Flora and Fauna Constraints Assessment Report

Warringah Recreation Centre

Report prepared by Narla Environmental

for Northern Beaches Council

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environmental

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Glossary

Acronym/ Term	Definition
ASL	Above Sea Level
BAM	Biodiversity Assessment Method
BC Act	New South Wales Biodiversity Conservation Act 2016
BDAR	Biodiversity Development Assessment Report
Development	The use of land, and the subdivision of land, and the carrying out of a work, and the demolition of a building or work, and the erection of a building, and any other act, matter or thing referred to in section 26 that is controlled by an environmental planning instrument but does not include any development of a class or description prescribed by the regulations for the purposes of this definition (Environmental Planning and Assessment Act 1979).
DoEE	Department of Environment and Energy
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment
EP&A Act	Environmental Planning & Assessment Act 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FFA	Flora and Fauna Assessment Report
FFCA	Flora and Fauna Constraints Assessment
ha	Hectares
km	Kilometre
LGA	Local Government Area
Locality	The area within a 10 km radius of the Subject Site. The same meaning when describing a local population of a species or local occurrence of an ecological community.
m	metres
mm	millimetres
NSW	New South Wales
OEH	Office of Environment and Heritage (now known as the DPIE)
SEPP	State Environmental Planning Policy
Subject Site	Lot 2742/-/DP752038)
Threatened species, populations and ecological communities	Species, populations and ecological communities specified in Schedules 1 and 2 of the BC Act 2016
WDCP	Warringah Development Control Plan 2011
WLEP	Warringah Local Environmental Plan 2011

1. Introduction

1.1 Project Background

Narla Environmental Pty Ltd (Narla) was engaged by Northern Beaches Council ('the proponent') to prepare an Flora and Fauna Constraints Assessment Report (FFCA) to determine the development potential and ecological constraints of the land directly adjacent to the Warringah Recreation Centre (Lot 2742/-/DP752038; hereafter referred to as the 'Subject Site'; **Figure 1**).

It is understood that the proponent wishes to determine the ecological constraints identified within the Subject Site, particularly those associated with any Threatened Ecological Communities (TECs) and threatened species listed under the Biodiversity Conservation Act 2016 (BC Act) and the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Narla have produced this report in order to assess any potential impacts associated with future development proposals and to recommend appropriate measures to mitigate any potential ecological impacts.

1.2 Site Description and Location

The Subject Site is located adjacent to Warringah Recreation centre on Kentwell Street, North Manly, within the Northern Beaches Local Government Area (LGA) The Subject Site covers an area of approximately 0.34 ha and is bordered by Warringah Recreation Centre to the East, Kentwell Street to the south and Warringah Golf Course to the west. The Subject Site is located within an urban environment with the surrounding blocks of land adjoining the Subject Site comprised mostly of recreational and residential land.

1.3 Topography, Geology and Soil

The Subject Site occurs on relatively flat terrain and is elevated at approximately 0-2 metres above sea level (ASL). The Subject Site is situated on the Warriewood soil landscape, which comprises level to gently undulating swales, depression and infilled lagoon on Quaternary sands. Local relief is <10m with slopes of <3%. Most of the native vegetation associated with this soil landscape has been historically cleared. Remaining species often include *Melaleuca quinquenervia*, *Banksia integrifolia*, *Casuarina glauca* and *Eucalyptus robusta* (Chapman et al. 2009).

1.4 Hydrology

Brookvale Creek, a Strahler third order stream, is mapped as occurring through the centre of the Subject Site. No other unmapped watercourses, dams, or soaks were identified within the Subject Site at the time of the site assessment.

1.5 Scope of Assessment

The objectives of this Flora and Fauna Constraints Assessment were to assess all possible ecological constraints of the proposed activity within the Subject Site, pursuant to Part 4 of the EP&A Act 1979, the BC Act, the EPBC Act, and the local planning provisions of the Northern Beaches Council, including to:

- Undertake background research to determine the likelihood for NSW and/or Commonwealth threatened biota to utilise or occur within the Subject Site during any point of their lifecycles;
- Establish the likelihood of occurrence of migratory species, threatened species, endangered populations, and threatened ecological communities as listed under the BC Act and/or the EPBC Act;
- Identify and map the distribution of vegetation communities within the Subject Site and discuss patch size and condition;
- Record presence and the extent of any priority weed infestations that require management by law;
- Determine potential ecological impacts or risks that may result due to future works;
- Recommendation of any controls or additional actions to be taken to protect or improve environmental outcomes of future works; and
- Recommend any controls or additional actions to be taken to protect or improve ecological / biodiversity values of the Subject Site.

Figure 1. Subject Site within the locality.

1.6 Biodiversity Assessment Pathway

The requirements of the BC Act 2016 and Biodiversity Conservation Regulation 2017 are mandatory for all development applications assessed pursuant to Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

The test of significance (under s.7.3) determines whether the proposed activity is likely to significantly affect threatened species or ecological communities, or their habitats. If the activity is likely to have a significant impact, or will be carried out in a declared Area of Outstanding Biodiversity Value (AOBV), the proponent must apply the Biodiversity Offsets Scheme (BOS).

The environmental impact of activities that will not have a significant impact on threatened species will continue to be assessed under s.111 of the Environmental Planning and Assessment Act 1979.

1.7 Warringah Local Environmental Plan 2011 (WLEP)

1.7.1 Zoning

The Subject Site is zoned as 'RE1: Public Recreation'. The objectives of this zone are:

- To enable land to be used for public open space or recreational purposes.
- To provide a range of recreational settings and activities and compatible land uses.
- To protect and enhance the natural environment for recreational purposes.
- To protect, manage and restore public land that is of ecological, scientific, cultural or aesthetic value.
- To prevent development that could destroy, damage or otherwise have an adverse effect on those values.

1.7.2 Acid Sulfate Soils (Clause 6.1)

The objective of Clause 6.1 (Acid Sulfate Soils) is to ensure that development does not disturb, expose or drain acid sulfate soils and cause environmental damage. As the Subject Site occurs on Class 2 land (see **Table 1**), this clause applies to the Subject Site.

Table 1. Acid Sulfate Classes

Class of Land	Works
1	Any works.
2	**Works below the natural ground surface.** **Works by which the watertable is likely to be lowered.**
3	Works more than 1 metre below the natural ground surface. Works by which the watertable is likely to be lowered more than 1 metre below the natural ground surface.
4	Works more than 2 metres below the natural ground surface. Works by which the watertable is likely to be lowered more than 2 metres below the natural ground surface.
5	Works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5 metres Australian Height Datum and by which the watertable is likely to be lowered below 1 metre Australian Height Datum on adjacent Class 1, 2, 3 or 4 land.

The following controls therefore apply:

1) Development consent is required for the carrying out of works described in the Table (Table 1) to this subclause on land shown on the Acid Sulfate Soils Map as being of the class specified for those works.

2) Development consent must not be granted under this clause for the carrying out of works unless an acid sulfate soils management plan has been prepared for the proposed works in accordance with the Acid Sulfate Soils Manual and has been provided to the consent authority.

3) Despite subclause (2), development consent is not required under this clause for the carrying out of works if—
   a) a preliminary assessment of the proposed works prepared in accordance with the Acid Sulfate Soils Manual indicates that an acid sulfate soils management plan is not required for the works, and
   b) the preliminary assessment has been provided to the consent authority and the consent authority has confirmed the assessment by notice in writing to the person proposing to carry out the works.
4) Despite subclause (2), development consent is not required under this clause for the carrying out of any of the following works by a public authority (including ancillary work such as excavation, construction of access ways or the supply of power)—
   a) emergency work, being the repair or replacement of the works of the public authority required to be carried out urgently because the works have been damaged, have ceased to function or pose a risk to the environment or to public health and safety,
   b) routine maintenance work, being the periodic inspection, cleaning, repair or replacement of the works of the public authority (other than work that involves the disturbance of more than 1 tonne of soil),
   c) minor work, being work that costs less than $20,000 (other than drainage work).
5) Despite subclause (2), development consent is not required under this clause to carry out any works if—
   (a) the works involve the disturbance of less than 1 tonne of soil, and
   (b) the works are not likely to lower the watertable.

1.8 Warringah Development Control Plan 2011 (WDCP)

1.8.1 E3: Threatened Species, Populations, Ecological Communities Listed Under State or Commonwealth Legislation or High Conservation Habitat.

This control applies to land identified on the DCP Map Threatened and High Conservation Habitat and land identified as known or potential habitat for threatened species, as identified in the NSW Wildlife Atlas. Objectives of this clause are:

- To protect and promote the recovery of threatened species, populations and endangered ecological communities.
- To protect and enhance the habitat of plants, animals and vegetation communities with high conservation significance.
- To preserve and enhance the area's amenity, whilst protecting human life and property.
- To improve air quality, prevent soil erosion, assist in improving water quality, carbon sequestration, storm water retention, energy conservation and noise reduction.
- To provide natural habitat for local wildlife, maintain natural shade profiles and provide psychological & social benefits.

1.8.2 E6: Retaining Unique Environmental Features

This control applies to land to which Warringah Local Environmental Plan 2011 applies. As the WLEP applies to the Subject Site, this clause also applies. The objective of this clause is:

- To conserve those parts of land which distinguish it from its surroundings.

Development is to be designed to address any distinctive environmental features of the site and on adjoining nearby land and should respond to these features through location of structures, outlook, design and materials.

1.8.3 E11: Flood Prone Land

The Subject Site is identified on the Flood Risk Precinct Maps as being affected by flooding therefore this clause applies to the Subject Site. Objectives of this clause include:

- Protection of people.
- Protection of the natural environment.
- Protection of private and public infrastructure and assets.

The purpose of this Part is to guide development in accordance with the objectives and processes set out in the NSW Government's Flood Prone Land Policy as outlined in the NSW Government, Floodplain Development Manual, 2005. Development to which this Part applies must comply with the performance criteria set out in clause 1.1. Development that satisfies the prescriptive controls in clause 1.2 is deemed to have satisfied clause 1.1.

1.9 Relevant Legislation and Policy

The legislation and policy that are addressed in this report are listed in **Table 2.**

Table 2. Relevant Legislation and Policy Addressed.

Legislation/ Policy	Relevant Ecological Feature on Site	Triggered	Action Required
Environmental Planning and Assessment Act 1979 (EP&A Act)	All threatened species, populations and ecological communities and their habitat that occur or are likely to occur on the Subject Site during a part of their lifecycle.	Yes	This ecological assessment and all subsequent recommendations relevant to the planning process under 'Part 5 Infrastructure and Impact Assessment'.
Biodiversity Conservation Act (BC Act) (New South Wales)	One (1) BC Act listed species occurs within the Subject Site ▪ *Callistemon linearifolius*. One (1) BC Act listed endangered ecological community occurs within the Subject Site: ▪ Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregion.	Yes	A Test of Significance from any proposed works on BC Act listed threatened species will be required. This is to be included within a Flora and Fauna Assessment Report (FFA).

Legislation/ Policy	Relevant Ecological Feature on Site	Triggered	Action Required
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Commonwealth)	EPBC Act threatened species have the potential to occur within the Subject Site. One (1) EPBC Act listed Threatened Ecological Communities is present within the Subject Site: ▪ Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales.	Yes	An assessment of significance of impact from the proposed works on Matters of National Environmental Significance (MNES) EPBC Act Assessment of Significant Impact Criteria. This is to be included in a Flora and Fauna Assessment Report (FFA) or Biodiversity Development Assessment Report (BDAR).
Biosecurity Act 2015 (Bio Act)	One (1) priority weed for the Greater Sydney region was identified on the Subject Site: ▪ *Lantana camara*	Yes	Listed priority weeds must be managed in accordance with the Biosecurity Act 2015.
State Environmental Planning Policy (Koala Habitat Protection) 2020	The Subject Site occurs within the Northern Beaches LGA which is listed in Schedule 1 of the Koala Habitat Protection 2020 SEPP and together with adjoining land in the same ownership has an area of more than 1 hectare. Therefore, the Koala Habitat Protection 2020 SEPP applies.	Yes	Determination as to whether the land is potential koala habitat is needed.
State Environmental Planning Policy (Coastal Management) 2018	The Subject Site is not mapped as containing land identified as 'coastal wetlands', 'littoral rainforest', or proximity to either on the 'Coastal Wetlands and Littoral Rainforests Area Map'.	No	None.
Water Management Act 2000	Brookvale Creek, a Strahler third order stream, and its associated riparian corridor, is mapped as occurring in the centre of the Subject Site.	Yes	Works occurring within 30 metres of the highest bank of the river, lake or estuary are considered controlled activities under the WM Act. applicants must obtain a controlled activity approval from the NRAR before commencing the controlled activity.

2. Methodology

2.1 Desktop Assessment and Literature Review

A thorough literature review of local information relevant to the Northern Beaches Council area was undertaken. Searches using NSW Wildlife Atlas (BioNet; DPIE 2020b) and the Commonwealth Protected Matters Search Tool (DAWE 2020) were conducted to identify all current threatened flora and fauna, as well as migratory fauna records within a 100 km² search area centred on the Subject Site. This data was used to assist in establishing the presence or likelihood of any ecological values as occurring on or adjacent to the Subject Site, and helped inform our Ecologist on what to look for during the site assessment.

Soil landscape and geological mapping was examined to gain an understanding of the environment on the Subject Site and to assist in determining whether any threatened flora or ecological communities may occur there (Chapman et al. 2009).

2.2 Ecological Site Assessment

2.2.1 General Survey

A site assessment was undertaken by Narla Environmental Ecologist Jack Tatler on Tuesday the 3rd of November 2020. During the site assessments, the following activities were undertaken:

- Identifying and recording the vegetation communities present on the Subject Site, with focus on identifying any Threatened Ecological Communities (TEC);
- Recording a detailed list of flora species encountered on the Subject Site, with a focus on threatened species, species diagnostic of threatened ecological communities, and priority weeds;
- Recording opportunistic sightings of any fauna species seen or heard on or within the immediate surrounds of the Subject Site;
- Identifying and recording the locations of notable fauna habitat such as important nesting, roosting or foraging microhabitats;
- Targeting the habitat of any threatened and regionally significant fauna including:
    - Tree hollows (habitat for threatened large forest owls, parrots, cockatoos, and arboreal mammals);
    - Caves and crevices (habitat for threatened reptiles, small mammals, and microbats);
    - Termite mounds (habitat for threatened reptiles);
    - Soaks (habitat for threatened frogs);
    - Wetlands (habitat for threatened fish, frogs, and water birds);
    - Drainage lines (habitat for threatened fish and frogs);
    - Fruiting trees (food for threatened frugivorous birds and mammals);
    - Flowering trees (food for threatened nectivorous mammals and birds);
    - Trees and shrubs supporting nest structures (habitat for threatened birds and arboreal mammals);
    - Logs, bark and artificial debris (habitat for threatened frogs, reptiles, and snails);
    - Any other habitat features that may support fauna (particularly threatened) species; and
    - Assessing the connectivity and quality of the vegetation within the Subject Site and surrounding area.

2.2.2 Weather Conditions

Weather conditions recorded at the nearest weather station (Terrey Hills) prior to and during the general flora and fauna survey period are provided in **Table 3** (BOM 2020). The data reveals some rainfall leading up to the survey. These weather conditions may be conducive to the emergence of annual herbs.

Table 3. Weather Conditions Recorded at Terrey Hills (station 066059) Preceding and During the Site Assessment (survey date in bold).

Survey date	Day	Minimum Temp. (°C)	Maximum Temp. (°C)	Rainfall (mm)
27/10/2020	Tuesday	12.0	18.0	n.d.
28/10/2020	Wednesday	11.1	18.4	0
29/10/2020	Thursday	13.9	19.8	1.4
30/10/2020	Friday	10.9	20.6	1.8
31/10/2020	Saturday	16.1	25.3	0.8
01/11/2020	Sunday	12.4	17.9	16.0
02/11/2020	Monday	12.8	20.7	10.6
03/11/2020	**Tuesday**	**11.2**	**20.6**	**0**

2.2.3 Mapping and Analysis of Vegetation Communities

Narla examined local satellite imagery, geological mapping, soil landscape mapping and topographic mapping, in addition to existing vegetation mapping in order to stratify the Subject Site and guide the site assessment survey efforts. The following documents were consulted during assessment to assist with the identification of vegetation communities present within the Subject Site:

- Chapman G.A., Murphy C.L., Tille P.J., Atkinson G. and Morse R.J. (2009), Soil Landscapes of the Sydney 1:100,000 Sheet map, Ed. 4, Department of Environment, Climate Change and Water, Sydney; and
- Department of Planning, Industry and Environment NSW (DPIE 2020a) eSPADE v2.1;
- NSW Office of Environment and Heritage (OEH) (2016) The Native Vegetation of the Sydney Metropolitan Area. Volume 2: Vegetation Community Profiles. Version 3.1.

3. Native Vegetation

3.1 Vegetation Community

3.1.1 Historically Mapped Vegetation Communities

The Native Vegetation of the Sydney Metropolitan Area - Version 3.1 (OEH 2016) identified the vegetation within the Subject Site as Urban Exotic/Native. It also showed the following vegetation communities as occurring within the broader locality (**Figure 2**):

- S_FoW08: Estuarine Swamp Oak Forest;
- S_DSF09: Coastal Sandstone Gully Forest;
- S_DSF11: Sydney North Exposed Sandstone Woodland; and
- Urban_E/N: Urban Exotic/Native.

3.1.2 Field Validated Vegetation Communities

Field survey conducted by the Narla Ecologist identified two (2) vegetation community within the Subject Site (**Figure 3**):

- S_FoW08: Estuarine Swamp Oak Forest; and
- Weeds_Ex: Weeds and Exotics.

The Estuarine Swamp Oak Forest within the Subject Site was in low-moderate condition as much of the groundcover and mid-storey species were dominated by exotic species. A native canopy of *Casuarina glauca* dominated areas mapped under this community. Areas mapped as 'Weeds and Exotics" were dominated by exotic grasses and bordered the eastern and western extent of the Estuarine Swamp Oak Forest.

A description of these vegetation communities can be found in **Table 4** and **Table 5**.

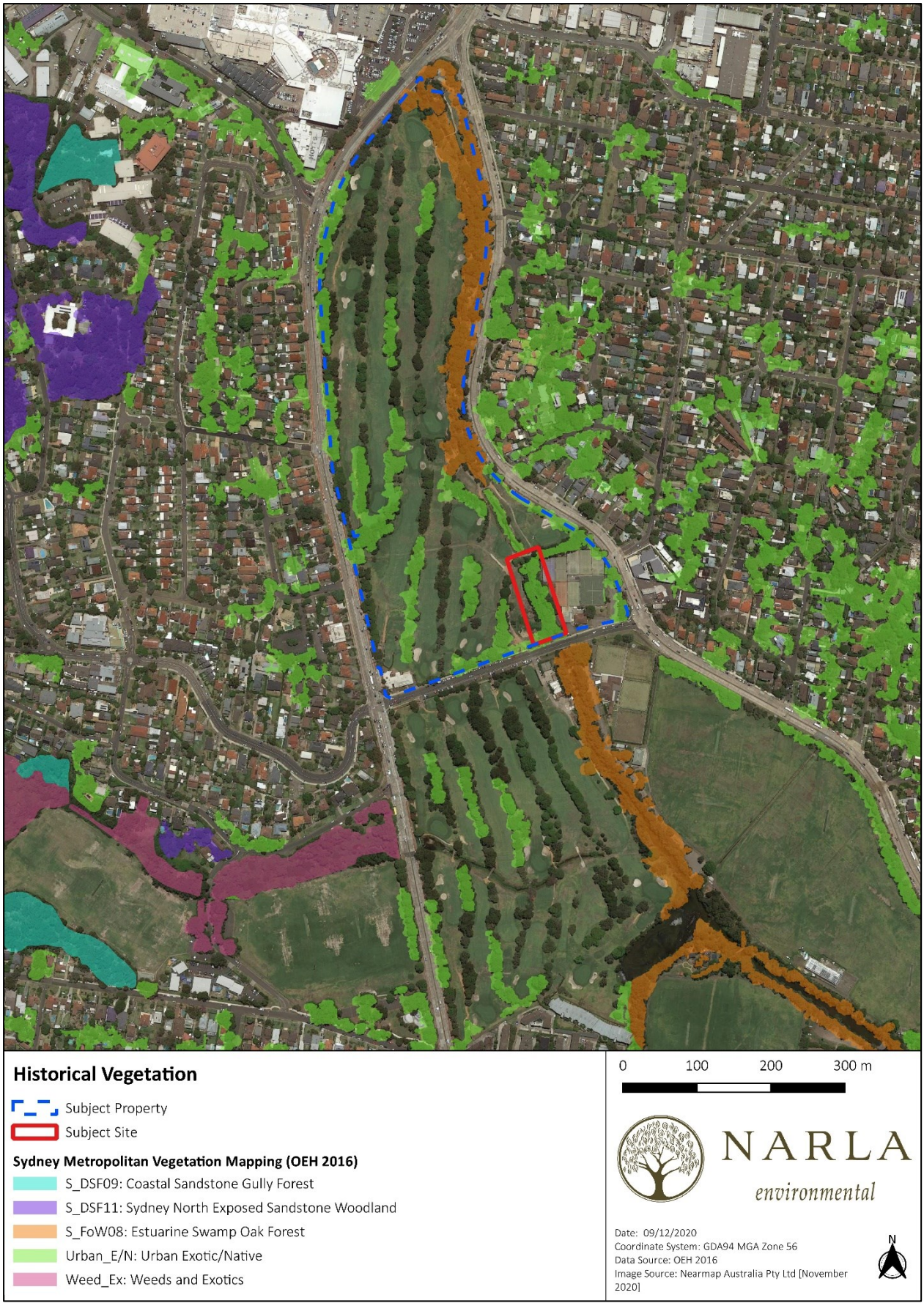

Figure 2. Historically mapped vegetation within the locality.

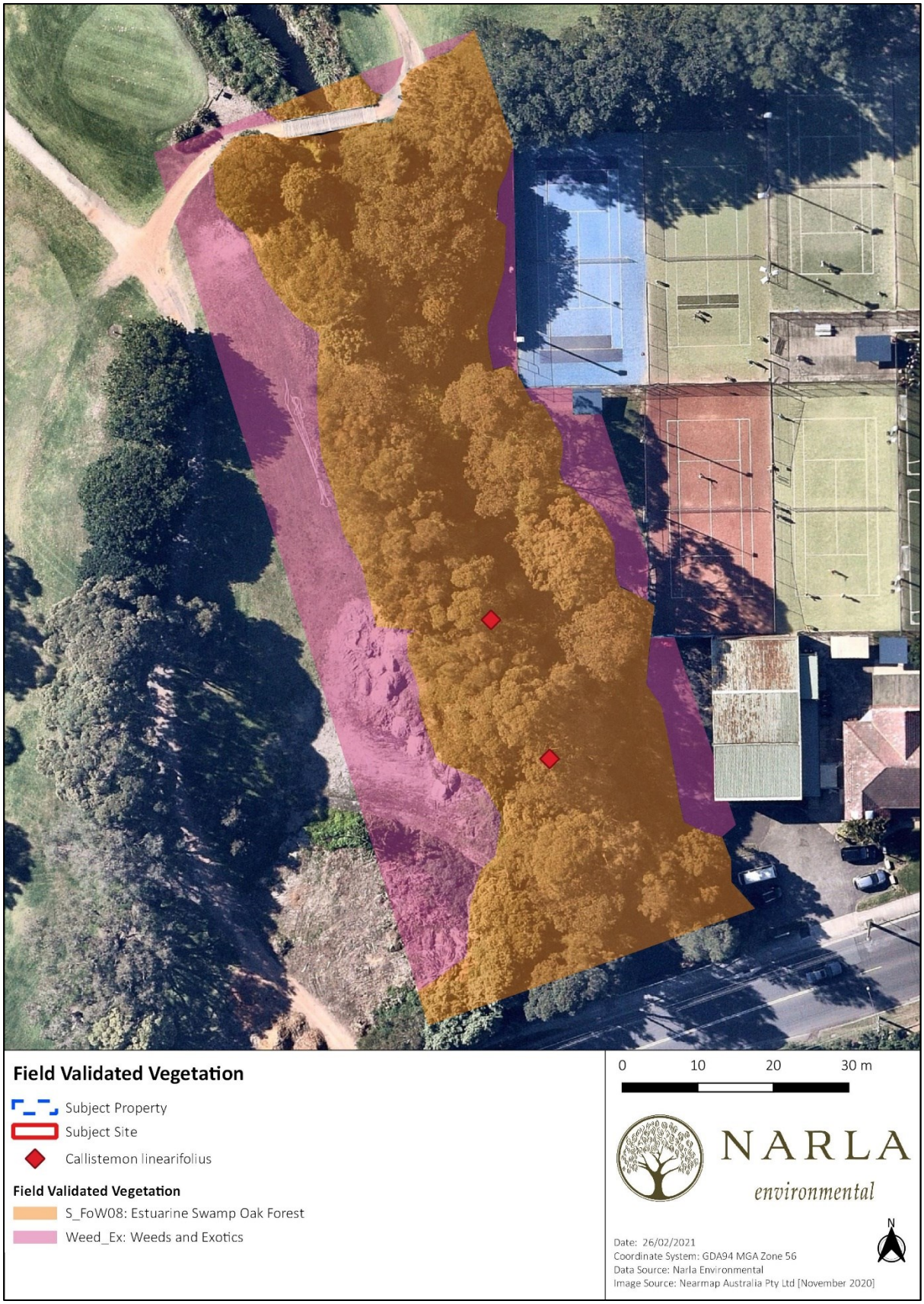

Figure 3. Narla Field-validated vegetation within the Subject Site.

Table 4. Description of S_FoW08: Estuarine Swamp Oak Forest occurring within the Subject Site.

S_FoW08: Estuarine Swamp Oak Forest	
	
Vegetation Formation / Keith Class	Coastal Floodplain Wetlands
Condition	Poor-moderate quality
Extent within Subject Site (approximate)	0.4 ha
Description of the Vegetation in the Subject Site	
The vegetation within the Subject Site consisted of poor-moderate quality Estuarine Swamp Oak Forest. This included a fairly thick canopy layer comprised of *Casuarina glauca* and *Melaleuca quinquenervia* with scattered *Angophora costata* (Sydney Red Gum), *Eucalyptus robusta* (Swamp Mahoganey) and *Eucalyptus saligna* (Sydney Blue Gum) spread throughout. The understorey included native species such as *Acacia lonigfolia*, *Banksia ericifolia* (Heath-leaved Banksia), and *Callicoma serratifolia* (Black Wattle) with ground species such as *Calochlaena dubia* (Soft Bracken),	

S_FoW08: Estuarine Swamp Oak Forest	
Lomandra longifolia (Spiny-headed Mat-rush) and *Viola hederacea* (Ivy-leaved Violet). Weed species were fairly abundant within the mid and ground layers including *Bromus catharticus* (Prairie Grass), *Ipomea indica* (Morning Glory), *Ehrharta erecta* (Panic Veldtgrass) and the priority weed *Lantana camara* (Lantana).	
Description from OEH (2016)	
In the zonation from mangroves to terrestrial sclerophyll and mesophyll forests and woodlands, Estuarine Swamp Oak Forest occurs immediately above tidal influence. It fringes the margins of saline waterbodies that include rivers, lagoons and tidal lakes. Swamp Oak (*Casuarina glauca*) forms dense monospecific stand above a thick ground cover of salt tolerant herbs, rushes and sedges. The shrub layer is low-growing and sparse, comprising a mix of terrestrial species while others typical of wetlands. It is a community of relatively low species diversity. Estuarine Swamp Oak Forest is widespread along the coast of the Sydney Basin where it is rarely found at more than two meters above sea level.	
Justification of Vegetation Community	The vegetation within the Subject Site contained a dense canopy of *Casuarina glauca,* a positive diagnostic canopy species for this vegetation community. The following four (4) characteristic species were also present: *Commelina cyanea*, *Livistona australis, Phragmites australis* and *Pittosporum undulatum.* Given the low floristic diversity of this community, the landscape position and geology were also crucial in determining the vegetation community. Estuarine Swamp Oak Forest appears to persist in areas that have grey-black clay-loams and sandy loams where the groundwater is saline or sub-salines, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes. The Subject Site is elevated at approximately 0-2 metres above sea level (ASL) and is mapped on the Warriewood soil landscape (Chapman et al. 2009). The Warriewood soil landscape is characterised by level to gently undulating swales, depressions and infilled lagoons on Quaternary sands. Topsoil consists of dark grey loamy sand with loose apedal single-grained structure and sandy fabric. This is consistent with that of the Estuarine Swamp Oak Forest vegetation community. The Subject Site is also situated along Brookvale Creek. The main channel flows through an alluvial floodplain before joining Manly Creek. Given the proximity to the coastal Manly Lagoon, saline influence along Brookvale Creek is to be expected. Furthermore, given the connectivity of the Subject Site with historically mapped areas of Estuarine Swamp Oak Forest (occurring immediately south and 100m north), the vegetation within the Subject Site is most-likely a modified variant of Estuarine Swamp Oak Forest.
BC Act Status	The vegetation within the Subject Site conforms to the BC Act listed EEC Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (See **Section 3.1.1**).
EPBC Act Status	The vegetation within the Subject Site conforms to the EPBC Act listed EEC Coastal Swamp Oak Forest of South-east Queensland and New South Wales Community (See **Section 4.1.2**).
References	Department of Planning, Industry and Environment (DPIE) (2020) NSW BioNet. The website of the Atlas of NSW Wildlife http://www.bionet.nsw.gov.au/

S_FoW08: Estuarine Swamp Oak Forest	
	NSW Office of Environment and Heritage (OEH) (2016) The Native Vegetation of the Sydney Metropolitan Area. Volume 2: Vegetation Community Profiles. Version 3.0 NSW Scientific Committee (2011) Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions – Final Determination, proposed gazettal date 08/07/11 Department of the Environment (2020). Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community in Community and Species Profile and Threats Database, Department of the Environment, Canberra.

Table 5. Description of weeds and exotics occurring within the Subject Site.

Weeds_Ex: Weeds and Exotics.	
	
Extent within Subject Site (approximate)	0.15 ha
Description of the Vegetation in the Subject Site	
This area consisted of common exotic and grasses including *Ehrharta erecta* and *Briza maxima.* The mid and upper vegetation strata have been cleared. Other exotic species in this zone included *Parietaira judaica, Rumex sagittatus, Setaria palmifolia* and *Lysimachia arvensis.* Native species diversity was minimal, consisting of *Viola hederacea* and *Cynodon dactylon.*	
Justification of Vegetation Assignment	The vegetation within this area was comprised of predominately exotic species characteristic of a weedy lawn.
BC Act Status	Not listed
EPBC Act Status	Not listed
References	N/A

4. Threatened Species and Ecological Communities

4.1 Threatened Ecological Communities

4.1.1 Listing under the BC Act: Swamp Oak Floodplain Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregions, an Endangered Ecological Community

The Subject Site contained species that are indicative of Swamp Oak Floodplain Forest (SOFF) in the Sydney Basin Bioregion indicated by the Final Determination for the EEC (NSW Scientific Committee 2011).

The following species listed within the Final Determination were identified:

- *Casuarina glauca*
- *Commelina cyanea*
- *Cynodon dactylon*
- *Dianella caerulea*
- *Lomandra longifolia*
- *Melaleuca quinquenervia*
- *Phragmites australis*

The SOFF within the Subject Site was in poor-moderate condition containing a weed dominated mid-storey, predominately exotic groundcover with a native canopy.

Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes, Port Stephens, Maitland, Newcastle, Cessnock, Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Hawkesbury, Baulkham Hills, Hornsby, Lane Cove, Blacktown, Auburn, Parramatta, Canada Bay, Rockdale, Kogarah, Sutherland, Penrith, Fairfield, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions.

The combination of features that distinguish Swamp Oak Floodplain Forest from other endangered ecological communities on the coastal floodplains include: its dominance by a tree canopy of either *Casuarina glauca* or, more rarely, *Melaleuca ericifolia* with or without subordinate tree species; the relatively low abundance of *Eucalyptus* species; and the prominent groundcover of forbs and graminoids. It generally occupies low-lying parts of floodplains, alluvial flats, drainage lines, lake margins and fringes of estuaries; habitats where flooding is periodic and soils show some influence of saline ground water. This latter habitat feature sets it apart from other floodplain communities.

The Subject Site is elevated at approximately 0-2 metres above sea level (ASL) and occurs within the Warringah (now Northern Beaches) LGA. The Subject Site is mapped on the Warriewood soil landscape (Chapman et al. 2009) which consists of dark grey loamy sand with loose apedal single-grained structure and sandy fabric. Saline influence in the Subject Site is expected due to its positioning along Brookvale Creek which flows into Manly Lagoon and indicated by the presence of saltmarsh species such as *Phragmites australis.* The canopy within the Subject Site is also characteristically dominated by *Casuarina glauca.* Such features are consistent with that of the Estuarine Swamp Oak Forest vegetation community and the community therefore qualifies under the BC Act.

4.1.2 Listing under the EPBC Act: Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales

Vegetation within the Subject Site meets the EPBC listing as a Category C patch. The area of Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales (CSF) is considered medium in size and contains some native understorey species (**Figure 4**). The vegetation within the Subject Site is considered continuous to the historically mapped southern patch of CSF as the gap (Kentwell Road) is less than 30 metres (DoEE 2018).

Condition thresholds Patch size classes➔ 🡻 Vegetation quality classes	**Large patch** The patch is at least 5 ha	**Medium patch** The patch is at least 2 ha and less than 5 ha	**Small contiguous** patch** The patch is at least 0.5 ha and less than 2 ha, and is connected to a larger area of native vegetation of at least 5 ha	**Small patch** The patch is at least 0.5 ha and less than 2 ha
HIGH QUALITY **Predominantly native understorey** Non-native species comprise **less than 20%** of total understorey vegetation cover*	CATEGORY A A large patch that meets **key diagnostics** and has a predominantly native understorey	CATEGORY B A medium patch that meets **key diagnostics** and has a predominantly native understorey OR A small patch that meets **key diagnostics** and has a predominantly native understorey and is contiguous** with another large area of native vegetation		CATEGORY C A small patch that meets **key diagnostics** and has a predominantly native understorey
GOOD QUALITY **Mostly native understorey** Non-native species comprise **less than 50%** of total understorey vegetation cover* AND transformer species*** comprise **less than 30%** of total understorey vegetation cover*	CATEGORY B A large patch that meets **key diagnostics** and has a mostly native understorey	CATEGORY C A medium patch that meets **key diagnostics** and has a mostly native understorey OR A small patch that meets **key diagnostics** and has a mostly native understorey and is contiguous** with another large area of native vegetation		
MODERATE QUALITY **Some native understorey** Non-native species comprise **less than 80%** of total understorey vegetation cover* AND transformer species*** comprise **less than 50%** of total understorey vegetation cover*	CATEGORY C A large or medium patch that meets **key diagnostics** and has some native understorey			

*Refers to total perennial understorey vegetation cover for the patch of the ecological community. Includes vascular plant species of all layers below the canopy with a life-cycle of more than two growing seasons. It includes herbs (graminoids and forbs), grasses, shrubs and juvenile plants of canopy species, but does not include annual plants, cryptogams, plant litter or exposed soil. Areas of little to no understorey vegetation cover (e.g. plant litter) are included if key diagnostics are met and non-native species are below thresholds.
**Contiguous means the patch is connected or in close proximity (within 30 m) to another area of native vegetation.
***Transformer species (e.g. *Chrysanthemoides monilifera, Asparagus* spp, *Pennisetum* spp, *Ipomoea* spp. etc.) are non-native plant species with the potential to permanently change the character, condition, form or nature of patches of the ecological community. See p. 43 for further information on weeds, including transformer species. Annual weeds, such as *Symphyotrichum subulatum* (saltmarsh aster), may be seasonally very abundant and temporarily restrict the development of native species, but would not be counted as transformer weeds in determining condition.

Figure 4. Condition thresholds, classes and categories for patches of Coastal Swamp Oak (Casuarina glauca) Forest of South-east Queensland and New South Wales (DoEE 2018).

4.1 Threatened Flora

Desktop analysis revealed a range of threatened flora as occurring or having the potential to occur on or within a 10 km radius of the Subject Site. Thorough targeted surveys were undertaken throughout the Subject Site for potentially occurring threatened flora which revealed two (2) *Callistemon linearifolius* individuals.

The following locally occurring species were assessed for their potential to occur on the Subject Site (**Table 6**).

Table 6. Likelihood of Occurrence of Threatened Flora Species Within the Subject Site.

Species	BC Act	EPBC Act	Number of historical records within 10km of the Subject Site	Habitat Requirements (DPIE 2020b)	Likelihood of Occurrence
Acacia bynoeana (Bynoe's Wattle)	Endangered	Vulnerable	11	Occurs in heath or dry sclerophyll forest on sandy soils. Prefers open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches.	Low. The Subject Site does not occur in heath or dry sclerophyll forest. The vegetation within the Subject Site is dense and weed infested, making the occurrence of this species unlikely. No individuals were located within the Subject Site during field survey.
Acacia terminalis subsp. *terminalis* (Sunshine Wattle)	Endangered	Endangered	206	Coastal scrub and dry sclerophyll woodland on sandy soils. Habitat is generally sparse and scattered. Most areas of habitat or potential habitat are small and isolated. Most sites are highly modified or disturbed due to surrounding urban development. Flowers in autumn but may be through to early winter. Seed viability is high and recruitment occurs mainly after fire. A fire temperature of 60 degrees is required for optimum germination. Although plants are	Low. The habitat requirements of this species (coastal scrub and dry sclerophyll woodland) were not present within the Subject Site. No individuals were located within the Subject Site during field survey.

Species	BC Act	EPBC Act	Number of historical records within 10km of the Subject Site	Habitat Requirements (DPIE 2020b)	Likelihood of Occurrence
				killed by fire, they have been recorded sprouting from the base.	
Caladenia tessellata (Thick Lip Spider Orchid)	Endangered	Vulnerable	2	Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Low. Although this species is known to occur on sandy soils, which were present within the Subject Site, the highly disturbed nature of the Subject Site also makes the occurrence of this threatened plant highly unlikely.
Callistemon linearifolius (Netted Bottle Brush)	Vulnerable	-	5	The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. Three of the remaining populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve and Spectacle Island Nature Reserve.	**Present.** A targeted survey revealed two (2) individuals (**Figure 3**; **Appendix C**).
Chamaesyce psammogeton (Sand Spurge)	Endangered	-	4	Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex (*Spinifex sericeus*) and Prickly Couch (*Zoysia macrantha*).	Low. The Subject Site does not occur on foredunes. No individuals were located within the Subject Site during field survey.
Epacris purpurascens var. purpurascens	Vulnerable	-	2	Found in a range of habitat types, most of which have a strong shale soil influence. Lifespan is recorded to be 5-20 years, requiring 2-4 years before seed is produced in the wild. Killed by fire and re-establishes from soil-stored seed.	Low. Given the degraded and weed dominated groundlayer the occurrence of this species is unlikely. No individuals of the *Epacris* genus were identified within the Subject Site.

Species	BC Act	EPBC Act	Number of historical records within 10km of the Subject Site	Habitat Requirements (DPIE 2020b)	Likelihood of Occurrence
Eucalyptus camfieldii (Camfield's Stringybark)	Vulnerable	Vulnerable	17	This species occurs in poor coastal country in shallow sandy soils overlying Hawkesbury sandstone.	Low. The habitat for this species does not occur within the Subject Site. No individuals were located within the Subject Site during field survey.
Eucalyptus nicholii (Narrow-leaved Black Peppermint)	Vulnerable	Vulnerable	4	This species is geographically restricted to the New England Tablelands, however is commonly planted as urban trees within the Sydney region. It typically grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or metasedimentary rock.	Low. The Subject Site does also not occur within the natural distribution of this species. No individuals were located within the Subject Site during field survey.
Genoplesium baueri (Bauer's Midge Orchid)	Endangered	Endangered	1	Grows in dry sclerophyll forest and moss gardens over sandstone. Flowers February to March.	Low. The associated habitat for this species (dry sclerophyll forest) does not occur within the Subject Site. Furthermore, the highly disturbed nature of the Subject Site also makes the occurrence of this threatened plant highly unlikely.
Grevillea caleyi (Caley's Grevillea)	Endangered	Critically Endangered	7	Restricted to an 8 km square area around Terrey Hills, approximately 20 km north of Sydney. Occurs in three major areas of suitable habitat, namely Belrose, Ingleside and Terrey Hills/Duffys Forest within the Ku-ring-gai, Pittwater and Warringah Local Government Areas. Commonly found in the endangered Duffys Forest ecological community	Low. The Subject Site does not occur within the Duffys Forest ecological community. No individuals were located within the Subject Site during field survey.

Species	BC Act	EPBC Act	Number of historical records within 10km of the Subject Site	Habitat Requirements (DPIE 2020b)	Likelihood of Occurrence
Hibbertia superans	Endangered	-	1	The species occurs on sandstone ridgetops often near the shale/sandstone boundary. Occurs in both open woodland and heathland, and appears to prefer open disturbed areas, such as tracksides.	Low. The Subject Site does not occur on a sandstone ridgetop near the shale/sandstone boundary. No individuals were located within the Subject Site during field survey.
Melaleuca biconvexa (Biconvex Paperbark)	Vulnerable	Vulnerable	1	This species generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects	Moderate. The Subject Site occurs near a stream in low-lying areas. A targeted survey was undertaken, however no individuals were identified.
Microtis angusii (Angus' Onion Orchid)	Endangered	Endangered	2	It is not easy to define the preferred natural habitat of this orchid as the Ingleside location is highly disturbed. The dominant species occurring on the site are introduced weeds *Hyparrhenia hirta* (Coolatai grass) and *Acacia saligna*. The Ingleside population occurs on soils that have been modified but were originally those of the restricted ridgetop lateritic soils in the Duffys Forest - Terrey Hills - Ingleside and Belrose areas. These soils support a specific and distinct vegetation type, the Duffys Forest Vegetation Community which is listed as an endangered ecological community under the BC Act and ranges from open forest to low open forest and rarely woodland.	Low. The Subject Site does not occur within the Duffys Forest Vegetation Community. Furthermore, the highly disturbed nature of the Subject Site also makes the occurrence of this threatened plant highly unlikely.

Species	BC Act	EPBC Act	Number of historical records within 10km of the Subject Site	Habitat Requirements (DPIE 2020b)	Likelihood of Occurrence
Persoonia hirsuta (Hairy Geebung)	Endangered	Endangered	26	The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. It is usually present as isolated individuals or very small populations.	Low. Appropriate habitat requirements were not identified within the Subject Site. No individuals were located within the Subject Site during field survey.
Pimelea curviflora var. *curviflora*	Vulnerable	Vulnerable	29	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowland Grassy Woodland habitat at Albion Park on the Illawarra coastal plain.	Low. Appropriate habitat requirements were not identified within the Subject Site. No individuals were located within the Subject Site during field survey.
Prostanthera marifolia (Seaforth Mintbush)	Critically Endangered	Critically Endangered	171	Occurs in localised patches in or in close proximity to the endangered Duffys Forest ecological community. Located on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses, a soil type which only occurs on ridge tops and has been extensively urbanised.	Low. The associated ecological community and soil landscape do not occur within the Subject Site. No individuals were located within the Subject Site during field survey.
Rhodamnia rubescens (Scrub Turpentine)	Endangered	-	1	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. This species is characterised as highly to extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.	Low. The degraded and weedy nature of the Subject Site makes the occurrence of this threatened plant highly unlikely. A targeted survey was undertaken however no individuals were identified.

Species	BC Act	EPBC Act	Number of historical records within 10km of the Subject Site	Habitat Requirements (DPIE 2020b)	Likelihood of Occurrence
Senecio spathulatus (Coast Groundsel)	Endangered	-	1	Coast Groundsel grows on frontal dunes.	Low. The Subject Site does not occur on frontal dunes. No individuals were located within the Subject Site during field survey.
Syzygium paniculatum (Magenta Lilly Pilly)	Endangered	Vulnerable	36	On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Low. No such habitat was identified within the Subject Site. No individuals were located within the Subject Site during field survey.
Tetratheca glandulosa	Vulnerable	-	90	Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone, with associated soil landscapes such as Lucas Heights, Gymea, Lambert and Faulconbridge. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches.	Low. The associated habitat requirements and soil landscapes do not occur within the Subject Site. No individuals were located within the Subject Site during field survey.

4.2 Threatened Fauna

A number of habitat features were present within the Subject Site, including rock crevices and dense shrubbery (**Table 7**). Desktop analysis revealed that a number of threatened fauna species have the potential to utilise such habitat within the Subject Site during part of their lifecycles (**Table 8**).

A few predominantly native, common avian and reptile fauna species were identified within and surrounding the Subject Site during the site assessment. All native fauna species encountered were listed as 'protected' under the BC Act (**Appendix A**). No threatened fauna species were observed within the Subject Site by the Narla Ecologist during the site assessment in November, 2020.

Table 7. Fauna habitat values.

Habitat component	Site values
Coarse woody debris	Absent.
Rock outcrops and bush rock	Rocky areas were present throughout the Subject Site, which is an important component of the structure of forests and woodlands and provides refuge habitat for ground-dwelling fauna.
Caves, crevices and overhangs	Rocky crevices were present throughout the Subject Site which provides refuge habitat for reptiles.
Culverts, bridges, mine shafts, or abandoned structures	One (1) culvert was present on the southern end of the Subject Site, which could provide potential roosting habitat for microbats such as *Myotis macropus* (Southern Myotis).
Nectar/lerp-bearing Trees	Many nectar-bearing trees were recorded within the Subject Site including Sydney Redgum, Sydney Blue Gum and Swamp Mahogany. These trees may provide intermittent nectar and/or lerp sources for nomadic nectivores, such as Grey-headed Flying-fox.
Nectar-bearing shrubs	Nectar-bearing shrubs were recorded within the Subject Site including Heath-leaved Banksia and Black Wattle. These trees may provide intermittent nectar and/or lerp sources for similar nectivores.
Koala and Greater Glider browse	The following Koala feed trees were identified on the Subject Site: *Eucalyptus robusta.* Although, the lack of recent, proximal records of this distinct arboreal mammal suggests the potential for Koala presence is low. The Eucalypt species are also potential feed trees for the Greater Glider, but there is also a lack of recent, proximal records.
Large stick nests	No large stick nests suitable for threatened raptorial birds of prey were observed on the Subject Site.
Sap and gum sources	Native sap and gum source trees were recorded within the Subject Site including Sydney Redgum, Sydney Blue Gum and Swamp Mahogany.
She-oak fruit (Glossy Black Cockatoo feed)	*Casuarina cunninghamiana* and *Casuarina glauca* were present, which may provide foraging habitat for Glossy Black Cockatoos. However, the lack of recent, proximal records of this distinct parrot suggests the potential for Glossy Black Cockatoo presence is low.
Seed-bearing trees and shrubs	Seed-bearing trees such as Eucalypt species may provide foraging habitat for Gang-gang Cockatoo.
Soft-fruit-bearing trees	Some some-fruit-bearing trees were identified within the Subject Site such as *Pittosporum undulatum* (Sweet Pittosporum) and may provide potential foraging habitat for bird species.

Habitat component	Site values
Dense shrubbery and leaf litter	Dense thickets of *Lantana camara* and areas of dense grasses could provide habitat for birds and ground-dwelling fauna.
Tree hollows	Absent.
Decorticating bark	Absent.
Wetlands, soaks and streams	Brookvale Creek, a Strahler third order creek, runs through the Subject Site, providing potential habitat to a plethora of aquatic invertebrates, freshwater birds, amphibians and reptiles.
Open water bodies	Brookvale Creek, a Strahler third order creek, runs through the Subject Site, providing potential habitat to a plethora of aquatic invertebrates, freshwater birds, amphibians and reptiles.
Estuarine, beach, mudflats, and rocky foreshores	Brookvale Creek, a Strahler third order creek, runs through the Subject Site. Given its proximity to Manly Lagoon, this stream would have some saline influence and estuarine characteristics but would not classify as an estuary. The creek is now however greatly modified (channelised, culverts etc.) and as such does not meander naturally.

4.2.1 Migratory Fauna Species

The following EPBC Act listed migratory fauna species were considered to potentially utilise habitat within or around the Subject Site for foraging or passage:

- *Cuculus optatus* (Oriental Cuckoo);
- *Hirundapus caudacutus* (White-throated Needletail);
- *Monarcha melanopsis* (Black-faced Monarch);
- *Motacilla flava* (Yellow Wagtail);
- *Myiagra cyanoleuca* (Satin Flycatcher); and
- *Rhipidura rufifrons* (Rufous Fantail).

Based on the heavily urbanised nature of the Subject Site, it is deemed that any potential occurrence of these species would be purely sporadic fly-ins. It is not deemed likely that future development within the Subject Site would result in a significant impact to any of these species.

Table 8. Likelihood of Occurrence of Threatened Fauna Species Within the Subject Site.

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
Anthochaera phrygia (Regent Honeyeater)	Critically Endangered	Critically Endangered	2	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years, flocks converge on flowering coastal woodlands and forests.	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	Low. The Subject Site is unlikely to provide suitable habitat as it has been heavily altered and is surrounded by urban development, with minimal canopy cover remaining in close proximity.
Artamus cyanopterus cyanopterus (Dusky Woodswallow)	Vulnerable	-	5	Dusky Woodswallows are widespread in eastern, southern and south western Australia. The species occurs throughout most of New South Wales, but is sparsely scattered	Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other	Low. The Subject Site is unlikely to provide suitable habitat as it has been heavily altered and is surrounded by urban development. The Subject Site does not contain course woody

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
				in, or largely absent from, much of the upper western region. Most breeding activity occurs on the western slopes of the Great Dividing Range.	shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland.	debris or dry open eucalypt forest. A small vegetated corridor fragmented by a large road to the south would be considered sub-optimal habitat for this species.
Botaurus poiciloptilus (Australasian Bittern)	Endangered	Endangered	1	Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west.	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. Feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. Nests are built in secluded places in densely-vegetated wetlands on a platform of reeds.	Low. The Subject Site is unlikely to provide suitable habitat as it has been heavily altered and is surrounded by urban development. The Subject Site does not occur in a densely vegetated wetland. A small vegetated corridor fragmented by a large road to the south would be considered sub-optimal habitat for this species.

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
Burhinus grallarius (Bush Stone-curlew	Endangered	-	9	The Bush Stone-curlew is 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. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch.	Low. The Subject Site is unlikely to provide suitable habitat as it has been heavily altered and is surrounded by urban development. The Subject Site does not have a sparse grassy groundlayer with fallen timber. A small vegetated corridor fragmented by a large road to the south would be considered sub-optimal habitat for this species.
Calidris alba (Sanderling)	Vulnerable	-	8	A regular summer migrant from Siberia and other Arctic breeding grounds to most of the Australian coastline. It is uncommon to locally common, arriving from September and leaving by May (some may overwinter in Australia). Sanderlings occur along the NSW coast, with occasional inland sightings.	Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands.	Low. No such habitat was identified within the Subject Site.
Calidris canutus (Red Knot)	-	Endangered	2	The Red Knot is a non-breeding migratory visitor from Arctic regions of Siberia. It is capable	In NSW the Red Knot mainly occurs in small numbers on intertidal mudflats, estuaries,	Low. No such habitat was identified within the Subject Site.

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
				of flying non-stop between north-eastern China and northern Australia. Birds arrive between September and October and leave between March and April, with a small number of individuals overwintering. In NSW, it is recorded in small numbers along some of the major river estuaries and sheltered embayment's of the coastline, in particular the Hunter River estuary.	bays, inlets, lagoons, harbours and sandflats and sandy beaches of sheltered coasts. It is occasionally found on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms and is a rare visitor to terrestrial saline wetlands and freshwater swamps. It usually forages near the water's edge, with feeding activity regulated by the tide as birds closely follow the tide-edge.	
Calidris ferruginea (Curlew Sandpiper)	Endangered	Critically Endangered	3	The Curlew Sandpiper is distributed around most of the Australian coastline (including Tasmania). It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Inland records are probably mainly of birds pausing for a few days during migration. The Curlew Sandpiper breeds in Siberia	It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. It roosts on	Low. No such habitat was identified within the Subject Site.

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
				and migrates to Australia (as well as Africa and Asia) for the non-breeding period, arriving in Australia between August and November, and departing between March and mid-April.	shingle, shell or sand beaches; spits or islets on the coast or in wetlands; or sometimes in salt marsh, among beach-cast seaweed, or on rocky shores.	
Calidris tenuirostris (Great Knot)	Vulnerable	Critically Endangered	4	In NSW, the species has been recorded at scattered sites along the coast down to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith.	Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. Forages for food by methodically thrusting its bill deep into the mud to search for invertebrates, such as bivalve molluscs, gastropods, polychaete worms and crustaceans.	Low. No such habitat was identified within the Subject Site.
Calyptorhynchus lathami (Glossy Black Cockatoo)	Vulnerable	-	20	The species is uncommon although widespread throughout suitable forest and	Inhabits open forest and woodlands of the coast and the Great Dividing Range where	Low. Whilst *Casuarina glauca* and *Casuarina cunninghamiana* occur, the

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
				woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia.	stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods.	Subject Site has been heavily altered and is surrounded by urban development. A small vegetated corridor fragmented by a large road to the south would be considered sub-optimal habitat for this species.
Cercartetus nanus (Eastern Pygmy Possum)	Vulnerable	-	411	The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes.	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.	Low. The Subject Site has been heavily altered and is surrounded by urban development. A small vegetated corridor fragmented by a large road to the south would be considered sub-optimal habitat for this species. This species requires tree hollows, rotten stumps, dense mid-storey vegetation and large vegetated areas as males have non-exclusive home-ranges of about 0.68 hectares and females about 0.35 hectares.

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
Chalinolobus dwyeri (Large-eared Pied Bat)	Vulnerable	Vulnerable	5	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel),* frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years.	Low. The Subject Site does not contain extensive areas of cliffs and caves. This species might forage within the Subject Site on occasion. A small vegetated corridor fragmented by a large road to the south would be considered sub-optimal habitat for this species.
Charadrius leschenaultia (Greater Sand-plover)	Vulnerable	Vulnerable	3	The Greater Sand-plover breeds in central Asia from Armenia to Mongolia, moving further south for winter. In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the	Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks.	Low. No such habitat was identified within the Subject Site.

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
				population. The species is apparently rare on the east coast, usually found singly. In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries.		
Charadrius mongolus (Lesser Sand-plover)	Vulnerable	Endangered	2	The Lesser Sand-plover breeds in central and north eastern Asia, migrating further south for winter. In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records.	Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms.	Low. No such habitat was identified within the Subject Site.
Daphoenositta chrysoptera (Varied Sittella)	Vulnerable	-	2	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands.	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-	Low. A small vegetated corridor fragmented by a large road to the south and surrounded by urban

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				Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades.	barked gums with dead branches, mallee and Acacia woodland.	development would be considered sub-optimal habitat for this species.
Dasyurus maculatus (Spotted-tailed Quoll)	Vulnerable	Endangered	2	The range of the Spotted-tailed Quoll has contracted considerably since European settlement. It is now found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. Only in Tasmania is it still considered relatively common.	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. Quolls use hollow-bearing trees, fallen logs, other animal burrows, small caves and rock outcrops as den sites.	Low. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat for this species. No hollows, course woody debris, small caves and rock outcrops were identified within the Subject Site.
Esacus magnirostris (Beach Stone-curlew)	Endangered	-	2	In NSW, the species occurs regularly to about the Manning River, and the small population of north-eastern NSW is at the limit of the normal range of the species in Australia.	Beach Stone-curlews are found exclusively along the coast, on a wide range of beaches, islands, reefs and in estuaries, and may often be seen at the edges of or near mangroves. They forage in the intertidal	Low. No such habitat was identified within the Subject Site.

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					zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves.	
Glossopsitta pusilla (Little Lorikeet)	Vulnerable	-	3	The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury. Nomadic movements are common, influenced by season and food availability, although some areas retain residents for much of the year and 'locally nomadic' movements are suspected of breeding pairs.	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species. Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe, and only rarely in orchards.	Moderate. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat for this species. The species is however nomadic and could use flowering eucalypts to forage.
Haematopus fuliginosus (Sooty Oystercatcher)	Vulnerable	-	19	Sooty Oystercatchers are found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Small	Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide for	Low. No such habitat was identified within the Subject Site.

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				numbers of the species are evenly distributed along the NSW coast. The availability of suitable nesting sites may limit populations.	foods such as limpets and mussels. Breeds in spring and summer, almost exclusively on offshore islands, and occasionally on isolated promontories.	
Haematopus longirostris (Pied Oystercatcher)	Endangered	-	8	The species is distributed around the entire Australian coastline, although it is most common in coastal Tasmania and parts of Victoria, such as Corner Inlet. In NSW the species is thinly scattered along the entire coast, with fewer than 200 breeding pairs estimated to occur in the State.	Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish. Nests mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas. Nests are shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones.	Low. No such habitat was identified within the Subject Site.
Haliaeetus leucogaster (White-bellied Sea-Eagle)	Vulnerable	-	29	The White-bellied Sea-eagle is distributed around the Australian coastline, including Tasmania, and well inland	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment with large

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				along rivers and wetlands of the Murray Darling Basin. In New South Wales it is widespread along the east coast, and along all major inland rivers and waterways.	sea. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest). Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'.	amounts of human activity. Additionally, no nests were identified during the site assessment.
Heleioporus australiacus (Giant Burrowing Frog)	Vulnerable	Vulnerable	3	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria.	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites,	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development and tidal/saline influences of Brookvale Creek. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be

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					some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.	considered sub-optimal habitat.
Hieraaetus morphnoides (Little Eagle)	Vulnerable	-	2	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW.	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	Low. The Subject Site has been heavily altered and is surrounded by urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat for this species.
Isoodon obesulus obesulus (Southern Brown Bandicoot)	Endangered	Endangered	4	The Southern Brown Bandicoot has a patchy distribution. It is found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, southern coastal Victoria and the Grampian Ranges, south-eastern South Australia, south-	Southern Brown Bandicoots are largely crepuscular (active mainly after dusk and/or before dawn). They are generally only found in heath or open forest with a heathy understorey on sandy or friable soils. They feed on a variety of ground-dwelling invertebrates	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be

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				west Western Australia and the northern tip of Queensland.	and the fruit-bodies of hypogeous (underground-fruiting) fungi. Their searches for food often create distinctive conical holes in the soil.	considered sub-optimal habitat for this species. The Subject Site also did not contain a heathy understorey.
Ixobrychus flavicollis (Black Bittern)	Vulnerable	-	5	The Black Bittern has a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. The species also occurs in the south-west of Western Australia. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night.	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat for this species.
Lathamus discolor (Swift Parrot)	Endangered	Critically Endangered	9	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations.	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented

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				Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes.	Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Forest Red Gum *E. tereticornis*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*. Commonly used lerp infested trees include Inland Grey Box *E. microcarpa*, Grey Box *E. moluccana*, Blackbutt *E. pilularis*, and Yellow Box *E. melliodora*.	by a large road to the south and surrounded by urban development would be considered sub-optimal habitat for this species. Few potential feed trees occur within the Subject Site.
Litoria aurea (Green and Golden Bell Frog)	Endangered	Vulnerable	2	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated.	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available.	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. Furthermore, the stream did not contain *Typha* spp. or *Eleocharis* spp. and was heavily shaded.

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Lophoictinia isura (Square-tailed Kite)	Endangered	-	3	In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March.	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. Appears to occupy large hunting ranges of more than 100km^2. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	Low. The highly urbanised environment of the Subject Site makes the presence of this raptor highly unlikely. No nests were identified during the site assessment.
Macronectes giganteus Southern (Giant Petrel)	Endangered	Endangered	2	The Southern Giant Petrel has a circumpolar pelagic range from Antarctica to approximately 20°S and is a common visitor off the coast of NSW.	Over summer, the species nests in small colonies amongst open vegetation on Antarctic and subantarctic islands, including Macquarie and Heard Islands, and in the Australian Antarctic territory.	Low. No such habitat was identified within the Subject Site.

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Macronectes halli (Northern Giant-Petrel)	Vulnerable	Vulnerable	1	The Northern Giant-Petrel has a circumpolar pelagic distribution, usually between 40-64°S in open oceans. Their range extends into subtropical waters (to 28°S) in winter and early spring, and they are a common visitor in NSW waters, predominantly along the south-east coast during winter and autumn.	Breeding in Australian territory is limited to Macquarie Island and occurs during spring and summer.	Low. No such habitat was identified within the Subject Site.
Micronomus norfolkensis (Eastern Coastal Free-tailed Bat)	Vulnerable	-	1	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW.	Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures.	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat for this species. This species may forage in the Subject Site on occasion however no tree hollows were identified.

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Miniopterus australis (Little Bent-winged Bat)	Vulnerable	-	20	East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW.	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Low. No suitable roosting or breeding habitat exists within the Subject Site. The highly urbanised and fragmented vegetation of the Subject Site is considered sub-optimal foraging habitat.
Miniopterus orianae oceanensis (Large Bent-winged Bat)	Vulnerable	-	1	Large Bent-winged Bats occur along the east and north-west coasts of Australia.	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Breeding or roosting colonies can number from 100 to 150,000 individuals. Hunt in forested areas, catching moths and other flying insects above the tree tops.	Low. No suitable roosting or breeding habitat exists within the Subject Site. The highly urbanised and fragmented vegetation of the Subject Site is considered sub-optimal foraging habitat.
Myotis Macropus (Southern Myotis)	Vulnerable	-	22	The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels,	Moderate. Roosting habitat exists in the nearby culvert. The highly urbanised and fragmented vegetation of the Subject Site is however

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				found more than 100 km inland, except along major rivers.	buildings, under bridges and in dense foliage.	considered sub-optimal foraging habitat.
Neophema pulchella (Turquoise Parrot)	Vulnerable	-	1	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range.	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat for this species.
Ninox connivens (Barking Owl)	Vulnerable	-	2	The Barking Owl is found throughout continental Australia except for the central arid regions.	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by

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					habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance.	urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat for this species. This species may forage in the Subject Site on occasion however no tree hollows were identified.
Ninox strenua (Powerful Owl)	Vulnerable	-	224	The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with	The species breeds and hunts in open or closed sclerophyll forest or woodlands and hunts small mammals. It roosts by day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*,	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be

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				scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low densities throughout most of its eastern range, rare along the Murray River and former inland populations may never recover.	Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angophora floribunda*, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species. This species favours hollows >20cm in diameter.	considered sub-optimal habitat for this species. This species may forage in the Subject Site on occasion however no tree hollows were identified.
Numenius madagascariensis (Eastern Curlew)	-	Critically Endangered	1	Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Eastern Curlews are rarely recorded inland. In NSW the species occurs across the entire coast but is mainly found in estuaries such as the Hunter River, Port Stephens, Clarence River, Richmond River and ICOLLs of the south coast.	It generally occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed.	Low. No such habitat was identified within the Subject Site.

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Onychoprion fuscata (Sooty Tern)	Vulnerable	-	2	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 cyclone	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.	Low. No such habitat was identified within the Subject Site.
Pandion cristatus (Eastern Osprey)	Vulnerable	-	11	Common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas.	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	Low. No such habitat was identified within the Subject Site.
Perameles nasuta (Long-nosed Bandicoot, North Head)	Endangered Population	-	2296	Restricted to North Head in the Manly Local Government Area.	Essentially a solitary animal that occupies a variety of habitats on North Head. Forages mainly at or after dusk, digging for invertebrates, fungi and tubers. The conical holes it leaves in the soil are often seen at the interface of naturally vegetated and areas of open grass around the Quarantine	Low. The Subject Site occurs outside of the known distribution of this endangered population.

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					Station, former Defence Lands and Saint Patrick's Estate.	
Petroica boodang (Scarlet Robin)	Vulnerable	-	2	The Scarlet Robin is found from south east Queensland to south east South Australia and also in Tasmania and south west Western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter.	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat.	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat. Furthermore, no logs or fallen timber was identified within the Subject Site.
Phascolarctos cinereus (Koala)	Vulnerable	Vulnerable	6	The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In New South Wales, koala populations are found on the central and north coasts, southern highlands, southern	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 browse species.	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be

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				and northern tablelands, Blue Mountains, southern coastal forests, with some smaller populations on the plains west of the Great Dividing Range.		considered sub-optimal habitat. Eucalypt species were scattered sparsely through a canopy dominated by mostly *Casuarina glauca.*
Pseudomys novaehollandiae (New Holland Mouse)	-	Vulnerable	2	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland.	Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. The Subject Site lacked a heathland understorey.
Pseudophryne australis (Red-crowned Toadlet)	Vulnerable	-	82	The Red-crowned Toadlet has a restricted distribution. It is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains.	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.	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development and tidal/saline influences of Brookvale Creek. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat.

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Pterodroma leucoptera leucoptera (Gould' Petrel)	Vulnerable	Endangered	2	Breeds on both Cabbage Tree Island, 1.4 km offshore from Port Stephens and on nearby Boondelbah island. The range and feeding areas of non-breeding petrels are unknown.	Principal nesting habitat is located within two gullies which are characterised by steeply, sloping rock scree with a canopy of Cabbage Tree Palms. They nest predominantly in natural rock crevices among the rock scree and also in hollow fallen palm trunks, under mats of fallen palm fronds and in cavities among the buttresses of fig trees.	Low. No such habitat occurs was identified within the Subject Site.
Pteropus poliocephalus (Grey-headed Flying Fox)	Vulnerable	Vulnerable	349	Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations.	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. Individual camps may have tens of thousands of animals and are	Low-Moderate – No roosting camps were observed within the Subject Site although the mobile species may visit the Subject Site to forage.

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					used for mating, and for giving birth and rearing young. This species feeds on the nectar and pollen of native trees, in particular *Eucalyptus*, *Melaleuca* and *Banksia*, and fruits of rainforest trees and vines.	
Ptilinopus magnificus (Wompoo Fruit-Dove)	Vulnerable	-	1	Occurs along the coast and coastal ranges from the Hunter River in NSW to Cape York Peninsula. It is rare south of Coffs Harbour. Three subspecies are recognised, with the most southerly in NSW and south-eastern Queensland. It used to occur in the Illawarra, though there are no recent records.	Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests. Feeds on a diverse range of tree and vine fruits and is locally nomadic - following ripening fruit. Thought to be an effective medium to long-distance vector for seed dispersal.	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat.
Ptilinopus regina (Rose-crowned Fruit-Dove)	Vulnerable	-	2	Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria.	Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. They feed entirely on fruit from	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented by a large road to the south

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
					vines, shrubs, large trees and palms, and are thought to be locally nomadic as they follow the ripening of fruits.	and surrounded by urban development would be considered sub-optimal habitat. Vines and fruit producing trees were not abundant throughout the Subject Site.
Ptilinopus superbus (Superb Fruit-Dove)	Vulnerable	-	3	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. It is much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya. There are records of vagrants as far south as eastern Victoria and Tasmania.	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.	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat. No fig trees or large fruit-bearing palms were present in the Subject Site.
Puffinus assimilis (Little Shearwater)	Vulnerable	-	2	A widespread species in the subtropical Atlantic, Pacific and Indian Oceans. Lord Howe Island has one of the larger breeding colonies in the Australian region.	Marine Breeding sites at Lord Howe Island include Roach Island, Muttonbird Island, Blackburn Island and on the main Island at Muttonbird Point and Transit Hill.	Low. No such habitat occurs was identified within the Subject Site.

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
Scoteanax rueppellii (Greater Broad-nosed Bat)	Vulnerable	-	1	The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m.	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat. No abandoned building or tree hollows were identified within the Subject Site.
Sternula albifrons (Little Tern)	Endangered	-	2	Migrating from eastern Asia, the Little Tern is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria.	Almost exclusively coastal, preferring sheltered environments; however, may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands. Often seen feeding in	Low. No such habitat occurs was identified within the Subject Site.

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
					flocks, foraging for small fish, crustaceans, insects, worms and molluscs by plunging in the shallow water of channels and estuaries, and in the surf on beaches, or skipping over the water surface with a swallow-like flight.	
Thalassarche cauta (Shy Albatross)	Vulnerable	Vulnerable	1	This species is circumpolar in distribution, occurring widely in the southern oceans. Islands off Australia and New Zealand provide breeding habitat. In Australian waters, the Shy Albatross occurs along the east coast from Stradbroke Island in Queensland along the entire south coast of the continent to Carnarvon in Western Australia. Although uncommon north of Sydney, the species is commonly recorded off southeast NSW, particularly between July and November, and has been recorded in Ben Boyd National Park.	This pelagic or ocean-going species inhabits subantarctic and subtropical marine waters, spending the majority of its time at sea. While at sea, it soars on strong winds and when calm, individuals may rest on the ocean, in groups during the breeding season or as individuals at other times.	Low. No such habitat occurs was identified within the Subject Site.

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
Thalassarche melanophris (Black-browed Albatross)	Vulnerable	Vulnerable	2	The Black-browed Albatross has a circumpolar range over the southern oceans, and are seen off the southern Australian coast mainly during winter. This species migrates to waters off the continental shelf from approximately May to November and is regularly recorded off the NSW coast during this period. The species has also been recorded in Botany Bay National Park.	Inhabits Antarctic, subantarctic, subtropical marine and coastal waters over upwellings and boundaries of currents.	Low. No such habitat occurs was identified within the Subject Site.
Tyto novaehollandiae (Masked Owl)	Vulnerable	-	2	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution.	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats.	Low. The Subject Site is unlikely to provide suitable habitat due to the heavily altered environment surrounded by urban development. A small vegetated corridor fragmented by a large road to the south and surrounded by urban development would be considered sub-optimal habitat.
Varanus rosenbergi	Vulnerable	-	47	Rosenberg's Goanna occurs on the Sydney Sandstone in	Found in heath, open forest and woodland. Associated with	Low. The Subject Site is unlikely to provide suitable habitat

Species	BC Act	EPBC Act	Number of Historical Records within 10km of the Subject Site	Distribution (DPIE 2020b)	Habitat and Ecology (DPIE 2020b)	Likelihood of Occurrence
(Rosenberg's Goanna)				Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River. Also occurs in South Australia and Western Australia.	termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat. Feeds on carrion, birds, eggs, reptiles and small mammals. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens.	considering it does not contain heath, open forest and/or woodland. Furthermore, no termite mounds were present.
Vespadelus troughtoni (Eastern Cave Bat)	Vulnerable	-	1	The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT.	A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest.	Low. No such habitat occurs was identified within the Subject Site.

5. Recommendations

5.1 Avoidance of Impacts

5.1.1 Swamp Oak Floodplain Forest Endangered Ecological Community

The vegetation mapped as S_FoW08: Estuarine Swamp Oak Forest within the Subject Site (**Figure 3**) conforms to the BC Act listed EEC 'Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions' and the EPBC listed Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales. If proposed works will involve the clearing of the EEC within the Subject Site, an 'Assessment of Significance', also known as a '5-part test', will be required in order to determine whether the proposed activity will have a significant impact on the threatened ecological community. An assessment of significance of impact from the proposed works on Matters of National Environmental Significance (MNES) EPBC Act Assessment of Significant Impact Criteria will also be required.

If it is deemed that the proposed works will have a significant impact on this ecological community, further assessment of impacts pursuant to the BC Act (e.g. Biodiversity Development Assessment Report) will be required.

5.1.2 Threatened Flora *Callistemon linearifolius*

An 'Assessment of Significance', also known as a '5-part test', will also be required if proposed works will have any direct or indirect impacts on the *Callistemon linearifolius* within the Subject Site. If it is deemed that the proposed works will have a significant impact on this species, further assessment of impacts pursuant to the BC Act (e.g. Biodiversity Development Assessment Report) will be required.

5.2 Biodiversity Constraints Mapping

Narla has mapped the Subject Site into two (2) levels of 'Biodiversity Development Constraints'. The interpretation of each zone is detailed in **Table 9**. This map was produced using information gathered from both desktop assessment of existing/historical mapping and data obtained from fieldwork undertaken by the Narla Ecologist. It is to be used as a guide only and a strong degree of caution must be expressed when interpreting it. This map is presented in **Figure 5**.

Table 9. Biodiversity development constraints mapping key.

Zone	Description
Moderate Constraints Area - Orange	This zone is deemed to have medium potential for future development with accompaniment of the appropriate environmental assessments and implementation of appropriate restrictions and guidelines (e.g. the implementation of a Vegetation Management Plan). This zone encompasses: ▪ The Vegetated Riparian Zone (VRZ) for a 3rd order stream (30m each side of watercourse).
High Constraints Area - Red	This zone is deemed to have a low potential for future development without the implementation of impact mitigation strategies. This zone encompasses: ▪ Threatened species habitat; and ▪ Swamp Oak Floodplain Forest (SOFF) in the Sydney Basin Bioregion EEC.

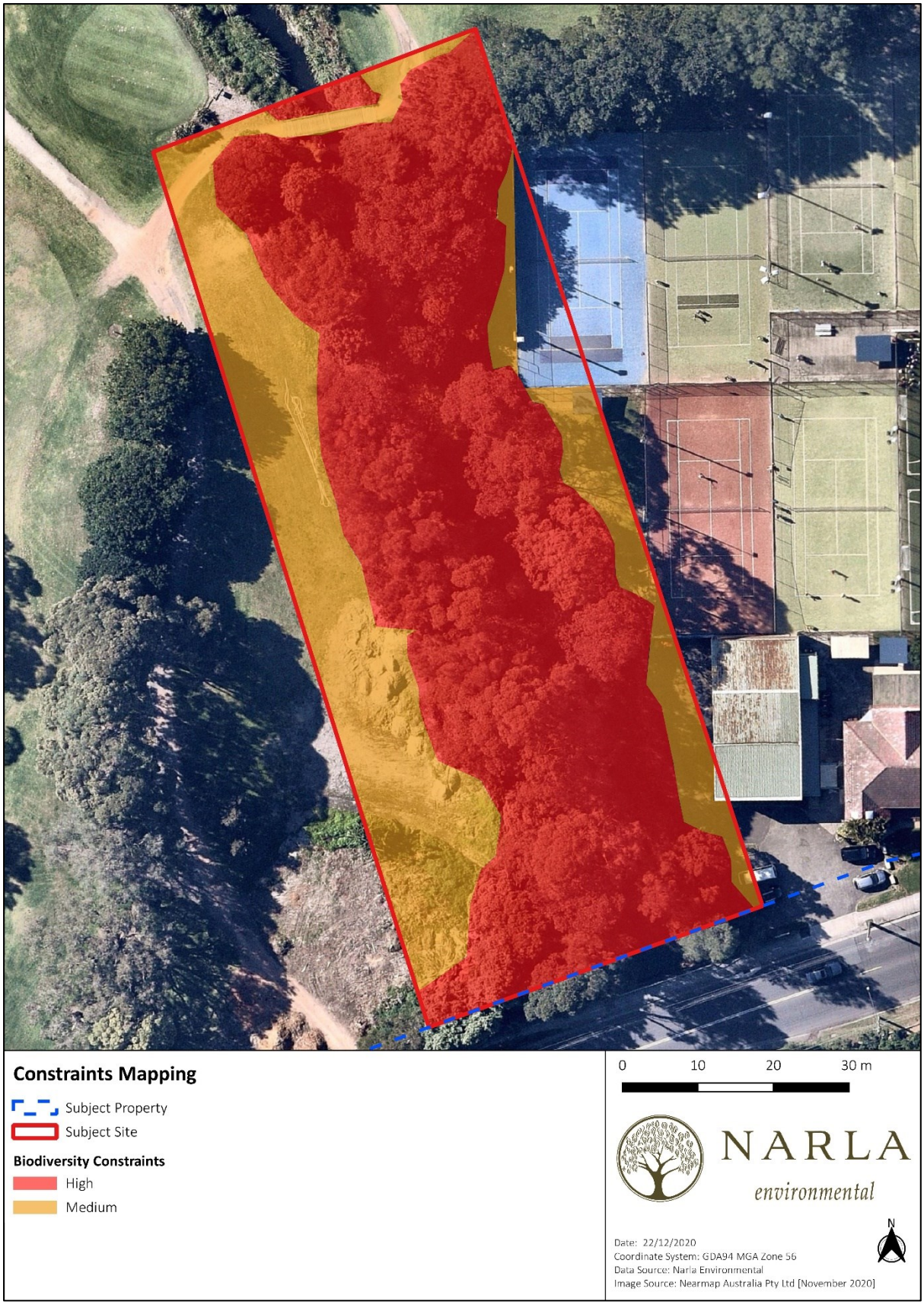

Figure 5. Biodiversity development constraints mapped within the Subject Site.

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7. Appendices

Appendix A. Flora species identified within the Subject Site.

Appendix B. Fauna species identified within and surrounding the Subject Site.

Appendix A. Flora species identified within the Subject Site.

Scientific Name	Groundcover	Mid-Story	Canopy
Acacia longifolia		x	
*Ageratina adenophora**			x
Angophora costata	x		
Banksia ericifolia		x	
Brachychiton acerifolius		x	
*Briza maxima**			x
*Bromus catharticus**			x
Callicoma serratifolia		x	
Callistemon linearifolius		x	
Callistemon salignus		x	
Callistemon viminalis		x	
Calochlaena dubia			x
Casuarina cunninghamiana	x		
Casuarina glauca	x		
*Cinnamomum camphora**		x	
Cissus antarctica			x
Commelina cyanea			x
*Conyza bonariensis**			x
Cyathea cooperi		x	
*Cyclospermum leptophyllum**			x
Cynodon dactylon			x
Dianella caerulea			x
*Ehrharta erecta**			x
Eucalyptus robusta	x		
Eucalyptus saligna	x		
Gahnia sp.			x
Homalanthus populifolius		x	
*Hydrocotyle bonariensis**			x
Hypolepis sp.			x
*Ipomea indica**			x
*Lantana camara**		x	
Leptospermum sp.		x	
Livistona australis		x	
Lomandra longifolia			
*Lysimachia arvensis**			x
Melaleuca quinquinervia	x		
Melaleuca linariifolia		x	
*Murraya paniculata**		x	
*Nephrolepis cordifolia**			x
*Nothoscordum gracile**			x
*Parietaria Judaica**			x
Persicaria sp.			x
Phragmites australis		x	

Scientific Name	Groundcover	Mid-Story	Canopy
Pittosporum undulatum		x	
*Rumex sagittatus**			x
*Setaria palmifolia**			x
*Sida rhombifolia**			x
*Tradescantia fluminensis**			x
*Tradescantia pallida**			x
*Tropaeolum majus**			x
*Vicia sativa**			x
Viola hederacea			x

** Denotes exotic species*

Appendix B. Fauna species identified within and surrounding the Subject Site.

Class	Scientific Name	Common Name	Status
Aves	*Cacatua galerita*	Sulphur-crested Cockatoo	Protected
	Corvus coronoides	Australian Raven	
	Dacelo novaegunieae	Laughing Kookaburra	
	Eudynamys orientalis	Eastern Koel	
	Manorina melanocephala	Noisy Miner	
	Scythrops novaehollandiae	Channel-billed Cuckoo	
	Trichoglossus haematodus	Rainbow Lorikeet	
	Vanellus miles	Masked Lapwing	
Reptilia	*Intellagama lesueurii*	Eastern Water Dragon	

Appendix C. Confirmation of *Callistemon linearifolius* from the National Herbarium of NSW.

The Royal Botanic Gardens & Domain Trust

National Herbarium of New South Wales

Sarah CARDENZANA
Narla Environmental
Unit 2/8 Apollo Street
Warriewood, NSW 2102

BIS Enquiry No: 21533
Botanical.Is@rbgsyd.nsw.gov.au
Ph. No: (02) 9231 8111
Date: 15 February 2021

Dear Sarah,

Re: plant identification – specimen from creekline adjacent to Warringah Recreation Centre

Your specimen has been determined as:

Callistemon linearifolius - det. Peter G. Wilson – 27th Jan 2021 – some of the flowers in the upper part of the inflorescence are axillary in regular-sized leaves, this is sometimes a feature of hybrids.

We have retained this specimen for the herbarium collection – registration no. NSW1101291.

Thank you for your enquiry.

Yours sincerely

Andrew Orme
Identification Technical Officer
Botanical Information Service

PlantNET

Go to our online Botanical Information Services at plantnet.rbgsyd.nsw.gov.au to find out more about plants of New South Wales

NSW Government | Planning, Industry & Environment

The Botanical Information Email address is Botanical.Is@rbgsyd.nsw.gov.au
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