Environmental assessment

4-18 Northwood Rd & 274 & 274a

Longueville Rd, Lane Cove

Prepared for Lane Cove Council

18th March 2021

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DOCUMENT VERIFICATION

Document Title	**Environmental assessment 4-18 NORTHWOOD RD & 274 & 274A LONGUEVILLE RD LANE COVE**
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Revision	**Prepared by**	**Reviewed by**	**Date**
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ACKNOWLEDGMENTS

APPLIED ECOLOGY Pty Limited wishes to thank all representing organisations and individuals who assisted with fieldwork and contributed to the production or commented on the content of this report including:

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1 Background and summary

Applied Ecology has been contracted by Lane Cove Council to undertake an ecological assessment on the site of a proposed mixed use, multi storey development located across multiple lots at 4-18 Northwood Rd & 274 & 274a Longueville Rd Lane Cove, including a subsurface car park. The assessment was to determine any potential additional impacts that are supplementary to the impacts outlined in Cumberland Ecology's report to the Pathway Group in August 2020. The focus of investigations was the off site impacts of the proposal, specifically to the east of the proposal where vegetation around the Lane Cove Golf Course is contiguous with bushland in the Lane Cove Bushland Park and Gore Creek Reserve. The key impacts identified were changes to:

- How fauna use the immediate area
- Off site hydrology; and
- Overshadowing of vegetation.

These impacts would change, over time, the composition of the vegetation community adjoining the site and the way local fauna species utilize the bushland. The building has the potential to directly impact fauna through bird-building collisions and light spill. The assessment also records additional fauna, flora and fungi surveys, including desktop and field observations.

2 Site information

2.1 Location and context

The study site location and context are shown in Figures 1 and 2. The site is located in the suburb of Lane Cove with access from Northwood Road within the Lane Cove Council LGA.

Figure 1 Site detail

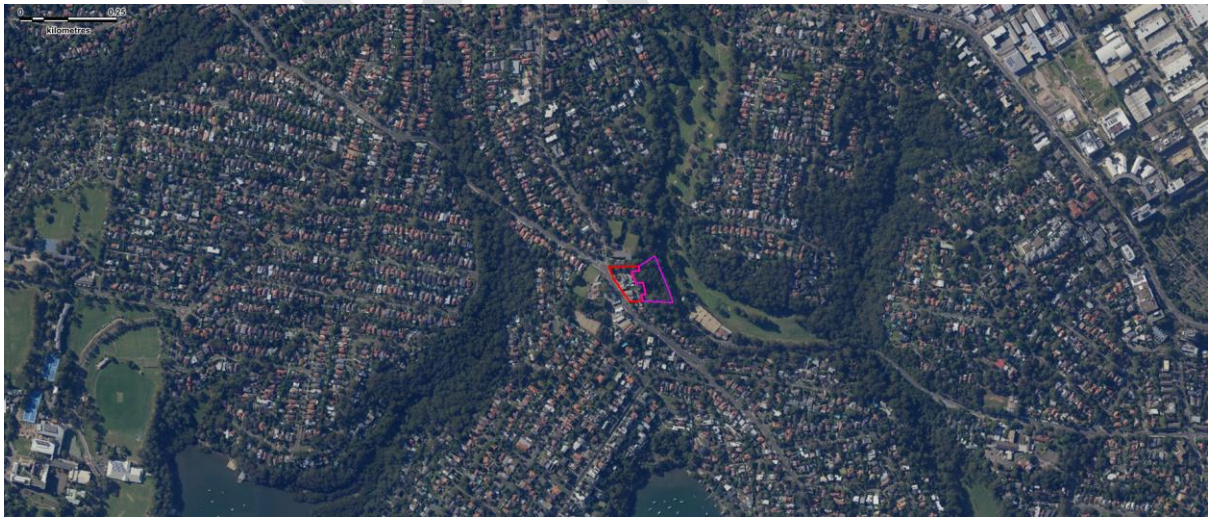


Figure 2 Location overview

2.2 Proposed works

The proposed works include the construction of a 5 storey multi use development with 2 storeys subsurface at street level and 3 above ground. At the rear of the property this will be closer to 4 storeys above ground level.

The application seeks consent for the demolition of existing structures, consolidation of lots, site preparation works (excavation), removal of 11 trees, relocation of 3 existing trees, and construction of a part 3 storey (fronting Northwood Road) and part 5 storey (at the rear) mixed used development comprised of the following:

(a) A residential care facility with 122 bedrooms (containing 143 beds) and ancillary services;

(b) 7 x commercial premises (totalling 2,051m^2) and medical centre including a hydrotherapy pool and gym;

(c) 2 levels of basement car parking containing 86 car parking spaces (20 spaces for staff and 15 visitor spaces associated with the residential care facility, and 51 spaces associated with the commercial component), 6 motorcycle spaces and 65 bicycle spaces.

with associated landscaping, paving and retaining walls and introduction of 7 x new street trees.

The stormwater plan (Acor 2020) involves discharge in the form of evenly spread out perforations in a PVC pipe within a gravel trench (along a portion of the eastern property boundary). This gravel trench sits behind a gabion cage wall. This system allows the site discharge to be spread out evenly along this boundary portion. The perforations have been sized to ensure that the 100yr flow velocity is limited to 1m/s.

The location of stormwater infrastructure in relation to vegetation on site is depicted below in Figure 3.

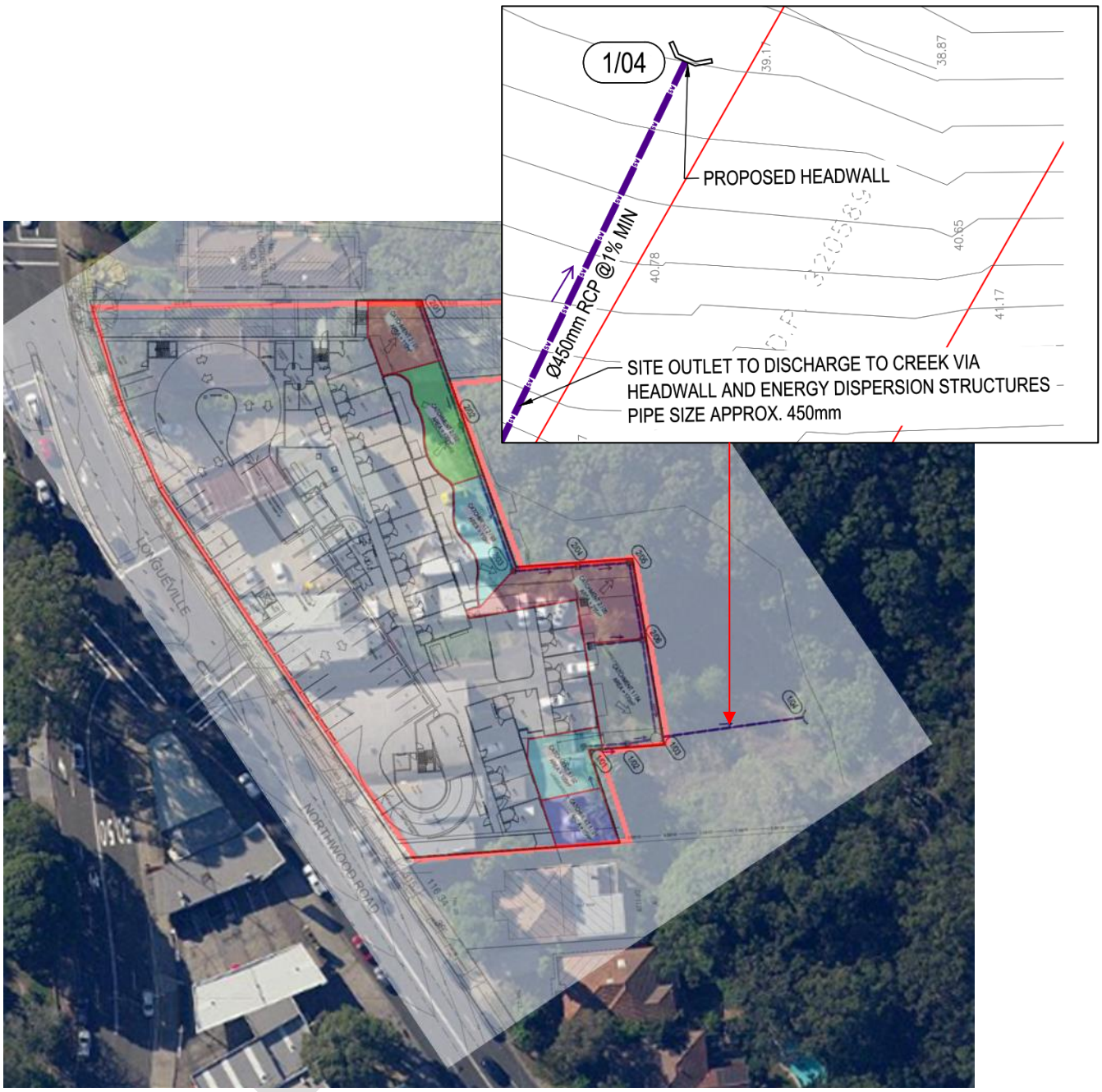


Figure 3 Stormwater infrastructure in relation to vegetation with (inset) headwall and 450mm pipe detail (Acor 2020)

The location of the stormwater infrastructure is not clear in the site landscape plans (Figure 3) and is provided separately (Figure 5).

Figure 4 Proposed landscape plan (Brendan Moar 2020)

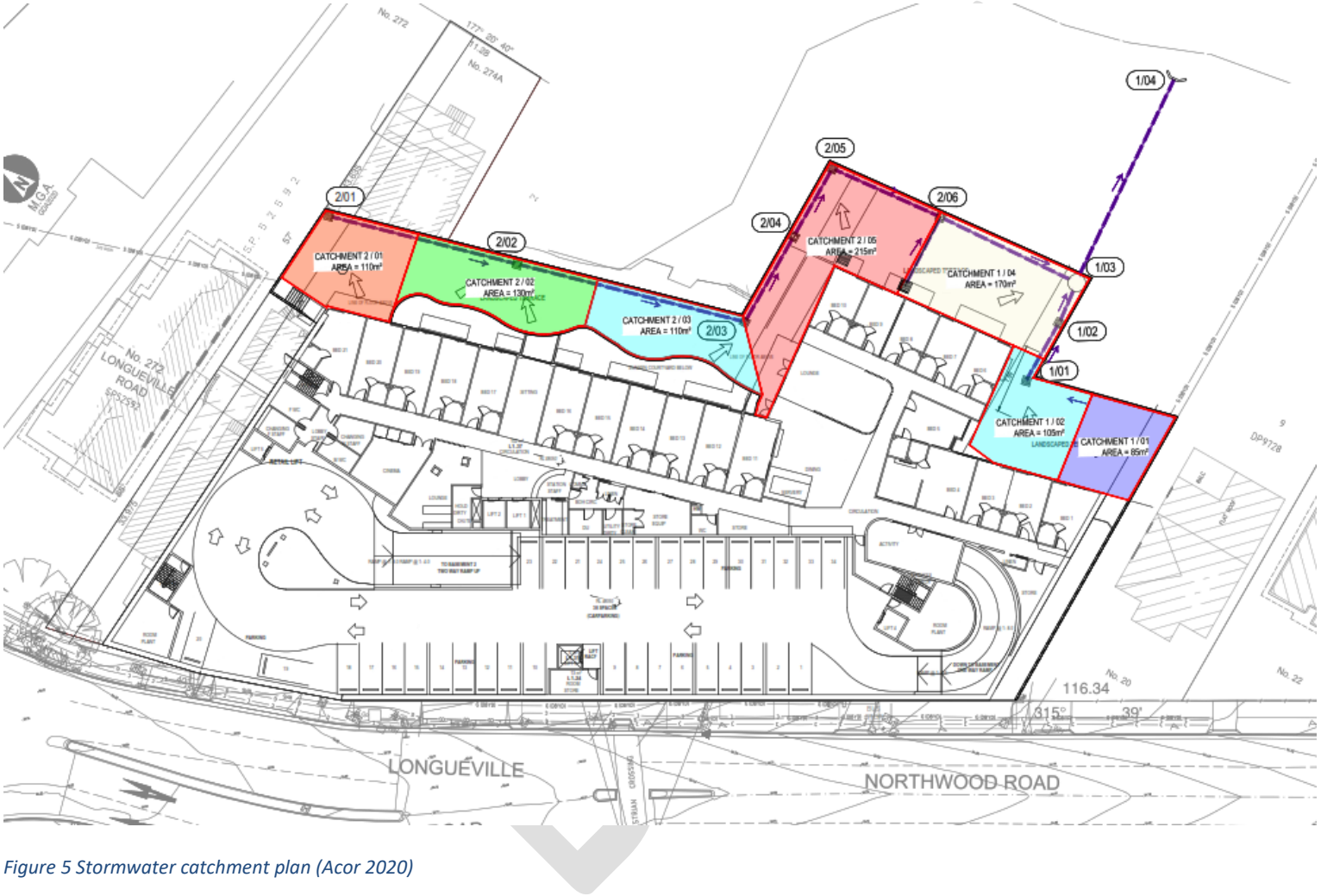


Figure 5 Stormwater catchment plan (Acor 2020)

3 FLORA AND FAUNA SURVEYS

3.1 DATABASE SEARCHES

Searches of several databases were made to identify threatened species and Endangered Ecological Communities (EECs) that may potentially be found on the subject site. Databases were accessed on 3rd February 2021. These included:

- NSW Wildlife Atlas (www.bionet.nsw.gov.au/) – mapped below (Figure 6),
- EPBC Act database (www.environment.gov.au/erin/ert/epbc/index.html).

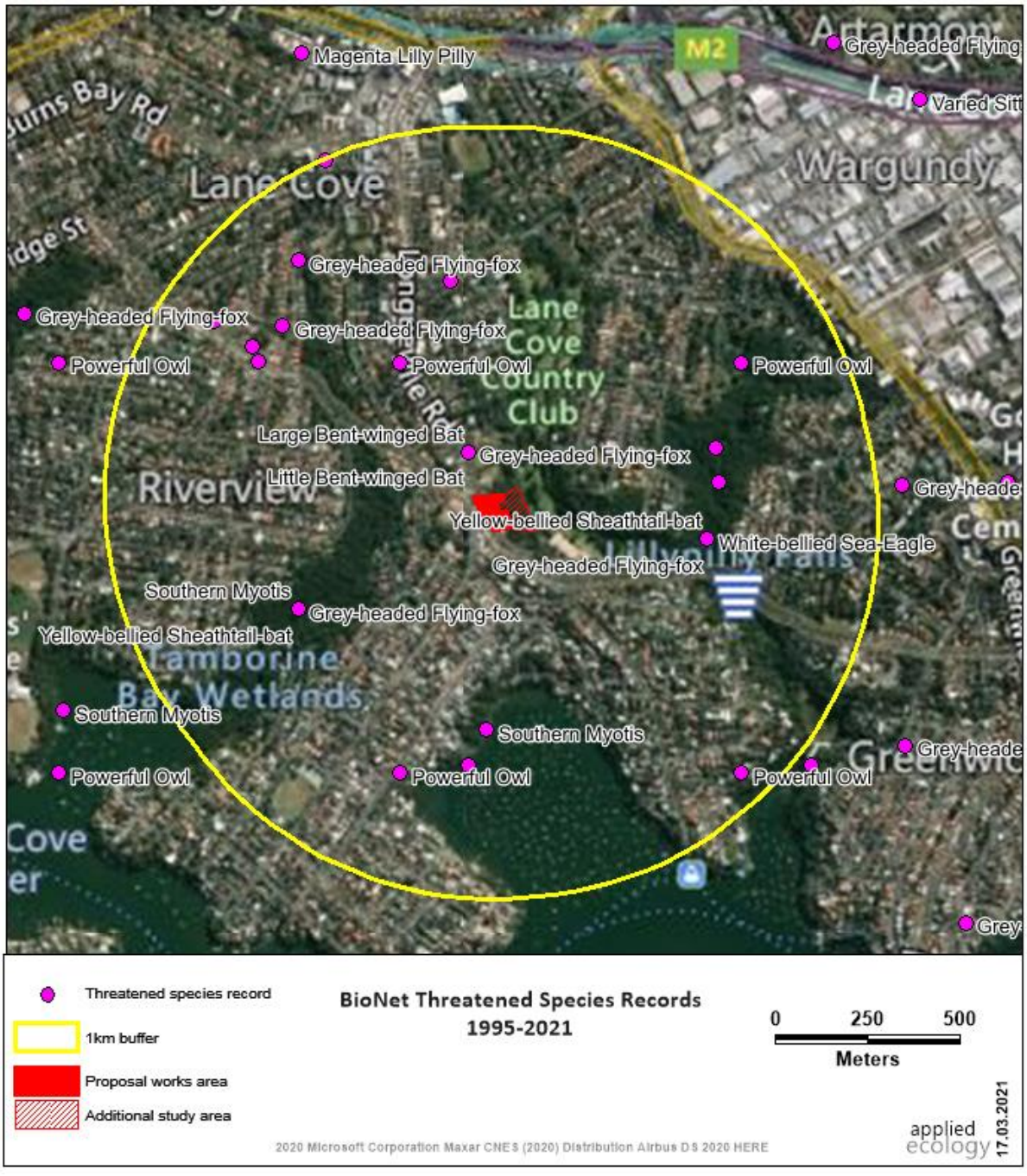


Figure 6 Threatened species near the subject site (BioNet 1995-2020)

3.2 FLORA SURVEYS

3.2.1 THREATENED FLORA

Four threatened flora species are recorded in BioNet as occurring within 2kms of the subject site (Table 1). None of these were recorded on the subject site during this survey.

Table 1 Threatened flora species within 2kms of the subject site (BioNet records 1995-2021)

Family Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Fabaceae (Mimosoideae)	Sunshine wattle	*Acacia terminalis subsp. Eastern Sydney*	E1	E	6
Myrtaceae	Narrow-leaved Black Peppermint	*Eucalyptus nicholii*	V	V	1
Myrtaceae	Scrub Turpentine	*Rhodamnia rubescens*	E4A		1
Myrtaceae	Magenta Lilly Pilly	*Syzygium paniculatum*	E1	V	2

3.2.2 FLORA SURVEYS

The subject site for the proposed development at 4 Northwood Rd, Lane Cove was divided into two zones based on condition of vegetation:

- Upper section, comprising the most degraded part of the site
- Lower section, mostly good quality bushland with some weeds

Figure 7 Survey zones used for flora surveys on the subject site at 4 Northwood Rd in February 2021

Flora surveys were conducted on 7th February 2021. A total of 37 species of native flora were recorded on site (Table 2). No threatened species were recorded and no threatened populations.

Table 2 Native flora species recorded on the subject site in February 2021

SPECIES NAME	COMMON NAME	UPPER	LOWER	CESMF
Acacia fimbriata	Fringed Wattle		y	
Acacia longifolia	Golden Wattle	y		
Allocasuarina torulosa	Forest Sheoak		y	diagnostic
Angophora costata	Smooth-barked Apple	y	y	diagnostic
Archontophoenix cunninghamiana	Bangalow Palm	y		
Asplenium australasicum	Birds Nest Fern	y		
Banksia spinulosa	Hairpin Banksia		planted	
Brachychiton acerifolius	Illawarra Flame Tree	y		
Cayratia clematidea	Native Grape		y	
Commelina cyanea	Scurvy Weed	y	y	
Cordyline stricta	Narrow-leaved Palm-lily	y		
Cryptostylis erecta	Bonnet Orchid		y	
Cyathea australis	Rough Tree Fern	y		
Dianella caerulea	Blue Flax Lily	y		diagnostic
Dodonaea triquetra	Hopbush		y	diagnostic
Elaeocarpus reticulatus	Blueberry Ash	y	y	diagnostic
Entolasia stricta	Wiry Panic		y	diagnostic
Eucalyptus pilularis	Blackbutt		planted	diagnostic
Eucalyptus piperita	Sydney Peppermint		planted	diagnostic
Eucalyptus resinifera	Red Mahogany	y	y	
Eucalyptus saligna	Sydney Blue Gum	y	y	
Eustrephus latifolius	Wombat Berry		y	diagnostic
Exocarpus cupressiformis	Cherry Ballart		y	
Glochidion ferdinandi	Cheese Tree		y	diagnostic
Hibbertia dentata	Twining Guinea Flower		y	diagnostic
Homalanthus populifolius	Bleeding Heart	y	y	
Lomandra longifolia	Spiny Mat-rush		y	diagnostic
Microlaena stipoides	Weeping Meadow Grass	y	y	diagnostic
Notolaea longifolia	Mock Olive		y	diagnostic
Oplismenus aemulus	Basket Grass		y	
Oplismenus imbecilis	Basket Grass		y	diagnostic
Pandorea pandorana	Wonga Vine		y	diagnostic
Passiflora herbertiana	Native Passionfruit	y		
Pittosporum undulatum	Sweet Pittosporum	y		diagnostic
Podocarpus elatus	Plum Pine		y	diagnostic
Pseuderanthemum variabile	Pastel Flower		y	diagnostic
Pteridium esculentum	Harsh Bracken		y	diagnostic
Syncarpia glomulifera	Turpentine	y	y	diagnostic
TOTAL SPECIES PRESENT		17	26	(21)

A total of 39 species of introduced flora were recorded on site (Table 3). The Biosecurity Act 2015 lists priority control weeds for the Greater Sydney LLS region. All weeds listed under this Act have a General Biosecurity Duty as follows:

*All plants are regulated with a **general biosecurity duty** to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.*

Table 3 Introduced flora species recorded on the subject site in February 2021

SPECIES NAME	COMMON NAME	CONTROL PRIORITY
Ageratina adenophora	Crofton Weed	Weed of regional concern
Anredera cordifolia	Madeira Vine	Prohibition on dealings
Arbutus unendo	Strawberry Tree	
Asparagus aethiopicus	Asparagus Fern, Ground Asparagus	Prohibition on dealings
Bidens pilosa	Cobblers Pegs	
Celtis orientalis	Hackberry	Weed of regional concern
Cenchrus clandestinus	Kikuyu	Weed of regional concern
Cinnamomum camphora	Camphor Laurel	Weed of regional concern
Citrus x sinensis	Orange Tree	
Conyza sp	Fleabane	
Cynodon dactylon	Common Couch	
Dietes sp	Butterfly Iris	
Digitaria sanguinalis	Summer Grass	
Ehrharta erecta	Ehrharta, Panic Veldt Grass	
Formium tenax	New Zealand Flax Plant	Weed of regional concern
Genista monspessulana	Montpellier Broom, Cape Broom	Prohibition on dealings
Grevillea robusta	Silky Oak	
Hedera helix	English Ivy	
Hypochaeris radicata	Flatweed	
Ipomoea indica	Blue Morning Glory	Weed of regional concern
Lantana camara	Lantana	Prohibition on dealings
Ligustrum lucidum	Large-leaved Privet	Weed of regional concern
Ligustrum sinense	Small-leaved Privet	Weed of regional concern
Lonicera japonica	Japanese Honeysuckle	Weed of regional concern
Monsteria deliciosa	Fruit Salad Plant	
Morus alba	Mulberry Tree	
Musa sp	Banana Plant	
Nandeena domestica	Heavenly Bamboo	
Ochna serrulata	Mickey Mouse Bush	Weed of regional concern
Olea europaea subsp. *cuspidata*	African Olive	Regional Recommended Measure
Parietaria judaica	Asthma Weed, Pellitory	
Paspalum dilatatum	Paspalum	
Paspalum urvillei	Vasey Grass	

SPECIES NAME	COMMON NAME	CONTROL PRIORITY
Senna pendula var *glabrata*	Smooth Senna	Weed of regional concern
Setaria viridis	Pigeon Grass	
Sida rhombifolia	Paddys Lucerne	
Stenotaphrum secundatum	Buffalo Grass	
Tradescantia fluminensis	Trad, Wandering Jew	Weed of regional concern
Triadica sebifera	Chinese Tallow	Weed of regional concern

There five state level priority control weeds recorded on the subject site. The control requirements for these species in the Greater Sydney LLS Region are as follows.

Prohibition on dealings - Must not be imported into the State or sold:

- Madeira Vine (*Anredera cordifolia*)
- Asparagus Fern, Ground Asparagus (*Asparagus aethiopicus*)
- Montpellier Broom, Cape Broom (*Genista monspessulana*)
- Lantana (*Lantana camara*)

Regional Recommended Measure - African Olive (*Olea europaea* subsp*. cuspidata*):

- An exclusion zone is established for all lands in Blue Mountains City Council local government area and in Penrith local government area west of the Nepean River. The remainder of the Greater Sydney region is classified as the core infestation area.
- **Whole region**: The plant or parts of the plant are not traded, carried, grown or released into the environment. **Core infestation area**: Land managers prevent spread from their land where feasible. Land managers reduce impacts from the plant on priority assets.

3.2.3 VEGETATION MAPPING

Vegetation on the subject site has been mapped primarily as S_WSFO2 Coastal Enriched Sandstone Moist Forest by OEH (2016) (Figure 8). State Vegetation Mapping uses a consistent approach across NSW by describing this vegetation as a Plant Community Type (PCT). For this vegetation the equivalent PCT is Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region (PCT Id 1841). This is not considered to be part of an Endangered Ecological Community listed in NSW or under the federal EPBC Act.

A smaller patch of vegetation on site has been described as Urban_EN: Urban Exotic/Native. These were ground truthed on site, based on the methodology provided by OEH (2016) in the Native Vegetation of the Sydney Metropolitan Area, Volume 2, version 3. This provides the diagnostic criteria used to identify each vegetation community. For S_WSFO2 Coastal Enriched Sandstone Moist Forest, a 0.04 hectare site (ie. 20m x 20m quadrat or equivalent) located in this map unit is expected to contain at least 17 positive diagnostic species provided the total number of native species in the site is 33 or greater. Since this assessment was conducted for the purpose of confirming the extant vegetation community, and given the degraded nature of the site, the extent of the area was expanded to include the whole of the survey site (approximately 0.73 hectares). Within the site there was a total of 38 native flora species, which is more than the minimum number

required to complete the diagnostic test. Of these, 21 are considered diagnostic species for S_WSFO2 Coastal Enriched Sandstone Moist Forest (see **Error! Reference source not found.**)

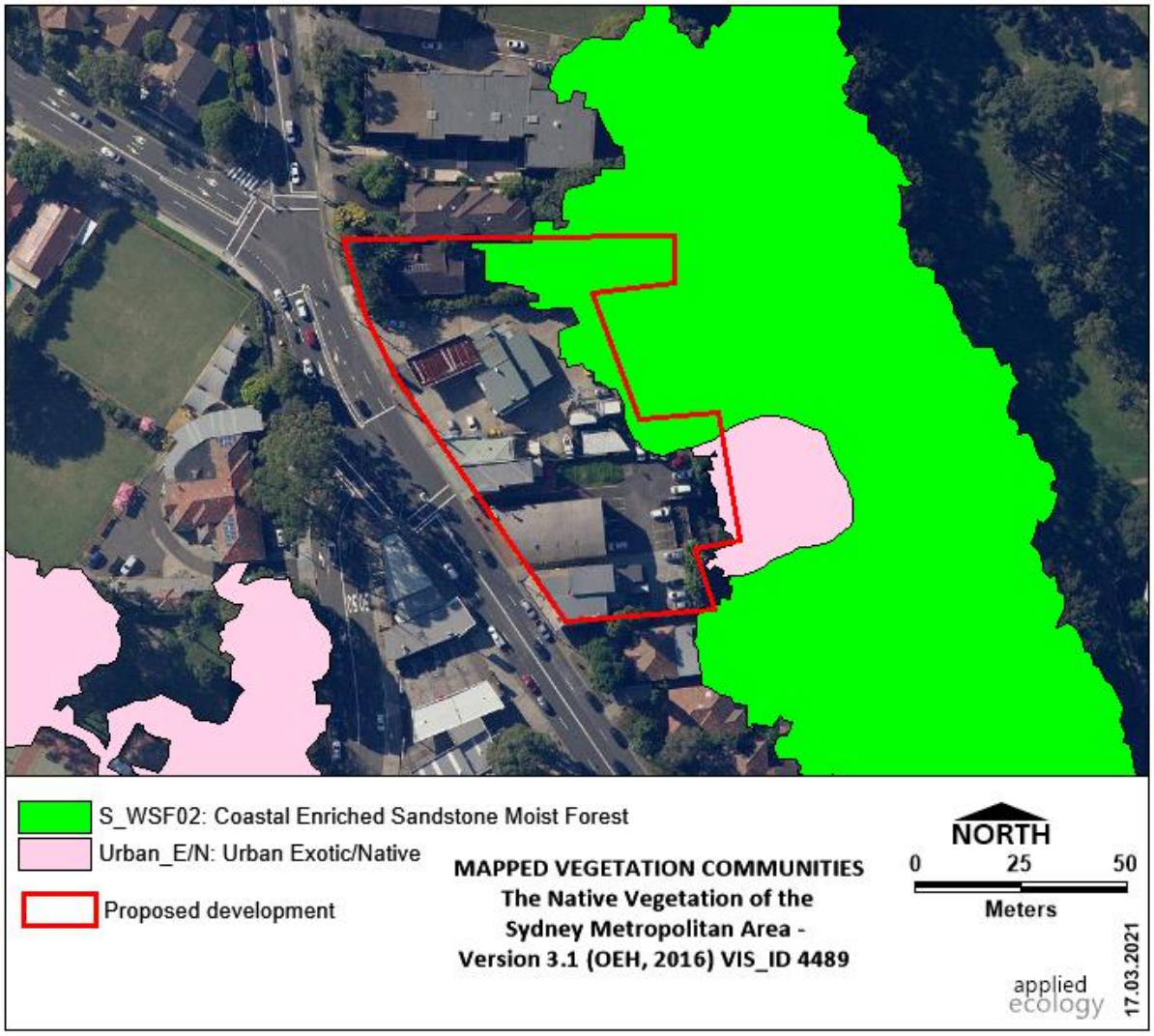


Figure 8 Vegetation mapping (OEH 2016)

3.2.4 FLORA AND VEGETATION ON SITE

There are several key impacts from development adjoining bushland, specifically changes in local hydrology and runoff, changes to light regimes in locations where this is increased shading, and the introduction of exotic plant species that have the potential to invade bushland. All three of these impacts are noted behind the house on Lot 2 DP857133 and the larger block of flats two doors to the north. The block of flats, in particular, has had a significant shading impact on the bushland immediately behind it. The result is increasing moisture because of reduced evapotranspiration from plants and evaporation from soils, decreased light availability, and very successful invasion and establishment of weeds from upslope (Figure 9). The canopy trees have been cleared from the back boundary of the flats but have been retained behind the old house and behind some of the commercial properties that form part of the proposed development site (Figure 10).

Figure 9 Vegetation behind adjoining buildings has been affected by shading and become quite weedy

Figure 10 Mature canopy trees are still present along the edge of the proposed development site, and will be affected

Figure 11 Areas of good quality native canopy trees are undergrown by weedy shrubs and vines

The land generally slopes steeply from immediately behind the commercial properties. These have retaining walls to stabilise and increase the usable area at the rear of the premises. Once the slope reaches the native soils it becomes much less steep, and the level of disturbance to vegetation is also less. The result is areas of good quality native canopy trees, including Turpentines (*Syncarpia glomulifera*) and Smooth-barked Apples (*Angophora costata*). The vegetation underneath is much weedier, with a dense shrub layer of woody weeds and vines (Figure 11). The contrast is quite obvious when viewed from the back of the commercial properties, especially where there has been some clearing of the native canopy (Figure 12).

This type of vegetation – retained canopy with understorey dominated by weeds is quite typical of the upper survey zone, except where the canopy has been cleared for bushfire management or other reason. The result of clearing and modified soil levels is weedy vegetation, especially in the higher parts of the upper zone (Figure 13).

Figure 12 Seen from above, there is a dense mid storey layer of weedy shrubs below the native canopy in the upper section

Figure 13 Most of the vegetation at the back of the proposed development site is very weedy and has impacted adjoining bushland

Behind the old animal hospital is an area that has been cleared of weeds, creating a gap in the thick midstorey layer of dense woody weeds (Figure 14). Access to this area is via a steep rocky slope that consists of poorly stabilised building debris and fill (Figure 15). The vegetation in this area has been affected by increased shading, modified soil levels and the introduction of weed propagules. The increased moisture and decreased light regimes have favoured the establishment of weeds over the native species and their seeds from the soil seedbank.

Figure 14 Downslope from the animal hospital car park is an area that has been cleared of weeds and replanted

Figure 15 The slope consists of poorly stabilised building debris and fill, and is now deeply shaded and dominated by weeds

The revegetation area is at the base of this slope and has evidence of extensive weed control including removal of woody weeds and vines. The proposed stormwater pipe will run through this area, discharging from an outlet just below the edge of the clearing (Figure 16). The planting includes a number of mature saplings and shrubs. Considerable time and money have been invested in this revegetation (Figure 17). Nearly all the species are entirely appropriate for the extant vegetation community.

Figure 16 The revegetation area will be traversed by the proposed stormwater pipe, with the outlet below

Figure 17 Considerable time and money has been invested in community appropriate species for replanting

Vegetation condition in the lower zone is in much better condition (Figure 18). It is currently not adversely affected by shading, and there are only minor alterations to local moisture regimes and the resulting microclimate. Weeds have either been controlled in this area, or are yet to reach here, and the extant vegetation has a much lower weed burden than upslope.

Figure 18 Outside the area impacted by the existing development the vegetation is predominantly native

A band of good quality vegetation runs along the lower section of the slope behind properties on Northwood Rd (Figure 19). The proposed development will discharge stormwater from the site into this bushland, with the likely results similar to what can be seen further upslope – changed soil moisture and nutrient regimes, increased shading, introducing of water borne weed propagules, increasing cover by weeds, degradation of native vegetation, and so on. The current condition of bushland includes mature trees that have good habitat potential with a mix of midstorey and understorey species (Figure 20). Based on the modelled increase in shade from the proposed development, the impacts will immediately begin to affect the entire strip of bushland all the way to the fairway below on Lane Cove Golf Course (Figure 21), and during winter will shade the tennis courts and other facilities for a larger part of the day.

Figure 19 A band of good quality vegetation stretches along the lower section of the slope behind the existing properties

Figure 20 Mature native trees are present along with a mixture of native shrubs, ferns and grasses

Figure 21 Shading from the new development will affect bushland all the way down to the fairway and tennis courts

3.3 FUNGI SURVEYS

3.3.1 THREATENED FUNGI

Nine threatened fungi species are recorded in BioNet as occurring within 2kms of the subject site (Table 1). None of these were recorded on the subject site during this survey. One endangered fungi community, the Hygrocybeae Community of Lane Cove Bushland Park, was also reported.

Table 4 Threatened flora and fungi species within 1kms of the subject site (BioNet records 1995-2021)

Family Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Hygrophoraceae		*Camarophyllopsis kearneyi*	E1		1
Hygrophoraceae		*Hygrocybe anomala var. ianthinomarginata*	V		1
Hygrophoraceae		*Hygrocybe aurantipes*	V		1
Hygrophoraceae		*Hygrocybe austropratensis*	E1		1
Hygrophoraceae		*Hygrocybe collucera*	E1		1
Hygrophoraceae		*Hygrocybe griseoramosa*	E1		1
Hygrophoraceae		*Hygrocybe lanecovensis*	E1		1
Hygrophoraceae		*Hygrocybe reesiae*	V		2
Hygrophoraceae		*Hygrocybe rubronivea*	V		1

The following information is supplemented with extracts from a development assessment survey conducted on the same patch of bushland in 2011 by Applied Ecology in conjunction with Dr Ray and Mrs Elma Kearney from the Sydney Fungal Studies Group.

3.3.2 METHODS

Fungal survey methods need to accommodate their unique characteristics such as the patchy distribution of sporocarps. The random meander search field search for fungi included scrutinizing the full range of microhabitats available across the site. The record of fungi encountered includes identification based on Fuhrer (2009) and Young & Smith (2005), and for species from the Hygrophoraceae family, further reference was made to threatened species identification material and Young & Orchard (2005). For all fungi, and particularly those from the Hygrophoraceae family and other unfamiliar species, photographs were taken of the top view, the under-surface of the cap and the comparative size of the fungi. Data recorded included recent climatic conditions as well as a description of the substrate, such as soil, moss, root, decaying wood or leaf litter from which the specimen was growing.

A total of 6 hours was spent searching for fungi in the current survey. This current study was supplemented with results from a 2011 survey (Figure 22). This earlier field survey was undertaken on 22nd December 2011, totaling 10 hours of searching. This was used as a preliminary guide for the identification of fungi recorded during the current survey, which included opportunistic sightings during the flora and vegetation survey. Areas more likely to have species from the Hygrophoraceae family (ie. on soils) were specifically targeted during the current survey. Weather in the preceding days had been hot and showery providing conditions that permitted fruiting of some fungal species.

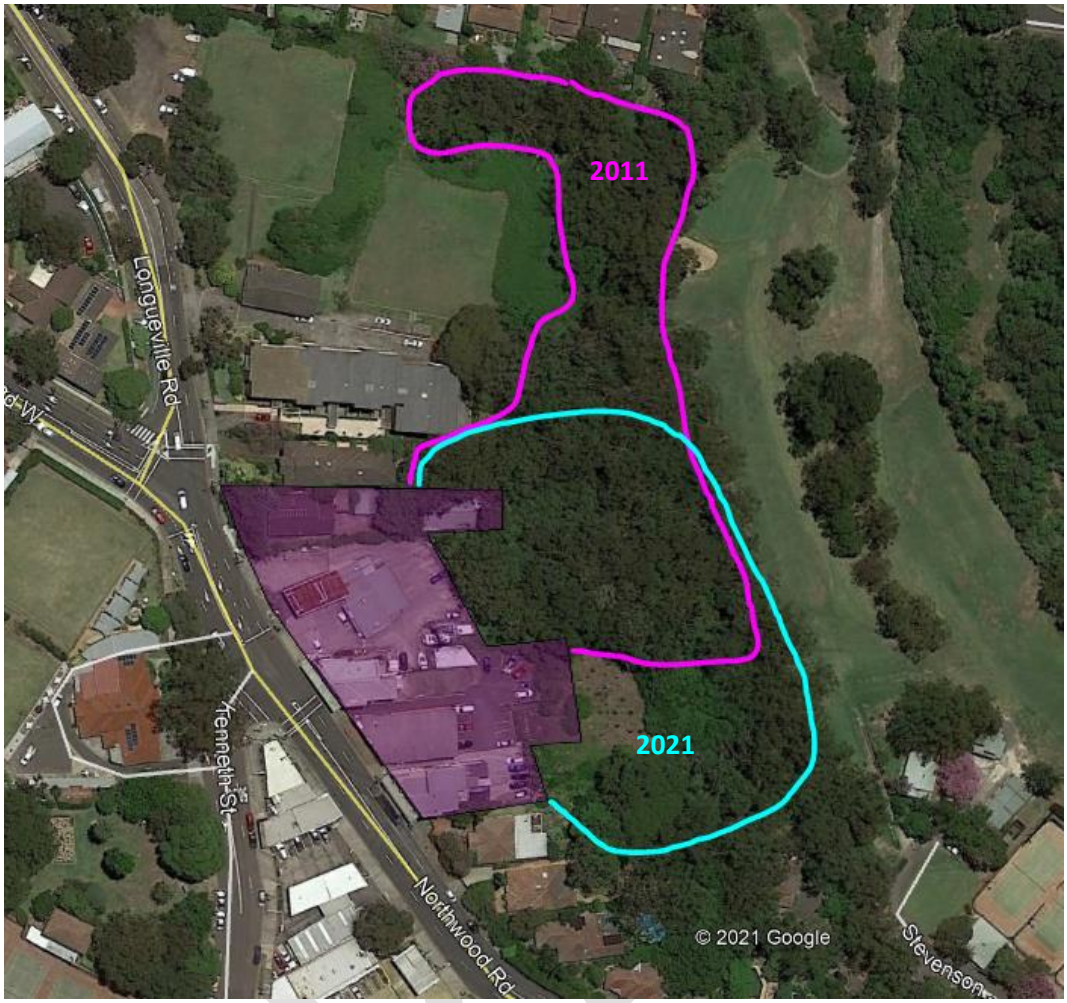


Figure 22 Areas included in 2021 surveys and 2011 surveys

3.3.3 FIELD SURVEY RESULTS

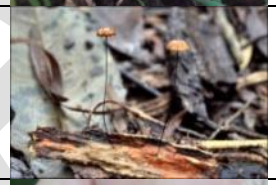
A total of 21 species of fungi have been recorded within the search area, including 20 species in 2011, and 13 species in 2021, one of which was not previously recorded on site (Table 5). The following list was determined from macro features. Some specimens were too dry or degraded to obtain a spore print. Identification in a few cases is tentative (?) at the species level subject to detailed microscopic investigation. Accuracy of identification was sufficient to determine whether the recorded specimens were among the threatened species potentially present.

Table 5 Fungi survey results and identification information, 2011 and 2021

CLASS & ORDER	GENUS/SPECIES	COMMENTS	PHOTOGRAPH	DEC 2011	FEB 2021
Division Myxomycota					
Class Myxomycetes	*Fuligo septica* (?)	Slime mould on leaf litter		Present	Present
Division Ascomycota					
Class Sordariomycetes Order Xylariales	*Xylaria sp*	specimen growing on dead wood; Cylindrical 20-25mm tall, covered with white powdery conidia		Present	Present
Division Eumycota Subdivision Basidiomycotina					
Class Homobasidiomycetes Order Aphyllophorales	*Fomitopsis sp F. hemitephrus?*	on living tree – may be causing 'heart-rot'. Specimen immature on damaged *Angophora costata*		Present	Present
	Ganoderma applanatum	young specimen; on rotting stump	picture not available	Present	Not noted

	Hexagonia tenuis	on rotting stump		Present	Present
	"Polypore" Sp. 1	Immature, resupinate, cream, with very small round pores; smallish patches, on dead wood		Present	Present
	Polyporus arcularius	on rotting log	picture not available	Present	Not noted
	Pycnoporus cinnabarinus	on rotting log		Present	Present
	Schizophyllum commune	on rotting log; toxic, inhaling spores can cause pneumonia		Present	Not noted
	Stereum illudens	on rotting log	picture not available	Present	Not noted

	Trametes versicolor	on rotting stump and logs		Present	Not noted
Order Agaricales	*Agaricus sp.*	spores dark brown, on soil in grassland		Present	Not noted
	Amanita umbrinella	on soil in grassland		Present	Present
	Boletellus obscurecoccineus	damaged, aged specimen – bright red cap, bright yellow pores, and scales scattered on stem. The stem grades to deep red at the base. Pores stain blue when scratched		Present	Not noted
	Gymnopilus sp.	Cap to 15mm diam., bright ferruginous, surface a little matt; gills bright ferruginous, shallow, stem mostly slightly excentric, 2mm dia. x 10-15mm long.		Present	Present

					
	Omphalotus nidiformis	yellowish variety to be re-named; luminescent (green) species on rotting stump (luminescence was observed during night surveys)		Present	Present
	Marasmius sp. (? *M. crinisequi*)	dry, damaged specimen growing from rotting bark and leaf litter		Present	Present
	Mycena sp.	White cap, smooth; stem long and slender, slightly brownish tinge, towards the base. Growing in soil amongst leaf litter		Present	Present
	Xerula aff. radicata	Immature specimen. Previously listed as *Oudemansiella aff. Radicata.* Growing in soil amongst leaf litter		Present	Present

Class Agaricomycetes Order Auriculariales	*Auricularia auricula-judae*	Brown-yellow jelly fungus on rotting log		Present	Not noted
	Geastrum sp.	Earth Star on soil beside tree roots	Picture not available	Not noted	Present
Class Gastromycetes Order Lycoperdales	*Morganella purpurascens*	Grey-purple Puff Balls on rotting log		Present	Not noted

Note: There were no species in the family Hygrophoraceae recorded on this occasion.

3.3.4 FUNGI ASSESSMENT

The following description is taken from Ray and Elma Kearney's report from 2011:

"The area under survey could best be described as weed-infested, degraded, warm-temperate wet sclerophyll forest - with a general east-west aspect. It is evergreen, hygrophilous in character with weed overgrowth in some sections. The vegetation is a mixture of open forest species, but not luxuriant. In some sections as little as 20 percent of the sunlight shining on the crown of the trees reaches the ground in the understorey. At the bottom of the subject bushland is valley now a golf course (formerly a tributary of Gore Creek) and is partly surrounded by often steep-sided ridges which carry run-off rainwater. The major rock types, Wianamatta shale and Hawkesbury sandstone, give rise to two distinctly different types of soil in the subject site which was heavily weed infested in parts.

"It should be noted that fungal fruiting is dependent on many factors including moisture, temperature, seasonal triggers as well as the fungal species. Drought conditions tend to affect underground mycelium which may take years to recover – this has been noted previously in Lane Cove Bushland Park, and is particularly relevant for the subject site after several years of drought conditions. Most fungal species produce fruiting bodies in the autumn and winter months. Species in the family Hygrophoraceae fruit mainly during June and July in Lane Cove Bushland Park. Thus the fungal sightings in this survey would be an under-estimate as fungal surveys are best undertaken throughout the year to obtain a more accurate and meaningful record."

The lack of records on the subject site of the threatened fungi species recorded nearby in Lane Cove Bushland Park from this survey and from a single previous survey should not be interpreted as proof that they are absent. Length of recovery post drought can be difficult to determine for fungi and for plants. Loss of native vegetation may not be accompanied by loss of native fungi, especially for those that grow on a soil based substrate, such as the threatened Hygrocybe species. However, the accompanying changes in the soil chemistry that favour weeds over the local native flora species are also likely to be less favourable for any Hygrocybe species that may be in the area but currently unrecorded.

3.4 FAUNA SURVEYS

3.4.1 THREATENED FAUNA

Fourteen species of threatened fauna have been recorded within 2kms of the subject site (BioNet 1995-2021). These are listed below (Table 6)

Table 6 Threatened fauna species (BioNet 1995-2021)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Reptilia	Loggerhead Turtle	*Caretta caretta*	E1,P	E	1
Aves	Black Bittern	*Ixobrychus flavicollis*	V,P		1
Aves	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V,P		4
Aves	Bush Stone-curlew	*Burhinus grallarius*	E1,P		1
Aves	Little Lorikeet	*Glossopsitta pusilla*	V,P		1
Aves	Powerful Owl	*Ninox strenua*	V,P,3		89
Aves	Sooty Owl	*Tyto tenebricosa*	V,P,3		1
Aves	Varied Sittella	*Daphoenositta chrysoptera*	V,P		1
Mammalia	Grey-headed Flying-fox	*Pteropus poliocephalus*	V,P	V	37
Mammalia	Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V,P		4
Mammalia	Southern Myotis	*Myotis macropus*	V,P		7
Mammalia	Greater Broad-nosed Bat	*Scoteanax rueppellii*	V,P		2
Mammalia	Little Bent-winged Bat	*Miniopterus australis*	V,P		5
Mammalia	Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V,P		10

A subset of these species are located in close proximity to the site

Table 7 Threatened fauna species within 1km of the subject site (BioNet 1995-2021)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V,P		1
Aves	Powerful Owl	*Ninox strenua*	V,P,3		30
Mammalia	Grey-headed Flying-fox	*Pteropus poliocephalus*	V,P	V	10
Mammalia	Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V,P		2
Mammalia	Southern Myotis	*Myotis macropus*	V,P		3
Mammalia	Greater Broad-nosed Bat	*Scoteanax rueppellii*	V,P		1
Mammalia	Little Bent-winged Bat	*Miniopterus australis*	V,P		3
Mammalia	Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V,P		4

3.4.2 FAUNA SURVEYS

Fauna surveys were undertaken on the 6th of February and the 16th of February. A total of six hours was spent on site. Bat detectors was deployed for 10 nights to record the ultrasonic calls of microbat species using the bushland immediately east of the site. A song meter was also deployed in the bushland to record bird and amphibian sounds. Time was spent traversing the site looking for and listening for local fauna. The survey period was punctuated by periods of high wind and rain (Figure 23) likely suppressing observations of some species.

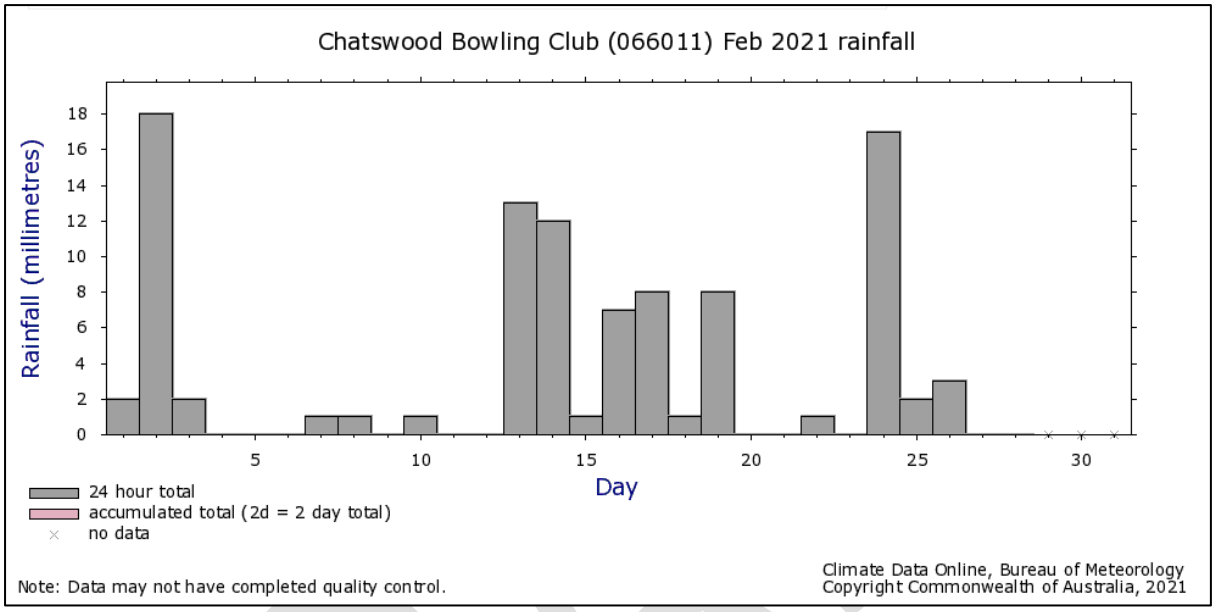


Figure 23 Rainfall data during survey period – Chatswood being the nearest station (BoM http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=&p_c=&p_stn_num=066011)

3.4.3 FAUNA SURVEY RESULTS

A total of 19 species were recorded utilizing the bushland immediately adjoining the site including four threatened species (Table 8). Green shading denotes a threatened species. Of the five microbat species detected two are considered urban adapted; Gould's Wattled Bat *Chalinolobus gouldii* and White-striped Free-tailed Bat *Austronomus australis.*

Table 8 Fauna recorded during the snapshot survey – February 2021

SPECIES	SCIENTIFIC NAME
Australian Boobook	*Ninox boobook*
Australian Raven	*Corvus coronoides*
Laughing Kookaburra	*Dacelo novaeguineae*
Grey Butcherbird	*Cracticus torquatus*
Pied Currawong	*Strepera graculina*
Rainbow Lorikeet	*Trichoglossus haematodus*
Australian Magpie	*Cracticus tibicen*
Noisy Miner	*Manorina melanocephala*
Powerful Owl	*Ninox strenua*

SPECIES	SCIENTIFIC NAME
Mammals	
Common Brushtail Possum	*Trichosurus vulpecula*
Common Ringtail Possum	*Pseudocheirus peregrinus*
Grey-headed Flying-fox	*Pteropus poliocephalus*
Chocolate Wattled Bat	*Chalinolobus morio*
Gould's Wattled Bat	*Chalinolobus gouldii*
Little Bentwing Bat	*Miniopterus australis*
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*
White-striped Freetailed Bat	*Austronomus australis*
Herpetofauna	
Dark-flecked garden sun skink	*Lampropholus delicata*
Amphibians Common Froglet	*Crinia signifera*

3.4.4 FAUNA AND HABITAT RESOURCES

The bushland adjoining the site is a mix of weedy mid and understorey species near the area of proposed works interspersed with mature native trees. The bushland becomes less weedy on a gradient to the toe of the bank where it abuts the manicured grass lawns of the Lane Cove Golf Course (Figure 25). Both the weedy vegetation (Figure 24) and the better native vegetation provide potential habitat for a range of species.

Figure 24 Dense weedy vegetion below the existing retaining wall.

Figure 25 Bushland immediately adjoining the site viewed from the golf course.

Powerful Owls are known to breed and roost nearby, and one was recorded calling on the site, or very close by on the 12th of February 2021. Other records are held by Council and these have been mapped in Figure 26 along with Birdlife and BioNet records for Powerful Owls. Habitat along the edge of the golf course may be important habitat for dispersing owls from both Warraroon Reserve/Tambourine Creek corridor, which is less than 250 metres to the west of the subject site, and the contiguous areas of bushland along Gore Creek including Lane Cove Bushland Park, Osbourne Park, Gore Creek Reserve and Lane Cove Golf Course. The subject site is located at the point where these two large areas of bushland are in closest proximity and it is potentially the easiest and safest area for wildlife to move between the two major corridors (Figure 27).

Birdlife Australia guidelines recommend (in Sydney) that the buffer zones for Powerful Owl nest sites be 100m, with 50m around roost sites. In addition, the guidelines state lighting installations should include impact modelling and adhere to the buffer zones described.

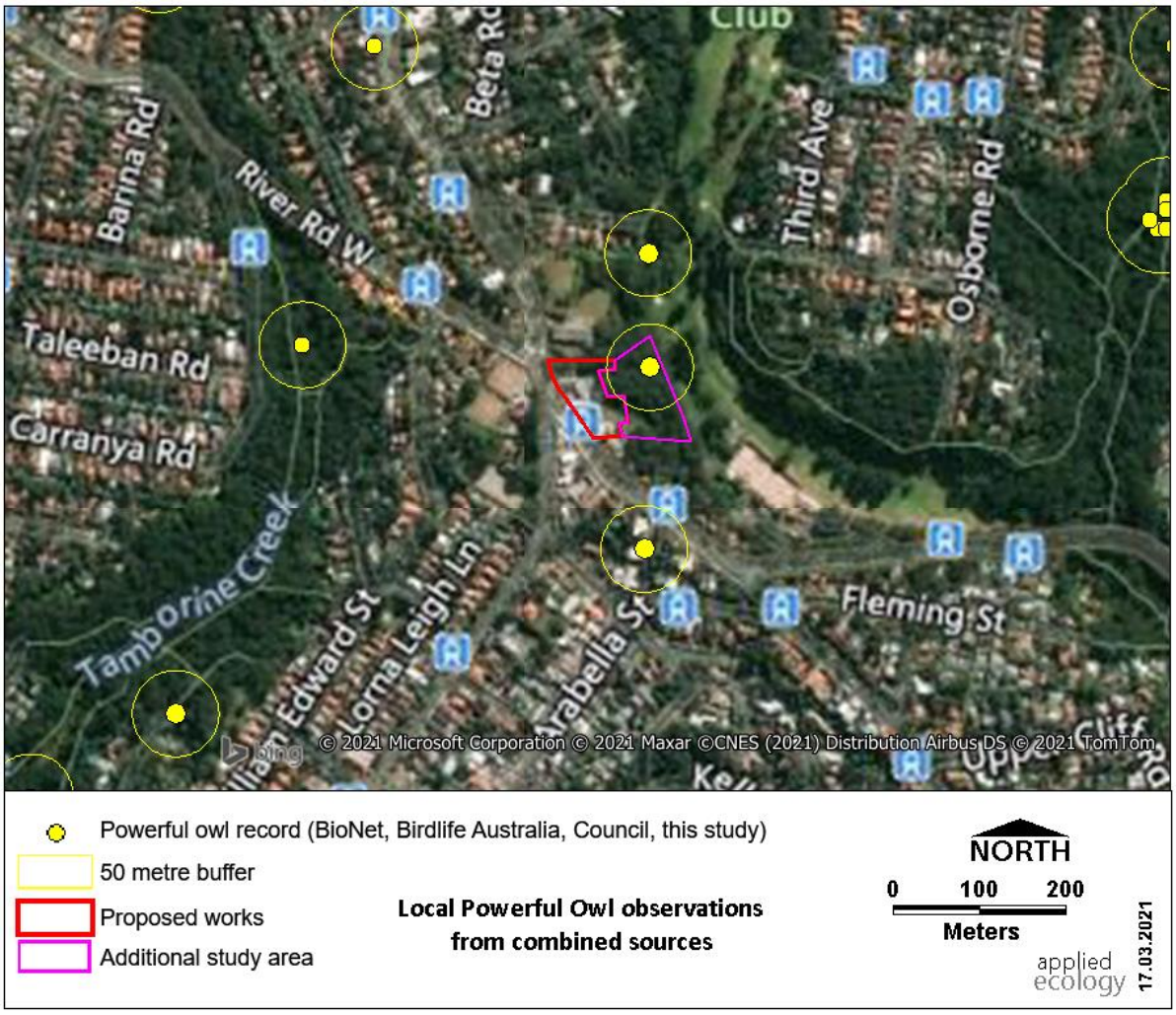


Figure 26 Powerful owl observations near the subject site

Figure 27 The subject site in relation to Warraroon Reserve to the west and Lane Cove Bushland Park to the east.

It is important to retain and protect hollow bearing trees within the LGA – both to maintain hollow dependent prey numbers for the Powerful owls and as potential breeding sites. Many threatened bat species recorded in the LGA are also hollow dependent.

Several trees were observed to be potentially forming sizeable hollows (Figure 28).

Figure 28 Angophra costata with trunk hollows forming.

Grey-headed Flying-foxes were detected on or near the adjoining bushland on all nights except the most wet and windy. This species is a threatened species and also an important prey species of the Powerful Owl.

Little Bent-winged Bat *Miniopterus australis*[1] were recorded during the current survey. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Large Bentwing-bat and, in winter, the two species may form mixed clusters. There is suitable foraging habitat and roosting habitat for this species within the subject site and adjoining bushland. There is a known large mixed roost with the Large Bentwing-bat in North Sydney, but there are likely other roosts within the Lane Cove LGA.

[1] Adapted from the OEH species profile
https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10533

The Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* [2]were recorded during the current survey. This species roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, it flies high and fast over the forest canopy, but lower in more open country. It forages in most habitats across its very wide range, with and without trees, and appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn. There is suitable foraging habitat and roosting habitat for this species within the subject site and adjoining bushland.

For microbat species more generally some studies report a reduced richness and greater dominance of a few species in highly urbanised areas (Jung and Kalko 2011). In general, there tends to be a positive relationship with native remnant vegetation. Vegetation cover provides roost sites and predicts, along with soil fertility and forage availability (invertebrate biomass) which are positively correlated with the presence of microbat species in urban environments (Threlfall 2013). Basham et al. (2011) in a study of the "leafy" northern suburbs of Sydney found that species richness was strongly correlated to low density residential areas with large areas of remnant bushland in steep gullies and large gardens (often > 0.1 ha) with tall trees. High density housing with areas of remnant bushland has lower species diversity (Hourigan et al. 2010). Other considerations for microbats include competition for roost sites, especially tree hollows (Threlfall et al. 2013).

4 ISSUES

The most likely impacts from the proposed development are changes in local hydrology and runoff, changes to light regimes resulting in increased shading during the day and light spill at night, the introduction and facilitation of exotic plant species that already invade bushland. In addition, it is poorly understood how changed subsurface flows due to excavation for two underground levels of carparking will affect local hydrology.

There is already evidence of some of these impacts in bushland adjoining the site, especially behind taller buildings or buildings where the maximum height is towards the rear (eastern end) of the property. Shadow modelling for the site supports that changes will occur (Figure 29 to Figure 33). We used ShadowCalculator - Show sun shadows on google maps (http://shadowcalculator.eu/#/lat/-33.823631072330414/lng/151.17282716605467) to estimate the existing light and shade regime for the subject site, and compared that to a modelled shadow that would be cast by the proposed development. This modelled shadow was estimated based on the dimensions of the new building as shown in plans provided by Council as submitted with the site DA. We have aimed to ensure the modelled shading reflects what would reasonably be expected if the development does proceed. The primary impacts for bushland are in the afternoon. These were modelled for midsummer and midwinter, and are illustrated in the following pages.

The overall impacts include earlier shading in summer (about 2 hours less direct sunlight; Figure 29), followed by total shading by 7pm, compared to minor shading currently experienced (Figure 30), and

[2] Adapted from the OEH species profile
https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10741

culminating around 7.45pm with the current patchy shading being replaced by total shading of the bushland, the fairway, and properties on the opposite side (Figure 31). In winter the impacts will be directed to the southeast. At 4.15 the site would normally be beginning to experience shadowing, but with the new development the whole bushland area will be in shade (Figure 32), and by 4.30pm the existing shadow would cover that bushland while the new shadow will affect the tennis courts and other parts of the golf course, as well as residential properties to the southeast on Northwood Rd (Figure 33).

Figure 29 5.30pm midsummer – there currently is no shade impacts on bushland from buildings, but following the new development approximately one third of the site will be in shadow

Figure 30 By 7pm in midsummer the new development will cast a shadow over the entire bushland patch, whereas it is currently only slightly impacted by shading

Figure 31 By 7.45pm midsummer the new development will be casting shadows across the whole of the golf course and onto properties on the eastern side, whereas the existing buildings cast a shadow that doesn't reach the lowest edge of the bushland

Figure 32 At 4.15pm in midwinter the existing buildings cast some shadow over bushland, while the proposed development will shadow an area towards the southeast that reaches beyond the bushland and will affect residences on Northwood Rd

Figure 33 By 4.30pm midwinter the existing buildings cast shadows across the whole of the bushland strip, while the new development will overshadow the tennis courts and adjoining residential properties to the southeast

There are currently no formal discharges of stormwater to the bushland patch below the proposed development. Localised runoff enters the site on an informal basis and is dispersed across the whole of the bushland patch. The proposed development includes an agricultural type drain at the perimeter and a 450mm pipe through the revegetation patch to an outlet at the lower end of this

area (Figure 3). The location of the outlet is at the top of the better vegetation within the bushland patch. The likely consequences of this include changes to local soil moisture regimes, both at and below the outlet. Changes to the existing stormwater regimen will result in changes to soil nutrient levels as stormwater typically carries higher nutrient levels than rainwater, especially when discharged off road surfaces and managed landscaped gardens. Other pathways for changes to soil nutrients include different subsurface moisture pathways resulting in changes to the way that nutrients are leached through the site. All of this will have a net downstream impact that includes the golf course fairways.

The proposed lighting regime is unknown so the level of impact could be low or high. Some light spill into adjoining bushland is likely inevitable. The impacts of light penetrating into bushland areas are well documented and any lighting design for the proposal must minimize light spill. Some species show a noticeable response to artificial light in the wild, while others show no response at all (Beier, 2006). Predatory diurnal birds such as Laughing Kookaburras and Pied Currawongs can exploit the twilight conditions created by light spill to hunt nocturnal and crepuscular species while some species, such as the Rainbow Lorikeet, roost near lighting as a strategy to assist in detecting nocturnal predators such as the Powerful Owl (Debus, 2015). Impacts on bats and their prey depend on the light spectra produced by lights. Ultraviolet (UV) wavelengths attract more insects and consequently insectivorous bats (Rowse et al, 2016). Relationships between bat species and artificial illumination may be very complex and reflect differences in, for example, the type of light source, bat ecology and landscape context. While certain light sources attract insects and subsequently foraging bats, artificial illumination can disrupt bat foraging behaviour and flight paths.

Lighting at night can also impact on nocturnal birds through bird-building collisions. Bird-building collisions are a significant source of bird mortality in the urban landscape. Window collisions kill more birds than any other human-related factor except habitat destruction. Bird-building collisions impact both diurnal and nocturnal species. Dr Stephen Ambrose (Australian Geographic 2019) notes that “Recently there has been a significant increase in the number of powerful owl strikes in Sydney. Again, the encroachment of residential development into bushland is exacerbating the problem”. A study by Loss et al (2019) found that size of building (height) and proximity to bushland (near) are positively associated with the highest levels of mortality and exacerbated by the area of glass (large) in these buildings. These results are supported by other studies at a variety of building types that have illustrated increased bird mortality due to bird-building collisions occurring most frequently with greater building height (Loss et al 2014, Hager et al 2008), area and/or percentage of windows or glass (Klem et al 2009, Hager et al 2008, Cusa 2015), and vegetation near buildings (Klem et al 2009, Bracey et al 2016, Kummer et al 2016).

4.1 POTENTIAL IMPACTS SUMMARY

Applied Ecology has identified that potential impacts would occur because of the scale and location of the building with many impacts occurring immediately off site. These are:

- Overshadowing of the site will change the way fauna use the site – including site avoidance for some species.
- Changes in lighting, and the structure in the landscape will change how microbat species, including threatened species use the immediate area.

- Potential for bird-building collisions, for both local birds and birds moving between the Gore Creek corridor and the Tambourine Bay corridor.
- Overshadowing combined with reduced sight and flight lines reduces the value of the immediate area as supplementary Powerful Owl habitat
- Reduced sight and flight lines reduces the value of the area as a movement point for fauna between the Tambourine Creek corridor and the Gore Creek corridor
- Numerous species of protected fauna are resident in the immediate area and will be impacted by works - particularly during the construction phase. Birds would nest in bushland adjacent to the area of proposed works and impacts on these resident species is inevitable. Impacts include displacement of individuals from the site through noise and vibration impacts and death of nestlings if works commence during breeding season.
- Changes in hydrology, particularly concentrated flows in areas where there were none can result in tree death
- Unless carefully managed bushland is likely to be severely degraded by weed invasion
- Shift in native species composition due to overshadowing, increased nutrients and changed site hydrology

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6 PROJECT SENIOR STAFF

Senior Consultant Dr. Meredith Brainwood

Dr. Meredith Brainwood carried out plant identification tasks and assisted in report writing and review. Meredith holds a Bachelor of Applied Science (Environmental Science), a Master of Science (Honours) and completed a PhD in Ecohydromorphology.

Meredith has extensive experience in preparing plans of management, aquatic and terrestrial flora and fauna surveys, and the development of rigorous scientific methodologies. She held contract roles with companies such as A&S Bushcare Services, National Trust Bushland Management Services, Good Bush People and NSW National Parks and Wildlife Service. Meredith worked as a senior environmental scientist with Australian Wetlands before joining Applied Ecology Pty Ltd.

Senior Consultant Anne Carey

Anne undertook fieldwork, mapping and report writing. Anne holds a Degree in Science (Conservation Biology) and a Masters Degree in Wildlife Habitat Management and has over 25 years industry experience.

Prior to Applied Ecology, Anne worked as the Operations Manager at Australian Wetlands (Sydney Design group), as an Environmental Manager for PSP- an alliance of private companies delivering infrastructure projects for Sydney water, as field ecologist, undertaking fauna and flora assessments and vegetation mapping, for various companies including NSW National Parks and Wildlife Service.