24 March 2020

Mr Brad Harrison
c/- Tom Wright
Landscape Designer
Landart
398 Pittwater Road
North Manly NSW 2100

Cumberland Ecology
PO Box 2474
Carlingford Court 2118
NSW Australia
Telephone (02) 9868 1933
ABN 14 106 144 647
Web: www.cumberlandecology.com.au

RE: ECOLOGICAL ASSESSMENT FOR PROPOSED DEVELOPMENT AT 57 BOWER STREET, MANLY

Dear Mr Harrison,

Cumberland Ecology was engaged by Landart to provide ecological services for 57 Bower Street, Manly (Lot 64 DP 8075), specifically to undertake a flora and fauna assessment, including a long-nosed bandicoot assessment, to accompany a development application (DA) to be lodged with Northern Beaches Council (Council).

The property is located within an area mapped by the Council as providing habitat for the Long-nosed Bandicoot (*Perameles nasuta*) – North Head population (refer to Development Control Plan – Schedule 1 – Map D). This population is listed as endangered under the *NSW Biodiversity Conservation Act 2016* (BC Act). As such, any DA within this area requires a formal bandicoot assessment to accompany the DA. The required bandicoot assessment must assess the development's potential impacts on the species/population in an assessment known as a Test of Significance under section 7.3 of the BC Act.

An assessment of areas proposed to be impacted by the DA was undertaken by Cumberland Ecology on 27 February 2020. This letter contains details of the assessment, including supporting photographs and figures (**Appendix A**), threatened species likelihood of occurrence analysis (**Appendix B)** and a test of significance for the Long-nosed Bandicoot - North Head population (**Appendix C**).

Yours sincerely

Vanessa Orsborn
Senior Project Manager/Ecologist
vanessa.orsborn@cumberlandecology.com.au

APPENDIX A :
Flora and Fauna Assessment

A.1. Background

Cumberland Ecology has been engaged by Landart to prepare a Flora and Fauna Assessment (FFA) for the proposed development application for 57 Bower Street, Manly (the 'study area'). The proposed development entails the demolition of existing stairs, the implementation of a new entry and carport structure to the front of the property (Bower St), as well as, implementation of new pergola structure to the rear garden (referred to as the 'Project'). This FFA forms part of an application under Part 4 of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act).

The study area comprises Lot 64 DP 8075 and is located within the Northern Beaches Council (Council) Local Government Area (LGA) (**Figure 1**). The study area is approximately 0.06 ha and is zoned as E3 Environmental Management under the *Manly Local Environment Plant 2013* (LEP). The study area currently contains a residential building, planted gardens and lawn areas, paved cleared areas and pathways, a swimming pool and driveway access roads.

The study area is located within a highly urban area and is largely surrounded by urban development. However, the study area is within approximately 300m of Sydney Harbour National Park and is located within an area mapped by the Council as providing habitat for the Long-nosed Bandicoot (*Perameles nasuta*) – North Head population (refer to Development Control Plan – Schedule 1 – Map D). This population is listed as endangered under the NSW *Biodiversity Conservation Act 2016* (BC Act).

A.2. Purpose

The purpose of this letter is to document the findings of ecological investigations completed across the study area (**Figure 1**). Biodiversity values considered include threatened species and ecological communities protected under the BC Act and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The main objective of this letter is to determine whether the Project is likely to significantly affect threatened biodiversity values, in particular to assess the impact upon the Long-nosed Bandicoot (*Perameles nasuta*) – North Head population, as required by the Council and to outline how the Project plans to mitigate those impacts.

Specifically, the objectives of this FFA are to:

- Document the reasons why the Biodiversity Offsets Scheme under the BC Act does not apply to the Project;
- Describe and map vegetation communities of the study area, identifying threatened ecological communities (TECs) listed under the BC Act and/or the EPBC Act;
- Identify and map the location of threatened flora and fauna species (if present);
- Assess the likelihood as to whether threatened flora and fauna species could occur within the study area;
- Describe the types and extent of potential impacts arising from the Project; and
- Where relevant, recommend mitigation measures to reduce the impacts of the proposed development on biodiversity values.

A.3. Relevant Legislation

A.3.1. Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Under the EPBC Act, any action (which includes a development, project or activity) that is considered likely to have a significant impact on Matters of National Environmental Significance (MNES) (including nationally threatened ecological communities and species, and listed migratory species) must be referred to the Commonwealth Minister for the Environment. The purpose of the referral is to allow a decision to be made about whether an action requires approval on a Commonwealth level. If an action is considered likely to have a significant impact on MNES, it is declared a "controlled action" and Commonwealth approval is required.

A.3.2. NSW Biodiversity Conservation Act 2016 (BC Act)

The BC Act is the key piece of legislation in NSW relating to the protection and management of biodiversity and threatened species. The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. The BC Act is supported by regulations, including the *Biodiversity Conservation Regulation 2017* (BC Regulation).

The BC Act requires consideration of whether a development or an activity is likely to significantly affect threatened species. For Part 4 local developments under the *Environmental Planning and Assessment Act 1979* (EP&A Act), projects that significantly affect threatened species trigger the Biodiversity Offsets Scheme (BOS). The BOS is intended to simplify biodiversity assessment and improve biodiversity outcomes by creating consistent assessment requirements to measure the likely biodiversity loss of development proposals and gains in biodiversity value achieved at offset sites through active management. The BOS requires an assessment following the Biodiversity Assessment Methodology (BAM) by an accredited BAM assessor and the preparation of a Biodiversity Development Assessment Report (BDAR).

A.3.3. Assessment of Entry into the Biodiversity Offsets Scheme

For the proposed development to trigger the BOS, it would need to be considered as likely to significantly affect threatened species, which could occur as follows:

- It is likely to significantly affect threatened species or ecological communities, or their habitats, according to the test of significance in Section 7.3 of the BC Act; or
- It exceeds the biodiversity offsets scheme threshold; or
- It is carried out in a declared area of outstanding biodiversity value (AOBV).

These three criteria are further detailed in the sections below. The results indicated that the proposed development does not trigger the BOS and therefore a general flora and fauna assessment is provided.

A.3.3.1. Test of Significance

A test of significance in accordance with Section 7.3 of the BC Act was undertaken for all threatened communities and species known, or considered likely, to be impacted by the proposed development (see

Appendix C). None of these entities are considered to be significantly affected by the project and therefore the BOS is not triggered by this mechanism.

A.3.3.2. Biodiversity Offsets Scheme Threshold

A development can exceed the BOS threshold if it is or involves:

- The clearing of native vegetation of an area above a prescribed threshold based on the minimum lot size; or
- The clearing of native vegetation, or other prescribed action, on land included on the Biodiversity Values Map.

An assessment of these two components is provided below.

A.3.3.3. Area Threshold

Any development being assessed under Part 4 (Local Development) of the EP&A Act that clears native vegetation above a threshold specified based on minimum lot size would trigger entry into the BOS. The threshold levels of clearing for each minimum lot size are defined by the *Biodiversity Conservation Regulation 2017* and a reproduced in **Table 1**.

The minimum lot size for the study area is 0.05 ha under the LEP, therefore allowing native vegetation clearance of up to 0.25 ha without triggering the BOS. The project will be clearing a small area of 0.02 ha of planted native/exotic vegetation within the study area and therefore entry into the BOS is not triggered through clearing of native vegetation.

Table 1 Area thresholds for entry into the BOS

Minimum Lot Size	Area of Clearing (Native Vegetation)
Less than 1 hectare	0.25 hectares or more
Less than 40 hectares but not less than 1 hectare	0.5 hectares or more
Less than 1,000 hectares but not less than 40 hectares	1 hectare or more
1,000 hectares or more	2 hectares or more

A.3.3.4. Biodiversity Values Map

Any development being assessed under Part 4 (Local Development) of the EP&A Act that occurs within areas mapped on the Biodiversity Values Map would automatically enter into the BOS. No portion of the study area is included on the Biodiversity Values Map, and therefore the BOS will not be triggered by clearing vegetation within an area occurring on the Biodiversity Values Map.

A.3.3.5. Declared Area of Outstanding Biodiversity Value (AOBVs)

The BC Act currently lists the following AOBVs:

- Gould's Petrel habitat;

- Little Penguin population in Sydney's North Harbour habitat;
- Mitchell's Rainforest Snail in Stotts Island Nature Reserve; and
- Wollemi Pine habitat.

The study area is not located within any of the currently identified AOBVs.

A.4. Methodology

A.4.1. Desktop Assessment

Mapping layers from The Native Vegetation of the Sydney Metropolitan Area (OEH 2016), which covers the study area were reviewed to determine the potential vegetation communities present, including those that align to TECs.

Database analysis was conducted for the locality using the BioNet Atlas and the EPBC Act Protected Matters Search Tool. The locality is defined as the area within a 5 km radius of the study area. The BioNet Atlas and the Protected Matters Search Tool were examined for records of any threatened flora and fauna species (excluding marine and marine over-fly species) listed under the BC Act and/or EPBC Act within the locality.

A.4.2. Site Surveys

A.4.2.1. Flora Survey

A flora survey was conducted on 27 February 2020 by an ecologist from Cumberland Ecology. The flora survey consisted of:

- Random meander survey across the entire study area to compile a species list and to map vegetation communities;
- Targeted searches for threatened flora species identified as being present within the locality; and
- Photographs taken of vegetation to provide a visual documentation of Plant Community Types (PCTs) present and their condition.

The locations of flora surveys within the study area are shown in **Figure 2**.

A.4.2.2. Fauna Survey

A.i. General

A fauna habitat assessment was conducted by an ecologist on 27 February 2020. The study area was assessed for groundcover, shrub/understory cover, canopy cover, tree hollows as well as other habitat features such as bush rock, fallen trees and signs of fauna use such as scats, scratches and scrapings.

The nature and extent of fauna habitats in the study area were assessed and areas where fauna species could reside, or forage were identified. This included consideration of important indicators of habitat condition and complexity including the occurrence of microhabitats such as tree hollows, fallen logs, bush rock and wetland areas such as creeks and soaks.

An assessment of the structural complexity of vegetation, the age structure of the vegetation and the nature and extent of human disturbance throughout the study area was also undertaken and considered. Tree hollows were used as a general indication of habitat quality for arboreal fauna and hollow-dwelling birds and bats. Any hollows observed during surveys were recorded and the general vegetation condition and tree maturity was used to predict whether trees on site were likely to contain hollows.

During this habitat assessment opportunistic sightings of diurnal fauna were recorded.

A.ii. Long-nosed Bandicoot

The Long-nosed Bandicoot assessment included active searches through all areas of potential habitat for the Long-nosed Bandicoot (i.e. vegetated areas) that are proposed to be removed. This included searches within garden beds and lawns within the study area (**Figure 2**). Active searches included searching through potential habitat by hand and recording any signs of Long-nosed Bandicoot occupation including scats, diggings, dens and/or individuals.

A.5. Results

A.5.1. Vegetation Communities

The study area is not mapped by broad-scale mapping conducted by the Environment, Energy and Science group (EES) (formerly the Office of Environment and Heritage (OEH)) for the Sydney Metropolitan (2016). Surveys by Cumberland Ecology for this assessment identified the following vegetation community:

- Planted Native/Exotic Garden Vegetation.

The study area consists of 0.02 ha of Planted Native/Exotic vegetation. A description of this vegetation community is provided below.

A.5.1.1. Planted Native/Exotic Vegetation

BC Act Status: Not listed

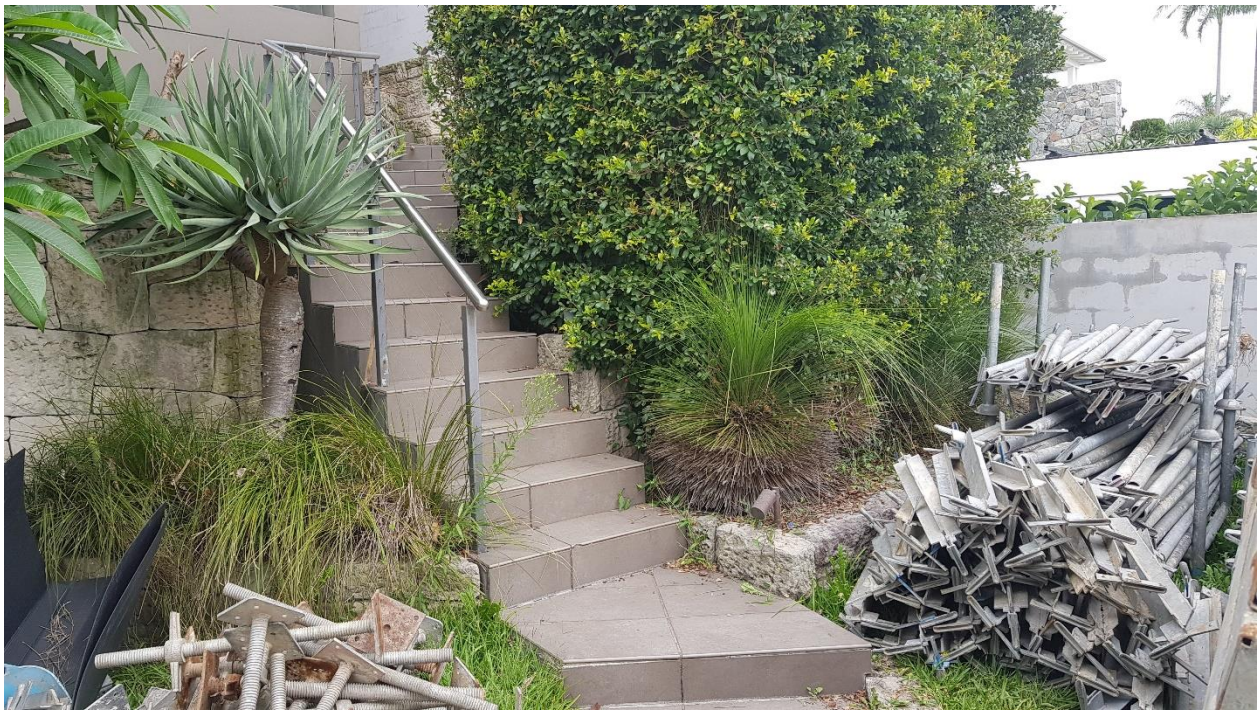
EPBC Act Status: Not listed

Planted Native/Exotic Vegetation is present in garden beds throughout the study area (~0.02 ha). This community does not conform to any naturally occurring vegetation community. An example of this community within the study area is shown in **Photographs 1-3.**

Canopy species within this vegetation community are predominantly planted native and exotic species. Planted non-endemic native canopy species include *Podocarpus elatus* (Plum Pine) and *Cupaniopsis anacardioides* (Tuckeroo). Planted exotic trees include *Magnolia grandiflora* (Magnolia), *Plumeria sp.* (Franjipani), *Syagrus romanzoffiana* (Cocos Palm)). Shrubs and small trees are a mix of natives (including non-endemic natives) such as; *Xanthorrhoea sp.* (Grass tree), *Doryanthes excelsa* (Gymea Lily), *Macrozamia spp.* (Cycad) and exotics including *Syzygium australe* (Lily pilly cultivar), *Yucca sp.*, *Rhapis excelsa* (Rhapis Palm), *Cyperus involucratus* (Umbrella Sedge) and *Strelitzia reginae* (Bird of Paradise). Ground covers include native species such as; *Commelina cyanea* (Scurvy Weed), *Psilotum nudum* (Skeleton Fork-fern), *Lomandra longifolia* (Matt Rush) and cultivar/exotic species, such as, *Bouteloua dactyloides* (Buffalo Grass), *Ehrharta erecta* (Panic Veldtgrass)

Pennisetum sataceus (Fountain Grass), Lomandra longifolia "Tanika", *Liriope muscari 'variegated'*, and *Liriope muscari* 'Monroe White'.

Photograph 1 Planted Native and Exotic Vegetation (Front of Property - Bower Street)



Photograph 2. Planted Native and Exotic Vegetation (Front of Property - Bower Street)

Photograph 3 Planted Native/Exotic Vegetation (Rear of Property – Montperlier Place)

A.5.2. Flora

Forty-two species were recorded throughout the study area during the survey. The dominant plant family encountered was Poaceae (12%). Species present consisted of a mix of exotic (67%) and native (33%) (**Table 2**).

Three species of priority weeds were recorded within the study area: *Asparagus aethiopicus* (Asparagus Fern), which is a Weed of National Significance (WONS), and two species listed as Other Weeds of Regional Concern under the under the NSW *Biosecurity Act 2015* (LLS: Greater Sydney 2019) (**Table 2)**.

Twenty-one threatened species had records within the locality (i.e. 5km) of the study area, however, none of these records were located within the study area. No threatened flora are considered likely to occur within the study area (**Appendix B**). Cumberland Ecology surveys did not find any threatened flora species in the study area.

Table 2 Flora Survey Species List

Family	Scientific Name	Common Name	Exotic / Cultivar	High Threat Weed
Agavaceae	*Beaucarnea recurvata*		*	
Agavaceae	*Yucca spp.*			
Amaryllidaceae	*Clivia miniata*		*	
Apocynaceae	*Plumeria spp.*	Franjipani	*	
Arecaceae	*Rhapis excelsa*		*	
Arecaceae	*Syagrus romanzoffiana*	Cocos Palm	*	OWRC
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	*	WONS
Asparagaceae	*Dracaena spp.*	Cordyline	*	
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	*	
Asteraceae	*Sonchus asper*	Prickly Sowthistle	*	
Commelinaceae	*Commelina cyanea*	Native Wandering Jew		
Cyperaceae	*Cyperus involucratus*	Umbrella Plant	*	
Davalliaceae	*Nephrolepis cordifolia*	Fishbone Fern		
Doryanthaceae	*Doryanthes excelsa*	Gymea Lily		
Euphorbiaceae	*Euphorbia prostrata*	Red Caustic Weed	*	
Fabaceae (Faboideae)	*Trifolium repens*	White Clover	*	
Iridaceae	*Neomarica gracilis*	Walking Iris	*	
Liliaceae	*Liriope muscari "Monroe White"*	Liriope - Monroe White	*	
Liliaceae	*Liriope muscari "variegated"*	big blue lilyturf	*	
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		
Lomandraceae	*Lomandra longifolia "tanika"*	Matt rush		
Magnoliaceae	*Magnolia grandiflora*	Southern Magnolia	*	
Myrtaceae	*Syzygium australe*	Brush Cherry - cultivar	*	
Oxalidaceae	*Oxalis bowiei*		*	
Passifloraceae	*Passiflora caerulea*	Blue Passionflower	*	
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		
Phormiaceae	*Phormium tenax*	New Zealand Flax	*	OWRC
Phyllanthaceae	*Phyllanthus tenellus*	Hen and Chicken	*	
Poaceae	*Bouteloua dactyloides*	Buffalo Grass	*	
Poaceae	*Cenchrus setaceus "rubrum"*	Fountain Grass	*	
Poaceae	*Cynodon dactylon*	Common Couch		
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	*	

Family	Scientific Name	Common Name	Exotic / Cultivar	High Threat Weed
Poaceae	*Oplismenus aemulus*			
Podocarpaceae	*Podocarpus elatus*	Plum Pine		
Psilotaceae	*Psilotum nudum*	Skeleton Fork-Fern		
Sapindaceae	*Cupaniopsis anacardioides*	Tuckeroo		
Scrophulariaceae	*Cymbalaria muralis*	Ivy-leaved Toadflax	*	
Strelitziaceae	*Strelitzia reginae*		*	
Verbenaceae	*Verbena rigida*	Veined Verbena	*	
Xanthorrhoeaceae	*Xanthorrhoea spp.*			
Zamiaceae	*Macrozamia spp.*	Cycad sp.		
Zamiaceae	*Zamia furfuracea*	Cardboard Plant	*	

Notes: WONS = Weed of National Significance; OWRC =Other Weed of Regional Concern

A.5.3. Fauna Habitat

The vegetation within the study area provides some potential, albeit sub-optimal, habitat for fauna, including the Long-nosed Bandicoot. Within the study area there are two small patches of open lawn (dominated by *Bouteloua dactyloides* (Buffalo grass)) and garden beds planted with a variety of native and exotic long- and tussock-forming grasses, which are both considered potential foraging and nesting habitat for the Long-nosed Bandicoot by NPWS (NPWS, 2004) (**Photograph 1 and 2**).

With respect to other fauna, the habitat in the study area is considered to be of lower value due to its location within a highly developed residential area and the lack of microhabitats such as tree hollows, logs and rocky outcrops. There is no habitat for tree hollow-dependent fauna as no trees in the study area were found to contain hollows. Although there are many exotic flora species within the study area, these can provide potential foraging resources for nectivorous mammals and birds that may use the study area from time to time as part of a larger foraging range.

The existing residential building does not provide suitable roosting habitat for microchiropteran (small insectivorous) bat species as the structures do not provide potential cavities for roosting.

A.5.4. General Species

Numerous vertebrate fauna species are known to occur within the locality. The study area is degraded through use for residential development and fauna habitats are limited. As such is it unlikely that habitat within the study area would be utilised for purposes other than foraging by common fauna species such as birds, bats, other mammals (i.e. possums) and some reptiles.

Opportunistic species recorded within the study area was limited to three bird species: Noisy Minor (*Manorina melanocephala*), Rainbow Lorikeet (*Trichoglossus moluccanus*) and Sulphur Crested Cockatoo (*Cacatua galerita*).

A.5.5. Threatened Fauna Species

A number of threatened fauna species have been recorded from the locality and have the potential to occur within the study area. **Appendix B** analyses the likelihood of occurrence within the study area for each threatened fauna species predicted to occur within the locality. One threatened fauna species is considered as having a potential to occur within the study area, the Long-nosed Bandicoot (*Perameles nasuta*). A discussion of the potentially occurring threatened fauna species is provided below.

A.i. Long-nosed Bandicoot

The targeted Long-nosed bandicoot survey did not detect any evidence of the species within the study area i.e. no conical diggings, no nesting sites were observed.

The study area is comprised of sloping block with tiered planted garden beds, some of which include plantings of tussocky grasses and grass-like plants, e.g. *Lomandra longifolia, Liriope muscaris spp.,and Xanthorrea spp*., and two very small lawn areas, which are considered suitable foraging habitat for the Long-nosed Bandicoot (NPWS 2004). The property is situated in a residential area within close proximity (~300m) to the Sydney Harbour National Park, where there is a known population of Long-nosed Bandicoots. As a mobile species, capable of moving through an urban landscape matrix, it is possible that the study area is utilised for movement or foraging from time to time as part of a broader foraging range. However, the amount of suitable available vegetation within the study area is very small (0.02ha), and the tussocky grasses present in some garden beds are patchily distributed and relatively limited in extent and size and thus are unlikely to be used as nesting habitat. Furthermore, the study area does not form part of a vegetation corridor and ultimately, is unlikely to support individuals on an ongoing, permanent, basis. Particularly as a larger patch of suitable habitat is situated in the nearby National Park. A test of significance was undertaken in accordance with section 7.3 of the BC Act that found the project would not have a significant impact on the Endangered Long-nosed Bandicoot – North Head population (**Appendix C**).

A.6. Impacts

A.6.1. Direct Impacts

A.6.1.1. Vegetation Removal

A total of up to 0.02 ha of vegetation will be removed within the study area. This includes one vegetation community "Planted Native/Exotic". This community is not listed as a TEC under the BC Act or EPBC Act. It is noted, however, that there will be new plantings undertaken as part of the project.

A.6.1.2. Habitat Removal

The project involves the removal of up to 0.02 ha of planted garden beds and lawn areas. These are considered habitat features for the Long-nosed Bandicoot. However, the project also includes new plantings that will reinstate some of the area impacted by initial phases of the project, such as building a new carport and staircase.

A.6.2. Indirect Impacts

The study area forms potential, albiet marginal, habitat for various urban adapted species as well as the Long-nosed Bandicoot. This assemblage is comprised of highly mobile species that may utilise the study area as part of their larger foraging range. A number of general indirect impacts may occur to threatened and non-threatened fauna species. These include:

- Habitat disturbance during the construction phase of the project (e.g. changes in noise); and
- Run-off, erosion and sedimentation.

With respect to noise, it can affect animal physiology and behaviour, and if it becomes an ongoing stress, it can be injurious to an animal's energy budget, reproductive success and long-term survival. There are other potential impacts that include habitat loss through avoidance, reduced reproductive success and a retreat away from favourable habitats (AMEC 2005).

It is likely that most animal species will habituate to the periodic noise disturbance (AMEC 2005), and the construction phases of the project are likely to cause temporary disturbance only to fauna. In the long-term, the levels of noise are not likely to be higher than existing levels in an urban environment and are not expected to have a significant, long-term, impact on any wildlife populations.

A.7. Mitigation Measures

A.7.1. Revegetation - Recommended Planting List

Clause 3.3.1 of the Manly Development Control Plan (DCP) requires areas of potential habitat for the Long-nosed Bandicoot, such as the study area, to include native plantings within landscaped areas that provide potential foraging and/or nesting habitat for the species. In order to meet the requirements of this DCP, the following plant species are considered appropriate for inclusion in the landscape plans prepared for the study area: *Lomandra* sp. *Dianella* sp., *Banksia spinulosa*, *Caustis* sp., *Xanthorrhoea* sp., *Isolepis* sp., *Juncus* sp., *Adiantum* sp., *Calochlaena* sp., *Callistemon* sp., *Grevillea juniperina*, *Gleichenia* sp., *Grevillea* 'Robyn Gordon' and tussocky native grasses (e.g. Kangaroo Grass). Any native plantings should be sourced from local provenance and planted at a high density to improve habitat for the Long-nosed Bandicoot.

A.7.2. Erosion, Sedimentation and Pollution Control

Potential impacts to flora and fauna occurring in the construction phase that can be managed include: run-off, sedimentation, erosion and pollution. To reduce sedimentation on the construction site and adjacent vegetation and local waterways, erosion control measures should be implemented in accordance with an erosion and sediment control plan. This includes minimising the amount of exposed soils on the site at any given time. All soil stockpiles should be adequately covered when not in use to prevent erosion from heavy rainfall. Sediment fences should be established around the perimeter of the development area to prevent the impacts of sedimentation on the adjoining vegetation. During development, precautions should be taken to ensure that no pollution, such as petrochemical substances or water containing suspended solids, escapes the construction site. Pollution traps and efficient removal of pollution to an off-site location would help to minimise pollution impacts.

A.7.3. Weed Control Measures

Weed species occurring within the study area should be managed in order to prevent further spread. Numerous exotic species are present within the study area and there is potential for further introduction and spread of weeds throughout the construction phase. Weeds either already present or established throughout the construction phase should be removed via manual removal, or hand weeding. Hand weeding is an effective form of weed control when all viable parts of the plant are removed from the soil (roots, fruiting material and rhizomes) and site. All weeds removed by hand should be handled according to best practice bush regeneration techniques to prevent subsequent seed set from the removed weeds. Any weed material containing propagules, or plant parts capable of asexual reproduction should be bagged and removed from study area.

If hand weeding is ineffective, herbicides may be used as a secondary option. All herbicides should be used according to recommendations on the herbicide label. Appropriate Personal Protective Equipment should be worn, and consideration given to time of day, likelihood of rainfall, wind direction and likely impact on native species as per guidelines on the label.

A.8. References

AMEC (2005). Mackenzie Gas Project: Effects of Noise on Wildlife, AMEC Americas Limited.

LLS: Greater Sydney (2019). Greater Sydney Regional Strategic Weed Management Plan 2017 - 2022 - Revised September 2019, Local Land Services NSW.

National Parks and Wildlife Service (NPWS) (2004) Environmental Impact Assessment Guidelines – Endangered Lon-nosed Bandicoot Population at North Head, NPWS, Hurstville, retrieved at https://www.environment.nsw.gov.au/resources/nature/PnasutaEia0704.pdf on 23.2.2020

OEH (2016). The Native Vegetation of the Sydney Metropolitan Area - Volume 1: Technical Report, Office of Environment and Heritage Sydney.

APPENDIX B :
Likelihood of Occurrence Analysis

Table 3 Threatened Flora Likelihood of Occurrence Analysis

Family	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Fabaceae (Mimosoideae)	*Acacia terminalis subsp. terminalis*	Sunshine Wattle	E	E	511	Coastal scrub and dry sclerophyll woodland on sandy soils .	Unlikely to occur. No suitable habitat within study area.
Casuarinaceae	*Allocasuarina portuensis*	Nielsen Park She-oak	E	E	53	Originally found in Nielsen Park, in Woollahra local government area. No plants are left at the original site, however, propagation material has been planted successfully. The original habitat is tall closed woodland featuring canopy species such as, *Ficus rubiginosa, Angophora costata, Elaeocarpus reticulatus and Gloichidion ferdinandi* and a shrub layer of *Pittosporum revolutum, Kunzea ambigua and Monotoca elliptica*. The original habitat occurs on shallow sandy soils that area highly siliceous, coarsely textured and devoid of a soil profile.	Unlikely to occur. No suitable habitat within study area.
Myrtaceae	*Callistemon linearifolius*	Netted Bottle Brush	V	-	1	Grows in dry sclerophyll forest on the coast and adjacent ranges.	Unlikely to occur. No suitable habitat within study area.

Family	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Euphorbiaceae	*Chamaesyce psammogeton*	Sand Spurge	E	-	1	Found on the foredunes and headlands of the eastern coast from Jervis Bay to Queensland.	Unlikely to occur. No suitable habitat within study area.
Ericaceae	*Epacris purpurascens var. purpurascens*		V	-	1	Found in a range of habitat types, most of which have a strong shale soil influence.	Unlikely to occur. No suitable habitat within study area.
Myrtaceae	*Eucalyptus camfieldii*	Camfield's Stringybark	V	V	13	Found in exposed areas on sandstone ridges, slopes and plateaus near tall coastal heath or low open woodland.	Unlikely to occur. No suitable habitat within study area.
Myrtaceae	*Eucalyptus nicholii*	Narrow-leaved Black Peppermint	V	V	2	Occurs in dry grassy woodland on shallow soils of slopes and ridges. Prefers infertile soils derived from granite or metasedimentary rock on the lower slopes of the landscape.	Unlikely to occur. No suitable habitat within study area.

Family	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Myrtaceae	*Melaleuca biconvexa*	Biconvex Paperbark	V	V	1	Occurs in damp areas, often near watercourses, on alluvium soils over shale. Vegetation communities associated with the species include 'Eucalypt open-forest' with Sydney Blue Gum (*Eucalyptus saligna*), Swamp Mahogany (*Eucalyptus robusta*) and Mountain Cedar Wattle (*Acacia elata*) and in 'Paperbark scrub' with Prickly-leaved Paperbark (*Melaleuca styphelioides*), Snow-in-summer (*Melaleuca linariifolia*), White Feather Honeymyrtle (*Melaleuca decora*), Sieber'sPaperbark (*Melaleuca sieberi*) and *Melaleuca nodosa*.	Unlikely to occur. No suitable habitat within study area.
Proteaceae	*Persoonia hirsuta*	Hairy Geebung	E	E	1	Occurs in dry sclerophyll forest and woodland with a shrubby understorey.	Unlikely to occur. No suitable habitat within study area.
Thymelaeaceae	*Pimelea curviflora var. curviflora*		V	V	3	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	Unlikely to occur. No suitable habitat within study area.

Family	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Lamiaceae	*Prostanthera marifolia*	Seaforth Mintbush	E	CE	209	Grows on ridge tops in or in close proximity to the endangered Duffys Forest community,	Unlikely to occur. No suitable habitat within study area.
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine	E	-	1	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. The species is distributed in coastal districts north from Batemans Bay in New South Wales to areas inland of Bundaberg in Queensland. Populations of *R. rubescens* typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm.	Unlikely to occur. No suitable habitat within study area.
Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	E	V	22	On south coast of NSW occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Unlikely to occur. No suitable habitat within study area.

Family	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Fabaceae (Mimosoideae)	*Acacia bynoeana*	Bynoe's Wattle	E	V	1	Found in heath and woodland on sandy soils. Prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include *Corymbia maculata* (Red Bloodwood), *Eucalyptus haemastoma* (Scribbly Gum), *Eucalyptus parramattensis* (Parramatta Red Gum), *Banksia serrata* (Saw Banksia) and *Angophora bakeri* (Narrow-leaved Apple).	Unlikely to occur. No suitable habitat within study area.
Rutaceae	*Asterolasia elegans*		E	E	1	Occurs on Hawkesbury sandstone growing between sandstone boulders and rocky outcrops found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. It is currently only known from 7 populations occurring in the hills north of Maroota within a 22 km^2 extent of occurrence.	Unlikely to occur. No suitable habitat within study area.

Family	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Orchidaceae	*Caladenia tessellata*	Thick-lipped Spider-orchid	E	V	1	Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Unlikely to occur. No suitable habitat within study area.
Orchidaceae	*Cryptostylis hunteriana*	Leafless Tongue-orchid	V	V	1	Occur in a wide variety of habitats including heathlands, heathy woodlands, sedgelands, Xanthorrhoea spp. plains, dry sclerophyll forests (shrub/grass sub-formation and shrubby sub-formation), forested wetlands, freshwater wetlands, grasslands, grassy woodlands, rainforests and wet sclerophyll forests. Soils are generally considered to be moist and sandy, however, this species is also known to grow in dry or peaty soils. Is associated with the community Bloodwood / Scribbly Gum / Silver-top Ash Forest on the South Coast. Species is known to have occurrence associated with other Cryptostylis species. Flowering occurs generally from November to February.	Unlikely to occur. No suitable habitat within study area.
Orchidaceae	*Genoplesium baueri*	Yellow Gnat-orchid	E	E	1	Grows in dry sclerophyll forest and moss gardens over sandstone.	Unlikely to occur. No suitable habitat within study area.

Family	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Polygonaceae	*Persicaria elatior*	Knotweed	V	V	1	Species in known to occur in Raymond Terrace and Grafton areas. Grows in damp places, preferring areas near streams and lakes and occasionally found in swamp forest.	Unlikely to occur. No suitable habitat within study area.
Lamiaceae	*Prostanthera junonis*	Somersby Mintbush	E	E	1	The species is restricted to the Somersby Plateau. It occurs on both the Somersby and Sydney Town soil landscapes on gently undulating country over weathered Hawkesbury sandstone within open forest/low woodland/open scrub. It occurs in both disturbed and undisturbed sites.	Unlikely to occur. No suitable habitat within study area.
Santalaceae	*Thesium australe*	Austral Toadlfax	V	V	1	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast.	Unlikely to occur. No suitable habitat within study area.

V = Vulnerable; E = Endangered, CE = Critically Endangered

Table 4 Threatened Fauna Likelihood of Occurrence Analysis (Excluding Marine and Marine Over-fly Species)

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Amphibia	*Heleioporus australiacus*	Giant Burrowing Frog	V	V	1	Occurs in heath, woodland and open dry sclerophyll forest on a variety of soil types. Breeding habitat for this species usually contains soaks or pools within first of second order streams.	Unlikely to occur. No suitable habitat, such as soaks and pools, is present within study area. Likely to utilise habitat in broader locality.
Amphibia	*Litoria aurea*	Green and Golden Bell Frog	E	V	1	The species is found in a wide range of water bodies except fast moving streams. It commonly inhabits disturbed sites such abandoned quarries and mines, though generally breeds in habitats that include still, shallow, unpolluted water bodies, that are unshaded, contain aquatic plants are free of Mosquito fish and other predators, with a range of diurnal shelter sites (emergent aquatic vegetation).	Unlikely to occur. No suitable habitat, e.g. waterbodies, are within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Amphibia	*Pseudophryne australis*	Red-crowned Toadlet	V	-	30	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters.	Unlikely to occur. No suitable habitat within study area. No suitable breeding habitat, e.g. waterbodies, is within study area. Likely to utilise habitat in broader locality.
Aves	*Anthochaera phrygia*	Regent Honeyeater	CE	CE	1	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Botaurus poiciloptilus*	Australasian Bittern	E	E	1	Occurs in freshwater wetlands, and more rarely, estuarine wetlands. It favours wetlands with tall, dense vegetation, and forages in shallow water up to a depth	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
						of 0.3m. It nests in deep vegetative cover over shallow pools.	
Aves	*Burhinus grallarius*	Bush Stone-curlew	E	-	3	Found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Calidris canutus*	Red Knot	-	E	1	Found on the coast in sandy estuaries with tidal mudflats.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Dasyornis brachypterus*	Eastern Bristlebird	E	E	1	Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Esacus magnirostris*	Beach Stone-curlew	E	-	1	Beach Stone-curlews are found exclusively along the coast, on a wide range of beaches, islands, reefs and in estuaries, and may be seen at the edges of or near mangroves. They forage in the intertidal zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves. Beach Stone-curlews breed above the littoral zone, at the backs of beaches, or on sandbanks and islands, among low vegetation of grass, scattered shrubs or low trees; also among open mangroves. In Australia, the Beach Stone-curlew is found along coastlines from Point Cloates in Western Australia, across northern and north-eastern Australia and south to north-eastern NSW, with occasional vagrants to south-eastern NSW and Victoria. In NSW, the species occurs regularly to about the Manning River.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Gallinago hardwickii*	Latham's Snipe	-	M	1	Seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. They also use crops and pasture.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Glossopsitta pusilla*	Little Lorikeet	V	-	1	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophoras, Melaleucas and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Also utilises isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees. Roosts in treetops, often distant from feeding areas. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Grantiella picta*	Painted Honeyeater	V	V	1	Occurs in Boree, Brigalow and Box-Gum Woodlands and Box-Ironbarks. Feeds primarily on mistletoe fruit and insects.	Unlikely to occur. No suitable habitat within study area.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Haematopus fuliginosus*	Sooty Oystercatcher	V	-	6	Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Haematopus longirostris*	Pied Oystercatcher	E	-	1	Prefers intertidal flats of inlets and bays, open beaches and sandbanks. Nests primarily on coastal or estuarine beaches.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V	C	8	The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Hieraaetus morphnoides*	Little Eagle	V	-	2	The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland, or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Hirundapus caudacutus*	White-throated Needletail	-	V	1	Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Occur over most types of habitat, particularly above wooded areas including open forest and rainforest, between trees or in clearings and below the canopy.	Unlikely to occur. May forage aerially over the site on occasion but unlikely to utilise the site for foraging or nesting.
Aves	*Hydroprogne caspia*	Caspian Tern	-	M	6	Prefers sheltered coastal emabyments but is known to occur in near-coastal or inland terrestrial wetlands. Builds nests in open areas or areas with low vegetation.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Ixobrychus flavicollis*	Black Bittern	V	-	3	Inhabits terrestrial and estuarine wetlands, generally in areas containing permanent water and dense vegetation. The species can occur in flooded grassland, woodland, rainforest, and mangroves. It feeds on frogs, reptiles, fish, and invertebrates such as snails, dragonflies, shrimp and crayfish. It roosts during the day on the ground amongst dense reeds or within trees. It nests in branches overhanging water.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Lathamus discolor*	Swift Parrot	E	CE	1	In NSW mostly occurs on the coast and south west slopes. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Eucalyptus robusta, Corymbia maculata, C. gummifera, E. sideroxylon, and E. albens. Breeds in Tasmania in spring and summer.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name		Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Limosa baueri*	*lapponica*	Bar-tailed Godwit	-	V	1	It is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt marsh, salt lakes and brackish wetlands, sandy ocean beaches and rock platforms. It is a migratory wader, arriving in NSW for part of the year (August - October) before departing overseas, with only a few individuals overwintering. It has been recorded in the Tweed, Richmond, Clarence, Macleay, Hastings, Hunter and Shoalhaven river estuaries, Port Stephens and Botany Bay. It is a rare visitor to wetlands away from the coast with scattered records as far west as along the Darling River and the Riverina.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Limosa lapponica menzbieri*	Northern Siberian Bar-tailed Godwit	-	CE	1	The bar-tailed godwit (northern Siberian) usually forages near the edge of water or in shallow water, mainly in tidal estuaries and harbours. They prefer exposed sandy or soft mud substrates on intertidal flats, banks and beaches. A migratory wader to Australia during the non-breeding period, the distribution of L. l. menzbieri is predominantly in the north and north-west of Western Australia and in south-eastern Asia.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Ninox connivens*	Barking Owl	V	-	2	Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. Nests in hollows of large, old eucalypts. Hunts small arboreal mammals such as Squirrel Gliders and Ringtail Possums, but when loss of tree hollows decreases these prey populations it becomes more reliant on birds, invertebrates and terrestrial mammals. Requires very large permanent territories in most habitats due to sparse prey densities.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Ninox strenua*	Powerful Owl	V	-	60	In NSW the Powerful Owl lives in forests and woodlands occurring in the coastal, escarpment, tablelands and western slopes environments. Specific habitat requirements include eucalypt forests and woodlands on productive sites on gentle terrain; a mosaic of moist and dry types, with mesic gullies and permanent streams; presence of leafy sub canopy trees or tall shrubs for roosting; presence of large old trees to provide nest hollows. Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities of arboreal marsupials.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Numenius madagascariensis*	Eastern Curlew	-	CE	1	Prefers sheltered coasts, especially estuaries, bays, harbours, inlets and lagoons. Also known to occur in sewage farms, wetlands and mangroves. Species roosts on sandy spits and in low Saltmarsh or mangroves.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Numenius phaeopus*	Whimbrel	-	M	1	Occurs primarily in intertidal mudflats or sheltered coasts, but also occurs in sheltered coastal areas and saline or brackish lakes near the coast. Nesting usually occurs in mangroves and tall coastal trees.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Onychoprion fuscata*	Sooty Tern	V	-	1	The Sooty Tern is found over tropical and sub-tropical seas and on associated islands and cays around Northern Australia. In NSW only known to breed at Lord Howe Island. Occasionally seen along coastal NSW, especially after cyclones. Large flocks can be seen soaring, skimming and dipping but seldom plunging in off shore waters. Breeds in large colonies in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Pachyptila turtur subantarctica*	Fairy Prion	-	V	1	In Australia, breeding is recorded on two rock stacks off Macquarie Island and on the nearby Bishop and Clerk Island. The population may have been larger prior to the arrival of black rats on Macquarie Island. The subspecies digs burrows among rocks or low vegetation in which to nest. Burrows may be dug below mat forming herbs. Feeds by plucking food from the ocean surface. Some individuals may migrate towards New Zealand and southern Australia in winter	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Pandion cristatus*	Eastern Osprey	V	-	5	Found in littoral and coastal habitats and terrestrial wetlands. They generally are found in coastal areas though will travel inland along major water courses. They visit a wide range of wetland habitats including inshore waters, reefs, bays, coastal cliffs, estuaries, mangrove swamps, broad rivers, reservoirs, large lakes, and water holes. They feed on fish over clear, open water, and nest in trees or dead trees, generally within one kilometre of the ocean.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Pluvialis squatarola*	Grey Plover	-	M	3	Found in coastal areas where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Ptilinopus regina*	Rose-crowned Fruit-Dove	V	-	2	Occurs primarily in sub-tropical and dry rainforest, and occasionally in moist eucalypt forest and swamp forest.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Ptilinopus superbus*	Superb Fruit-Dove	V	-	1	Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Rostratula australis*	Australian Painted Snipe	-	E	1	Inhabits fringes of shallow inland wetlands, swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Aves	*Stagonopleura guttata*	Diamond Firetail	V	-	1	Occurs in grassy eucalypt woodland, open forest and riparian areas.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Sterna hirundo*	Common Tern	-	M	468	Marine, pelagic and coastal habitats. The species is a non-breeding migrant to Australia, where it is widespread and common on the eastern coast south to eastern Victoria, and common on parts of the northern coast, mainly east of Darwin.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Sternula nereis nereis*	Australian Fairy Tern	-	V	1	Species nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. It has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline. It roosts on beaches at night.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Aves	*Thinornis rubricollis rubricollis*	Hooded Plover	E	V	1	The species inhabits coastal areas, on or near high energy sandy beaches. They are generally found close to the shore but may visit coastal lakes.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Mammal	*Dasyurus maculatus maculatus*	Spotted-tail Quoll	V	E	1	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites.	Unlikely to occur. No suitable habitat within study area.
Mammal	*Petauroides volans*	Greater Glider	-	V	1	Occurs in eucalypt forests and woodlands from north-eastern Queensland to the Central Highlands of Victoria. The species has a relatively small home range which consists of numerous tree hollows.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Mammal	*Petrogale penicillata*	Brush-tailed Rock-wallaby	E	V	1	Prefers rocky habitats, including loose boulder-piles, rocky outcrops, steep rocky slopes, cliffs, gorges, and isolated rock stacks. Vegetation types associated with the species include dense forest, wet sclerophyll forest, vine thicket, dry sclerophyll forest, and open forest.	Unlikely to occur. No suitable habitat within study area.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Mammal	*Phascolarctos cinereus (combined populations of QLD, NSW and the ACT*	Koala	V	V	1	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred feed species. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.	Unlikely to occur. No suitable habitat within study area.
Mammalia	*Cercartetus nanus*	Eastern Pygmy-possum	V	-	301	Species is found in a broad range of habitats from rainforest to wet and dry sclerophyll forests through to woodland and heath. Woodland and heath habitats are preferred. The species feeds on pollen and nectar from banksias, eucalypts, and bottlebrushes, though will eat soft fruits when flowers are unavailable, and will also eat insects throughout the year. They shelter in tree hollows, rotten stumps, holes in the ground, abandoned birds nests and Ringtail Possum dreys, and thickets of vegetation. Tree hollows are preferred for nesting but the species will also nest under tree bark and shredded bark in tree forks.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Mammalia	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	2	The species is assocated with areas dominated by sandstone escarpments; sandstone cliffs and fertile woodland valley habitat occurring in close proximity to each other is important for the species. It roosts in cliff/escarpment areas and forages in fertile forest. Roosting is predominately in arch caves with dome roofs, but has been observed in disused mines shafts, overhangs, and disused Fairy Martin nests.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Mammalia	*Isoodon obesulus obesulus*	Southern Brown Bandicoot (eastern)	E	E	2	Within NSW, the species is rare and almost exclusively restricted to the coastal fringe of the state, from the southern side of the Hawkesbury River in the north to the Victorian border in the south. More specifically, the subspecies is considered to occur primarily in two areas: Ku-ring-gai Chase and Garigal National Parks; and in the far south-east corner of the state. Occurs within their distribution in a variety of habitats including heathland, shrubland, sedgeland, heathy open forest and woodland.	Unlikely to occur. No suitable habitat within study area.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Mammalia	*Miniopterus australis*	Little Bent-winged Bat	V	-	2	Moist eucalypt forest, rainforest or dense coastal banksia scrub. Little Bentwing-bats roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Mammalia	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	V	-	116	Forages above the canopy and eats mostly moths. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Mammalia	*Myotis macropus*	Southern Myotis	V	-	9	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Mammalia	*Perameles nasuta*	Long-nosed Bandicoot, North Head	E	-	2159	Restricted to North Head in the Manly Local Government Area. Evidence of foraging via diggings (conical holes) left in the soil are often seen at the interface of naturally vegetated and areas of open grass around the Quarantine Station, former Defence Lands and Saint Patrick's Estate. Shelters during the day in a well-concealed nest based on a shallow hole lined with leaves and grass, sometimes under debris, sometimes hidden with soil and with the entrance closed for greater concealment.	Potential to occur. Suitable habitat including lawn, garden beds with tussock forming grasses present in the study area.
Mammalia	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	10495	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

Class	Scientific Name	Common Name	BC Act	EPBC Act	Number of Records	Habitat Requirements	Liklihood of Occurrence
Mammalia	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V	-	1	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, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
Mammalia	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V	-	1	Found mainly in the gullies and river systems that drain the Great Dividing Range. Usually roosts in tree hollows and buildings. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.
	Pseudomys novaehollandiae	New Holland Mouse	-	V	1	Occurs in open habitats (heathland, woodland and forest) with a heath understorey and vegetated sand dunes. The species prefers deep soft top soils in order to burrow.	Unlikely to occur. No suitable habitat within study area. Likely to utilise habitat in broader locality.

V = Vulnerable; E = Endangered, CE = Critically Endangered; M =Migratory

APPENDIX C : Test of Significance

C.1. Introduction

This appendix contains the formal Test of Significance required under Section 7.3 of the BC Act that have been prepared in accordance with the Threatened Species Test of Significance Guidelines (OEH, 2018). The Test of Significance is used for determining whether proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats.

Tests of Significance have been provided for communities and species listed as vulnerable, endangered or critically endangered under the BC Act. A Test of Significance is a series of factors (shown as italicised text below) for which a response has been supplied beneath in plain text.

C.2. Long-nosed Bandicoot – North Head Population

The Long-nosed bandicoot (*Perameles nasuta*) was once widespread in the Sydney Region however, many formerly recorded populations have become extinct. The population on North Head population is isolated and disjunct occurring on the area of North Head south of Addison Road, Manly (NSW Scientific Committee 1997).

The study area is located within a highly urban area and is largely surrounded by urban development. However, it is located within an area mapped by the Council as providing habitat for the Long-nosed Bandicoot (*Perameles nasuta*) – North Head population (refer to Development Control Plan – Schedule 1 – Map D). This population is listed as endangered under the NSW *Biodiversity Conservation Act 2016* (BC Act). The study area is comprised of sloping block with tiered planted garden beds, some of which include plantings of tussocky grasses and grass-like plants, e.g. *Lomandra longifolia, Liriope muscaris spp.,and Xanthorrea spp*., and two very small lawn areas, which are considered suitable foraging habitat for the Long-nosed Bandicoot (NPWS 2004). The Long-nosed bandicoot survey did not detect any evidence of the species within the study area i.e. no conical diggings, no nesting sites were observed.

a. *in the case of a threatened species, whether the proposed development or activity 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 Long-nosed bandicoot has not been recorded within the study area; however, they have been recorded in the locality. The local population of this potentially occurring species is considered to extend beyond the study area and are assessed as viable.

The Long-nosed Bandicoot will primarily be impacted by the project through removal of some potential foraging habitat within the study area. As a mobile species, capable of moving through an urban landscape matrix, it is possible that the study area is utilised occasionally or opportunistically for movement or foraging as part of a broader foraging range on North Head. However, the amount of suitable available vegetation within the study area is very small (0.02ha), and the tussocky grasses present in some garden beds are patchily distributed and relatively limited in extent and size and thus are unlikely to be used as nesting habitat.

Furthermore, the study area does not form part of a vegetation corridor and ultimately, is unlikely to support individuals on an ongoing, permanent, basis.

Any local population of the species that may access the vegetation within the study area would also have access to more heavily vegetated areas, particularly within the nearby Sydney Harbour National Park. The habitat to be removed as part of the proposed development represents a very small portion of potential foraging habitat available within the locality. As such, the proposed development is not considered to affect the lifecycle of these species such that a viable local population is placed at risk of extinction.

b. In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

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*

Not applicable

c. In relation to the habitat of a threatened species or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

iii. *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.*

Approximately 0.02 ha of potential foraging habitat for this population will be removed as part of the project, however, some portion of this will be revegetated post construction works within the study area.

The habitat occurring within the study area and immediate surrounds has previously been fragmented by various developments. Within this area, available habitat for these species exists as fragmented, tiered garden beds and small lawn patches. The project predominantly requires clearing a small area of planted native and exotic garden beds (0.02 ha), some portion of which will be revegetated. Therefore, the proposed development will not contribute significantly to further fragmentation beyond the fragmented habitat patches that currently exist. The long-nosed bandicoot that may potentially occur within the study area are highly mobile and their movements are unlikely to be hindered by the proposed development.

The project will not remove, modify, fragment or isolate important habitat. Habitat within the study area is not important for these species in the locality as it is a small area (0.02 ha) of planted garden beds and modified vegetation. The study area would only likely provide minimal foraging habitat, as the tussocky grasses present in some garden beds are patchily distributed and relatively limited in extent and size and thus are unlikely to be used as nesting habitat. Furthermore, the study area does not form part of a vegetation corridor and

ultimately much larger areas of potential habitat occur within the nearby Sydney Harbour National Park. This tract of vegetation would provide more favourable nesting and foraging habitat for this species. It is therefore considered that the habitat provided on the study area is not important for the long-term survival of the species in the wider locality.

d. Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

Only four areas of outstanding biodiversity value have been declared within NSW. No declared areas of outstanding biodiversity value will be impacted in any way by the proposed development.

e. *Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of, a key threatening process*.

The proposed development may potentially impact these species through the following process:

• Clearing of native vegetation as this directly reduces the abundance of suitable habitat for these species.

Clearing of native vegetation will result in removal of a very small area of potential foraging habitat for the Long-nosed Bandicoot. This is considered insignificant in relation to the amount of potential habitat available in the wider locality.

Conclusion

The proposed development will remove small areas of potential foraging habitat for the Long-nosed Bandicoot. Given that it is a mobile species and likely to utilise a variety of habitat resources, including retained habitat in the wider locality of North Head, and with due consideration to the proposed mitigation and compensation measures, the proposed development is considered unlikely to have a significant impact on the species.

FIGURES

Legend

Study Area

Sydney Harbour National Park

Image Source:
Image © Nearmap (2020)
Dated: 21/01/2020

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 25 50 75 100 m

I:\...\20039\Figures\RP1\20200303\Figure 1. Study Area

Figure 1. Study Area

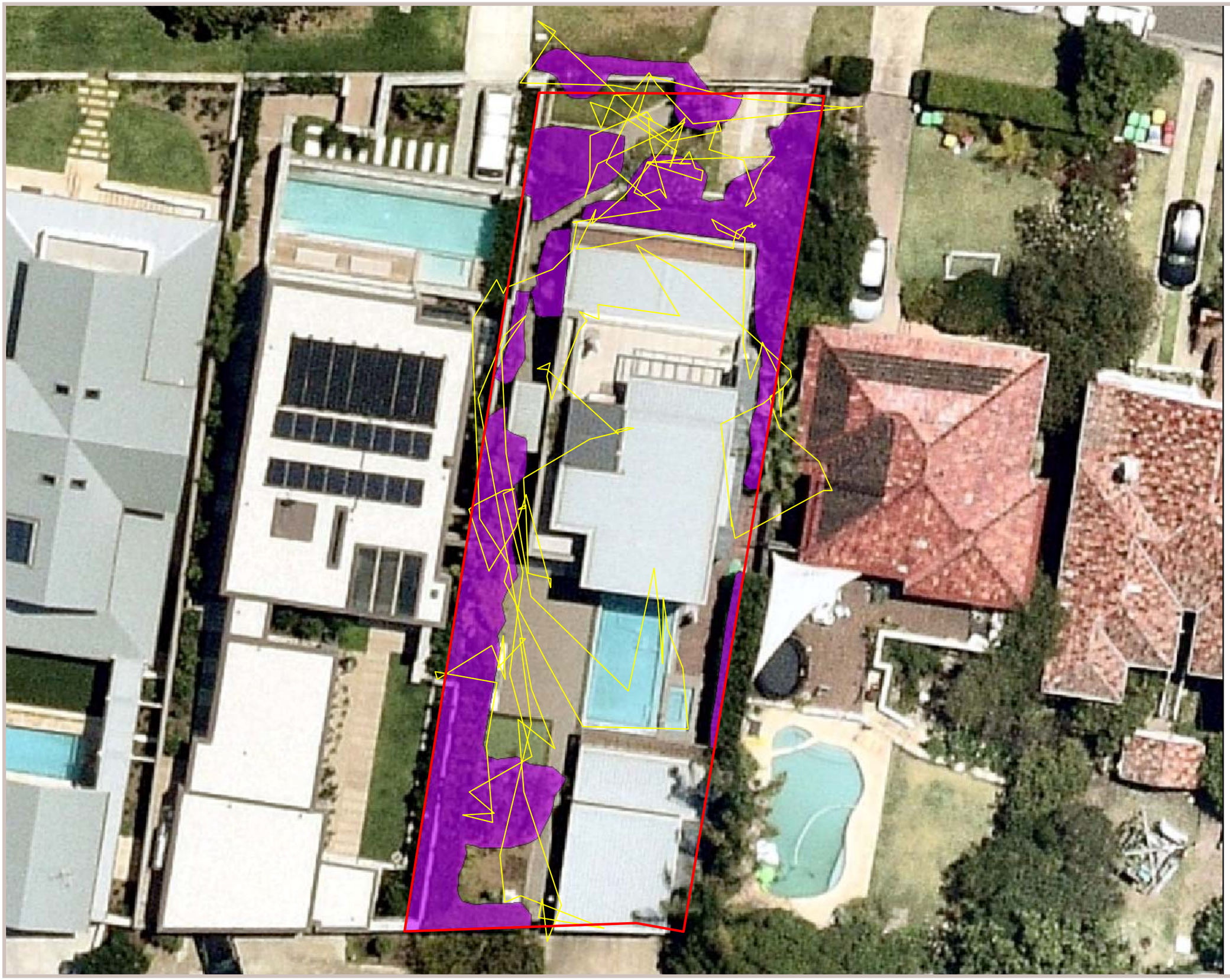


Figure 2. Survey Locations within the Study Area

Figure 3. Vegetation within the Study Area