# Biodiversity Development Assessment Report

## Greenwich Hospital Redevelopment
## Lot 3 DP 584287
## 97-115 River Road
## Greenwich
## Lane Cove LGA

**For: Hammondcare**

**Ref: LCC 17-916**

**18th January 2019**

KEYSTONE
ECOLOGICAL


Keystone Ecological Pty Ltd
abn 13 099 456 149
PO Box 5095 Empire Bay NSW 2257
telephone 1300 651 021
email office@keystone-ecological.com.au

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Authors:

Elizabeth Ashby and Ashleigh McTackett

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**Keystone Ecological**
*Flora and Fauna Specialists*

Mail: PO Box 5095 Empire Bay NSW 2257
Telephone: (02) 4368 1106
Email: office@keystone-ecological.com.au
ABN: 13 099 456 149

**Cover photograph:** Aerial photograph of the development site showing the hospital buildings, car park, historic Pallister House and vegetation.

**Source:** Nearmap, image taken 18th January 2018

# DEFINITIONS

Some terms require definition for the Biodiversity Development Assessment Report and largely include those as per the Biodiversity Conservation Act (2016) and Biodiversity Assessment Method (2017) for matters listed under NSW legislation.

**BAM:** the Biodiversity Assessment Method.
**Critically endangered ecological community (CEEC):** an ecological community specified as critically endangered in Schedule 2 of the BC Act and/or listed under Part 13, Division 1, Subdivision A of the EPBC Act
**Development:** has the same meaning as development at section 4 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act), or an activity in Part 5 of the EP&A Act. It also includes development as defined in section 115T of the EP&A Act.
**Development footprint:** the area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials.
**Development site:** an area of land that is subject to a proposed development that is under the EP&A Act.
**Endangered ecological community (EEC):** an ecological community specified as endangered in Schedule 2 of the BC Act, or listed under the EPBC Act.
**Habitat:** an area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component.
**Habitat component:** the component of habitat that is used by a threatened species for either breeding, foraging or shelter.
**High threat exotic plant cov**er: plant cover composed of vascular plants not native to Australia that if not controlled will invade and outcompete native plant species.
**Hollow bearing tree:** a living or dead tree that has at least one hollow. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the minimum entrance width is at least 5cm; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); (d) the hollow is at least 1m above the ground. Trees must be examined from all angles.
**IBRA region:** a bioregion identified under the Interim Biogeographic Regionalisation for Australia (IBRA) system, which divides Australia into bioregions on the basis of their dominant landscape-scale attributes.
**IBRA subregion:** a subregion of a bioregion identified under the IBRA system.
**Major project:** State Significant Development and State Significant Infrastructure.
**Native ground cover:** all native vegetation below 1m in height, including all such species native to NSW (i.e. not confined to species indigenous to the area).
**Native ground cover (grasses):** native ground cover composed specifically of native grasses.
**Native ground cover (other):** native ground cover composed specifically of non-woody native vegetation (vascular plants only) <1m that is not grass (e.g. herbs, ferns).
**Native ground cover (shrubs):** native ground cover composed specifically of native woody vegetation <1m.
**Native mid-storey cover:** all vegetation between the over-storey stratum and a height of 1m (typically tall shrubs, under-storey trees and tree regeneration) and including all species native to NSW (i.e. native species not local to the area can contribute to mid-storey structure).
**Native over-storey cover:** the tallest woody stratum present (including emergent) above 1m and including all species native to NSW (i.e. native species not local to the area can contribute to over-storey structure). In a woodland community the over-storey stratum is the tree layer, and in a shrubland community the over-storey stratum is the tallest shrub layer. Some vegetation types (e.g. grasslands) may not have an over-storey stratum.
**Number of trees with hollows:** a count of the number of living and dead trees that are hollow bearing.

# CONTENTS

# PREAMBLE – STRUCTURE OF THE REPORT

Keystone Ecological has been contracted by HammondCare to prepare an assessment of the likely impacts of a proposed development upon nationally and state listed biodiversity matters. The proposal is for a staged application for a concept proposal for the redevelopment of Greenwich Hospital. As a State Significant Development (SSD) Major Project, an Environmental Impact Assessment (EIS) is being prepared pursuant to the Secretary's Environmental Assessment Requirements (SEARS), as re-issued on 22nd November 2017.[1]

In reference to biodiversity impacts, the SEARS calls for the following:

> ***"9. Biodiversity***
>
> *Biodiversity impacts related to the proposal and the preparation of a Biodiversity Assessment are to be addresses in accordance with the requirements of the Biodiversity Conservation Act 2016."*

This Biodiversity Development Assessment Report (BDAR) has been prepared as part of the EIS, in accordance with the *Biodiversity Conservation Act (BCA) 2016*. Specifically, this BDAR follows the protocols detailed in the Biodiversity Assessment Method (BAM) as declared in the *Biodiversity Assessment Method Order 2017*, dated 24th August 2017.

Overall, the BAM[2] requires the BDAR to be presented in two parts: Stage 1 Biodiversity Assessment, and Stage 2 Impact Assessment. This BDAR reflects that required format, with a separate Appendix of relevant maps and data provided for each section as detailed below.

- Stage 1 Biodiversity Assessment includes the following sections:
  - Section 1 – Introduction;
  - Section 2 – Landscape Features;
  - Section 3 – Native Vegetation;
  - Section 4 – Threatened Species;
- Stage 2 Impact Assessment includes the following sections:
  - Section 5 – Avoid and Minimise Impacts;
  - Section 6 – Impact Summary;
  - Section 7 – Biodiversity Credit Report;
- Conclusion
- Appendix 1 – Figures
- Appendix 2 – Photographs
- Appendix 3 – Tables
- Appendix 4 – Biodiversity Credit Reports

Assessments pursuant to Commonwealth legislation and local controls are addressed in a companion Biodiversity Impact Assessment report (McTackett and Ashby 2018).

[1] Documentation relevant to this proposal can be found on the NSW Planning and Environment website at http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=8699.
[2] The things to be addressed within each Stage of the BDAR are detailed in Table 25 (Stage 1) and Table 26 (Stage 2) of the BAM.

# STAGE 1 BIODIVERSITY ASSESSMENT

## 1 INTRODUCTION

### 1.1 The Site and Proposal

The development site is located at Lot 3 DP 584287 (97-115 River Road, Greenwich) and Lot 4 DP 584287 (95 River Road, Greenwich) in the Lane Cove Local Government Area (LGA). The site occupies approximately 3.38 hectares, made up of a pair of L-shaped lots of 2.25 hectares (Lot 3) and 1.14 hectares (Lot 4). A locality map is provided at Figure 1 in Appendix 1.

The area that is now known as the suburb of Greenwich was occupied by Europeans early in the life of the colony, with the local Aboriginal people, through disease and dispossession, all but absent by the 1860s.[3] Initially, European settlement was concentrated around a boatbuilding industry at Greenwich Point (1.5 kilometres to the south of the development site), but the impacts of the building of Sydney town spread quickly across the landscape. The accessible forests of the lower north shore were impacted profoundly, with Governor Macquarie reporting in 1810 that "*I went this day to visit the Government saw pits at Lane Cove … The timber there is getting scarce. The saw pits must soon be moved to another place where timber is more abundant*."[4]

Greenwich and surrounds now comprise low and medium density residential development, interspersed with regrowth bushland that is largely restricted to gully habitats associated with tributaries of the Lane Cove River. A site map showing this is provided in Figure 2 in Appendix 1. This pattern is clearly evident in historical aerial photography dating from 1943 (see Figure 3 in Appendix 1).

The development site currently supports Greenwich Hospital, which was opened in the mid-1960s. It comprises a sprawling series of buildings, roads, car parks, lawns, gardens, and a derelict outdoor pool. The hospital and associated infrastructure are mostly confined to the larger Lot 3, on the broad ridge and its associated steep west and south-west facing slope.

Pallister House and its curtilage are located in Lot 4 at the southern tip of the ridge and its associated steep east facing slope. This historic building dates from 1892 and is listed on the State Heritage Register. Its curtilage includes an old bridle path, internal vehicular roads, formalised car parks, lawns, gardens, and areas of naturally-occurring vegetation. Pallister House ceased to be used as a family residence in 1937, after which it was used for various community purposes. It now houses some of HammondCare's administrative functions.

A close aerial view of the site in 1943 and the same scene photographed in 2018 are shown at Figure 4 in Appendix 1. These clearly demonstrate that the character of Lot 4 has not changed significantly over that period. The obvious differences are the addition of access and internal

[3] Macleod, P. (2012) *Greenwich* in Dictionary of Sydney. Available at http://dictionaryofsydney.org/entry/greenwich, viewed 18 Feb 2018

[4] Russell, E. (1970) Lane Cove 1788-1970: a North Shore History. Lane Cove Municipal Council. Quoted in Benson, D. and Howell, J. (1990) *Taken for Granted – the bushland of Sydney and its suburbs*

roads that interrupt the bridle path, two car parking areas alongside Pallister House, and the growth of canopy trees.

By contrast, Lot 3 has changed considerably. The areas that now house the current network of hospital buildings and car parks that extend across the ridge and down the steep slopes were, in 1943, occupied by cleared grassy areas, a single building, open natural rocky terraces and regenerating low vegetation.

The proposed redevelopment is shown in the Masterplan provided at Figure 5 in Appendix 1. This has been the result of an iterative process of an expert multi-disciplinary team comprising urban planners, architects, engineers, European and Aboriginal heritage consultants, arborists, bushfire consultant, and ecologists.

Essentially, the proposal is for the staged demolition of the hospital buildings in Lot 3, and construction of new hospital facilities, seniors living apartments, and seniors living villas. Pallister House is to be untouched.

The current operational footprint includes the buildings, car parks, and gardens; these areas total approximately 3.14 hectares. The remaining 0.25 hectares is currently unused and comprises the derelict pool, and the slope at the site's south western corner below the car park. This slope is too steep to manage and is therefore largely dominated by uncontrolled infestations of weeds.

The construction footprint totals 2.83 hectares and comprises the following:

- Hospital buildings: 13,872 square metres, including basement carpark beneath with an ultimate footprint of 6,273 square metres;
- Seniors Living Apartments: 12,807 square metres, including basement carpark beneath with an ultimate footprint of 4,058 square metres; and
- Seniors Living Villas: 1,600 square metres.

The proposal is to be a staged construction, with temporary construction facilities located within the current footprint. These are detailed within the Staging Plans provided under separate cover and prepared by Bickerton Masters Architects.

Existing access points to the site will be maintained: two main entries from River Road on the northern boundary, and a supplementary vehicular access from St Vincents Road on the eastern boundary. Foot traffic will continue to gain access at the north eastern corner along the route of the historic bridle path.

A close aerial photo showing the existing site features is provided at Figure 6 in Appendix 1.

## 1.2 Information Sources

The following project plans and consultant reports were relied upon for this BDAR:

- SEARs for the redevelopment of Greenwich Hospital (Concept Proposal), 97-115 River Road, Greenwich (SSD 8699), dated 14th September 2017.

- Architectural Plans prepared by Bickerton Masters Architects. Concept Plan, drawing number S.02, revision A. Dated 16/03/2018.
- Survey Plans prepared by Lockley Land Title solutions, dated 19.02.2010. Job reference 32677DT.
- Arboricultural Preliminary report prepared by Redgum Horticultural, dated 26th October 2017.
- Bushfire Hazard Assessment Report prepared by Building Code and Bushfire Hazard Solutions Pty Ltd, reference number 171272, dated 5th December 2017.

## 1.3 Digital Shape Files

A number of digital shape (shp) files have been generated as part of this BDAR assessment. A general list of suitable layers to be generated (but not limited to) is provided below with specific files to be uploaded to the governing authority as part of this BDAR assessment.

- Site boundaries;
- Cadastre boundaries;
- 1.5 kilometre buffer area;
- IBRA subregion;
- Streams and waterways;
- Riparian lands;
- Movement corridors (established by Keystone Ecological);
- Soil landscapes;
- Areas of geological significance; and
- Lands containing biodiversity values.

# 2 LANDSCAPE FEATURES

## 2.1 IBRA and NSW Landscapes

IBRA stands for Interim Biogeographic Regionalisation for Australia and is a country-wide classification of natural landscapes that capture broad, landscape-scale natural features and processes. IBRA Regions and Subregions aid planning, but particularly conservation planning. NSW (or Mitchell) Landscapes are a finer-scale classification of ecosystems across NSW.

The subject land is wholly within the Sydney Basin IBRA region, the Pittwater IBRA subregion, and Port Jackson Basin NSW Mitchell Landscape. The relationship between the site and these features are shown in Figure 7 with a closer view of the site in relation to the IBRA subregion provided in Figure 8 in Appendix 1.

**Sydney Basin IBRA region** occupies over 3.6 million hectares and extends from just north of Batemans Bay to Nelson Bay on the central coast, and almost as far west as Mudgee. It includes a significant proportion of the catchments of the Hawkesbury-Nepean, Hunter and Shoalhaven river systems, all of the smaller catchments of Lake Macquarie, Lake Illawarra, Hacking, Georges and Parramatta Rivers, and smaller portions of the headwaters of the Clyde and Macquarie Rivers.[5]

**Pittwater IBRA subregion** occupies almost 150,000 hectares and extends from Botany Bay in the south, to Bucketry in the north. Its geology is characterised by Triassic Hawkesbury Sandstone with thin ridge capping of Ashfield Shale; Narrabeen sandstones exposed in valleys and along the coast; and Quaternary coastal sands. Characteristic landforms include the Hornsby plateau of quartz sandstone with occasional shale caps; small beach, dune and lagoon barrier systems; steep coastal cliffs, and rock platforms. Soils are typically deep yellow earths or rocky outcrop on plateau tops; uniform and texture contrast soils on sandstones and shale slopes; loamy sands in alluvium along creeks; clean quartz sands with moderate shell content on beaches and frontal dunes; and organic sands and muds in estuaries.[6]

**Port Jackson Basin NSW (Mitchell) Landscape** is characterised by deep elongated harbours with steep cliffs on Triassic quartz sandstone geology. At the heads of most tributary streams, there are small pocket beaches and more extensive estuaries of muddy sands of Quaternary age. Elevation is low (0 to 80 metres), with local relief usually 10 to 50 metres. Sandstone slopes and cliffs have patches of uniform or gradational sandy soil on narrow benches and within joint crevices that support forest and woodland. Common dominant trees on the exposed habitats include *Eucalyptus piperita* Sydney Peppermint, *Angophora costata* Smooth-barked Apple, *Corymbia gummifera* Red Bloodwood, and *Eucalyptus pilularis* Blackbutt. Sheltered gullies typically contain some *Syncarpia glomulifera* Turpentine, *Ceratopetalum apetalum* Coachwood, and *Tristaniopsis laurina* Water Gum. In many places, the estuarine sands that were originally dominated by saltmarsh have been taken over by *Avicennia marina* Grey Mangrove over the past century,[7] probably as a result of siltation arising from clearing and development in the

[5] Sydney Basin Bioregion, at http://www.environment.nsw.gov.au/bioregions/SydneyBasinBioregion.htm
[6] Sydney Basin – subregions, at http://www.environment.nsw.gov.au/bioregions/SydneyBasin-Subregions.htm
[7] Department of Environment and Climate Change (no date) Descriptions for NSW (Mitchell) Landscapes

catchments.

## 2.2 Native Vegetation

The value of the habitats provided by native vegetation of the development area are assessed in the context of a 1.5 kilometre buffer measured from the outer boundaries of the development site. The area subtended by such a polygon for this development site is approximately 704 hectares.

This buffer area encompasses almost all of Greenwich, plus parts of the surrounding suburbs of Longueville, Lane Cove, St Leonards, Wollstonecraft, and Woolwich. It is composed of a complex of residential, industrial, and commercial development, and is criss-crossed by major transport corridors, such as the Pacific Highway and the main northern railway line.

The buffer area in relation to the local area is shown in Figure 9 in Appendix 1.

Natural areas within the buffer area include sheltered waterways associated with the Lane Cove River and the Parramatta River, being Woodford Bay and Gore Cove respectively. Parks and open space include Gore Hill Cemetery and Lane Cove Golf Course.

Urban bushland in the buffer area is typical of the Lane Cove LGA, being almost exclusively concentrated along Council reserves along gullies. These local reserves are:

- A complex of bushland and open space in a connected series of parks along Gore Creek. These include the protected native vegetation of the lower slopes alongside Bob Campbell Oval; an area of riparian and lower slope vegetation upstream of the oval; and lower slope vegetation in Osborne Park and northwards into Lane Cove Park;
- Bushland across all topographic positions in a set of tributaries of Gore Creek within Lane Cove Bushland Park;
- Bushland of the riparian zone and lower slope vegetation associated with Berrys Creek, including Holloway Park, Milray Reserve, Greendale Park, Smoothey Park, and Newlands Park;
- Part of the bushland on Berry Island Reserve; and
- Vegetation of the slopes and ridges north of Wollstonecraft Bay in Badangi Reserve, Wallumetta Park, and Harry Howard Reserve.

Confirmation of the current extent of woody vegetation in the buffer was made by:

- Analysis of vegetation mapping prepared by the Office of Environment and Heritage for the metropolitan area[8];
- Inspection of the entire buffer area using current aerial photography, the latest used being 18th January 2018, available from Nearmap at http://maps.au.nearmap.com/;
- Visiting and traversing some areas on foot. Such close inspection was undertaken in the bushland immediately to the south of the development site in Bob Campbell Oval, in Lane Cove Bushland Park, and in a series of the parks along Berrys Creek; and

[8] OEH (2013) The Native Vegetation of the Sydney Metropolitan Area. Volumes 1 and 2 and maps. Version 2.0. NSW Office of Environment and Heritage, Sydney

- Rapid visual inspection from a vehicle.

Photographs of some of these bushland areas are provided in Photographs 1 to 5 in Appendix 2.

For the purposes of defining the area of native vegetation cover within the buffer area, native canopy vegetation is used to determine the percent cover in woody vegetation types.

Using these methods and criterion, the extent of native vegetation within the buffer area is estimated to be approximately 101 hectares and is shown in Figure 10 in Appendix 1. This represents approximately 14% of the total buffer area.

Within the buffer, vegetation mapping by OEH (2013) shows a total of 6.34 hectares (or 0.8% of the total buffer area) as listed Endangered Ecological Communities. These communities are Blue Gum High Forest, Littoral Rainforest, and Swamp Oak Floodplain Forest.

The areas of vegetation that were closely inspected – including the development site – were confirmed as being equivalent in type and extent to that shown in the available vegetation mapping (OEH 2013). Investigations confirmed that there has been little change to the extent of vegetation since that mapping was produced.

## 2.3 Rivers, Streams and Wetlands

Rivers and streams recognised under the *Water Management Act 2000* are those shown on 1:25,000 topographic maps. The significance of the streams and the protections they attract are determined by their stream order, according to the Strahler system. In essence, this is defined by the number and types of upper branches.

In the buffer area of the development site, there are a number of mapped streams, and their orders have been determined by inspection of the Parramatta River 1:25,000 topographic map.

For most of its length, Gore Creek is a first order stream, as are the other local creeks Tambourine Creek and Berrys Creek. In the 1920s, the mouth of Gore Creek was filled and turned into playing fields, with the lower part of Gore Creek channelised. The Lane Cover River is a major waterway, with the highest classification of a fourth order stream.

These streams and their order per the relevant topographic map (9130-3N Parramatta River) are shown in Figure 11 in Appendix 1.

Although not a stream that is otherwise mapped, Lane Cove Council recognises a waterway and associated riparian zone along the western boundary of the development site (see Figure 6 in Appendix 1). This comprises two main parts, above and below a low escarpment (see Photographs 6 to 8 in Appendix 2).

In its upper half, it is a shallow and narrow depression at the base of the west facing slope, situated between the development site and neighbouring properties (see Photograph 6 in Appendix 2). This was not observed to carry water during the survey period. The lower half, however, is fed by a stormwater pipe that was observed to carry water (see Photograph 7 in Appendix 2) at each

survey.

The area below the rock shelf is in a seemingly more natural condition, despite the stormwater pipe, with a steep and rocky fall into the channelised part of Gore Creek. However, this area has also been highly disturbed and modified by the installation of the sewer, and disturbances associated with the filling of the estuary and channelizing of Gore Creek (see Photograph 8 in Appendix 2).

The waterway to the south of the site, including the Lane Cove River**,** have been mapped as wetland areas under the NSW wetland mapping scheme.[9]

The waterway mapping is shown at Figure 12 in Appendix 1.

Prior to filling, the lower reaches of Gore Creek may have supported vegetated wetlands but probably few mangrove areas.[10] Now, the mouth of Gore Creek has accumulated a significant amount of silt (see Photograph 9 in Appendix 2), and the resultant mudflats would provide estuarine wetland habitat for fauna such as shorebirds.

There are not wetlands recognised under the State Environmental Planning Policy (Coastal Management) 2018 or under the Department of the Environment and Energy within the buffer area or otherwise nearby.

## 2.4 Geology and Soils

There are no areas of recognised geological significance on the development site or within the buffer area.

Information regarding soils and geology is maintained in the spatial database eSPADE 2.0. The available data are sourced mainly from the NSW Soil and Land Information System (SALIS) and includes soil hazards and soil landscape mapping.

The available soil hazard mapping shows the site as having no risk of acid sulphate soils (see Figure 13 in Appendix 1).

Soil landscape mapping of the Sydney 1:100,000 map sheet reveals the underlying patterns of geology and landform and also describes the vegetation and land uses it supports.[11]

The development site is perched on a ridge, which is coincident with the Gymea soil landscape. The steep slopes below the ridge occupy the Hawkesbury soil landscape. An extract of this mapping is shown in Figure 14 in Appendix 1.

[9] Kingsford R. T. , Brandis K. , Thomas R. F. , Crighton P. , Knowles E. Gale E. (2004) Classifying landform at broad spatial scales: the distribution and conservation of wetlands in New South Wales, Australia. *Marine and Freshwater Research* 55:17-31

[10] McLoughlin, L. (1987) Mangroves and Grass Swamps: changes in the shoreline vegetation of the middle Lane Cove River, Sydney, 1780's – 1880's. *Wetlands (Australia)* 7(1):13-24

[11] Chapman and Murphy (1989) Soil landscapes of the Sydney 1:100,000 sheet

The **Gymea** soil landscape is an erosional soil landscape that occurs extensively throughout the Hornsby Plateau and along the foreshores of Sydney Harbour on Hawkesbury sandstone. Typical topography includes undulating to rolling low hills where local relief is between 20 metres to 80 metres ASL and where slopes have a gradient between 10% to 25%. Severe sheet erosion occurs following bushfires which reduce the stability of soils.

The limitations to development on this soil landscape are:

- Erosion hazard
- Rock outcrop
- Rockfall hazard (localised)
- Steep slopes (localised)
- Shallow soil

In general, the soils of the Gymea soil landscape are generally shallow, stony, moderately acid and highly permeable with low available water capacities. They also have a low to very low nutrient status with very low phosphorus and nitrogen levels.

The **Hawkesbury** soil landscape is a rugged colluvial soil landscape on Hawkesbury sandstone slopes and ridges of the Macdonald Ranges, Hornsby Plateau and Hawkesbury Valleys.

Hawkesbury sandstone generally consists of medium to coarse-grained quartz sandstone with minor shale and laminite lenses. The combination of bedding planes and widely spaced joints gives sandstone outcrops a distinctive blocky appearance.

Typical topography includes very steep, rolling hills with slope gradients ranging between 25% and 70%. Local relief varies from 40 to 200 metres, with slope gradients of 25 to 70%.

Crests and ridges are convex and narrow, and slopes may be moderately inclined to precipitous. Rock outcrop occurs as horizontal benches and broken scarps up to 10 metres high. Boulders and cobbles cover up to 50% of the ground surface. Valleys are narrow and incised.

Limitations include:

- Mass movement hazard
- Rockfall hazard
- Steep slopes
- Severe erosion hazard
- Rock outcrop
- Shallow soils

In general, the soils of the Hawkesbury soil landscape unit are extremely acidic with a low to very low nutrient status. The soils are severely deficient in nitrogen and phosphorus. They are also shallow and stony with low available water capacities and high aluminium toxicity.

## 2.5 Connectivity

The more connected that habitats are, the more valuable they are to biodiversity. This is partially a result of a larger area of habitat being available, which may support more individuals simply due to its greater size. However, a larger area of habitat may also provide for a more diverse suite of species, due to the chance of it supporting a greater diversity of habitat niches. Larger areas may also cater for species that require large home ranges, such as owls.

Linked habitats also provide movement corridors for dispersing young or plant propagules, or for refuge from catastrophic events such as fire. This is particularly so for species that have limited mobility, such as snails or some plants.

Separated patches of habitat also have value as "stepping stones" for highly mobile species such as birds and bats.

As is typical for the Lane Cove valley, connectivity in the buffer area is limited to a handful of narrow corridors concentrated on gullies and lower slope habitats. The largest of these is Lane Cove Bushland Park, which is more or less connected to the habitats of the development site, with the largest barrier being River Road.

In nearby Willoughby LGA, surveys for microbats have been conducted by Dr Arthur White in an exploration of the way that they move through the urban landscape.[12] That study established the critical importance of gully bushland, and bushland along the foreshore for foraging and movements of these small flying insectivores. This study also established that the Pacific Highway is a major barrier to low-flying species, and bat mortality along busy roads is an often overlooked but significant impact on local populations.

Taking into account the likely movement of the species thought likely to use the locally available habitats, connectivity corridors have been identified and are shown in Figure 15 in Appendix 1.

## 2.6 Areas of High Biodiversity Values

Currently, no area of the development site is mapped as having Biodiversity value (see Figure 9 in Appendix 1 for an extract from the BVMATT mapping tool).

Some of the larger riparian zones in the local area are mapped as having Biodiversity Value but no Areas of Outstanding Biodiversity Values (AOBVs) are yet recognised on site or in the buffer area.

Currently, the areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995* for the Little Penguin and Wollemi Pine have become the first AOBVs in NSW.

[12] A. White (2011) Factors in the design of an urban microbat flyway. Pp. 464-470 in *The Biology and Conservation of Australasian Bats,* edited by Bradley Law, Peggy Eby, Daniel Lunney and Lindy Lumsden. Royal Zoological Society of NSW, Mosman

# 3 NATIVE VEGETATION

## 3.1 Background Information

A number of sources of information were used to aid in the sampling and identification of vegetation types and vegetation zones on the development site. This includes recent high quality aerial photography, the published scientific literature, and scientific databases.

**Soil landscape**

The soil landscape mapping program identifies vegetation assemblages typically found within each soil landscape. In the case of the development site, it contains both Gymea and Hawkesbury soil landscapes.[13]

The original vegetation on Gymea soil landscapes in the Sydney area was a dry sclerophyll woodland and open forest, however, this has been extensively cleared due to urban development. On ridges and upper slopes, low dry sclerophyll open woodland will often dominate. Common dominant canopy species include *Corymbia gummifera* Red Bloodwood, *Eucalyptus eximia* Yellow Bloodwood, *Eucalyptus haemastoma* Scribbly Gum, *Eucalyptus capitellata* Brown Stringybark and *Banksia serrata* Old Man Banksia. However, where this soil landscape occurs on more sheltered slopes, *Eucalyptus sieberi* Silvertop Ash, *Eucalyptus piperita* Sydney Peppermint and *Angophora costata* Smooth-barked Apple are commonly found. Understorey species are largely made up from families Epacridaceae, Myrtaceae, Fabaceae and Proteaceae.

Vegetation on Hawkesbury soil landscapes in the Sydney area include mostly uncleared dry sclerophyll open-woodland, with pockets of wet sclerophyll tall open-forest, and closed-forest (rainforest). These differing types of vegetation are correlated with topographic position and exposure.

On exposed crests and ridges, there is usually a low open-woodland containing the canopy trees *Corymbia gummifera* Red Bloodwood, *Eucalyptus oblonga* Narrow-leaved Stringybark, *Eucalyptus haemastoma* Scribbly Gum, *Eucalyptus capitellata* Brown Stringybark, and *Banksia serrata* Old Man Banksia.

On the more sheltered sideslopes, a dry sclerophyll open-forest containing the canopy trees *Eucalyptus sieberi* Silvertop Ash, *Eucalyptus piperita* Sydney Peppermint, *Angophora costata* Smooth-barked Apple and *Allocasuarina littoralis* Black Sheoak predominate.

In both situations, the understorey is dominated by shrub species of the families Epacridaceae, Myrtaceae, Fabaceae and Proteaceae.

Within sheltered gullies, wet sclerophyll closed-forests of *Eucalyptus pilularis* Blackbutt, *Eucalyptus saligna* Sydney Blue Gum, *Tristaniopsis laurina* Water Gum and occasionally *Ceratopetalum apetalum* Coachwood occur. *Callicoma serratifolia* Black Wattle, *Backhousia*

[13] Office of Environment and Heritage (2017) Soil Landscapes of Central and Eastern NSW, NSW Office of Environment and Heritage, Sydney. Available at http://www.environment.nsw.gov.au/eSpade2Webapp

*myrtifolia* Native Myrtle and *Pteridium esculentum* Bracken form a closed scrubby understorey.

Many sheltered valley floors are overrun with weeds (garden escapes washed in with sediment) and may include many serious transformer weeds such as Privets (*Ligustrum* species), Lantana (*Lantana camara*), and Morning Glory (*Ipomoea* species).

**Vegetation Mapping**

The development site is within an area that has been addressed by a number of vegetation mapping programs, at both fine and coarse scales.

Coarse-scale vegetation mapping of the Sydney 1:100,000 map sheet by the Royal Botanic Gardens[14] depict the development site as cleared, with map unit 10ag Sydney Sandstone Gully Forest alongside. The composition of 10ag is determined by its position, and may be variously expressed as:

- open-forest / woodland, dominated by *Eucalyptus piperita* Sydney Peppermint, *Angophora costata* Smooth-barked Apple and *Corymbia gummifera* Red Bloodwood on sheltered hillsides and gullies;
- tall open-forest, dominated by *Eucalyptus pilularis* Blackbutt and *Syncarpia glomulifera* Turpentine in gullies and sheltered aspects; and
- closed-forest, dominated by *Ceratopetalum apetalum* Coachwood and *Tristaniopsis laurina* Water Gum in sheltered gullies.

More detailed mapping of the Cumberland Plain and surrounding areas undertaken by the NSW National Parks and Wildlife Service[15] show the site as mostly cleared, but with vegetated parts unclassified. The closest vegetation identified are classified as Map Unit 33 Western Sandstone Gully Forest, and Map Unit 43 Turpentine-Ironbark Forest, a subset of the endangered ecological community Sydney Turpentine Ironbark Forest.

This Cumberland Plain mapping was revisited and incorporated into a much larger investigation of the coastal vegetation of NSW from Sydney south to the Victorian border.[16] In that expanded analysis, the site is depicted as cleared, but the scale of the mapping is not appropriate to recognise small areas. Nevertheless, the local gullies are depicted as supporting Map Unit DSF p140 Coastal Sandstone Gully Forest.

Map Unit DSF p140 is defined as occurring within gullies on the Hornsby and Woronora coastal sandstone plateaus below 500 metres. It has a forest structural form, dominated by eucalypts in the canopy, with a diverse sclerophyll shrub layer beneath and an open ground cover of sedges.

[14] Benson, D. and Howell, J. (1994) The natural vegetation of the Sydney 1:100,000 map sheet. *Cunninghamia* 3(4):677-787

[15] Tozer, M.G. (2003) Native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities. *Cunninghamia* 8(1):1-75

[16] Tozer, M.G., Turner, K., Keith, D.A., Tindall, D., Pennay, C., Simpson, C., MacKenzie, B., Beukers, P. and Cox, S. (2010) Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands *Cunninghamia* 11(3):359–406

Canopy species include *Banksia serrata* Old Man Banksia, *Eucalyptus piperita* Sydney Peppermint, *Angophora costata* Smooth-barked Apple, and *Corymbia gummifera* Red Bloodwood. The shrub layer typically contains *Persoonia levis, Leptospermum polygalifolium, Lomatia silaifolia, Persoonia pinifolia, Banksia ericifolia, Acacia terminalis, Leptospermum trinervium, Platysace linearifolia, Banksia spinulosa, Ceratopetalum gummiferum,* and *Acacia suaveolens.* The ground layer is dominated by *Lomandra longifolia, Pteridium esculentum, Gonocarpus teucrioides, Entolasia stricta, Caustis flexuosa, Dianella caerulea, Doryanthes excelsa, Lepidosperma laterale* with the climber *Smilax glyciphylla.*

The most recent detailed fine scale mapping program relevant to the development site has been undertaken by the NSW Office of Environment and Heritage across the Sydney metropolitan catchment.[17]

This mapping shows the development site and immediate surrounds supporting three vegetation communities:

- Coastal Enriched Sandstone Dry Forest S_DSF04;
- Coastal Sandstone Foreshores Forest S_DSF06; and
- Coastal Sandstone Gallery Rainforest S_RF02.

An extract of this mapping is provided at Figure 16 in Appendix 1 and each is described below.

**Coastal Enriched Sandstone Dry Forest S_DSF04** is mapped as occurring in the eastern part of the site, generally concurrent with the garden in the historic curtilage of Pallister House.

It is widespread on the Hornsby plateau in areas that receive greater than 1,000 millimetres of mean annual rainfall and are at elevations less than 200 metres ASL. Sites are typically located downslope from large residual shale caps or on exposed Narrabeen sandstone or thin clay bands on coastal sandstone ridgetops. The subsequent clay influence is not immediately discernible at sites but does appear expressed in the plant assemblage, resulting in more prominent mesic and grass species and less abundant heath plants compared with the sheltered forests found on rockier and more siliceous sandstones.

This vegetation community most commonly occurs on the upper slopes and dry gullies of urban areas. Its natural structure is a tall open eucalypt forest with an understorey of dry sclerophyll shrubs with ferns and forbs amongst the ground cover. Dominant tree species include *Angophora costata* Smooth-barked Apple, *Corymbia gummifera* Red Bloodwood and *Eucalyptus piperita* Sydney Peppermint. *Eucalyptus pilularis* Blackbutt is common on gully slopes of the north shore. A sparse layer of small trees such as *Allocasuarina littoralis* and *Banksia serrata* Old Man Banksia is common above a variety of *Acacia, Leptospermum, Persoonia* and *Xanthorrhoea* species. *Pittosporum undulatum* Sweet Pittosporum may be prevalent in areas where fire has been excluded for an extended period of time.

[17] OEH (2013) The Native Vegetation of the Sydney Metropolitan Area. Volumes 1 and 2 and maps. Version 2.0. NSW Office of Environment and Heritage, Sydney

**Coastal Sandstone Foreshores Forest S_DSF06** is mapped as occurring along the lower slopes of Gore Creek, directly above and below the sandstone ledge in the development site's south western corner.

This community is found on sheltered Hawkesbury or Narrabeen sandstone slopes along the foreshores of Sydney's major waterways and coastal escarpments. Its distribution is also driven by a combination of low elevation (2 to 45 metres ASL) and a high mean annual rainfall (in excess of 1,100 millimetres).

In its natural form, it has an open forest structure, with a moist shrub layer and a ground cover of ferns, rushes and grasses. The canopy is most often a combination of *Angophora costata* Smooth-barked Apple, *Eucalyptus botryoides* Bangalay, and *Banksia integrifolia* Coast Banksia closest to the coast. In more sheltered locations and where there may be some minor shale enrichment, canopy trees often include *Eucalyptus piperita* Sydney Peppermint and *Eucalyptus pilularis* Blackbutt.

The understorey is typically a layer of hardy mesic small trees and shrubs, such as *Pittosporum undulatum* Sweet Pittosporum, *Glochidion ferdinandi* Cheese Tree and *Elaeocarpus reticulatus* Blueberry Ash. The relative density of these understorey species is probably related to time since fire.

**Coastal Sandstone Gallery Rainforest S_RF02** is shown as occurring in the south western corner of the development site, extending along the steep rocky riparian zone that is recognised by Council.

In the Sydney region, this community is found on sandy alluvium or rocky streams in deep protected sandstone gully systems. It occurs in higher rainfall zones (greater than 900 millimetres per annum).

In terms of floristic composition, it is a depauperate warm temperate rainforest and has a low species diversity compared to more complex rainforests associated with richer soils. *Ceratopetalum apetalum* Coachwood usually dominates the tallest stratum, with a scattered cover of small trees in the sub-canopy layer, usually comprising *Callicoma serratifolia* Black Wattle, *Acmena smithii* Lilly Pilly, *Tristaniopsis laurina* Water Gum and tree ferns (*Cyathea* species). The usual array of vines common to other rainforest assemblages are absent, and the ground cover is an open cover of ferns amongst sandstone boulders and fallen logs.

None of these vegetation communities are recognised as part of or equivalent to any currently listed endangered ecological community.

Site investigations (see below) confirmed that the best fit to the observed extent of vegetation and type of vegetation is that of OEH (2013).

**BioNet Vegetation Classification**

This used to be known as the Vegetation Information System (VIS) and is the standard database

for plant community types for NSW, and underpins the analytical tools applied as part of the Biodiversity Assessment Method. The database facilitates vegetation classification by a series of queries of critical features (e.g. structure, location, canopy dominants), and inspection of all related data relevant to each recognised plant community type.

This database was used in the clarification of the vegetation observed on and near the development site and is further discussed below.

## 3.2 Sampling

The vegetation on and near the site was sampled by way of random meander and full floristics quadrats and transects in accordance with the BAM.

Flora survey was conducted on the following dates and locations:

- 20th July 2017
    - inspection on foot of Greendale Park
    - inspection on foot of vegetation along Gore Creek at Bob Campbell Oval
    - random meander on the development site concentrated in the northern half of the historic curtilage, the trees nearest Pallister House and the horticultural plantings immediately surrounding the hospital buildings
- 21st September 2017
    - inspection of the plantings around the Pallister House car park
- 17th October 2017
    - inspection of the weedy batter and riparian zone along western boundary of the development site
    - inspection of vegetation at the rear of Pallister House
    - inspection of vegetation in the historic curtilage
    - inspection on foot of vegetation along Gore Creek at Bob Campbell Oval
    - inspection of the vegetation above Gore Creek and below the development site in the rocky riparian zone recognised by Council and the areas beneath the sandstone overhang
- 18th October 2017
    - inspection of the vegetation above Gore Creek and below the development site in the rocky riparian zone recognised by Council and the areas beneath the sandstone overhang
- 16th November 2017
    - inspection of the weedy batter and riparian zone along western boundary of the development site
- 21st November 2017
    - completion of sampling quadrats in accordance with the BAM
- 4th December 2017
    - Investigation of Lane Cove Bushland Park and the habitat features required for the Hygrocybeae Community of Lane Cove Bushland Park critically endangered ecological community
    - Inspection during rain of the riparian area recognised by Council at the site's

western boundary
- 5th December 2017
  - inspection of hollow-bearing trees
- 25th January 2018
  - random meander across the entire site to detect seasonal changes

This sampling was intended to achieve the following:

- Compile as complete a species list as possible by surveying through a number of seasons;
- Determine the boundaries of the vegetation types;
- Identify the condition of vegetation across the site;
- Identify indicator species for the vegetation communities;
- Better understand the context of the development site's vegetation and habitats by inspection of surrounding areas;
- Determine which of the locally-native trees that have likely been planted;
- Identify threatening processes; and
- Understand the habitat features of the development site and its relationship with surrounding lands.

## 3.3 Plant Community Types (PCTs)

Using the investigations listed above, it is determined that the naturally-occurring vegetation on site equates to the types mapped by OEH (2013), although the pattern of their distribution differs from the published map.

The naturally occurring elements of the development site have been assigned to the following PCTs:

- DSF04 = PCT 1776 Smooth-barked Apple – Red Bloodwood Open Forest on enriched sandstone slopes around Sydney and the Central Coast;
- DSF06 = PCT 1778 Smooth-barked Apple – Coast Banksia / Cheese Tree Open Forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney; and
- RF02 = PCT 1828 Coachwood – Lilly Pilly – Water Gum Gallery Rainforest in sandstone gullies of the Sydney Basin.

DSF04 (PCT 1776) occurs in the eastern part of the site, where the historic curtilage to Pallister House is semi-natural, including both naturally-occurring and planted canopy trees. These large trees occur over gardens, lawns, and rocky outcrops.

DSF06 and RF02 occur in small patches in the south-western corner of the development site and will not be altered or impacted (directly or indirectly) by the proposal. Therefore, assessment of these vegetation communities has not been formally undertaken in the BAM calculator as the outcome for these areas will remain the same in the post-development landscape.

The majority of the site consists of horticultural of both native and exotic species. The species composition and layout indicate it has very few natural-occurring elements. Although these

landscaped areas are not directly associated with a PCT, a 'best-fit' PCT has been assigned to it based on the native species composition and richness observed.

The chosen PCT for the landscaped gardens is PCT 684 Blackbutt-Narrow-leaved White Mahogany Shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion. This was based on the few native species observed within the assessed quadrat / transect and surrounding gardens, and other environmental factors (such as geology, topographic position, and aspect).

The extent of each of these vegetation types on site is shown in Figure 17 in Appendix 1.

Features of PCT 1776 and PCT 684 are detailed below.

**Coastal Enriched Sandstone Dry Forest**

Vegetation mapping code (OEH 2013): DSF04

Plant Community Type: PCT 1776 Smooth-barked Apple – Red Bloodwood open forest on enriched sandstone slopes around Sydney and the Central Coast.

Vegetation formation: Dry Sclerophyll Forests (shrubby sub-formation)
Vegetation Class: Sydney Coastal Dry Sclerophyll Forests.

Pre-European extent: 4,880 hectares.
Current extent: 1,741 hectares.
Percent cleared: 64%

NSW status: Not listed. May occur on slopes below Duffy's Forest EEC.
EPBC status: Not listed.

Area on site: 0.77 hectares – calculated from the Tree Protection Zones (TPZs) of trees on natural ground.

Vegetation zones on site: Represented by one vegetation zone, being VZ 1-A, and totalling 0.77 hectares.

Species relied upon for identification: *Angophora costata* Smooth-barked Apple (dominant), *Eucalyptus pilularis* Blackbutt (co-dominant) in the canopy and *Pittosporum undulatum* in the understorey.

Description: Occurs on the upper slopes and dry gullies of Sydney urban areas. It is a tall open eucalypt forest with an understorey of dry sclerophyll shrubs with ferns and forbs in amongst the ground cover. Canopy tree species commonly recorded include *Corymbia gummifera* Red Bloodwood, *Eucalyptus piperita* Sydney Peppermint and *Angophora costata* Smooth-barked Apple. *Eucalyptus pilularis* Blackbutt is common on gully slopes of the North Shore. A sparse layer of small trees also occurs, including *Allocasuarina littoralis* and *Banksia serrata*. In long-unburnt areas, *Pittosporum undulatum* may be prevalent.

Justification for PCT identification:

- Naturally-occurring canopy trees align with the PCT description;
- The absence of understorey meant that canopy species and other features (such as soil landscape, topographic position, evidence from surrounding areas) were heavily relied upon, and these aligned;
- The Vegetation Description of the PCT in the "Scientific description" tab make mention of the potential for some clay influence from upslope clay lenses. Inspection of upslope vegetation established the presence of *Syncarpia glomulifera* Turpentine (which was the dominant tree in Lane Cove Bushland Park);
- The listed distributional factors aligned with this PCT (IBRA region and subregion);
- There was a high degree of certainty in the OEH mapping that the subject vegetation is DSF04; and
- BioNet Vegetation Classification database states that there is a high confidence level that DSF04 is represented by PCT 1776.

**Landscaped Gardens**

Vegetation mapping code (OEH 2013): Urban / Exotic vegetation

Plant Community Type assigned: PCT 684 Blackbutt – Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion.

Vegetation formation: Wet Sclerophyll Forests (shrubby sub-formation)
Vegetation class: North Coast Wet Sclerophyll Forests

Pre-European extent: Not assessed.
Current extent: Not assessed.
Precent cleared: 42%.

NSW status: Not listed.
EPBC status: Not listed.

Area on site: 1.54 hectares.

Vegetation zones on site: Represented by one vegetation zone, being VZ 2-A, and totalling 1.54 hectares.

Species relied upon for identification: native species within the extent of this vegetation community on site were limited with the determination relying on the occurrence of *Eucalyptus pilularis* Blackbutt on site.

Description: The extent of the landscaped gardens across the site is 1.54 hectares and is comprised of horticultural plantings. PCT 684 occurs within the Pittwater and Wyong IBRA subregions on coastal lowlands and foothills mainly north from the Hawkesbury River to the Watagan Mountains. It is a tall eucalypt forest with an open mesic understorey. Species include *Eucalyptus*

*pilularis* Blackbutt, *Angophora floribunda* Rough-barked Apple, *Allocasuarina torulosa* Forest Sheoak, *Breynia oblongifolia* Coffee Bush, *Persoonia linearis* Narrow-leaved Geebung, *Dianella caerulea*, *Lomandra longifolia*, *Pteridium esculentum* and *Imperata cylindrica* var. *major*.

Justification for PCT identification:

This PCT is assigned to the Landscaped Gardens for the purposes of the calculator only. It is dominated by planted horticultural specimens and the PCT allocation has a "low" level of certainty.

Vegetation within this area is mapped by OEH (2013) as Urban – native / exotic vegetation. The native elements within the garden are used to assign a PCT for assessment under the BAM. This PCT was chosen for the following reasons:

- Of the 6 native species identified within the floristic quadrat / transect, only one species (*Eucalyptus pilularis* Blackbutt) was repeatedly common within a number of candidate PCTs. No other native species recorded were associated with the occurrence of *Eucalyptus pilularis* Blackbutt;
- The absence of understorey meant that canopy species and other features (such as soil landscapes, topographic position, evidence from surrounding areas) were heavily relied upon; and
- The listed distribution factors (IBRA bioregion and Subregion) aligned with this PCT;

## 3.4 Vegetation Integrity Assessment

**Vegetation zones**

Polygons are defined as being the same vegetation zone if it contains the same PCT in the same condition.

A total of 4 PCTs are present on the development site: 3 being naturally occurring vegetation communities and one made up of landscaped gardens (native and exotic) that must be assigned to a PCT as per the BAM guidelines.

Of these 4 PCTs, only two require assessment (PCT 1776 and PCT 684) as they occur in the development area. DSF06 and RF02 occur as very small patches in the south-western corner of the subject lot and will not be altered or impacted (directly or indirectly) by the proposal.

Only one vegetation zone was identified within each of these PCTs to be addressed:

- PCT 1776: VZ 1 – Low condition, native vegetation with sparse understorey. 0.44 hectares of this vegetation zone will be removed by the hospital redevelopment; and
- PCT 684: VZ 2 – Very low condition, landscaped gardens (native and exotic). 0.87 hectares of this vegetation zone will be removed by the hospital redevelopment.

The vegetation zones to be assessed are shown in Figure 17 in Appendix 1.

Patch size is an important concept in the BAM as it helps to identify the threatened species that are likely to use the site, and therefore the species likely to be impacted by the proposal and thus the species in need of assessment. However, determining the patch size for the vegetation on site is somewhat problematic. This arises due to a combination of its poor existing condition, and apparent ambiguities in the BAM regarding patch size definition.

The vegetation zones on the development site have virtually no understorey and are therefore not 'intact' as defined in the BAM. Thus, it is exempt from the strict definition of patch size.

The vegetation zone of PCT 1776 occupies an area of 0.77 hectares and is within 100 metres of a much larger area of other vegetation of different PCTs that is intact, nearly all of which is off site. The larger area of intact vegetation occupies 45.9 hectares. Under one interpretation, this is the relevant patch size.

However, if the subject vegetation zone should be included - irrespective of its condition – then the patch size is 46.67 hectares.

In either case, the patch size area is assigned to the Vegetation zone as being 25 to 100 hectares (see Section 5.3.2 of the BAM). Therefore, the greater patch size of 46.67 has been used for the calculation.

All survey effort for vegetation is detailed above.

One sampling quadrat for each of the vegetation zones identified on site were required by the BAM. The locations of these quadrats are shown in Figure 17 in Appendix 1 and the data sheets for each vegetation zone are provided in Tables 1 and 2 in Appendix 3 with the calculated scores for each vegetation zone in Table 3 in Appendix 3.

**Vegetation integrity score**

Vegetation integrity is an overall measure of the site's ecological value and is made up of a measure of its composition, structure and function. The integrity scores of the sample site are compared with the benchmark scores of the relevant PCT in order to judge its relative ecological value.

Benchmark data provided in the BAM tool for the PCTs of interest for composition, structure and function[18] are detailed in Table 3 in Appendix 3.

**Composition condition scores** are initially scored out of 100 and are calculated using the mean species richness of the growth form group. The average observed values for each growth form group are converted to unweighted condition score.

**Structure condition scores** are calculated initially out of 100 and by the mean of all observed cover values for a growth form within a vegetation zone and is converted to a continuous

[18] NSW Government (2017) Biodiversity Assessment Method Order 2017 under the Biodiversity Conservation Act 2016. NSW Sydney

unweighted condition score.

**Function condition score** is determined for a PCT classified as:

- vegetation formations that are rainforests, wet sclerophyll forests, dry sclerophyll forests, forested wetlands, grassy woodlands, semi-arid woodlands, and
- vegetation classes that are Wallum Sand Heaths, Sydney Coastal Heaths, Northern Montane Heaths, and Sydney Montane Heaths.

The current vegetation integrity score for VZ 1 (PCT 1776) on site is 34.7, which is made up of:

- Composition condition score: 17.7
- Structure condition score: 30.1
- Function condition score: 78.8

The current vegetation integrity score for VZ 2 (PCT 684) on site is 14.1, which is made up of:

- Composition condition score: 9.2
- Structure condition score: 12.3
- Function condition score: 24.9

These data are detailed in Table 3 in Appendix 3.

The current vegetation integrity score for VZ 2 (PCT 684) is below the minimum integrity thresholds assigned under Section 3.1.1.3 of the BAM for assessing vegetation zones. Specifically:

*'3.1.1.3 If, during the assessment of biodiversity values for any type of development, clearing or biodiversity certification proposal as required by Chapter 5, the assessor determines that:*

*a) an area of land does not contain native vegetation, or*
*b) a vegetation zone has a vegetation integrity score <15 where the PCT is representative of an endangered or critically endangered ecological community, or*
*c) a vegetation zone has a vegetation integrity score <17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community, or*
*d) a vegetation zone has a vegetation integrity score <20 where the PCT is not representative of a TEC or associated with threatened species habitat.'*

*'then for that vegetation zone:*
*e) assessment of native vegetation is not required beyond Section 5.4, and*
*f) an assessment of threatened species habitat according to Section 6.2 and Paragraph 6.2.1.4 is not required.'*

Therefore, no further assessment of the vegetation or threatened species habitats within VZ 2 (PCT 684) is required.

# 4 THREATENED SPECIES

## 4.1 Threatened Species Survey

Background information was gathered on threatened species known to occur in the local area, principally an interrogation of BioNet for threatened species recorded within 10 kilometres of the site, further filtered . to a buffer area of 1.5 kilometres radius. This was combined with expert habitat assessment of the site and surrounds, and a list of species compiled that were considered worthy of targeted survey.

No threatened flora species are considered likely to occur.

Fauna surveys were conducted from the 13th to 21st November 2017, 4th December 2017, and 5th December 2017. The fauna survey was intended to sample the various habitats present and detect any fauna likely to use the site.

Fauna were surveyed by call detection (audio and ultrasonic recorders), visual observation (stag watching, spotlighting, diurnal bird counts), specific habitat searching and searches for other signs of presence (tracks or traces). Due to the simplified urban nature of the site, specific targeted survey did not include terrestrial mammals due to the lack of suitable habitat and the vulnerability of survey equipment.

**Amphibians**

- Recording of calls using a Bioacoustic Audio Recorder (BAR) from the 16th November to 21st November 2017 and the 4th December 2017, totalling 37.5 survey hours. In November, the recorder was placed in the area most likely to provide appropriate habitat, being alongside the riparian area at the site's western boundary;
- Active listening for frogs; and
- Opportunistic survey at all times on site.

**Reptiles**

- Targeted survey on the 21st November 2017 and 4th December 2017 within the rocky outcropping on site; and
- Opportunistic survey at all other times on site.

**Diurnal Birds**

- Recording of calls using a BAR from the 16th November to 21st November 2017 and 4th December 2017, totalling 13 survey hours;
- Active listening for diurnal birds;
- Opportunistic survey.

**Nocturnal Birds**

- Recording of calls using a BAR from the 16th November to 21st November 2017 and 4th December 2017, totalling 24.5 survey hours;
- Scat searches for species of conservation significance during random meander survey on the 21st November 2017 and 4th December 2017;
- Spotlighting across the whole site on the 4th December and 5th December 2017;
- Active listening at all times during nocturnal survey; and
- Opportunistic survey.

**Terrestrial Mammals**

- Opportunistic survey occurred at all times on site.

**Arboreal Mammals**

- Recording of calls using a BAR from the 16th November to 21st November 2017 and 4th December 2017, totalling 24.5 survey hours;
- Spotlighting across the whole site on the 4th December and 5th December 2017;
- Opportunistic survey occurred at all times on site.

**Megachiropteran Bats**

- Recording of calls using a BAR from the 16th November to 21st November 2017 and 4th December 2017, totalling 24.5 survey hours;
- Spotlighting across the whole site on the 4th December and 5th December 2017.

**Microchiropteran Bats**

- Recording of microbats using an Anabat Express occurred from dusk to dawn from the 13th November to 21st November 2017 (in the eastern part of the site), and during dusk and early evening on the 5th December 2017 across the site, totalling 24.5 survey hours.

It is an acknowledged limitation that, no matter how much effort or expertise is employed, not all species of flora and fauna that occur and/or use a site will be recorded during ecological survey. For many fauna species, this is due to their mobility, cryptic nature and unpredictable movement throughout their habitat. In addition, migratory species may be present on the site at some times of the year, and absent at others. In addition to ecological reasons, environmental factors (such as weather, drought, and bushfire) may impact on the type and number of species recorded within a site at any one time.

The season of survey also influences the plant species that may be detected: many grasses, for example, can only be identified when they are flowering and fruiting; many orchids can only be detected when they are flowering. However, for the species of interest for this site, the season and method of survey were considered appropriate.

In support of that assertion, the climatic records for the survey period collected at the nearest weather station (Observatory Hill) are provided in Table 4 in Appendix 3.

The species observed as a result of the flora and fauna surveys are detailed in Tables 5 and 6 in Appendix 3.

## 4.2 Survey Results

Site surveys revealed no flora species of conservation significance occurring on site. A full list of the flora species recorded during survey is provided in Table 5 in Appendix 3.

A full list of the fauna species recorded during survey is provided in Table 6 in Appendix 3. Fauna survey recorded the following threatened species:

- ***Pteropus poliocephalus*** **Grey-headed Flying-fox.** Several individuals of this species were observed foraging on the flowers and blossom of *Eucalyptus saligna* Sydney Blue Gum within the canopy trees in the historic curtilage. Chattering of this species was also recorded regularly during each night of recorded survey, likely foraging on the fruits of the Fig tree near the location of the BAR.
- ***Saccolaimus flaviventris*** **Yellow-bellied *Sheathtail*-bat.** Three short foraging calls were recorded at 3:13am on the 21st November 2017. The timing indicates that this species is not roosting on site and the few calls indicate a relatively low level of foraging activity. There were only three short calls and they were somewhat masked by a feeding buzz, but the frequency is outside the range of all other known bats from this area.
- ***Chalinolobus dwyeri*** **Large-eared Pied Bat.** A short series of calls were recorded on two occasions during surveys – at 11:09pm on the 16th November 2017 and again at 3:40am on the 21st November 2017. This species roosts by day and rests at night in sandstone overhangs and forages near its day roost sites. The sandstone escarpment below the development site probably provides suitable roosting habitat, with the historic curtilage providing suitable foraging habitat. The short number of passes made the identification level of this species as only "probable".

A possible call of *Mormopterus* sp. was recorded during survey however, identification of the species associated with the call was uncertain.

Of these 3 threatened species recorded during surveys, only *Chalinolobus dwyeri* Large-eared Pied Bat is listed as a Candidate threatened species (Species credit species).

*Pteropus poliocephalus* Grey-headed Flying-fox (foraging habitat) and *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat are classified as predicted threatened species (Ecosystem credit species).

## 4.3 Predicted Threatened Species (Ecosystem Credit Species)

The vegetation type (PCT), patch size, and vegetation integrity assessment are used by the BAM calculator to predict what threatened species are likely to occur. Those species thought to be reliably predicted to occur in any particular PCT are referred to as "ecosystem credit species" and

loss of their habitat can be adequately addressed by the offsetting of ecosystem credits (which are, in essence, PCT or vegetation type credits).

The list of 13 predicted threatened species were generated by the BAM calculator and are detailed in Table 7 in Appendix 3.

In addition to that list generated by the calculator, foraging calls identified as "probable" *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat were recorded on site during survey. Although this species is not listed as a predicted threatened species for the PCT on site, the habitats available are suitable for foraging and there are many suitable potential roost sites in the hollow-bearing trees.

Therefore, this species was added to the list of species for consideration by the model.

Some of the species generated by the model are highly unlikely to occur and so it is proposed to exclude the following 6 species from consideration:

- ***Dasyurus maculatus* Spotted-tailed Quoll.** This species relies on large areas of well-connected habitat. Many features make the development site unlikely to support this species, namely the highly urbanised nature of the surrounding lands, the absence of terrestrial shelter sites, and the poor quality habitat for its favoured prey species.
- ***Haliaeetus leucogaste*r White-bellied Sea-Eagle (foraging).** This species forages over large waterbodies and perches in areas where view of prey is unobstructed.
- ***Lathamus discolor* Swift Parrot (Foraging).** This species occurs on the mainland during the winter months and relies on the presence of winter-flowering trees with high quality blossom and nectar, such as *Eucalyptus robusta* Swamp Mahogany. No such foraging resources occur on site.
- ***Pandion cristatus* Eastern Osprey (Foraging).** This species is a fishing hawk, and therefore forages in the waterways and not in the terrestrial habitats available in the development site.
- ***Phascolarctos cinereus* Koala (Foraging).** There are no preferred foraging tree species on site. Records of this species from within 10 kilometres of the site are either historic (e.g. from Canada Bay in 1955), or mistaken data entry by citizen scientists (e.g. attributed to the observer's address rather than the location of the observation), records of captive animals in Taronga Zoo, or records of dead specimens held in the Australian Museum.[19]
- ***Anthochaera phrygia* Regent Honeyeater (Foraging).** This is a very rare visitor to the Sydney area, and then usually on flowering Spotted Gums and Swamp Mahogany. There is no such foraging habitat on or near the site, and of the 18 records within 10 kilometres of the site, most are historic, with all but one recorded prior to 1976.
- ***Petroica boodang* Scarlet Robin.** Although this species is known to occasionally visit more open habitats such as grasslands, farmland and urban parks and gardens during winter, they need abundant logs and coarse woody debris for perching and foraging. No such structural components are available in the habitats of the development site.

[19] Source: Atlas of Living Australia database search: https://biocache.ala.org.au/occurrences/search?q=taxon_name:%22Phascolarctos%20cinereus%22&lat=-33.8280374&lon=151.184438&radius=10

## 4.4 Candidate Threatened Species (Species Credit Species)

Some species are considered less reliably accounted for by ecosystem credits and may require species credits. They therefore require specific attention and potentially targeted survey.

A total of 27 candidate threatened species were also generated by the BAM calculator. A full list of candidate threatened species is detailed in Table 8 in Appendix 3.

Only 2 listed candidate threatened species were considered to occur on site, or have suitable potential habitat on site:

1. *Chalinolobus dwyeri* Large-eared Pied Bat (foraging); and
2. *Myotis macropus* Southern Myotis (roosting).

Calls of *Chalinolobus dwyeri* Large-eared Pied-bat were recorded on site during survey. Details of specific habitat features for this species is shown in Table 9 in Appendix 3.

*Chalinolobus dwyeri* Large-eared Pied Bat is a species that roosts in sandstone overhangs during the day and also uses similar habitats for resting at night between bouts of foraging. Suitable roosting habitat is available nearby in the sandstone escarpment below the development site.

This species is known to forage near its roost sites, and therefore the development site is considered to provide suitable habitat in PCT 1776.

*Myotis macropus* Large-footed Myotis emerged from the BAM calculator as a candidate species because of the presence of potentially suitable roost sites in hollow-bearing trees close to potential foraging habitat in Gore Creek.

Species polygons of suitable foraging habitat for *Chalinolobus dwyeri* Large-eared Pied Bat and *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat are illustrated in Figure 18 in Appendix 1. The locations of hollow-bearing trees (potential roosting habitat for *Myotis macropus* Large-footed Myotis) are shown in Figure 19 in Appendix 1.

# STAGE 2 IMPACT ASSESSMENT

## 5 AVOID AND MINIMISE IMPACTS

The *Biodiversity Conservation Act 2016* requires as a legislative imperative that impacts are to be avoided, then minimised by implementation of ameliorative measures, with offsetting only of unavoidable impacts. Prior to the commencement of this Act, this cascade of principles was only good practice and not enforceable.

### 5.1 Impacts Avoided

The concept Masterplan footprint is shown in Figure 19 in Appendix 1. The BAM details a number of ways in which a development proposal can demonstrate avoidance and minimisation of impact. Relevant clauses are paraphrased and addressed below:

- **Project footprint located according to biodiversity values and may be iterative, depending on findings.**

  Most of the redevelopment footprint is within the area already developed for the existing hospital.

  An iterative process was employed during many meetings of the consultant team, where results were shared as they became available. Plans were amended to suit. An example is that the location and extent of the Seniors Villas footprint was adjusted to retain the most valuable trees in the historic curtilage.

- **Direct impacts avoided and minimised by locating the project in areas where there are no biodiversity values.**

  The majority of the footprint is located in the area already developed for the existing hospital. No mapped areas of biodiversity values occur within the area of proposed development.

- **Direct impacts avoided and minimised by locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition.**

  The areas of naturally-occurring native vegetation are in poor condition, being within the historic curtilage. These areas have no native understorey, in fact in most of the historic curtilage there is no understorey at all, being occupied instead by a deep leaf litter generated by the rest of the site and deposited by the grounds staff.

- **Direct impacts avoided and minimised by locating the project in areas that avoid habitat for species that have a high biodiversity risk weighting or native vegetation that is a critically endangered ecological community or an endangered ecological community.**

*Chalinolobus dwyeri* Large-eared Pied Bat is the only species recorded on site that has a very high biodiversity risk weighting and is considered a species with potential Serious and Irreversible Impacts (SAIIs). The site supports no roosting habitat for this species, and there is little evidence of foraging on site. This supports the judgement that the vegetated parts provide poor quality foraging habitat for this species.

There are no endangered ecological communities on or near the site and therefore no such impacts are likely.

- **Direct impacts avoided and minimised by locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained.**

  The existing connectivity of the site to surrounding vegetation and habitats will be maintained and improved by the implementation of the Landscape Plan. Under ecological guidance, the Concept Landscape Plan recognises a number of zones across the site, based on their value as natural habitat. The riparian area on the western boundary will be greatly improved by control of serious weeds and revegetation with appropriate native species. This has the potential to significantly improve connectivity along the local gully system. Also, the understorey beneath the trees of the historic curtilage is to be replanted with species appropriate to the vegetation type Coastal Enriched Sandstone Dry Forest S_DSF04.

- **Detail other constraints to the footprint location.**

  The site is impacted by the potential for bushfire hazard from the well-connected vegetation along Gore Creek. Therefore, the building line observes the required Asset Protection Zone (APZ), with a perimeter road and parking located in the intervening parts. These areas currently support similar open hardstand.

  The APZ requirements also play a role in the determination of the types of plantings to be used in the Landscape Plan in the south western part of the site. Species selection is guided by the twin objectives of restoring locally-native species that do not pose a significant fire hazard.

  The location of the existing sewer and stormwater pipes are important constraints to the nature and pattern of the plantings in the western boundary riparian zone as well. For example, deep-rooted trees cannot be planted over such easements.

- **Detail how prescribed impacts *sensu* the *Biodiversity Conservation Regulation 2017* are avoided and minimised.**

  The only prescribed matter is the removal of non-native vegetation that is used by threatened species. There is the potential for the garden areas to provide foraging habitat for bats. Three threatened species were recorded during survey: *Chalinolobus dwyeri* Large-eared Pied Bat, *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat, and *Pteropus poliocephalus* Grey-headed Flying-fox.

The potential for the site to provide foraging habitat for the microchiropteran bats is low as it is of poor quality with little or no understorey, or otherwise dominated by exotic species. The prescribed impacts of the proposal to these species have been minimised by the location of the new footprint mostly in the existing footprint, and by the improvements in potential foraging habitats that will be delivered by an improved landscape treatment.

The foraging habitat for *Pteropus poliocephalus* Grey-headed Flying-fox is of greater value, with mature eucalypts and figs scattered across the site. The proposed footprint of the Seniors Villas was adjusted to allow for maximum retention of mature eucalypts and mature figs.

## 5.2 Unavoidable Impacts and their Control

The direct and indirect adverse impacts of the Concept Masterplan are:

- **Loss of 0.44 hectares of PCT 1776 (Coastal Enriched Sandstone Dry Forest S_DSF04).** This is a permanent loss due to the construction and occupation of the Seniors Villas in the historic curtilage.

  In addition to formal offset arrangements as dictated by the BAM calculator (see later), this loss will be offset by the implementation of the Concept Landscape Plan in this area. The species list for the Concept Landscape Plan will rely on locally-native species (and local provenance material) in this area and is mindful of the need to restore structural diversity to the areas of natural vegetation on site. It will also remove significant weeds and exotics with the potential to become environmental weeds. This will improve habitats on site as well as off site, as it will remove a source of weed propagules otherwise raining down on sensitive downslope environments.

- **Disturbance to and removal of weedy infestations** on the steep lands in the riparian zone along the site's western boundary. The removal of weeds and stabilising of this area will represent a temporary loss of dense understorey – which may be used by small birds as shelter and forage – but it is made up almost exclusively of significant weeds such as Lantana and Bamboo.

  If this area is stable enough to remain as natural ground, then it will be planted out with species suitable to the surrounding natural vegetation (local provenance material of DSF06 and RF02) but restricted to those species considered to have a low bushfire hazard (such as mesic scramblers). However, the steep batter may need to be stabilised by terracing (such as with rock gabion) or otherwise engineered. These works (if necessary) will be confined to the already disturbed parts above the level of the natural rock shelf.

- **Loss of 0.87 hectares of (PCT 684)**, made up of horticultural plantings. These are dominated by trees with lawn, and are located around the existing buildings.

  This loss will be offset by the implementation of the Landscape Plan across the site after construction. Provision of foraging resources for significant species (such as *Pteropus*

*poliocephalus* Grey-headed Flying-fox and microbats) is an important consideration.

- **The loss of 4 hollow-bearing trees**, of the 11 identified on site. Tree hollows provide important sheltering and breeding habitat for many species, including threatened species. This is particularly so in urban environments, where many hollow trees are removed because of their instability and conflict with human safety.

  Hollow tree removal has the potential to directly impact animals resident in the hollows at the time of felling, as well as impact them due to the removal of the habitat. Thus, these potential impacts will be ameliorated by:

  - The installation of nest boxes and salvaged natural hollows in retained trees as a replacement for the hollows to be lost. The numbers of replacement hollows will be at a ratio of at least 1:1 and will be of a design suitable for the species likely to be displaced (e.g. Kookaburra, Brushtail Possum, Ringtail Possum, microbats, small parrots).
  - The hollow-bearing trees will be removed under ecological supervision to protect animal welfare. Clearing protocols will be implemented that protect the contractors, resident fauna, and surrounding retained vegetation. Felling techniques will be determined by the individual circumstances of each tree. Rescued animals will be relocated into nest boxes / salvaged hollows as appropriate or given veterinary care if injured.

- **The loss of 0.44 hectares of potential foraging habitat of *Chalinolobus dwyeri* Large-eared Pied Bat**, a species with a Very High biodiversity risk weighting. Therefore, avoiding and minimising impacts on its habitat are particularly important. This species is listed under the *'Guidance to assist a decision-maker to determine a serious and irreversible impact'* and is detailed further in Section 6.1 of this report.

  Little is known about the ecology of this species, but its wing morphology is indicative of manoeuvrable flight, suggesting that it forages on small flying insects below the forest canopy.[20] Appropriate roosting habitat occurs immediately to the south west of the development site, in the sandstone overhangs of the low escarpment along Gore Creek. No such habitat occurs on site.

  Recent habitat modelling in the southern Sydney region suggests that this species is largely restricted to the interface of sandstone escarpment (for roosting) and relatively fertile valleys (for foraging).[21] The Threatened Species Profile Database considers that habitat within 2 kilometres of potential roosting sites constitutes foraging habitat for this species. Therefore, its potential foraging habitat encompasses all of the vegetated gullies within the local reserve system, as well as the naturally-occurring vegetation and treed

[20] Hoye, G.G. and Schulz, M. (2008) Large-eared Pied Bat *Chalinolobus dwyeri*. Pp. 531-5322 in Van Dyck, S. and Strahan, S. (eds.) The Mammals of Australia. Third Edition. (Reed New Holland, Sydney)

[21] Department of Environment and Climate Change (2007) Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region: Volume 2 Species of Conservation Concern and Priority Pest Species. Sydney CMA, Department of Environment and Climate Change

gardens of the development site.

Although this species was recorded on site on two occasions, each recording was of only a few brief calls, each absent the distinctive feeding buzz. This indicates a low level of activity on site by this species, with the calls probably of an animal flying through to other parts of its home range.

Of course, this species may forage on site at other times, or on areas on site that were not surveyed. However, the habitats on site are highly modified, and unlikely to provide high quality foraging habitat. Disturbances to foraging habitat include artificial lighting (which is known to interrupt natural feeding patterns of microbats[22]), noise and movements throughout the night, large areas of heat-generating open car parks, with almost no native understorey, weedy infestations, and gardens within which insect control is carried out.

Therefore, the areas of potential foraging habitat on site are likely to be of little consequence to this species. Nevertheless, impacts have been avoided and minimised in the historic curtilage by the reduction in the numbers, extent, and construction method of the Seniors Villas in order to retain as many naturally-occurring trees as possible. The planting of native understorey (local provenance material) as part of the implementation of the Landscape Plan is considered likely to improve the value of the site as potential foraging habitat for this species.

- **The loss of 0.44 hectares of potential foraging habitat of *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat.** Like *Chalinolobus dwyeri* Large-eared Pied Bat, the calls recorded that were attributed to *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat were also fleeting, indicating a similar level of use as foraging habitat.

  The timing and duration of the calls of *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat further indicate that it does not roost on site, despite the presence of 11 hollow-bearing trees.

  The loss of non-native vegetation from the site is considered to be likely to be of little to no consequence. However, the enrichment of its habitat by the installation of appropriate roosting sites (nest boxes and salvaged hollows) and the improvements in the condition and diversity of the native vegetation is considered to be of advantage to this species.

- **The loss of foraging habitat of *Pteropus poliocephalus* Grey-headed Flying-fox.** Of the 46 locally-native trees to be removed, *Pteropus poliocephalus* Grey-headed Flying-fox is likely to forage on 9 of these: 3 x *Eucalyptus saligna* Sydney Blue Gum, 2 x *Eucalyptus sideroxylon* Mugga Ironbark, and 4 x *Ficus rubiginosa* Port Jackson Fig.

  Summer blossom is provided by the *Eucalyptus saligna* Sydney Blue Gum and are a favoured food source when in flower. However, the trees to be removed are not large, and therefore not of high value. There are 7 Blue Gum trees on site.

[22] Scanlon, A. and Petit, S. (2008) Effects of site, time, weather and light on urban bat activity and richness: considerations for survey effort. *Wildlife Research* 35(8):821-834

Winter blossom is provided by *Eucalyptus sideroxylon* Mugga Ironbark, a time when such resources are scarce. These trees have been planted and do not form part of the natural mix of the vegetation communities on site.

There are at least 19 *Ficus rubiginosa* Port Jackson Fig trees on site, many of which are very old, and therefore bear a large amount of fruit. The 4 Figs to be removed are large (>800 millimetres DBH), but are in conflict with the footprint. This species is very common in the local area, particularly on the sandstone escarpment along Gore Creek.

Such foraging resources will remain common on site and in the immediate area. *Pteropus poliocephalus* Grey-headed Flying-fox is a highly mobile species and is known to fly up to 60 kilometres in a night (personal observation) from their day camps to preferred feeding grounds at night. The animals foraging on the development site are most likely to be from the closest camps used currently at Gordon, Gladesville and / or Centennial Park. The loss of 9 individual trees in the metropolitan area is unlikely to have great impact on this population.

The tree species to be planted will include consideration of replacement of lost foraging habitat for this threatened species.

- **Potential sedimentation of downslope environments.** As demolition proceeds and vegetation is cleared, there is the potential for the mobilisation of soil and the deposition of sediment downslope in Gore Creek and beyond. Such hazards can be easily controlled by the implementation of standard sediment and erosion controls and will routinely be part of a construction management plan.

- **Potential indirect impacts from stormwater collection and discharge.** The development will result in an increase in impervious surfaces, but a number of additional water management controls will be implemented that are not currently in place. As per the Stormwater Management Plan, these include:

    - For the Seniors Apartments and Hospital - capture and use of roof water using rainwater tanks, an on-site detention system and a cartridge stormwater filter system;
    - For the Seniors Villas - Installation of combined OSD and rainwater reuse tanks to facilitate the storage and treatment of stormwater on-site.

- **Potential accidental damage to retained areas.** Areas of vegetation to be retained (such as the riparian zone along the western boundary) and individual trees to be retained will be fenced off during construction and protected using standard protection protocols such as those in AS4970 *Protection of Trees on Development Sites*.

- **Potential spread of disease.** The opening up of soil has the potential to mobilise soil-borne disease (such as the root rot fungus *Phytophthora*). Best practice hygiene protocols are to be observed if there is any indication of *Phytophthora* infection.

As the use of the site will remain largely unchanged, the impacts of the ongoing occupation of the site will largely remain unchanged.

Recommended management actions are detailed in Table 9.

# 6 IMPACT SUMMARY

Maps relevant to this section are provided in Appendix 6.

## 6.1 Serious and Irreversible Impacts

Serious and Irreversible Impacts (SAIIs) considered to potentially occur on the development site have been determined in accordance with Appendices 1, 2 and 3 of the *Guidance to assist a decision-maker to determine a serious and irreversible impact* framework[23].

Appendix 1 of the Guidelines identified 4 principles in which threatened species and Threatened Ecological Communities (TECs) are assessed against to determine if they are potential SAII entities in accordance with Section 6.7 of the *Biodiversity Conservation Regulation 2017*.

The four principles to assist decision-making are:

- Principle 1 – Species or ecological community currently in a rapid rate of decline;
- Principle 2 – Species or ecological communities with very small population size;
- Principle 3 – Species or area of ecological community with very limited geographic distribution; and
- Principle 4 - Species of ecological community that is unlikely to respond to management and is therefore irreplaceable.

Of the candidate threatened species identified in the BAM calculator, only 2 were considered as having potentially suitable habitat on the development site. Of these, *Chalinolobus dwyeri* Large-eared Pied Bat was identified as being a species with potentially Serious and Irreversible Impacts (SAIIs) as per Appendix 2 of the guidelines.

No other candidate species determined to have suitable habitat available on site were identified as potential SAII entities.

Neither of the PCTs assessed on site are associated with any TEC therefore, are not listed in Appendix 3 of the guidelines. Furthermore, the listing of the PCTs did not meet the criteria to be classified as SAII entities.

*Chalinolobus dwyeri* Large-eared Pied Bat is nominated in the Threatened Species Profile Database as being potentially vulnerable to Serious and Irreversible Impacts. However, this applies to its breeding habitat, as its cave habitats cannot be replaced, or losses otherwise ameliorated.

No such habitat occurs on the development site and there is no likelihood of impact on any nearby roosting or breeding habitat off site.

Therefore, no SAIIs to this species or its habitats will occur as a result of the proposed development.

[23] Office of Environment and Heritage (2017). Guidance to assist a decision-maker to determine a serious and irreversible impact. NSW Government, Sydney.

## 6.2 Impacts Requiring Offset

According to Section 10.3 of the BAM:

> *'The assessor is required to determine an offset for all impacts of development or impacts from the conferral of biodiversity certification on PCTs that are associated with:*
>
> 1. *a vegetation zone that has a vegetation integrity score ≥15 where the PCT is representative of an endangered or critically endangered ecological community, or*
> 2. *a vegetation zone that has a vegetation integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community, or*
> 3. *a vegetation zone that has a vegetation integrity score ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat'.*

The development site conforms with requirements 2 and 3, with the future vegetation integrity score of 31.8 and providing threatened species habitat (*Pteropus poliocephalus* Grey-headed Flying-fox, *Chalinolobus dwyeri* Large-eared Pied Bat, *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat).

Output from the BAM calculator indicates that a total of 7 ecosystem credits will sufficiently offset the impacts to PCT 1776 Smooth-barked Apple - Red Bloodwood open forest on enriched sandstone slopes around Sydney and the Central Coast.

No credits are required for the removal of PCT 684 on site due to the extent of this vegetation having a very low vegetation integrity score (14.1).

The location of such impacts and likely mitigation areas are shown in Figure 20 in Appendix 1.

Output from the BAM calculator indicates that a total of 11 species credits will sufficiently offset the loss of the impacts to the foraging habitat of *Chalinolobus dwyeri* Large-eared Pied Bat within the extent of PCT 1776 on site.

## 6.3 Impacts Not Requiring Offset

Native vegetation across the development site is made up of:

- 0.77 hectares of Coastal Enriched Sandstone Dry Forest DSF04 (PCT 1776);
- 1.54 hectares of Landscaped gardens (native and exotic) (PCT 684);
- 0.04 hectares of Coastal Sandstone Foreshores Forest DSF06 (PCT 1778); and
- 0.10 hectares of Coastal Sandstone Gallery Rainforest RF02 (PCT 1828).

The remainder of the site (approximately 1.66 hectares) is made up of existing hardstand,

buildings and highly exotic vegetation.

The proposal will require the removal of 0.87 hectares of PCT 684 Blackbutt - Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion. The extent of this PCT on site is considered to be in a very low condition with the current vegetation integrity score being 14.1. As a result, impacts to the removal of this PCT on site do not require offsetting in the BAM.

Furthermore, impacts to threatened species habitats (as represented by ecosystem credits) within the extent of PCT 684 are not required to be assessed as per Section 3.1.1.3 of the BAM.

The extent of PCT 1778 and PCT 1828 on site will remain unchanged by the proposed development. Therefore, direct impacts were not assessed.

The entire site was assessed for the flora and fauna and their habitats on site in accordance with Chapter 6 of the BAM.

# 7 BIODIVERSITY CREDIT REPORT

Outputs from the BAM calculator are provided in Appendix 4, and include:

- **Credit Summary Report**

  This report shows that 7 ecosystem credits (for the loss of 0.4 hectares of PCT 1776) and 11 species credits (for the loss of *Chalinolobus dwyeri* Large-eared Pied Bat foraging habitat) are required to offset the unavoidable losses arising from the Concept Masterplan.

- **Candidate Species Report**

  This report shows that the microbats *Myotis macropus* Large-footed Myotis and *Chalinolobus dwyeri* Large-eared Pied Bat required targeted survey during the appropriate season (November to March and September to March respectively).

  The presence of *Chalinolobus dwyeri* Large-eared Pied Bat was confirmed by survey, but no *Myotis macropus* Large-footed Myotis were detected.

- **Predicted Species Report**

  This report lists the species that are considered by the model as reliably predicted to use the site, based on the vegetation types present.

- **Vegetation Zones Report**

  This report shows that one sampling plot in PCT 1776 was required to satisfy the model.

- **Biodiversity Credit report**

  This report details the like-for-like biodiversity credits that need to be traded for the biodiversity credits required.

  - **7 ecosystem credits** for the loss 0.4 hectares of PCT 1776 can be offset with the retirement of any combination of 11 credits from PCTs 1138, 1253, 1625, 1636, 1638, 1776, 1778, 1782, 1786; in trading groups that are between 50 and 70% cleared; that contain hollow-bearing trees; and come from IBRA subregions Pittwater, Cumberland, Sydney Cataract, Wyong or Yengo OR any IBRA subregion within 100 kilometres of the outer edge of the development site; and
  - **11 species credits** required can only be offset with *Chalinolobus dwyeri* Large-eared Pied Bat species credits, but they may be from any part of NSW.

- **Biodiversity Credit Report (Variation Options)**

  In the event of no suitable credits being available after a suitable period of time has elapsed, the Biodiversity Conservation Trust may approve a variation offset:

- 7 ecosystem credits – from any PCT in the Dry Sclerophyll Forest (Shrubby sub-formation) Formation; in Tier 6 or higher; that contains hollow-bearing trees or artificial sites (i.e. nest boxes); and from the Sydney Basin IBRA Region, or any subregion within 100 kilometres of the outer edge of the development site.

- **Payment Report**

  Instead of the proponent finding and retiring credits before proceeding, the *Biodiversity Conservation Act 2016* allows for the proponent to pay the Biodiversity Conservation Trust to undertake that responsibility.

  The cost per credit for such exchanges is modelled on previous trades of that credit type or similar (if there is no credit history), and includes an added risk premium.

  As of the 16th January 2019 when the report was generated, the cost (ex-GST) was $24,389.45 to retire 7 ecosystem credits ($3,484.21 per credit) for PCT 1776, and $11,432.86 to retire 11 species credits ($816.33 per credit) for *Chalinolobus dwyeri* Large-eared Pied-bat.

  These prices may change at any time with no prior notice.

# 8 CONCLUSION

The proposed redevelopment of Greenwich Hospital at Lot 3 DP 584287 (97-115 River Road, Greenwich) and Lot 4 DP 584287 (95 River Road, Greenwich) in the Lane Cove LGA has been assessed by way of a BDAR, as per request of the SEARs (dated 14th September 2017).

The site occupies approximately 3.38 hectares and encompasses the historic lot of Pallister House, including the historic gardens.

The proposed redevelopment will be staged to include the demolition of some of the existing hospital buildings, the construction of the new proposed hospital facilities, senior living apartments and seniors living villas. The historic building of Pallister House will not be altered by the proposal and majority of the historic gardens will remain.

The proposal will require the removal and modification to approximately 0.44 hectares of native vegetation identified across the site as PCT 1776 Smooth-barked Apple - Red Bloodwood open forest on enriched sandstone slopes around Sydney and the Central Coast. A further 0.87 hectares of landscaped gardens identified as PCT 684 Blackbutt - Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion will be removed and modified by the proposal.

The removal of vegetation within the extent of PCT 1776 on site will remove suitable foraging habitat for at least three threatened species recorded on site during survey:

- *Pteropus poliocephalus* Grey-headed Flying-fox
- *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat
- *Chalinolobus dwyeri* Large-eared Pied Bat

Removal of potential foraging resources within PCT 684 have not been assessed under the BAM due to the very low condition of vegetation recorded.

No threatened flora species or endangered ecological communities were recorded across the development site during survey.

Native vegetation of concern is restricted to within the historic garden of Pallister House along the eastern boundary of the site and impacts to this vegetation have attempted to avoid and minimise the impacts to the extent of native vegetation identified on site.

The loss of non-native vegetation on site will be ameliorated by the implementation of a Landscape Plan. This will aim to reinstate native vegetation associated with PCT 1776 across the site in the post development landscape.

A total of 4 hollow-bearing trees within the extent of PCT 1776 and non-native vegetation on site will be removed by the proposed development. The loss of hollow-bearing trees will be ameliorated by the installation of suitable nest boxes within the retained vegetation on site and within the western portion of the site, downslope of the hospital grounds.

Overall, the proposed development will be required to offset the extent of native vegetation identified on site and the associated predicted threatened species by obtaining 7 Ecosystem credit species.

Impacts to *Chalinolobus dwyeri* Large-eared Pied Bat habitat will also require 11 Species credits to be obtained.

In order to reduce potential impacts to vegetation and available habitats on site, a set of management actions have been recommended that will further avoid and ameliorate potential impacts during the construction phase:

- All works in and around retained native trees are to be supervised by the Project Arborist.
- All suitable Tree Protection Zone and Structural Root Zone controls are to be implemented under supervision of the Project Arborist.
- Species to be planted as part of the Landscape Plan are to be informed by locally native species listed as occurring within the vegetation community Coastal Enriched Sandstone Dry Forest S_DSF04 (OEH 2013).

It is considered that the proposed development is not likely to impose significant adverse impacts on any matters of import and that it does not trigger the Biodiversity Offset Scheme.

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**APPENDIX 1**

**FIGURES**

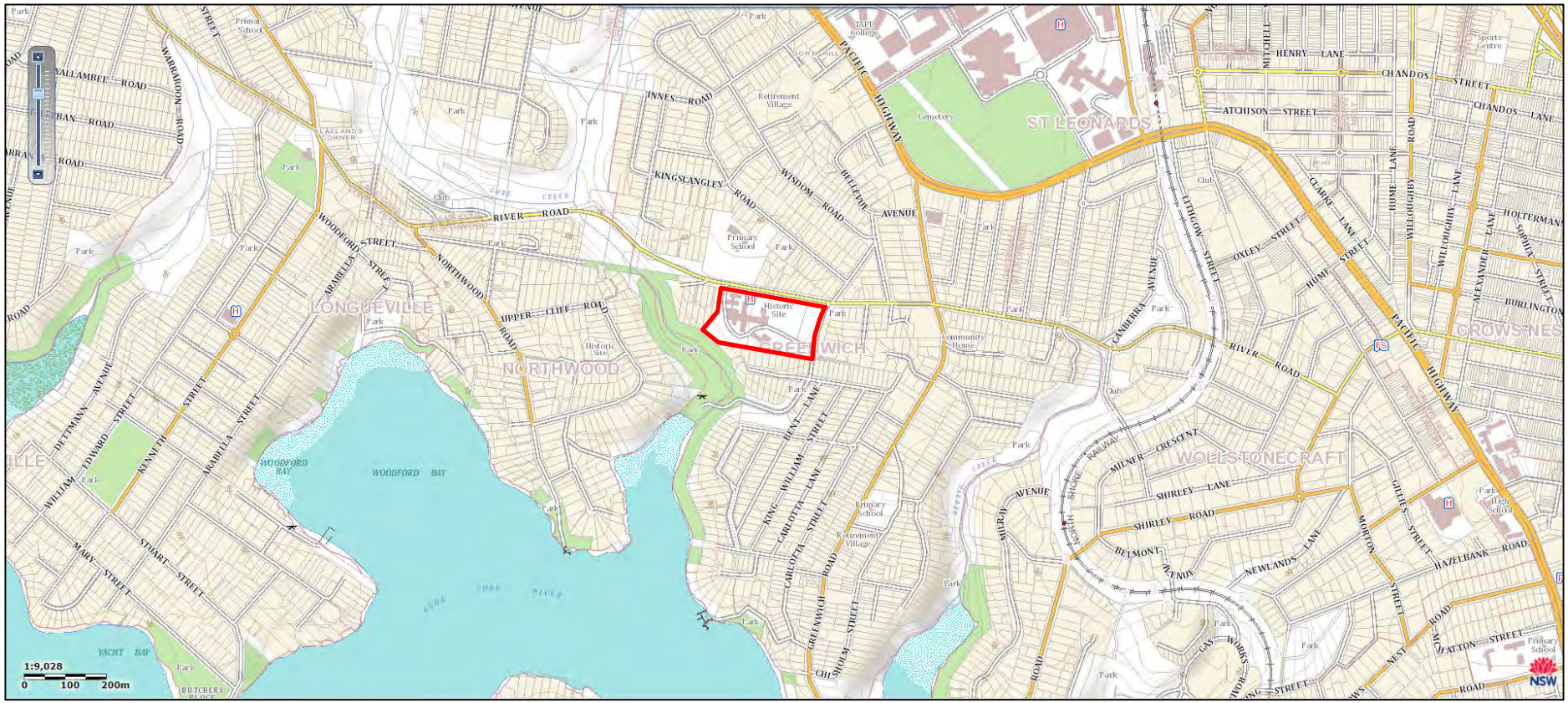


**Figure 1:** Location of the development site (red outline) in relation to local features. Source: SIXMaps (https://maps.six.nsw.gov.au/).


**Figure 2:** Contemporary aerial photograph showing the development site (red outline) in relation to the local area. Source: SIXMaps (https://maps.six.nsw.gov.au/).


**Figure 3:** Aerial photography from 1943 showing a similar pattern of development to that seen today. Source: SIXMaps (https://maps.six.nsw.gov.au/).


**Figure 4:** Comparison of close aerial photograph of the development site (red outline) from 1943 (top) with an aerial photograph from 18th January 2018 (bottom). Sources: SIXMaps (https://maps.six.nsw.gov.au/) and Nearmap (http://maps.au.nearmap.com/).

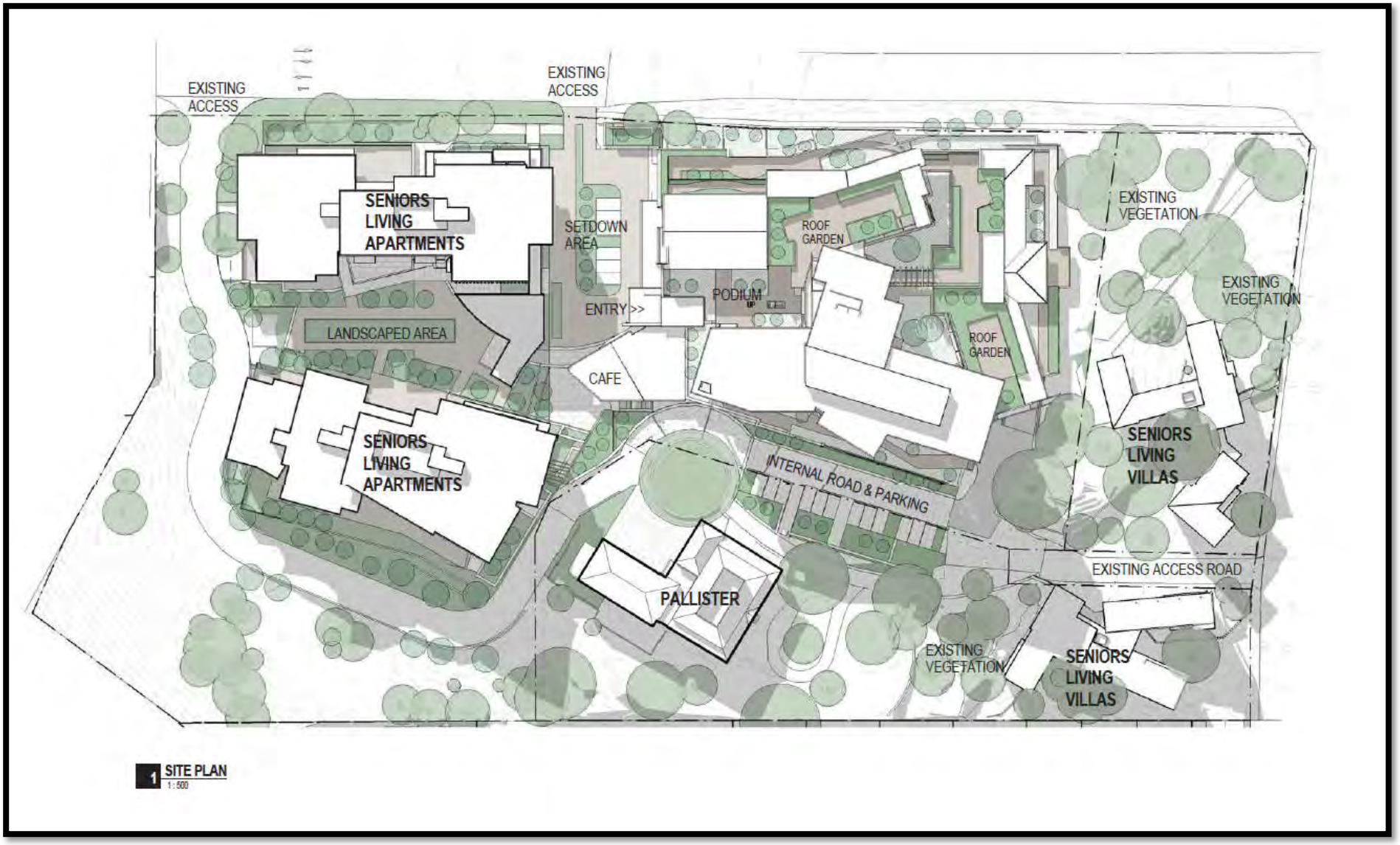


**Figure 5:** Concept Plan, drawing S.02, revision A, dated 16/03/2018. Source: Bickerton Masters Architects.

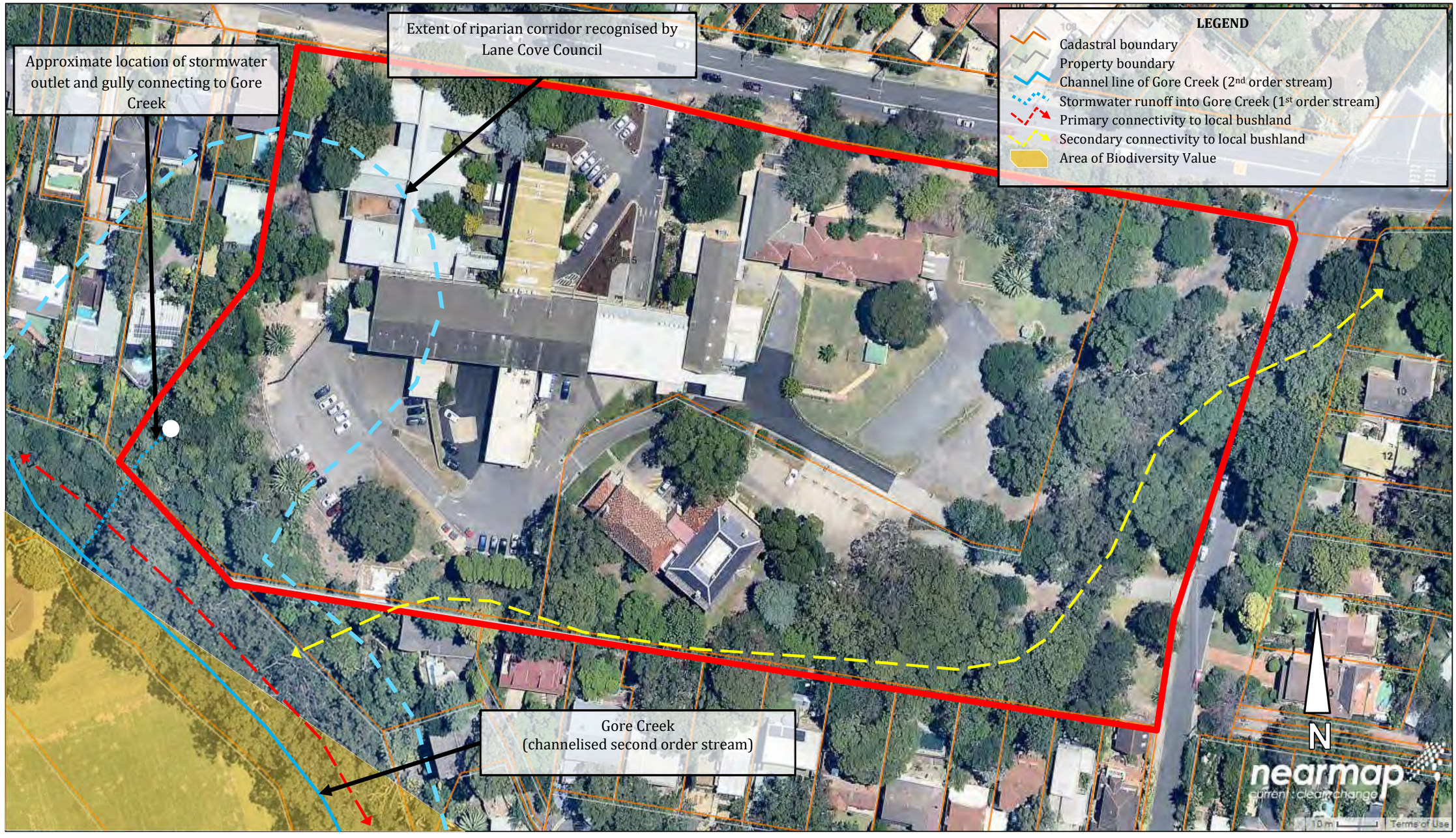


**Figure 6:** Close recent aerial showing the existing conditions, cadastral boundaries, riparian features, and habitat connectivity.

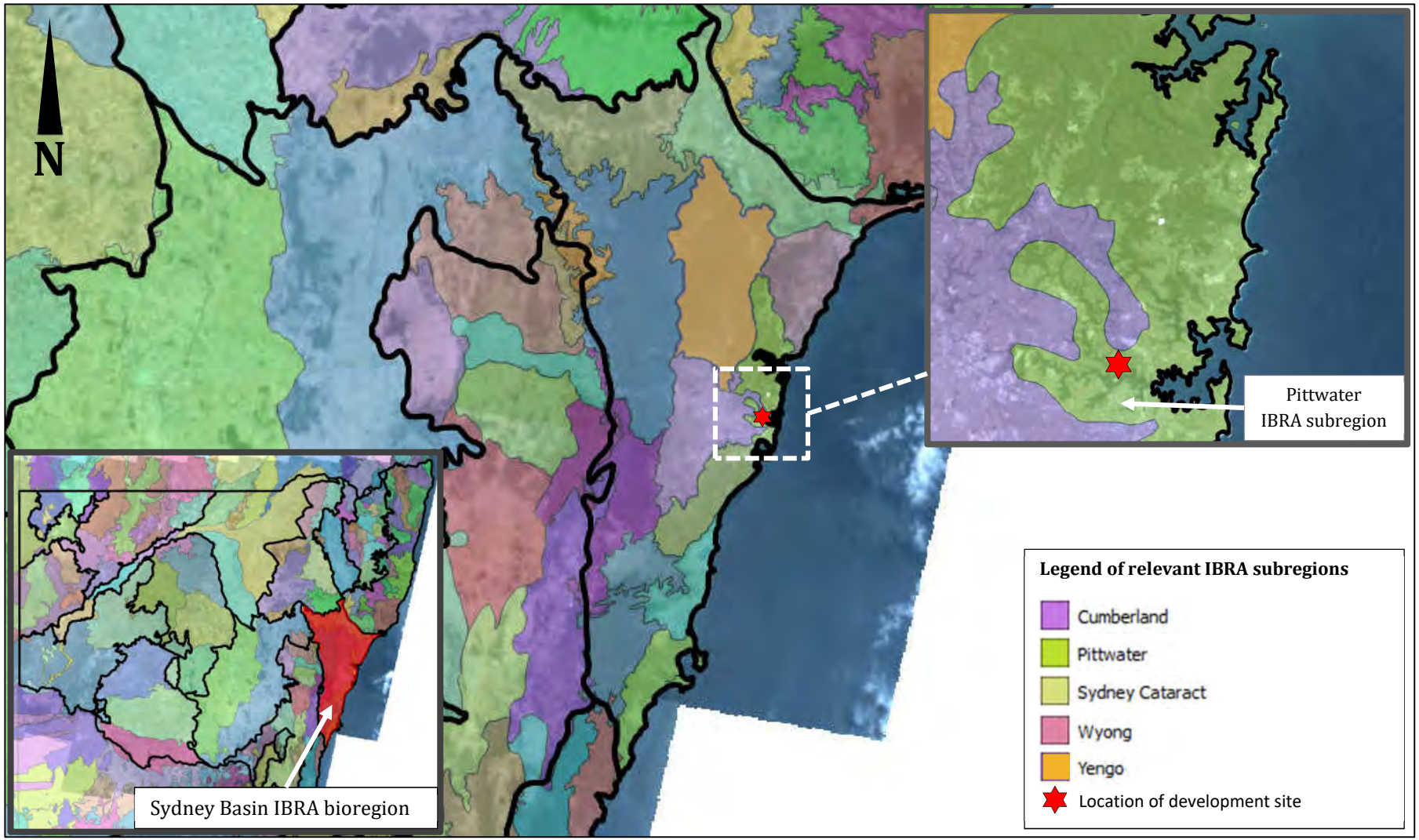


**Figure 7:** The site in relation to IBRA. The development site (location indicated by green concentric circles) is wholly within the Pittwater IBRA subregion (black outline) of the Sydney Basin IBRA Bioregion (mustard, pink outline).

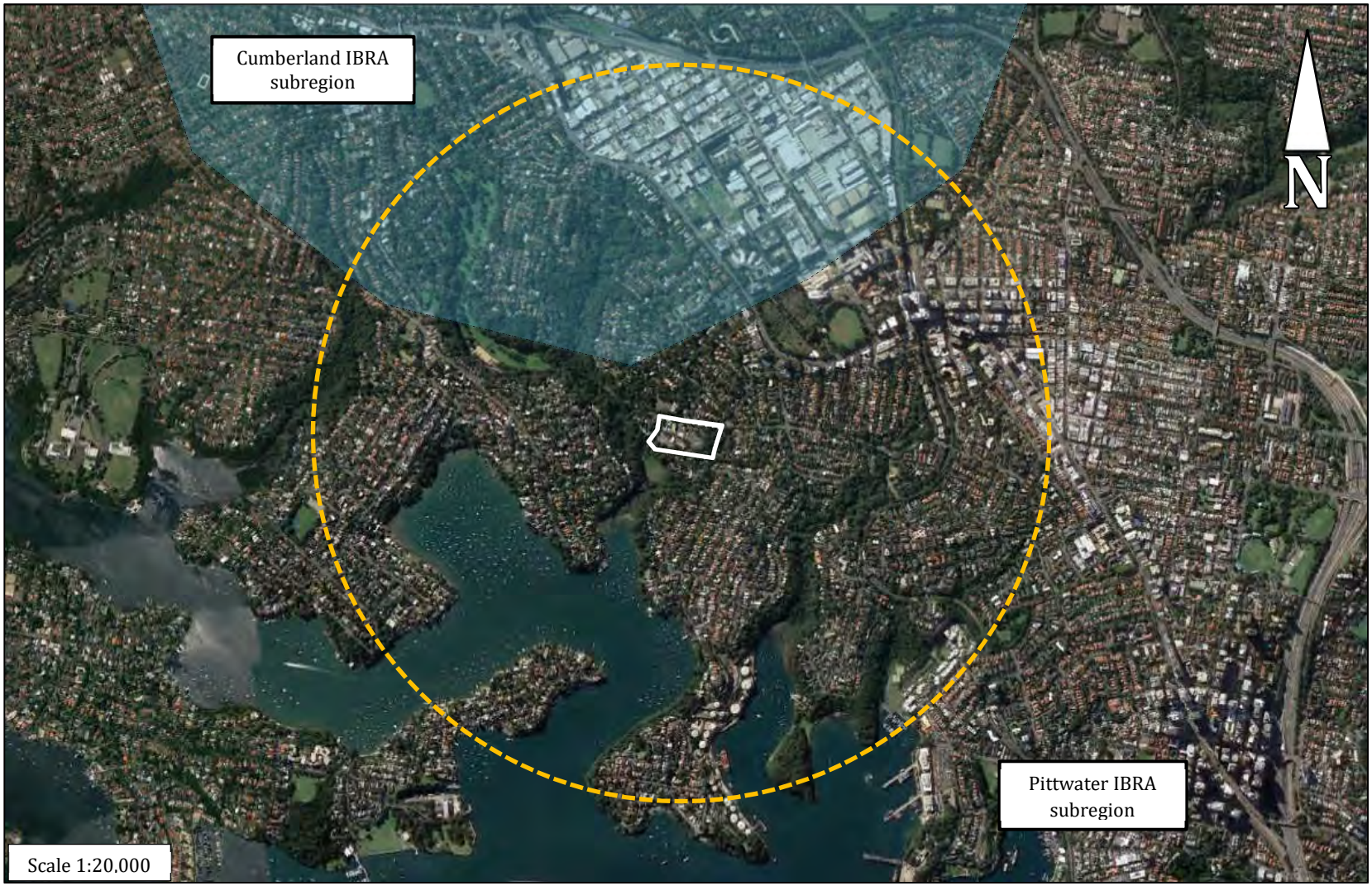


**Figure 8:** The development site (white) in relation to the IBRA bioregions and subregions of the local area. The site is wholly within the Pittwater IBRA subregion (green) in the Sydney Basin IBRA Bioregion with the Cumberland IBRA subregion (Blue) to the north. The assessment buffer is shown as a white dashed line.

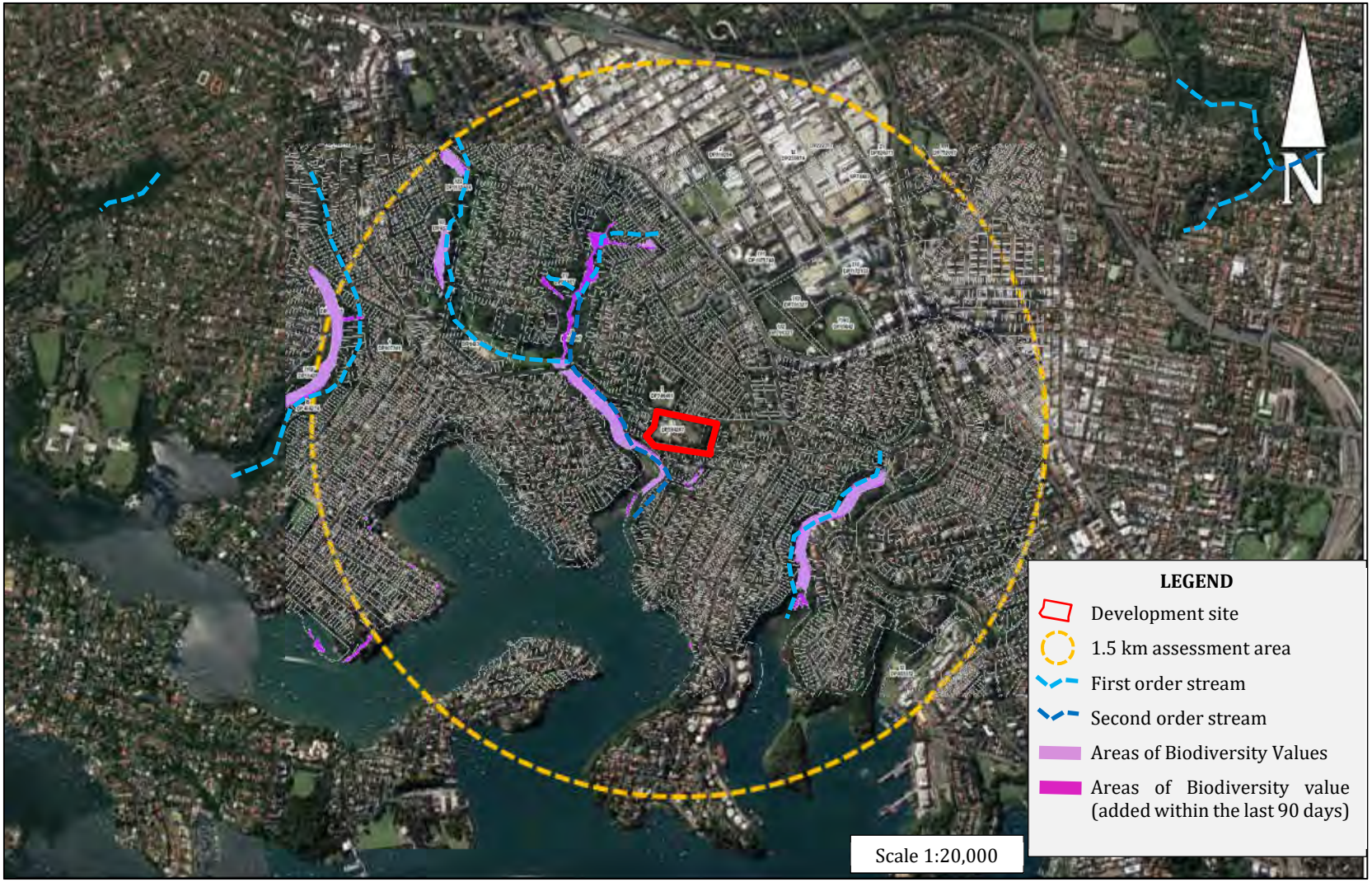


**Figure 9:** Waterways and streams, and areas of Biodiversity value within 1.5km of the development site (red). BVMAT map accessed 14th January 2019.

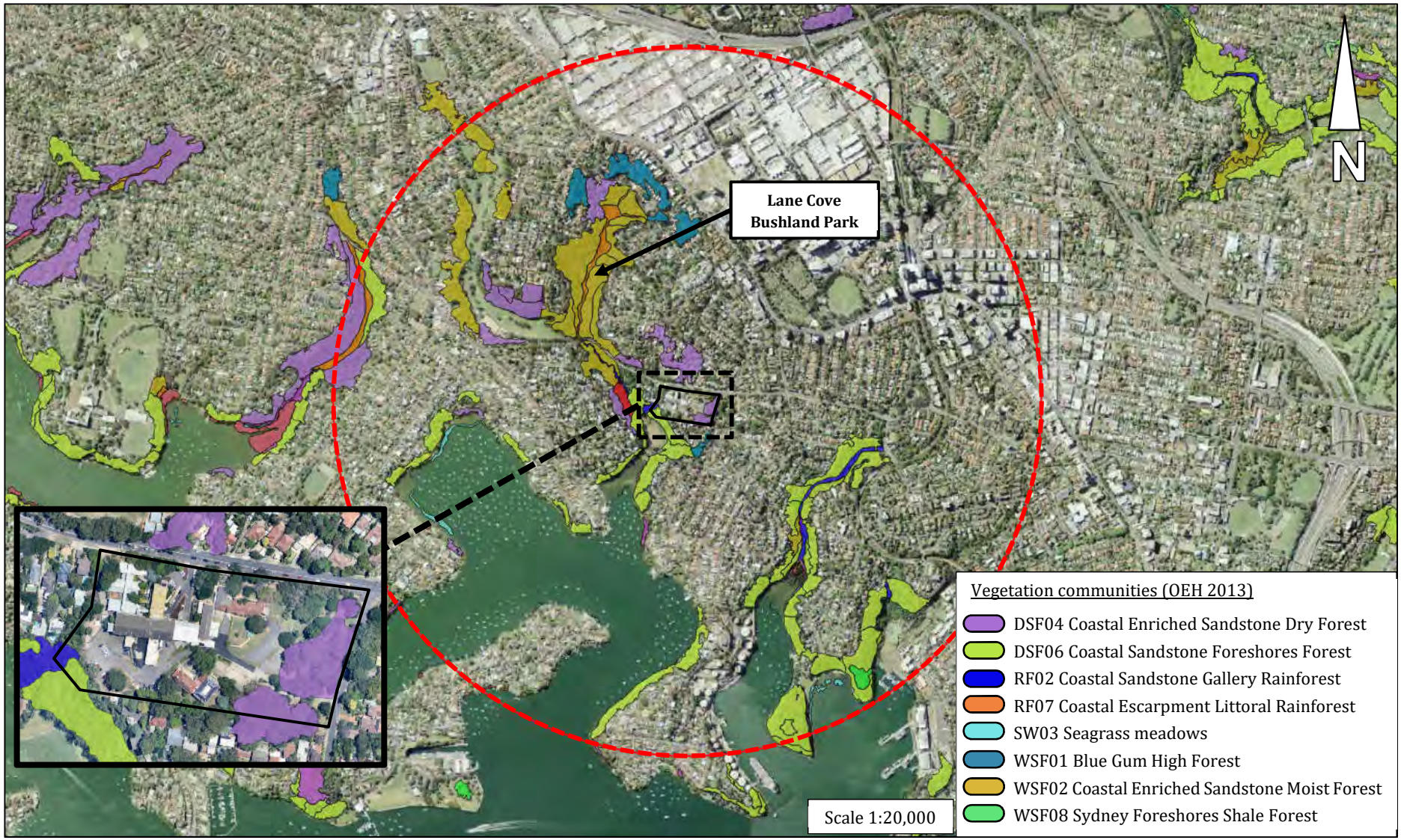


**Figure 10:** Extent of native vegetation within 1.5 kilometres of the development site. Source (OEH 2013).

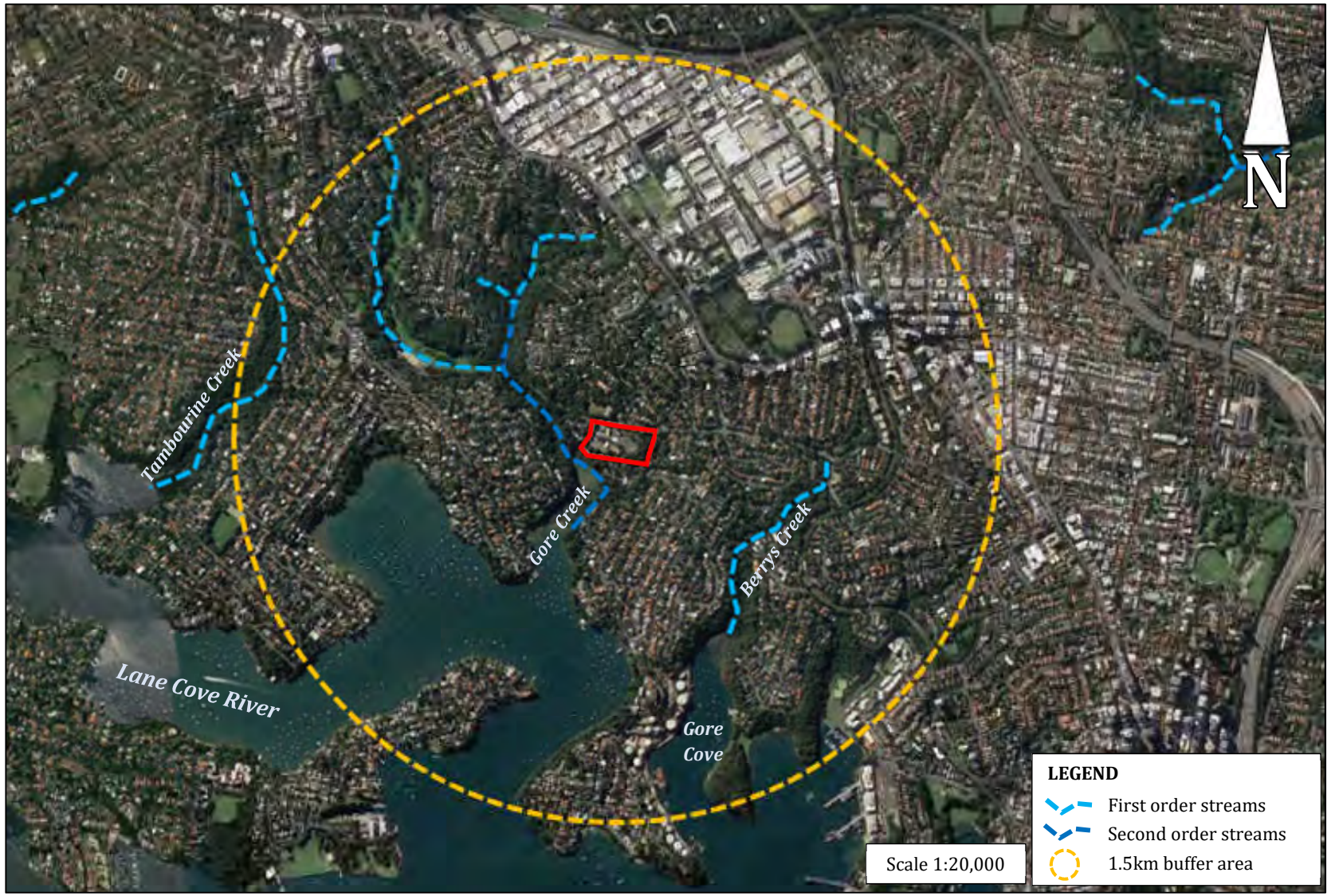


**Figure 11:** Rivers and streams within the local area recognised under the *Water Management Act 2000*, in relation to the proposed development site (red). The assessment buffer is shown as a yellow dashed circle.

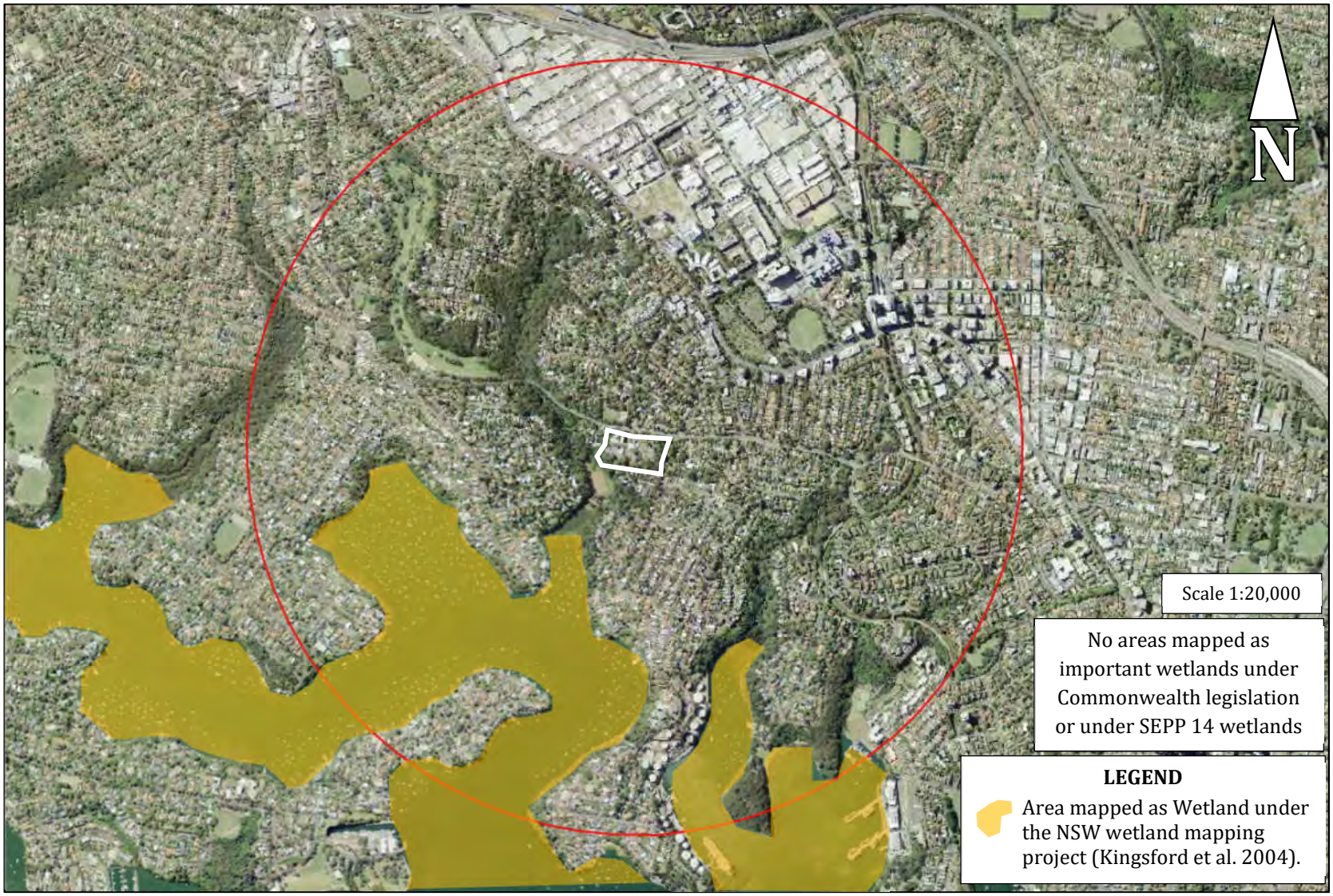


**Figure 12:** Areas mapped as wetlands under the NSW Wetland mapping project (Kingsford et al. 2004). No SEPP 14 wetlands are mapped within the local area.

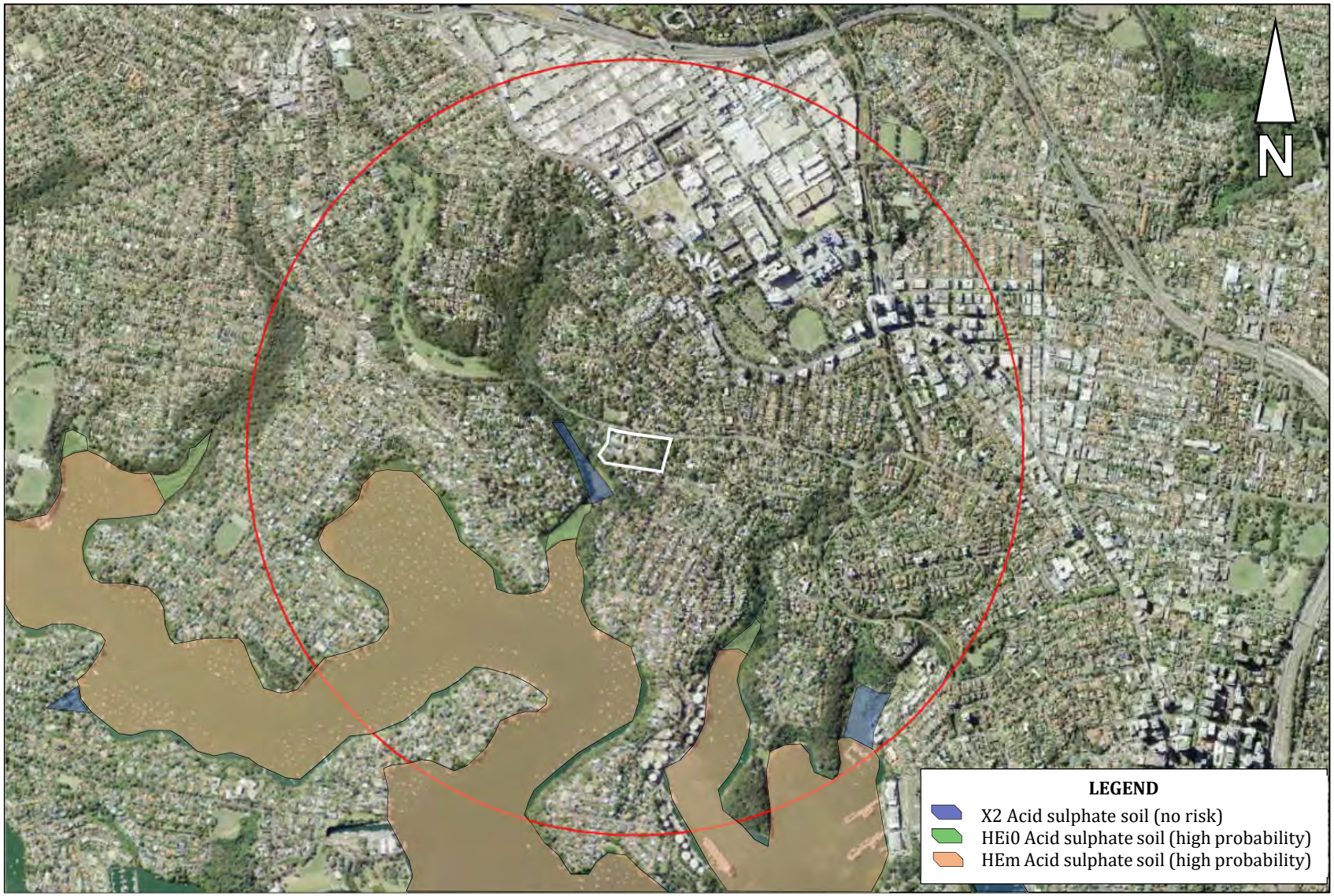


**Figure 13:** Soil hazard features, particularly acid sulphate soils.

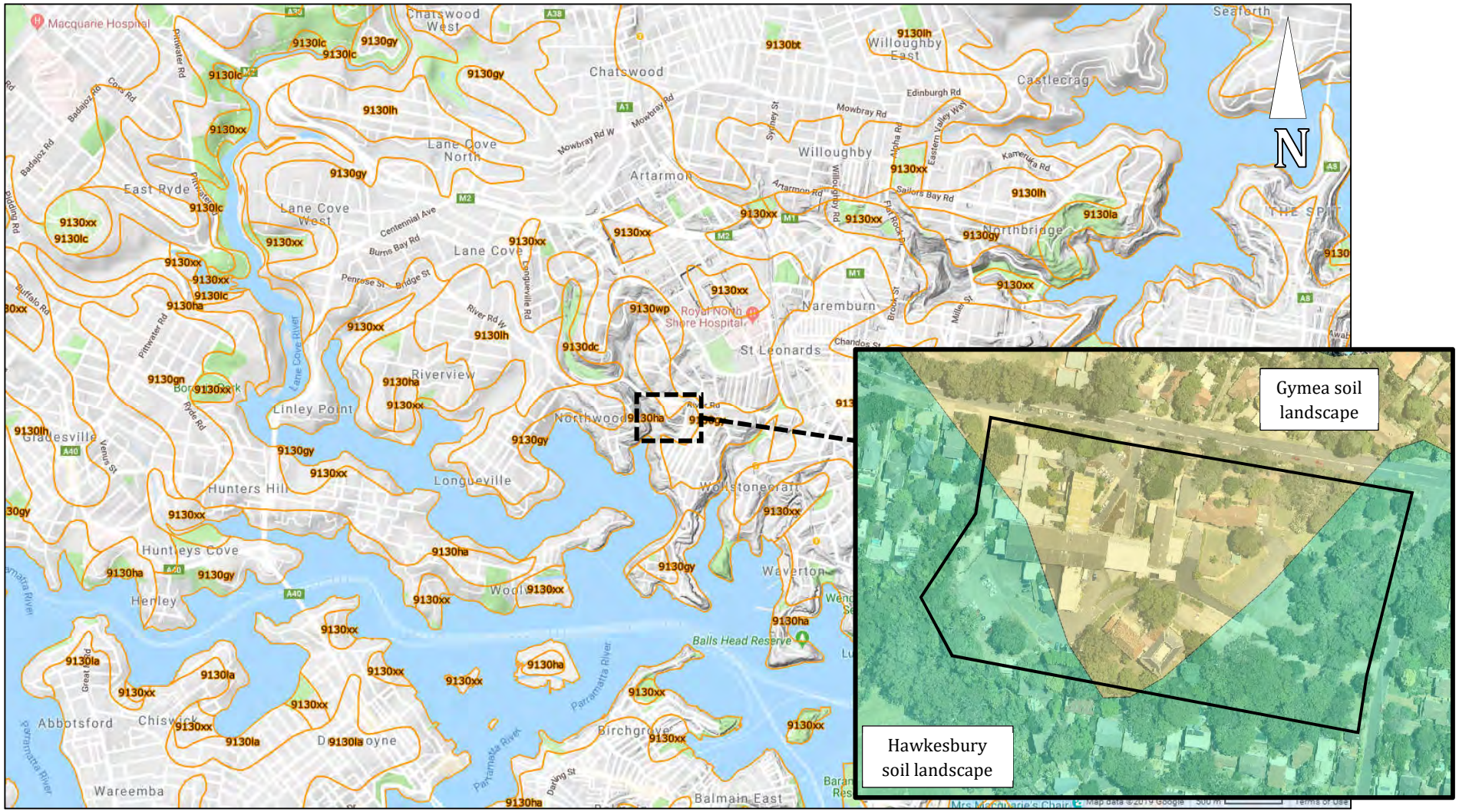


**Figure 14:** Soil landscape mapping.

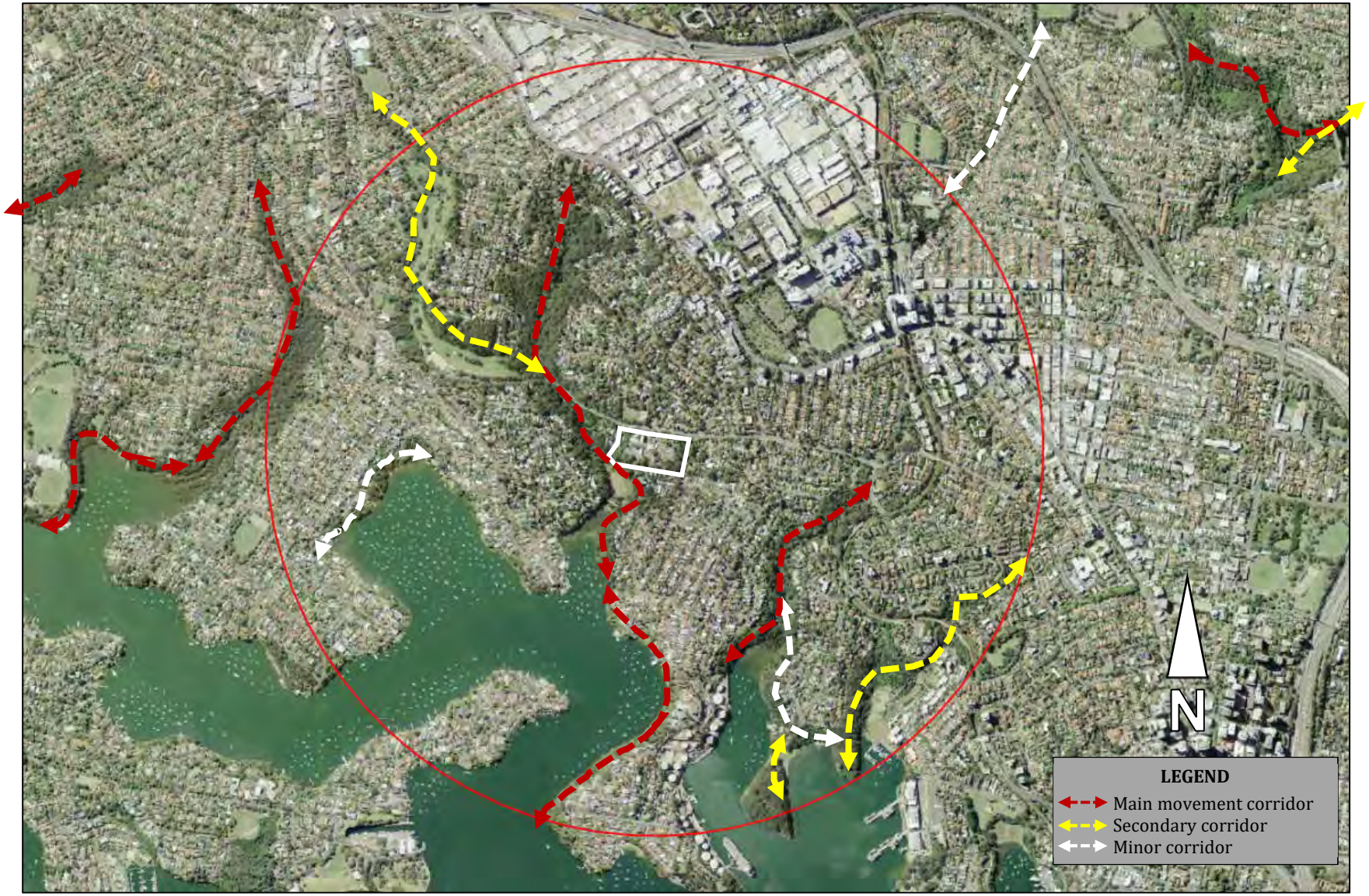


**Figure 15:** Connectivity of the site to different areas of habitat within the local area.

**Figure 16:** Vegetation mapping of the Sydney Metropolitan Catchment Management Authority showing the development site and the vegetation communities mapped by The Office of Environment and Heritage (2013). Green = DSF04 Coastal Enriched Sandstone Dry Forest; Dark blue= RF02 Coastal Sandstone Gallery Rainforest; Orange = DSF06 Coastal Sandstone Foreshores Forest; Red = Urban exotic/native. Source: OEH (2013).