AEP

ECOLOGY | BIOBANKING | OFFSETS | BUSHFIRE

BUSHFIRE THREAT ASSESSMENT

FOR

PROPOSED RESIDENTIAL DEVELOPMENT AT

8 FOREST ROAD, WARRIEWOOD NSW

Prepared for: **Jackson Teece**

October 2020

AEP Ref: No 1377.01

Rev: 01

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1.0 Introduction

A residential subdivision is proposed within land identified as 8 Forest Road Warriewood, NSW (the Subject Site). At the request of Michelle Ramjan on behalf of Jackson Teece (the client), Anderson Environment & Planning (AEP) have undertaken the necessary investigations to inform the production of a Bushfire Threat Assessment (BTA) report addressing the proposed development.

This report is specifically intended to assess the bushfire protection measures required by the NSW Rural Fire Service's "Planning for Bushfire Protection 2019" (PBP) and the construction requirements of the proposed development in accordance with the provisions of the Building Code of Australia – Volume 2, Edition 2010 and Australian Standard 3959-2009 (AS 3959) – *"Construction of buildings in bushfire-prone areas"*.

The proposal will involve subdivision for residential purposes as per 100B of the *Rural Fires Act 1997* (RF Act). As a result, a Bushfire Safety Authority (BSA) is required from the Rural Fire Service (RFS) to enable the development to proceed. This report addresses the required heads of consideration relevant to obtaining a BSA.

For the purposes of referencing, this document should be referred to as:

> Anderson Environment & Planning (2020). *Bushfire Threat Assessment for Proposed Residential Development at 8 Forest Road Warriewood, NSW.* Unpublished report for Jackson Teece, August 2020.

2.0 Site Particulars

- **Address** – 8 Forest Road Warriewood, NSW
- **Lot / DP** – Lot 1 DP 5055
- **LGA** – Northern Beaches Council
- **Subject Site** – The Subject Site covers approx. 5.6ha. It currently consists of an abandoned residence, 3.24ha of native remnant vegetation, a highly disturbed area that has been the subject of clearing and Narrabeen Creek runs along the northern boundary of the site.
- **Zoning** – R3 – Medium Density Residential, RE1 – Public Recreation and RU2 – Rural Landscape.
- **Current Land Use** – Residential lot with abandoned dwelling.
- **Surrounding Land Use** – Narrabeen Creek runs along the northern boundary of the site with associated riparian vegetation and is zoned RE1 – Public Recreation, to the south and west exists a large area of contiguous native vegetation zoned E2 – Environmental Conservation. Also, to the south is Mater Maria Catholic College, to the east areas of residential development zoned R3 – Medium Density Residential and to the north is native vegetation adjoining the site, industrial development zoned IN2 – Light Industrial and land zoned B7 – Business Park.

Figure 1 depicts the extent of the subject site overlain on an aerial photograph of the locality.

AEP

Title: Figure 1 - Site Location

Date: August 2020

Location: Forest Road, Warriewood

Client: Jackson Teece

AEP Ref: 1377.01

3.0 Proposed Development

The proposed development will be undertaken in 2 stages:

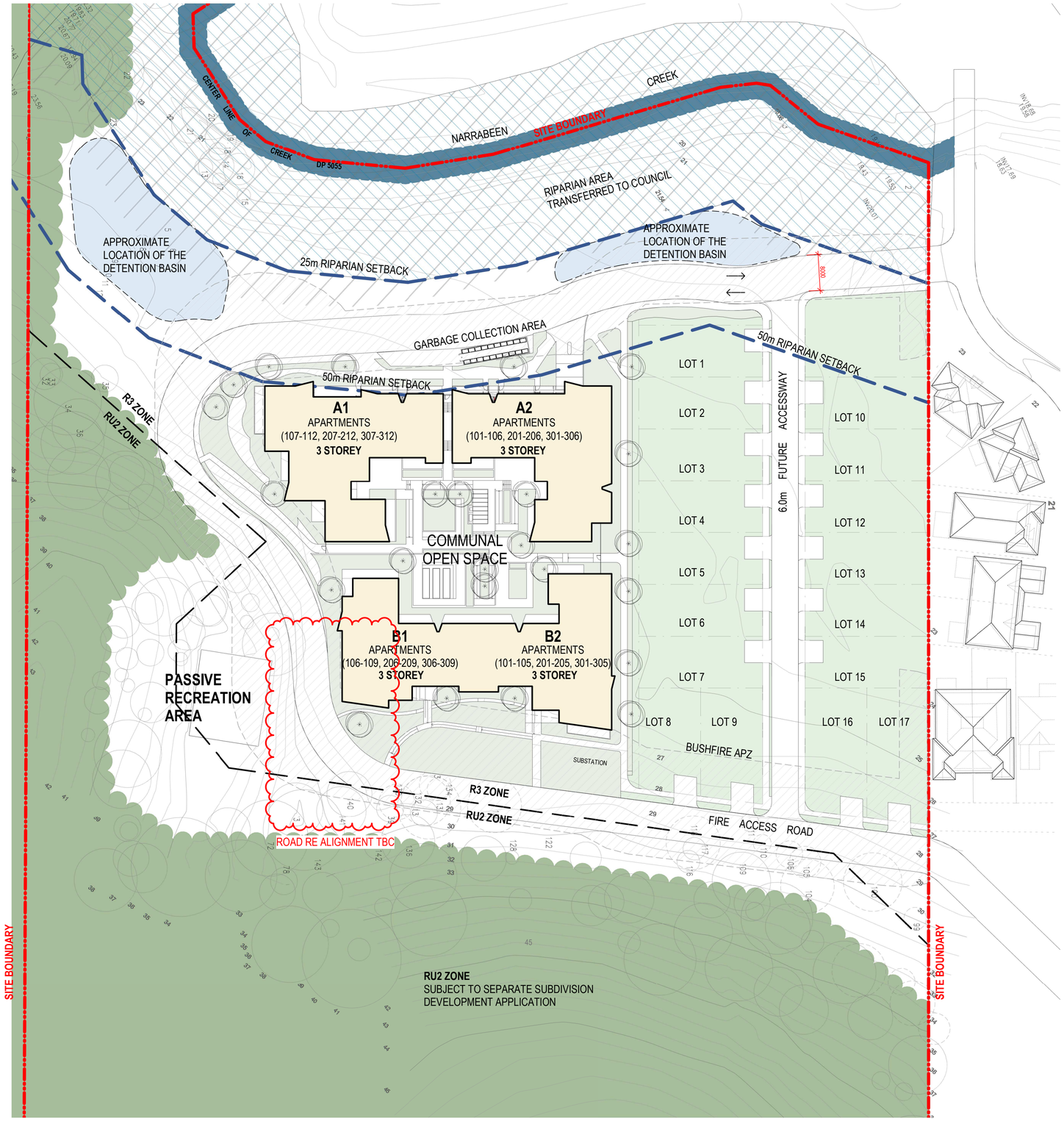
- **Stage 1**: demolition of the existing dwelling, construction of internal roads, and subdivision of land to provide 17 Torrens title residential lots, one superlot, two lots for the construction of private internal roads with associated civil and stormwater works and one community lot.
- **Stage 2**: construction of a residential flat building within the superlot. The proposed building comprises 64 residential apartment units with a single level basement car park.

Proposed development includes:

- A three-storey residential apartment building comprising 64 units with central courtyard and a single level basement carpark.
- Seventeen subdivision lots allocated for low density housing.
- Two above ground bioretention/detention basins and one below ground OSD tank.

Approximately 0.33ha of native vegetation is proposed to be totally cleared for development and Asset Protection Zone.

Figure 2 depicts an indicative proposed development plan within the Subject Site.



SITE SUMMARY

- TOTAL SITE AREA: 5.680 Ha
- RU2 SITE AREA: 2.823 Ha
- R3 SITE AREA: 2.855 Ha
- LANDSCAPE AREA: 2,354.7m^2
- TOTAL FOOTPRINT AREA: 9,306.4m^2
- PRIVATE OPEN SPACE: 1,353.9m^2

DEVELOPMENT SUMMARY

BUILDING A1

- 18 APARTMENTS
- 3 STOREYS
- MAX. HEIGHT 10.5m
- 15 x 2 BED
- 3 x 3 BED

BUILDING A2

- 18 APARTMENTS
- 3 STOREYS
- MAX. HEIGHT 10.5m
- 15 x 2 BED
- 3 x 3 BED

BUILDING B1

- 12 APARTMENTS
- 3 STOREYS
- MAX. HEIGHT 10.5m
- 9 x 2 BED
- 3 x 3 BED

BUILDING B2

- 15 APARTMENTS
- 3 STOREYS
- MAX. HEIGHT 10.5m
- 12 x 2 BED
- 3 x 3 BED

SUBDIVISIONS

- 17 SUBDIVISION LOTS FOR RESIDENTIAL USE
- MAX. HEIGHT 10.5m

- 63 UNITS
- 17 SUBDIVISION LOTS
- 1 EXISTING DWELLING HOUSE
- 77% SOLAR ACESS COMPLIANCE (46 UNITS)
- 85% NATURAL VENTILATION COMPLIANCE (46 UNITS)

81 TOTAL DWELLING UNITS

LEGEND

- SITE BOUNDARY
- RIPARIAN SETBACK
- PROPOSED APARTMENT BUILDINGS
- EXISTING DWELLINGS
- LANSCAPED AREA
- EXISTING VEGETATION TREES
- EXISTING NARRABEEN CREEK
- BUSHFIRE APZ
- 25M RIPARIAN ZONE

AMENDMENTS

ISSUE	DESCRIPTION	APPROVED	DATE
A	ISSUE FOR INFORMATION		15.05.20
B	PRE DA ISSUE		03.06.20
C	ISSUE FOR CO ORDINATION		17.07.20
D	ISSUE FOR DEVELOPMENT APPROVAL		21.08.20

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THIS DRAWING ISSUE HAS BEEN REVIEWED FOR

PRELIMINARY

CHECKED BY:	APPROVED BY:	SIGNATURE:
MR	JS	

CLIENT

WARRIEWOOD VALE PTY LTD
8 FOREST ROAD WARRIEWOOD

SITE PLAN

DATE	SCALE @ A1	DRAWN
23/07/20	1 : 500	Author

PROJECT NUMBER	DISCP.	DRAWING NUMBER	ISSUE
2019068	A	DA-030	D

PROJECT

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JACKSON TEECE

4.0 Bushfire Hazard Assessment

4.1 Bushfire Prone Land Mapping

Examination of the NSW Planning Portal (2019) Bushfire Prone Land (BPL) mapping (2019) confirms that part of the Subject Site is mapped as "Bushfire Prone Land - Buffer" and "Vegetation Category 1". This designation has triggered the need for the assessment herewith.

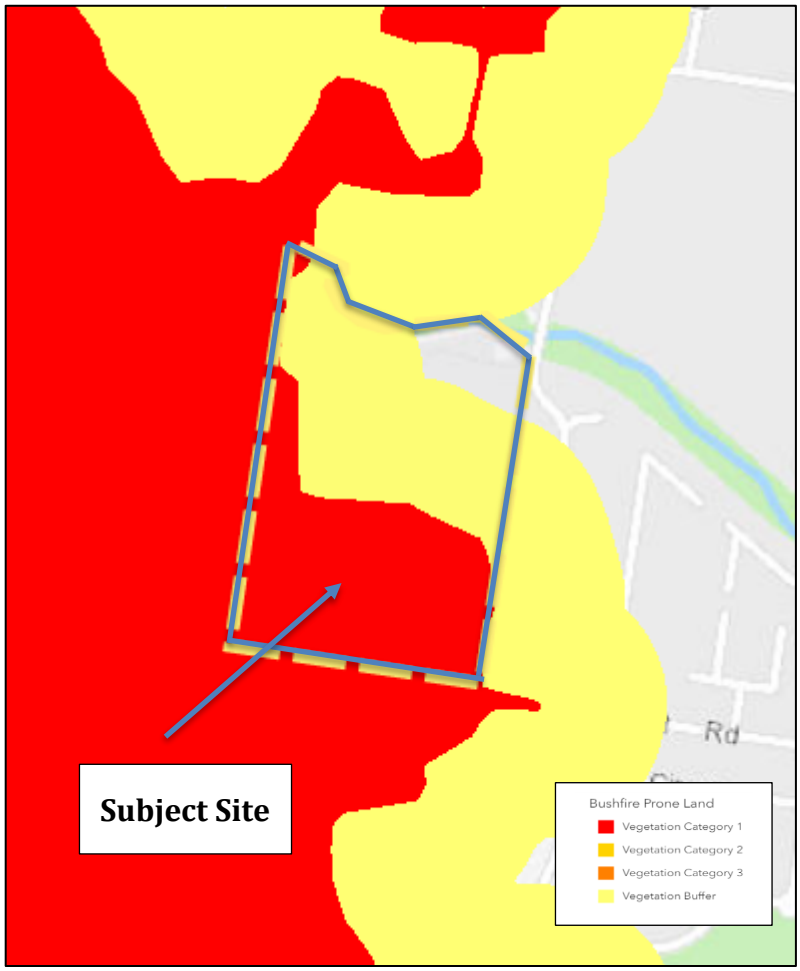


Figure 3 – Extract from the NSW Planning Portal Bushfire Prone Land Mapping (2019).

Appendix 1 of the PBP provides the steps required to determine the level of bushfire hazard that applies to the site. Factors influencing the hazard level include:

- The formation of vegetation surrounding the site (as defined by Keith 2004);
- The distance between vegetation and the site (or proposed buildings therein);
- The effective slope for each patch of vegetation; and
- The Fire Danger Index (FDI) of the council area within which the development occurs.

These factors together provide an indication of the level of threat posed to the development from any vegetation retained within the site and surrounding vegetation in the event of a bushfire, and the required mitigation measures to be taken in the form of Asset Protection Zones (APZs) and building construction standards. These measures are detailed further in **Section 5** below.

4.2 Vegetation Analysis

The site and surrounds occur within the Greater Sydney Region, with existing vegetation subsequently classified with a Fire Danger Index (FDI) of 100 as NSW Rural Fire Service (2017) NSW Local Government Areas FDI.

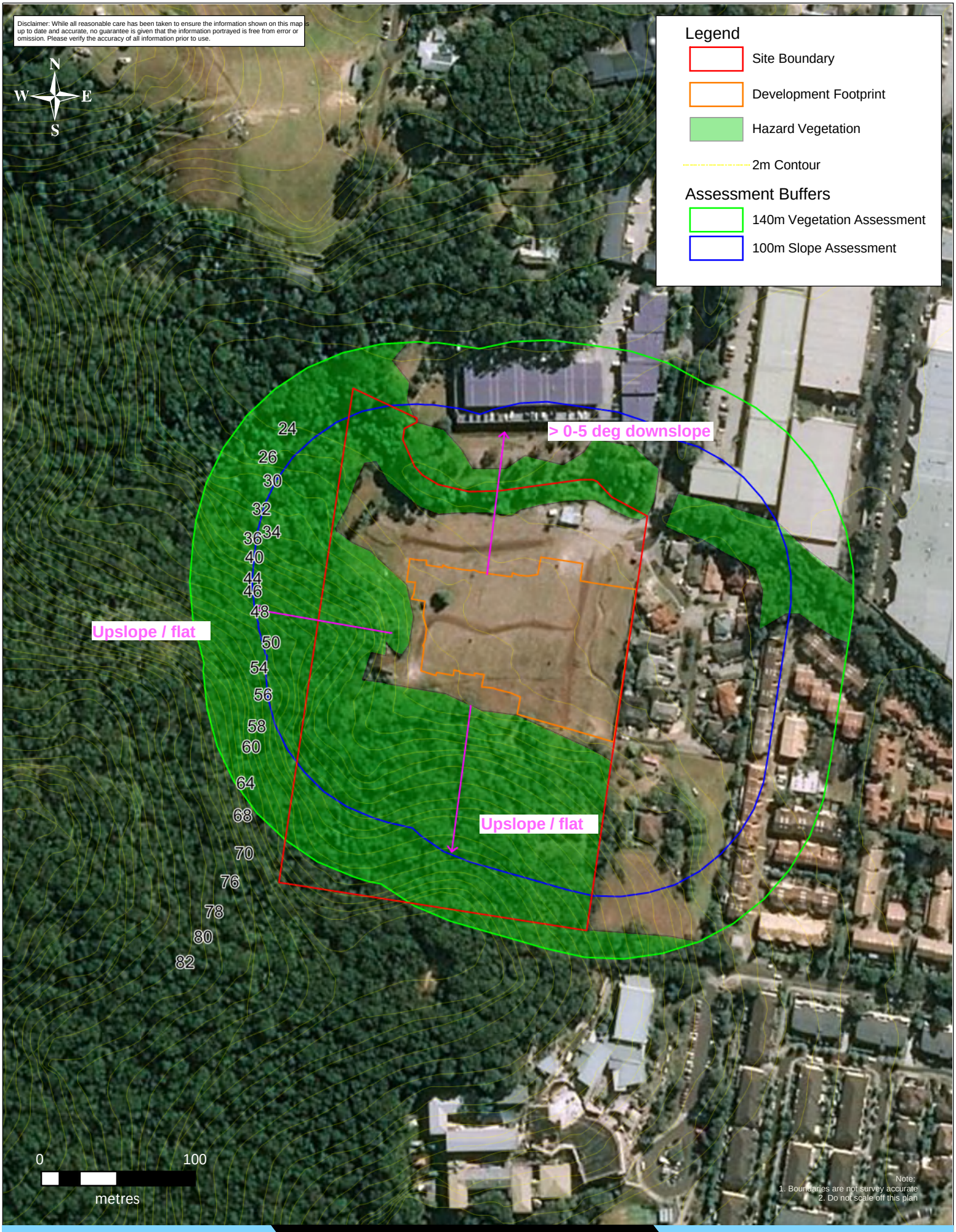
It is proposed to clear 0.33ha of vegetation surrounding the development to accommodate the required development and APZ.

The proposal will be affected by remnant vegetation to the north, west and south. Vegetation to the north exists as a narrow band along Narrabeen Creek and is identifiable by its dense tree layer dominated by the warm temperate rainforest tree, *Ceratopetalum apetalum* above a sparse to moderate groundcover of ferns. This vegetation comprises elements of both Map Unit RF02 'Coastal Sandstone Gallery Rainforest' and RF03 'Coastal Warm Temperate Rainforest' of OEH (2013). This vegetation has been classified as "Rainforest" under the PBP (2019).

Vegetation immediately to the west found on the mid to upper escarpment slopes exists in relatively poor condition, has been subject to canopy thinning and comprises a dense sub canopy regrowth of *Allocasuarina littoralis* and Lantana thickets. This community resembles both Map Unit DSF04 'Coastal Enriched Sandstone Dry Forest' and (to a lesser extent) DSF06 'Coastal Sandstone Foreshore Forest' of OEH (2013). This vegetation has been classified as "Forest" under the PBP (2019).

Vegetation to the west and south most closely resemble Map Unit WSF02 'Coastal Enriched Sandstone Moist Forest' of OEH (2013). The disturbed edge of this community adjoining the development is similarly in poor condition, subject to canopy thinning and Lantana thickets. It has been Classes as "Forest" under the PBP (2019).

For more comprehensive vegetation descriptions and a map showing vegetation assemblages across the Subject Site see **Appendix B.**



AEP

Title: Figure 4 - Slope and Vegetation Assessment

Date: October 2020

Location: Warriewood, NSW

Client: Jackson Teece

AEP Ref: 1377.01

4.3 Slope Analysis

The site upon which the proposed development is to occur generally slopes from north to south. See **Figure 4**.

Examination of slope class to relevant hazard areas reveals:

- **North** – >0-5 degrees downslope towards 'Rainforest' Vegetation;
- **West and south** – Flat/ upslope towards 'Forest' Vegetation.

4.4 Required Asset Protection Zones

Based on the information presented previously, the following derivation of required Asset Protection Zones (APZs) was concluded.

Consideration of APZs relates to the identified offsite hazards.

Fire Danger Index Rating = 100

North

- Predominant Vegetation – Rainforest
- Effective slope – >0-5 degrees downslope
- Required Minimum APZ – 14m

West and south

- Predominant Vegetation – Forest
- Effective slope – Flat/ upslope
- Required Minimum APZ – 24m

Note that the derived APZ setbacks are based upon the need to conform to Level 3 construction as per AS 3959 for a building of Class 1 or 2 under the BCA. Construction standard options are discussed further in the report.

4.4.1 Inner and Outer Protection Area

It is to be noted that the APZ to the west and south may be managed as two distinct management zones, an Inner Protection Area (IPA) and an Outer Protection Area (OPA). The OPA may stretch 10m into the APZ from the unmanaged vegetation with the IPA making up the remaining area between the OPA and development.

Inner Protection Area

The IPA is the area closest to the development and creates a fuel-managed area which can minimise the impact of direct flame contact and radiant heat on the development and act as a

defendable space. Vegetation within the IPA should be kept to a minimum level. Litter fuels within the IPA should be kept below 1cm in height and be discontinuous.

In practical terms the IPA is typically the curtilage around the building, consisting of a mown lawn and well-maintained gardens (PBP 2019).

Outer protection Area

An OPA is located between the IPA and the unmanaged vegetation. It is an area where retention of some vegetation is allowable or the undertaking of suitable revegetation may take place. Within the OPA there is maintenance of the understorey and some separation in the canopy, the reduction of fuel in this area aims to decrease the intensity of an approaching fire and restricts the potential for fire spread from crowns; reducing the level of direct flame, radiant heat and ember attack on the IPA.

Due to the nature of an OPA, they are only applicable in forest vegetation (PBP 2019).

The below image gives an example of allowable vegetation assemblages within the two distinct zones.

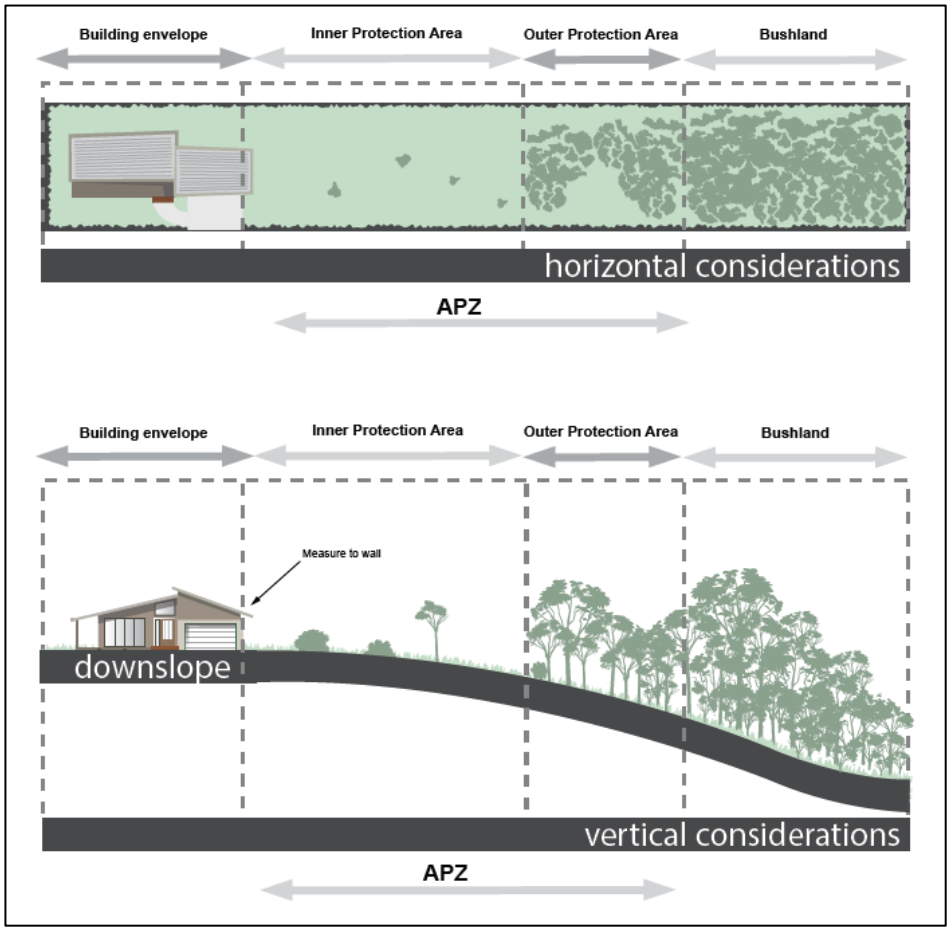


Figure 5 – Typical Inner and Outer Protection Areas (PBP 2019)

4.5 Water Supply

It is expected that the development will be serviced by a reticulated water supply system extended from existing and proposed residential areas.

The reticulated water supply and street hydrant access will need to be delivered in accordance with AS 2419.1–2005.

4.6 Access and Egress

Access and egress will be provided via Jubilee Avenue adjoining the site to the east.

Emergency response times would be expected to be prompt as the Ingleside Rural Fire Brigade Station is 4km away and an approx. seven -minute drive from the Subject Site.

5.0 Bushfire Hazard Determination

5.1 Construction Standards – AS 3959-2018

Bushfire Impact and AS-3959

The Australian Standard 3959-2018 Construction of buildings in bushfire prone areas, details six (6) levels of construction standards that are required for buildings, depending upon the expected impact of a bushfire from adjacent areas. These Bushfire Attack Levels (BALs) are measured from the edge of the hazard and incorporate vegetation type and slopes (see above) to determine the relevant distance for each BAL rating (and associated construction standard).

The relationship between the expected impact of a bushfire and the BAL rating is provided in **Table 1** below.

Table 1 – BAL Construction Standard

Bushfire Attack Level	Maximum radiant heat impact (kW/m²)	Level of construction standard under AS 3959-2018
Low		No special construction requirements
12.5	≤12.5	BAL – 12.5
19	12.6 to 19.0	BAL – 19
29	19.1 to 29	BAL - 29
40	29 to 40	BAL – 40
Flame Zone	≥40	BAL – FZ (Not deemed to satisfy provisions)

The BAL construction standards that apply to the subject site are as follows:

North >0-5 degrees downslope towards 'Rainforest' vegetation

- <11m: BAL – Flame Zone
- 11 to <14m: BAL – 40
- 14 to <21m: BAL – 29
- 21 to <29m: BAL – 19
- 29 to <100m: BAL – 12.5

West and south – Flat/ upslope towards 'Forest' Vegetation

- <18m: BAL – Flame Zone
- 18 to <24m: BAL – 40
- 24 to <33m: BAL – 29
- 33 to <45m: BAL – 19
- 45 to <100m: BAL – 12.5

These BALs are to be adopted as the minimum requirement for each specific zone. Any lessening of these requirements would require reassessment to ensure increased APZs are provided, or other acceptable mitigation measures are in place.

Figure 6 depicts the required BAL construction standards applicable for the proposed development.

AEP

Title: Figure 6 - Required BALs and APZ

Date: Oct 2020

Location: Warriewood, NSW

Client: Jackson Teece

AEP Ref: 1377.01

6.0 Other Considerations

The following analysis applied to the site in reference to environmental features present.

- **Riparian Corridors** – Narrabeen Creek runs along the northern boundary of the site.
- **SEPP (Coastal Management) 2018** – none present.
- **SEPP (Koala Habitat Protection) 2019** – none present.
- **Areas of geological interest** – none present.
- **Environmental protection zones or steep lands (>18°)** – none present.
- **Land slip or flood prone areas** – none present.
- **National Parks estate or various other reserves** – none present.
- **Threatened species matters** – Powerful Owl was recorded onsite which will be assessed within the associated Ecological Assessment Report.
- **Aboriginal Heritage** – none known to be present.

7.0 Conclusion

Investigations undertaken for this Bushfire Threat Assessment have revealed that the proposed development will be affected by bushland hazard to the north, west and south.

AEP understands that the development will be serviced by the existing reticulated water supply and street hydrant access in accordance with AS 2419.1–2005.

Access and egress are provided via Jubilee Avenue to the east and an internal road. It is considered that the proposed access and egress arrangements are appropriate and no issues have been identified with evacuation, safe haven zones, or firefighting logistics.

All Asset Protection Zones (APZs) have been fully incorporated into the design and are wholly located within the subject site.

It is considered that the proposed protection measures, principally APZs and relevant construction standards, comply with the relevant requirements of Planning for Bushfire Protection and AS-3959. When applied, these measures should provide adequate protection to life and property within the proposed development in the event of a bushfire occurring in the immediate locality. However, it can never be guaranteed that the site and residents and property therein will not at some stage be affected by a bushfire event.

8.0 References

Australian Building Codes Board. *International Fire Engineering Guidelines*. Edition 2005.

Environmental Planning & Assessment Act 1979. NSW Government.

Keith D (2004). *Ocean Shores to Desert Dunes*. DEC, Sydney.

NSW Rural Fire Service (2019). *Planning for Bushfire Protection: A guide for councils, planners, fire authorities and developers*. November 2019.

OEH (2013) The native vegetation of the Sydney metropolitan area. Volume 2 - Vegetation Community Profiles. Version 2. OEH, Sydney.

OEH (2020). *Threatened Species, Populations and Ecological Communities* website. (*http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/*)

Northern Beaches Council (2019). *Bushfire Prone Land Map*.

Rural Fires Act 1997. NSW Government.

Rural Fires Act Regulation 2013. NSW Government.

Standards Australia (2018) AS-3959 Construction of Buildings in Bushfire-Prone Areas.

Standards Australia (2010) AS-3745 Emergency Control Organisation and Procedures for Buildings, Structures and Workplaces' for Residential Accommodation

Appendix A – Site Photographs

Above and below looking South towards Forest vegetation.

Above looking Southwest towards Forest vegetation.

Below looking East towards residential development.

Above looking Northeast across the site towards Rainforest vegetation.

Below looking North / Northwest towards Rainforest vegetation.

Above and below looking West towards Forest vegetation.

Above and below looking West towards Forest vegetation.

Above looking Northwest towards Rainforest vegetation.

Below looking East along the northern creekline / riparian vegetation.

Above looking Northeast towards Rainforest vegetation.

Below looking South across the site towards Forest vegetation.

Above looking West across site towards Forest vegetaion.

Below Looking Northeast across development site.

Above Looking across development site to Northwest corner.

Appendix B – Sclerophyll Ecological Considerations Letter

Sclerophyll
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2 July 2015

Craig Anderson
Anderson Environment and Planning

RE: FLORA SURVEY, 8 FOREST ROAD, WARRIEWOOD, NSW

Introduction

Sclerophyll Flora Surveys and Research Pty Ltd ('Sclerophyll') was commissioned by Craig Anderson of Anderson Environment and Planning to undertake a baseline flora survey of a site described as 8 Forest Road, Warriewood, NSW, Lot 1 DP 5055, to assist in site redevelopment planning.

The site is located on the north-eastern edge of the Warriewood escarpment on Sydney's northern beaches within the Pittwater LGA. Narrabeen Creek forms the site's northern boundary which drains downstream to Mullet Creek, ultimately emptying into Narrabeen Lagoon.

The site is approximately 5.5 hectares in area, with the elevated southern half of the property supporting forested habitats and the lower lying northern half predominantly cleared of native vegetation with a dwelling and disused nursery houses. The study area is shown in **Figure 1**.

The site is mapped as being underlain by Hawkesbury Sandstone geology with minor shale lenses (Herbert 1983) and the Watagan (colluvial) soil landscape group, comprising the Narrabeen group of sediments supporting 'mostly interbedded laminate and shale with quartz to lithic quartz sandstone' (Chapman and Murphy 1989).

This letter serves as a description of the methods and results of the flora survey undertaken by Sclerophyll on the subject site in June 2015.

Methods

A search of the *BioNet* website (NSW Wildlife Atlas June 2015), a review of local and regional vegetation mapping and classification reports and a Commonwealth Protected Matters Search Report (June 2015) was undertaken as part of a desktop review to identify a reasonably comprehensive spectrum of Threatened species and native vegetation communities (including Endangered and Critically Endangered Ecological Communities, EECs/CEECs listed under the TSC/EPBC Acts) previously recorded in the Pittwater LGA in recent times.

A quadrat-based baseline botanical survey was undertaken to inventory vascular plants across the site on 22-23 and 25 June 2015. A total of 5 x 400 m^2 full floristic quadrats (quadrat dimension = 20m x 20m; 10m x 40m in Narrabeen Creek) were sampled in all four native vegetation types recorded across the site. All vascular taxa within and overhanging the quadrats were recorded on Sclerophyll proforma field data sheets and assigned a projected foliage cover class based on the Native Vegetation Interim Type Standard (Sivertsen 2009) along with other bio-physiographic attributes such as vegetative structure, soil colour and texture, geology, slope, aspect, topographic position, location, and general condition.

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The structural classification used for the vegetation community descriptions follows Specht (1981). Subformation names for vegetation types follows the classification proposed by Beadle and Costin (1952) and Floyd (1990) for rainforests. Botanical nomenclature follows Harden (1990-1993, 2000, 2002) and those published on the NSW National Herbarium '*PlantNET*' website. Classification of the native vegetation types recorded during the survey follows OEH (2013).

The quadrat based survey was supplemented with a total of 3 rapid data points (RDPs) in dry and moist sclerophyll forest types to assist in vegetation mapping of the site. Three dominant taxa from each strata were recorded at each RDP along with limited bio-physiographic information on Sclerophyll RDP proformas.

The quadrat-based baseline survey was also supplemented with opportunistic searches of both protected and Threatened (TSC/EPBC listed) taxa whilst traversing the site between quadrats and RDPs in all 4 native vegetation types.

Survey effort was in accordance with the Threatened Biodiversity Survey and Assessment Guidelines (Draft DEC 2004) and was heavily biased towards the forested habitats on the southern half of the property and along the western boundary (west of the dwelling). A detailed weed survey of the 'paddock' and garden plantings in the cleared northern half of the property was not undertaken (with the exception of the riparian habitat along Narrabeen Creek).

Survey site locations are shown in **Figure 2**.

An assessment of the conservation status of the native vegetation types recorded on site was made with reference to OEH (2013) as well as listings made under the NSW *Threatened Species Conservation Act* 1995 (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

All tracks and waypoints comprising flora quadrats, RDPs and search transects were referenced using a hand held Garmin GPS unit (projection GDA94 MGA56).

The flora survey was used to validate and refine the regional native vegetation mapping (OEH 2013) for the site. A native vegetation map for the site is provided as **Figure 3**.

A total of 10 hours was spent by Sclerophyll on the site during the flora survey.

Results – Vegetation Types

A total of 109 plant taxa from 54 families were recorded by Sclerophyll during the flora survey. This plant total included 1 non-vascular species and 2 introduced taxa. A floristic list with quadrat and RDP data is provided as **Attachment A**.

A total of 4 native vegetation types were recorded during the flora survey, as described below.

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Vegetation Type 1 - *A.costata/C.gummifera/E.piperita* Dry Sclerophyll Open Forest

Table 1 – Floristic/Structural Summary - Vegetation Type No. 1
(based on 2 quadrats, QDSF1, QDSF2 and 2 RDPs, RDPDSF1, RDPDSF2)

Growth Form	Height Range (metres)	% Cover Range	Typical Species
Tree	12	30-40	*Angophora costata, Corymbia gummifera, Eucalyptus piperita, Syncarpia glomulifera*
Small Tree	4-7	40-80	*Banksia serrata, Allocasuarina littoralis, Elaeocarpus reticulatus, Pittosporum undulatum*
Shrub	2-4	10-20	*Acacia ulicifolia, Persoonia levis, Persoonia pinifolia, Persoonia linearis, Lasiopetalum ferrugineum, Pultenaea flexilis, Leucopogon lanceolatus var lanceolatus, Myrsine variabilis (juv), Notelaea longifilia (juv), Correa reflexa, Zieria smithii*
Groundcover including low shrubs	<1.5	40-50	*Dianella caerulea, Entolasia stricta, Lomandra obliqua, Lomandra glauca, Lomandra longifolia, Lepidosperma laterale, Xanthorrhoea media, Xanthorrhoea arborea, Pteridium esculentum, Austrostipa pubescens, Aristida vagans, Pseuderanthemum variabile, Pratia purpurascens*.
Vine/Climber	N/A	N/A	*Billardiera scandens, Hibbertia dentata, Smilax glyciphylla*

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This vegetation type was recorded on sandstone-derived dry to moist loamy sands on the mid to upper escarpment slopes on site with varying levels of outcropping (extensive to minor). Substantial areas supporting this vegetation type on the site were in relatively poor condition, subject to canopy thinning, dense sub canopy regrowth of *Allocasuarina littoralis* (resulting in a thick carpet of Oak needles and extensive canopy shading) and Lantana thickets. The best condition of this vegetation type was recorded in the far south-western corner of the property where a dense monospecific *Allocasuarina* subcanopy was noticeably absent. This vegetation type is likely subject to minor clay enrichment of its sandy soils from shale lenses and colluvial washdown from possible upslope clay caps. This vegetation type graded downslope into Vegetation type 2 as the degree of shelter and soil moisture increased.

Vegetation type 1 is considered to most closely resemble Map Unit DSF04 ‘Coastal Enriched Sandstone Dry Forest’ and (to a lesser extent) DSF06 ‘Coastal Sandstone Foreshore Forest’ of OEH (2013). OEH (2013) note that map unit DSF04 is reserved in the metropolitan Sydney region within Garigal, Lane Cove, Georges River and Royal National Parks, with 70% of its total extant area of 1741 ha in the OEH Sydney metropolitan study area occurring in NPWS and non NPWS reserves.

OEH (2013) do not correlate this vegetation type with any EECs/CEECs currently listed under the TSC/EPBC Acts.

This vegetation type is mapped as having an extant area on site of 1.79 hectares.

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Vegetation Type 2 - *S.glomulifera/E.piperita/E.botryoides* Moist Sclerophyll Forest

Table 2 Floristic/Structural Summary - Vegetation Type No. 2 (based on 1 quadrat and 1 RDP, QMSF1, RDPMSF1)

Growth Form	Height Range (metres)	% Cover Range	Typical Species
Tree	to 15	40	*Eucalyptus piperita, Eucalyptus botryoides, Eucalyptus scias, Syncarpia glomulifera, Angophora costata*
Small tree	to 8	30	*Livistona australis, Allocasuarina torulosa, Callicoma serratifolia, Glochidion ferdinandi, Elaeocarpus reticulatus*
Shrub	2-4	30	*Astrotricha floccosa, Dodonaea triquetra, Breynia oblongifolia, Notelaea longifolia, Maytenus silvestris, Pittosporum revolutum*
Ground	to 1.5	40	*Gahnia sieberiana, Lepidosperma elatius, Oplismenus imbecillis, Calochlaeana dubia, Lomandra longifolia, Lantana camara**
Vine/Climber	-	-	*Geitonoplesium cymosum, Stephania japonica, Billardiera scandens, Hibbertia dentata, Cissus hypoglauca, Pandorea pandorana*

This vegetation type was recorded on sandstone-derived moist loamy sands on the lower escarpment slopes (abutting the cleared paddock) on site with minor to moderate levels of outcropping. Some areas supporting this vegetation type on the site were similarly in poor

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condition, subject to canopy thinning and Lantana thickets, ultimately impacting on species diversity. The escarpment midslope near the western boundary supported this vegetation type in the best condition. This vegetation type is similarly likely subject to minor clay enrichment of its sandy soils from shale lenses and colluvial washdown from possible upslope clay caps (as per vegetation type 1). This vegetation type graded into Escarpment Littoral Rainforest as shelter further increased near the site's north-western boundary, just south of Narrabeen Creek.

Vegetation type 2 is considered to most closely resemble Map Unit WSF02 'Coastal Enriched Sandstone Moist Forest' of OEH (2013). OEH (2013) note that map unit WSF02 is reserved in the metropolitan Sydney region within Lane Cove, Ku-ring-gai Chase, Royal and Sydney Harbour National Parks, with 68% of its total extant area of 1084 ha (within the OEH 2013 Sydney metropolitan study) present in NPWS and non NPWS reserves. Importantly, and unlike vegetation type 1, the OEH (2013) Sydney metropolitan study area encompasses the majority of the distribution of this vegetation type in the Sydney Basin bioregion. As a result, remaining stands outside the reserve system should be considered of high conservation value as the total extant area of this community is not high.

OEH (2013) note that this vegetation type may grade into moist/wet shale forests, such as the TSC listed EECs, Blue Gum High Forest and Sydney Turpentine Ironbark Forest. It is considered that vegetation type 2 has only a subtle shale influence on site and is not representative of either of these EECs based on floristics and location. This vegetation type also does not represent any of the vegetation types typical for Duffys Forest EEC which occur on ridgetop laterites (overlying sandstone) in the Duffys Forest/Ingleside/Frenchs Forest/Belrose/Terrey Hills district based on Smith and Smith (2000).

Vegetation type 2 does, however, hold some floristic affinities with River flat Eucalypt Forest and Swamp Sclerophyll Forest on Coastal Floodplain as well as Bangalay Sand Forest EECs listed under the NSW *Threatened Species Conservation Act* (TSC Act), particularly in relation to an area immediately south-east of the site dwelling where a small stand of Bangalay (*E.botryoides*) dominates along the foot of a minor lower escarpment slope gully, where drainage is likely to be slightly impeded during wet weather. This area is clearly however, a sandstone escarpment environment (ie. bedrock), by virtue of the presence of extensive sandstone outcropping at the foot of the escarpment slope, and not a fluvial depositional (floodplain) environment 'with level landform patterns with active erosion and aggradation by channelled and overbank stream flow', as defined in the Scientific Committee Determinations for the 2 coastal floodplain EECs. The small stand of Bangalay also does not occur on aeolian sands (dunal) with which the latter Bangalay Sand Forest EEC is intended to capture. Consequently, it is considered that this small stand of Bangalay that forms part of Vegetation type 2 is not intended to be captured under and does not form part of these 3 EECs. This is further demonstrated by the fact that the site is not mapped as occurring on either aeolian or fluvial depositional soil landscapes (Chapman and Murphy 1989).

This vegetation type is mapped as having an extant area on site of 1.18 hectares.

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Vegetation Type 3 - *G.ferdinandi/S.glandulosum* Escarpment Littoral Rainforest

Table 3 Floristic/Structural Summary - Vegetation Type No. 3 (based on 1 quadrat,QLRf1)

Growth Form	Height Range (metres)	% Cover Range	Typical Species
Emergent	to 12	5	*Eucalyptus botryoides, Angophora floribunda*
Small Tree	to 7	80	*Glochidion ferdinandi var ferdinandi, Synoum glandulosum*
Shrub	to 2.5	10	*Breynia oblongifolia*
Ground	to 1m	40	*Calochlaena dubia, Lomandra longifolia, Lepidosperma laterale*
Vines	-	-	*Smilax glyciphylla, Cissus hypoglauca, Geitonoplesium cymosum, Stephania japonica, Eustrephus latifolius*

This vegetation type was recorded on moist, dark loamy sands at the foot of the escarpment slope in the north-western corner of the site just south of Narrabeen Creek and is identifiable by its dense, small tree layer dominated by warm temperate/subtropical rainforest trees *Glochidion ferdinandi* and *Synoum glandulosum* with woody vines and a sparse groundcover of ferns. The majority of the occurrence of this community is located outside the site boundary (to the west).

Vegetation type 3 is considered to most closely resemble Map Unit RF07 ‘Coastal Escarpment Littoral Rainforest’ of OEH (2013) which forms a component of the TSC listed Littoral Rainforest EEC and EPBC listed Littoral Rainforest critically endangered ecological community (CEEC).

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OEH (2013) note that this vegetation type is reserved in the metropolitan Sydney region within Ku-ring-gai Chase, Royal and Sydney Harbour National Parks, with 76% of its total 64 ha extant area (within the OEH 2013 study area) present in NPWS and non NPWS reserves.

This vegetation type is mapped as having an extant area on site of 0.03 hectares.

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Vegetation Type 4 - *C.apetalum* Warm Temperate Rainforest (based on 1 quadrat, QGRf1)

Table 4 Floristic/Structural Summary - Vegetation Type No. 4

Growth Form	Height Range (metres)	% Cover Range	Typical Species
Emergent	to 12	5	*Eucalyptus botryoides*
Tree and small tree	to 10	80	*Ceratopetalum apetalum, Livistona australis, Cyathea australis, Phyllostachys sp.*, Acmena smithii, Synoum glandulosum*
Shrub	to 1.5	30	*Breynia oblongifolia, Lantana camara*, Wilkiea huegeliana*
Ground	to 1m	10	*Hypolepis muelleri, Sticherus flabellatus, Pseuderanthemum variabile, Gymnostachys anceps, Commelina cyanea*
Vines	-	-	*Geitonoplesium cymosum, Cissus hypoglauca*

This vegetation type was recorded as a narrow band along Narrabeen Creek on moist to wet alluvial sands and is identifiable by its dense tree layer dominated by the warm temperate rainforest tree, *Ceratopetalum apetalum* above a sparse to moderate groundcover of ferns. This vegetation type was subject to a high degree of disturbance on site due to the presence of Lantana and Bamboo infestations along the length of the creekline.

Vegetation type 4 supports elements of both Map Unit RF02 'Coastal Sandstone Gallery Rainforest' and RF03 'Coastal Warm Temperate Rainforest' of OEH (2013). This vegetation type forms part of Floyd's (1990) *Ceratopetalum apetalum* Warm Temperate Rainforest alliance and is **not** considered part of the Lowland Rainforest EEC listed under the TSC Act as it does not occur in conjunction with other Floyd (1990) subtropical and dry rainforest sub-alliances (listed in the EEC Final Determination) on the site.

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OEH (2013) note that this vegetation type (as RF02) is reserved in the metropolitan Sydney region within Ku-ring-gai Chase, Lane Cove, Royal, Garigal, Georges River and Sydney Harbour National Parks, with 87% of its extant area of 235 ha (within the OEH 2013 Sydney metropolitan study area) present in NPWS and non NPWS reserves.

This vegetation type is mapped as having an extant area on site of 0.11 hectares.

Results – Threatened Flora Species

No Threatened flora species were recorded during the flora survey. Those Threatened flora species (listed under the TSC/EPBC Acts) considered as possible occurrences on the site include *Epacris purpurascens* var *purpurascens*, *Tetratheca glandulosa*, *Callistemon linearifolius*, *Syzygium paniculatum* and *Microtis angusii*. All these taxa have been recorded in the Narrabeen/Warriewood/Mona Vale/Ingleside suburbs on Sydney's northern beaches. No Threatened flora species have been reported for the enriched sandstone communities recorded on the subject site by OEH as part of its Sydney metropolitan vegetation classification and mapping program (OEH 2013) although their presence should not be discounted.

The Bionet website shows a 2005 record for the TSC-listed *Eucalyptus nicholii*, a tree, either on or close to the site. It is noted that this tree is a common Sydney street/landscape planting and is indigenous only to the northern tablelands area of NSW. This tree is not considered as Threatened in the Sydney region and was not recorded on site in native bushland habitats.

Limitations

June is not an ideal time to survey for Threatened flora species on the northern beaches sandstone escarpments as some of those species considered as possible occurrences will not be flowering until late winter and early spring. Threatened species such as *Epacris purpurascens* var *purpurascens*, *Tetratheca glandulosa* and *Callistemon linearifolius* are difficult to detect and/or identify/distinguish from closely related taxon when not flowering. Furthermore, the orchid *Microtis angusii*, remains as a dormant subterranean tuber until flowering in spring. As such, it is recommended that targeted searches for these Threatened flora in all native habitats recorded on site (as well as the orchid in cleared habitats) be carried out in spring to increase the likelihood of detection and accurate identification.

As with any vegetation mapping, polygon linework should be treated as an approximation of vegetation type distribution. Subtle ecotones exist on the subject site (particularly between vegetation types 1 and 2) which are often difficult to incorporate into vegetation linework.

Lastly, a baseline flora survey conducted as a snapshot in one season only will not give a 'complete' inventory of flora across a site due to the presence of dormant species (eg. terrestrial orchids) and the dynamic nature of natural ecosystems.

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Yours Faithfully

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Figure 1 - Study Area

Figure 1: Study Area

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Figure 2 – Survey Site Locations

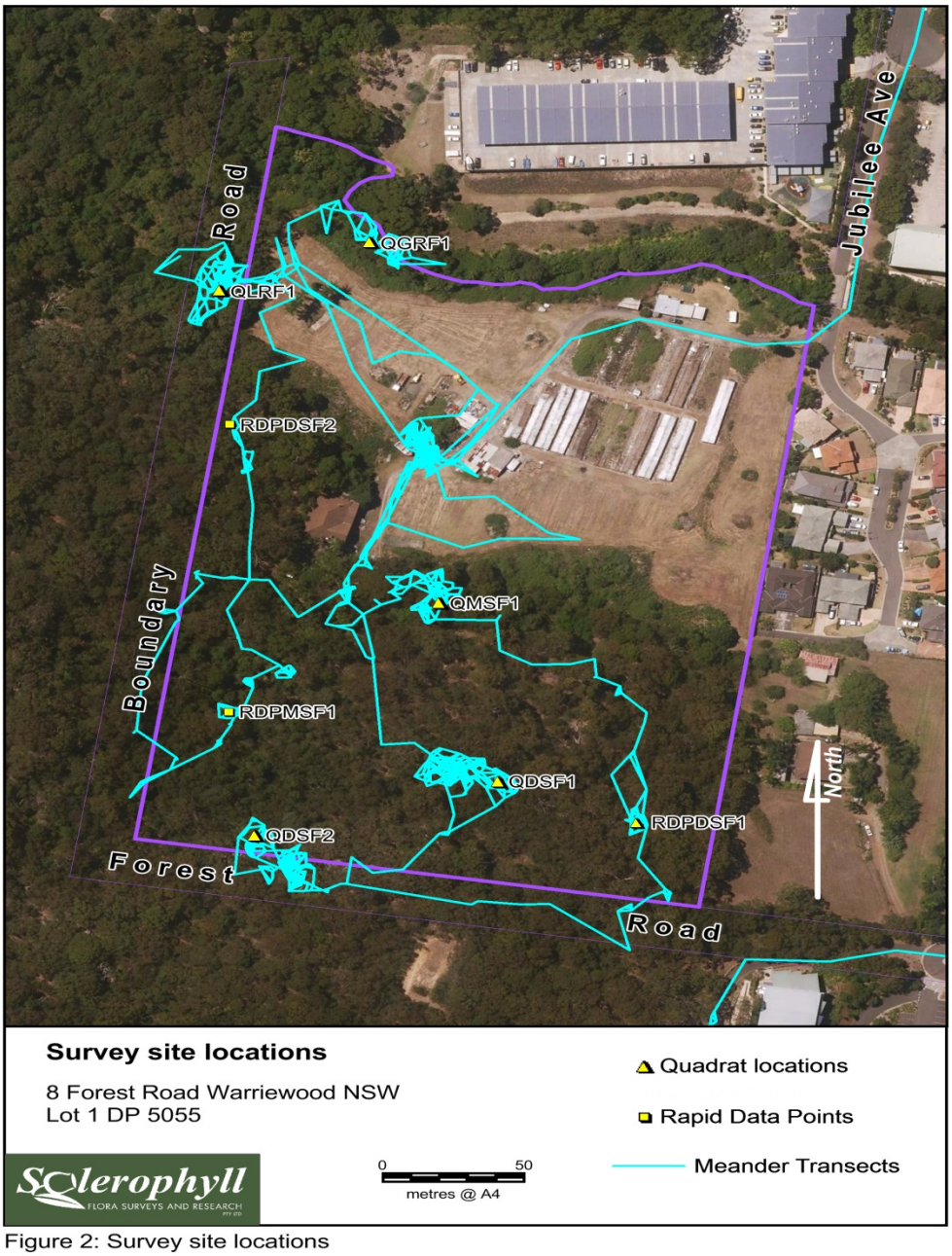

Figure 2: Survey site locations

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Figure 3 – Native Vegetation Map

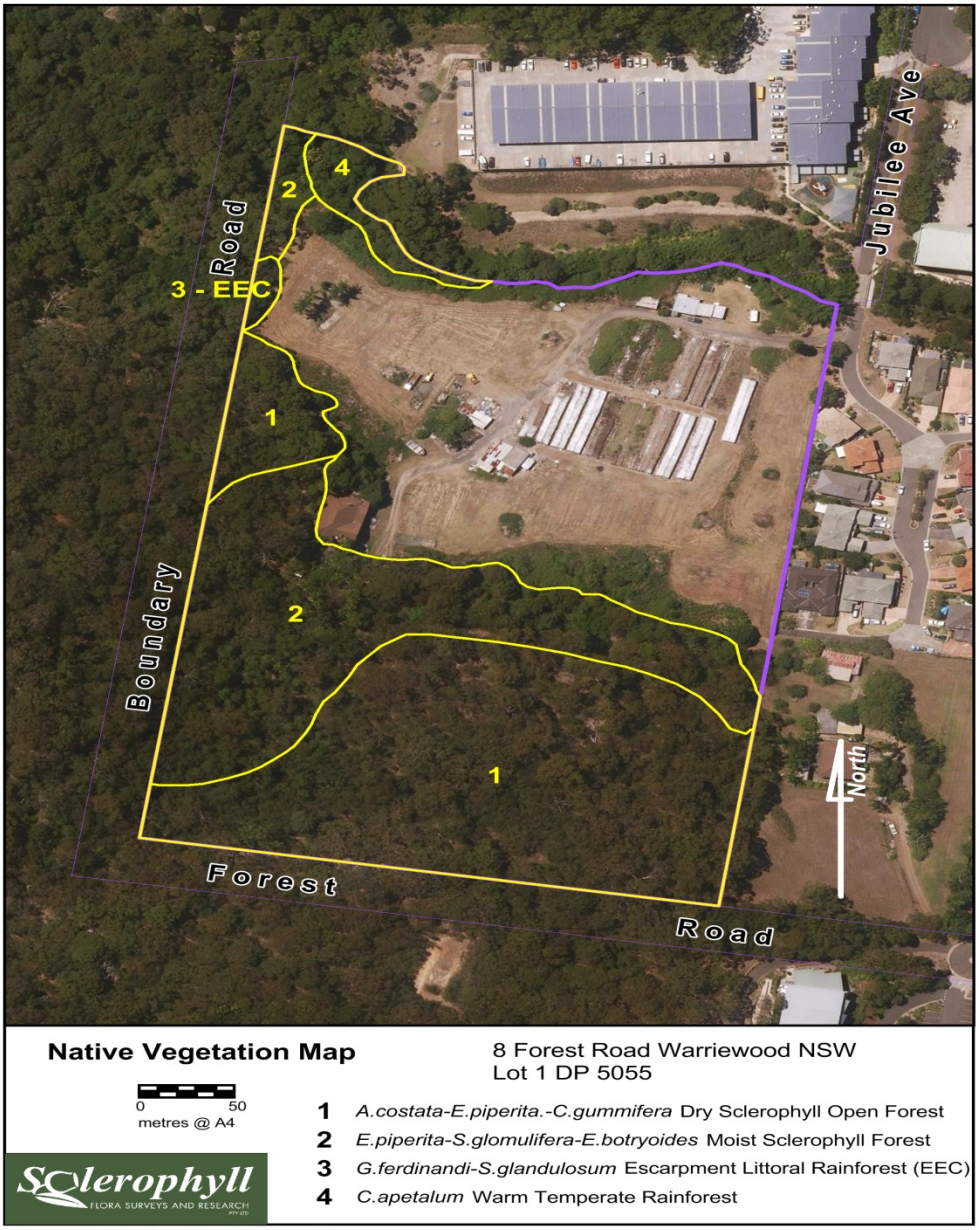

Figure 3: Native Vegetation Map

Attachment A - Floristic List and Quadrat Data for 8 Forest Road, Lot 1 DP5055, Warriewood, NSW (June 2015)

Class/Family	Scientific Name	Quadrat (PFC%)					Additional plants recorded opportunistically outside quadrats (veg type #)
		QDSF1	QDSF2	QMSF1	QLRf1	QGRf1	
CLASS LYCOPSIDA (Clubmosses and Quillworts)							
SELAGINELLACEAE	*Selaginella uliginosa*						(2)
CLASS CONIFEROPSIDA (Conifers)							
PODOCARPACEAE	*Podocarpus spinulosus*						(2)
CLASS FILICOPSIDA (Ferns)							
ASPLENIACEAE	*Asplenium flabellifolium*						(2)
BLECHNACEAE	*Blechnum ambiguum*				<5		
CYATHEACEAE	*Cyathea australis*						(4)
DENNSTAEDTIACEAE	*Pteridium esculentum*	20	30				
	Hypolepis muelleri				<5	30	
DICKSONIACEAE	*Calochlaena dubia*			15	30	5	
GLEICHENIACEAE	*Sticherus flabellatus*					10	
LINDSAEACEAE	*Lindsaea linearis*						(1)
CLASS MAGNOLIOPSIDA (Flowering Plants)							
Subclass Magnoliidae (Dicotyledons)							
ACANTHACEAE	*Pseuderanthemum variabile*	<5	<5			<5	

Class/Family	Scientific Name	Quadrat (PFC%)					Additional plants recorded opportunistically outside quadrats (veg type #)
		QDSF1	QDSF2	QMSF1	QLRf1	QGRf1	
APIACEAE	*Actinotus minor*						(1)
	Actinotus helianthi						(1)
	Xanthosia pilosa		<5				
ARALIACEAE	*Astrotricha floccosa*			<5			
	Polyscias sambucifolia		<5				
ARECACEAE	*Livistona australis*	<5	<5	20	10	20	
BIGNONIACEAE	*Pandorea pandorana*			<5			
CASUARINACEAE	*Allocasuarina littoralis*	60	40				
	Allocasuarina torulosa	20					
CELASTRACEAE	*Maytenus silvestris*			<5			
CONVOLVULACEAE	*Dichondra repens*			<5			
CUNONIACEAE	*Ceratopetalum apetalum*					80	
	Ceratopetalum gumiferum						(1)
	Callicoma serratifolia			5			
DILLENIACEAE	*Hibbertia dentata*	5	<5	5			
	Hibbertia aspera	<5					
ELAEOCARPACEAE	*Elaeocarpus reticulatus*		<5				

Class/Family	Scientific Name	Quadrat (PFC%)					Additional plants recorded opportunistically outside quadrats (veg type #)
		QDSF1	QDSF2	QMSF1	QLRf1	QGRf1	
ERICACEAE: Styphelioideae	*Leucopogon lanceolatus* var. *lanceolatus*	<5	<5				
EUPOMATIACEAE	*Eupomatia laurina*						(2)
FABACEAE: Faboideae	*Glycine clandestina* complex			<5	<5		
	Hardenbergia violacea		<5				
	Platylobium formosum						(2)
	Pultenaea flexilis	<5					(2)
	Pultenaea daphnoides						(2)
FABACEAE: Mimosoideae	*Acacia ulicifolia*		<5				
	Acacia longissima						(2)
GOODENIACEAE	*Goodenia hederacea*						(1)
HALORAGACEAE	*Gonocarpus teucrioides*						(2)
LAMIACEAE	*Clerodendrum tomentosum*		<5	<5	5		
LAURACEAE	*Cassytha glabella*			<5			
	Cassytha pubescens						(1)
	Cryptocarya microneura						(2)
	Endiandra sieberi						(2)
LOBELIACEAE	*Pratia purpurascens*	<5			<5		

Class/Family	Scientific Name	Quadrat (PFC%)					Additional plants recorded opportunistically outside quadrats (veg type #)
		QDSF1	QDSF2	QMSF1	QLRf1	QGRf1	
	Lobelia dentata						(1,2)
MALVACEAE	*Lasiopetalum ferrugineum*						(1)
MELIACEAE	*Synoum glandulosum*			10	10	<5	
MENISPERMACEAE	*Stephania japonica* var *discolor*			5	5		
MONIMIACEAE	*Wilkiea huegeliana*					10	
MYRSINACEAE	*Myrsine variabilis*		<5				
MYRTACEAE	*Acmena smithii*					<5	
	Angophora floribunda				5		
	Angophora costata	10	40	10			
	Corymbia gummifera		10				
	Syncarpia glomulifera			30			(1)
	Eucalyptus botryoides		5				(2), (4)
	Eucalyptus resinifera subsp. *resinifera* (possible intergrade with *E.scias*)						(1,2)
	Eucalyptus piperita			40			
OLEACEAE	*Notelaea longifolia* f *longifolia*	<5		<5			
	*Ligustrum sinense**						(3)

Class/Family	Scientific Name	Quadrat (PFC%)					Additional plants recorded opportunistically outside quadrats (veg type #)
		QDSF1	QDSF2	QMSF1	QLRf1	QGRf1	
PHYLLANTHACEAE	*Glochidion ferdinandi* var. *ferdinandi*			20	80		
	Glochidion ferdinandi var. *pubens*						(1)
	Breynia oblongifolia			10	5	<5	
	Poranthera microphylla			<5			
	Phyllanthus hirtellus						(2)
PITTOSPORACEAE	*Billardiera scandens*	<5	<5	<5			
	Pittosporum undulatum			<5	10		
	Pittosporum revolutum			<5			
PROTEACEAE	*Banksia integrifolia*				<5		(1)
	Banksia serrata		20				
	Persoonia levis	<5	<5				
	Persoonia pinifolia	<5	5				X
	Persoonia linearis	<5					
RUBIACEAE	*Pomax umbellata*	<5	<5				
RUTACEAE	*Correa reflexa*						(1)
	Zieria smithii						(1)
SANTALACEAE	*Leptomeria acida*						(1)

Class/Family	Scientific Name	Quadrat (PFC%)					Additional plants recorded opportunistically outside quadrats (veg type #)
		QDSF1	QDSF2	QMSF1	QLRf1	QGRf1	
SAPINDACEAE	*Dodonaea triquetra*	<5		<5			
ULMACEAE	*Trema tomentosa* var. *aspera*						
VERBENACEAE	*Lantana camara**			30	15	40	
VITACEAE	*Cissus hypoglauca*				5	5	(2)
XANTHORRHOEACEAE	*Xanthorrhoea media*	<5	5				
	Xanthorrhoea arborea		20				
CLASS MAGNOLIOPSIDA (Flowering Plants)							
Subclass Liliidae (Monocotyledons)							
ARACEAE	*Gymnostachys anceps*					5	
COMMELINACEAE	*Commelina cyanea*				5	<5	
CYPERACEAE	*Lepidosperma laterale*	15	5	<5			
	Lepidosperma elatius						(2)
	Lepidosperma gunnii						(1)
	Gahnia sieberiana						(2)
LOMANDRACEAE	*Lomandra obliqua*						(1)
	Lomandra cylindrica						(1)
	Lomandra filiformis subsp. *filiformis*		<5				

Class/Family	Scientific Name	Quadrat (PFC%)					Additional plants recorded opportunistically outside quadrats (veg type #)
		QDSF1	QDSF2	QMSF1	QLRf1	QGRf1	
	Lomandra glauca	<5					
	Lomandra longifolia subsp. *longifolia*	5	5	5	10		
	Lomandra multiflora subsp. *multiflora*	5	<5	<5			
LUZURIAGACEAE	*Eustrephus latifolius*				<5		
	Geitonoplesium cymosum			<5		<5	(1)
PHORMIACEAE	*Dianella caerulea*	15	<5	5	5		
POACEAE	*Poa affinis*						(2)
	Aristida vagans	<5					
	Austrostipa pubescens	50	5				
	Entolasia stricta	20	30	20	<5		
	Entolasia marginata	<5					
	Imperata cylindrica var *major*		<5	<5	<5		
	Oplismenus imbecillis			10	20		
	*Phyllostachys sp.** (Bamboo)					30	
	Themeda australis						(1)
SMILACACEAE	*Smilax glyciphylla*		<5	5	5		

Note: Projected Foliage Cover (PFC) classes for all taxa are based on NVITS (2010).

Vegetation Type Legend

Veg Type 1 – *A.costata/C.gummifera/E.piperita* DSF
Veg Type 2 – *E.piperita/S.glomulifera/E.botryoides* MSF
Veg Type 3 – *Glochidion ferdinandi/Synoum glandulosum* Escarpment Littoral Rainforest
Veg Type 4 – *Ceratopetalum apetalum* Gallery Rainforest

Rapid Data Point Summary
8 Forest Road Lot 1 DP5055 Warriewood, NSW
Jun-15

Site name	Projection	Easting	Northing	Canopy	Mid	Ground	Topopos	Slope (o)	Aspect	Elevation	Veg Type (OEH 2013)
RDPDSF1	GDA94 MGA56	340992	6271755	A.costata	A.littoralis, G.ferdinandi, P.pinifolia	P.esculentum, E.stricta, L.laterale	upper slope	0-5	NW	62m	DSF04
RDPDSF2	GDA94 MGA56	340843	6271925	A.costata, C.gummifera, E.botryoides	A.floccosa, A.littoralis, L.camara*	X.arborea, E.stricta, C.reflexa G.sieberiana,	lower slope	0-5	NE	58m	DSF04
RDPMSF1	GDA94 MGA56	340845	6271798	A.costata, E.scias/resinifera, E.piperita	C.serratifolia, N.longifolia, E.reticulatus	C.dubia, L.elatius, P.esculentum	midslope	5 to 10	N/NW	59m	WSF02