to implementation of Biodiversity Conservation Strategy and support target monitoring and reporting	This will include understanding / collating : • Literature and documentation held within Council (e.g. Plans of Management, Bush regeneration maps, policies and procedures) • Reports prepared by external bush regeneration teams • Current and historical photos The process will be carried out in partnership with the Bushland Maintenance Team This process will inform the preparation of detailed habitat restoration plans and assist in implementing the actions within this Strategy.	H	Bushland Maintenance/ Environment and Sustainability
HAB 2	Conduct facilitated Detailed Habitat Restoration Planning exercise with bush regeneration staff for parks and reserves within Key Habitat Areas.	Detailed Habitat Restoration Plans are to be developed for each of the Key Habitat Areas under Council management.	H	Bushland Maintenance/ Environment and Sustainability
HAB 3	Incorporate Detailed Habitat Restoration Plans for parks and reserves within Key Habitat Areas as part of the next review and update of the Plan of Management or Masterplan.	The Detailed Habitat Restoration Plans will be incorporated into Plans of Management and/or Master Plans as they are updated. The content of the Detailed Habitat Restoration Plans is provided in section 11.1.1	M	Open Space Management
HAB 4	Update relevant sections of the Plans of Management for all parks and reserves to include	Relevant sections are to be updated to align with the objectives and actions within this Biodiversity Conservation Strategy.	M	Open Space Management

	Action	Description / Notes	Priority	Department /Team
	biodiversity conservation provisions as part of the next review and update of the Plan of Management or Masterplan.			
HAB 5	Develop and Implement a Threatened Species Management Plan	A threatened species management plan will be prepared to improve the protection and viability of these species.	M	Bushland Maintenance/ Environment and Sustainability
HAB 6	Monitor spread of phytophora throughout Cooper Park and implement control procedures where practical	Phytophthora cinnamomi is a microscopic soil-borne organism, which causes root rot of a wide variety of native and introduced plant species. Council bush regeneration staff have identified a zone where phytopthora is present in Cooper Park. The current approach is the sterilisation of equipment (boots and tools) when working in that area to minimise spread. Should grant funding become available, the construction of a raised walkway is considered as a possible option to address this issue.	M	Bushland Maintenance
HAB 7	Continue monitoring of Bansksia serrata remnants in Gap and Cooper Park to determine presence of Banksia aemula	Bush regeneration staff are regularly monitoring the individuals to confirm species identification.	M	Bushland Maintenance
HAB 8	Identify sites that could benefit from scarification	Scarification in the botanical sense involves cutting the seed coat using abrasion, thermal stress or chemicals to encourage germination. Scarification is considered more appropriate than ecological burning in Woollahra due to the small size of vegetated areas, and their proximity to developed land.	H	Bushland Maintenance

	Action	Description / Notes	Priority	Department /Team
HAB 9	Bush regeneration staff to keep abreast of research into genetic provenance for Woollahra region, and plant known locally native species where possible	Some indicative plant species likely to have occurred in Woollahra's original vegetation types which could be utilised in revegetation works are listed in Appendix E.	M	Bushland Maintenance
HAB 10	Adopt Sydney Weeds Committee Weed Incursion Plan 2010-2015 and access funding for emergency weed management as required.	The Weed Incursion Plan was prepared as part of a regional requirement under the Department of Primary Industry's Weed Action Plan. The Plan provides guidance to help Woollahra deal with new incursions as they occur.	M	Bushland Maintenance
HAB 11	Implement Eastern Suburbs Banksia Scrub Recovery Plan actions as appropriate for Woollahra	The Eastern Suburbs Banksia Scrub Recovery Plan constitutes the formal Commonwealth and New South Wales Recovery Plan for the Eastern Suburbs Banksia Scrub endangered ecological community. It identifies the actions to be taken to ensure the long-term viability of Eastern Suburbs Banksia Scrub in nature and the parties who will carry these out.	L	Bushland Maintenance
HAB 12	Conduct annual assessments of seahorse populations on swimming net enclosures.	Assessments should be carried out at all swimming enclosures. It is recommended that monitoring occurs in summer months, as this is likely to give the most accurate population of the extent of the population. Monitoring should be carried out by an experienced professional.	H	Environment and Sustainability
HAB 13	Conduct further ground truthing of Johnston's Lookout as a potential regeneration site to determine presence of Woody Pear and other native species.	Investigation should include assessment of soil seed bank at a range of depths.	L	Bushland Maintenance
HAB 14	Conduct ongoing maintenance of riparian vegetation in Parsley Bay Creek	Parsley Bay Creek is one of the few remaining natural waterways in Woollahra. Significant revegetation of riparian vegetation has occurred in Parsley Bay Creek in recent years. To ensure that the investment made in this area is	H	Bushland Maintenance

	Action	Description / Notes	Priority	Department /Team
		maximised, ongoing and regular maintenance should be prioritised.		
HAB 15	Conduct annual aquatic fauna assessments in Parsley Bay Creek and Cooper Creek	Aquatic fauna assessments should be conducted as part of the overall biodiversity monitoring program. All aquatic fauna assessments should be carried out by an experienced professional.	H	Environment and Sustainability
HAB 16	Collaborate with Sydney Water regarding reconstruction of Estuarine Coastal Saltmarsh vegetation on the lower reaches of the Rose Bay culvert.	Preliminary investigations have been carried out and the construction of a wetland and coastal saltmarsh has been costed. Council will continue to look for grant funding options to complete this project.	H	Environment and Sustainability
HAB 17	Identify unused land that may be used for planting of native gardens and/or trees for the purposes of reducing urban heat island effect, increasing habitat, increasing permeable surfaces, and improving the amenity of unused spaces.	Approvals and maintenance requirements are to be addressed prior to planting.	H	Environment and Sustainability
HAB 18	Investigate opportunities for collection of logs/ stumps/ branches removed by Park and Tree Management teams and use in the creation of habitat in bushland areas	Park and Tree Management staff to identify any stumps/ logs/ branches that are to be removed for park maintenance/ tree maintenance that may be useful for habitat creation in bushland areas. Bush regeneration team to identify suitable sites to allow immediate use when stumps/logs/ branches become available.	M	Bush Management Team/ Open Space Management

11.1.1 Biodiversity Conservation Provisions and Detailed Habitat Restoration Planning

The following section indicates the content to be included in Detailed Habitat Restoration plans for each of the Key Habitat Areas. The Detailed Habitat Restoration Plans are to be implemented by the bushland management team and are to be incorporated into the Plans of Management and Master Plans.

The plans should incorporate existing restoration works/plans and include schedules of future works. The plans should map each area into management zones with specific tasks and targets.

The plans should identify the works that are to be undertaken by professional bush regenerators, Councils Bush Management Team, and Bushcare volunteers. The plans should also provide guidelines for monthly and annual reporting of bush regeneration works, describing work completed, quantity and location of plantings, observations, management issues, fauna/ nest sightings etc.

The Plans should include the following works:

- Primary, secondary and maintenance weed control works. The Plans should ensure weed clearance and revegetation works are undertaken at a pace that ensures follow-up and maintenance works are adequately resourced and small bird habitat is not temporarily decreased
- Re-vegetation works focussing on enhancing wildlife corridor connectivity
- Specific fauna habitat management guidelines including the maintenance and extension of small bird habitat
- Vegetation pruning/removal to manage bushfire risk
- Where possible, ceasing mowing and promoting natural regeneration to improve the long-term viability of endangered remnant vegetation
- Where appropriate, scarification of the soil surface to stimulate natural regeneration from the soil seed bank where required
- Where necessary, plans should be developed to exclude and/or reduce opportunities for feral, introduced and over-aggressive native species including Noisy Miners, Indian Mynas, foxes and rabbits

Ideally the plans should be prepared after detailed on-ground flora and fauna surveys have been completed.

Detailed Habitat Restoration Plans should be based on a ten year time frame. Within this ten year timeframe, the plans should be reviewed for accuracy and updated prior to inclusion in the relevant Plan of Management.

11.1.2 Threatened Species Management Plan

A Threatened Species Management Plan will be prepared to improve the protection and viability of threatened (endangered and vulnerable) species within Woollahra. The plan will be prepared in a user-friendly format, designed to be used as community education

resource and incorporate actions from the relevant Threatened Species Recovery Plans. The following elements will be covered in the plan:

- A profile of each species/group including its ecology, threats and its particular management issues within Woollahra
- Whether the species is protected under relevant state or commonwealth legislation and specific legislative obligations
- Community engagement and education opportunities
- Management actions and guidelines to protect and enhance the habitat of the threatened species such as:
    - Protective fencing and/or interpretive signage
    - Use of nest boxes and artificial roosts
    - Conservation of hollows, fallen logs, dead trees and rock features
    - Control/exclusion of dogs and cats
    - Specifications on the staged removal of dense weedy areas to minimise impacts upon small bird habitat
    - Specifications on the plant species and planting configurations for revegetation works to promote small bird habitat
    - Food tree plantings
- Management of marine structures and harbour pool nets to minimise impacts on seahorses

11.2 Data Collection, Research and Monitoring

The following table contains each of the actions within this category, and a description or notes on the action. The complete suite of actions is contained in section 11.10

Table 11-2. Data Collection, Research and Monitoring – Action Summary

	Action	Description / Notes	Priority	Department /Team
DAT 1	Implement a Biodiversity Monitoring Program. Conduct monitoring every 2 years.	Guidelines for developing the monitoring program are provided in section 12	H	Environment and Sustainability
DAT 2	Undertake a water quality monitoring program.	Further information is provided in section 11.2.1.	H	Environment and Sustainability

11.2.1 Water Quality Monitoring Program

The whole of catchment water quality monitoring program will be designed to:

- Identify significant stormwater impact locations affecting remnant vegetation and the harbour foreshore marine ecosystem
- Assess the condition of natural waterways

The monitoring program will inform the prioritisation of locations to:

- Undertake stormwater quality management works
- Enhance and extend riparian vegetation
- Re-establish natural creek-banks and riparian zones on suitable channelised waterways

11.3 Biodiversity Sensitive Council Operations

The following table contains each of the actions within this category, and a description or notes on the action. The complete suite of actions is contained in section 11.10.

Table 11-3. Biodiversity Sensitive Council Operations Actions – Action Summary

	Action	Description	Priority	Department /Team
WMC 1	Conduct annual workshops with indoor and outdoor staff to update Council staff on legal obligations with regard to threatened and significant biodiversity, and the relevant targets and actions contained within this Biodiversity Conservation Strategy.	Workshops are to be targeted at teams or individuals whose day to day activities have the potential to negatively or positively impact on Key Habitat Areas, listed, or protected/listed species	M	Civil Works/ Environment and Sustainability
WMC 2	Undertake review of Councils maintenance and cleaning procedures, and where possible, integrate biodiversity monitoring or conservation measures into procedures.	Procedures to be reviewed should include those related to: • Mowing, pruning, green waste removal • Use of pesticides and cleaning agents in outdoor areas • Maintenance of marine structures (sea walls, moorings, jetties, swimming nets etc.)	H	Environment and Sustainability / Open Space Management
WMC 3	Conduct internal information sessions on the relevance and use of spatial biodiversity information.	Internal workshops with specific departments or teams are to be conducted to allow staff to familiarise themselves with the spatial environmental information available, and the range of uses for this data. Fact sheets are to be developed to accompany the workshop material. An in-field GPS data collection system is being developed with the potential to allow bush regeneration staff and volunteers to upload site based information directly to Councils GIS database.	M	Environment and Sustainability/ GIS

11.4 Private Land Use

The following table contains each of the actions within this category, and a description or notes on the action. The complete suite of actions is contained in section 11.10.

Table 11-4. Private Land Use – Action Summary

	Action	Description	Priority	Department /Team
PLU 1	Prepare landscape design guide to be included in Development Assessment Guide.	The guide is to further encourage use of native species and habitat conducive landscape design in private gardens. Guidance on tree selection will encourage native species with the following characteristics: • **Nectar:** Plants that produce nectar attract a wide range of birds and insects. • **Insect Pollinated:** Insect pollinated plants include acacias, figs and often those that have scented white flowers. • **Fruit:** Plant produces succulent fruit that is a known food source for fauna such as birds, Grey-headed Flying-fox and possums. • **Hollow Forming:** Most prevalent in mature smooth barked eucalypts – provides habitat for micro bat, bird and possum species. • **Autumn/Winter Flowering:** Provides important source of nectar when there few other resources, particularly for threatened fauna species such as Grey-headed Flying-fox. • **Shelter:** Dense and or prickly foliage providing shelter and nesting habitat for small birds and some protection from opportunistic bird species such as Noisy Miner and Pied Currawong. • **Threatened Species Habitat**	H	Environment and Sustainability

11.5 Domestic/ Feral Animal Management

The following table contains each of the actions within this category, and a description or notes on the action. The complete suite of actions is contained in section 11.10.

Table 11-5. Domestic/Feral Animal Management – Action Summary

	Action	Description / Notes	Priority	Department /Team
DOM 1	Parks Officer and Bush regeneration staff to inform Rangers/ Companion Animals Officer of key parks, times and offenders against dog prohibition/on leash regulations to inform prioritisation of patrols	It is envisaged that increased communication between parks officers / bush regeneration staff with rangers will allow more efficient action with regard to enforcing the Companion Animals Act.	H	Bushland Maintenance / Open Space Management
DOM 2	Maintain existing cat owner engagement and education program to encourage responsible self-monitoring pet ownership.	The Companion Animals Officer currently coordinates responsible pet ownership engagement activities.	H	Compliance
DOM 3	Continue to review and improve dog prohibition signage in currently prohibited areas	Dog prohibition signage is regularly reviewed, and updated on an as needs basis.	H	Open Space Management
DOM 4	Develop formal procedure for Council trapping of foxes when sighted in Key Habitat Areas	Ad hoc fox trapping has occurred in recent years in response to fox sighting. A formal procedure will be developed to ensure safety and environmental management measures are in place.	H	Bushland Maintenance

11.6 Education and Awareness

The following table contains each of the actions within this category, and a description or notes on the action (where required). The complete suite of actions is contained in section 11.10.

Table 11-6. Education and Awareness – Action Summary

	Action	Description / Notes	Priority	Department /Team
EDU 1	Conduct an annual Biodiversity in Woollahra photography competition	An annual biodiversity photography competition would encourage residents to visit Woollahra's natural areas, and take note of the biodiversity within the LGA.	H	Environment and Sustainability
EDU 2	Conduct bi-annual urban biodiversity information forums/ training sessions for bushcare volunteers.	Representatives of other land management organisations should be invited including NPWS, Sydney Living Museums, Royal Sydney Golf Club, and RMS.	M	Environment and Sustainability
EDU 3	Establish a demonstration small-bird friendly garden/ native bee hive and/or pond habitat at a high profile Council Reserve	Native bee hives have previously been established by volunteers at Gap Park and Vaucluse Public School. Trumper Park Nursery is a potential site for a native bee hive.	L	Environment and Sustainability
EDU 4	Establish an online form for the community to report fauna and flora sightings, and upload photographs	The form currently used for Penguin Watch could be adapted for this purpose. This data would supplement Council biodiversity monitoring. Confirmed sightings, with accompanying photographs, of species not previously known to reside/forage in the LGA would be added to the Master Fauna List.	M	Environment and Sustainability
EDU 5	Provide bi-annual biodiversity related stories to local media	Biodiversity related stories should be included in media communications to emphasise the biodiversity within Woollahra, and promote the natural areas available for residents. Specific events such as whale migrations, or seasonal changes in flora could be highlighted.	L	Environment and Sustainability/ Bushland Maintenance

	Action	Description / Notes	Priority	Department /Team
EDU 6	Provide annual native garden/ habitat friendly garden workshops	Workshops, with supplementary educational material, are to be provided for residents wanting to implement native habitat-friendly gardens and increase habitat. The workshop facilitator will demonstrate how to increase locally native species in gardens and design gardens to maximise the habitat value of the space.	M	Environment and Sustainability
EDU 7	Implement targeted education program for residents and landholders adjacent to Key Habitat Areas	Targeted program to include educational fliers for residents and landholders living adjacent to Key Habitat Areas, and information on Councils website. Fliers will provide specific information about the Key Habitat Area including listed species, information about the ecosystem function of the area, threats, and current Council initiatives.	M	Environment and Sustainability
EDU 8	Develop and implement biodiversity lesson plans for schools and child care centres, adaptable to suit all year levels from early childhood to year 12.	Established biodiversity lessons would be provided to all schools and child care centres, and promoted through the Council website and school networks for example the ESSSN (Eastern Suburbs Sustainable Schools Network) Development of the lessons include the production of resources and educational material. Lessons may be presented as part of an excursion to a Council bush reserve, or as an incursion. Council's environmental education officer and bushcare liaison officers would be responsible for the delivery of these presentations.	L	Environment and Sustainability

11.7 Regional Collaboration

The following table contains each of the actions within this category, the action number, and any explanation or notes on the action. The complete suite of actions is contained in section 11.10.

Table 11-7. Regional Collaboration – Action Summary

	Action	Description / Notes	Priority	Department /Team
COL 1	Establish a web portal for information sharing and collaboration between Council and external organisations responsible for overseeing landscape/biodiversity maintenance within Woollahra	Portal should allow transfer of information between NPWS, Sydney Living Museums, Royal Sydney Golf Club, RMS, Waverly, Sydney and Randwick Councils.	L	Environment and Sustainability
COL 2	Contact and establish process for collaborating with DPI and RMS on the management of seagrass habitat within Woollahra foreshore areas. Collate information on any programs related to monitoring seagrass populations	Management of the seagrass population is the jurisdiction of the Department of Primary Industries – Fisheries and Aquaculture. Council is to support DPI research and data collection activities.	H	Environment and Sustainability
COL 3	Contact and establish process for collaborating on biodiversity conservation project(s) with the Sydney Harbour Federation Trust regarding the Marine Biological Station Park and Macquarie Lightstation	The nature and scope of the projects will be determined following discussions with Sydney Harbour Federation Trust staff.	**L**	Environment and Sustainability
COL 4	Contact and establish process for collaborating on biodiversity conservation project(s) with NPWS regarding SHNP (Neilsen Park, Hermitage Foreshore, Green Point, South Head, Gap Bluff)	The nature and scope of the projects will be determined following discussions with National Parks and Wildlife Service staff.	**L**	Environment and Sustainability

	Action	Description / Notes	Priority	Department /Team
COL 5	Contact and establish process for collaborating on biodiversity conservation project(s) with Sydney Living Museums regarding the management of Vaucluse House and Vaucluse Bay	The nature and scope of the projects will be determined following discussions with Sydney Living Museums staff.	**L**	Environment and Sustainability

11.8 Funding

The following actions relate to sourcing of funds for the implementation of biodiversity conservation projects and programs outlined in this Strategy. The complete suite of actions is contained in section 11.10.

Table 11-8. Funding – Action Summary

	Action	Priority	Department /Team
FUN 1	Develop a list of potential grant projects and possible funding sources to allow proactive grant funded project implementation	H	Environment and Sustainability/ Bushland Maintenance
FUN 2	Continue to investigate options for grant funding to allow implementation of biodiversity conservation projects across the LGA from the following funding bodies: • The NSW Environmental Trust • The Metropolitan Greenspace Program (MGP) • NSW Saving our Species Partnership Grant Program (funded by the NSW Environmental Trust) • NSW Coastal and Estuary Management Program	H	Environment and Sustainability/ Bushland Maintenance

11.9 Future Consideration

The following actions may be implemented in the future following further investigation. The complete suite of actions is contained in section 11.10.

Table 11-9. Future Considerations

	Action	Description / Notes	Priority	Department /Team
FC 1	Undertake a risk assessment and viability study for the potential re-introduction of locally extinct flora and fauna species into suitable habitat areas.	Re-introduction of native species into an urban environment where there is significant existing pressure from external factors could pose a challenge and risk for Council and would require consideration and evaluation. In general re-introduction of lost plant species is not currently recommended unless the species is considered to contribute to a key ecological function and source material of an appropriate genetic source is available. It is considered that due to a lack of genetic certainty, local provenances should be retained and limited resources should be concentrated on ensuring that no more species are added to the "locally extinct" list (Benson 2011). With respect to fauna, considerations would need to factor in habitat suitability, viability, animal welfare, and genetics. It is recommended that a risk assessment and viability study be undertaken that identifies target species and matches these to target reserves, in order for the appropriate strategies to be identified and put in place prior to undertaking actions. *Guidelines for the translocation of Threatened Plants in Australia, Second Edition* should be used as a resource during the risk assessment and viability study. Available through the Australian Network for Plant Conservation Inc.	L	Environment and Sustainability

11.10 Biodiversity Action Plan Summary

The following table summarises the Biodiversity Conservation Actions. More detail on each of the options in this table is provided in sections 11.1 to 11.9.

Biodiversity Conservation Action Plan

LEGEND	
H	High Priority - completed by 2017-18
M	Medium Priority -completed by 2020-21
L	Low Priority - completed by 2024-25

No.	Action	Priority	Responsible Team	To improve our understanding of biodiversity in Woollahra through collation of data and monitoring of trends	To increase the extent, diversity and resilience of Woollahra's natural flora species and vegetation communities.	To increase the abundance, diversity and resilience of Woollahra's native fauna species	To control and reduce the abundance of introduced animal species	To reduce the abundance of introduced flora species and weeds	To protect and enhance creek and estuary ecosystems	To improve the water quality and habitat value of Woollahra's foreshore and marine areas	To collaborate with the community and other organisations contributing to biodiversity conservation in Woollahra.	To increase engagement with the broader community on biodiversity
HAB 01	Collaborate with Bushland Maintenance Team to determine options for further contributing to implementation of Biodiversity Conservation Strategy and support target monitoring and reporting	H	Bush Management Team/ Environment and Sustainability Team	✓	✓	✓	✓	✓	✓	✓		
HAB 02	Conduct facilitated Detailed Habitat Restoration Planning exercise with bush regeneration staff for parks and reserves within Key Habitat Areas.	H	Bush Management Team/ Environment and Sustainability Team	✓	✓	✓	✓	✓	✓	✓		
HAB 08	Identify sites that could benefit from scarification.	H	Bush Management Team					✓				
HAB 12	Conduct annual assessments of seahorse populations on swimming net enclosures.	H	Environment and Sustainability Team							✓		
HAB 14	Conduct ongoing maintenance of riparian vegetation in Parsley Bay Creek	H	Bush Management Team		✓				✓	✓		
HAB 15	Conduct annual aquatic fauna assessments in Parsley Bay Creek and Cooper Creek	H	Environment and Sustainability Team	✓		✓	✓					
HAB 16	Collaborate with Sydney Water regarding reconstruction of Estuarine Coastal Saltmarsh vegetation on the lower reaches of the Rose Bay culvert.	H	Environment and Sustainability Team		✓				✓	✓	✓	✓
HAB 17	Identify unused land that may be used for planting of native gardens and/or trees for the purposes of reducing urban heat island effect, increasing habitat, increasing permeable surfaces, and improving the amenity of unused spaces.	H	Environment and Sustainability Team		✓	✓			✓	✓		
DATA 01	Implement a Biodiversity Monitoring Program. Conduct monitoring every 2 years.	H	Environment and Sustainability Team	✓								
DATA 02	Undertake a water quality monitoring program.	H	Environment and Sustainability Team	✓					✓			

No.	Action	Priority	Responsible Team	To improve our understanding of biodiversity in Woollahra through collation of data and monitoring of trends	To increase the extent, diversity and resilience of Woollahra's natural flora species and vegetation communities.	To increase the abundance, diversity and resilience of Woollahra's native fauna species	To control and reduce the abundance of introduced animal species	To reduce the abundance of introduced flora species and weeds	To protect and enhance creek and estuary ecosystems	To improve the water quality and habitat value of Woollahra's foreshore and marine areas	To collaborate with the community and other organisations contributing to biodiversity conservation in Woollahra.	To increase engagement with the broader community on biodiversity
COL 02	Contact and establish process for collaborating with DPI and RMS on the management of seagrass habitat within Woollahra foreshore areas. Collate information on any programs related to monitoring seagrass populations	H	Environment and Sustainability Team			✓		✓		✓	✓	
DOM 01	Parks Officer and Bush regeneration staff to inform Rangers/ Companion Animals Officer of key parks, times and offenders against dog prohibition/on leash regulations to inform prioritisation of patrols	H	Bush Management Team	✓			✓					
DOM 02	Maintain existing cat owner engagement and education program to encourage responsible self-monitoring pet ownership.	H	Compliance		✓	✓	✓					
DOM 03	Continue to review and improve dog prohibition signage in currently prohibited areas	H	Open Space Management Team		✓	✓	✓					
DOM 04	Develop formal procedure for Council trapping of foxes when sighted in Key Habitat Areas	H	Bush Management Team		✓	✓	✓					
PLU01	Prepare landscape design guide to be included in Development Assessment Guide.	H	Environment and Sustainability Team									
EDU 01	Conduct an annual Biodiversity in Woollahra photography competition	H	Environment and Sustainability Team									✓
WMC 02	Undertake review of Councils maintenance and cleaning procedures, and where possible, integrate biodiversity monitoring or conservation measures into procedures.	H	Civil Works / Environment and Sustainability Team			✓			✓	✓		
EDU 08	Develop and implement biodiversity lesson plans for schools and child care centres, adaptable to suit all year levels from early childhood to year 12.	H	Environment and Sustainability Team								✓	✓
HAB 03	Incorporate Detailed Habitat Restoration Plans for parks and reserves within Key Habitat Areas as part of the next review and update of the Plan of Management or Masterplan.	M	Open Space Management Team		✓	✓	✓	✓	✓	✓		
HAB 04	Update relevant sections of the Plans of Management for all parks and reserves to include biodiversity conservation provisions as part of the next review and update of the Plan of Management or Masterplan.	M	Open Space Management Team		✓	✓	✓	✓	✓	✓		
HAB 05	Develop and Implement a Threatened Species Management Plan	M	Bush Management Team/ Environment and Sustainability Team		✓	✓					✓	

No.	Action	Priority	Responsible Team	To improve our understanding of biodiversity in Woollahra through collation of data and monitoring of trends	To increase the extent, diversity and resilience of Woollahra's natural flora species and vegetation communities.	To increase the abundance, diversity and resilience of Woollahra's native fauna species	To control and reduce the abundance of introduced animal species	To reduce the abundance of introduced flora species and weeds	To protect and enhance creek and estuary ecosystems	To improve the water quality and habitat value of Woollahra's foreshore and marine areas	To collaborate with the community and other organisations contributing to biodiversity conservation in Woollahra.	To increase engagement with the broader community on biodiversity
HAB 06	Monitor spread of phytophora throughout Cooper Park and implement control procedures where practical	M	Bush Management Team		✓			✓				
HAB 07	Continue monitoring of Bansksia serrata remnants in Gap and Cooper Park to determine presence of Banksia aemula	M	Bush Management Team					✓				
HAB 09	Bush regeneration staff to keep abreast of research into genetic provenance for Woollahra region, and plant known locally native species where possible	M	Bush Management Team		✓							
HAB 10	Adopt Sydney Weeds Committee Weed Incursion Plan 2010-2015 and access funding for emergency weed management as required.	M	Bush Management Team				✓		✓	✓		
EDU 02	Conduct bi-annual urban biodiversity information forums/ training sessions for bushcare volunteers.	M	Environment and Sustainability Team								✓	✓
EDU 04	Establish an online form for the community to report fauna and flora sightings, and upload photographs	M	Environment and Sustainability Team	✓								✓
EDU 06	Provide annual native garden/ habitat friendly garden workshops	M	Environment and Sustainability Team			✓						✓
EDU 07	Implement targeted education program for residents and landholders adjacent to Key Habitat Areas	M	Environment and Sustainability Team		✓			✓	✓	✓	✓	✓
WMC 01	Conduct annual workshops with indoor and outdoor staff to update Council staff on legal obligations with regard to threatened and significant biodiversity, and the relevant targets and actions contained within this Biodiversity Conservation Strategy.	M	Civil Works / Environment and Sustainability Team			✓			✓	✓		
WMC 03	Conduct internal information sessions on the relevance and use of spatial biodiversity information.	M	Environment and Sustainability Team/ GIS	✓								
HAB 18	Investigate opportunities for collection of logs/ stumps/ branches removed by Park and Tree Management teams and use in the creation of habitat in bushland areas	M	Bush Management Team/ Open Space Management		✓	✓						
HAB 11	Implement Eastern Suburbs Banksia Scrub Recovery Plan actions as appropriate for Woollahra	L	Bush Management Team	✓	✓	✓						
HAB 13	Conduct further ground truthing of Johnston's Lookout as a potential regeneration site to determine presence of Woody Pear and other native species.	L	Environment and Sustainability Team / Bush Management Team	✓	✓	✓						

No.	Action	Priority	Responsible Team	To improve our understanding of biodiversity in Woollahra through collation of data and monitoring of trends	To increase the extent, diversity and resilience of Woollahra's natural flora species and vegetation communities.	To increase the abundance, diversity and resilience of Woollahra's native fauna species	To control and reduce the abundance of introduced animal species	To reduce the abundance of introduced flora species and weeds	To protect and enhance creek and estuary ecosystems	To improve the water quality and habitat value of Woollahra's foreshore and marine areas	To collaborate with the community and other organisations contributing to biodiversity conservation in Woollahra.	To increase engagement with the broader community on biodiversity
COL 01	Establish a web portal for information sharing and collaboration between Council and external organisations responsible for overseeing landscape/biodiversity maintenance within Woollahra	L	Environment and Sustainability Team								✓	
COL 03	Contact and establish process for collaborating on biodiversity conservation project(s) with the Sydney Harbour Federation Trust regarding the Marine Biological Station Park and Macquarie Lightstation	L	Environment and Sustainability Team		✓	✓	✓					
COL 04	Contact and establish process for collaborating on biodiversity conservation project(s) with NPWS regarding SHNP (Neilsen Park, Hermitage Foreshore, Green Point, South Head, Gap Bluff)	L	Environment and Sustainability Team		✓	✓	✓			✓	✓	
COL 05	Contact and establish process for collaborating on biodiversity conservation project(s) with Sydney Living Museums regarding the management of Vaucluse House and Vaucluse Bay	L	Environment and Sustainability Team		✓	✓	✓			✓	✓	
EDU 03	Establish a demonstration small-bird friendly garden/ native bee hive and/or pond habitat at a high profile Council Reserve	L	Environment and Sustainability Team		✓	✓						
EDU 05	Provide bi-annual biodiversity related stories to local media	L	Environment and Sustainability Team/ Bush Management Team									✓

Woollahra Municipal Council

Biodiversity Conservation Strategy

2015 - 2025

12. BIODIVERSITY MONITORING PROGRAM FRAMEWORK

This report should be cited as 'Woollahra Municipal Council, 2015. Woollahra Biodiversity Conservation Strategy 2015-2025"

ACKNOWLEDGEMENTS

This Strategy was prepared by Woollahra Municipal Council staff and Eco Logical Australia, and was the subject of an expert peer review completed by Total Earth Care in 2014. The Strategy was developed incorporating feedback and input of Woollahra Municipal Council Sustainability, Bushland Management, Tree Management, and Planning staff. Council wishes to thank the Woollahra residents and visitors who contributed to the Strategy through their involvement in the online survey. Council also wishes to thank the representatives of key agencies who provided feedback through the stakeholder survey.

Cover photo: Acacia terminalis subspecies terminalis, Gap Park, Watsons Bay

12. Biodiversity Monitoring Program Framework

To monitor the condition of biodiversity in the LGA, and assess the impact of biodiversity conservation actions, a Biodiversity Monitoring Program will be developed.

The Biodiversity Monitoring Program will involve the collection of data gained through on-ground bush regeneration works, specific surveys and monitoring programs, and information provided by State and Federal Governments.

A data entry protocol will be developed to ensure completeness, accuracy and consistency of data. For example, users should record all information associated with the data (e.g. survey method, name of person entering data, date that data is entered, corresponding reports etc.), and allow notes to be made to allow consistency and information sharing between users.

The data included in the Biodiversity Monitoring database should be developed into spatial information layers, where possible.

Table 12-1 contains the suite of monitoring activities, and the proposed frequency of monitoring.

Table 12-1.Biodiversity Monitoring Program – Data sources and Frequency

Biodiversity Indicator	Proposed Monitoring Frequency
Fauna and Flora Species List (including conservation status)	Frequency: Updated annually by bushland maintenance staff and bushcare volunteers, and community sightings as they are reported
Condition of remnant vegetation in Key Habitat Areas	Frequency: In 2015-16, then every 2 years A vegetation classification and condition mapping exercise should be conducted to provide Council with an accurate baseline. The mapping exercise will include the following: • A comprehensive species list for each vegetation type • Validation of threatened flora records on the NSW Bionet Atlas • Validation of the *Pimelea curviflora var. curviflora* record at South Head[1] • An updated list of vegetation types within Woollahra with photos, description (structure, dominant and associated tree species and common understorey species), habitat, distribution, local and regional conservation significance and potential for threatened species habitat • Ground truthing of weedy areas for their potential for native soil seed bank and future management as bush-regeneration sites
Threatened Species, Microbats and small birds – condition, abundance and	Frequency: In 2015-16, then every 2 years

[1] Note: Field assessments undertaken as part of this Biodiversity Conservation Strategy did not identify the species; however some primary locations for this species were not accessible.

Biodiversity Indicator	Proposed Monitoring Frequency
threats	
Stormwater quality	Frequency: Every 3 years Water quality monitoring results from catchment wide water quality monitoring program, updated every 3 years supplemented with weekly Beachwatch data, and stormwater quality data collected at pollution hotspots as required.
Revegetation and Bush Regeneration Works	Frequency: Annually Area (Ha) under regeneration and fully regenerated.
Seagrass Extent and Condition	Frequency: Every 5 years Change in condition and extent measured every 5 Years in collaboration with Department of Primary Industries – Fisheries and Aquaculture
Notes: 1. *Pimelea curviflora* var. *curviflora* was not sighted during field investigations as part of this Strategy, however many areas were not accessible	

Woollahra Municipal Council

Biodiversity Conservation Strategy 2015 - 2025

REFERENCES

References

Australian Museum Business Services (AMBS) (2002). Port Survey for Introduced Marine Species – Sydney Harbour. Prepared for Sydney Ports Corporation.

Auld T. D. and Keith D.A., 2009. Dealing with Threats: Integrating Science and Management Ecological Management & Restoration 10 p79 – 87

Bens, M., 2011. 'Liquid Asset Prized in any Language' Sydney Morning Herald 20 August p 17 viewed October 2013 http://newsstore.smh.com.au/apps/viewDocument.ac;jsessionid=007C8BFF8E5608B9E71656DEA94707D9?sy=afr&pb=all_ffx&dt=selectRange&dr=1month&so=relevance&sf=text&sf=headline&rc=10&rm=200&sp=brs&cls=18888&clsPage=1&docID=SMH110820IF7014NK5LD

Benson, D and Howell, J., 1990a. Taken for Granted: The bushland of Sydney and its suburbs Kangaroo Press in association with the Royal Botanic Gardens Sydney

Benson, D and Howell, J., 1990b. Sydney's vegetation 1788-1988: utilization, degradation and rehabilitation. Proceedings of the Ecological Society of Australia 16: 115-127.

Benson, D and Howell, J., 1994. The natural vegetation of Sydney 1:100 000 map sheet. Cunninghamia 3(4): 679-729.

Benson, D, 2011. Native plants of Sydney Harbour National Park: historical records and species lists, and their value for conservation monitoring Cunninghamia 12(1) pp 61 – 84

Birch, G.F. and Olmos, M.A (2008). Sediment-bound heavy metals as indicators of human influence and biological risk in coastal water bodies. ICES Journal of Marine Science, 65 (pp.1407-1413)

Biotrack, 2005a. Biological water quality assessment of Parsley and Cooper Park Creeks, Spring 2005.

Biotrack, 2005b. Biological water quality assessment of Parsley, Cooper Park and Rose Bay Creeks, Autumn 2005.

Cardno, 2013. Woollahra Coastal Zone Management Plan Stage 1, prepared for Woollahra Municipal Council.

City of Sydney, 2014. Urban Ecology Strategic Action Plan

Creese, R.G, Davis, A. R. and Glasby T. M, 2004. Eradicating and preventing the spread of the invasive alga Caulerpa taxifolia in NSW, NSW Fisheries Final Report Series No. 64

Department of Primary Industries (DPI), 2007. Seagrasses Prime Fact 629 http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0019/203149/seagrasses-primefact-629.pdf

Department of Primary Industries (DPI), 2011. Distribution of Caulerpa taxifolia and seagrasses within Port Jackson. Available http://www.dpi.nsw.gov.au/fisheries/pests-diseases/marine-pests/nsw/caulerpa-taxifolia [accessed May 2014].

Department of Primary Industries, n.d. Seahorses and their Relatives http://www.dpi.nsw.gov.au/fisheries/species-protection/protected-species/marine-or-estuarine-species/syngnathiformes [accessed October 2013].

Department of Primary Industries (DPI), 2012. Endangered populations in NSW: *Posidonia australis* in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie – Factsheet, Fisheries ecosystem unit, Port Stephens Fisheries Institute

Department of Primary Industries (DPI), 2013a. Fishing and Aquaculture 'What is currently listed?' Available: http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what-current [accessed 23 October 2013]

Department of the Environment (then DEST), 1996 . National Strategy for the Conservation of Australia's Biological Diversity, Department of the Environment, Sport and Territories, Canberra

Creese, R.G., Glasby, T.M., West, G. and Gallen, C (2009). Mapping the Habitats of NSW Estuaries. Prepared for the Hunter Central Rivers Catchment Management Authority

Eco Logical Australia, 2010. Cooper Park Vegetation Management Plan Report prepared for Woollahra Municipal Council

Fuller, R, Irvine, K, Devine-Wright, P, Warren, P and Gaston, J 2007. Psychological benefits of greenspace increase with biodiversity Biology Letters 3 p 390-394

Gosper, n.d, Creating Habitat for Birds, Fact Sheet 6. Available http://www.environment.nsw.gov.au/resources/nature/sbsDrpStage106HabitatForBirds.pdf [accessed May 2014]

Harasti D, Glasby TM and Martin-Smith K, 2010. Striking a Balance between Retaining Populations of Protected Seahorses and Maintenance of Swimming Nets http://www.dpi.nsw.gov.au/research/areas/aquatic-ecosystems/outputs/2010/1263

Hoisington, C 2011 quoted in Bens, M., 2011. 'Liquid Asset Prized in any Language' Sydney Morning Herald 20 August p 17 viewed October 2013

Hutchings, P, Ahyong, S, Ashcroft, M, McGrouther, M and Reid, A, 2010. Sydney Harbour: its diverse biodiversity The Royal Zoological Society of New South Wales Volume 36 (3)

Kelleway, J, Williams, R J & Allen C B, 2007. An Assessment of the Saltmarsh of the Parramatta River and Sydney Harbour NSW Department of Primary Industries, Cronulla Fisheries Research Centre of Excellence

Landarc, 1991. Register of Significant Trees Volume 2, Report prepared for Woollahra Municipal Council

National Parks and Wildlife Service, NSW, 2010. Sydney Harbour National Park Draft Plan of Management - Section 3 Precincts. NSW Government

Office of Environment and Heritage, 2012. Plan of Management Sydney Harbour National Park http://www.environment.nsw.gov.au/resources/planmanagement/final/20120757SydneyHarbourNPFinal.pdf accessed September 2013

Office of Environment and Heritage, 2013a. The Native Vegetation of the Sydney Metropolitan Area, Volume 1: Technical Report, Version 2.0

Office of Environment and Heritage (2013b) Beachwatch Monitoring Program. State of the Beaches 2010-2011: Sydney Estuarine Beaches Region. Beachwatch, NSW Office of Environment and Heritage.

Office of Environment and Heritage, 2014. NSW Wildlife Atlas search tool. (Accessed 2014).

Pearson, L, Heyenga, S, Wang, X and Whitten, S., 2007. Environmental Asset Management Plan Feasibility Study – Brisbane City Council. CSIRO Sustainable Ecosystems, Brisbane.

Randwick City Council, 2013. Biodiversity webpage http://www.randwick.nsw.gov.au/Looking_after_our_environment/Sustaining_our_city/Biodiversity/index.aspx [accessed October 2013]

DSEWPaC, 2012. National Wildlife Corridors Plan: A framework for landscape-scale conservation, Department of Sustainability, Environment, Water, Population and Communities.

Sydney Institute of Marine Sciences (SIMS) (2012). Source: http://www.sims.org.au. Accessed 9 August 2012.

Smith, P. and Smith, J., 2009. Warringah Natural Area Survey: Vegetation History and Wildlife Corridors 2009 Update, P. and J. Smith Ecological Consultants, Report prepared for Warringah Council

State of the Environment, 2011. Committee. Australia state of the environment 2011. Independent report to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities.
Canberra: DSEWPaC, 2011.

The Ecology Lab Pty Ltd, 2008. Watsons Bay Baths Upgrade Aquatic Ecology Survey. Prepared for Woollahra Municipal Council

Thomas Berrill Landscape Design Pty Ltd, 2011. Cooper Park Conservation Management Plan Report prepared for Woollahra Municipal Council

UNSW, 2011. The Nielsen Park Invertebrate Survey

Woollahra Municipal Council, 1995. Woollahra Council Flora and Fauna List 1995.

Woollahra Municipal Council, 1996a, Plan of Management Christian Park adopted May 1996

Woollahra Municipal Council, 1996b, Plan of Management Natural Areas (Foreshores) adopted June 1996

Woollahra Municipal Council, 1996c, Plan of Management Trumper Park adopted March 1996

Woollahra Municipal Council, 1996d. Plan of Management District Park adopted May 1996.

Woollahra Municipal Council, 1996e. Plan of Management McKell Park adopted June 1995

Woollahra Municipal Council, 1997a. Redleaf Plan of Management adopted December 1997.

Woollahra Municipal Council, 1997b. Plan of Management Drainage Reserves adopted April 1997.

Woollahra Municipal Council, 2001a. Cooper Park Plan of Management adopted March 2001

Woollahra Municipal Council, 2001b. Woollahra Park Plan of Management adopted March 2001.

Woollahra Municipal Council, 2003a. Lyne Park Plan of Management Volume One: Description, Legislation and Tenure adopted April 2003

Woollahra Municipal Council, 2003b. Lyne Park Plan of Management Volume Two: Planning Issues and Action Plans adopted April 2003

Woollahra Municipal Council, 2004. Robertson Park Plan of Management and Action Plan adopted November 2004.

Woollahra Municipal Council, 2005a. Rushcutters Bay Park, Yarranabbe Park and Plantation Reserve Plan of Management

Woollahra Municipal Council, 2005b. Royal Hospital for Women Park Plan of Management adopted March 2005.

Woollahra Municipal Council, 2010. Chiswick Gardens Plan of Management adopted July 2010.

Woollahra Municipal Council, 2013a. Revised Community Strategic Plan Woollahra 2025 - our community, our place, our plan adopted June 2013

Woollahra Municipal Council, 2013b. Draft Street Tree Master Plan 2013.

Woollahra Municipal Council, 2014. Harbour View Park Plan of Management

Flora and Fauna list References

- Benson,D. H., 1990. Taken for granted: the bushland of Sydney and its suburbs. The Royal Botanic Gardens Sydney.
- Benson. D., 2011. Native plants of Sydney Harbour National Park: historical records and species lists, and their value for conservation monitoring. Cunninghamia 12(1): 61-84.
- Eco Logical Australia, 2007. Ecological Assessment Fauna Report for the Gap Park Masterplan. Report prepared for Thompson Berrill Landscape Design Pty Ltd.
- Eco Logical Australia, 2010. Cooper Park Vegetation Management Plan, prepared for Woollahra Municipal Council
- Eco Logical Australia, 2013. Site surveys completed to inform Woollahra Biodiversity Strategy
- Hirschfeld et al, 1999. Adaptation from the 'Flora list for Nielsen Park of the Council of the City of Randwick Community Nursery', compiled by D. Hirschfeld, P. Ibbetson & J.A.D. Hilliard. October 1998 to July 1999
- HLA-Envirosciences Pty Limited, 2004, Bushland Management Plan HMAS Watson, prepared for Defence Maintenance Management Pty Ltd.
- NSW National Parks and Wildlife Service, 2007. South Head Stage 1 Draft Conservation Management Plan - Volume 1.
- NSW Department of Environment (then DECCW), 2010. Sydney Harbour National Park Draft Plan of Management - Section 3 Precincts.
- Office of Environment and Heritage, 2013. NSW Wildlife Bionet Atlas (Accessed September 2013).
- Office of Environment and Heritage, 2014. NSW Wildlife Bionet Atlas (Accessed May 2014)
- Pers comms Woollahra BushCare staff and volunteers, 2013.
- Pers comms Jeff Hill, Woollahra Municipal Council Technical Officer, Parks, 2013
- Pers Comms Woollahra BushCare staff and volunteers, 2014.
- Total Earth Care, 2014. Site assessments as part of the peer review of the Woollahra Biodiversity Conservation Strategy
- Woollahra Municipal Council, 1995. Woollahra Council Flora and Fauna List 1995.
- Woollahra Municipal Council, 2001. Cooper Park Plan of Management 2001.
- Woollahra Municipal Council, 2003. Gap Park Flora and Fauna Survey 2002/2003.
- Woollahra Council, 2003. Parsley Bay Reserve Vegetation Management Report and recommended action plans.

Additional References and Reading Material (not referenced)

Australian Bureau of Statistics 2013 Australia's Biodiversity http://www.abs.gov.au/ausstats/abs@.nsf/Previousproducts/1301.0Feature%20Article12009%E2%80%9310?opendocument&tabname=Summary&prodno=1301.0&issue=2009%9610&num=&view= accessed October 2013

Australian Government, Department of Agriculture The Welfare of Translocated Vulnerable Native Animals in Australia http://www.daff.gov.au/animal-plant-health/welfare/aaws/aaws_international_animal_welfare_conference/the_welfare_of_translocated_vulnerable_native_animals_in_australia accessed October 2013

Australian Museum Business Services 2011 Biodiversity Study of the Waverley Local Government Area Report prepared for Waverley Council

BirdLife Australia: Birds in Backyards n.d. Small insect-eating birds accessed 05/06/13 http://www.birdsinbackyards.net/birds/featured/Small-insect-eating-birds

Eco Logical Australia 2007. Ecological Assessment – Fauna Report for the Gap Masterplan. Prepared for Thompson Berrill Landscape Design Pty Ltd

Eco Logical Australia 2013, Results of Stage 1 Stakeholder Engagement Plan – Woollahra Biodiversity Conservation Strategy, Draft Report prepared for Woollahra Municipal Council

HLA-Envirosciences, 2004 Bushland Management Plan HMAS Watson – Final Prepared for Defence Maintenance Management Pty Ltd

Hirschfeld, D, Ibbetson P. & Hilliard. A. D October 1998 to July 1999 Flora list for Nielsen Park of the Council of the City of Randwick Community Nursery'

Historic Houses Trust n.d. The Gardens of Vaucluse House Brochure http://www.hht.net.au/__data/assets/pdf_file/0009/90639/Guide_to_gardens_of_Vaucluse_House.pdf [accessed September 2013]

Holmer, M and Nielsen, M, (2007) Effects of Filamentous Algal Mats on Sulfide Invasion in Eelgrass (Zostera marina) Journal of Experimental Marine Biology and Ecology 353, 245–252

Macreadie, P, Baird M, Trevathan-Tackett, S, Larkum, A and Ralph P, nd. Quantifying and Modelling the Carbon Sequestration Capacity of Seagrass Meadows – A Critical Assessment Marine Pollution Bulletin August 2013 (in press)

Manfred Lenzen 2005. An Ecological Footprint study of Eastern Sydney. Prepared for Randwick Council. University of Sydney

NSW National Parks and Wildlife Service 2000. Endangered Population of Little Penguins (*Eudyptula minor*) at Manly Recovery Plan Approved October 2000

National Parks and Wildlife Service, NSW 2007. SOUTH HEAD Stage 1 Draft Conservation Management Plan

Parkland Environmental Planners 2005. Rushcutters Bay Park, Yarranabbe Park and Plantation Reserve Plan of Management adopted November 2005. Prepared for Woollahra Municipal Council.

Richardson, K, 2010. The welfare of translocated vulnerable native animals in Australia. School of Veterinary and Biomedical Sciences, Murdoch University. Available: http://www.daff.gov.au/__data/assets/pdf_file/0006/1046715/67-ken-richardson.pdf

Sydney Bush Regeneration Company 2010 Waverley Flora Study Report prepared for Waverley Council

West, G and Williams R. J. 2008, A Preliminary Assessment of the Historical, Current and Future Cover of Seagrass in the Estuary of the Parramatta River NSW Department of Primary Industries – Fisheries Final Report Series No. 98

Woollahra Municipal Council, 1996. Plan of Management General Community Use (Reserves) adopted May 1996.

Woollahra Municipal Council, 1996. Plan of Management Local Parks adopted December 1995.

Woollahra Municipal Council, 2003c. Gap Park Flora and Fauna 2002/2003. Woollahra Municipal Council, Double Bay