

Appendix E

Flora and Fauna Survey



FINAL
***Ecological
Investigations:
Flora & Fauna Survey***

***M2 Hills Motorway
Transurban Cultural
Biolink Reserve,
Macquarie Park***

25 February 2016

*Prepared for
Landcare Australia Limited*

*Prepared by
UBM Ecological
Consultants Pty Ltd*



UBM Ecological Consultants P/L
‘St Clements’
1238 Bells Line of Road
Kurrajong Heights
Tel/Fax:(02) 4567 7979
ubmc@urbanbushland.com.au
www.urbanbushland.com.au



Executive Summary

Background

UBM Ecological Consultants Pty Ltd ('UBM') has been commissioned by Landcare Australia Ltd to undertake baseline ecological investigations and then to recommend strategies for inclusion in a Vegetation Management Plan addressing the opportunities and constraints for the rehabilitation of the area known as the Transurban Cultural Biolink Site, which adjoins the Hills M2 Motorway at Macquarie Park (the Subject Property).

The Ecological Investigation for the Subject Property at Macquarie Park forms Part 1 of the proposed Landcare Australia Project, while the Vegetation Management Plan is addressed as Part 2. Both reports have been prepared as 'stand alone' documents.

The Subject Property is approximately 5.4 ha in size and is located on the northern side of the M2 Hills Motorway between Christie Street and Khartoum Road. Two (2) permanent watercourses are located at the western (Shrimptons Creek) and eastern (Industrial Creek) ends of the area proposed for rehabilitation. Both creeks flow to the Lane Cove River, and it is anticipated that site rehabilitation will in the end, improve water quality in creeks flowing into the River.

The site is leased by Transurban from the NSW Roads & Maritime Authority ('RMS') and until fairly recently, part of the site was occupied by a secure storage facility for vehicles and plant used for the recent upgrade the M2 infrastructure. UBM understands that the site has been partly filled in the past, and that the site is in a poor ecological condition; subject to weed invasion, and the soils are likely to be compacted by past land uses.

The Brief prepared by Landcare Australia states that (vegetation) rehabilitation work is required to establish a native plant community to include key species of the Endangered *Sydney Turpentine Ironbark Forest* (STIF) ecological community where topographical and edaphic conditions allow. Although stands of remnant STIF are known for the Locality and Region, naturally occurring vegetation immediately surrounding the Subject Property is mapped as *Hornsby Enriched Sandstone Exposed Woodland* (OEH 2013) - where the term 'enriched' means that there is a substantial shale soil component present in the low nutrient sandy soil.

Under The *Ryde Local Environmental Plan 2014* the Subject Property is zoned as SP2 Infrastructure and adjoins land zoned as E1 National Parks and Nature Reserves (being Lane Cove National Park).

The objective of the Ecological Investigations Report is to provide up to date information on the ecological resources of the Subject Property, and to determine the likelihood of any threatened ecological communities, species or populations occurring on site.

This flora and fauna assessment report has been prepared to consider those threatened entities listed under the Schedules of the NSW *Threatened Species Conservation Act 1995* ('TSC Act') and/or the Commonwealth *Environmental Protection & Biodiversity Conservation Act 1999* ('EPBC Act').



Results:

Flora: 175 plant species were recorded in, or directly adjacent to the Study Area. This number includes 87 species of exotic introductions or weeds (of these 22 are noxious weeds); 80 species which are considered to be naturally occurring and characteristic of the *Hornsby Enriched Sandstone Exposed Woodland* ecological community; three (3) non-indigenous species that have been planted, and another five (5) locally indigenous species planted at some time in past. The greatest concentration of weeds occurs in the riparian zones of Industrial and Shrimptons Creeks. The filled and seeded area, described as 'The Deck', consists of a dense groundcover of exotic grasses and forbs with a number of woody weeds.

No (0) naturally occurring Endangered, Vulnerable, Near-threatened and/or Threatened (EVNT) flora species listed under the NSW *TSC Act* or Commonwealth *EPBC Act* were recorded in the current Study Area but a single individual of the endangered (*TSC Act*) *Melaleuca deanei* was recorded in the interface with Lane Cove National Park.

Fauna: The majority of the Study Area is comprised of weed thickets and exotic grassland with an overall lack of structural complexity. The permanent water sources within the existing detention basins as well as the riparian habitat along the creeks are a valuable resource for local native fauna.

By the completion of the current field survey (February 2016), two (2) native mammals (excluding microbats), 17 native birds, seven (7) native reptiles, two (2) native amphibians and five (5) native invertebrates were recorded within or in close proximity to the Study Area. A high level of microbat activity was observed; with 11 microbat species detected utilising the Study Area. This included four (4) threatened microbat species, being the Eastern Bentwing-bat (*Miniopterus orianae (schreibersii) oceanensis*), Southern Myotis (*Myotis macropus*), False Pipistrelle (*Falsistrellus tasmaniensis*), and the Greater Broad-nosed Bat (*Scoteanax rueppellii*).

No other EVNT fauna species, listed under either the *EPBC Act* and/or *TSC Act*, were observed during the course of these Ecological Investigations, however it is considered that potential foraging habitat is available for two (2) additional threatened microbats, being the Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*), and Eastern Freetail-bat (*Mormopterus norfolkensis*).

Recommendations:

In considering the proposed rehabilitation of the M2 Hills Motorway Transurban Cultural Biolink Reserve, a comprehensive Vegetation Management Plan is to be prepared, and UBM recommends that this Plan should be implemented as follows:

- Given that the M2/Transurban rehabilitation project is being undertaken primarily to serve as an ecological buffer to the Lane Cove National Park, and to arrest the spread of weeds into the National Park, a targeted weed control program is essential to success.
- Noxious, Weeds of National Significance and keystone environmental weeds should be controlled across the site and on adjacent land as a matter of priority, and a comprehensive and targeted weed control program undertaken *prior to* commencement of any earthworks or drainage works.



- Targeted weed control should be carried out for both creeklines upstream of the Subject Land (i.e. on the northern side of the M2 Motorway).
- Vegetation retained should be subject to regular maintenance, specifically weed control (weeding methods and frequency of maintenance is recommended in the Vegetation Management Plan).
- Soil testing and subsequent remediation will be required prior to any planting program. This will necessarily include importation of geologically similar weed-free topsoil, ripping, and landscape modification to create a more 'naturalistic' topography.
- The planting program should endeavour to use locally indigenous species for preference, especially using species characteristic of the *Hornsby Enriched Sandstone Exposed Woodland* ecological community, with revegetation undertaken using seed collected from adjacent bushland reserve or the National Park. This will assist in retaining local landscape character.
- Where soil conditions allow, some species characteristic of the EEC Turpentine Ironbark Forest community may be incorporated into the indigenous planting plan.
- Any future earthworks should avoid impacting areas of significant geology, and protect the existing drainage easements and riparian zones of Shrimptons and Industrial Creeks, ensuring that further degradation is avoided.
- Again, for any future earthworks, maintain a setback distance ('buffer') from indigenous riparian vegetation and minimize soil disturbance impacting on drainage lines or waterbodies.
- Riparian zones of both creeklines will require specialist treatment, as determined by GHD and Landcare Australia (part of a comprehensive soil and water management plan).
- Implementation of a vertebrate pest control program within the Subject Property (targeting rabbits) prior to the commencement of work to protect the integrity of any future planting.
- Community engagement through the use of educational signage to inform nearby residents and the local community about the project and the importance of such bushland habitat and the fauna and flora it supports.
- Encourage local residents keep dogs under control and their cats inside at night.
- The removal of Lantana and Privet thickets should be undertaken incrementally, and should be replaced by native shrubs that provide similar functional habitats for reptiles and small mid-storey birds.
- Care should be taken when using machinery for broad scale clearing to remove woody weeds which provide habitat and to prevent birds and other fauna being permanently lost from the site.
- Avoid removing woody weeds during the peak bird breeding season between July and January/February.



- Maintain a high standard of hygiene that requires the cleaning of vehicles and other plant entering the site. This will ensure the site is free of dirt and debris imported from other sites and will help to minimise the potential spread of bacterial and fungal disease such as *Chytridiomycosis* that can spread rapidly throughout amphibian populations.

The recommendations identified in this Report will assist to improve local biodiversity and benefit local bushland that the flora or fauna species and populations occurring within the Subject Property and Locality.

Plates – Front Cover:

Photo 1 –Grey Goshawk observed during the fauna survey;

Photo 2 –Industrial Creek to the east of the Study Area; and

Photo 3 – View from the top of the embankment on the edge of ‘the deck’ (facing east).



Table of Contents

1	INTRODUCTION	1
1.1	Background Information.....	1
1.2	Proposed Landcare Australia Rehabilitation Project.....	4
1.3	Report Purpose and Objectives.....	5
1.4	Scope of Works.....	5
2	SITE DESCRIPTION	7
2.1	Location and Setting.....	7
2.2	Site Definition.....	8
2.3	Physical Environment.....	9
2.4	Biological Environment.....	10
2.5	Legislative & Planning Context.....	13
3	FLORA ASSESSMENT	15
3.1	Methods.....	15
3.1.1	Literature Review.....	15
3.1.2	Flora Field Survey.....	15
3.1.3	Limitations.....	16
3.2	Results.....	17
3.2.1	Overview.....	17
3.2.2	Introduced Species/Noxious Weeds.....	21
3.3	Conservation Significance of the Vegetation.....	24
3.3.1	Threatened Flora Species.....	24
3.3.2	Threatened Plant Communities.....	24
3.4	Flora Assessments of Significance.....	27
4	FAUNA ASSESSMENT	28
4.1	Overview.....	28
4.2	Fauna Methods.....	28
4.2.1	Limitations to Fauna Field Surveys.....	33
4.3	Survey Results.....	33
4.3.1	Fauna Species Recorded.....	33
4.3.2	Fauna Habitat Assessment.....	36
4.3.3	Habitat Features.....	39
4.3.4	Connectivity.....	41
4.3.5	Threatened Fauna Assessment.....	42



5	CONCLUSION, DECLARATION & SIGN-OFF	54
6	REFERENCES	57
7	APPENDICES	61

List of Figures

Figure 1-1: Local Positioning of the Subject Property.....	2
Figure 1-2 Aerial Imagery of the Subject Property	3
Figure 1-3: Proposed Layout of Site Rehabilitation Works (source: Landcare Australia).....	5
Figure 2-1: Land Zoning (Ryde LEP 2014).....	8
Figure 2-2: Soil Landscapes (Chapman & Murphy 1989).....	10
Figure 2-3: Native Vegetation Communities Mapped for DECCW (OEH 2013)	12
Figure 3-1: Flora Survey Effort (UBM 2016).....	17
Figure 3-2: Landscape Units (UBM 2016)	22
Figure 3-3: Weed Density.....	23
Figure 4-1: Fauna Monitoring Equipment Layout and Track Log (UBM 2016)	32
Figure 4-2: Locations of Habitat Features within the Study Area (UBM 2016)	40
Figure 4-3: Connectivity	41

List of Tables

Table 2-1: Site Definition	8
Table 2-2: Physical Features of the Study Area & Environs	9
Table 2-3: Summary of Local Planning Policies & Legislative Requirements.....	13
Table 3-1: Noxious Weed Species recorded for the Study Area.....	21
Table 3-2: List of Threatened Flora Species Known to Occur in the Region	25
Table 4-1: Fauna survey effort (February 2016)	29
Table 4-2: Assessment criteria for the potential utilisation of a fauna species for the Study Area	43
Table 4-3: Threatened Fauna Assessment for species recorded in the Region during the past 10 years	44

List of Appendices

APPENDIX 1: List of Flora Species Recorded for the Study Area (UBM February 2016).....	61
APPENDIX 2: List of Fauna Species Recorded for the Study Area (UBM February 2016).....	67
APPENDIX 3: Conservation Significance of Fauna Habitat (UBM 2016)	70
APPENDIX 4: NSW State Legislative Considerations (TSC Act 1995) for EVNT Fauna species	71



Certification

I, Judith Rawling Managing Director of UBM Ecological Consultants Pty Ltd hereby state that the Ecological Investigations undertaken for the Subject Property, Lot 60 in DP 16178 at Macquarie Park, have been prepared in consideration of the schedules and requirements of the NSW *Threatened Species Conservation Act 1995* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Survey methods conform to the '*Threatened Species and Regional Biodiversity Survey and Assessment Guidelines*' (DECC 2007).

The UBM Ecological Consultants project team charged with preparing this Report were:

- Judith Rawling (BA, DipEd, DipEnvStud, MEnvSt)
- Anna Douglas-Morris (BSc, PGDipWldMgt)
- Jessie Bear (BNatSc pending)
- David Thomas (Consultant Botanist)

Disclaimer

This Report has been prepared in accordance with the Brief provided by the Client Landcare Australia Ltd, and has relied upon the data and results collected at or under the times and conditions specified in the Report. All findings, conclusions or recommendations contained within the Report are based only on the aforementioned circumstances.

The Report has been prepared for use by the Client, and no responsibility for its use by other parties is accepted by UBM Ecological Consultants Pty Ltd.

Judith Rawling

Managing Director UBM Ecological Consultants
Member AIB, MESA, MEIANZ, ECA (NSW)

Draft VI 19th February 2016

Draft V2 Report 24th February 2016

Final Report 25th February 2016

Copyright © UBM Ecological Consultants Pty Ltd February 2016



Definition of Terms

Council – here, Ryde City Council

DECCW – NSW Department of Environment, Climate Change and Water (now the Office of Environment & Heritage under the Department of Premier and Cabinet).

Direct Impacts are those that directly affect the habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat.

Ecological Community – an assemblage of species with 6 types of properties, composition; structure; habitat; distribution; interactions between their component species, and ecological processes and function (Keith 2009); and occupying a particular area at a particular time.

EEC – Endangered Ecological Community – as determined by the NSW Scientific Committee and described as a community facing a risk of extinction in the immediate future, as listed under the *NSW Threatened Species Conservation Act 1999 and/or Commonwealth Environment Protection & Biodiversity Conservation Act 1999*: **CEEC** means a critically endangered ecological community.

EVNT – Critically Endangered, Endangered, Vulnerable, Near-threatened and/or Threatened fauna/flora species or populations listed under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* and/or the *NSW Threatened Species Conservation Act 1995*.

EPBC Act – *Commonwealth Environment Protection & Biodiversity Conservation Act 1999*.

Habitat – an area or areas permanently, periodically and/or occasionally occupied by a species, population or ecological community, and including any biotic or abiotic components present.

HESEW - Hornsby Enriched Sandstone Exposed Woodland, a commonly occurring plant community (per OEH 2013) (formerly known as Coastal Sandstone Ridgetop Woodland, per Tozer *et al.* 2010).

Indirect Impacts occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas.

LGA – Local Government Area.

Locality – generally, an area within 1-2 kilometres of the Subject Property.

Noxious Weed – a species gazetted for the LGA under the *Noxious Weeds Act 1995* (amended 2000).

NPWS – National Parks & Wildlife Unit of the Office of Environment & Heritage.



OEH – Office of Environment & Heritage under the NSW Department of Premier and Cabinet (formerly DECCW).

SCIVI – *Southeast NSW Native Vegetation Classification and Mapping*, by Tozer *et al.* 2010 for former NSW Department of Environment and Climate Change (DECCW)¹.

Subject Property – refers to the property known as Lot 181 in DP 1150938, located on the northern side of the M2 Hills Motorway between Christie and Khartoum Roads.

SMCMA – Sydney Metropolitan Catchment Management Area.

SSTF – Shale Sandstone Transition Forest, a critically endangered ecological community (CEEC) under the NSW *TSC Act*.

STIF - Sydney Turpentine Ironbark Forest, an endangered ecological community listed under the NSW *Threatened Species Conservation Act* and listed as critically endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act*.

TSC Act – NSW *Threatened Species Conservation Act 1995*.

UBM – UBM Ecological Consultants Pty Ltd: formerly trading as Urban Bushland Management Consultants ('UBMC').

Vegetation Community – described as an assemblage of native flora species known to occur in association with each other because of topography, soil landscape and rainfall.

WoNS – Weed of National Significance (Commonwealth Listing).

¹ **Reference:** Tozer, M.G., Turner, K., Simpson, C., Keith, D.A., Beukers, P., MacKenzie, B., Tindall, D. & Pennay, C. (2010). Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tableland, in *Cunninghamia* 11 (3)



1 INTRODUCTION

1.1 Background Information

UBM Ecological Consultants (UBM) has been commissioned by Landcare Australia Ltd to undertake baseline Ecological Investigations and then to recommend strategies for inclusion in a Vegetation Management Plan addressing the opportunities and constraints for the rehabilitation of the area known as the Transurban Cultural Biolink Site, which adjoins the Hills M2 Motorway at Macquarie Park (the Subject Property).

The Subject Property is approximately 5.4 ha in size and is located on the northern side of the M2 Hills Motorway between Christie Street and Khartoum Road. Two (2) permanent watercourses are located at the western (Shrimptons Creek) and eastern (Industrial Creek) ends of the area proposed for rehabilitation. Both creeks flow to the Lane Cove River and it is anticipated that site rehabilitation will in the long-run, improve water quality in creeks flowing into the River.

The Property is leased by Transurban from the NSW Roads & Maritime Authority (RMS), and until fairly recently part of the site was occupied by a secure storage facility for vehicles and plant used for the recent upgrade the M2 infrastructure. UBM understands that the site has been partly filled in the past, and that the site is in a poor ecological condition; subject to weed invasion and the soil is likely to be compacted by past land uses.

The Brief prepared by Landcare Australia states that (vegetation) rehabilitation work is required to establish a locally indigenous native plant community which includes key species of the Endangered *Sydney Turpentine Ironbark Forest* (STIF) ecological community where topographic and edaphic conditions allow. Although stands of remnant STIF are known for the Locality, the naturally occurring native vegetation immediately surrounding the Subject Property is mapped as *Hornsby Enriched Sandstone Exposed Woodland* (OEH 2013) - where the term 'enriched' means that there is a substantial shale soil component present in the low-nutrient sandy soil. UBM notes the potential to 're-create' a modified form of STIF on this site, provided that the physical and chemical characteristic of the underlying soils are deemed to be suitable - as determined by soil testing and where necessary, through soil remediation², and also that limitations to site drainage are addressed.

The recommendations of the VMP to be prepared as Stage 2 of the Landcare Australia Project will be based on the outcomes of the preliminary Ecological Investigations (flora and fauna survey/habitat assessment), and will provide strategies to re-create appropriate flora and fauna habitat; to control noxious and keystone environmental weeds, and to guide the establishment of a modified form of a native plant community (which may include STIF species) through a program of selective planting.

UBM has surveyed the site to determine and quantify any existing flora and fauna values. Survey results are incorporated into this Report. The local positioning of the Subject Property is shown in *Figure 1-1*. An aerial view of the Property is shown in *Figure 1-2*.

² Soil testing and remediation to be undertaken by Landcare Australia



Figure 1-1: Local Positioning of the Subject Property

Source: <https://maps.six.nsw.gov.au/>

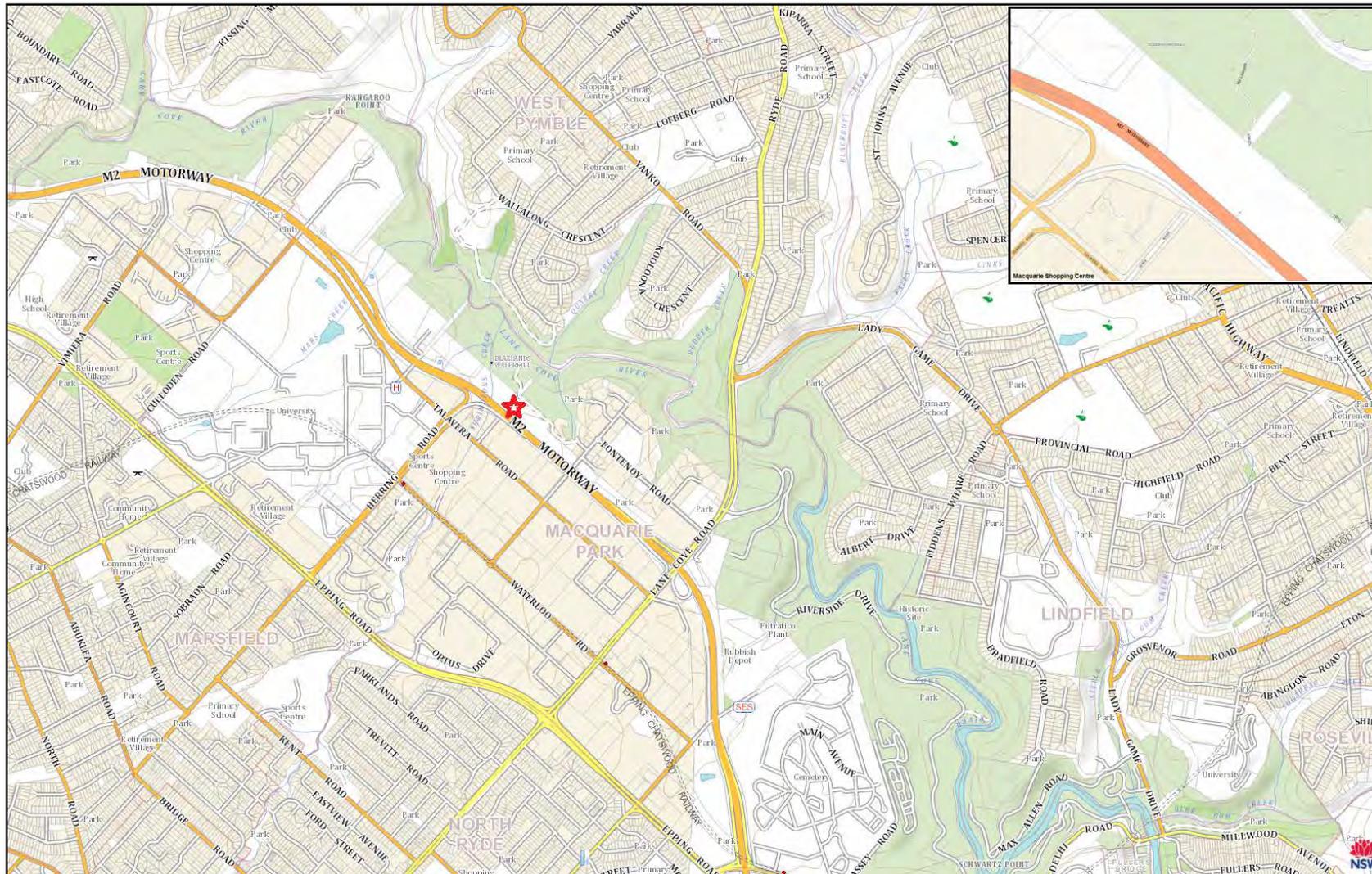




Figure 1-2 Aerial Imagery of the Subject Property

Source: Google Earth Pro; Imagery Date: October 2015





1.2 Proposed Landcare Australia Rehabilitation Project

Landcare Australia has been commissioned by Transurban to implement a bushland rehabilitation initiative for a degraded site adjoining the M2 Hills Motorway at Macquarie Park. As part of the Hills M2 Motorway Agreement, Transurban leases the site from the NSW Roads and Maritime Authority (RMS).

Transurban is seeking to rehabilitate approximately 5.4 hectares of their leased site; thereby substantially increasing its ecological functionality and increasing community engagement. The project aims and objectives set out below have been summarised from the Project Brief provided by Landcare Australia.

1. The environmental amenity of the leased area will be greatly improved by rehabilitation of the overall 5.4-hectare site to recreate native bushland communities consistent with pre-European conditions.
2. Supported by appropriate signage and targeted communications, the site's strategic location will assist to increase community awareness about protecting threatened species and managing the interface between urban areas and the Lane Cove National Park.
3. Transurban will also commission and construct a prominent cultural installation to mark the significance of the site and improve visual amenity. The installation will be visible to passing traffic and neighbouring properties, and will complement the environmental assets of the location.
4. The surrounding rehabilitation work will enhance the visual impact of the cultural installation, with some revegetated areas land-formed to a height of approximately 1.5-2m as a backdrop to the installation. Sightlines to the installation by passing traffic will be maintained through selection and planting of appropriate small shrub and groundcover species. For bushfire safety, an Asset Protection Zone of 15m will be maintained between dense revegetation and the cultural installation.
5. Once the rehabilitation work is completed, the site will form an important transition between urban infrastructure and the conservation objectives of Lane Cove National Park. The site will also create substantial environmental benefits for the National Park and improve downstream water quality in both Shrimptons and Industrial Creeks. It will also greatly improve the aesthetic characteristics of the site and surrounding environs.

In addition to the rehabilitation and reinstatement of a native vegetation community on the cleared and degraded sectors of Subject Property, it is proposed to improve riparian habitat on both creeks by stabilising their creekbanks with rock battering to reduce erosion and sediment transport downstream. This work will be undertaken by GHD and Landcare Australia, and does not form part of this Report or the forthcoming Vegetation Management Plan.

The layout of the rehabilitation site as proposed by Landcare Australia is shown on *Figure 1-3*.



Figure 1-3: Proposed Layout of Site Rehabilitation Works (source: Landcare Australia)



1.3 Report Purpose and Objectives

The objectives of the current Report are to provide accurate up to date information about the ecological resources of the Subject Property and to identify any species, populations or ecological communities listed under the legislation (*TSC Act/EPBC Act*) which might occur on site.

The presence of any threatened entity may provide some level of constraint for the proposed site rehabilitation work, and if any such entities are present the direct and indirect impacts of the proposed development must be assessed under Section 5(a) of the *Environmental Planning & Assessment Act 1979* ('*EP&A Act*') – this Assessment of Significance is commonly referred to as the Seven-part Test).

For any threatened entity present deemed to be of National Significance the impacts of the Proposal must be reviewed under the Commonwealth Significant Assessment Guidelines. The role of the Ecological Investigations (this Report) is to flag any issues of ecological significance to be addressed in the development design.

1.4 Scope of Works

In undertaking the Ecological Investigations for the Transurban M2 Hills Cultural Biolink Reserve (the Subject Property) the following scope of works was applied; detailing actions and tasks as follows:

- a) Definition of report purpose and statement of clear management objectives;



- b) Provision of background information and site descriptions necessary to make informed decisions about the future management of the native vegetation on the Property;
- c) Field investigations to identify flora and fauna habitat values, identify linkages and corridors and to document impacts such as weed invasion and alterations to the natural site drainage;
- d) Identify actions required to create/enhance site conservation values, including the management of weeds, indigenous plantings, soil and water management and public safety;
- e) Planning for the recreation and management of about 54000 sq metres (5.4 ha) of locally indigenous native vegetation within the extent of the Subject Property; and
- f) Provide advice to other expert team members about revegetation methods, site drainage and soil remediation and stabilisation.

The outcome of the ecological investigations will inform and guide the Vegetation Management Plan.



2 SITE DESCRIPTION

This chapter provides a brief description of the physical and biological environments for the Subject Property at Macquarie Park. This information has been gathered from a range of sources, including previous surveys and investigations, information held by Landcare Australia, Ryde City Council, and the author's local knowledge.

2.1 Location and Setting

The information below has been sourced from the Project Brief prepared by Landcare Australia.

The M2 site is separated from the Macquarie Park commercial and residential centre by the Hills M2 Motorway, which forms the southern site boundary. The site is bounded in the east by Khartoum Road. Importantly, Lane Cove National Park adjoins the majority of the northern boundary and a nature reserve is on the western boundary.

Towards the western end of the site, Shrimptons Creek flows under the Hills M2 Motorway via a large arched culvert and drains in a northerly direction to the Lane Cove River, less than 300m from the northern boundary. On the M2 site, the bed of the creek is naturally incised sandstone bedrock and sandy material.

A second watercourse, Industrial Creek, enters the south-eastern corner of the site near Khartoum Road via a 1.8m diameter pipe; flows through a short gully of broken rock in a northerly direction, and exits the M2 site via a box culvert draining to Lane Cove River approximately 300m from the site boundary.

Stormwater runoff from the Hills M2 Motorway road surface is collected by pipe and table drain and directed to a retention basin on the northern site boundary, located approximately 50m from Shrimptons Creek. Water from the retention basin will overflow to Shrimptons Creek during significant rain events. Other stormwater run-off from the M2 site will eventually drain to the two (2) creeks and Lane Cove River.

The M2 site has been significantly disturbed and exhibits very poor ecological and aesthetic characteristics. Small remnants of native vegetation communities are badly degraded. The majority of the site is dominated by exotic weed species, including Weeds of National Significance (WoNS) and species listed under the *Noxious Weeds Act 1993*. Riparian vegetation alongside the creeks is also in very poor condition.

The centre of the site contains an area of approximately one (1) hectare of land that once served as the main compound for plant and machinery used in the recent upgrade of the M2 Motorway (described in this Report as 'The Deck'. The area comprises a relatively level site created from compacted fill of unknown stability, flanked by relatively steep slopes on the northern (~1:3m) and western sides (~1:2.5m). In 2013, the Deck area was seeded with a mixture of shrub and groundcover species, but is now also dominated by exotic weeds, particularly Flax-leaf Broom (*Genista linifolia*), which is locally a noxious weed and nationally a Weed of National Significance (WoNS).

Poor water quality, gross pollutants and the degraded condition of the riparian vegetation communities reflect the highly urbanised catchment areas of the creeks, local land uses comprising mainly residential and commercial properties with some light industrial development.



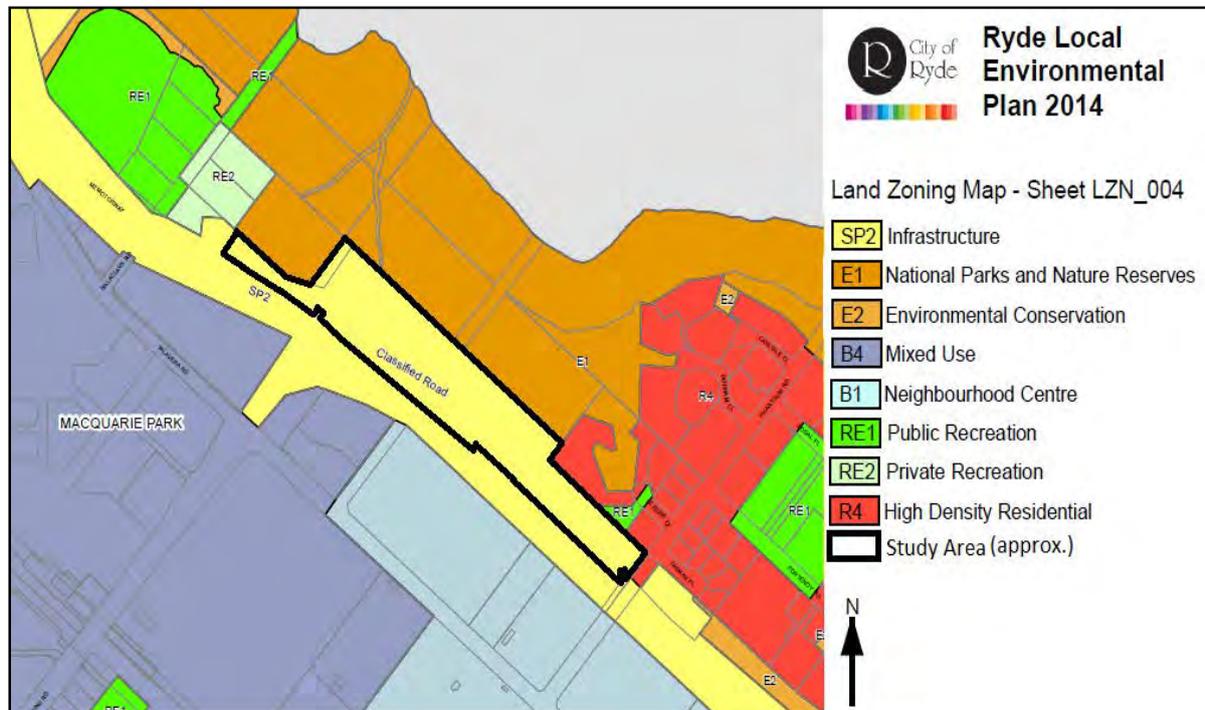
2.2 Site Definition

Site Definition for the Subject Property is provided in *Table 2-1*.

Table 2-1: Site Definition

TITLE INFORMATION	Lot 181 DP 1150938
LOCATION	North of M2 Hills Motorway between Christie Street and Khartoum Road, Macquarie Park
TOTAL AREA	Rehabilitation Area ~5.4 ha
TOPOGRAPHIC MAP	Parramatta 9130-3N 1: 25 000 series
GRID REFERENCE	Latitude: -33.774595, Longitude: 151.124495 (centroid)
OWNERSHIP	Roads & Maritime Authority (leased by Transurban until end of 2048)
LOCAL GOVERNMENT AREA	Ryde City Council
BUSHFIRE PRONE LAND	Not mapped as bushfire prone
ZONING (Ryde LEP 2014)	SP2 Infrastructure: adjoining E1 National Parks & Nature Reserves (see <i>Figure 2-1</i>)
CURRENT LAND USE	Vacant land: previously works depot for M2 Motorway
PROPOSED DEVELOPMENT	Site rehabilitation to create an indigenous plant community with a cultural installation (see <i>Figure 1-3</i>).

Figure 2-1: Land Zoning (Ryde LEP 2014)





2.3 Physical Environment

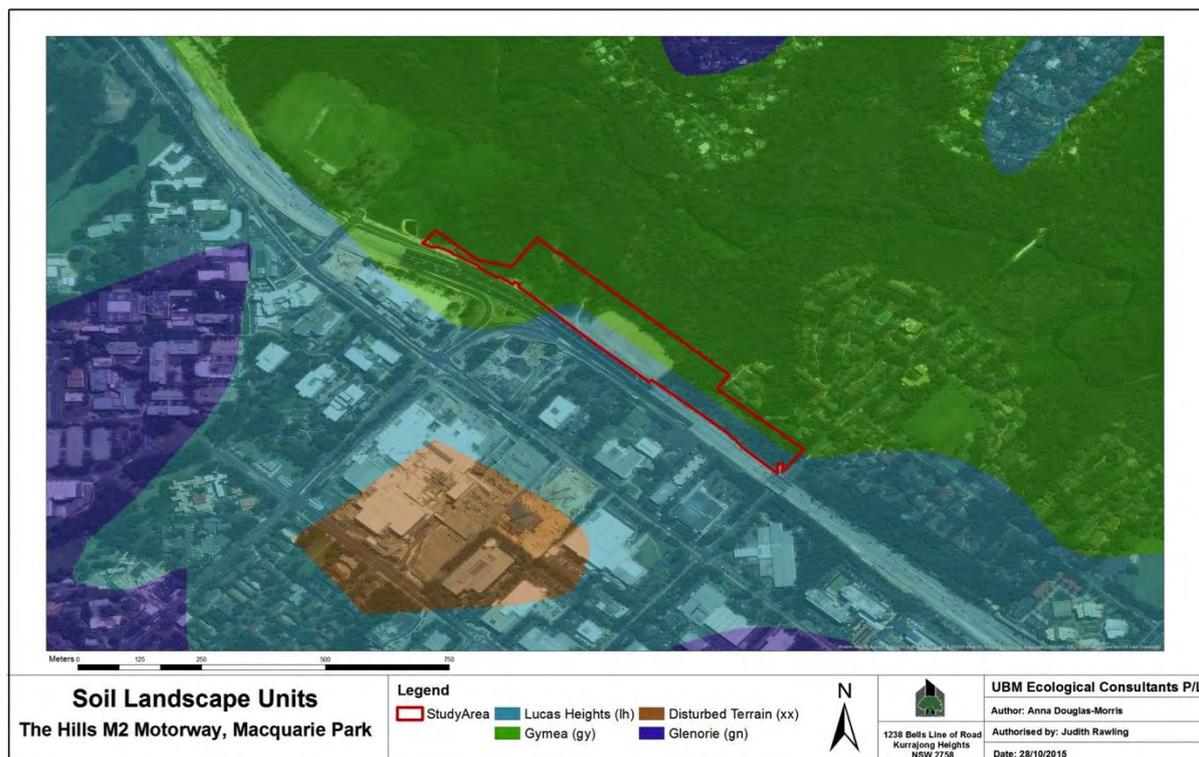
The physical characteristics of the Study Area and local environs are summarised in *Table 2-2*.

Table 2-2: Physical Features of the Study Area & Environs

FEATURE	DESCRIPTION
SOIL LANDSCAPE UNIT	Land in the Subject Property is mapped partly within the Lucas Heights (lh) Soil Landscape Unit (to south), and partly within the Gymea (gy) Soil Landscape Unit (to north) (Chapman & Murphy 1989) (see <i>Figure 2-2</i>).
TOPOGRAPHY	<p>Lucas Heights SLU is a gently undulating landscape on the crests and ridge of the plateau surfaces of the Mittagong Formation, which is located stratigraphically between the Wianamatta Group Shales and the Hawkesbury Sandstone. Local relief to 30m; slopes usually <10%.</p> <p>Gymea SLU - undulating to gently rolling low hills on Hawkesbury Sandstone, with local relief 20-80m and slopes of 10-25%.</p>
GEOLOGY & SOILS	<p>Lucas Heights SLU is located on the Mittagong Formation with moderately deep (50-150 cm) hard setting duplex and gradational soils. <u>Limitations</u> include stony soils, low soil fertility and low available water capacity.</p> <p>Gymea SLU is located on Hawkesbury Sandstone, which is a medium to coarse-grained quartz sandstone with minor shale and laminite lenses. Gymea SLU contains a wide range of soil types including uniform coarse, gradational and duplex profiles.</p> <p><u>Limitations</u> include localised steep slopes, high erodibility, shallow, highly permeable soil and very low soil fertility. Sheet erosion increases substantially wherever vegetation is disturbed.</p> <p>The major geological elements of the Lane Cove River valley are Hawkesbury Sandstone and the Wianamatta group of sedimentary rocks, predominantly Ashfield Shale.</p>
LOCAL HYDROLOGY	Two (2) natural watercourses, Shrimptons and Industrial Creeks, traverse the site at the western and south-eastern corners respectively. Both creeks flow into the Lane Cove River, located approximately 250m from the Subject Site. There is a small on-site detention pond adjoining Shrimptons Creek, as well as constructed drainage lines/channels.
CLIMATIC DETAILS	<p>The mean daily maximum temperature is 22.3°C, with highest temperatures recorded in January and February. The mean daily minimum temperature is 12.3°C, with lowest temperatures recorded in June, July and August.</p> <p>Mean annual rainfall is 1150.0mm; with January, February and March recording the highest mean levels. July is the driest month on average (Bureau of Meteorology 2016, Temperature: Riverview Observatory #06613; Rainfall: Macquarie Park (Willandra Village) #066156).</p>



Figure 2-2: Soil Landscapes (Chapman & Murphy 1989)



2.4 Biological Environment

Vegetation Communities

The native vegetation on land forming the Subject Property has been mapped by the Office of Environment & Heritage (OEH 2013) as **Cleared**, with areas of **Weeds and Exotics** found throughout the site (see *Figure 2-3*).

Vegetation to the north in this part of Lane Cove National Park is mapped as **Hornsby Enriched Sandstone Exposed Woodland**³ (see *Figure 2-3*). This community was formerly known as Coastal Ridgetop Sandstone Woodland (Tozer *et al.* 2010). It is widespread in the Sydney Basin Bioregion, and is not considered to be under threat.

UBM notes the potential of rehabilitating some of the degraded portions of the Subject Property via a Vegetation Management Plan that includes species characteristic of the Sydney Turpentine Ironbark Forest (STIF) - an 'endangered ecological community' (EEC) listed under the NSW *TSC Act* and as 'critically endangered' (CEEC) under the Commonwealth *EPBC Act*. However, the closest stands of STIF vegetation are found in the grounds of Macquarie University to the south-west (see *Figure 2-3*).

Ecological investigations undertaken by UBM (February 2016) concurs with the vegetation community descriptions offered by Tozer *et al.* 2010 and OEH 2013)

³ Formerly Sydney Sandstone Ridgetop Woodland (per Tozer *et al.* 2010)



The results of the flora survey undertaken for the Subject Property are presented in *Section 3.2* of this Report.

Lane Cove National Park

Lane Cove National Park is a 670 ha protected reserve managed by the NSW National Parks & Wildlife Service and adjoining areas managed by Ryde, Ku-ring-gai, Lane Cove, Willoughby and Hornsby Councils. It is the largest and most bio-diverse bushland area between the sandstone national parks in the north, south and west of Sydney (NSW NPWS 2012).

Situated within a highly urbanised area, this important area of remnant bushland supports a diversity of habitats, including shrubby sandstone woodland and open forest, Casuarina woodlands, wet sclerophyll forest and simple rainforest, riparian strips and estuarine habitats (OEH 2004). The Park is also home to rare and threatened vegetation communities, as well as threatened native plants and animals. A number of Endangered Ecological Communities occur within the park, including Sydney Turpentine-Ironbark Forest (STIF), Shale Sandstone Transition Forest (SSTF), Coastal Saltmarsh of the Sydney Basin Bioregion, Duffys Forest, Freshwater Wetlands on Coastal Floodplains, and Swamp Oak Floodplain Forest (SOFF).

In 2001, UBM Ecological Consultants was commissioned by the NSW National Parks & Wildlife Service to undertake comprehensive vegetation mapping within the park. The field survey comprised 96 locations and identified 17 vegetation communities and 348 native flora species, including *Darwinia biflora* and *Melaleuca deanei*, both listed as vulnerable under the *TSC* and *EPBC Acts*. In addition, 76 exotic species were recorded, with weed invasion observed to be generally restricted to disturbed areas.

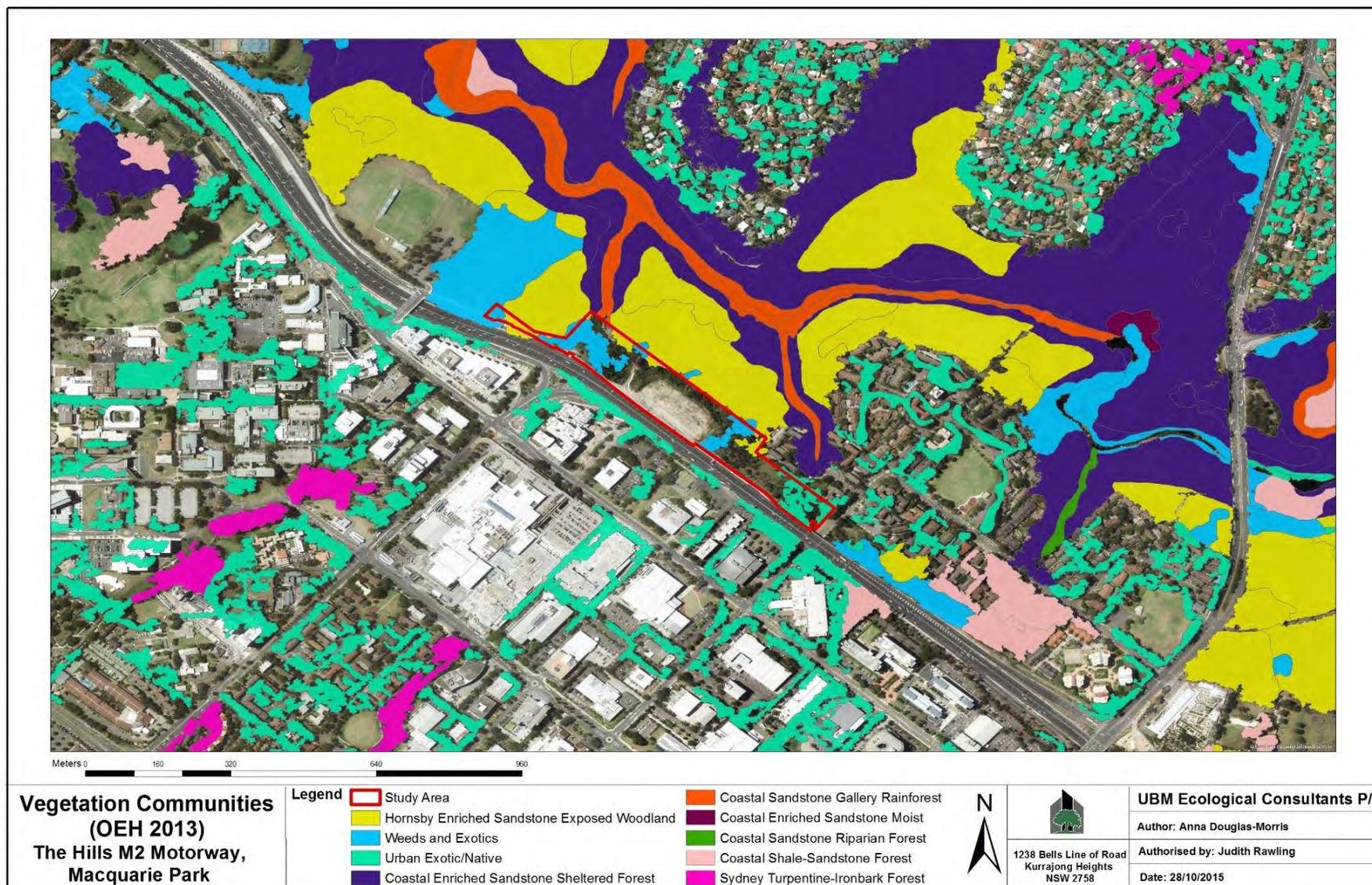
In total, over 580 native plant species have been recorded within the park, including nine (9) listed as threatened under the *TSC Act* (NSW NPWS 2012).

In 2004, systematic fauna surveys covering 47 sites within Lane Cove National Park and adjacent council-managed land were undertaken. As a result, 106 vertebrate species were identified, including four (4) threatened species under the *TSC Act*, being the Powerful Owl, Red-crowned Toadlet, Eastern Bentwing-bat and Grey-headed Flying-fox, and one (1) endangered population, the Gang-gang Cockatoo population of Hornsby and Ku-ring-gai Local Government Areas.

Important for its natural and cultural values, the park is subject to programs to manage fire, vertebrate pests and weeds including community involvement through local Bushcare groups.



Figure 2-3: Native Vegetation Communities Mapped for DECCW (OEH 2013)





2.5 Legislative & Planning Context

Comments and assessments within this Report are based on the requirements of the *Environmental Planning and Assessment Act 1979* – with consideration given to the principals of Ecologically Sustainable Development, NSW *TSC Act*, and Commonwealth *EPBC Act*.

Table 2-3 provides a summary of policies, local planning and legislative requirements applicable to the Subject Property and the current Planning Proposal.

Table 2-3: Summary of Local Planning Policies & Legislative Requirements

GOVERNMENT LEVEL	RELEVANT POLICY /LEGISLATION	RELEVANCE TO SUBJECT PROPERTY
LOCAL	<i>Ryde Local Environment Plan 2014</i>	Under The <i>Ryde Local Environmental Plan 2014</i> the Subject Property is zoned as SP2 Infrastructure, adjoining E1 National Parks and Nature Reserves (being Lane Cove National Park
	<i>Noxious Weeds Act 1993 (Amended 2005)</i>	Twenty-two (22) noxious weeds gazetted for Ryde LGA were recorded for the Property. Noxious weeds were recorded for most parts of the Study Area and are heavily concentrated along Shrimptons and Industrial Creeks (see <i>Table 3-1</i>). The Property Owners (RMS) are required to control noxious weeds and prevent their spread to adjoining land.
	<i>Threatened Species Conservation Act 1995</i>	No endangered ecological communities, flora species or populations are present in the Subject Property, this area having been substantially cleared during construction of the Hills M2 Motorway. A number of EVNT fauna are known to occur in the Locality, with some species considered likely to utilise the resources of the Subject Property on ‘occasion’ (see <i>Table 4-3</i>). Four (4) threatened microbats were detected during the fauna survey: the Eastern Bentwing-bat (<i>Miniopterus orianae (schreibersii) oceanensis</i>), Southern Myotis (<i>Myotis macropus</i>), False Pipistrelle (<i>Falsistrellus tasmaniensis</i>), and the Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)
	<i>Fisheries Management Act 1994</i>	The Proposal includes work on land likely to impact on the waters of a natural water body or creek. Further investigations by specialists will be required.
STATE	<i>Water Management Act 2000 (replacing the River and Foreshores Improvement Act 1948)</i>	Construction undertaken within 40 metres of a waterway will likely be designated as a ‘controlled activity’* which will require a permit from the NSW DPI. * Works which may obstruct, or detrimentally affect the flow
	<i>Environment Protection and Biodiversity Conservation Act 1999</i>	No ecological community, species or populations listed under the Act occur on the Subject Property. Flora and fauna species listed under the legislation are known to occur in the Locality, however no EVNT species were observed during the site investigations.
COMMONWEALTH		



Other relevant NSW State government legislation may include:

- *Environment Planning & Assessment Act 1979;*
- *Crown Lands Act 1989;*
- *Rural Fires Act 1997;*
- *National Parks and Wildlife Act 1974;*
- *Soil Conservation Act 1938;*
- *Rural Lands Protection Act 1998;*
- *Pesticides Act 1999;*
- *Occupational Health & Safety Act 1983;*
- *Waste Minimisation and Management Act 1995;*
- *Protection of the Environment Administration Act 1991; and*
- *Protection of the Environment Operations Act 1997.*



3 FLORA ASSESSMENT

The flora assessment was undertaken to determine the ecological communities occurring within and adjacent to the Subject Property and to describe the current status of the indigenous vascular vegetation present. The conservation value of the vegetation in the Commonwealth/National, State and Regional context has been considered in relation to vegetation community types and flora species present.

3.1 Methods

3.1.1 Literature Review

During the preparation of this Report, relevant databases and other studies were accessed, including previous studies and investigations for the Locality.

The main documents referenced were:

- *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands* (Tozer, et al. for DECCW 2006/2010);
- *Vegetation Mapping for the Sydney Metropolitan Area V2* (OEH for SMCMA 2013).

In addition, the *Atlas of New South Wales Wildlife Database* (OEH 2015; search area 10 km x 10 km) centred on the Subject Property (Latitude: -33.774595, Longitude: 151.124495 centroid) were accessed to identify previous recordings of flora species of conservation significance within the Locality and Region.

3.1.2 Flora Field Survey

A General Survey of the Subject Property was carried out by Consultant Botanist David Thomas on the 4th and 9th February 2016. The survey covered all parts of the Subject Property in order to establish a list of plant species, and to identify the locations and extent of vegetation types. For survey purposes and as an aid to future management, the Subject Property was divided into separate areas or landscape units (based on topography) (see *Figure 3-2*).

Plant identifications were made according to nomenclature in PlantNet (Botanic Gardens Trust 2011). Stands of vegetation were described by their structural characteristics according to Specht (1981). The plant community was initially described using the dominant tree species and structure of the community. This was subsequently related to the Final Determinations for potential threatened ecological communities.

Survey methodology was based on the typical requirements of the document entitled *Guidelines for Threatened Species Survey and Assessment* (DECC 2007). Based on the above, the survey used the Random Meander technique described by Cropper 1993 and Thompson (2013) and applied to the native vegetation throughout the vegetated parts of the Subject Property ('the Study Area').

Desktop research undertaken prior to the field survey provided a list of Endangered, Vulnerable, Near-threatened and/or Threatened (EVNT) flora species listed under the *EPBC Act* (1999) and/or *TSC Act*



(1995) and known to occur within a 10 km radius of the Property. Targeted searches for each of these species were conducted in the field; informed by habitat associations and the life history of these species.

Searches were carried out for those threatened plant species which have been recorded nearby in similar habitats (see *Table 3-2*).

The Study Area was divided into natural landscape divisions (see *Figure 3-2*):

- T1 - the lower, relatively flat section in adjoining Lane Cove National Park (the Interface);
- T2 -the steep slopes, embankments and batters around the northern, eastern and western sides of the old works compound, known as “The Deck”;
- T3 - The Deck; and
- Riparian zones in Shrimptons Creek (T4) and Industrial Creek (T5).

A small detention basin occurred on the slope, but was not surveyed separately from the slopes and batter unit owing to the general lack of different flora occurring.

The survey methodology was limited to the use of a meandering transect in each of the above-named landscape units. Quadrats were not used owing to the dominance of exotic species in all except the National Park section, which was outside the project area and unlikely to be affected directly by construction and rehabilitation work. In addition, it was unlikely that detailed quadrat information would be needed to identify significant vegetation or separate closely-related units.

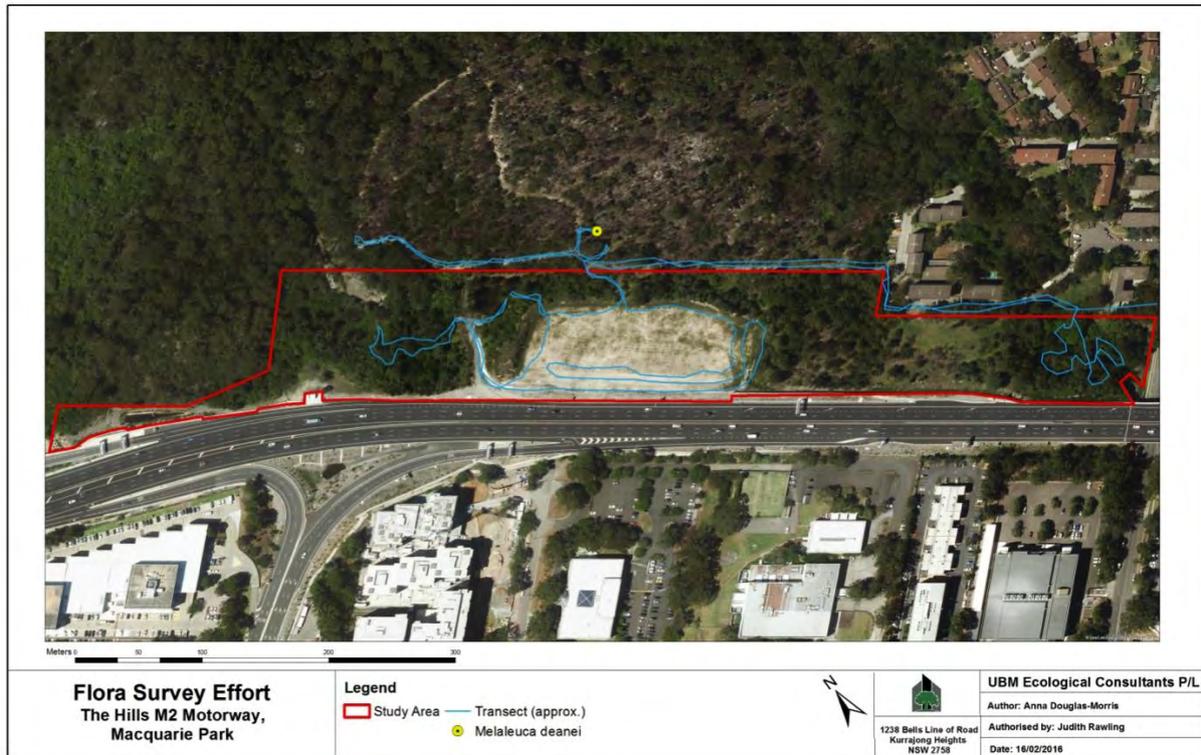
The Study Area for the flora survey included all parts of the Subject Property (as outlined on maps provided by Landcare Australia) plus a small section of Lane Cove National Park, the latter comprising a band of approximately 20 metres in width along the northern boundary of the Property.

3.1.3 Limitations

The field surveys were conducted in mid-summer (February) when many of the native flora species were in flower. Identification included assessment using vegetation characteristics, and wherever possible, floristic features. Weather conditions during the flora surveys were warm (25-28°), with little if any wind noted. Rain periods had been frequent over the preceding weeks. No significant floristic limitations were encountered.



Figure 3-1: Flora Survey Effort (UBM 2016)



3.2 Results

3.2.1 Overview

The Subject Property comprises the portion of Lot 181 DP 1150938 lying north-east of the M2 Biolink at Macquarie Park. Shrimptons and Industrial Creeks traverse the site at the western and south-eastern corners respectively and are fully vegetated, although both creeklines are badly degraded by woody weed thickets, introduced grasses and forbs (see Figure 3-3).

Flora

175 plant species were recorded in, or directly adjacent to the Study Area. This number includes 87 species of exotic introductions or weeds; 80 species which are considered to be naturally occurring and characteristic of the *Hornsby Enriched Sandstone Exposed Woodland* ecological community; three (3) non-indigenous species that have been planted, and another five (5) locally indigenous species planted at some time in past. The greatest concentration of weeds occurs in the riparian zones of Industrial and Shrimptons Creeks. The filled and seeded area, described as 'The Deck', consists of a dense groundcover of exotic grasses and forbs with woody weeds also occurring.

No (0) naturally occurring Endangered, Vulnerable, Near-threatened and/or Threatened (EVNT) flora species listed under the NSW *TSC Act* or Commonwealth *EPBC Act* were recorded in the current Study Area, however one (1) specimen of the endangered (*TSC Act*) *Melaleuca deanei* was recorded in the National Park (see Figure 3-1). The interface zone with the National Park is important as it provides a buffer to the highly disturbed land on the Subject Property, and it represents the pre-disturbance



(naturally-occurring) plant community. The fire trail in this area provides the only access for pedestrians if the site.

Four (4) landscape units were identified in the Study Area (see *Figure 3-2*). The vegetation was generally consistent within each unit. A description of each Landscape Unit is provided below.

National Park Section

The National Park section occurred north of the Subject Property at the foot of the steep slope/batter, presumably created for the construction of the Hills M2 Motorway. A fire trail had been cleared along the boundary fence of the M2 property and the National Park. A sign erected at the entry to the fire trail behind apartments off Leisure Close notifies that bush regeneration work is being carried out in this part of the Park.

Downslope of the fire trail and boundary fence the vegetation largely comprised a generally natural plant community but with some disturbance. A fire had burnt in the area in the past several years, and the vegetation comprised a mix of recovering mature plants and seral stages of regeneration.

The soil in this section was substantially naturally-occurring and generally comprised sandy material, however there appeared to be small amounts of depositional clay colluvium from the fill material upslope. Sandstone rocks and outcrops were common, resulting in skeletal soil in numerous locations. The vegetation varied according to the soil depth and nature. Typical sandstone heathland shrubby species were concentrated in the more sandy and shallow soil; while grasses dominated the deeper or more clay-enriched soil.

The tree canopy was sparse to largely absent, resulting in a woodland to open woodland structure. Where trees occurred, *Eucalyptus piperita* (Sydney Peppermint) was the most common species, with *Angophora costata* (Smooth-barked Apple) and *Eucalyptus resinifera* (Red Mahogany) being less common. This section had been planted with various native species including *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus robusta* (Swamp Mahogany), *Casuarina glauca* (Swamp Oak) and near the western-most apartment block near Leisure Close, *Eucalyptus microcorys* (Tallowwood).

The small tree stratum was highly variable, but *Allocasuarina littoralis* (Black She-oak) was typical and widespread. In a few locations veteran *Banksia ericifolia* (Heath Banksia), up to approximately five (5) metres tall had survived the earlier fire. Numerous *Trema aspera* (Poison Peach) were at shrub size, having regenerated from seed following the same fire.

The shrub stratum was discontinuous, as mentioned above, owing to the last fire and the varying growing conditions. *Kunzea ambigua* (Tick Bush) was common, especially on skeletal soils. Other common species included: *Acacia longifolia* (Sydney Golden Wattle), *Ozothamnus diosmifolius* (White Dogwood), *Polyscias sambucifolius* (Elderberry Panax) and *Micrantheum ericoides*. Relics of planted, non-local *Melaleuca armillaris* (Bracelet Honey-myrtle) remained in some areas

The ground cover ranged from dense grasses (especially *Imperata cylindrical* [Blady Grass], *Microlaena stipoides* [Weeping Meadow-grass] and *Oplismenus aemulus* [Basket Grass]); to leaf litter and scattered species such as *Panicum simile*, *Xanthosia pilosa* (Woolly Xanthosia), and *Wahlenbergia gracilis* (Native Bluebell).



Based on the species and habitat in this section, it was concluded that the vegetation was, or would have been before disturbance, a mosaic of woodland and heath of the Hornsby Enriched Sandstone Exposed Woodland⁴ as mapped by OEH (2013).

Steep Slopes, Embankments and Batters

The soil in this unit appeared to be largely imported from other areas (i.e. imported fill) and contained sandy and clay material as well as concrete and other non-natural material.

The previous wholesale removal of native vegetation and importation of modified soil and fill had resulted in the vegetation in this landscape unit mainly comprising exotic species. *Ligustrum lucidum* (Large-leaved Privet) was the most common species throughout this unit. Other common species were: *Lantana camara* (Lantana), *Ligustrum sinense* (Small-leaf Privet), *Ipomoea indica* (Morning Glory), *Genista linifolia* (Flax-leaf Broom) and *Acacia parramattensis* (Parramatta Wattle). The latter was probably planted as a landscape rehabilitation element following construction of the M2 Tollway.

Canopy trees were sparse, with introduced *Casuarina glauca* (Swamp Oak), *Eucalyptus tereticornis*, *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus microcorys* and remnant *Eucalyptus piperita* being recorded. Small trees included *Acacia* spp., *Allocasuarina littoralis* and *Ulmus parvifolius* (Small-leaved Elm).

The ground cover was generally either sparse, owing to the dense cover of *Ligustrum* spp. (Privets) or localised carpets of seedling *Ligustrum sinense* (Small-leaved Privet).

OEH have mapped this section of vegetation as “exotic vegetation” (see *Figure 2-3*).

“The Deck”

The highest part of the site was the flat-topped “Deck”, adjacent to the M2 carriageway. This area comprises consolidated fill material as described in the previous section and used as a works compound during the M2 construction. Whilst the main flat section contains a low cover of shrubs and grasses the perimeter is fringed with taller species from the Slopes and Batters. Some of these were beginning to invade The Deck unit.

Previous rehabilitation work has created a vegetation community dominated by exotic species, with a few native species and a moderate to high density of invasive weeds.

The rehabilitation work appears to have involved the seeding of grasses (mainly *Cynodon dactylon* – Couch Grass and smaller amounts of *Eragrostis curvula* [African Love-grass] and *Chloris gayana* [Rhodes Grass]) with various wattles also present, including *Acacia saligna* (Golden Wreath Wattle), *Acacia longifolia* (Sydney Golden Wattle), *Acacia parramattensis* and *Acacia fimbriata* (Fringed Wattle). However, weedy species such as *Genista linifolia*, *Verbena* spp (Purpletop). and various Asteraceae and Poaceae (*Appendix 1*) have colonised.

Subsequent small plantings of native species were observed near the table drain near the tollway, including *Angophora costata*, *Eucalyptus piperita*, *Dodonaea triquetra* (Common Hop Bush), *Acacia*

⁴ Previously known Sydney Sandstone Ridgetop Woodland (Tozer *et al.* 2010)



myrtifolia (Myrtle-leaved wattle) and *Themeda triandra* (Kangaroo Grass). On the carriageway, a row of *Banksia integrifolia* (Coast Banksia) had been planted.

Riparian Zones – Shrimptons Creek

Shrimptons Creek passes under the M2 Motorway into the western end of the Study Area. South of the M2 Motorway the creek passes through clay soil areas, some of which contain relics of Blue Gum High Forest and Shale-Sandstone Transitional Forest. These communities are ex-Study Area.

The soil north of the M2 Motorway appears mainly to contain sandy material and had exposed sandstone bedrock. The riparian zone along the creeks was generally flat and low-lying, topped by a bench approximately 200-400 mm above the creekbed. The shallow soils in the riparian zone, and high water table during moist seasons, limit the range of plant species suited to those conditions. Owing to severe disturbance previously, there was little of the original natural vegetation remaining at the time of this survey (*Appendix 1*).

The dominant vegetation comprised *Ligustrum lucidum* closed and low closed forest. Variants to this included occasional *Cinnamomum camphora* (Camphor Laurel), *Ipomoea indica*, *Erythrina crista-galli* (Indian Coral Tree) and numerous *Acer negundo* (Box Elder). The shrub stratum was dominated by *Ligustrum sinense*. Individuals of *Casuarina glauca*, *Salix babylonica* (Weeping Willow) and *Eucalyptus grandis* (Flooded Gum) were noted.

Owing to the deep shade created by the canopy the ground cover was either absent or limited to a very dense cover of *Tradescantia albiflora/fluminensis* (Wandering Jew) or *Ligustrum sinense*.

Riparian Zones – Industrial Creek

Industrial Creek passes under the M2 near Khartoum Road, into the eastern end of the Study Area. Although the creek has a distinct channel, a low-lying area adjacent appears to carry water in high flow events, and probably retains a high water table for significant lengths of time following rain.

Sandstone was exposed along some of the creek within this part of the Study Area. However, the creek banks contained clay soil in some sections, with fill material from the creek bank upslope adjacent to the apartment block in Leisure Close. Large pebbles had been deposited in the creek, apparently in order to stabilise the creek bed. Sandstone outcropping occurred across the southern end of the creek, and a concrete culvert was located adjacent to the apartment block.

Most of the natural vegetation of the riparian zone and adjacent area had been cleared many decades previously and replaced by exotic species. Most of these were probably introduced incidentally by birds and other vectors; however the *Acer negundo* may have been planted.

The vegetation mainly comprised *Ligustrum lucidum* with a small tree stratum of *Ligustrum sinense* and juvenile *Ligustrum lucidum*, and a ground cover of *Tradescantia fluminensis* (*Appendix 1*). One large *Salix babylonica* (Weeping Willow) was growing on the top of the concrete culvert. Other species near the creek included *Hedera helix* (English Ivy), *Cardiospermum grandiflorum* (Balloon Vine), two (2) introduced *Callistemon* spp. *Cyathea cooperi* (Straw Tree Fern), *Ehrharta erecta* (Veldt Grass) and *Nephrolepis cordifolia* (Fishbone Fern). The only locally indigenous species present were a few *Pteris*



tremula (Tender Brake), *Christella dentata* (Binung), *Persicaria decipiens* (Spotted Knot Weed), and *Rumex brownii* (Swamp Dock).

3.2.2 Introduced Species/Noxious Weeds

At least of 22 species recorded in the Study Area are gazetted as noxious weeds in the Ryde City Council Local Control Area (see *Table 3-1*). Noxious weed control is a legal responsibility under the Noxious Weeds Act 1995/2005).

Table 3-1: Noxious Weed Species recorded for the Study Area

FAMILY	BOTANICAL NAME	COMMON NAME	NOXIOUS WEED CLASS
Apocynaceae	<i>Araujia sericifera</i>	Moth Vine	Class 4
Asparagaceae	<i>Asparagus aethiopicus</i>	Ground Asparagus	Class 4; WoNS
	<i>Asparagus asparagoides</i>	Bridal Creeper	Class 4; WoNS
	<i>Asparagus densiflorus</i>	Fern Asparagus	Class 4; WoNS
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	Class 4; WoNS
Basellaceae.	<i>Anredera cordifolia</i>	Madeira Vine	Class 4
Caprifoliaceae	<i>Lonicera japonica</i>	Japanese Honeysuckle	Class 4
Convolvulaceae	<i>Ipomoea indica</i>	Morning Glory – purple	Class 4
Fabaceae	<i>Erythrina crista-galli</i>	Cockspur Coral Tree	Class 4
	<i>Genista linifolia</i>	Flax-leaf Broom	Class 4, WoNS
	<i>Senna pendula</i> var. <i>glabrata</i>	Cassia	Class 4
Ochnaceae	<i>Ochna serrulata</i>	Mickey Mouse Plant	Class 4
Oleaceae	<i>Olea europaea</i> ssp. <i>cuspidata</i>	African Olive	Class 4
	<i>Ligustrum lucidum</i>	Broad-leaf Privet	Class 4
	<i>Ligustrum sinense</i>	Narrow-leaf Privet	Class 4
Poaceae	<i>Arundo donax</i>	Giant Reed	Class 4
Poaceae	<i>Cortaderia selloana</i>	Pampas Grass	Class 3
Polygonaceae	<i>Acetosa sagittata</i>	Turkey Rhubarb	Class 4
Rosaceae	<i>Rubus fruticosus</i> spp. aggregate	Blackberry	Class 4; WoNS
Sapindaceae	<i>Cardiospermum grandiflorum</i>	Balloon Vine	Class 4
Solanaceae	<i>Cestrum parqui</i>	Green Cestrum	Class 3
Verbenaceae	<i>Lantana camara</i>	Lantana	Class 4; WoNS

Actions Required for Noxious Weed Classes

- 1 The plant must be eradicated from the land and the land must be kept free of the plant
- 2 The plant must be eradicated from the land and the land must be kept free of the plant
- 3 The plant must be fully and continuously suppressed and destroyed
- 4 The growth and spread of the plant must be controlled according to the measures specified in a management plan* published by the local control authority and the plant may not be sold, propagated or knowingly distributed
- 5 The requirements in the Noxious Weeds Act 1993 (as amended 2005) for a notifiable weed must be complied with



Figure 3-2: Landscape Units (UBM 2016)

* to be read with flora species list in *Appendix 1*.





Figure 3-3: Weed Density

Map courtesy of Dr Shane Norrish, Landcare Australia Ltd.





3.3 Conservation Significance of the Vegetation

3.3.1 Threatened Flora Species

A 10 km² search of the Atlas of NSW Wildlife database indicates the potential occurrence of nine (9) ENVT species (see *Table 3-2*). Although it is likely that no appropriate habitat for these species remains within the Subject Property, targeted searches were carried out for individuals or populations of the listed species during the flora survey.

One (1) plant species in the Study Area, but not occurring within the proposed rehabilitation area, was recorded; one individual of *Melaleuca deanei*. This occurred in Lane Cove National Park, north of the fire trail, near its intersection with a second trail that branched northwards, near the main gate into the Subject Property.

3.3.2 Threatened Plant Communities

No (0) plant community recorded in or directly adjacent to the Study Area is listed under the NSW *TSC Act* or Commonwealth *EPBC Act* as a threatened ecological community. The nearest occurrence of a threatened community is Sydney Turpentine Ironbark Forest, that occurs sporadically in the area bounded by Macquarie Shopping Centre, Epping Road and Epping Boys High School (OEH, 2013).

Sydney Turpentine Ironbark Forest and Blue Gum High Forest also occur along parts of Shrimptons Creek south of Epping Road.



Table 3-2: List of Threatened Flora Species Known to Occur in the Region

Conservation Status: CE – Critically Endangered; E/E1/E2/E4A – Endangered; and V - Vulnerable

SCIENTIFIC NAME & COMMON NAME	LEGAL STATUS		NUMBER OF RECORDS [^]	HABITAT REQUIREMENTS*	LIKELIHOOD OF OCCURANCE WITHIN STUDY AREA
	TSC ACT	EPBC ACT			
<i>Tetradthea glandulosa</i> (Black-eyed Susan)	V	-	8	A small, spreading shrub with distribution restricted to northern/north-western LGAs in Sydney (Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong (OEH, 2013). Associated with shale-sandstone transition habitat, and shallow soils consisting of clayey/sandy loam (OEH, 2013).	Unlikely owing to lack of suitable habitat including highly modified soils and fill material.
<i>Epacris purpurascens</i> <i>var. purpurascens</i>	V	-	7	An erect shrub, occurring from Gosford to Avon Dam, and west to Silverdale (OEH, 2012). Found in habitats where there is a strong shale soil influence (OEH, 2012).	Unlikely owing to extent of dense shading in gully areas that it tends to favour.
<i>Darwinia biflora</i>	V	V	120	Recorded in Baulkham Hills and surrounding LGAs, on edges of weathered shale-capped ridges where integration with Hawkesbury Sandstone occurs. Vegetation structure is usually woodland, open forest or scrub-heath (OEH, 2015).	Habitat unsuitable for this species.
<i>Eucalyptus nicholii</i> Narrow-leaved Black Peppermint	V	V	2	Sparsely distributed on the New England Tablelands, and planted as urban trees, windbreaks and corridors outside this area. Typically grows in dry grassy woodland, on shallow soils of slopes and ridges (OEH, 2014).	This species is not indigenous to the Sydney Basin Bioregion.
<i>Melaleuca deanei</i> Deane’s Paperbark	V	V	1	Occurs in the Ku-ring-gai/Berowra area, mostly in ridgetop woodland, with 5% of sites in heath on sandstone (OEH, 2014).	This species was recorded in the National Park adjacent to the project area.
<i>Syzygium paniculatum</i> Magenta Lilly Pilly	E1	V	12	Only found in NSW in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest, and occurs on gravels, sands, silts, and clays north of Sydney (OEH, 2014).	Habitat unsuitable for this species.
<i>Pimelea curviflora</i> <i>var. curviflora</i>	V	V	64	Populations known between northern Sydney and Maroota in the north-west. Occurs on shaley/lateritic soils over sandstone and shale/sandstone	Unlikely to occur owing to lack of suitable habitat



SCIENTIFIC NAME & COMMON NAME	LEGAL STATUS		NUMBER OF RECORDS [^]	HABITAT REQUIREMENTS*	LIKELIHOOD OF OCCURANCE WITHIN STUDY AREA
	TSC ACT	EPBC ACT			
				transition soils on ridgetops and upper slopes amongst woodlands (OEH, 2014).	including highly modified soils and fill material.
<i>Hibbertia sp.</i> <i>Turramurra</i>	E4A	-	1	A decumbent 'shrublet' that grows to roughly 30cm tall. It is endemic to and restricted to 3 locations within NSW and known to occur in forests with sparse under-storey in light clay soils over shale sandstone transition. It flowers predominantly in October and November (OEH 2015).	Unlikely to occur owing to lack of suitable habitat including highly modified soils and fill material.
<i>Grevillea parviflora</i> <i>subsp. parviflora</i> (Small-flower Grevillea)	V	V	1	Sydney region occurrences are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation (OEH, 2015). Inhabits a range of vegetation types from heath and shrubby woodland to open forest, often occurring in open, slightly disturbed sites (e.g. along tracks). Easiest to detect when flowering (July-Dec).	Unlikely to occur owing to lack of suitable habitat including highly modified soils and fill material.

* Habitat requirements were extracted from OEH (2012-2015).

[^] Within a 10 km² area centered on the Study Area (-33.774595, Longitude: 151.124495) provided by the *Atlas of NSW Wildlife* database (BioNet; Accessed: 12.02.2016).



3.4 Flora Assessments of Significance

The NSW *TSC Act* aims to conserve threatened species, populations, ecological communities and their habitats; to promote their recovery; and manage the processes that threaten or endanger them. Threatened species are listed under Schedules 1 and 2 of the Act, while communities considered ‘at risk of extinction’ are listed as ‘Endangered Ecological Communities’ (EECs) under Part 3, Schedule 1. Critically endangered entities (CEECs) are listed under Schedule 1A.

Under the terms of the legislation, Local Government must assess the impacts of any proposed activity which might adversely impact on the EEC/CEEC or any threatened species or populations, and where these are likely to occur, must identify strategies to minimise any such impacts. Further, development on adjoining land may also have a significant impact on the bushland’s natural values, so that such activities must be carefully assessed by the Consent Authority (here Ryde CC) prior to Development Consent being granted.

Under Section 5A of the *EP&A Act*, any development activity impacting on a species, population or ecological community listed under the *TSC Act* requires the application of an “Assessment of Significance”. As well, listings under the Commonwealth *EPBC Act* require are subject to a similar Assessment process.

An Assessment of Significance (commonly called ‘the Seven-part Test’) is designed to determine “*whether there is likely to be a significant effect on threatened species, populations, ecological communities or their habitats*” (as listed on the Schedules of the NSW *TSC Act*), and consequently, to determine whether a Species Impact Statement is required.

In order to determine whether further studies are required, a search of the relevant ecological databases is required in order to identify those ecological communities, threatened species or populations known for the Locality and Region. This is followed by a comprehensive site survey to determine the presence, or potential presence of any threatened entities.

The field investigations undertaken provide the required ecological studies. Results of those investigations are presented in *Section 3.2* (flora) and *Section 4.3* (fauna) of this Report. The recommendation on whether or not to apply the Seven-part Test has been made with respect to the outcomes of these investigations.

Given that no threatened ecological community, species or populations occur within the Study Area, no Assessments have been required for flora issues. The single threatened species recorded in the National Park unit is outside the area proposed for rehabilitation and will not be impacted under the Landcare Australia Proposal.



4 FAUNA ASSESSMENT

4.1 Overview

The three (3) major habitats types present within the Subject Property are low closed-forest and shrubland, open grassland and aquatic habitats which afford suitable foraging, sheltering, nesting and breeding habitat for a suite of resident fauna genera as well as for vagrant or migratory species. The two (2) retention basins offer a constant water source throughout the year. The Study Area is highly connected through Lane Cove Valley and River.

The majority of fauna species recorded during the current site investigations were typically urban-tolerant species, however a high diversity of herpetofauna was observed.

In order to assess the likelihood of native fauna species utilising the native vegetation within the Subject Property as habitat, a comprehensive fauna survey was undertaken. All species listed as Endangered, Vulnerable, Threatened or Near-Threatened ('EVNT') under the NSW *TSC Act* and/or Commonwealth *EPBC Act 1999* (see *Table 4-3*) has been considered during the field survey.

4.2 Fauna Methods

A fauna survey was conducted to determine the potential for threatened species to utilise the Subject Property. A comprehensive habitat assessment and fauna survey were undertaken by Ecologist Anna Douglas-Morris (BSc, PGDipWldMgt) assisted by Jessie Bear (BNatSc pending) on 9th February 2016. Fauna monitoring equipment was deployed at that time. Survey effort is outlined in *Table 4-1*.

The area subject to the whole of the proposed rehabilitation works comprised the Study Area, with particular focus on the vegetated areas where the scattered native canopy remains. A GPS (Garmin *GPSmap 62S*) was used to record habitat features and the placement of fauna monitoring equipment.



Table 4-1: Fauna survey effort (February 2016)

DATE	TIME OF DAY	WEATHER CONDITIONS				ACTIVITY
		TEMP (°C)	WIND (km/h)	CLOUD (obs)	RAIN (mm)	
09/02/2016	AM (3 hrs)	25	18 S	Light cover	0	Deployment of fauna monitoring equipment, habitat assessment, bird survey and herpetofauna search
09-15/02/2016	AM/PM	19-30	Up to 19km/h	Variable	0	2x Infrared camera monitoring (SG550V8, ScoutGuard)
	PM					Ultrasonic bat call detector (Anabat unit)
	18:00-06:00					SongMeter (SM2+)
15/02/2016	AM (1 hr)	29	Up to 9 km/h	Light cover	0	Opportunistic bird survey and herpetofauna search, habitat assessment, collection of monitoring equipment

The fauna field survey was aimed at assessing the species richness of the site, to investigate the range of fauna habitats present, and to determine the potential for local threatened fauna species to occur.

The fauna survey incorporated a range of techniques designed to target species from all fauna groups that would be expected to occur on the site, including birds, mammals and reptiles. These techniques included a series of diurnal bird censuses, searches for active herpetofauna, and recording of indirect evidence of fauna presence (*e.g.* tracks, scats, hollows, nests, diggings, bones and other traces). In addition, all opportunistic sightings of fauna were recorded.

All relevant previous reports and databases were reviewed and drawn upon. Particular attention was paid to records of species listed under the Schedules of the *EPBC* or *TSC Acts*.

Field surveys were restricted to the land (terrestrial environment) that comprised the described Study Area. Whilst surveying this area, the condition and structure of any fauna habitats present were identified, and a consideration of their potential to support locally occurring populations of threatened fauna was determined.

Species-specific survey methods are set out below.

Diurnal Avifauna

Formal bird point censuses using the transect-point method (refer to *Survey Guidelines for Australia's threatened birds*, DSWEPaC 2010) were conducted from various locations within the Study Area. The formal census involved 'point bird counts' at this location, in addition to an opportunistic bird census conducted over the remaining areas of the Study Area. Birds were



identified on the basis of visual identification and by their characteristic calls. All opportunistic observations of bird species were recorded while undertaking general field survey activities.

Nocturnal Fauna

One (1) SongMeter was deployed to target nocturnal birds, fauna and amphibians over six (6) nights from the 9th of February 2016. The SongMeter was positioned adjacent to aquatic habitat (Shrimpton Creek) and vegetation towards the NW of the Study Area. Spectrograms of recordings were visually analysed using *Audacity* (Audio editor software).

Herpetofauna

Reptiles and amphibians were surveyed using a combination of diurnal hand-searches and visual searches (refer to *Survey Guidelines for Australia's threatened reptiles*, DSWEPaC 2011b) within the Study Area. Hand searches concentrated on areas containing woody debris or urban refuse and around the base of trees; and this included techniques such as carefully turning over logs, rocks or large pieces of debris wherever these were encountered. Visual surveys were focused in areas with suitable sheltering habitat with areas that received sun adjacent (providing suitable basking habitat for reptiles). All opportunistic sightings were recorded.

Mammals

Mammals were surveyed by deploying two (2) motion-activated wildlife cameras on the site (see below for details) – one positioned adjacent to the retention basin of Shrimptons Creek towards the NW of the Study Area, and the other within the Privet forest to the SE of the Study Area. A diurnal search for potential habitat features and signs of mammalian activity, including dreys (indicative of possums), scats, tracks and scratches on habitat (hollow bearing trees) and/or other signs of mammals were also recorded and verified using the Triggs (2004) field guide. Diurnal searches were conducted along a random meander across the majority of the Study Area (refer to *Survey Guidelines for Australia's threatened mammals*, DSWEPaC 2011a). All opportunistic sightings were recorded.

Microbats

One (1) stationary ultrasonic bat call detector (Anabat Express, Titley Electronics) was used to record bat calls within the Study Area. The unit was positioned where predicted 'fly-ways' exist (in this case, adjacent to the retention basin of Shrimptons Creek on the boundary of cleared and vegetated habitat) and left in position for six (6) nights (recording for 12 hours from 6pm to 6am), in accordance with the *Survey Guidelines for Australia's threatened bats* (2011b), from the 9th of February 2016.

In relation to the analysis of those microchiropteran (microbat) calls obtained, it is noted that some insectivorous bat species have distinctive echolocation calls that are unlikely to be confused with those of other species. Other bats species overlap in both call frequency and structure, making identification problematic in some cases. The degree of confidence or reliability associated with call identifications will depend on the quality of the recordings as well as the activity of the bat at the time of recording and flight direction. In some instances, a particular species may be identified with confidence, while at other times its identification will be less certain (refer to *Bat Calls of NSW* Pennay *et al.* 2004). A definition of the reliability of identification is as follows:



Definite: One or more calls were recorded and there is no doubt about the identification of the species;

Probable: most likely to be the species named, low (<20%) probability of confusion with species that use similar calls; and

Possible: call is comparable with the names species, with a moderate to high probability (50-80%) of confusion with species of similar calls.

All Fauna

Two (2) infrared cameras (SG550V8, ScoutGuard) were placed on site and left in position for six (6) days and nights (see *Figure 4-1*) from the 9th of February 2016. The units employ a passive infrared (PIR) system, operating diurnally and nocturnally. The cameras were set to a sensitivity level of 'normal', capturing three (3) images when triggered with a one (1) minute recovery time. The cameras were placed at a height of around 1.5m above ground level and angled slightly downwards (as per the directions provided in the unit's instruction manual). The camera traps were baited with traditional bait balls consisting of a combination of peanut butter, oats and honey.

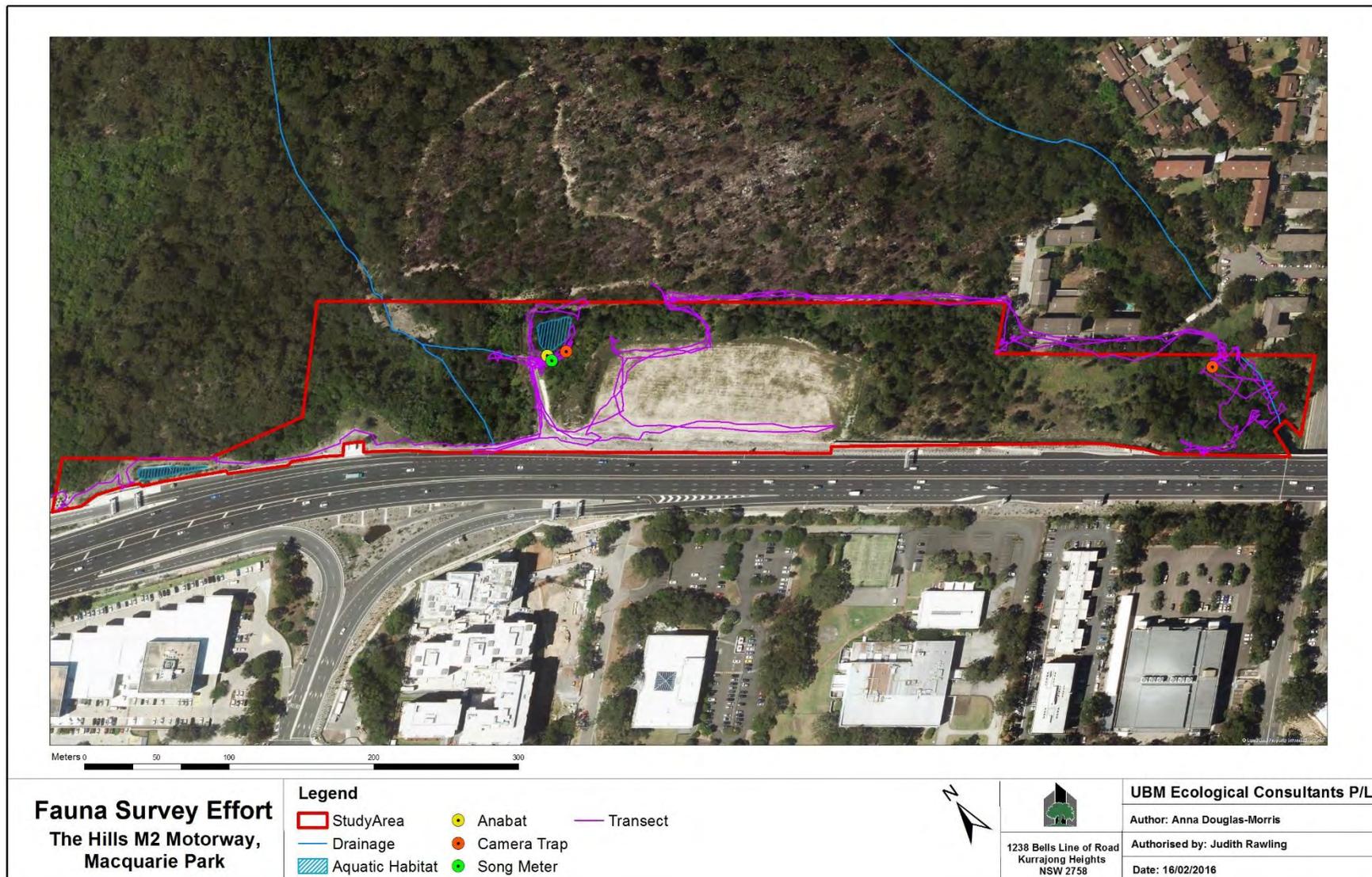
Searches for Evidence of Fauna Presence

Searches were conducted for animal scats of both predatory and non-predatory species. Where these were encountered, scats were identified on site; first to genus and then to species level, wherever possible with reference to the Triggs (2004) field guide. If scats were not identifiable, samples and photographs were taken and identification and cross-checking was verified within 24 hours of the field survey. The search concentrated on the ground beneath trees, edge sites, near burrows and dens, as well as amongst leaf litter and urban debris.

Searches were also made for other characteristic signs of fauna species' presence; including tracks, bones, hair, shed skins and animal remains, as well as nests, diggings, burrows, chew marks, scratching, orts (chewed cones) underneath feed tree species of black cockatoos, and pellets (indicative of birds of prey).



Figure 4-1: Fauna Monitoring Equipment Layout and Track Log (UBM 2016)





4.2.1 Limitations to Fauna Field Surveys

The diversity of the species recorded during the current field surveys is expected to be influenced by a number of seasonal and climatic factors. Field surveys are best timed according to the seasonal activity of the targeted faunal groups. For this reason, survey results can always be improved by extending the time allowed to provide investigations in all seasons.

The list of fauna species recorded by the current field surveys provides an indication of the species present at the time of the survey (February 2016). Surveys carried across all seasons over a period of several years are needed to identify all of the species present in an area, especially as some species are only present at certain times of the year (*e.g.* migratory birds), while others may require specific weather patterns and seasonal conditions for optimum levels of detection (*e.g.* amphibians).

Therefore, when establishing the suite of resident native species occurring or potentially occurring in an area by utilising the habitat requirements and associations of these animals, the diversity of other native species that could occur on occasion can be determined. For example, if a hollow-associated owl is detected, then there is the potential that, if previously recorded in the vicinity of the Study Area, other species of owls with similar nesting requirements may also be present. By using those species recorded to predict the full range of fauna potentially present in the Study Area helps to overcome some of the limitations associated with seasonal constraints and of surveys of limited duration.

Due to time and budget constraints relating to this project, surveying the Subject Property/Study Area during all seasons was not possible. With the combination of both active diurnal searches and deployment of monitoring equipment, it is assumed that the survey conducted was comprehensive and attempted to eliminate possible limitations associated with seasonality by maximising survey effort.

The field survey was conducted within the period that the majority of microbat species are best detected (October to March). The field survey commenced after a recent period of rain, with moderate summer temperatures and light winds, which would have also aided the chances of microbat detection.

4.3 Survey Results

4.3.1 Fauna Species Recorded

Previous fauna surveys and compilation lists from the *Atlas of NSW Wildlife* (BioNet OEH, 2015) database have identified 14 native frogs, 39 native reptiles, 208 native birds, 17 native mammals (excluding bat species) and 21 native bat species in the Region (*i.e.* within a 10 km x 10 km area centred on the Subject Property).

Of those native species recorded in the Region in the past 10 years, 19 are listed as EVNT species under the Schedules to the *EPBC* and/or *TSC Acts* (see *Table 4-3*).

Ten (10) introduced bird species and six (6) domesticated or pest mammals have also been recorded in the Region.



By the completion of the current field survey (February 2016), two (2) native mammals (excluding microbats), 17 native birds, seven (7) native reptiles, two (2) native amphibians and five (5) native invertebrates were recorded within or in close proximity to the Study Area.

A diversity of fauna, including birds, amphibians, reptiles and mammals, was detected within or adjacent to the large detention basin, which provides a valuable permanent water source for local fauna species. A number of Black Rats (*Rattus rattus*) were captured at night-time on the camera trap, with an Eastern Brown Snake (*Pseudonaja textilis*) captured the following day. Rats are likely to make up a large proportion of the diet of Eastern Brown Snakes in the Locality, and this individual was likely attracted by the scent left behind. A Red-bellied Black Snake was also observed during the field survey. This species specialises in eating frogs, and its presence within the Study Area suggests there is an adequate amount of prey species available.

A Grey Goshawk (*Accipiter novaehollandiae*) was observed during the field survey, a species with an uncommon and patchy distribution in many places rare due to forest clearing (Morcombe & Stewart, 2014). This species prefers mature forest with an open understorey that suits hunting technique of pursuing its prey in flight, striking at speed and even chasing prey into dense undergrowth. They primarily prey on mammals (rodents, bandicoots, rabbits) and birds (mostly non-passerines or non-perching birds less than 250 grams e.g. quail, parrots, pigeons), but will also prey of reptiles (large dragon lizards), frogs, insects and occasionally carrion. Grey Goshawks are monogamous and hold a territory, and the species' presence within the Study Area indicates a sufficient availability of food. They are known to breed in gullies or steep hillslopes, high in the canopy, rarely in forest regrowth less than 30 years old, and therefore are unlikely to utilise the Study Area as breeding habitat.

A high level of microbat activity was observed, with at least 11 microbat species detected through Anabat recordings with varying levels of confidence. This included four (4) threatened microbat species, being the Eastern Bentwing-bat (*Miniopterus orianae (schreibersii) oceanensis*), Southern Myotis (*Myotis macropus*), False Pipistrelle (*Falsistrellus tasmaniensis*), and the Greater Broad-nosed Bat (*Scoteanax rueppellii*).

No other EVNT species, listed under the *EPBC Act* or *TSC Act*, were detected on the Subject Land.

Two (2) introduced birds, two (2) pest mammal species – the Black Rat (*Rattus rattus*) and the European Red Fox (*Vulpes vulpes*) – and one (1) introduced invertebrate were also detected.

The control of vertebrate pests is important for the survival of medium-sized ground-dwelling and semi-arboreal mammals. The adjacent bushland is at present subject to a fox control program, with 1080 poison baits laid in within the national park boundaries from March 2015 – March 2016. Implementation of a on-going vertebrate pest control and monitoring program within the Subject Land is recommended before the commencement of works.



Plates: Fauna Survey

Photo Details (clockwise from top left): Grey Goshawk (*Accipiter novaehollandiae*) observed on the edge of the Subject Land; mature Lace Monitor (*Varanus varius*) observed near the detention basin of Shrimptons Creek; reptile eggs likely to be a clutch of the Dark-flecked Garden Sunskink (*Lampropholis delicata*) observed underneath a rock; remains of a Common Yabby (*Cherax destructor*) found on the banks of the retention basin of Shrimptons Creek; and Eastern Brown Snake (*Pseudonaja textilis*) and seasonal breeding colouration of a mature male Eastern Water Dragon (*Intellagama lesueurii*) captured on the camera trap.





4.3.2 Fauna Habitat Assessment

There are three (3) types of habitat present within the Study Area and these include:

- Low closed-forest and shrubland;
- Cleared (exotic) grassland; and
- Aquatic habitat.

The following descriptions of the habitats present outline the habitat features and the fauna conservation significance of each habitat present.

Habitat Type: Low closed-forest

Fauna Conservation Significance: Moderate

Much of the vegetated areas within the Study Area is comprised of dense thickets of Lantana (*Lantana camara*) and Privet (*Ligustrum* spp.) forming a low closed-forest where little light can penetrate.

Structural habitat is very limited in all strata, with little woody debris observed on the ground stratum and the sparse native canopy being too young to contain hollows that may be utilised by native fauna for shelter and nesting. Occasional arboreal termite mounds were observed within mature native trees, which provide valuable habitat and food source for a number of species known to occur in the area, including the Lace Monitor observed during field investigations.

Note: not all of the Study Area was traversed on foot due to the often impenetrable nature of the dense weed thickets and safety hazard of steep terrain.

Whole scale removal of Lantana has been identified as detrimental to reptile biodiversity, especially skinks (Virkki *et al.* 2012). Although Superb Fairy-wrens prefer native shrubs, Lantana has been identified as a substitute (shelter and nesting) habitat in urbanised weedy areas (Parsons *et al.* 2008). Fairy-wrens were detected within the weed thicket habitat, as well as Eastern Whipbirds (*Psophodes olivaceus*), White-browed Scrubwrens (*Sericornis frontalis*) and Silvereyes (*Zosterops lateralis*) which are also known to utilise Lantana as habitat. A number of Eastern Water Skinks (*Eulamprus quoyii*) were also observed along the creek line where dense low-lying vegetation was present.

Plates: Low closed-forest

Photo Details: typical composition of low closed-forest within the Study Area.





Habitat Type: Cleared (exotic) Grassland

Fauna Conservation Significance: Low

This habitat comprised much of the Study Area. Such habitat is of ‘low’ conservation significance for local fauna, having been cleared entirely with little shrub stratum persisting. No structural habitat is available in the form of hollow-bearing trees or fallen logs, and accumulations of leaf litter are absent that would otherwise be present if scattered canopy trees were present. Only limited sheltering habitat is available in the form of overgrown grasses and cracking soils. Such habitat is likely to be utilised by small ground-dwelling herpetofauna and mammals only, and a number of Dark-flecked Garden Sunskinks (*Lampropholis delicata*) were observed within such areas, as well as a mature Red-bellied Black Snake (*Pseudechis porphyriacus*) basking at the edge of the forested habitat.

The cleared open exotic grassland provides low-quality foraging habitat for local fauna, including granivorous (seed-eating) birds such as the Crimson and Eastern Rosella, however no birds were observed utilising such habitat during the field survey. A large number of flying insects were flushed from such habitat during the field survey, which indicates potential foraging habitat for insectivorous birds and bats. The internal fence lines, access tracks and clearings within the Subject Land are likely to be utilised by the European Red Fox (*Vulpes vulpes*) for hunting, of which fresh scats were detected during the field survey.

Plates: Cleared Grassland

Photo Details: view of the cleared grassland habitat of “the deck”



Habitat Type: Aquatic Habitat

Fauna Conservation Significance: Moderate - high

The aquatic habitat within the Study Area is comprised of Shrimptons and Industrial Creeks and the existing detention basins. Such aquatic habitat has been adversely affected by development within the catchment, with foamy surface scum visible in Shrimptons Creek, and scattered urban debris visible along Industrial Creek, as well as encroaching weed infestations.

A high occurrence of impervious surfaces within Macquarie University, Macquarie Shopping Centre and local business parks would create high rates of discharge during rain events leading to issues of erosion, sedimentation and pollution of aquatic habitat within the Study Area.

Much fauna activity (including reptiles, amphibians, birds, mammals and invertebrates) was concentrated around the large retention basin in the northern corner of the Study Area, which



provides a permanent water source for resident and vagrant fauna species. A high level of microbat activity was also detected by the Anabat, and two (2) native tree frogs were detected in Song Meter recordings, which were both deployed adjacent to the basin. However, there is a general lack of aquatic vegetation, which would otherwise provide nesting and breeding opportunities for amphibians and aquatic birds. The combination of limited aquatic vegetation, weed infestation and polluted water, deems available aquatic habitat unsuitable for the threatened Red-crowned Toadlet (*Pseudophryne australis*) and Green and Golden Bell Frog (*Litoria aurea*) recorded in the Region.

Drainage lines and other depressions create ephemeral water features after periods of significant rain, which may also offer potential breeding habitat for amphibians.

Overall the aquatic habitat is considered to be of 'moderate-high' conservation value given the high level of disturbance and issues of weed infestation.

Note: Aquatic habitat may be indirectly affected by the Proposal through soil erosion and run-off and it is recommended a suitable barrier be maintained at all times throughout future earthworks to minimise disturbance.

Plates: Aquatic Habitat

Photo Details: top row – retention basin and drainage line of a small tributary of Shrimptons Creek to the NW of the Study Area (left); and Industrial Creek (right); bottom row – outlet of Industrial Creek (left) and large retention basin within Study Area.





4.3.3 Habitat Features

Habitat trees are defined and characterised by hollows (small, medium or large), and containing fissures, exfoliating bark on any external surface (trunk and/or tips of branches), hollow stags and as any tree containing a nest (in a hollow, in arboreal termite mound or stick/grass nest). Any native fauna that are located will need to be relocated to a suitable nearby area or (if injured) taken to the nearest wildlife carer or a WIRES representative.

Structural habitat was limited with no habitat trees recorded within the Study Area. Canopy trees were largely absent, and where present were too young to contain hollows. No nests or dreys were observed during the fauna survey, however occasional arboreal termite mounds were observed that provide nesting and foraging opportunities for a suite of local fauna.

Scattered rocks and the concrete of the culverts and drainage lines provides potential basking and sheltering habitat for small ground-dwelling herpetofauna, with the culverts also providing potential roosting habitat for microbats.

Artificial habitat is provided by artificial debris that has washed up or been dumped along Industrial Creek or scattered throughout the Study Area, and an Eastern Water Skink (*Eulamprus quoyii*) was observed utilising such habitat in the form of a car tyre.

Plates: Habitat features

Photo Details: top row – rock habitat scattered throughout the site that provides basking, sheltering and foraging habitat for local native fauna. Bottom row – large concrete culvert of Shrimptons Creek with gaps between the overarching slabs providing suitable microbat roosting and breeding habitat (photos courtesy of Patrick Tegart).





Figure 4-2: Locations of Habitat Features within the Study Area (UBM 2016)





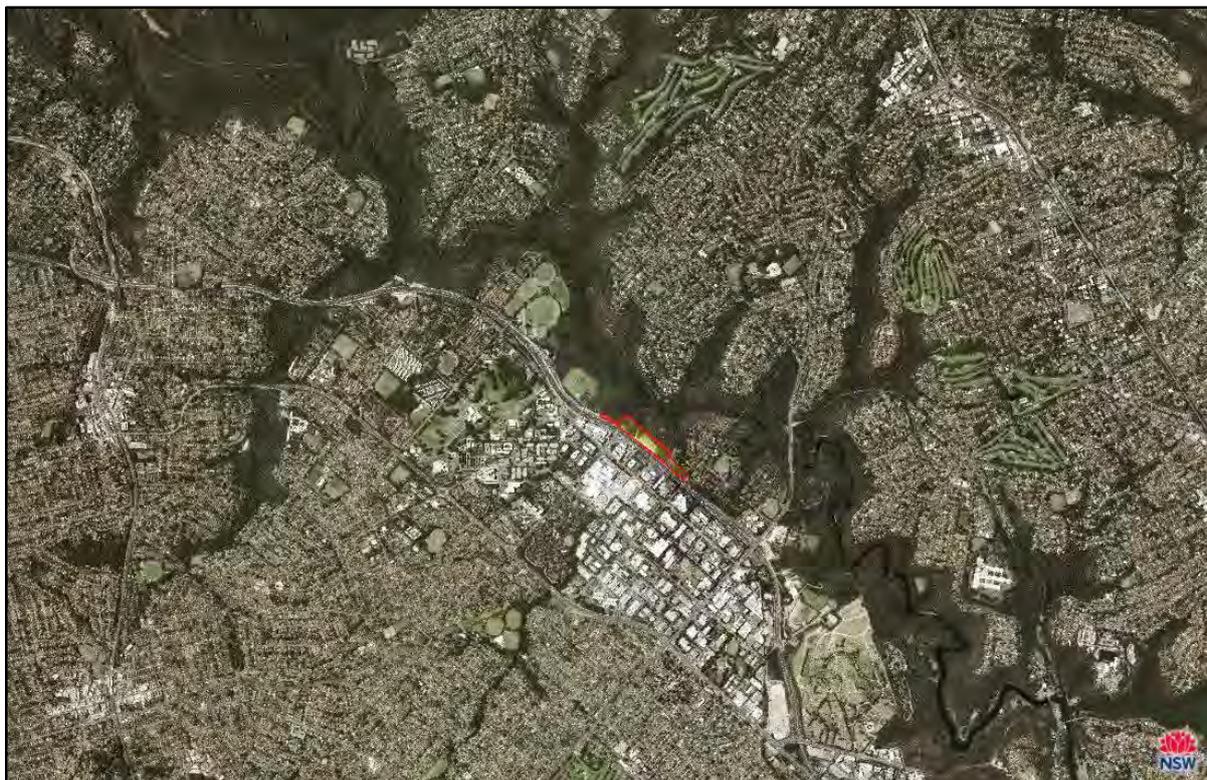
4.3.4 Connectivity

The Study Area is located in a highly urbanised area comprising mainly residential and commercial properties with some light industrial development, however the site shares its north-east boundary with the riparian corridor of the Lane Cove River which forms part of the Lane Cove National Park. At 670 ha in size, the Park is a viable and regional significant bushland habitat corridor, forming the south-eastern projection of an almost contiguous 35 km wildlife corridor linking bushland in central Sydney with the Hawkesbury/Nepean Catchment, in addition to forming the spine for many smaller urban bushland remnants and providing an important riparian buffer for the Lane Cove River (NSW NPWS, 2012). The Lane Cove River is situated approximately 250m from the Subject Land, and the Proposal presents an opportunity to increase the buffer and enhance the corridor by increasing the size and functionality of the existing corridor.

Natural habitat linkages can act as habitat, filters, barriers, sources and sinks, and are used in different ways by different species (Gleeson & Gleeson, 2012). The riparian corridor forms an important network of habitat connectivity for wildlife allowing fauna to travel great distances with a constant water source and suitable cover. The connectivity of the site is both consistent and substantial to the north-west toward the larger areas of Lane Cove National Park and to the south-east towards and beyond the estuary zone of Lane Cove River (NPWS 2016). The current proposal presents an opportunity to increase the size and functionality of the existing corridor, and to contribute to the viability of the Subject Land as a buffer along the national park boundary.

Figure 4-3: Connectivity

Source: OEH SIXMaps (<https://maps.six.nsw.gov.au/>; Accessed: 03/02/2016)





4.3.5 Threatened Fauna Assessment

A database search for all species listed under both Commonwealth and State legislation as either Critically Endangered, Endangered, Vulnerable, Threatened or Near-threatened (referred to as EVNT species) using *BioNet* (Atlas of NSW Wildlife; OEH) for records within the last 10 years and covering a 10km radius from the centre of the Study Area was undertaken (Parameters – North: -33.72 West: 151.07 East: 151.17 South: -33.82). This list was used to undertake an assessment of threatened fauna species (*Table 4-3*) based on a set of assessment criteria (*Table 4-2*).

This Assessment outlines the habitat requirements of the species, the species status, the most recent observation and proximity to the Subject Property, the likelihood and potential utilisation of the species to the Study Area and conclusions of the likely impact and assessment considerations.

Four (4) threatened microbat species were detected during the field survey. The Eastern Bentwing-bat (*Miniopterus orianae (schreibersii) oceanensis*) was identified with a definitive level of confidence, whilst the Southern Myotis (*Myotis macropus*), False Pipistrelle (*Falsistrellus tasmaniensis*), and Greater Broad-nosed Bat (*Scoteanax rueppellii*) were identified with a probable level of confidence.

In addition, it is considered that potential habitat is available for the Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) and Eastern Freetail-bat (*Mormopterus norfolkensis*), although habitat is not considered ideal.

As part of the NSW *Threatened Species Conservation Act* (1995), an Assessment of Significance (7-part Test) has been completed to assess the likely impacts of any future development and the associated removal and/or modification of vegetation on the Land on these threatened species.

Appendix 4 provides the results of these Assessments and summarises the requirement for further action based on a species by species assessment.

In summary, these Assessments of Significance for each species have confirmed that the proposed rehabilitation program to be instated on the study area will not significantly impact any of these species, and will indeed be beneficial to their survival in the locality in the long-term.



Table 4-2: Assessment criteria for the potential utilisation of a fauna species for the Study Area

LIKELIHOOD RATING	CRITERIA FOR UTILISATION
Unlikely	Species considered unlikely to occur/use the Subject Property fit one or more of the following criteria; <ul style="list-style-type: none">▪ species not recorded in the field survey;▪ species not recorded previously in the Subject Property or locality (within 10km of the Subject Property);▪ species with a known distribution or range outside of the Subject Property; and/or▪ species that rely on habitats and habitat features that do not occur in the Subject Property. ☒
Possible	Species considered possibly to occur/use the Subject Property fit one or more of the following criteria; <ul style="list-style-type: none">▪ species with occasional records (within the last 10 years) of occurring within the locality (within 10km of the Subject Property);▪ species with preferred habitat or habitat features occur on the Subject Property, however they occur in poor or modified condition or extremely limited; and/or▪ species that may use or occur in habitats within the Subject Property opportunistically i.e. seasonally, however unlikely to be present on the property permanently and hence have no immediate impact on nesting/roosting or feeding habitat.
Likely	Species considered likely to occur/use the Subject Property fit one or more of the following criteria; <ul style="list-style-type: none">▪ species that have frequent and recent (within the last 10 years) incidence of previous records on the Subject Property and/or locality (within 10km of the Subject Property);▪ species that preferentially use habitat and/or habitat features that occur within the Subject Property and which are abundant and/or in good condition;▪ species with resident populations known to occur in the Subject Property; and/or▪ species are known to frequently use habitat or habitat features within the Subject Property or locality (within 10km of the Subject Property) and/or are highly likely to visit the Subject Property in particular, during seasonal dispersal or migration.
Confirmed	A species identified within the Subject Property during the recent fauna field survey or a recent fauna field survey conducted by an independent consultant and/or qualified Ecologist/Environmental Representative.



Table 4-3: Threatened Fauna Assessment for species recorded in the Region during the past 10 years

Conservation Status: CE – Critically Endangered; E1/E - Endangered Species; and V - Vulnerable Species

NB: Habitat requirements were generally extracted from OEH (2012), with other references used being identified in the bibliography

^ Within a 10 x 10 km² area centered on the Study Area (Parameters – North: -33.72 West: 151.07 East: 151.17 South: -33.82)

COMMON NAME & SCIENTIFIC NAME	LEGAL STATUS		HABITAT REQUIREMENTS*	DISTRIBUTION IN THE REGION [^]			POTENTIAL UTILISATION OF STUDY AREA	LIKELY IMPACT & ASSESSMENT CONSIDERATIONS
	TSC ACT	EPBC ACT		RECORDS WITHIN 10KM	RECORDS WITHIN 1KM	MOST RECENT		
Amphibians (2)								
Green and Golden Bell Frog (<i>Litoria aurea</i>)	E1	V	Largely aquatic species found among aquatic emergent vegetation or riparian vegetation within or at the edges of permanent water, favouring those with bulrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.) (Cogger 2014; OEH 2013). Often found under debris on low, oft-flooded river flats (Cogger 2014). Inhabits marshes, dams and stream-sides, as well as artificial water bodies with non-native emergent vegetation (OEH 2013). Recorded in highly disturbed areas within the Greater Sydney region. Frequently active by day. Breeds in summer when conditions are warm and wet (OEH 2013). Will forage up to 500 m of breeding habitat, amongst vegetation (aquatic & riparian) and fallen timber including within grassland, cropland and modified pastures (OEH 2013).	2	-	Jan-2010	Unlikely	Little suitable habitat is available. Permanent aquatic habitat lacks emergent vegetation. Further assessment is not required.



COMMON NAME & SCIENTIFIC NAME	LEGAL STATUS		HABITAT REQUIREMENTS*	DISTRIBUTION IN THE REGION [^]			POTENTIAL UTILISATION OF STUDY AREA	LIKELY IMPACT & ASSESSMENT CONSIDERATIONS
	TSC ACT	EPBC ACT		RECORDS WITHIN 10KM	RECORDS WITHIN 1KM	MOST RECENT		
Red-crowned Toadlet (<i>Pseudophryne australis</i>)	V	-	Found in heath or eucalypt forests, mostly on Hawkesbury and Narrabeen Sandstones (OEH 2012). Inhabits ephemeral or intermittent low order drainage lines below sandstone ridges that often have shale lenses or cappings (Cogger 2014). Shelters under rocks and logs, amongst dense vegetation or thick piles of leaf litter (OEH 2012). Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters, avoiding even mildly polluted water (OEH 2012).	6	3	Dec-2009	Unlikely	No suitable habitat available. Weed infestations and pollution render habitat unsuitable. Habitat downslope (outside of the Study Area) is likely to benefit from habitat restoration within the Study Area. Further assessment is not required.
Birds (8)								
Australasian Bittern (<i>Botaurus poiciloptilus</i>)	E	E	Fairly specific habitat preferences, primarily occurring in shallow permanent and seasonal terrestrial freshwater wetlands (occasionally estuarine) with tall dense vegetation, especially those dominated by sedges, bulrushes (<i>Typha</i> spp.), spikerushes (<i>Eleocharis</i> spp.) and/or reeds. Forages at the edges of waterways and pools in still shallow water, or from vegetation platforms over deep water (Marchant & Higgins, 1990; DSEWPAC 2014)	1	-	Jun-2011	Unlikely	The Study Area does not meet the specific habitat requirements of this species. Further assessment is not required.
Black Bittern (<i>Ixobrychus flavicollis</i>)	V		Inhabits tree-lined terrestrial freshwater (occasionally estuarine) wetlands in areas of dense vegetation (OEH 2014). Also found in flooded grassland, forest,	1	-	Aug-2008	Unlikely	The Study Area does not meet the specific habitat



COMMON NAME & SCIENTIFIC NAME	LEGAL STATUS		HABITAT REQUIREMENTS*	DISTRIBUTION IN THE REGION^			POTENTIAL UTILISATION OF STUDY AREA	LIKELY IMPACT & ASSESSMENT CONSIDERATIONS
	TSC ACT	EPBC ACT		RECORDS WITHIN 10KM	RECORDS WITHIN 1KM	MOST RECENT		
			woodland, rainforest and mangroves where permanent water is present. Favours habitats dominated by sedges, rushes and /or reeds growing over muddy or peaty substrate. Roosts in trees or on the ground amongst dense trees during the day, and feeds on frogs, reptiles, fish and invertebrates (snails, dragonflies, shrimps, crayfish etc) at dusk and at night (OEH 2014).					requirements of this species. Further assessment is not required.
Little Eagle (<i>Hieraetus morphnoides</i>)	V		Occupies a variety of habitats including open eucalypt forest, woodland or open, <i>She-oak</i> , <i>Acacia</i> or riparian woodland. An abundance of prey items is important, which includes birds, reptiles and small mammals (including rabbits) and occasionally large insects or carrion (OEH, 2015). This species nests in tall living trees in remnant patches of vegetation (Pizzey & Knight, 2003). Occurs as a single population throughout NSW (OEH, 2015).	1	-	Aug-2012	Unlikely	The Study Area does not meet the specific habitat requirements of this species. Further assessment is not required.
Square-tailed Kite (<i>Lophoictinia isura</i>)	V		Generally rare species that inhabits a variety of timbered habitats including open forests and dry woodlands, favouring those that have a broken canopy, are Eucalypt-dominated or close to a waterway (OEH, 2014; Morcombe & Stewart, 2014). In coastal areas associated	1	-	Jan-2013	Unlikely	The Study Area does not meet the specific habitat requirements of this species. Further assessment is not required.



COMMON NAME & SCIENTIFIC NAME	LEGAL STATUS		HABITAT REQUIREMENTS*	DISTRIBUTION IN THE REGION [^]			POTENTIAL UTILISATION OF STUDY AREA	LIKELY IMPACT & ASSESSMENT CONSIDERATIONS
	TSC ACT	EPBC ACT		RECORDS WITHIN 10KM	RECORDS WITHIN 1KM	MOST RECENT		
			with tropical and temperature forests on fertile soils. Will forage along road verges with remnant or planted trees, near the openings and edges of dense forest, and in areas of logging regrowth (OEH, 2014). The Square-tailed Kite occupies a large hunting range (>100km ²) and is a specialist hunter of passerines, especially honeyeaters, and insects in the tree canopy (OEH, 2014).					
Eastern Osprey (<i>Pandion cristatus</i>)	V		Forages over protected clear open water, favouring coastal areas, particularly the mouths of large rivers, lagoons and lakes. Breeding takes place from July to September in NSW. Nests are constructed high in dead trees or in crowns of live trees or artificial towers within 1km of the ocean (OEH 2012).	2	-	May-2012	Unlikely	The Study Area does not meet the specific habitat requirements of this species. Further assessment is not required.
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>) population in the Hornsby and Ku-ring-gai Local Government Areas	E	-	Found in a variety of forest and woodland types, usually in areas with old growth attributes as the species requires tree hollows with a min. diameter of 10 cm for breeding and roosting purposes (OEH 2015). The small Hornsby and Ku-ring-gai population (of 18-40 pairs) is believed to be largely confined to an area bounded by Thornleigh and Wahroonga in the north, Epping and North Epping in the south,	2	-	Jun-2010	Unlikely	The Study Area does not meet the specific habitat requirements of this species. Further assessment is not required.
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)	V	-						



COMMON NAME & SCIENTIFIC NAME	LEGAL STATUS		HABITAT REQUIREMENTS*	DISTRIBUTION IN THE REGION^			POTENTIAL UTILISATION OF STUDY AREA	LIKELY IMPACT & ASSESSMENT CONSIDERATIONS
	TSC ACT	EPBC ACT		RECORDS WITHIN 10KM	RECORDS WITHIN 1KM	MOST RECENT		
			Beecroft and Cheltenham in the west and Turramurra/South Turramurra to the east. It is known to inhabit areas of Lane Cove National Park, Pennant Hills Park and other forested gullies in the area.					
Little Lorikeet (<i>Glossopsitta pusilla</i>)	V	-	Mainly occur in dry, open eucalypt forests and woodlands, but also recorded in old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes (OEH, 2014). Feed primarily on nectar and pollen in the tree canopy, particularly on profusely flowering eucalypts, but also on a variety of other species including, melaleucas and mistletoes (OEH, 2014). Nest hollows are located at heights of between 2 -15 m, mostly in living, smooth-barked eucalypts, especially Manna Gum (<i>Eucalyptus viminalis</i>), Blakely's Red Gum (<i>E. blakelyi</i>) and Tumbledown Gum (<i>E. dealbata</i>) (OEH, 2014). Hollow openings are very small, approximately 3 cm in diameter, and are kept open by the activities of the occupants, which use their beaks to bite away living bark from around the opening (OEH, 2014).	2	-	Jun-2010	Unlikely	The Study Area does not meet the specific habitat requirements of this species. Further assessment is not required.



COMMON NAME & SCIENTIFIC NAME	LEGAL STATUS		HABITAT REQUIREMENTS*	DISTRIBUTION IN THE REGION^			POTENTIAL UTILISATION OF STUDY AREA	LIKELY IMPACT & ASSESSMENT CONSIDERATIONS
	TSC ACT	EPBC ACT		RECORDS WITHIN 10KM	RECORDS WITHIN 1KM	MOST RECENT		
Swift Parrot (<i>Lathamus discolor</i>)	E	E	In NSW this species is a winter migrant and mostly occurs on the coast and southwest slopes (OEH 2012). On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Known feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Mugga Ironbark <i>E. sideroxylon</i> , and White Box <i>E. albens</i> and lerp infested trees such as Grey Box <i>E. microcarpa</i> , Grey Box <i>E. moluccana</i> and Blackbutt <i>E. pilularis</i> (OEH 2012).	1	-	May-2010	Unlikely	The Study Area does not meet the specific habitat requirements of this species. Further assessment is not required.
Barking Owl (<i>Ninox connivens</i>)	V	-	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and will forage up to 250m from preferred vegetation types into adjoining grasslands (OEH 2014). Roost in shaded portions of tree canopies, including tall mid-storey trees with dense foliage such as <i>Acacia</i> and <i>Casuarina</i> species. Breeds in large hollows (>20 cm diameter) of taller canopy trees (at least 4m above the ground) (OEH 2014). Living eucalypts are	5	-	Mar-2013	Unlikely	Little foraging habitat and no suitable breeding habitat is available within the Study Area for this species. Further assessment is not required.



COMMON NAME & SCIENTIFIC NAME	LEGAL STATUS		HABITAT REQUIREMENTS*	DISTRIBUTION IN THE REGION [^]			POTENTIAL UTILISATION OF STUDY AREA	LIKELY IMPACT & ASSESSMENT CONSIDERATIONS
	TSC ACT	EPBC ACT		RECORDS WITHIN 10KM	RECORDS WITHIN 1KM	MOST RECENT		
			preferred though dead trees are also used (NPWS, 2014).					
Powerful Owl (<i>Ninox strenua</i>)	V	-	The largest owl in Australasia, the Powerful Owl is endemic to eastern and SE Australia (OEH 2014). Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest (OEH 2014). Mature eucalypt trees (at least 150 years old) with hollows at least 0.5 metres deep are required for breeding. Densely vegetated gullies are favoured for roosting. Mainly prey upon medium-sized arboreal mammals that require hollows and a shrub layer, and as such this species generally requires large tracts of land with suitable habitat for prey items (Pizzey & Knight 2003; OEH 2014). Common Ringtail Possums and Flying Foxes are important prey items.	173	-	Aug-2015	Possible	This species is known to disperse up to 18 km. The Study Area may on occasion be utilised for foraging purposes by local breeding pair, however due to the presence of better quality bushland in the vicinity, the Study Area is unlikely to be of importance to this species. Further assessment is not required.
Mammals (6)								
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	V	V	Australia's largest bat, this species can be found in a range of habitats including sub-tropical and temperate rainforests, tall open-forests, closed and Open Woodlands, heaths, <i>Melaleuca</i> swamps and <i>Banksia</i> woodlands (OEH, 2015). Roosting camps	153	-	Mar-2015	Possible	It is possible that this species' does utilise vegetation within the Study Area upon occasion for foraging. However, considering the nature of the Proposal, and that



COMMON NAME & SCIENTIFIC NAME	LEGAL STATUS		HABITAT REQUIREMENTS*	DISTRIBUTION IN THE REGION [^]			POTENTIAL UTILISATION OF STUDY AREA	LIKELY IMPACT & ASSESSMENT CONSIDERATIONS
	TSC ACT	EPBC ACT		RECORDS WITHIN 10KM	RECORDS WITHIN 1KM	MOST RECENT		
			are usually located in gullies, near water on lakes, rivers or coastlines (Van der Ree <i>et al.</i> 2005) and within 20km of a regular food source (OEH, 2015).					habitat improvement is the expected outcome, further assessment is not required.
Yellow-bellied Sheathtail-bat (<i>Saccolaimus flaviventris</i>)	V	-	Occurs in almost all habitats across its very wide range (Churchill, 2008). When foraging for insects, flies high and fast over the forest canopy, but lower in more open country (OEH, 2014). Forages in habitat with and without trees and appears to defend an aerial territory. Roosts in large tree hollows and buildings; in treeless areas they are known to utilise mammal burrows (OEH, 2014).	1	-	Mar-2014	Possible	Although not detected through Anabat recordings, potential foraging habitat for this species is present within the Study Area. An Assessment of Significance for the Yellow-bellied Sheathtail-bat is required (refer to Appendix 4).
Eastern Freetail-bat (<i>Mormopterus norfolkensis</i>)	V	-	Inhabits dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range (OEH 2014). Roosts mainly in hollows of dead or alive trees but will also roost under bark or in man-made structures (Churchill 2008).	2	-	Apr-2014	Possible	Although not detected through Anabat recordings, potential foraging habitat for this species is present within the Study Area. An Assessment of Significance for the Eastern Freetail-bat is required (refer to Appendix 4).
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	V	-	Generally inhabits Open and Closed-Eucalypt forests that are in moist areas, preferring to roost in Eucalypt hollows around 20m off the ground (Churchill,	2	-	Feb-2014	Likely	This species was detected in Anabat recordings with a probable level of confidence, however was unable to be distinguished



COMMON NAME & SCIENTIFIC NAME	LEGAL STATUS		HABITAT REQUIREMENTS*	DISTRIBUTION IN THE REGION^			POTENTIAL UTILISATION OF STUDY AREA	LIKELY IMPACT & ASSESSMENT CONSIDERATIONS
	TSC ACT	EPBC ACT		RECORDS WITHIN 10KM	RECORDS WITHIN 1KM	MOST RECENT		
			2008; OEH, 2014). Also known to roost under loose bark on trees or in buildings (OEH, 2014). Hunts just above or just below the tree canopy (OEH, 2014). Prefer to forage in moist habitat with trees >20m in height. This species hibernates during winter.					from other species with similar calls. An Assessment of Significance for the Eastern False Pipistrelle is required (refer to Appendix 4).
Eastern Bentwing-bat (<i>Miniopterus schreibersii oceanensis</i>)	V	-	Hunts in forested areas, and is associated with dry sclerophyll forests and forested wetlands within the Sydney Metro region (OEH, 2014). Primarily roost in caves, however also known to roost in stormwater pipes, disused mines, buildings and other man-made structures (OEH, 2014). Limestone maternity caves require specific temperature and humidity ranges (Churchill, 1998). No known maternity colonies exist in the Sydney Metro CMA (OEH, 2014).	28	-	Mar-2015	Confirmed	This species was detected in Anabat recordings with a definite level of confidence. An Assessment of Significance for the Eastern Bentwing-bat is required (refer to Appendix 4).
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	V	-	Occurs in a wide variety of habitat including moist and dry sclerophyll forests, rainforests, open woodland, tree-lined creeks in open areas, and cleared paddocks with remnant trees (Churchill, 2008). Commonly found in tall wet forest (OEH, 2014). Known to roost in tree hollows, cracks and fissures in trunks and	2	-	Jun-2014	Likely	This species was detected in Anabat recordings with a probable level of confidence, however was unable to be distinguished from other species with similar calls. An Assessment of Significance for the Greater



COMMON NAME & SCIENTIFIC NAME	LEGAL STATUS		HABITAT REQUIREMENTS*	DISTRIBUTION IN THE REGION^			POTENTIAL UTILISATION OF STUDY AREA	LIKELY IMPACT & ASSESSMENT CONSIDERATIONS
	TSC ACT	EPBC ACT		RECORDS WITHIN 10KM	RECORDS WITHIN 1KM	MOST RECENT		
			dead branches, under exfoliating bark as well as the roofs of old buildings (Churchill, 2008). Riparian corridors and woodland or forest edges are preferred foraging habitat (Churchill, 2008; OEH, 2014).					Broad-nosed Bat is required (refer to <i>Appendix 4</i>).



5 CONCLUSION, DECLARATION & SIGN-OFF

The current report has provided ecological data for the Subject Land Lot 181 of DP1150938 on the eastern side of the M2 Hills Motorway in Macquarie Park. It also considers the potential impacts on native flora and fauna that may arise from the Proposal.

Impacts upon the Ecological Community may be described as Direct Impacts – activities expected to directly affect the listed community *e.g.* clearing of vegetation, or Indirect Impacts – activities which are expected to affect the community indirectly *e.g.* changes in local hydrology and an increase in soil nutrient levels due to runoff from lawns and gardens.

Results:

Flora: 175 plant species were recorded in, or directly adjacent to the Study Area. This number includes 87 species of exotic introductions or weeds (of which 22 are noxious weeds); 80 species which are considered to be naturally occurring and characteristic of the *Hornsby Enriched Sandstone Exposed Woodland* ecological community; three (3) non-indigenous species that have been planted, and another five (5) locally indigenous species planted at some time in past. The greatest concentration of weeds occurs in the riparian zones on Industrial and Shrimptons Creeks. The filled and seeded area, described as 'The Deck', consists of a dense groundcover of exotic grasses and forbs with a number of woody weeds.

No (0) naturally occurring Endangered, Vulnerable, Near-threatened and/or Threatened (EVNT) flora species listed under the NSW *TSC Act* or Commonwealth *EPBC Act* were recorded in the current Study Area but a small stand of the endangered (*TSC Act*) *Melaleuca deanei* was recorded in the interface with Lane Cove National Park. The interface zone between the Study Area and Lane Cove National Park is important as it provides a buffer to the highly disturbed land on the Subject Property, and it provides the only access for pedestrians if the site is to be used in the future for recreational purposes.

Fauna: The majority of the Study Area is comprised of weed thickets and exotic grassland with an overall lack of structural complexity. The permanent water sources within the existing detention basins as well as the riparian habitat along the creeks are a valuable resource for local native fauna.

By the completion of the current field survey (February 2016), two (2) native mammals (excluding microbats), 17 native birds, seven (7) native reptiles, two (2) native amphibians and five (5) native invertebrates were recorded within or in close proximity to the Study Area. A high level of microbat activity was observed; with 11 microbat species detected utilising the Study Area. This included four (4) threatened microbat species, being the Eastern Bentwing-bat (*Miniopterus orianae (schreibersii) oceanensis*), Southern Myotis (*Myotis macropus*), False Pipistrelle (*Falsistrellus tasmaniensis*), and the Greater Broad-nosed Bat (*Scoteanax rueppellii*).

No other EVNT fauna species, listed under either the *EPBC Act* and/or *TSC Act*, were observed during the course of these Ecological Investigations.

An Assessment of Significance undertaken for each of the threatened species listed above has concluded that the Proposal is not expected to significantly impact any of these species or their habitats, but rather lead to an improvement of the quality of habitat available.



Recommendations:

In considering the proposed rehabilitation of the M2 Hills Motorway Transurban Cultural Biolink Reserve, a comprehensive Vegetation Management Plan is to be prepared, and UBM recommends that this Plan should be implemented as follows:

- Given that the M2/Transurban rehabilitation project is being undertaken primarily to serve as an ecological buffer to the Lane Cove National Park, and to arrest the spread of weeds into the National Park, a targeted weed control program is essential to success.
- Noxious, Weeds of National Significance and keystone environmental weeds should be controlled across the site and on adjacent land as a matter of priority, and a comprehensive and targeted weed control program undertaken *prior to* commencement of any earthworks or drainage works.
- Targeted weed control should be carried out for both creeklines upstream of the Subject Land (i.e. on the northern side of the M2 Motorway).
- Vegetation retained should be subject to regular maintenance, specifically weed control (weeding methods and frequency of maintenance is recommended in the Vegetation Management Plan).
- Soil testing and subsequent remediation will be required prior to any planting program. This will necessarily include importation of geologically similar weed-free topsoil, ripping, and landscape modification to create a more 'naturalistic' topography.
- The planting program should endeavour to use locally indigenous species for preference, especially using species characteristic of the *Hornsby Enriched Sandstone Exposed Woodland* ecological community, with revegetation undertaken using seed collected from adjacent bushland reserve or the National Park. This will assist in retaining local landscape character.
- Where soil conditions allow, some species characteristic of the EEC Turpentine Ironbark Forest community may be incorporated into the indigenous planting plan.
- Any future earthworks should avoid impacting areas of significant geology, and protect the existing drainage easements and riparian zones of Shrimptons and Industrial Creeks, ensuring that further degradation is avoided.
- Again, for any future earthworks, maintain a setback distance ('buffer') from the riparian vegetation and minimize soil disturbance impacting on drainage lines or waterbodies.
- Riparian zones of both creeklines will required specialist treatment, as determined by GHD and Landcare Australia (part of a comprehensive soil and water management plan).
- Implementation of a vertebrate pest control program within the Subject Property (targeting, rabbits and hares) prior to the commencement of work to protect the integrity of any future planting.
- Community engagement through the use of educational signage to inform nearby residents and the local community about the project and the importance of such bushland habitat and the fauna and flora it supports.
- Encourage local residents keep dogs under control and their cats inside at night.



- The removal of Lantana and Privet thickets should be undertaken incrementally, and should be replaced by native shrubs that provide similar functional habitats for reptiles and small mid-storey birds.
- Care should be taken when using machinery for broad scale clearing to remove woody weeds which provide habitat and to prevent birds and other fauna being permanently lost from the site.
- Avoid removing woody weeds during the peak bird breeding season between July and January/February.
- Maintain a high standard of hygiene that requires the cleaning of vehicles and other plant entering the site. This will ensure the site is free of dirt and debris imported from other sites and will help to minimise the potential spread of bacterial and fungal disease such as *Chytridiomycosis* that can spread rapidly throughout amphibian populations.

The recommendations identified in this Report will assist to improve local biodiversity and benefit local bushland for the flora or fauna species and populations occurring within the Subject Property and Locality.



6 REFERENCES

- Benson, D. and Howell, J. (1990).** *Taken for Granted The Bushland of Sydney and its Suburbs.* Kangaroo Press, Sydney.
- Benson, D., Howell, J. & McDougall, L. (1996).** *Mountain Devil to Mangrove.* Royal Botanic Gardens Sydney.
- BIB (2016).** *Weeds.* Birds in Backyards. Available online: <http://www.birdsinbackyards.net/Weeds> [Accessed 11.02.2016].
- Bureau of Meteorology (2016).** *Climate Data Online.* <http://www.bom.gov.au/climate/data/> [Accessed February 2016].
- Chapman, G.A. and Murphy, C.L. (1989).** *Soil Landscapes of the Sydney 1:100 000 Sheet.* Soil Conservation Service of NSW, Sydney.
- Churchill, S. (2008).** *Australian Bats, 2nd Edition.* Jacana Books, Crows Nest, Sydney.
- Cogger, H.G. (2014).** *Reptiles and Amphibians of Australia.* 7th Edition. CSIRO Publishing.
- Department of Environment & Climate Change (DECC) (2007).** *Threatened species assessment guidelines: the Assessment of Significance.* Accessed at: <http://www.environment.nsw.gov.au/resources/threatenedspecies/tsaguide07393.pdf>
- Department of Environment, Climate Change & Water* (2013).** *The Native Vegetation of the Sydney Metropolitan Catchment Authority.* Prepared for Sydney Metropolitan Catchment Management Authority Sydney (*now Office of Environment & Heritage)
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2010a).** *Survey guidelines for Australia's threatened frogs.* Available online: <http://www.environment.gov.au/resource/survey-guidelines-australias-threatened-frogs-guidelines-detecting-frogs-listed-threatened>
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2010b).** *Survey guidelines for Australia's threatened bats.* Available online: <https://www.environment.gov.au/resource/survey-guidelines-australias-threatened-bats-guidelines-detecting-bats-listed-threatened>
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2010c).** *Survey guidelines for Australia's threatened birds.* Available online: <http://www.environment.gov.au/resource/survey-guidelines-australias-threatened-birds-guidelines-detecting-birds-listed-threatened>
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2011a).** *Survey guidelines for Australia's threatened reptiles.* Available online:



<http://www.environment.gov.au/resource/survey-guidelines-australias-threatened-reptiles-guidelines-detecting-reptiles-listed>

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2011b). *Survey guidelines for Australia's threatened mammals.* Available online: <http://www.environment.gov.au/resource/survey-guidelines-australias-threatened-mammals-guidelines-detecting-mammals-listed>

Fairley, A. (2004). *Seldom Seen, Rare Plants of Greater Sydney.* Reed New Holland Sydney.

Fairley, A & Moore, P. (2010). *Native Plants of the Sydney District,* Allen & Unwin, Sydney NSW.

Gleeson, J. & Gleeson, D. (2012). *Reducing the Impacts of Development on Wildlife.* CSIRO Publishing, Collingwood, VIC.

Harden, G. (Ed) (1992, 1993, 2000 & 2002). *Flora of New South Wales: Vols. 1 (2nd ed.), 2 (2nd ed.), 3 and 4.* NSW University Press, Kensington.

Keith, D.A. 2009 The interpretation, assessment and conservation of ecological communities. In *Ecological Management and Restoration* 10 (S3 – S15).

Menkhorst, P. and Knight, F. (2011). *A Field Guide to the Mammals of Australia: Third Edition.* Oxford University Press, Melbourne.

Morcombe, M., & Stewart, D. (2014). *The Michael Morcombe and David Stewart eGuide to the Birds of Australia.* Mydigitalearth.com.

NSW Department of the Environment & Conservation (2004). *Systematic survey of vertebrate fauna in Lane Cove National Park.* The Department of Environment and Conservation, NSW.

NSW National Parks & Wildlife Service of NSW (2002). *Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney, Final Edition.* NSW National Parks and Wildlife Service, Hurstville

NSW National Parks & Wildlife Service of NSW (2012). *Lane Cove National Park Draft Plan of Management.* NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks & Wildlife Service of NSW (2016). *Lane Cove National Park (Visitors information).* Accessed at: <http://www.nationalparks.nsw.gov.au/visit-a-park/parks/Lane-Cove-National-Park/Map>. [Accessed 05.02.2016]

NSW Department of Primary Industry (2015) *Noxious Weed Declarations.* <http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed> [Accessed February 2016] (now Industry and Investment).

NSW Office of Environment & Heritage (OEH) (2013). *Threatened Species Survey and Assessment Guidelines.* Accessed at: <http://www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm>



- NSW Office of Environment & Heritage (2015).** *BioNet - Atlas of NSW Wildlife Database.* <http://www.bionet.nsw.gov.au/> [Accessed February 2016]] (formerly Department of Environment, Climate Change and Water – DECCW).
- NSW Office of Environment & Heritage (2012-2015).** *Threatened Species* [Accessed February 2016]: <http://www.environment.nsw.gov.au/threatenedSpeciesApp/>
- NSW Scientific Committee** (Various dates). *Final Determinations.* Accessed February 2016]: <http://www.environment.nsw.gov.au/committee/finaldeterminations.htm>
- Parsons, H., French, K., and Major, R.E. (2008).** The vegetation requirements of Superb Fairy-wrens (*Malurus cyaneus*) in non-urban edge and urbanised habitats. *EMU* 108, 283–291.
- Pellow, B.J., Henwood, M. and Carolin, R.C. (2009).** *Flora of the Sydney Region.* 5th Edition. Sydney University Press, Sydney.
- PlantNET (2016).** *The NSW Plant Information Network System.* Royal Botanic Gardens and Domain Trust, Sydney. <http://plantnet.rbgsyd.nsw.gov.au> [February 2016]
- Richardson F.J., Richardson R.G., Shepherd R.C.H. (2007).** *Weeds of the South-East, an Identification Guide for Australia.* R.G. and F.J. Richardson, Meredith.
- Robinson, L. (2003).** *A Field Guide to the Native Plants of Sydney.* 3rd Edition, Kangaroo Press, Sydney.
- Thomas, D (1994).** Bushland Survey of Shrimptons Creek Catchment. Unpublished report prepared for Ryde City Council.
- Tozer, M. (2003).** *The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities in Cunninghamia* (2003) 8(1):1-75.
- Tozer, M.G., Turner, K., Simpson, C., Keith, D.A., Beukers, P., MacKenzie, B., Tindall, D. & Pennay, C. (2010).** *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands*, in *Cunninghamia* 11 (3) 2010. * published as a draft report in 2006.
- Triggs, B. (2004).** *Tracks, Scats and Other Traces: A Field Guide to Australian Mammals.* Oxford University Press, Melbourne.
- UBBS (1997).** James T (ed). *Urban Bushland Biodiversity Survey* (NSW National Park and Wildlife Service: Hurstville)
- Urban Bushland Management Consultants (1999).** *Vegetation Management Plan for Shrimptons Creek, North Ryde.* Unpublished report for Ryde City Council, December 1999.
- UBMC Ecological Consultants (2001).** *Riparian Zone Rehabilitation: Shrimptons Creek, North Ryde* - for Ryde City Council.
- UBM Ecological Consultants (2001).** *Lane Cove National Park Vegetation Survey.* Unpublished report prepared for the NSW National Parks and Wildlife Service.



Virkki, DA, Tran, C, and J. Guy Castley JG (2012). Reptile Responses to Lantana Management in a Wet Sclerophyll Forest, Australia. *Journal of Herpetology* 46(2):177-185. 2012.

Walker, J. and Hopkins, M.S. (1990). Vegetation in: *Australian Soil and Land Survey Field Handbook*. R.C. McDonald, R.F. Isbell, J.G. Speight, J. Walker and M.S. Hopkins. Inkata Press, Melbourne.



7 APPENDICES

APPENDIX 1: List of Flora Species Recorded for the Study Area (UBM February 2016)

KEY	
Plant Communities:	
T1	Enriched sandstone exposed woodland (north of Subject Land)
T2	Privet-Lantana-Broom low closed forest & shrubland on slopes
T3	Couch Grass-Broom-Wattle" grassland and shrubland - The Deck"
T4	Privet-Box Elder low closed forest – Shrimptons Creek
T5	Privet-Box Elder low closed forest – Industrial Creek
Indicative frequency of occurrence in transects:	
v = very common	* indicates introduced species
c = common	adj = occurs adjacent to transect
o = occasional	pl = planted local species likely to have occurred naturally in site previously
r = rare	# = planted local species not considered naturally occurring in the site

STRATUM/FAMILY		SCIENTIFIC NAME	COMMON NAME	PLANT COMMUNITY				
				T1	T2	T3	T4	T5
Canopy Trees								
Aceraceae	*	<i>Acer negundo</i>	Box Elder				o	c
Casuarinaceae	*	<i>Casuarina glauca</i>	Swamp Oak	o	o		o	
Myrtaceae		<i>Angophora costata</i>	Smooth-barked Apple	r				
		<i>Eucalyptus haemastoma</i>	Scribbly Gum	r				
	*	<i>Eucalyptus grandis</i>	Flooded Gum				r	
	*	<i>Eucalyptus microcorys</i>	Tallowwood		r			r
		<i>Eucalyptus piperita</i>	Sydney Peppermint	o	o		r	
		<i>Eucalyptus resinifera</i>	Red Mahogany		r			
	*	<i>Eucalyptus robusta</i>	Swamp Mahogany	r				
	*	<i>Eucalyptus tereticornis</i>	Forest Red Gum	r				
Small Trees								
Casuarinaceae		<i>Allocasuarina littoralis</i>	Black She-oak	o	o			
Fabaceae	*	<i>Erythrina crista-galli</i>	Prickly Coral Tree				o	
	*	<i>Acacia binervia</i>	Coast Myall		r			
	*	<i>Acacia decurrens</i>	Green Wattle		r			
	*	<i>Acacia fimbriata</i>	Fringed Wattle		r			
		<i>Acacia implexa</i>	Hickory Wattle		r			
		<i>Acacia parramattensis</i>	Parramatta Wattle	o	o		o	
Oleaceae	*	<i>Ligustrum lucidum</i>	Large-leaved Privet		v		v	v
Lauraceae	*	<i>Cinnamomum camphora</i>	Camphor Laurel				o	
Lythraceae	*	<i>Lagerstroemia indica</i>	Crepe Myrtle	r				
Moraceae	*	<i>Morus alba</i>	Mulberry		r			
Myrtaceae	*	<i>Eucalyptus tereticornis</i>	Forest Red Gum		r			
	*	<i>Melaleuca armillaris</i>	Bracelet Honey-myrtle		o			



STRATUM/FAMILY		SCIENTIFIC NAME	COMMON NAME	PLANT COMMUNITY				
				T1	T2	T3	T4	T5
Pittosporaceae		<i>Pittosporum undulatum</i>	Sweet Pittosporum		o			
Proteaceae		<i>Banksia ericifolia</i>	Heath Banksia	o				
Salicaceae	*	<i>Salix babylonica</i>	Weeping Willow				r	r
Ulmaceae	*	<i>Ulmus parvifolia</i>	Small-leaved Chinese Elm		r	r		
Shrubs								
Aceraceae	*	<i>Acer negundo</i>	saplings				o	c
Apiaceae		<i>Platysace lanceolata</i>		r				
Araliaceae		<i>Polyscias sambucifolia</i>	Elderberry Panax	o				
Asteraceae		<i>Ozothamnus diosmifolius</i>	White Dogwood	o				
Baueriaceae		<i>Bauera rubioides</i>	River Rose				adj	
Casuarinaceae	*	<i>Casuarina glauca</i>	saplings			r		r
Dilleniaceae		<i>Hibbertia sp</i>		r				
Epacridaceae		<i>Leucopogon juniperinus</i>	Prickly Beard-heath	r				
Euphorbiaceae		<i>Breynia oblongifolia</i>	Dwarfs Apples	o				
		<i>Micranthemum ericoides</i>		o				
Fabaceae	*	<i>Senna floribunda</i>		r				
	*	<i>Senna pendula var glabrata</i>	Cassia	r	o		r	
	*	<i>Erythrina crista-gali</i>	saplings				r	
	*	<i>Genista linifolia</i>	Flax-leaf Broom		c	v		
		<i>Pultenaea flexilis</i>		r	r			
	pl	<i>P. villosa</i>				r		
	*	<i>Acacia falcata</i>	Sickle Wattle			r		
	*	<i>Acacia fimbriata</i>	saplings			o		
	#	<i>Acacia floribunda</i>	Sally Wattle	o		o		
		<i>Acacia longifolia</i>	Sydney Golden Wattle	c	r	v		
	pl	<i>Acacia myrtifolia</i>	Myrtle-leaved wattle			r		
		<i>Acacia parramattensis</i>	saplings			c		
	*	<i>Acacia saligna</i>	Golden Wreath Wattle		o	v		
	#	<i>Acacia stricta</i>				r		
		<i>Acacia suaveolens</i>	Sweet-scented Wattle	r				
		<i>Acacia terminalis</i>	Sunshine Wattle	r				
		<i>Acacia ulicifolia</i>	Prickly Moses	r				
Lauraceae	*	<i>Cinnamomum camphora</i>	saplings				r	
Moraceae	*	<i>Morus alba</i>					r	r
Malvaceae	*	<i>Pavonia hastata</i>		r				
Myrtaceae	pl	<i>Angophora costata</i>	saplings			o		
		<i>Angophora hispida</i>	Dwarf Apple	r				
	*	<i>Callistemon salignus</i>	Willow Bottlebrush		r			r
	*	<i>Callistemon viminalis</i>					r	r
		<i>Corymbia gummifera</i>	Red Bloodwood	r				
		<i>Eucalyptus pilularis</i>	Blackbutt	r				
	pl	<i>Eucalyptus piperita</i>	saplings			o		



STRATUM/FAMILY		SCIENTIFIC NAME	COMMON NAME	PLANT COMMUNITY				
				T1	T2	T3	T4	T5
		<i>Eucalyptus tereticornis</i>	saplings	r		r/pl		
	pl	<i>Eucalyptus sp.</i>	saplings			r		
		<i>Kunzea ambigua</i>	Tick Bush	v	o			
	*	<i>Melaleuca armillaris</i>	Bracelet Honey-myrtle	o				
		<i>Melaleuca deanei</i>		r (1)				
		<i>Leptospermum polygalifolium</i>	Yellow Tea Tree	r				
		<i>Leptospermum trinervium</i>	Paperbark Tea Tree	r				
		<i>Tristaniopsis laurina</i>	Water Gum				r	
Ochnaceae	*	<i>Ochna serrulata</i>	Mickey Mouse Plant	r			r	
Oleaceae	*	<i>Ligustrum lucidum</i>	saplings	r				v
	*	<i>Ligustrum sinense</i>	Small-leaved Privet	o	v		v	v
	*	<i>Olea europaea ssp cuspidata</i>	African Olive		r	r		
Pittosporaceae		<i>Pittosporum undulatum</i>	Sweet Pittosporum	c	o		o	
Platanaceae	*	<i>Platanus sp.</i>	Plane Tree					r
Proteaceae		<i>Banksia ericifolia</i>	Heath Banksia	r	r			
	*	<i>Banksia integrifolia</i>	Coast Banksia			o		
	*	<i>Banksia marginata</i>		r				
		<i>Grevillea buxifolia</i>	Grey Spider Flower	r				
		<i>Hakea saligna</i>	Willow Hakea	r				
		<i>Hakea sericea</i>	Silky Hakea	r				
		<i>Persoonia lanceolata</i>		r				
Rutaceae		<i>Zieria pilosa</i>		r				
		<i>Zieria smithii</i>			r			
Sapindaceae		<i>Dodonaea triquetra</i>	Common Hopbush		r	r/p l		
Solanaceae	*	<i>Solanum mauritianum</i>	Wild Tobacco	r	r			r
	*	<i>Cestrum parqui</i>	Green Cestrum		o			
Ulmaceae		<i>Trema aspera</i>	Poison Peach	o	r			
Verbenaceae	*	<i>Lantana camara</i>	Lantana	o	c		o	
Xanthorrhoeaceae		<i>Xanthorrhoea media</i>	a Grass Tree	r				
Arecaceae	*	<i>Phoenix canariensis</i>	Canary Island Date Palm				r	
Herbs - Ferns								
Cyatheaceae	*	<i>Cyathea cooperi</i>	Straw Tree Fern	r				o
Davalliaceae	*	<i>Nephrolepis cordifolia</i>	Fishbone Fern		r			r
Dennstaedtiaceae		<i>Hypolepis muelleri</i>	Harsh Ground Fern	adj				
Pteridaceae		<i>Pteris tremula</i>	Tender Brake					r
	*	<i>Pteris umbrosa</i>	Jungle Brake					r
Thelypteridaceae		<i>Christella dentata</i>	Binung				r	r
Herbs - Dicots								
Apiaceae		<i>Actinotus helianthi</i>	Flannel Flower	r				



STRATUM/FAMILY	SCIENTIFIC NAME	COMMON NAME	PLANT COMMUNITY				
			T1	T2	T3	T4	T5
	<i>Centella asiatica</i>	Pennywort	r				
	<i>Hydrocotyle pedunculata</i>		r				
	<i>Xanthosia pilosa</i>		r				
Asteraceae	* <i>Ageratina adenophora</i>	Crofton Weed				o	o
	* <i>Aster subultatus</i>	Wild Aster	r		r		
	* <i>Bidens pilosa</i>	Farmers Friends	r	o	r	r	r
	* <i>Cirsium vulgare</i>	Spear Thistle					r
	* <i>Conyza bonariensis</i>	Fleabane	c	o	v		
	<i>Euchiton sphaericum</i>		r				
	* <i>Gnaphalium sp.</i>	a Cudweed	o				o
	* <i>Hypochaeris radicata</i>	Flatweed	r		r		
	<i>Senecio hispidulus</i> var. <i>hispidulus</i>		r				
	* <i>Senecio madagascariensis</i>	Fireweed			o		
	* <i>Sonchus oleraceus</i>	Sow Thistle	r				
	<i>Sigesbeckia orientalis</i>		o	o			
	* <i>Taraxacum officinale</i>	Dandelion		r			
Brassicaceae	* <i>Brassica fruticulosa</i>			r			
Campanulaceae	<i>Wahlenbergia gracilis</i>	Small Bluebell	r				
Chenopodiaceae	<i>Einadia hastata</i>		r				
	<i>Einadia trigonos</i>	Fishweed	r				
Convolvulaceae	<i>Dichondra repens</i>	Kidney Plant	r				
Euphorbiaceae	<i>Poranthera micrantha</i>		r				
Fabaceae	* <i>Trifolium repens</i>	White Clover			v		
Gentianaceae	* <i>Anagallis arvensis</i>	Scarlet Pimpernel			r		
Geraniaceae	<i>Geranium homeanum</i>	Storksbill	r				
Lobeliaceae	<i>Pratia purpurascens</i>	Purplish Pratia	r	r			
Malvaceae	* <i>Modiola caroliniana</i>		r		r		
	* <i>Sida rhombifolia</i>	Paddys Lucerne	r		o		
Myrtaceae	<i>Eucalyptus piperita</i>	seedlings	r				
Oxalidaceae	* <i>Oxalis sp.</i>		r				
Polygonaceae	* <i>Acetosa sagittata</i>	Turkey Rhubatb				r	
	<i>Persicaria decipiens</i>						r
	<i>Rumex brownii</i>						r
Primulaceae	* <i>Centaurium tenuiflorum</i>		r				
Scrophulariaceae	<i>Veronica plebeia</i>	Trailing Speedwell	r				
Solanaceae	* <i>Solanum mauritianum</i>	saplings	r				
	* <i>Solanum nigrum</i>	Blackberry Nightshade	r				
Verbenaceae	* <i>Verbena spp.</i>	Purpletop/Verbena	r	o	c		
Herbs - Monocots							
Anthericaceae	* <i>Chlorophytum comosum</i>	Spider Lily		r			
Arecaceae	* <i>Alocasia brisbanensis</i>	Cunjevoi					r
Asparagaceae	* <i>Asparagus densiflorus</i>	Fern Asparagus				r	



STRATUM/FAMILY	SCIENTIFIC NAME	COMMON NAME	PLANT COMMUNITY					
			T1	T2	T3	T4	T5	
Commelinaceae		<i>Commelina cyanea</i>	Scurvy Weed	r			r	v
	* *	<i>Tradescantia albiflora</i> syn. <i>fluminensis</i>	Wandering Jew				v	
Cyperaceae	*	<i>Cyperus eragrostis</i>	Umbrella Sedge	r		r	r	r
		<i>Cyperus gracilis</i>		r				
		<i>Gahnia ?sieberiana</i>	Red Saw-sedge	r	r			
Juncaceae	*	<i>Juncus cognatus</i>				r	r	
Lomandraceae	pl	<i>Lomandra longifolia</i>	Spiny Matt-rush			r	r	r
		<i>Lomandra obliqua</i>			r			
Phormiaceae		<i>Dianella caerulea car producta</i>	Rough Flax Lily	r			r	
Poaceae	*	<i>Arundo donax</i>	Giant Reed				r	
		<i>Bothriochloa macra</i>	Red Leg Grass			r		
	*	<i>Briza subaristata</i>		r				
	*	<i>Chloris gayana</i>	Rhodes Grass			c		
	*	<i>Cortaderia selloana</i>	Pampas Grass		r			
		<i>Cynodon dactylon</i>	Couch Grass			v		
		<i>Dichelachne micrantha</i>	Short-haired Plume Grass	r				
		<i>Digitaria parviflora</i>	Finger Grass	r				
	*	<i>Ehrharta erecta</i>	Veldt Grass		o			r
		<i>Entolasia stricta</i>	Wiry Panic	o	o			
	*	<i>Eragrostis curvula</i>	African Love-grass			o		
		<i>Imperata cylindrica</i>	Blady Grass	c	o			
		<i>Microlaena stipoides</i>	Weeping Meadow- grass	c				
		<i>Oplismenus aemulus</i>	Basket Grass	c			o	
		<i>Panicum simile</i>		c				
	*	<i>Paspalum dilatatum</i>	Paspalum	o	o	o		
	*	<i>Paspalum urvillei</i>	Vasey Grass	r		o		
	*	<i>Pennisetum clandestinum</i>	Kikuyu		o	o		
	*	<i>Setaria gracilis</i>	Slender Pigeon Grass	o		o		
	*	<i>Sporobolus indica var capensis</i>	Parramatta Grass	o			r	
	*	<i>Stenotaphrum secundatum</i>	Buffalo Grass	r				
	pl	<i>Themeda triandra</i>	Kangaroo Grass			o		
Zingiberaceae	*	<i>Hedychium gardnerianum</i>	Indian Ginger				r	
Vines								
Apocynaceae	*	<i>Vinca major</i>	Periwinkle		r			
Araliaceae	*	<i>Hedera helix</i>	English Ivy		o			o
Asclepiadaceae	*	<i>Araujia sericifera</i>	Moth Vine		r			
Asteraceae	*	<i>Delairea odorata</i>	Cape Ivy		r			
Caprifoliaceae	*	<i>Lonicera japonica</i>	Japanese Honeysuckle	r	o		o	
Convolvulaceae	*	<i>Ipomoea indica</i>	Morning Glory	r	o		c	



STRATUM/FAMILY		SCIENTIFIC NAME	COMMON NAME	PLANT COMMUNITY				
				T1	T2	T3	T4	T5
Fabaceae		<i>Glycine microphylla</i>	A love creeper	r	r	r		
		<i>Hardenbergia violacea</i>	Purple Coral Pea			r		
		<i>Kennedia rubicunda</i>	Dusky Coral Pea	r				
Pittosporaceae		<i>Billardiera scandens</i>	Common Appleberry	r				
Ranunculaceae		<i>Clematis glycinoides</i>	Travellers Joy	r				
Rosaceae	*	<i>Rubus fruticosus</i>	Blackberry	r			r	
Sapindaceae	*	<i>Cardiospermum grandiflorum</i>	Balloon Vine		r			r
Vitaceae	#	<i>Cissus antarctica</i>	Kangaroo Vine	r				
Asparagaceae	*	<i>Asparagus asparagoides</i>	Bridal Veil Creeper	r				
Smilacaceae		<i>Smilax glycyphylla</i>	Sarsaparilla		r			



APPENDIX 2: List of Fauna Species Recorded for the Study Area (UBM February 2016)

Observation Type:

A	Stranding/Beaching	H	Hair, feathers or skin	S	Shot
B	Burnt	I	Subfossil/Fossil remains	T	Trapped or netted
C	Cat kill	K	Dead	U	Anabat
D	Dog Kill	M	Miscellaneous	V	Fox kill
E	Nest/Roost	N	Not located	W	Heard
F	Tracks or scratchings	O	Seen	X	In scat
FB	Burrow	P	Scat	Y	Bone, teeth, shell
G	Crushed cones	Q	Camera	Z	In raptor/owl pellet
GI	Incisions / chews	R	Road kill		

*Introduced species > greater than + at least # threatened species

Note: For this report, echolocation call identifications have been assigned to three categories with regard to certainty of identification (see *Section 4.2*). These are:

D – *Definite*; one or more calls were there is no doubt about the identification of the species.

Pr – *Probable*; most likely to be the species named, low probability of confusion with species that use similar calls.

Po – *Possible*; call is comparable with the named species, with a moderate to high probability of confusion with species of similar calls.

COMMON NAME	SCIENTIFIC NAME	Observation Method	Count	
			Within Site	Nearby/ Fly-Over
Amphibians (2)				
Peron's Tree Frog	<i>Litoria peronii</i>	Song Meter	2+	-
Leaf-green Tree Frog	<i>Litoria phyllochroa</i>	Song Meter	2+	-
Reptiles (7)				
Eastern Water Skink	<i>Eulamprus quoyii</i>	O/Q	1	-
Eastern Water Dragon	<i>Intellagama lesueurii</i>	Q	2	-
Eastern Brown Snake	<i>Pseudonaja textilis</i>	Q		
Dark-flecked Garden Sunskink	<i>Lampropholis delicata</i>	O	-	1
Lace Monitor	<i>Varanus varius</i>	O	1	-
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>	O	1	-
Eastern Snake-neck Turtle	<i>Chelodina longicollis</i>	O	1	-
Birds (17)				
Australian Raven	<i>Corvus coronoides</i>	W	1	1+
Australian Magpie	<i>Cracticus tibicen</i>	W	-	1
Common Myna*	<i>Sturnus tristis</i>	O/W	1+	-
Eastern Yellow Robin	<i>Eopsaltria australis</i>	W	1	-
Eastern Whipbird	<i>Psophodes olivaceus</i>	O	2	-
Fairy-wren	<i>Malarus sp.</i>	O/W	2	-
Grey Butcherbird	<i>Cracticus torquatus</i>	C (Goshawk or cat kill)	-	1



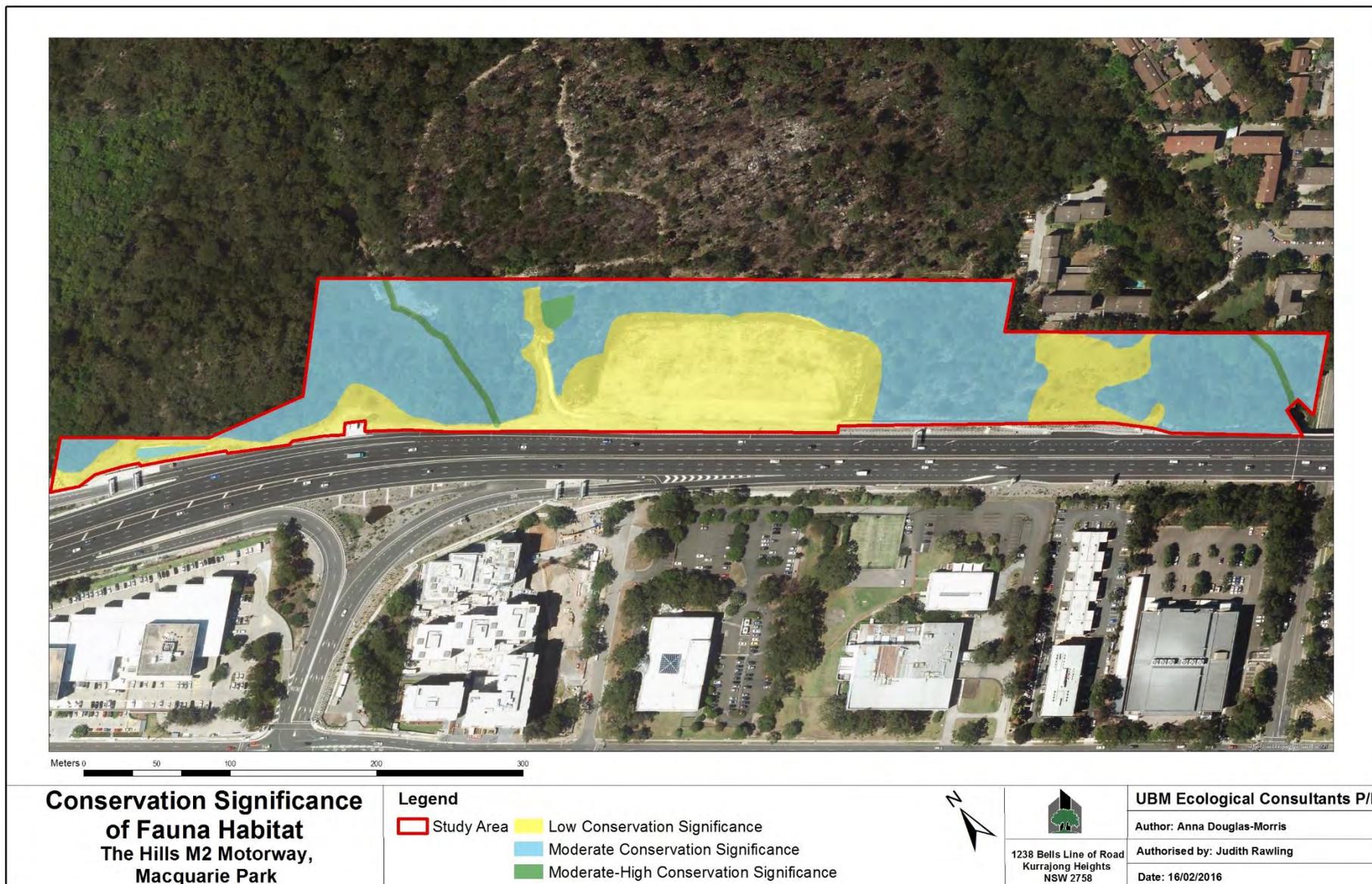
COMMON NAME	SCIENTIFIC NAME	Observation Method	Count	
			Within Site	Nearby/ Fly-Over
Grey Goshawk	<i>Accipiter novaehollandiae</i>	O	1	-
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	W/Q	1	1
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>	O	1	-
Masked Lapwing	<i>Vanellus miles</i>	Song Meter	-	1
Noisy Miner	<i>Manorina melanocephala</i>	O/W	1	-
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	O/W	-	1
Red-whiskered Bulbul*	<i>Pycnonotus jocosus</i>	O/W	2	-
Silvereye	<i>Zosterops lateralis</i>	W	-	3+
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	W	1	-
White Browed Scrub-wren	<i>Sericornis frontalis</i>	O	1	-
Mammals (15)				
Swamp Wallaby	<i>Wallabia bicolor</i>	P	1	-
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	P	1	-
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	U – D	1+	-
Eastern Bentwing-bat#	<i>Miniopterus orianae (schreibersii) oceanensis</i>	U – D	1+	-
White-striped Freetail-bat	<i>Austronomus australis</i>	U – D	1+	-
Southern Freetail-bat	<i>Mormopterus planiceps</i>	U – D	1+	-
Eastern Free-tailed Bat	<i>Mormopterus ridei</i>	U – D	1+	-
Eastern Broad-nosed Bat	<i>Scotorepens orion</i>	U – D	1+	-
-	<i>Scoteanax rueppellii#/ Scotorepens orion/ Falsistrellus tasmaniensis#</i>	U – Pr	1+	-
-	<i>Falsistrellus tasmaniensis#/ Vespadelus darlingtoni</i>	U – Pr	1+	-
Southern Forest Bat	<i>Vespadelus regulus</i>	U – Pr	1+	-
a Forest Bat	<i>Vespadelus vulturnus/ Vespadelus pumilus</i>	U – Pr	1+	-
-	<i>Myotis macropus#/ Nyctophilus sp.</i>	U – Pr	1+	-
Black Rat*	<i>Rattus rattus</i>	P/Q	1	-
European Fox*	<i>Vulpes vulpes</i>	P/Q	1	-
Invertebrates (6)				
Garden Snail*	<i>Helix aspera</i>	O	1+	-
Funnel-web Spider	<i>Atrax robustus</i>	E		1+
Common Yabby	<i>Cherax destructor</i>	O (shells)	2+	-



COMMON NAME	SCIENTIFIC NAME	Observation Method	Count	
			Within Site	Nearby/ Fly-Over
Native Cockroach	Order: <i>Blattodea</i>	0	1+	-
Wandering Percher	<i>Diplacodes bipunctata</i>	0	1+	-
Common Bluetail	<i>Ischnura heterosticta</i>	0	2+	-



APPENDIX 3: Conservation Significance of Fauna Habitat (UBM 2016)





APPENDIX 4: NSW State Legislative Considerations (TSC Act 1995) for EVNT Fauna species

Assessments of Significance (Seven-part Tests) considering the impacts of the proposed rehabilitation of the Subject Land adjoining the M2 Hills Motorway at Macquarie Park have been undertaken for the following six (6) threatened microbats:

- Eastern Bentwing-bat (*Miniopterus orianae (schreibersii) oceanensis*);
- Southern Myotis (*Myotis macropus*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)

Due to similar habitat requirements and associated impacts, a single Seven-part Test has been undertaken.

The **Eastern Bentwing-bat** is listed as 'Vulnerable' under Schedule 2 of the *TSC Act 1995*. This species has chocolate to reddish-brown fur, a short snout and a high 'domed' head with short round ears. Distributed along the east and north-west coasts of Australia, this species occurs in moist eucalypt forest, wet and dry sclerophyll forest, open grassland, rainforest, dense coastal forests, Melaleuca swamps and Banksia scrub (OEH, 2014; Churchill, 2008). This species hunts for moths and other flying insects (flies, cockroaches and beetles) above the canopy in well-timbered areas (Churchill, 2008). The Eastern Bentwing-bat requires karst (limestone) caves with very specific temperature and humidity regimes for breeding, however they are known to roost in derelict mines, storm water tunnels, buildings and other man-made structures (OEH, 2014). There are no known maternity colonies in the Sydney Metro CMA (OEH, 2014). This species was detected within the Study Area through Anabat recordings with a definite level of confidence.

The **Southern Myotis** is listed as 'Vulnerable' under Schedule 2 of the NSW *TSC Act 1995*. Previously called the Large-footed Myotis, this species is distributed in the coastal band from the north-west of Australia, across the top-end and south to western Victoria (OEH, 2014). This species generally roosts in small groups of 10-15 individuals close to water in caves, mine shafts, tree hollows, stormwater drains, buildings, and underneath bridges and dense foliage (OEH, 2014). The Southern Myotis forages exclusively over bodies of still or slowly moving water (e.g. pools, streams, creeks, rivers) feeding on aquatic insects and small fish (Churchill, 2008). This species was detected within the Study Area through Anabat recordings with a probable level of confidence, however was unable to be distinguished from other species with similar calls.

The **Eastern False Pipistrelle** is listed as 'Vulnerable' under Schedule 2 of the NSW *TSC Act 1995*. Distributed on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania, this species generally inhabits open and closed-eucalypt forests that are in moist areas (OEH, 2014). This species prefers to roost in eucalypt hollows around 20m off the ground, but is also known to roost under loose bark on trees or in buildings (Churchill, 2008; OEH, 2014). This relatively large species hibernates during winter. This species was detected within the Study Area through Anabat



recordings with a probable level of confidence, however was unable to be distinguished from other species with similar calls.

The **Greater Broad-nosed Bat** is listed as ‘Vulnerable’ under Schedule 2 of the NSW *TSC Act 1995*. Mainly occurs in gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland (OEH, 2014). Occurs in a wide variety of habitats including open woodland, moist and dry eucalypt forest and rainforest, cleared paddocks with remnant trees, but shows a preference for tall wet forest (Churchill, 2008; OEH, 2014). This species will roost in hollow-bearing trees, in cracks and fissures in trunks and dead branches, under exfoliating bark, as well as in the roofs of old buildings (Churchill, 2008). This species forages along creek and river corridors, forest remnants or along forest crowns at an altitude of 3-6 metres with a slow direct flight pattern, feeding on beetles, moths, ants and large flies. This species was detected within the Study Area through Anabat recordings with a probable level of confidence, however was unable to be distinguished from other species with similar calls.

The **Yellow-bellied Sheathtail-bat** is listed as ‘Vulnerable’ under Schedule 2 of the NSW *TSC Act 1995*. This large jet-black insectivorous bat has a white to yellow belly, long and narrow wings, with a flattened head and a sharply-pointed muzzle. Distributed from across northern and eastern Australia, this species occurs in almost all habitats across its very wide range (Churchill, 2008). When foraging for insects, flies high and fast over the forest canopy, but lower in more open country (OEH, 2014). This species roosts in large tree hollows and buildings; and in treeless areas they are known to utilise mammal burrows (OEH, 2014). Little is known of their seasonal movements; however, it is thought that they migrate to southern Australia in late summer and autumn (OEH, 2014). This species was not detected through Anabat recordings; however potential habitat is available within the Study Area.

The **Eastern Freetail-bat** is listed as ‘Vulnerable’ under Schedule 2 of the NSW *TSC Act 1995*. Distributed along the east coast from South Queensland to Southern NSW, this species is occurring in a range of habitats including dry sclerophyll forest, woodlands, rainforest, riparian open forest and swamp and mangrove forests east of the Great Dividing Range (OEH, 2014; Churchill, 2008). Primarily roosts in tree hollows, but will also roost under bark, in buildings and cracks in posts. This species forages for insects (mostly bugs, flies, beetles and some moths) in spaces between trees and along edges of vegetation, usually foraging within a few kilometres from its roost (Churchill, 2008). This species was not detected through Anabat recordings; however potential habitat is available within the Study Area.

(a) “...in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction...”

The Proposal will result in the rehabilitation of approximately 5.4 hectares of land. No hollow-bearing trees were observed during the field survey, and it is likely that native canopy species will be retained as part of works. Therefore, no potential roosting or breeding habitat will be impacted, and the rehabilitation of the site will result in an increase and enhancement of potential breeding and foraging habitat for threatened microbat species within the Locality. Therefore, it is considered that the Proposal is unlikely to disrupt the life cycle of these microbat species “such that a viable local population of the species is likely to be placed at risk of extinction”.



(b) “...in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction...”,

An endangered population is defined under the TSC Act as ‘a population specified in Part 2 of Schedule 1’. At present, no endangered populations of either species are listed under the Act.

(c) “...in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) “...is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction”, or

(ii) “...is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction...”

An Endangered Ecological Community means an ecological community specified in Part 3 of Schedule 1 of the TSC Act. Therefore, this point is not applicable to these threatened species.

(d) “...in relation to the habitat of a threatened species, population or ecological community:

(i) “...the extent to which habitat is likely to be removed or modified as a result of the action proposed...”, and

The Proposal entails the rehabilitation and reinstatement of a native vegetation community on the cleared and degraded sectors of Subject Property. In addition, the Proposal seeks to improve riparian habitat on both creeks by stabilising their creekbanks with rock battering to reduce erosion and sediment transport downstream.

Although this will require the removal or modification of the majority of vegetation within the Subject Property, the end result will be an increase and enhancement of the ecological attributes and functionality of the area, which will have a positive impact on microbat species in the Locality.

(ii) “...whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action...”, and

The Proposal may result in short-term fragmentation during construction works and up until the rehabilitated vegetation community becomes established. In the long-term, the Proposal will not result in areas of habitat becoming more fragmented or isolated from other areas of habitat.

(iii) “...the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality...”

Much of the Subject Property is cleared or highly degraded, with dense infestations of woody weed species. At present, the Subject Property affords some foraging habitat, with roosting habitat available through artificial structures such as culverts. The canopy stratum is sparse, and no hollow-bearing trees (potential roosting / breeding habitat) were observed.



In such a degraded state, the Subject Property is not considered to be of importance to the long-term survival of microbats in the locality. The Proposal represents an opportunity to increase and enhance the ecosystem function of the area.

(e) “...whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly) ...”

The Subject Property is not listed as critical habitat under Part 3 Division 1 of the *TSC Act*. Therefore, no critical habitat would be adversely affected by the Proposal.

(f) “...whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan...”

No recovery plan or threat abatement plan has been prepared for these species.

The main threats to these species are:

- Disturbance to roosting and summer breeding sites;
- Disturbance by recreational caving activities and mining operations (particularly during winter or breeding) for cave-roosting species;
- Hazard reduction and wildfires during the breeding season;
- Removal of foraging habitat;
- Loss of hollow-bearing trees;
- Application of pesticides in or adjacent to foraging areas; and
- For the Southern Myotis, a reduction in stream water quality that subsequently affects food resources.

These species will benefit from the retention of hollow-bearing trees, provision for hollow-tree recruitment, the identification of priority roost and maternity sites for protection, the retention of foraging habitat, minimised use of pesticides in foraging areas, the implementation of conservation and management strategies for priority sites, community education, and for the Southern Myotis, the retention of native riparian habitat along streams and rivers and around other water bodies (OEH, 2014).

(g) “...whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process...”

Currently 38 Key Threatening Processes (KTPs) are defined under Schedule 3 of the *TSC Act*. The following listed KTPs are relevant to the Proposal:

- Invasion, establishment and spread of *Lantana camara*;
- Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*;
- Invasion and establishment of exotic vines and scramblers;
- Invasion of native plant communities by exotic perennial grasses;
- Removal of dead wood and dead trees;



- Predation by the European Red Fox (*Vulpes vulpes*); and
- Predation by the feral cat (*Felis catus*).

It is unlikely that the Proposal will increase the impact of a key threatening process to any significant extent. As the outcome of the Proposal is the rehabilitation of the land and the reinstatement of a native vegetation community, the majority of these KTPs will need to be addressed.

The Subject Land is well connected to similar vegetation communities, and the highly mobile nature of these species means that the effect of the Proposal (notably during construction) will have a minimal effect on these within the Locality and Region.

Other KTPs such as the introduction and spread of weeds such as Privet and Lantana and exotic vines and scramblers and changes to site hydrology and to the fire regime are unlikely, provided that appropriate protection measures are in place.

Expected impact on Microbats

The Proposal is not considered to have a significant impact on these species such that a local viable population would be placed at risk of extinction considering that:

- The Proposal will result in the improvement of foraging and breeding habitat in the long-term;
- No hollow-bearing trees (potential roosting or breeding habitat) were observed during the field survey;
- The Proposal would not present a barrier to the dispersing or movement patterns of these species; and
- The Subject Land is well connected the protected bushland within Lane Cove National Park.

It is NOT considered that the proposed rehabilitation of the Subject Land adjoining the M2 Hills Motorway at Macquarie Park would have a significant impact on the Eastern Bentwing-bat (*Miniopterus orianae (schreibersii) oceanensis*), Southern Myotis (*Myotis macropus*), False Pipistrelle (*Falsistrellus tasmaniensis*), or the Greater Broad-nosed Bat (*Scoteanax rueppellii*). Therefore, the preparation of a Species Impact Statement that further considers the impacts of such a Proposal on these species is NOT REQUIRED.