

ATTACHMENT A

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**DRAFT URBAN ECOLOGY
STRATEGIC ACTION PLAN**

Urban Ecology Strategic Action Plan

Draft



BUSH RESTORATION

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Message from the Lord Mayor

A diverse and thriving urban ecology makes our city a healthier, more attractive and more enjoyable place to live.

Despite being the largest city in the country, Sydney is still home to native plants, small animals, birds, reptiles and insects. Our local biodiversity has been greatly reduced from its original state and it's important that we protect what remains.

The Urban Ecology Strategic Action Plan outlines the City of Sydney's approach to identify, protect and rebuild locally indigenous plants and animals. We want to work with the community to improve awareness and encourage people to conserve and foster the biodiversity of our city.

The Plan is part of the City's work to restore and conserve our urban ecosystems to create a liveable city for all of its inhabitants.



Lord Mayor Clover Moore



Executive Summary

Introduction

The City of Sydney (the City) commissioned this Urban Ecology Strategic Action Plan as one of many cross-organisational initiatives aimed at achieving the *Sustainable Sydney 2030* vision of a green, global, connected City. Urban ecology is a strategic focus area of the City's Greening Sydney Plan, which documents the City's commitment and aspirations for the 'living' green component of the *Sustainable Sydney 2030* vision.

The focus of this Plan is the biodiversity of the City of Sydney local government area (LGA). Although biodiversity has been greatly reduced from its original state within the LGA, some significant vegetation and many fauna species remain, and there is substantial potential to conserve and enhance these existing biodiversity values. There is also associated potential to improve community awareness of and appreciation for biodiversity, not just locally but more broadly.

The City's vision for the Plan is to restore and conserve resilient urban ecosystems that support a diverse range of locally indigenous flora and fauna species, and in so doing to create a liveable City for all of its inhabitants.

Approach

To guide the development of the Plan, the current status of biodiversity in the LGA was first determined by an Urban Ecology Survey, which comprised:

1. A review of existing information;
2. Flora and fauna surveys, vegetation mapping and habitat assessment;
3. Community consultation;
4. Identification of priority sites, supporting sites and priority fauna species;
5. Identification of potential habitat linkages across the LGA and between adjacent LGAs; and
6. Identification of threats to biodiversity within the LGA.

An overview of the survey results is presented in the following sections.

Flora

Small areas of vegetation representative of five recognisable communities, including some possible remnants and naturally occurring species, were identified and mapped in the LGA:

- Sydney Turpentine Ironbark Forest – possible remnant trees;
- Coastal Saltmarsh – planted and naturally regenerating patches;
- Coastal Swamp/Alluvial Forest – possible remnant trees;
- Mangrove Forest – planted and naturally regenerating trees;
- Coastal Sandstone Outcrop Complex – possible remnants and other naturally occurring species; and
- Freshwater Wetlands – vegetated constructed wetlands/ponds.

Several bush restoration sites and other plantings comprising indigenous/mostly indigenous species were also mapped.

All of the above are of conservation significance. Sydney Turpentine Ironbark Forest, Coastal Saltmarsh and Coastal Swamp/Alluvial Forest are of particular significance as they are representative of endangered ecological communities.

Around 365 indigenous flora species were recorded, and individuals of around 70 of these were considered to be naturally occurring. More than 80 weed species were also recorded.

Fauna

A total of 99 fauna species was confirmed in the LGA, comprising 87 indigenous species and 12 introduced species. The total comprises:

- 70 bird species, including seven introduced species;
- 13 mammal species (with an additional two unconfirmed), including five introduced species;
- 11 reptile species; and
- Five frog species.

Many of the species recorded have adapted well to urbanisation and are abundant and widespread in the LGA and other urban areas. In contrast, many of the other species were recorded in small numbers at only a small number of sites, and appear to be scarce in the LGA. These types of species have declined and in many cases disappeared altogether in this LGA and many other highly urbanised areas.

Three of the fauna species recorded – the Green and Golden Bell Frog, Grey-headed Flying-fox, Powerful Owl and one of the unconfirmed species, the Eastern Bent-wing Bat, are listed as threatened species. Long-nosed Bandicoots in the LGA may be part of an endangered population.

Priority sites

Six priority sites with relatively high biodiversity values were identified in the LGA based on the survey results. These are listed below (two actually comprise multiple sites that are in close proximity to each other, and three are not managed by the City):

- Sydney Park;
- Glebe Foreshore Walk East to Orphan School Creek;
- Pyrmont (sandstone cliffs and outcrops and bush restoration sites);
- the Royal Botanic Gardens and Domain (Yurong Precinct);
- Garden Island (northern end); and
- Moore Park (Mt Steel, Moore Park Golf and Lake Kippax).

Many other sites in the LGA were identified as having important biodiversity values in their own right and/or as having the potential to support the priority sites. These supporting sites include small, City-managed parks as well as sites managed by others.

Priority fauna species

Eight priority fauna species/groups were identified in the LGA, including all of the threatened species, as well as the species that were recorded in small numbers and at a small number of sites, and that are generally uncommon in urban areas. The priority species are:

- the Green and Golden Bell Frog and other frogs such as the Eastern Dwarf Tree Frog and Perons Tree Frog;
- Grey-headed Flying-fox;
- Powerful Owl;
- Long-nosed Bandicoot;
- Microbats such as Gould's Wattled Bat, Eastern Freetail Bat, and Little Forest Bat;
- Small birds such as the Superb Fairy-wren, New Holland Honeyeater and Silvereye;
- Freshwater wetland birds such as the Australian Reed-warbler, Black-fronted Dotterel, Black-winged Stilt, Buff-banded Rail and Royal Spoonbill; and
- Reptiles such as the Eastern Blue-tongue, Bar-sided Skink and Gully Skink.

Threats

Numerous threats to biodiversity were identified in the LGA. These are common to most urban areas, particularly inner city locations, and include:

- Limited habitat availability;
- Lack of habitat connectivity;
- Destruction and fragmentation of remaining habitat;
- Low genetic diversity;
- Weed invasion;
- Use of chemical herbicides and pesticides;
- Introduced fauna;
- Indigenous fauna;
- Diseases and pathogens;
- Poor water quality and inappropriate hydrological regimes;
- Light, noise, traffic, and other disturbance; and
- Climate change.

Strategic Action Plan

Objectives and targets

In order to achieve the City's vision for the Plan, a series of objectives and targets have been developed, as outlined in Table A.

Table A Urban Ecology Strategic Action Plan objectives, targets, and monitoring requirements

Category	Objectives	Targets
Locally indigenous vegetation	Protect, expand and improve condition of naturally occurring locally indigenous vegetation, including possible remnants	<ul style="list-style-type: none"> Area of naturally occurring vegetation maintained or increased from 2012 baseline of 2.7 hectares by 2023 Naturally occurring vegetation in good condition by 2023
	Increase the extent of bush restoration sites across the LGA, and maintain sites in good condition	<ul style="list-style-type: none"> Area of bush restoration sites increased by 100 per cent from 2012 baseline of 4.6 hectares by 2023 Bush restoration sites characterised by well-established, structurally complex vegetation, free of weeds by 2023
	Re-establish representative patches of the likely original vegetation communities	Representative patches of at least three likely original vegetation communities established by 2024
Fauna	Protect and enhance sites that provide habitat for priority fauna species	Indigenous fauna species diversity maintained or increased by 2023 based on 2012 baseline
	Increase the distribution and abundance of priority fauna species across the LGA	Priority fauna species recorded from greater number of locations and in higher numbers compared to 2012 baseline by 2023
Habitat connectivity	Improve habitat connectivity across the LGA, particularly between priority sites, and between identified habitat areas in adjoining LGAs	Progressive increase in number of habitat features for priority fauna species established along potential habitat linkages by 2023

Actions

To meet the objectives and targets, two broad types of actions are outlined in the Plan:

1. General actions – actions that require implementation across the City of Sydney organisation and/or the LGA as a whole. These have been further grouped into five categories:
 - Park and streetscape maintenance – actions focused on expanding bush restoration and other habitat enhancement works, and ensuring that best practice bush regeneration and biodiversity management practices are implemented;
 - Planning controls – actions focused on ensuring an appropriate level of ecological assessment is incorporated into the development assessment process, and maximising the potential for new developments to incorporate habitat features;
 - Staff and contractor engagement – actions focused on improving staff and contractor awareness of biodiversity and their requirements in relation to this Plan;
 - Community engagement – actions focused on improving community awareness of biodiversity and increasing participation in bush restoration and other habitat enhancement works; and
 - Partnerships – actions focused on collaborations with other land managers within the LGA, and with government departments, non-government organisations and research institutions to maximise the effectiveness of the Plan.
2. Specific actions – site-specific actions that relate to the six priority sites, and species-specific actions that relate to the priority fauna species.

Implementation, performance assessment, reporting and review

The Plan will be implemented over a ten-year period, from 2013–14 to 2022–23. Numerous actions are already in progress, and many will be ongoing. An annual implementation plan will be prepared and key projects will be incorporated into the City's annual Corporate Plan.

Plan implementation will require estimated one-off funding of \$597,000 and annual recurrent funding of approximately \$1,378,000. Approximately \$93,000 of one-off funding and \$1,263,000 of annual recurrent funding is covered within existing budgets. New budget items will be subject to the annual budget bid process.

In order to evaluate the City's performance in implementing the Plan, the overall number of actions implemented annually will be monitored and recorded and monitoring will also be undertaken in relation to the targets.

An annual report on the implementation of the Plan will be produced at the end of each financial year, with a summary incorporated into the City's annual State of Environment Report. Progress throughout the year will be reported in the City's quarterly Environmental Sustainability Progress Report.

The Plan will be subject to the principles of adaptive management, i.e. actions will be reviewed annually based on monitoring results and modified where necessary. Recommendations for modification of the plan will be incorporated into the annual report. The plan will also be subject to a full review after a ten-year period, i.e. in 2022–23.

01

Background

1.1 Introduction

The City of Sydney (the City) commissioned this Urban Ecology Strategic Action Plan (the Plan) as one of many cross-organisational initiatives aimed at achieving the *Sustainable Sydney 2030* vision of a green, global, connected City, and in response to considerable community interest. Urban ecology is a strategic focus area of the City's Greening Sydney Plan, which documents the City's commitment and aspirations for the 'living' green component of the *Sustainable Sydney 2030* vision.

This Plan outlines the City of Sydney's approach to biodiversity management over a five-year timeframe. It outlines the City's legislative and non-regulatory obligations in relation to biodiversity management, provides information about the past and present biodiversity of the local government area (LGA), identifies current threats to biodiversity within the LGA, outlines objectives, targets and the actions required to conserve and enhance biodiversity across the LGA, and outlines the monitoring that will be undertaken to measure progress and how this will be reported.

1.2 What is urban ecology and why is it important?

Urban ecology is the study of the relationship between living organisms and their environment in an urbanised context. Living organisms and the ecosystems they form are commonly termed 'biodiversity', a truncation of the words biological diversity.

Biodiversity provides the ecological processes including ecosystem services that are essential for the survival of humans and all other living organisms. These include maintenance of oxygen in and absorbing pollutants from the air (Pugh *et al.* 2012), soil enrichment, water purification, plant pollination, food production, pest control, climate regulation, decomposition of organic waste, and erosion control. These processes do not just take place in natural areas like extensive tracts of bushland – they take place in all environments, including urban areas like the LGA.

Biodiversity also has intrinsic cultural, aesthetic, and often economic values. Given most of Australia's (and the world's) human population now lives in urban areas, and urban areas are continuing to expand, urban biodiversity is and will continue to comprise the plants, animals and other organisms most people encounter in their day-to-day lives. It can contribute to the quality of life of urban residents by improving visual and recreational amenity, and providing a connection with the natural world (Miller 2005) – research shows that regular contact with nature can help to lower stress, boost immunity, heighten creativity and improve cognitive function. It is also important in helping urban residents to form an ethic of care for biodiversity, not just locally but more widely (Lunney & Burgin 2004). This has significant potential to lead to action being taken to address patterns of biodiversity decline not just at the local scale, but also at regional, national and global scales (Miller 2005; McKinney 2002).



Biodiversity can provide a connection with nature and enhance quality of life in the inner city.

a Indigenous vegetation at Embarkation Park, Potts Point.

b Habitat plantings undertaken by a Glebe resident.

c Bush restoration site on the Glebe foreshore.

d Indigenous grassland at Prince Alfred Park, Redfern.

e An inner-city resident enjoying Banksia blooms.

(Photos K. Oxenham)

This Plan is focused on the terrestrial biodiversity of the LGA, and mainly considers those groups of species for which a relatively large body of information is available, these being vertebrate fauna (amphibians, reptiles, birds and mammals) and vascular flora (including trees, shrubs, grasses, herbs and ferns). It is acknowledged, however, the vast majority of biodiversity comprises invertebrates, mosses, lichens, bacteria and other groups. The actions outlined in this Plan are intended to benefit all of these taxonomic groups.

1.3 Why an Urban Ecology Strategic Action Plan for the City?

The City is characterised by high-density residential, commercial and industrial land uses with open space largely dedicated to recreational uses. Almost all of the original vegetation and other natural features have been removed or modified. As a result, biodiversity within the LGA has been greatly reduced from its original state. Without appropriate management, increasing human population and ongoing development are likely to cause further declines. To prevent this, a Plan is required to provide a co-ordinated approach to ensuring the conservation and enhancement of biodiversity in the LGA.

Managing urban biodiversity involves many challenges, but also offers many opportunities. While the extent of vegetation clearance and removal or modification of other natural features has led to the loss of many species from the city, many species still can and do live in the LGA – in fact, numerous species, both indigenous and exotic, have flourished in urban areas including the city. However, many other species are present in the city in only small numbers and/or at a small number of sites – these are the types of species that are at risk of disappearing from the LGA without management action, and it is these species that are the focus of this Plan.

Many other cities around the world have implemented biodiversity-related initiatives as the importance of urban biodiversity has gained recognition. Examples include:

- Paris, France, where the Paris Council has adopted a biodiversity plan for the city that proposes the following three main courses of action:
 - Creation of ecological corridors to connect large natural areas;
 - Making biodiversity a key consideration in municipal actions, including urban planning and the use and sustainable management of green space, rivers and canals; and
 - Improving community awareness and engagement through the establishment of a Paris Biodiversity Observatory.
- Toronto, Canada, where the City of Toronto is preparing a Biodiversity Strategy and has produced the following with assistance from community groups, academics and other stakeholders:
 - The 'Biodiversity Series', a collection of publications on the variety of species found within the city;
 - Bird-friendly development guidelines; and
 - A green roof bylaw, requiring residential, commercial, industrial and institutional developments to incorporate green roofs.
- Nagoya, Japan, where the City of Nagoya has specified three focus areas relating to biodiversity in its Basic Environmental Plan, one of which is taking action to co-exist with nature, for example by:
 - The preservation and wise use of wetlands;
 - The regeneration of Higashiyama Zoo and Botanical Gardens; and
 - The creation of managed satoyama woodlands.
- Malmo, the third largest city in Sweden, where a 'green points' system has been applied to new residential developments to ensure the incorporation of habitat features such as ponds, bat roost boxes, butterfly flower beds and wildflower meadows.

Similarly, urban biodiversity initiatives are being implemented in other Australian cities. Brisbane City Council has prepared the Brisbane City Biodiversity Strategy, and the City of Melbourne is in the process of preparing an urban ecology and biodiversity strategy.



a



b



c



d



e



f

- a. A recently-constructed frog pond in a prominent park in central Paris (photo K. Oxenham)
- b. A green roof vegetated with indigenous species on a wi-fi zone in central Paris
- c. Living fence at the London Wetlands Centre (photo K. Oxenham)
- d. Sculpture designed to provide habitat for native bees in the Jardin des Plantes, Paris (photo K. Oxenham)
- e. The High Line in New York City – a disused, elevated railway converted into open space vegetated with diverse indigenous species
- f. Green roof on Chicago City Hall

1.4 Vision

The City's vision is to restore and conserve resilient urban ecosystems that support a diverse range of locally indigenous flora and fauna, and in so doing create a liveable City for all of its inhabitants.

To achieve this vision, three categories of objectives have been identified for this Plan, as outlined in Table 1.

Table 1 Objectives of the Urban Ecology Strategic Action Plan

Category	Objectives
Locally indigenous vegetation	<ul style="list-style-type: none"> • Protect, expand and improve condition of naturally occurring locally indigenous vegetation, including possible remnants. • Increase the extent of bush restoration sites across the LGA, and maintain sites in good condition. • Re-establish representative patches of the likely original vegetation communities.
Fauna	<ul style="list-style-type: none"> • Protect and enhance sites that provide habitat for priority fauna species. • Increase the distribution and abundance of priority fauna species across the LGA.
Habitat connectivity	<ul style="list-style-type: none"> • Improve habitat connectivity across the LGA, particularly between priority sites, and between identified habitat areas in adjoining LGAs.

1.5 Context

1.5.1 Legislation and planning instruments

Biodiversity is addressed in a range of legislation relevant to the City. In particular, under the *Local Government Act 1993* (LG Act), it is part of each council's charter to properly manage, develop, protect, restore, enhance and conserve the environment of the area for which it is responsible, in a manner that is consistent with and promotes the principles of ecologically sustainable development. This charter is reinforced by the objectives of numerous other Acts. Those most relevant to this Plan are listed below.



1.5.2 Non-regulatory local government functions

Like all local government authorities, the City also has an important non-regulatory role in traditional functions that have implications for biodiversity conservation. These include maintaining parks and other public open space, undertaking capital works, and setting the framework for future patterns of development. Like other local government authorities, the City is also able to offer other supporting mechanisms to promote biodiversity conservation such as grants and community education initiatives, and is well-placed to establish partnerships with Commonwealth and State agencies, private landholders, and other stakeholders to achieve biodiversity conservation objectives. There is strong community interest in biodiversity in the LGA and increasing community expectation the City play an active role in biodiversity conservation initiatives.

1.5.3 Other plans and policies

This Plan has been prepared in accordance with and/or aims to be consistent with and support the objectives of numerous other related City plans and policies; and it is also just as important that these plans and policies are implemented or applied to complement this Plan. Plans and policies of particular relevance are listed below, and discussed further in Appendix 1.

This Plan has also been prepared to be consistent with relevant national, state and regional strategies and plans, as well as those of neighbouring LGAs, which are also listed below.

City of Sydney Plans and Policies

- Sustainable Sydney 2030;
- Environmental Management Plan;
- Greening Sydney Plan;
- Sydney Local Environmental Plan 2012, Sydney Development Control Plan 2012, and Landscape Code (in development);
- Park Plans of Management;
- City of Sydney Tree Policies & Plans;
- Urban Forest Strategy;
- Community Gardens Policy;
- Livable Green Network;
- Companion Animals Policy; and
- Decentralised Water Master Plan.

National, State and regional strategies and plans

Australia's Biodiversity Strategy 2010–2030

Draft NSW Biodiversity Strategy 2010–2015

Sydney Metropolitan Catchment Action Plan

Other LGA strategies and plans

Marrickville Council Biodiversity Strategy 2011–2021 and Action Plan 2011–2015

Leichhardt Municipal Council Draft Native Revegetation and Biodiversity Management Plan (in preparation)

Woollahra Municipal Council Biodiversity Strategy (in preparation)

Randwick City Council Draft Biodiversity Strategy (in preparation)

Greenway Revegetation and Bushcare Plan

Biodiversity Study of the Waverley Local Government Area

02 Approach

2.1 Study area

The study area for this Plan is the City of Sydney Local Government Area (LGA). It is bordered by the Woollahra and Randwick LGAs to the east, Botany LGA to the south and the Leichhardt and Marrickville LGAs to the west. Sydney Harbour forms the northern boundary of the LGA, with the North Sydney and Mosman LGAs adjoining the harbour to its north (Figure 1).

The City of Sydney LGA covers 2,615 hectares of the Sydney metropolitan area. It is a highly urbanised area comprising the city centre, The Rocks, Millers Point, Ultimo, Pyrmont, Surry Hills, Woolloomooloo, Kings Cross, Elizabeth Bay, Potts Point, Rushcutters Bay, Darlinghurst, Chippendale, Darlington, Camperdown, Forest Lodge, Glebe, Alexandria, Beaconsfield, St Peters, Erskineville, Newtown, Redfern, Rosebery, Paddington, Centennial Park, Moore Park, Surry Hills, Waterloo, and Zetland (Figure 2).

The LGA is largely characterised by high-density residential, commercial and industrial land uses with open space largely dedicated to recreational uses.

2.2 Urban Ecology Survey

The current status of biodiversity in the LGA was assessed by an Urban Ecology Survey, which was undertaken by Australian Museum Business Services. The survey comprised six components, described in the following sections.

2.2.1 Review of existing information

Existing information regarding the flora and fauna of the LGA and the Sydney region, as well as urban ecology in general, was collated and reviewed. Information sourced included:




- Soil landscape maps;
- Vegetation maps;
- Database records;
- Published scientific literature;
- Flora and fauna survey reports relevant to the LGA;
- Biodiversity strategies and plans prepared for other LGAs;
- Records provided by the community;
- Records provided by the City;
- City management plans, policies and studies; and
- Recent and historical aerial photographs.

2.2.2 Field surveys

Flora and fauna surveys were undertaken within parks and other public land throughout the LGA in late 2010 and early 2011. Sites were selected on the basis of size, presence and diversity of indigenous vegetation and other habitat features, connectivity and/or distribution within the LGA (such that surveys were undertaken at all large parks and a representative selection of smaller parks across the LGA).



FIGURE 1
Regional Context of the City of Sydney LGA

-  City of Sydney Boundary
-  Surrounding LGAs
-  Sydney Harbour



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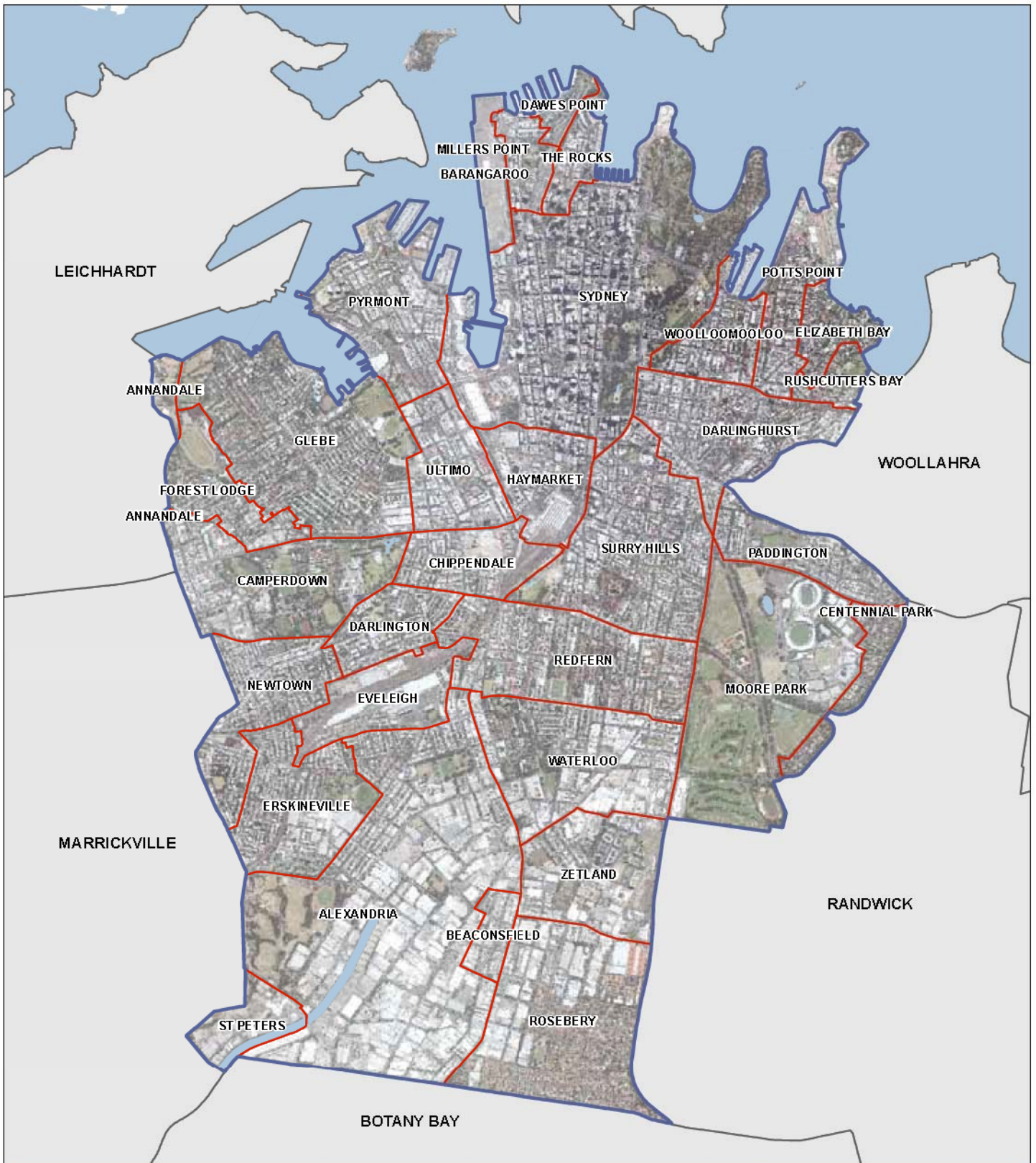

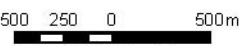


FIGURE 2
Suburb Locations within the LGA



- City of Sydney Boundary
- Suburb Boundaries
- Surrounding LGAs





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Flora surveys and habitat assessment

Flora surveys and habitat assessment were undertaken at 60 sites, the locations of which are indicated in Figure 3. Some sites were surveyed in detail, while others were subject to a brief inspection only.

The presence of naturally occurring vegetation, including possible remnants, was determined, and a list of indigenous and exotic plant species recorded was prepared for each site, and for the whole LGA.

Indigenous vegetation including bush restoration sites and other plantings, but generally excluding isolated trees or trees without an understorey, was mapped at each site with the assistance of aerial photographs, satellite images and vegetation mapping previously undertaken for the Sydney Metropolitan Catchment Management Authority (SMCMA) (DECCW 2009). Naturally occurring vegetation was generally classified according to the communities identified by DECCW (2009). Vegetation map unit boundaries were subsequently digitised using ArcGIS software.

Indigenous plantings identified or undertaken at additional sites subsequent to the surveys were also added to the vegetation maps.

Fauna surveys

Surveys were undertaken for frogs, reptiles, birds and mammals. The surveys comprised nocturnal searches for frogs at 14 sites, day-time searches for reptiles at 12 sites, day-time bird surveys at 22 sites, and spotlighting for possums, owls and other nocturnal fauna, plus microchiropteran bat surveys at 14 sites. Survey site locations are indicated in Figure 4.

A list of all fauna species recorded was prepared for the LGA. This was supplemented by opportunistic observations made by City staff, records provided via the online survey (refer Section 2.2.3), and other reports from the community made between October 2010 and March 2012, to provide a more comprehensive fauna list for the LGA.

Important fauna habitat features were added to the vegetation maps, including several that were identified after the surveys.

2.2.3 Community consultation

Community consultation involved in-depth discussions with targeted community groups and an online survey.

In-depth discussions were held with:

- The Glebe Society's Blue Wren Group;
- Pyrmont Ultimo Landcare volunteers; and
- Glebe Bushcare Group volunteers.

The purpose of the discussions was to identify issues affecting biodiversity in the LGA that each group would like to see addressed in this Plan.

The online survey was open for three months on the City's website in late 2010/early 2011. It aimed to:

- Obtain records of unusual/uncommon species observed in the LGA by the community;
- Identify the community's opinion of the relative importance of various activities towards improving biodiversity in the City; and
- Gauge the level of community interest in participating in bush restoration activities, planting days, biodiversity monitoring programs and similar.

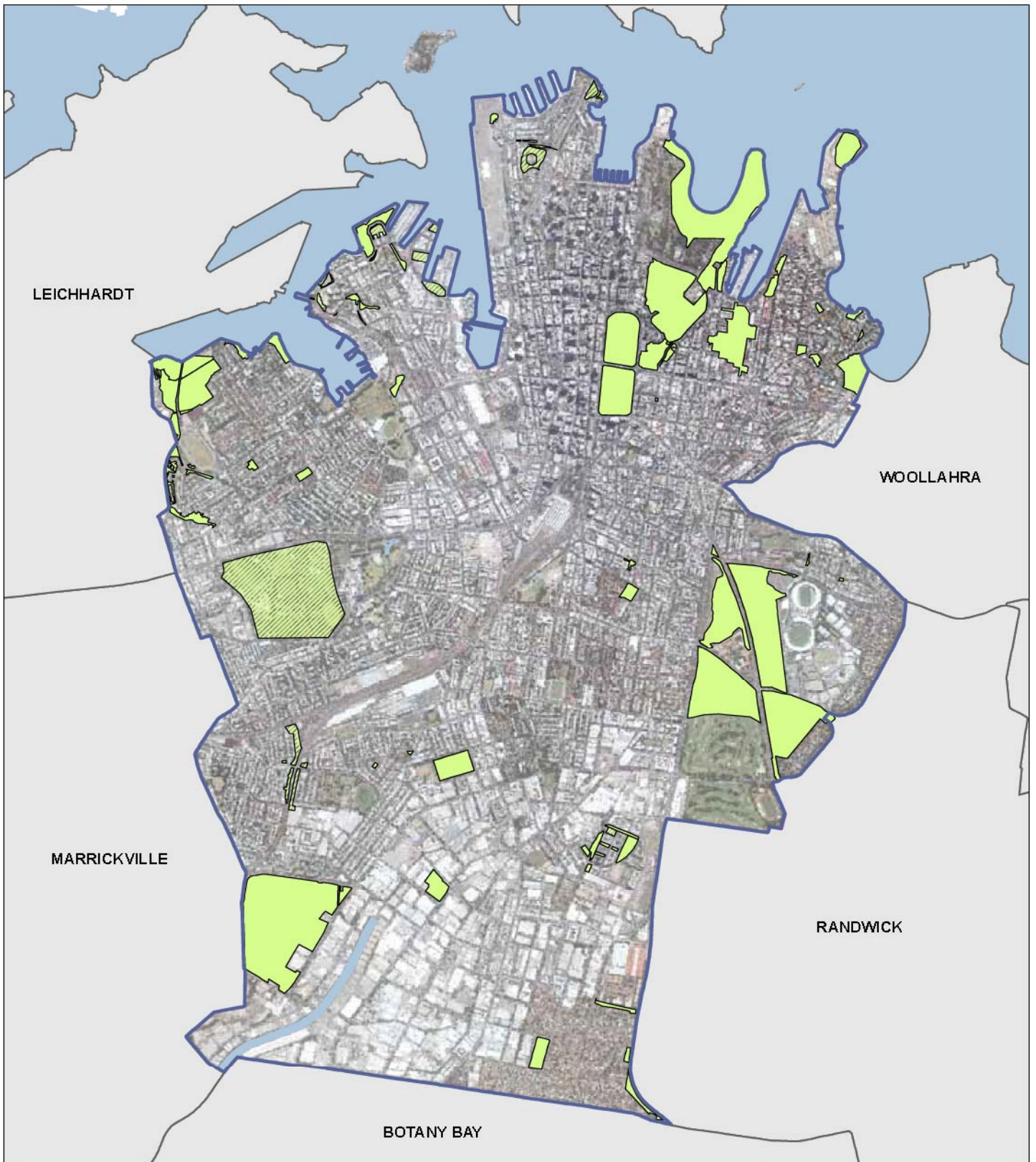


FIGURE 3
Flora Survey Sites

Survey Type

- Brief Notes
- Full Survey



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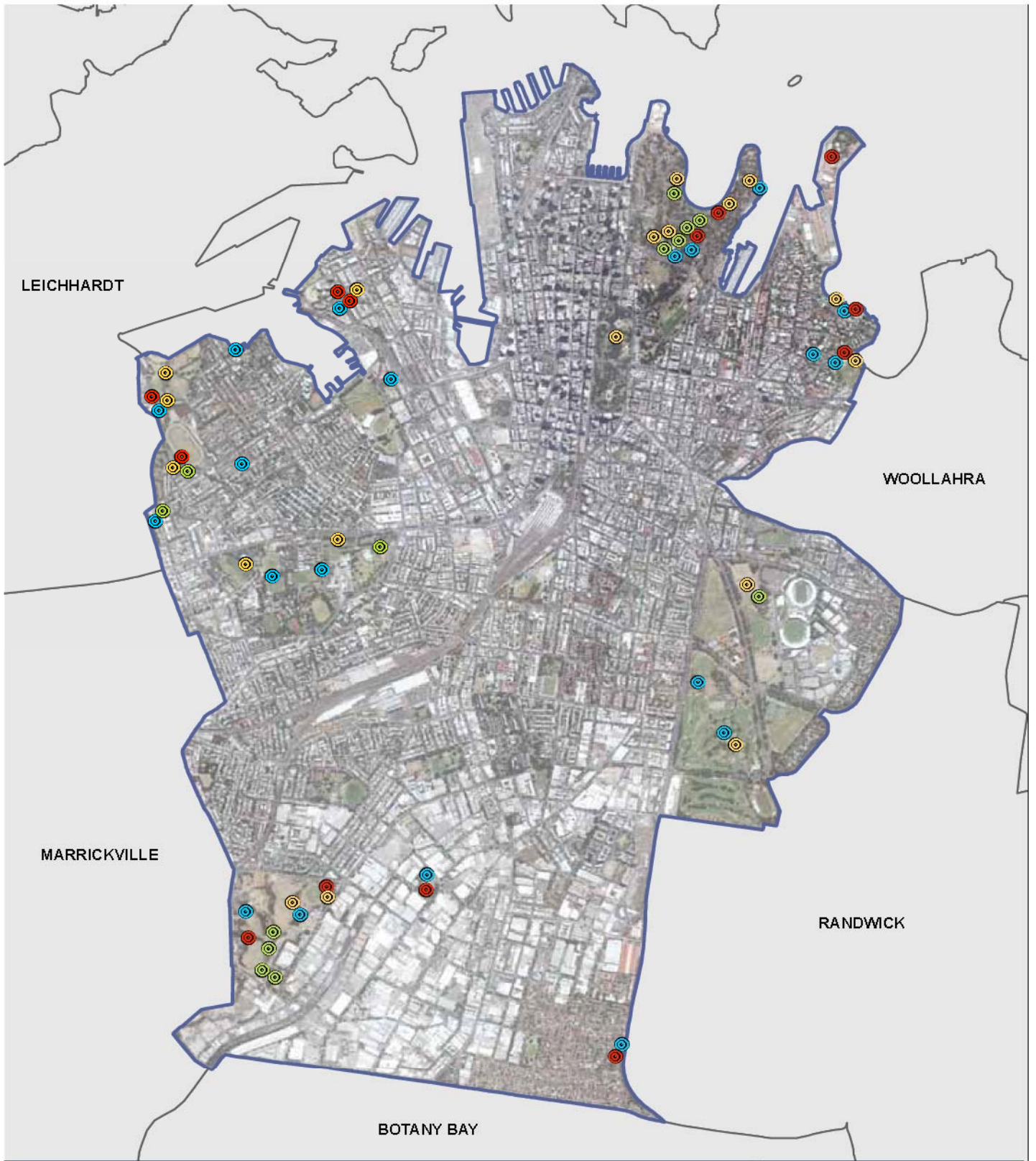

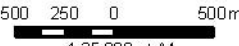


FIGURE 4
Fauna Survey Sites

-  Spotlighting and Anabat
-  Frogs
-  Reptiles (daytime)
-  Birds (daytime)




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2.2.4 Identification of conservation priorities

Priority sites and supporting sites

In order to identify priority sites for this Plan, the biodiversity value of surveyed sites was assessed within the context of the LGA. Criteria used in this assessment included size, vegetation structure, indigenous species diversity, presence of natural features including possible remnant vegetation, and potential to improve biodiversity values. Sites were classified as having high, medium or low biodiversity value and corresponding priority.

Priority fauna species

In order to identify priority fauna species, each species/group was assessed on the basis of survey results, a consideration of overall conservation status, status in the LGA and in urban areas generally, amount of potential habitat within the LGA, and potential to implement actions that may improve status in the LGA. Each species/group was classified as being of high, medium or low priority.

2.2.5 Identification of potential habitat linkages

A map indicating locations in which useful habitat linkages could potentially be created, both across the LGA and between adjacent LGAs, was produced using an aerial photograph of the city and surrounds and maps of the following:

- Vegetation and other habitat features including ponds;
- Priority sites and supporting sites;
- Existing and proposed parks;
- Community gardens;
- Green roofs;

- Priority pedestrian and cycle routes identified in the City's Liveable Green Network Strategy;
- Existing and proposed raingardens;
- Other water-sensitive urban design opportunities identified in the City's Decentralised Water Master Plan;
- Above-ground Sydney Water easements;
- Bush regeneration/restoration and other habitat enhancement sites in adjoining LGAs;
- Existing/potential habitat corridors identified in adjoining LGAs, including the proposed Greenway; and
- Other sites known or considered likely to have habitat value in adjoining LGAs, such as Sydney Harbour National Park, Centennial Parklands, Botany Wetlands, Sydney Airport and numerous golf courses.

All of the above maps were overlaid on the aerial photograph, enabling identification of the general areas in which habitat linkages could be created to connect priority sites to each other and to habitat areas in adjoining LGAs. Overland linkages were identified as well as linkages over water between foreshore headlands.

2.2.6 Identification of threats

Threats to biodiversity in the LGA were identified based on results from the Urban Ecology Survey, with reference to relevant Key Threatening Processes listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the NSW *Threatened Species Conservation Act 1995* where relevant.

03

Results

3.1 Flora

The City of Sydney LGA is situated on the sandstone formations of the Sydney Basin and original soils were mostly sandy, with sandstone rock outcropping and some clay (Chapman & Murphy 1989). Seven soil landscape units have been classified within the LGA (Figure 5).

The likely pattern of original vegetation within the LGA, based on Benson & Howell (1990 & 1994) is shown in Figures 6 and 7. Figure 6 provides a broad perspective of the Sydney region and identifies three vegetation types within the LGA (Turpentine-Ironbark Forest; Sandstone Heaths, Woodlands & Forests; and Eastern Suburbs Banksia Scrub). Freshwater wetlands including Billy Goat Swamp and Waterloo Swamp also occurred in the southern part of the LGA (Centennial Parklands, undated; Doran 2004) – these were part of the larger Botany wetlands system.

Figure 7 indicates the likely distribution of vegetation for the city centre in greater detail, identifying five plant communities (Turpentine-Ironbark Forest, Sandstone Woodland, Swamp Forest, Swamp Woodland, and Eastern Suburbs Banksia Scrub), along with two geological environments (mudflats and sand dunes). The Sandstone Woodland and Swamp Woodland are part of the larger sandstone complex mapped in Figure 6; Swamp Forest was not identified in mapping at the broader scale. Two additional communities, Coastal Saltmarsh and Mangrove Forest, are likely to have occurred on the mudflats. The likely original vegetation of remaining areas of the LGA has not been determined at the same level of detail as the city centre.

With such a range of environments and vegetation communities, the LGA is likely to have supported high diversity of flora species. The sandstone-dominated vegetation of Pyrmont, for example, is likely to have provided habitat for over 600 plant species (Broadbent 2010).

Since European colonisation in 1788, the original vegetation of the LGA has been almost completely removed as a result of urban development and associated activities including

shoreline reclamation, filling of swamps, and channelisation of watercourses including the Tank Stream in the city centre, Shea's Creek (now Alexandra Canal), Johnstons Creek and Rushcutters Bay Creek. The LGA is now largely characterised by high-density residential, commercial and industrial land uses, with open space largely dedicated to recreational use. Four of the likely original vegetation communities, Sydney Turpentine Ironbark Forest, Eastern Suburbs Banksia Scrub, Coastal Saltmarsh, and Sydney Freshwater Wetlands, are all now listed as endangered under NSW and/or Commonwealth legislation.

The photographs on page 22 indicate the extent of vegetation clearance and development that had occurred in the LGA by the middle of last century, but also the increase in vegetation cover that has occurred since that time, largely through planting undertaken in modified environments in public open space, some of which has been transformed in recent years from former industrial uses. This vegetation comprises a mix of planted indigenous (both local and from other parts of Australia) and exotic species.

Nevertheless, some naturally occurring vegetation, including possible remnants, was identified in the LGA during the surveys. This vegetation has survived in small refuges, persisted in lawns or garden beds, or recolonised modified environments. Ferns, grasses and groundcovers are the most widespread of the naturally occurring species, with a range of tree and shrub species at a smaller number of locations. Examples of naturally occurring species recorded are listed in Table 2.

Vegetation representative of five recognisable, naturally occurring vegetation communities was identified and mapped in the LGA. Coastal Saltmarsh and Mangrove Forest were included as naturally occurring because although current stands were planted, they are now spreading and regenerating naturally. Constructed freshwater wetlands, bush restoration sites, and other indigenous/mostly indigenous plantings were also mapped, as were identified major weed infestations. Table 3 lists all vegetation map units, states their conservation status, and describes their occurrence; Figures 8a-d indicates their location and extent.

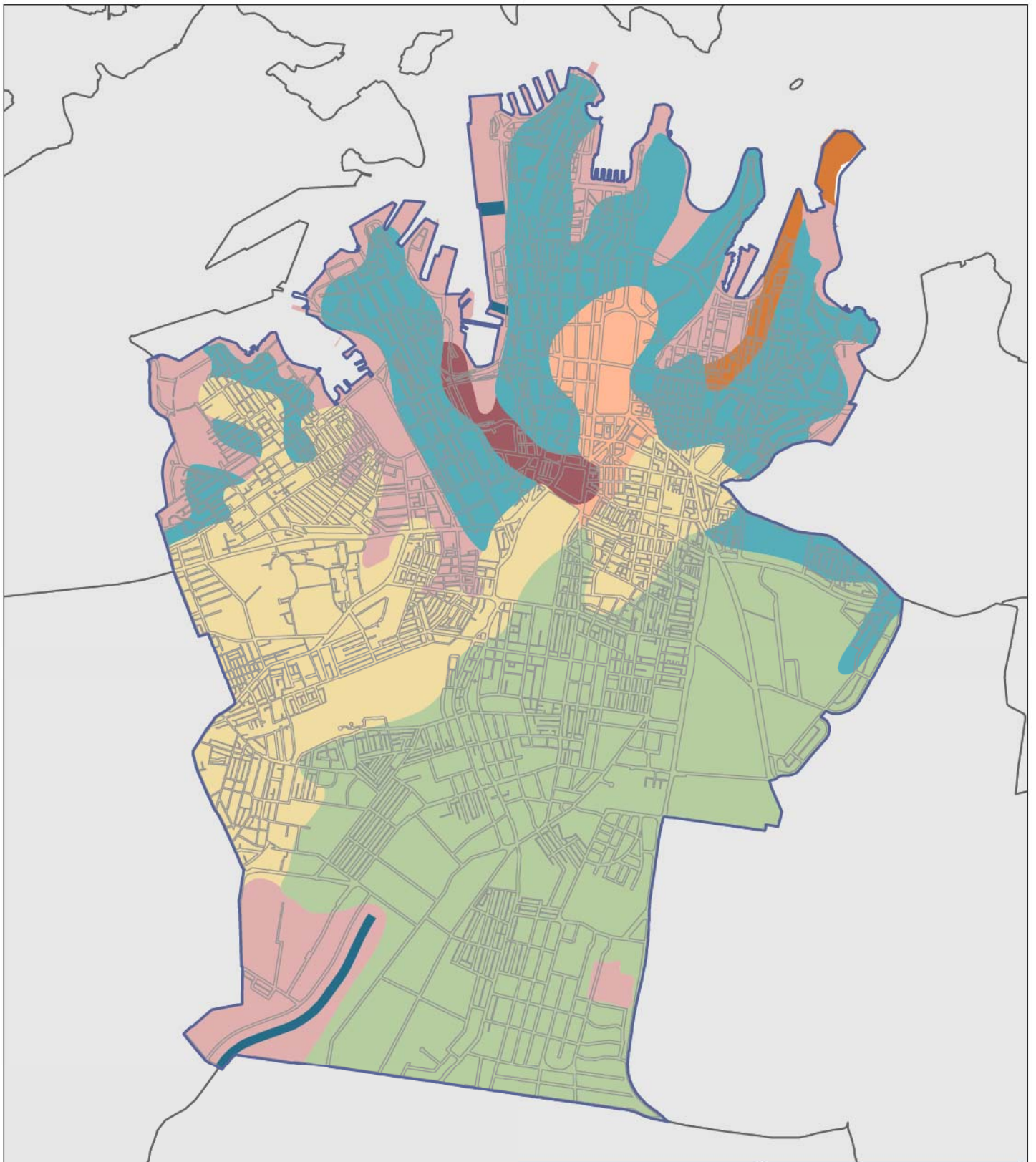











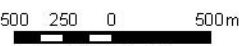
FIGURE 5
Soil Landscapes of the LGA

- | | |
|---|---|
|  Blacktown |  Hawkesbury |
|  Deep creek |  Lucas Heights |
|  Disturbed terrain |  Tuggerah |
|  Gymea |  Water |

Source: Chapman & Murphy (1989)



N



1:35,000 at A4

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FIGURE 6
Original Vegetation of the Sydney Region

- | | |
|----------------------------|---|
| City of Sydney LGA | Eastern Suburbs Banksia Scrub |
| Blue Gum High Forest | Estuarine and Freshwater Wetlands |
| Turpentine-Ironbark Forest | Castlereagh Woodlands |
| River-flat Forests | Sandstone Heaths, Woodlands and Forests |
| Cumberland Plain Woodlands | |

Source: Benson & Howell (1990)



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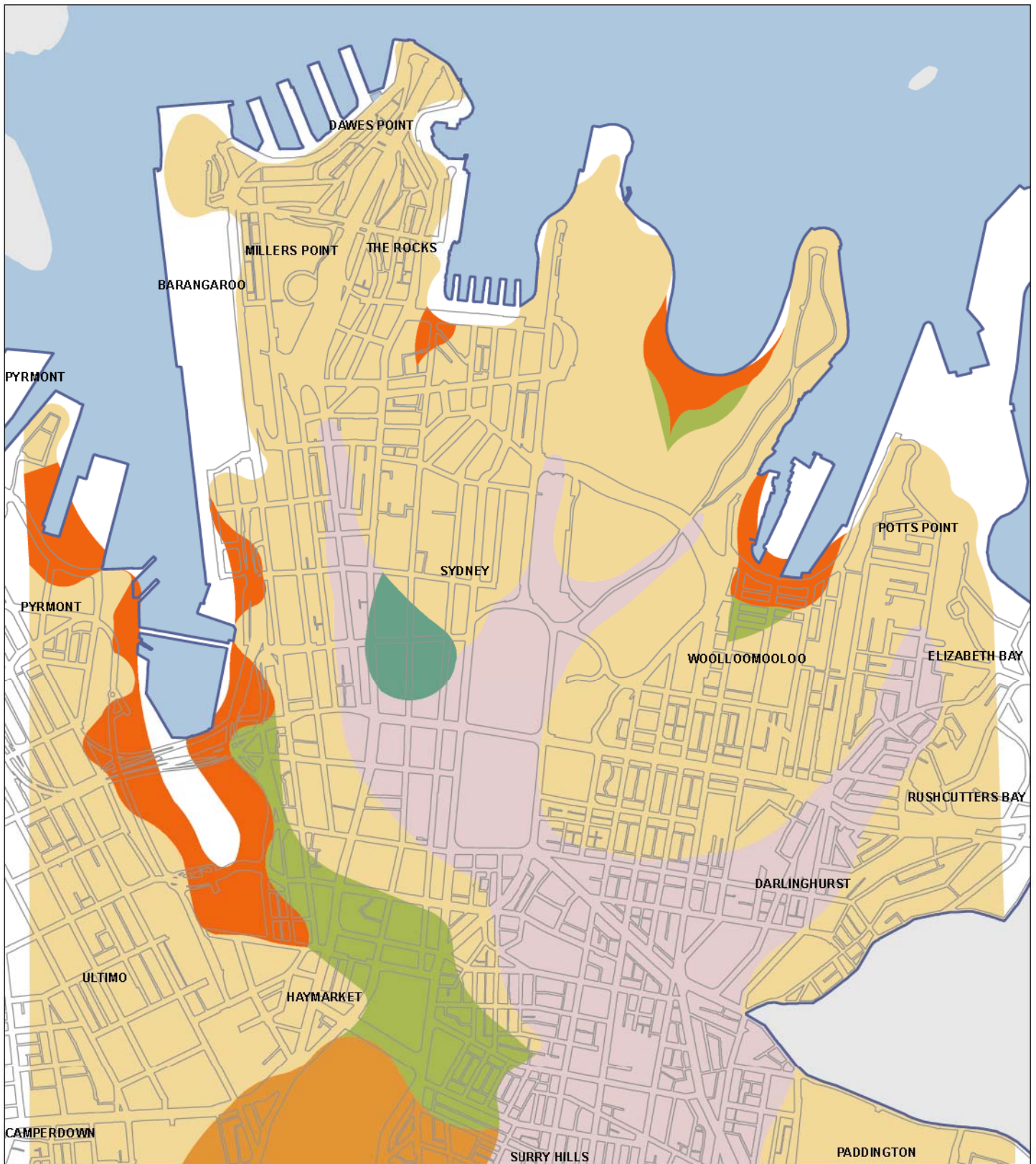



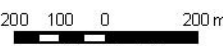
FIGURE 7
Likely Original Vegetation Communities in the Sydney CBD

- | | |
|--|--|
|  Hawkesbury sandstone slopes with woodland of <i>Eucalyptus pilularis</i> , <i>Eucalyptus gummifera</i> , <i>Eucalyptus piperita</i> and <i>Angophora costata</i> |  Swamp woodland with <i>Eucalyptus racemosa</i> |
|  Mudflats, exposed at low tide |  Forest of <i>Angophora costata</i> and <i>Eucalyptus pilularis</i> , the eastern limit of Turpentine-Ironbark Forest |
|  Swamp forest of <i>Casuarina glauca</i> and <i>Eucalyptus robusta</i> |  The edge of the sand dunes with Eastern Suburbs Banksia Scrub |

Source: Benson & Howell (1990)




N



200 100 0 200 m

1:15,000 at A4

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Improved vegetation cover in Glebe from 1943 (left) to 2011 (right), with areas such as Bicentennial Park, Blackwattle Bay Park and other parts of the Glebe foreshore transformed from industrial uses to public open space.



Sydney Park, St Peters – an industrial site in 1943 (left), transformed into a public open space featuring stands of indigenous vegetation and freshwater wetlands (right, in 2011).

Table 2 Examples of naturally occurring species identified in the LGA

Trees	Shrubs/small trees	Grasses	Groundcovers	Ferns
<i>Angophora costata</i>	<i>Acacia implexa</i>	<i>Microlaena stipoides</i>	<i>Carex inversa</i>	<i>Adiantum aethiopicum</i>
<i>Angophora floribunda</i>	<i>Angophora hispida</i>	<i>Dichelachne crinita</i>	<i>Cyperus gracilis</i>	<i>Asplenium</i>
<i>Casuarina glauca</i>	<i>Banksia integrifolia</i>	<i>Optismenus aemulus</i>	<i>Crassula sieberiana</i>	<i>flabellifolium</i>
<i>Eucalyptus botryoides</i>	<i>Breynia oblongifolia</i>		<i>Dichondra repens</i>	<i>Davallia solida</i> var.
<i>Eucalyptus paniculata</i>	<i>Glochidion ferdinandi</i>		<i>Lobelia anceps</i>	<i>pyxidata</i>
<i>Eucalyptus pilularis</i>	<i>Myrsine variabilis</i>		<i>Sarcocornia</i>	<i>Gleichenia dicarpa</i>
<i>Eucalyptus resinifera</i>			<i>quinquenervia</i>	<i>Psilotum nudum</i>
<i>Eucalyptus tereticornis</i>			<i>Suaeda australis</i>	
<i>Ficus rubiginosa</i>			<i>Wahlenbergia gracilis</i>	

Table 3 Indigenous vegetation map units identified in the LGA

Vegetation map unit	Conservation Status	Location within the LGA	Habitat	Description	Area (ha)
Sydney Turpentine Ironbark Forest*	Sydney Turpentine Ironbark Forest CEEC (EPBC Act); EEC (TSC Act)	Orphan School Creek, Forest Lodge and St John's Anglican Church, Glebe	Shale soils	Possible remnant <i>Angophora floribunda</i> tree near Orphan School Creek; possible remnant <i>Eucalyptus paniculata</i> tree and groundcover species at St John's Anglican Church	0.006
Coastal Saltmarsh*	Coastal Saltmarsh EEC (TSC Act)	Bicentennial, Federal and Jubilee Parks, Glebe	Intertidal zone	Planted and naturally regenerating stands in constructed wetland, along Johnstons Creek Canal and on the Rozelle Bay foreshore	0.30
Coastal Swamp/ Alluvial Forest*	Component of Swamp Oak Floodplain Forest/River-flat Eucalypt Forest EECs (TSC Act)	Royal Botanic Gardens and Lewis Hoad Reserve, Glebe	Sandstone cliff/Outcrop; reclaimed foreshore	Remnant <i>Eucalyptus tereticornis</i> and <i>Casuarina glauca</i> trees in Royal Botanic Gardens; possible remnant <i>Eucalyptus botryoides</i> tree in Lewis Hoad Reserve	0.02
Mangrove Forest*	PMV (FM Act)	Bicentennial Park and The Anchorage, Glebe	Intertidal zone	Planted and naturally regenerating stands of <i>Avicennia marina</i>	0.13

Table 3 Indigenous vegetation map units identified in the LGA continued

Vegetation map unit	Conservation Status	Location within the LGA	Habitat	Description	Area (ha)
Coastal Sandstone Outcrop Complex* (comprises elements of Coastal Sandstone Foreshores Forest, Sandstone Cliff Soak and Coastal Littoral Rainforest)	Local	Domain (Yurong Precinct); Garden Island, Woolloomooloo; Quarry Master Drive, Wentworth Park Light Rail Station and Light Rail Corridor, Pyrmont; Pirrama Road, Pyrmont; The Anchorage, Glebe; Arthur (Paddy) Grey Reserve, Glebe; Arthur McElhone Reserve, Elizabeth Bay; Embarkation Park and McElhone Stairs, Potts Point	Sandstone outcrop	Naturally occurring vegetation associated with sandstone cliffs and outcrops including possible remnants in the Royal Botanic Gardens, Domain and Garden Island, and possible remnant <i>Angophora hispida</i> tree at Arthur McElhone Reserve	2.30
Constructed Freshwater Wetlands	Local (not currently considered representative of Sydney Freshwater Wetlands EEC)	Sydney Park, St Peters; Woolwash Park, Zetland; University of Sydney, Darlington	Low-lying areas	Constructed wetlands and ponds with associated aquatic and fringing vegetation	2.45
Bush restoration sites	Local	Federal, Bicentennial and Jubilee Parks, The Anchorage and Arthur (Paddy) Grey Reserve, Glebe; Orphan School Creek, Forest Lodge; various sites in Pyrmont			4.62
Other indigenous/ mostly indigenous plantings	Local	Sydney Park, St Peters; Embarkation Park, Potts Point; Southern Cross Drive Reserve, Rosebery; Blackwattle Bay Park, Glebe			19.43
Indigenous plantings/ naturally occurring vegetation	Local	Domain (Yurong Precinct)			7.71

*Includes naturally occurring elements

CEEC – Critically Endangered Ecological Community

EEC – Endangered Ecological Community

PMV – Protected Marine Vegetation

EPBC Act – *Environment Protection and Biodiversity Conservation Act 1999*

TSC Act – *Threatened Species Conservation Act 1995*

FM Act – *Fisheries Management Act 1994*

As indicated in Table 3, most map units are of conservation significance in at least a local context. Sydney Turpentine Ironbark Forest (STIF), Coastal Saltmarsh and Coastal Swamp/Alluvial Forest (CSAF) are particularly significant as they are all representative of endangered ecological communities.

The area of all map units is very limited (Figures 8a-d). STIF and CSAF are represented only by a small number of remnant/possible remnant trees, with associated groundcover species in some cases, while Coastal

Sandstone Outcrop Complex (CSOC), which comprises elements of the Coastal Sandstone Foreshores Forest, Coastal Littoral Rainforest and Sandstone Cliff Soak communities described by DECCW (2009), has a more substantial occurrence, with possible remnant trees, shrubs and groundcovers in the Yurong Precinct of the Domain and the Royal Botanic Gardens (Benson & Howell 2002; Lesryk 2005) and Garden Island, where it was mapped by DECCW (2009). Stands of Coastal Saltmarsh, although limited, include the typical range of species that occur in this community in the Sydney region.



Examples of naturally occurring species in the LGA that have survived in small refuges or recolonised modified environments.

- a Lobelia
- b Necklace Fern
- c Port Jackson Fig at Pyrmont
- d Arthur McElhone Reserve



The endangered Coastal Saltmarsh community in a constructed wetland in Federal Park (left) and growing along Johnstons Creek Canal (right).



Planted and naturally regenerating Grey Mangroves *Avicennia marina* at Rozelle Bay.



Patches of Coastal Sandstone Foreshores Forest in the Yurong Precinct of the Domain.



Elements of possible remnant Coastal Sandstone Foreshores Forest at Garden Island (left), including senescent and regenerating Hickory Wattle (right).



Sandstone outcrops vegetated with elements of Coastal Sandstone Outcrop Complex at Lewis Hoop Reserve, Glebe (left) and at Embarkation Park, Potts Point (right).