

Waterway Impact Statement
for a
10 Residential and One Community Title Lot Subdivision
and **Construction of 9 houses**
at
96 - 104 Cabarita Road, Avalon



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November 2018

Prepared for
Meraki Developments Pty Ltd

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1 Introduction

This Waterway Impact Statement (Waterway Management Plan) is a requirement of Pittwater 21 DCP section B5.13 Development on Waterfront Land control 8. The information in this report is needed to for the Integrated Development referral to the NSW Department of Primary Industry (DPI) as requested by the Water Management Act 2000 for a Controlled Activity Approval and “general terms of approval”.

This report addresses the;

- Controls of Pittwater 21 DCP section B5.13
- Objectives of the Water Management Act 2000, “Guidelines for Riparian Corridors on waterfront land”.
- Requirements of the Biodiversity Conservation Act (Appendix 3)
- Need to identify the extent of the Vegetated Riparian Zone (Water Management Act 2000) and Biodiversity Conservation Act 2016

Accompanying this application is a Biodiversity Management Plan that describes measures to mitigate and minimise the impact to the riparian habitat values and adjacent waterway and a Biodiversity Development Assessment Report (BDAR) that assess the terrestrial ecological impacts and offsets. The offsetting for the Water Management Act is separate, and additional, to the BAM/BOS offsets and there is no “double dipping”.

1.1 Description of the Study Site

This Waterway Impact Statement applies to 96-104 Cabarita Rd, Avalon that is a large foreshore property on the Pittwater estuary (Careel Bay). The property is 12700m² in size and currently consists of 4 lots that are mostly covered by a tall native tree canopy with a native and weedy understorey that is habitat for a range of native flora and fauna species. This vegetation is representative of two Endangered Ecological Communities; Pittwater and Wagstaffe Spotted Gum Forest EEC, covering the majority of the site and Swamp Oak Floodplain Forest EEC, that occurs in a small part of the western end of the foreshore. An aerial photograph of the property and the locality are shown on the cover of this report and on maps in Figures 1.1 and 1.2 respectively. The site contains open lined channels running across the site and down the site and a creek line that is partly piped. Pittwater (Careel Bay) is a mature drowned river valley that is immediately adjacent to the north east. The northern property boundary is the mean high-water mark.

1.1.1 Riparian Corridor

The northern boundary of the site is adjacent to Pittwater (Careel Bay) which is an estuary. The “Guidelines for Riparian Corridors on Waterfront Land” states that the Vegetated Riparian Zone (VRZ) is 40m wide for estuaries. The VRZ therefore extends 40m into the site from the mean high-water mark. The Water Management Act 2000, the Biodiversity Conservation Act 2016 Biodiversity Assessment Method (BAM), the LEP and DCP require all DAs to avoid and minimise impact to the ecology of the Vegetated Riparian Zone. The BAM (Appendix 3) requires a 50m Vegetated Riparian Zone (VRZ) for developments adjacent to estuaries. The 40m and 50m Vegetated Riparian Zones are shown on the map in Figure 1.5. The vegetation on the site and along the coast are shown on the map in Figure 1.4.

1.2 The Locality

The adjacent allotments to the south, east and west are fully developed residential properties with a tall native tree canopy of mostly Spotted Gums and a mixed native exotic understorey. To the north is a tidal beach on the foreshore of Pittwater. The proximity of the site to the rest of Pittwater, Ku-ring-gai Chase National Park, water bodies, development and nearby bushland is shown in Figures 1.1, 1.2 and 1.3. There is no wetland on or immediately adjacent to the property, however, there is an estuarine wetland with mangroves and saltmarsh in Careel Bay approximately 615m east of the site. The Council storm water pipe drains directly into Pittwater. The water depth off the beach is shallow for up to 100 metres and is exposed at low tide. A single *Avicennia marina* (Grey Mangrove) tree is present on the beach in front of the property. There are no records of seagrass within 50 metres of the property. The topography and vegetation communities are shown on the map in Figure 1.3.



Legend

 Development Site (12700sqm)

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by Nicholas Skelton

Date: 16/11/2018

1:620 at A3

0 5 10 20 Meters



Figure 1.1
Aerial Photograph of the Site

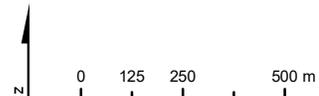


- Legend**
- Development Site
 - Buffer 1.5km
 - National Park

Figure 1.2.
Locality Aerial Photograph

96 - 104 Cabarita Rd, Avalon

Date: 14/11/2018



Disclaimer: Mapping is indicative and may contain errors from the source of the data. Information on these maps should only be used at the scale provided. Dimensions need to be determined by a registered surveyor.

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- Legend**
- Development Site
 - Buffer 1.5km
 - National Park

Figure 1.3
Locality, Topography and Features

96 - 104 Cabarita Rd, Avalon

Date: 14/11/2018

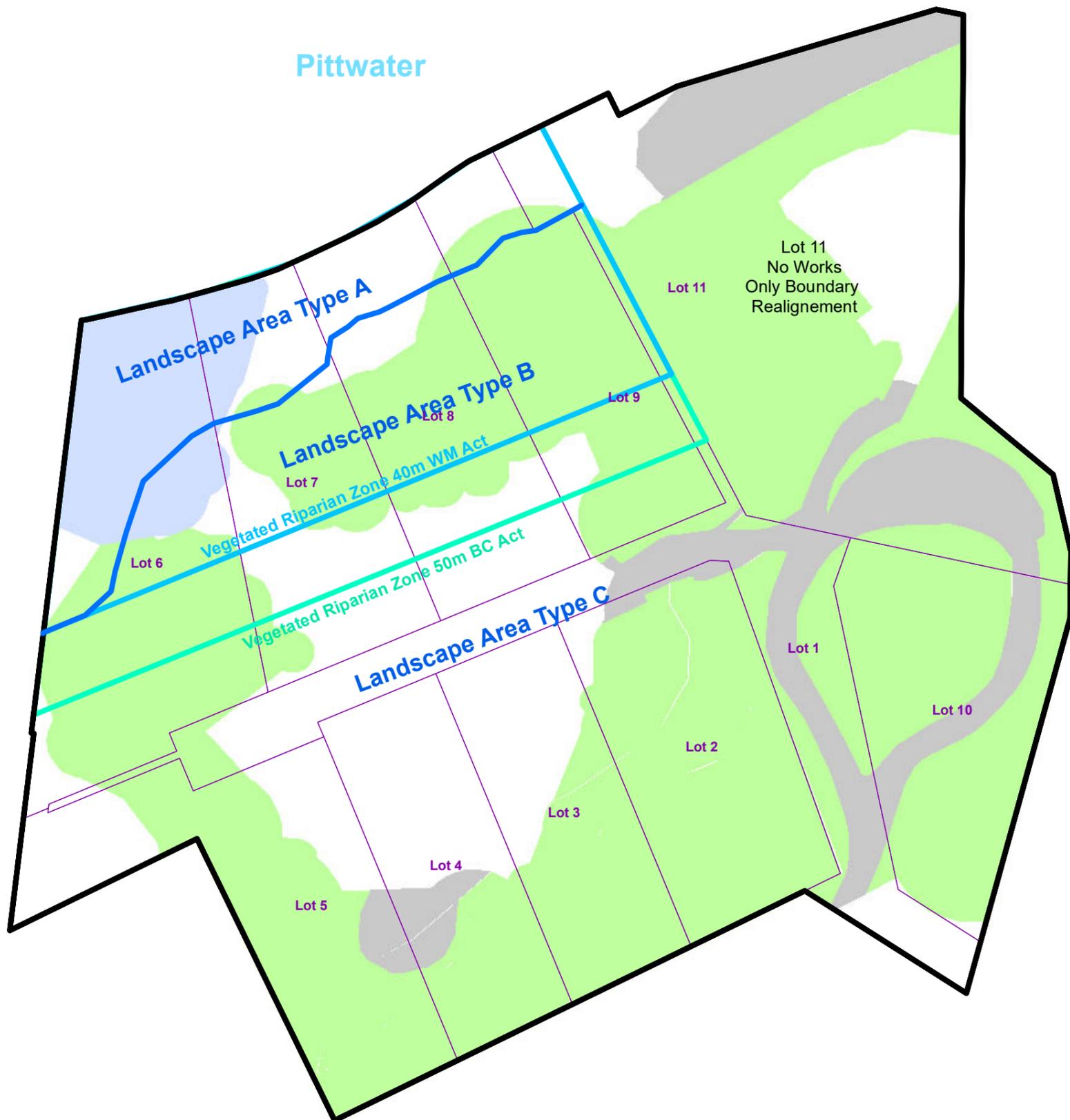


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CAREEL BAY

Pittwater



Legend

- Development Site (12700sqm)
- WM Act Vegetated Riparian Zone 40m (2500sqm)
- BC Act Vegetated Riparian Zone 50m

Vegetation Types (PCT)

- Native Tree Cover Over, Hard Surface or Lawn
- Pittwater Spotted Gum Forest EEC
- Swamp Oak Floodplain Forest EEC

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Figure 1.4
Vegetation Types and Vegetated Riparian Zones

by Nicholas Skelton
 Date: 30/11/2018

1:620 at A3

0 5 10 20 Meters



1.3 The Proposal

The proposal is a Development Application for re-subdivision of the existing property into 10 residential lots and one community title lot.

This report relates to 10 Development Applications, the first being for subdivision of the land into 10 Community Title lots (9 residential and one community lot) and 1 torrens title lot. Lodged concurrently are 9 DA's for individual dwelling houses on the Community Title residential lots. The existing house and boatshed are to be retained on proposed Lot 11, which is to remain as a torrens title lot. No works are proposed within this lot or below Mean High Water Mark.

The bulk of the impacts relate to the subdivision as this includes the provision of an access road, establishment of building footprints within each lot and provides for the protection of existing vegetation to be retained and enhanced. However, landscaping will form part of the dwelling house DA's and this is also an important aspect of ecological considerations.

The total development footprint, including landscaping is 8800m².

The proposal includes construction of the houses and associated utilities such as; stormwater treatment, relocation of Council's stormwater pipes, driveways, common access road, foreshore access stairs, bin area, connection of utilities, conservation and improvement of an Environment Protection Area, Natural Revegetation Area, Landscaping and a Vegetated Riparian Zone 40m that will have Landscaping of two kinds as shown in Figure 1.5. Areas that will be temporarily disturbed by construction (e.g pipe relocation, connection of utilities and construction buffer area around houses) will be re-established as Pittwater and Wagstaffe Spotted Gum Forest and is referred to as the Native Revegetation Area (see Figure 1.5). During the planning of this proposal there were extensive discussions and actions taken to avoid and mitigate ecological impacts, the offsets required for the residual impact were calculated in the Biodiversity Development Assessment Report by GIS Environmental Consultants (Nov 18).

The northern third of the Development Footprint is within a Vegetated Riparian Zone (Riparian Corridor). There are works proposed within the 40m Vegetated Riparian Zone, including construction of parts of the houses for Lots 6 to 9, landscaping and drainage works. See Figures 1.4 and 1.5.

Section 8.2.2 (d) of the BAM requires the project to be located to avoid and minimise impact to the Riparian corridor and section 9.3.2.3 (f) requires temporary fencing to reduce impact to the Riparian Zone. The WM Act requires a Controlled Activity Approval be obtained before commencing the activity and a Vegetation Management Plan.

1.4 Plans and Documents Used for this Report

Title	Author	Rev	DWG./Doc. No./Ref.	Date
Site Plan	Mark Hurcum Design Practice	-	A005 A	23 rd November 2018
Driveway Plan	Mark Hurcum Design Practice	-	A006 A	23 rd November 2018
Pre-lodgement Advice	Northern Beaches Council	-	PLM2018/0084	10 th May 2018
Landscape Masterplan	Jamie King	C	Sht-101	28 th November 2018
Biodiversity Development Assessment Report BDAR	GIS Environmental Consultants	-	-	30 th November 2018
Biodiversity Management Plan	GIS Environmental Consultants	-	-	30 th November 2018
Estuarine Hazard Assessment	Horton Coastal Engineering	-	-	14 th November 2018

2 Methods

The site was inspected in January, March, May, September and October 2018 by experienced and qualified ecologists; Nicholas Skelton, Sophia Mueller Sewell, Sarah Tuxworth and Joshua Drane. The site had previously been inspected by GIS Environmental Consultants in January and February 2002, May and June 2015.

The field survey involved the following procedures:

- Initial familiarisation with the site and its extent;
- Assessment of the physical characteristics of the site and the adjacent riparian areas and waterway, including existing disturbance and pollutants;
- Assessment of the habitats on the riparian land on the site and the adjacent waterway;
- Recording of all plant species within each habitat type in the riparian land;
- Assessment of potential pollutants sources (e.g stormwater run-off) from the property;
- Identification of fauna through sightings, calls and potential habitat: search for scats, remains, nests, dreys, bones, feathers, fur, diggings, scratches, tracks, owl white-wash and food sources;
- Detailed search for targeted threatened species;
- Assessment of the extent of disturbance and weed invasion; and
- Photography of the site.

The findings from other reports and mapping from nearby surveys and studies were also used to provide additional information.

3 Findings

3.1 Existing Quality of the Onsite and Offsite Waterways and Riparian Lands

3.1.1 *Physical Characteristics and Water Quality*

Pittwater is a large tidal marine estuary with a surface area of approximately 18.4 square kilometres. Pittwater is continuous with the ocean, northeast of the site, between West Head and Barrenjoey Head. The site is situated on the southern end of the western foreshore, the proposal is wholly above the mean high-water mark.

The locality has a long history of disturbance and the natural environment has been extensively changed since European settlement. The Riparian Corridor along Pittwater has been degraded by clearing for development, stormwater run-off, dumping, planting of garden species, weed invasion and human access. The water quality within Pittwater harbour is good. Sea grass was not found within 50m of site.

3.1.2 *Existing Erosion and Sediment Conditions*

There is currently no significant erosion or sedimentation occurring at this site and there are no sediment control measures at the site.

3.1.3 *Channel Form, Erosion Rate and Bank Stability*

None of the works will occur beyond the boundary of the property, and, as such, will have no impact on the stability of the bank, channel form. The existing seawall is in fair to poor condition and the Estuarine Hazard Assessment (Horton Coastal Engineering) recommends repair of the seawall.

3.1.4 *Stormwater Discharge Points and Stormwater Treatment Measures*

The storm water discharge at the site is currently via a pipe and an open lined channel along the north-western boundary of the property. The storm water from the property discharges into Pittwater. Pittwater is immediately adjacent to the north east.

3.2 Ecological Value of the Waterway and Riparian Land

Pittwater is an estuarine environment fringed by mostly native vegetation with areas of shallow and deep water, mudflats, mangroves, seagrass meadows and saltmarsh that is extensively used by aquatic and estuarine fauna including invertebrates, mammals, fish and birds.

3.2.1 Connectivity with Waterway Corridors, Bushland and Open Space

The existing site along the foreshore has high corridor value for ground dwelling and more mobile fauna in the east-west direction. The native tree canopy at the site partly overlaps with canopy to the south-east and to the south-west of the site. The canopy to the south-east of the site is not connected to any large area of habitat. The canopy on the south-west of the property joins with the canopy of other properties to form a large area of remnant canopy, the foreshore is continuous with the wetlands of Careel Bay. See the maps in Figures 1.1, 1.2 and 1.3.

3.2.2 Native Flora and Fauna in the Riparian Land

The site contains two Endangered Ecological Communities, Swamp Oak Floodplain Forest EEC in low condition and Pittwater and Wagstaffe Spotted Gum Forest EEC in low to medium condition. Both Endangered Ecological Communities occur within the Vegetated Riparian Zone.

There are approximately 226 (dead or alive) native trees at the site (see tree Schedule in Appendix A) including Spotted Gums (*Corymbia maculata*), Grey Ironbark (*Eucalyptus paniculata*), Swamp She-oak (*Casuarina glauca*), Sweet Pittosporum (*Pittosporum unulatum*) and four Threatened *Syzygium paniculatum* plants that provide habitat to a wide range of native fauna species including foraging, nesting and roosting habitats. The Casuarinas and Allocasuarinas are suitable foraging habitat for the Threatened Glossy Black-cockatoo. Some of the large Spotted Gums contain hollows which are suitable nesting and breeding habitat for fauna (see section 4.2.2 below). Microbats may forage over the tree tops. There is a very large (140cm diameter) *Ficus hillii* that provides good foraging habitat for the Threatened Grey-headed Flying-fox. There are sandstone retaining walls throughout the site that provide habitat for small reptiles. Nine (9) habitat trees with hollows were recorded in the site during the field survey. Two of these hollows occur within the VRZ.

The boat sheds are potential roosting habitat for microbats, these will not be changed as part of this proposal.

The lawn adjacent to the tidal beach north of the site, provide foraging habitat for estuarine birds and the native water rat.

See Table 1 for a list of fauna observed on or adjacent to the site.

See Table 2 for a list of plant species within each habitat zone at the site.

Table 1. Fauna Species Observed on and Adjacent to the Site

Common Name	Scientific Name	Evidence	Date
Birds			
Australian Brush-turkey	<i>Alectura lathamii</i>	Observed, Camera 1	11/09/18, 12/10/18
Australian Magpie	<i>Cracticus tibicen</i>	Observed	2002, 2018
Australian Pelican	<i>Pelecanus conspicillatus</i>	Observed	2002, Oct 2018
Australian Raven	<i>Corvus coronoides</i>	Observed	2002
Australian Wood duck	<i>Chenonetta jubata</i>	Observed, Camera 8	2002, 13-16/10/18
Australian White Ibis	<i>Threskiornis molucca</i>	Observed	2002
Black Shouldered Kite	<i>Elanus axillaris</i>	Observed	2002
Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	Observed	2002
Common Myna*	<i>Acridotheres tristis</i>	Observed	2002
Crimson Rosella	<i>Platycercus elegans</i>	Observed	2002
Eastern Rosella	<i>Platycercus eximius</i>	Observed	2002
Galah	<i>Eolophus roseicapilla</i>	Observed	2002, Sept 2018
Great Egret	<i>Ardea alba</i>	Observed	Sept 2018
Grey Butcherbird	<i>Cracticus torquatus</i>	Observed	2018
Grey Fantail	<i>Rhipidura fuliginosa</i>	Observed	2002
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	Observed	2002
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Observed	2002, 2018
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	Observed	2002, 2018
Little Corella	<i>Cacatua sanguiea</i>	Observed	2002
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	Observed	2002, 2018
Little Wattlebird	<i>Anthochaera chrysoptera</i>	Observed	2002
Mallard*	<i>Anas platyrhynchos</i>	Observed	2002
Noisy Miner	<i>Manorina melanocephala</i>	Observed, Camera 6	2002, 2018
Magpie-lark	<i>Grallina cyanoleuca</i>	Observed	2002, 2018
Pied Cormorant	<i>Phalacrocorax</i>	Observed	2002
Pied Currawong	<i>Strepera graculina</i>	Observed	2002, 2018
Pacific Black Duck	<i>Anas superciliosa</i>	Observed, Camera 8	2002 Sept-Oct 18
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	Observed, Nesting	2002, 2018
Red-browed Finch	<i>Neochmia temporalis</i>	Observed	2002
Red Wattlebird	<i>Anthochaera carunculata</i>	Observed, heard	2002, Oct 2018
Silver Gull	<i>Larus novaehollandiae</i>	Observed	2002, 2018
Short Billed Corella	<i>Cacatua sanguinea</i>	Heard	2018
Spotted Pardalote	<i>Pardalotus punctatus</i>	Observed	2002
Spotted Turtle-Dove*	<i>Streptopelia chinensis</i>	Observed	2002
Spur Winged Plover	<i>Vanellus miles</i>	Observed, Camera 8	2002, 2018
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	Observed, Heard	2002, 2018
Superb Fairy-wren	<i>Malurus cyaneus</i>	Observed	2002
Tree Martin	<i>Hirundo nigricans</i>	Observed	2002
Welcome Swallow	<i>Hirundo neoxena</i>	Observed, Camera 8	2002, 2018
White-faced Heron	<i>Egretta novaehollandiae</i>	Observed	2002
Whistling Kite	<i>Haliastur sphenurus</i>	Observed	2002
White-browed Scrubwren	<i>Sericornis frontalis</i>	Observed	2002
Willie Wagtail	<i>Rhipidura leucophrys</i>	Observed	2002
Variegated Fairy-wren	<i>Malurus lamberti</i>	Observed	2002
Mammals			
Brush-tailed Possum	<i>Trichosurus vulpecula</i>	Camera 4&6	2002, 12-21/10/18
Cat*	<i>Felis catus</i>	Observed, Camera 1	2002, 16/10/18
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	Observed	2002
Black Rat*	<i>Rattus rattus</i>	Observed	2002
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Observed (foraging only)	2002
Long-nosed Bandicoot	<i>Perameles nastuta</i>	Camera 1, Diggings	2002, 12, 21/10/18
Dog*	<i>Canis lupus familiaris</i>	Observed	2002, Jan-May 2018
Fox*	<i>Vulpes vulpes</i>	Camera 1,3 & 8	12-14/10/18
Rabbit*	<i>Oryctolagus cuniculus</i>	Scat	2002
Amphibians			

Common Name	Scientific Name	Evidence	Date
Common Eastern Froglet	<i>Crinia signifera</i>	Heard	2002
Frog Spawn (unknown species)	<i>Unknown species</i>	Observed	2018
Reptiles			
Eastern Water Dragon	<i>Physignathus lesueurii</i>	Observed	2002, 2018
Eastern Water Skink	<i>Eulamprus quoyii</i>	Observed	2002
Dark-flecked Garden Sunskink	<i>Lampropholis delicata</i>	Observed	2002, 2018
Pale-flecked Garden Sunskink	<i>Lampropholis guichenoti</i>	Observed	2002, 2018
Weasel Skink	<i>Saproscincus mustelinus</i>	Observed	2002
Eastern Blue-tongued Lizard	<i>Tiliqua scincoides</i>	Observed	2002

Table 2. Flora Species at the Site

96-104 Cabarita Road, Avalon Beach

Location: MGA 344130 6278673

September 2018

by Nicholas Skelton, GIS Environmental Consultants

Summary of Growth Form and Status

Growth Form	Local Native Species	Planted	Threatened	Weed	Total
Fern	5			2	7
Forb	5	1		9	15
Grass	7			7	14
Herb	8	11		16	35
Other	6			2	8
Shrub	9	12		10	31
Tree	33	21	1	4	59
Vine	8	3		1	12
Total	81	48	1	51	181

Genus and Species	Habit	Common Name	Status
<i>Allocasuarina torulosa</i>	Tree	Forest She-oak	Local Native Species
<i>Acacia floribunda</i>	Tree	White Sallow Wattle	Local Native Species
<i>Acacia implexa</i>	Tree	Hickory	Local Native Species
<i>Acacia longifolia</i>	Shrub	Sydney Golden Wattle	Local Native Species
<i>Acacia longissima</i>	Tree		Local Native Species
<i>Acacia prominens</i>	Tree	Gosford Wattle	Planted
<i>Acalypha wilkesiana</i>	Herb	Beefsteak Plant	Planted
<i>Adiantum aethiopicum</i>	Fern	Maidenhair Fern	Local Native Species
<i>Adiantum hispidulum</i>	Fern	Five Fingered Jack	Local Native Species
<i>Agapanthus orientalis</i>	Herb	Agapanthus	Planted
<i>Agathis robusta</i>	Tree	Queensland Kauri	Planted
<i>Agave americana</i>	Herb	American Cactus	Weed
<i>Agave attenuata</i>	Herb	Century Plant	Weed
<i>Agave sp.</i>	Herb	Century Plant	Planted
<i>Ageratina adenophora</i>	Herb	Crofton Weed	Weed
<i>Agonis flexuosa</i>	Tree	Willow Myrtle	Planted
<i>Allocasuarina torulosa</i>	Tree	Forest She-oak	Local Native Species
<i>Aloe saponaria</i>	Herb	Soap Aloe	Planted
<i>Alpinia sp.</i>	Herb	Ornamental Ginger	Planted
<i>Angophora floribunda</i>	Tree	Rough-barked Apple	Local Native Species
<i>Araucaria heterophylla</i>	Tree	Norfolk Island Pine	Planted
<i>Arbutus unedo</i>	Tree	Irish Strawberry	Planted
<i>Archontophoenis cunninghamiana</i>	Other	Bangalow Palm	Local Native Species
<i>Asparagus aethiopicus</i>	Fern	Asparagus Fern	Weed
<i>Asparagus officinalis</i>	Herb	Asparagus	Weed
<i>Atriplex prostrata</i>	Forb		Weed
<i>Avicennia marina</i>	Tree	Grey Mangrove	Local Native Species
<i>Avicennia marina var. australasica</i>	Tree		Local Native Species
<i>Banksia integrifolia ssp. integrifolia</i>	Tree	Coastal Banksia	Local Native Species
<i>Bidens pilosa</i>	Herb	Cobbler's Pegs, Pitchforks	Weed
<i>Billardiera scandens</i>	Other	Apple Berry, Dumplings	Local Native Species
<i>Bougainvillea sp.</i>	Shrub	Bougainvillea	Planted
<i>Brachychiton acerifolius</i>	Tree	Flame Tree	Planted
<i>Brachychiton populneum</i>	Tree	Kurrajong	Local Native Species
<i>Brassaia actinophylla</i>	Shrub	Umbrella Tree	Weed
<i>Breynia oblongifolia</i>	Shrub	Breynia	Local Native Species
<i>Briza minor</i>	Grass	Shivery Grass	Weed
<i>Bryophyllum delagoense</i>	Forb	Mother-of-millions	Weed
<i>Cakile edentula</i>	Herb		Weed
<i>Callistemon Hybrid</i>	Shrub	Bottle Brush	Planted
<i>Camellia japonica</i>	Tree	Camellia	Planted
<i>Camellia sasanqua</i>	Tree	Camellia	Planted

Genus and Species	Habit	Common Name	Status
<i>Carpobrotus glaucescens</i>	Herb	Pig Face	Local Native Species
<i>Castanospermum australe</i>	Tree	Black Bean	Planted
<i>Casuarina glauca</i>	Tree	Swamp Sheoak	Local Native Species
<i>Cayratia clematidea</i>	Vine	Slender Grape	Local Native Species
<i>Cerastium glomeratum</i>	Forb	Mouse Ear Chick Weed	Weed
<i>Ceratopetalum gummiferum</i>	Tree	NSW Christmas Bush	Local Native Species
<i>Chlorophytum comosum</i>	Herb	Spider Plant	Weed
<i>Chrysanthemoides monilifera</i>	Shrub	Boneseed	Weed
<i>Cinnamomum camphora</i>	Tree	Camphora Laurel	Weed
<i>Cissus antarctica</i>	Vine	Kangaroo Vine	Local Native Species
<i>Cissus hypoglauca</i>	Vine	Native Grape	Local Native Species
<i>Citharexylum spinosum</i>	Tree	Fiddlewood	Planted
<i>Clerodendrum tomentosum</i>	Shrub	Hairy clerodendrum	Local Native Species
<i>Clivea miniata</i>	Herb	Kaffir Lily	Planted
<i>Commelina cyanea</i>	Forb	Creeping Christian	Local Native Species
<i>Conyza bonariensis</i>	Shrub	Fleabane	Weed
<i>Conyza sp.</i>	Herb	Fleabane	Weed
<i>Corymbia gummifera</i>	Tree	Bloodwood	Local Native Species
<i>Corymbia maculata</i>	Tree	Spotted Gum	Local Native Species
<i>Craspedia variabilis</i>	Herb	Billy Buttons	Local Native Species
<i>Crassula multicava</i>	Herb	Fairy Crassula	Weed
<i>Cyanodon dactylon</i>	Grass	Common Couch	Local Native Species
<i>Cyathea cooperi</i>	Fern	Straw Tree Fern	Local Native Species
<i>Cymbidium suave</i>	Herb		Local Native Species
<i>Cynodon dactylon</i>	Grass	Common Couch	Local Native Species
<i>Cyperus sp.</i>	Grass		Weed
<i>Davallia pyxidata</i>	Fern	Hares Foot Fern	Local Native Species
<i>Dendrobium speciosum</i>	Herb		Planted
<i>Dianella caerulea var. producta</i>	Herb	Blue Flax Lily	Local Native Species
<i>Dichondra repens</i>	Herb	Kidney Weed	Local Native Species
<i>Dietes grandiflora</i>	Forb	Dietes	Planted
<i>Digitaria sanguinalis</i>	Grass	Summer Grass	Weed
<i>Dimorphotheca ecklonis</i>	Herb	Sailor Boy Daisy	Planted
<i>Dodonaea triquetra</i>	Shrub	Hop Bush	Local Native Species
<i>Ehrharta erecta</i>	Grass	Ehrharta	Weed
<i>Endiandra sieberi</i>	Tree	Corkwood	Local Native Species
<i>Entolasia marginata</i>	Grass		Local Native Species
<i>Entolasia stricta</i>	Grass	Wiry Panic	Local Native Species
<i>Epidendrum ibaguense</i>	Herb	Crucifix Orchid	Planted
<i>Eriobotrya japonica</i>	Shrub	Loquat	Planted
<i>Erythrina X sykesii</i>	Tree	Coral Tree	Weed
<i>Eucalyptus acmenoides</i>	Tree	White Mahogany	Local Native Species
<i>Eucalyptus botryoides</i>	Tree	Bangalay	Local Native Species
<i>Eucalyptus paniculata ssp. paniculata</i>	Tree	Grey Ironbark	Local Native Species
<i>Eucalyptus punctata</i>	Tree	Grey Gum	Local Native Species
<i>Eucalyptus robusta</i>	Tree	Swamp Mahogany	Local Native Species
<i>Eucalyptus umbra</i>	Tree	Bastard Mahogany	Local Native Species
<i>Eustrephus latifolius</i>	Vine	Wombat Berry	Local Native Species
<i>Ficus benjamina</i>	Tree	Weeping Fig	Planted
<i>Ficus microcarpa</i>	Tree	Fig Cultivar	Planted
<i>Ficus pumila</i>	Tree	Climbing Fig	Planted
<i>Ficus rubiginosa</i>	Tree	Port Jackson Fig	Local Native Species
<i>Freesia refracta</i>	Forb	Freesia	Weed
<i>Geitonoplesium cymosum</i>	Vine	Scrambling Lily	Local Native Species
<i>Geranium homeanum</i>	Herb		Local Native Species
<i>Glochidion ferdinandi var. ferdinandi</i>	Tree	Cheese Tree	Local Native Species
<i>Grevillea robusta</i>	Shrub	Silky Oak	Planted
<i>Harpephyllum caffrum</i>	Tree	Kaffir Plum	Local Native Species
<i>Hedychium gardnerianum</i>	Forb	Ginger Lily	Weed
<i>Hibiscus sp.</i>	Shrub	Hibiscus	Planted

Genus and Species	Habit	Common Name	Status
<i>Hydrangea macrophylla</i>	Herb	Hydrangea	Planted
<i>Hypochoeris glabra</i>	Herb	Smooth Cats Ear	Weed
<i>Imperata cylindrica</i> var. <i>major</i>	Grass	Blady Grass	Local Native Species
<i>Jacaranda mimosaeifolia</i>	Tree	Jacaranda	Planted
<i>Lantana camara</i>	Shrub	Lantana	Weed
<i>Leptospermum polygalifolium</i> ssp. <i>poly</i>	Shrub	Lemon Scented Tea Tree	Local Native Species
<i>Ligustrum lucidum</i>	Tree	Privet - broad leaved	Weed
<i>Ligustrum sinense</i>	Shrub	Privet - narrow leaved	Weed
<i>Lilium formosum</i>	Herb	Roadside Lilly	Weed
<i>Livistona australis</i>	Tree	Cabbage Tree Palm	Local Native Species
<i>Lolium perenne</i>	Grass	Perennial Rye Grass	Weed
<i>Lomandra longifolia</i>	Forb	Spiny-headed Mat-rush	Local Native Species
<i>Lonicera japonica</i>	Other	Japanese Honeysuckle	Weed
<i>Lophostemon confertus</i>	Tree	Brush Box	Planted
<i>Macrozamia communis</i>	Other	Burrawang	Local Native Species
<i>Magnolia grandifolia</i>	Tree	Evergreen Magnolia	Planted
<i>Marsdenia suaveolens</i>	Vine	Sweet-scented Doubah	Local Native Species
<i>Melaleuca quinquenervia</i>	Tree	Broad-leaved Paperbark	Local Native Species
<i>Melaleuca styphelioides</i>	Shrub	Prickly-leaved Paperbark	Local Native Species
<i>Melia azedarach</i>	Tree	White Cedar	Local native species
<i>Monstera deliciosa</i>	Herb	Swiss Cheese Plant	Weed
<i>Morus alba</i>	Tree	White Mulberry	Planted
<i>Musa</i> sp.	Herb	Banana	Planted
<i>Nandina domestica</i>	Shrub	Sacred Bamboo	Weed
<i>Nephrolepis cordifolia</i>	Fern	Fishbone Fern	Weed
<i>Nerium oleander</i>	Shrub	Oleander	Planted
<i>Notelaea longifolia</i>	Shrub	Nettle	Local Native Species
<i>Notelaea ovata</i>	Shrub	Mock Olive	Local Native Species
<i>Nothoscordum gracile</i>	Forb	Onion Weed	Weed
<i>Ochna serrulata</i>	Shrub	Mickey Mouse Plant	Weed
<i>Olea europaea</i> ssp. <i>africana</i>	Shrub	African Olive	Weed
<i>Oplismenus imbecillis</i>	Grass	Basket Grass	Local Native Species
<i>Oxalis rubens</i>	Forb		Local Native Species
<i>Pandorea pandorana</i>	Other	Wonga Wonga Vine	Local Native Species
<i>Parietaria judaica</i>	Herb	Asthma Weed	Weed
<i>Paspalum dilatatum</i>	Grass	Paspalum	Weed
<i>Passiflora herbertiana</i>	Vine	Passionfruit	Planted
<i>Philodendron bipinnatifidum</i>	Forb	Philodendron	Weed
<i>Phoenix canariensis</i>	Other	Canary Island Date Palm	Weed
<i>Physalis peruviana</i>	Herb	Cape Gooseberry	Weed
<i>Pinus</i> sp.	Tree	Pine	Weed
<i>Pittosporum revolutum</i>	Tree	Rough-fruit Pittosporum	Local Native Species
<i>Pittosporum undulatum</i>	Tree	Sweet Pittosporum	Local Native Species
<i>Plantago lanceolata</i>	Forb	Lamb's Tongues	Weed
<i>Plumeria lutea</i>	Tree	Frangipanni	Planted
<i>Portulacaria afra</i>	Shrub	Jade Plant	Planted
<i>Pratia purpurascens</i>	Herb	White Root	Local Native Species
<i>Prunus</i> sp.	Tree	Stonefruit	Planted
<i>Pseuderanthemum variabile</i>	Forb	Pastel Flower	Local Native Species
<i>Pteridium esculentum</i>	Fern	Bracken	Local Native Species
<i>Rapanea howittiana</i>	Tree	Brush Muttonwood	Local Native Species
<i>Rhododendron</i> sp.	Shrub	Azalea	Planted
<i>Rubus fruticosus</i>	Vine	Blackberry	Weed
<i>Rubus hillii</i>	Vine	Broad-leaved Bramble	Local Native Species
<i>Rubus parvifolius</i>	Other	Native Raspberry	Local Native Species
<i>Scolopia braunii</i>	Tree	Flintwood	Local Native Species
<i>Senecio madagascariensis</i>	Forb	Fire Weed	Weed
<i>Senna pendula</i>	Shrub	Cassia	Weed
<i>Solanum nigrum</i>	Herb	Black-berry Nightshade	Weed
<i>Stenocarpus sinuatus</i>	Tree	Fire Wheel Tree	Planted



Legend

- Development Site (12700sqm)
- WM Act Vegetated Riparian Zone 40m (2500sqm)
- BC Act Vegetated Riparian Zone 50m
- Vegetation Management Areas**
- Environment Protection Area (1125sqm)
- Native Revegetation Area (1641sqm)
- Vegetated Riparian Area Landscape Type A (424sqm)
- Vegetated Riparian Area Landscape Type B (667sqm)

Table 1. Summary of Vegetation Management and Landscaping

96 - 104 Cabarita Rd, Avalon

Acronym	Area on Fig 1.5	Size	Objective of Area	Management Document
EPA	Environment Protection Area	1125sqm	Protect and improve the endangered forest	Bushland Management Plan
NRA	Native Revegetation Area	1641sqm	Protect and improve the endangered forest whilst allowing supervised trenching for utilities and provision of screening planting	Bushland Management Plan
Vegetated Riparian Area VRA 1089sqm	Landscape Type A, Riparian Zone SOFF EEC	424sqm	Protect, allow supervised trenching and improve the two endangered forests and riparian corridor	Landscape Plan
	Landscape Type B, Riparian Zone PWSGF EEC	667sqm		
	Landscape Type C	8843sqm including houses and drive	Provide attractive landscaped gardens for the new houses that does not contain invasive species and provides some habitat value.	Landscape Plan



Table 3. Summary of Vegetation Management and Landscaping

96 - 104 Cabarita Rd, Avalon

Acronym	Area on Fig 1.5	Size	Objective of Area	Management Document	Management Actions	Planting Specification
EPA	Environment Protection Area	1125sqm	Protect and improve the endangered forest	Bushland Management Plan	No Access by builder, weed control and supplemental planting by qualified bushregerators	Planting density 3/sqm tubestock. Species mixture to be 100% Local providence PWSGF EEC species. Species mixture as specified in BMP.
NRA	Native Revegetation Area	1641sqm	Protect and improve the endangered forest whilst allowing supervised trenching for utilities and provision of screening planting	Bushland Management Plan	No access except supervised construction access, temporary protection fencing, light cover of native mulch where needed, weed control and planting by qualified bushregerators	Planting density 5/sqm tubestock. 100% Local providence PWSGF EEC species. Species mixture as specified in BMP. Screening planting in designated areas.
Vegetated Riparian Area VRA 1089sqm	Landscape Type A, Riparian Zone SOFF EEC	424sqm	Protect, allow supervised trenching and improve the two endangered forests and riparian corridor	Landscape Plan	Only supervised construction access, temporary protection fencing, weed control and planting supervised by qualified bushregerator. Protect and retain all existing native plants, avoid disturbance of the soil surface.	Minimum 80% Swamp Oak Floodplain Forest Endangered Ecological Community (SOFF EEC) species. See Schedule B
	Landscape Type B, Riparian Zone PWSGF EEC	667sqm				Minimum 80% Pittwater Wagstaff Spotted Gum Forest Endangered Ecological Community (PWSGF EEC) species. See Schedule A
	Landscape Type C	8843sqm including houses and drive	Provide attractive landscaped gardens for the new houses that does not contain invasive species and provides some habitat value.	Landscape Plan	Hard and soft landscaping, earthworks and construction. Building of; bio retension pond, garden, houses, drive, retaining walls, stairs, bin area and kayak storage. By builder and landscaping contractor	Landscape Plan shows specific locations and quantities of each species to be planted . 50% local providence species.

Notes: Recovery of native plants from Landscape Type C areas to to be planted within the EPA area prior to construction is recommended.

4 Assessment of Impacts

4.1 Ecological Impact

The “Guidelines for controlled activities on waterfront land” identify a Vegetated Riparian Zone (VRZ) to be 40 metres (from the mean high tide mark). Four of the 9 proposed new houses will be within the outer 50% of the Vegetated Riparian Zone and the drainage, landscaping and the connection of utility works are within the VRZ and some of the native vegetation and habitat within the Vegetated Riparian Zone will be removed.

The (WM Act) Guidelines state that

“Where suitable, applicants may undertake non-riparian corridor works or development within the outer 50 per cent of a VRZ, as long as they offset this activity by connecting an equivalent area to the RC within the development site.”

Actions to reduce impact within the Vegetated Riparian Area include retaining native vegetation where possible and revegetation using 80% of the original endangered community species. This area will be as per the Landscape Plan (Jamie King, 2018). The Vegetated Riparian Area is split into two areas; Landscape Area Type A and Landscape Area Type B. Landscape Area Type A will be planted with mostly Swamp Oak Floodplain Forest EEC species and Landscape Area Type B will be planted with mostly Pittwater and Wagstaffe Spotted Gum Forest EEC species (see Table 3).

The proposed Vegetated Riparian Area (and Riparian Corridor) will be partly linked with other conservation management areas on the property including the Native Revegetation Area and the Environment Protection Area as shown in Figure 1.5. The total area to be conserved and managed as a native ecological community covers a larger area than the area of the VRZ to be impacted (see Figure 1.5).

The likely temporary environmental impacts to the Riparian Land and Waterway will be, noise during the day and a potential increase in erosion and sedimentation due to removal of vegetation and excavation. Recommendations have been made to reduce the temporary environmental impacts, including installing sediment control devices prior to construction, keeping machinery and waste out of the lower part of the riparian land and prevent erosion.

4.2 Water Quality

There is potential for sediment, nutrients and other chemicals from this site to enter the adjacent and downslope important estuarine waterway, reducing water quality and increasing turbidity.

Recommendations to maintain water quality during construction include;

- Building waste and building materials are not be stored in the lower part of the Vegetated Riparian Zone and not on the lawn that may be subject to occasional flooding during storms or high tides.
- Installation of sediment fences below construction and around stockpiles.
- Sediment controls are to be maintained throughout construction to prevent sediment from entering the waterway.
- Retain natural rock features and existing retaining walls to prevent erosion and maintain habitat.
- Planting native species will prevent erosion and improve habitat value.

These measures are to improve the water quality leaving the site and prevent environmental damage to the estuarine habitat during construction.

If the mitigation measures in this report for the prevention of erosion, run-off and sediment deposition into the estuary are followed, then the proposal is not likely to have a significant, adverse effect on the water quality of Pittwater.

4.3 Channel Form, Erosion Rate and Bank Stability

The Estuarine Risk Management Report by Horton Coastal Engineering assesses these impacts. The construction phase of the proposal is unlikely to have any detrimental impact on the geomorphological processes of the estuary, as the works will not alter the driving forces behind the fluvial processes of the estuary. The proposed development work does include connection to the sewer which is below the mean high-water mark in the estuary. The works do involve realignment works to the stormwater channel and culvert in the seawall.

Recommendations have been made to reduce erosion and sedimentation such as sediment control measures during construction, retaining natural rock features and retaining and planting.

If the mitigation measures in this report for the prevention of erosion, run-off and sediment deposition into the estuary are followed, then the proposal will not have an adverse effect on the channel form, erosion rate and bank stability of the waterway.

4.4 Stormwater Discharge and Treatment Systems

There is a bioretention basin proposed in the western side of the property that will collect stormwater from the driveways and new houses, see stormwater report by NB Consulting Engineers. This will reduce the amount of nutrients, sediments and pollutants entering the harbour. Once filtered, water from the bioretention basin will discharge into Council's stormwater pipe on the western boundary which discharges into Pittwater.

4.5 Flood Impact Assessment

The proposal is not likely to increase the risk of any flood related impact to the watercourse, as the proposal is not likely to alter the watercourse function of flooding volumes or flow as the existing harbour banks will be retained in current form and alignment.

4.6 Modifications to Natural Creeklines or Overland Flow

The proposed development extent of work does not extend beyond the boundary of the property. The proposal will not have an adverse effect on any natural creekline or overland flow. The proposal does relocate and pipe the existing council stormwater open channel/pipe.

5 Assessment and Compliance with the Pittwater 21 DCP)

5.1 Controls B5.13 Development on Waterfront Land

1. Any waterfront land (as defined in the Water Management Act 2000) on the property shall be retained in their natural state to: carry stormwater/flood flows, maintain aquifers, retain stability, and provide habitat functions.
2. Natural or artificially modified water courses cannot be diverted onto adjoining lands, filled, channelized and/or dammed.
3. Waterfront land in a degraded state, should be restored and rehabilitated.
4. Development within waterfront land shall incorporate appropriately sized riparian corridor zones into design based on controlled activities on waterfront land: guidelines for outlet structures on waterfront land.
5. Development adjoining waterfront land is to be landscaped with local native species.
6. Council encourages the replacement of piped stormwater system where appropriate with a restored waterway, wherever feasible.
7. The piping or artificial channelling of natural watercourses and drainage channels is not permitted.

5.2 Assessment of Compliance

The Site will retain the existing lawn and some trees within the VRZ and there is a proposed Vegetated

Riparian Area within the VRZ. To avoid and minimise impact to the riparian habitat values on this site, trees and native plants will be retained where possible within the Vegetated Riparian Area. 80% local native species are proposed to be planted within the Vegetated Riparian Area as per the Landscape Plan (see Attachment A). The Vegetated Riparian Area is partly linked to other conservation management areas on the property including the Native Revegetation Area and the Environment Protection Area in which the existing native vegetation will be protected, where possible and supplementary planting will be with 100% Pittwater and Wagstaffe Spotted Gum Forest species. A Biodiversity Management Plan is included as part of the DA to describe the protection, establishment and maintenance of native vegetation in the Native Revegetation Area and Environment Protection Area.

The Water Management Act requires 40m VRZ and the management areas are shown on the map in Figure 1.5.

Realignment of the stormwater pipe and piping a section of open channel will occur, this realignment will stay within the property boundary.

The proposal generally complies with the controls of section B5.13 Development on Waterfront Land, of the Pittwater 21 DCP.

6 Assessment of Compliance with the Water Management Act 2000

The proposal will result in non-riparian corridor uses (construction of dwellings) in the outer 50% of the 40m Vegetated Riparian Zone at the site. The average rule in the “Guidelines for Riparian Corridors on Waterfront Land” states that

1. on riparian corridor works and activities can be authorised within the outer riparian corridor, so long as the average width of the vegetated riparian zone can be achieved over the length of the watercourse within the development site. That is, where appropriate 50 per cent of the outer vegetated riparian zone width may be used for non-riparian uses including asset protection zones, recreational areas, roads, development lots and infrastructure. However, an equivalent area connected to the riparian corridor must be offset on the site (see Figure 3) and the inner 50 per cent of the vegetation

The proposal does not comply with this rule, however, the proposal does propose alternative offsets. The DA will be an integrated development and the DA will be referred to Department of Primary Industries (DPI). It is likely that there will be “General Terms of Approval” and a Controlled Activity approval application will be required.

8 Conclusions

A Vegetation Management Plan that is consistent with the requirement of the “Guidelines for vegetation management plans on waterfront land” by DPI, OoW is likely to be required to describe how to manage weed control, the planting native vegetation, minimise ecological and environmental impact during construction and the long-term maintenance of the native vegetation in the VRA and elsewhere on the site.

The proposal includes the clearing of low resilience Pittwater Wagstaffe Spotted Gum Forest EEC and Swamp Oak Floodplain Forest EEC for the construction of 4 new houses, landscaping, relocation of Councils stormwater pipe within the Vegetated Riparian Zone (Riparian Corridor).

This impact will be offset by the proposed Vegetated Riparian Area planting with fully structured native vegetation between the houses and below the houses within the Vegetated Riparian Zone. Planting within the Vegetated Riparian Area will be as per the Landscape Plan (see Appendix A). This will also be offset by revegetating with local native species as part of the Native Revegetation Area and 2564m² of other Conservation Management proposed for elsewhere within the property that is described in the

Biodiversity Management Plan.

The bioretention basin will collect rain water from the driveways and filter nutrients out of the water before it is discharged into councils pipes and then into Pittwater. Sediment fences will be installed prior to construction and will remain in place for the duration of the construction works and no construction materials and waste will be stored in the lower part of the Site. These measures will reduce impacts to the riparian area and Pittwater.

The DA is an integrated development a Controlled Activity Approval application will need to accompany the DA application for referral to DPI and "General Terms of Approval" will be issued.

9 Qualifications and Experience of the Field Ecologist and Authors

Nicholas Skelton's formal qualifications include a Bachelor of Science with Honours (B. Sc. (Hons) USyd) and a Masters in Applied Science (M. App. Sc. in Vegetation Management UNSW). Nick has been an environmental scientist for 20 years, including a university lecturer, research ecologist and a bush regenerator for 8 years. His work is focused on the Sydney bioregion and he has published many papers in independently reviewed journals on the ecology of Sydney. He has expert knowledge of the local soils, the climate of this area and the local indigenous plants and animals as a result of over 900 ecological surveys. Nick is a member of the relevant professional organisations including: a practising member of the Ecological Consultants Association of NSW, Ecological Society of Australia, AURISA, Royal Zoological Society and Birds Australia. He is licensed by NSW DECCW and NSW Department of Primary Industries to carry out surveys on threatened plants and animals and he is a qualified Biobanking certifier. Further details can be found at www.ecology.net.au.

10 References

- Department of Primary Industries, Office of Water (2012), Guidelines for vegetation management plans on waterfront land - http://www.water.nsw.gov.au/_data/assets/pdf_file/0010/547219/licensing_approvals_controlled_activities_veg_mgt_plans.pdf
- Department of Primary Industries, Office of Water (2011) Controlled Activities - [Guidelines for Riparian Corridors](#),
- Ruszczyk, J., Turnbull, A. and Dickson, T. (2014) Using Research to Communicate Historic Legacies and the Need for Catchment Specific Approaches to Estuary Management. Warringah Council, Warringah.
- Strahler, A.N. (1957) *Strahler System of Stream Order*

11 Appendix A - Landscape Plan

