

Date: 14 October 2022
To: Dan Maurici
From: Troy Eyles

Pages: 17
Copy: Rev00
Ref: 21-000093 – 10-12
Boondah Road,
Warriewood

Subject: 10 – 12 Boondah Road, Warriewood - Stormwater and Flooding Management Strategy Memo

10 – 12 Boondah Road is located within the Northern Beaches Council. Situated within the Warriewood Valley Land Release Area, the site comprises a total of 2.04 Ha, and is currently used for agricultural purposes.

Upon project completion, the transformation of the site will accommodate approximately 42 new townhouse dwellings, a children’s playground, and pedestrian walkways. Calibre Professional Services (NSW) Pty Ltd has been engaged to prepare documentation to support the stormwater management strategy for the proposed townhouse development. This memo is intended to complement the Water Management Report prepared for this development (Rev04 – 02/06/22).

1. Introduction

Calibre has previously prepared a Water Management Report for the proposed development. This memorandum has been prepared to support the Water Management Report in terms of the Earthworks Strategy, the Stormwater Quality Management Strategy and ground water level impacts due to the proposed earthworks cuts.

The site location is shown in Figure 1.

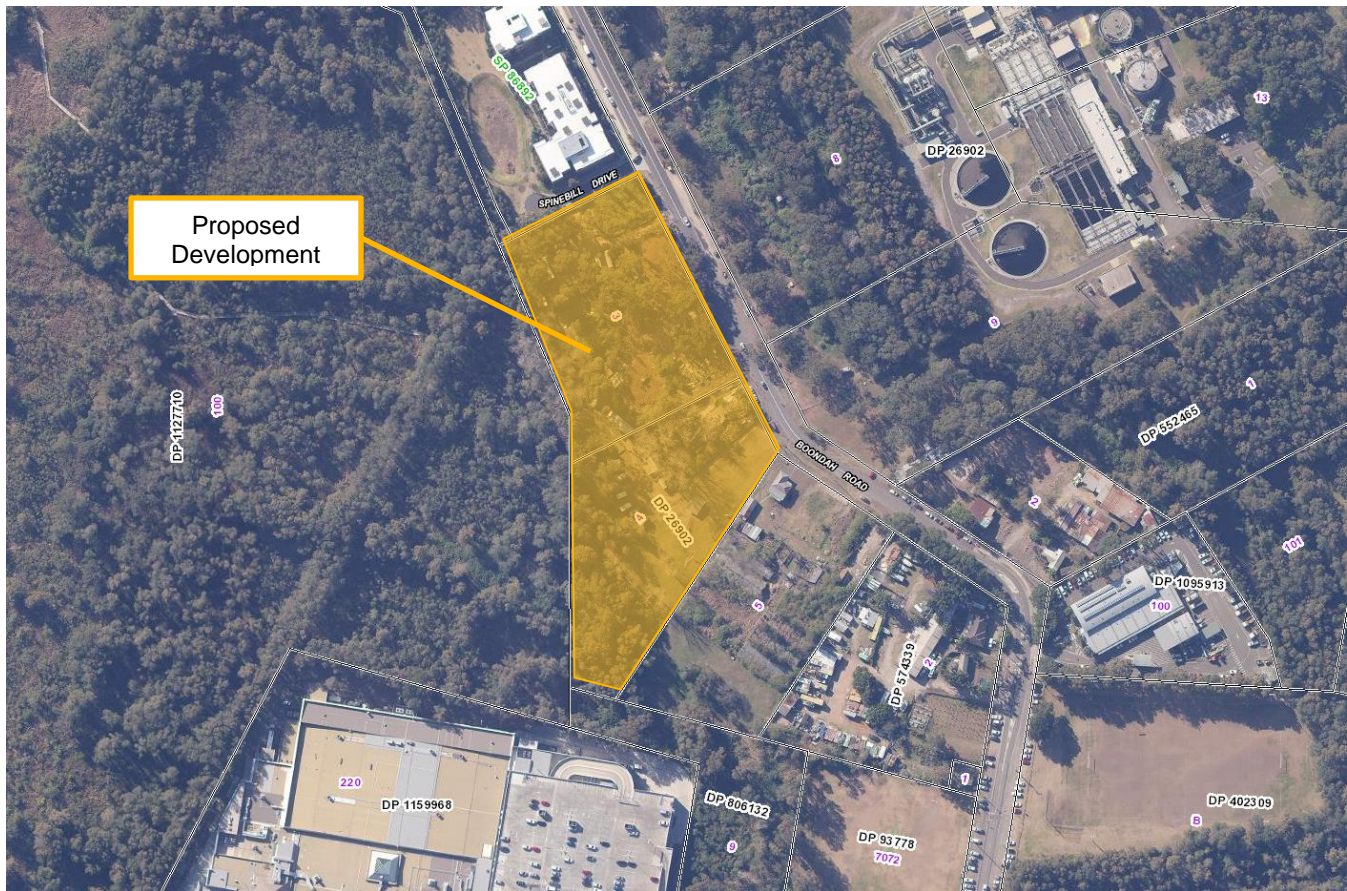


Figure 1: Development Site

Memorandum

Boondah Road fronts the development on its eastern boundary. On the eastern side of Boondah Road is Narrabeen Creek. Warriewood wetlands fronts the development on its western boundary. The proposed development layout is shown in Figure 2.



Figure 2: Proposed Site Plan

Figure 2 indicates that the townhouses will be built fronting internal driveways that connect to Boondah Road. The cycleways, pathways and vegetated areas will be built near the wetlands.

2. Earthworks

2.1 Ground Water Level

The ground water level monitoring for the proposed site has been undertaken by Douglas Partners on 23 November 2016 and 8 August 2019. The latest ground water levels measured at different borehole locations as per the report 'Groundwater Measurements 3-12 Boondah Road, Warriewood' (16/08/2019) is shown in Figure 3 and Table 1 below.



Figure 3: Location of Boreholes (Monitoring Wells) (Douglas and Partners 2016)

Table 1: Summary of Groundwater Measurements in Monitoring Wells

Borehole (Well)	Surface RL (m AHD)	Well Depth (m)	23 November 2016	8 August 2019
			Measured Depth (m) and RL (m, AHD) to Groundwater	
1	2.4	4.9	1.6 (RL 0.8)	1.7 (RL 0.7)
2	2.3	4.0	1.2 (RL 1.1)	1.0 (RL 1.3)
3	4.1	5.8	2.7 (RL 1.4)	2.9 (RL 1.2)
4	2.1	4.0	1.4 (RL 0.7)	Destroyed

The effect of the earthworks on the groundwater levels is determined in Sections 2.2 and 2.3 below.

2.2 Cut/Fill Analysis

Northern Beaches Council requires that proposed land developments be designed according to specific flood level controls, as given in their LEP, DCP and the pre-lodgement notes issued for this development. Calibre has used these controls to determine suitable RLs for each land use of the residential development, as shown in Table 2 below.

Table 2: Proposed Planning Levels for land uses

Area	Flood Level Control	RL
Townhouses	FPL	4.4
Roads and Driveways fronting townhouses	1% AEP + CC	3.9
Play Areas, Parks, and cycleways	20% AEP	2.5
Boondah Road	1% AEP + CC	3.9
Remaining Area (EEC and Riparian Corridor) (undeveloped)	N/A	As per existing conditions

The extent of the planning levels for each land type is shown in Figure 4.



Figure 4: Earthworks Strategy

To match the flood planning levels shown in Table 2, it is required that the site be regraded to accommodate these. The extent of the earthworks cut and fill to match the RLs given in Table 2 is shown in Figure 5 below.



Figure 5: Cut and Fill Plan

2.3 Conclusion on Cut/Fill Affectionation on Ground Water Level.

As shown in Figure 5, most of the area where cut has been proposed is located within in proximity to monitoring well 3. As per Table 1, the ground water level at monitoring well 3 is RL 1.2m – 1.4m AHD. The proposed surface level where the cut is proposed is RL 2.5m AHD which is minimum 1.1 – 1.3m above the ground water level at monitoring well 3. Thus, it can be concluded that the proposed cut will not impact ground water flow for this site as per ground water monitoring conducted by Douglas Partners. Detailed groundwater monitoring is proposed at the DA and detailed design stage.

3. Water Quality Modelling

3.1 General overview

The development would lead to a change in catchment hydrology, with the most obvious effect being an increase in stormwater flow. Stormwater from impervious surfaces is typically of poorer quality than runoff from pervious catchment and may result in a progressive deterioration of the environmental values of downstream waterways. Additionally, stormwater runoff from roads contains pollutants that are not typically found in runoff from rural catchments (including litter/gross pollutants, rubber, suspended solids, nitrogen, phosphorus, oil and grease, hydrocarbons, petroleum lead, zinc, iron, copper, cadmium, chromium, nickel, manganese, pesticides, and herbicides).

Pollutant loading for developments are typically expressed by four major variants – Total Phosphorus (TP), Total Nitrogen (TN), Total Suspended Solids (TSS) and Gross Pollutants (GP). Northern Beaches Council strategy for stormwater quality control requires reduction of these major pollutants.

3.2 Water Sensitive Urban Design (WSUD) guidelines

Northern Beaches Councils' Water Sensitive Urban Design guidelines state their required pollutant reduction targets, as shown in Table 3 below.

Table 3: Pollutant Reduction Target (Northern Beaches Council's Water Management for Development Policy, 2021)

Pollutant	Performance Requirements
Total Phosphorous	65% reduction in the post development mean annual load
Total Nitrogen	45% reduction in the post development mean annual load
Total Suspended Solids	85% reduction in the post development mean annual load
Gross Pollutants	90% reduction in the post development mean annual load ¹ (for pollutants greater than 5mm in diameter)
pH	6.5 - 8.5
Hydrology	The post-development peak discharge must not exceed the pre-development peak discharge for flows up to the 2 year ARI

Commercially available water quality controls are available to reduce the runoff of these pollutants. Calibre has assessed and determined some product types that would be suitable for this development. These measures have been implemented in a preliminary analysis as described in Section 3.3 below.

3.3 Water Quality Treatment

Water Quality Treatment can be provided within lots, private property, or public land. The different water quality treatments that can be applied for this property are listed as below:

1. Rainwater tank: Rainwater tanks help to improve quality of stormwater and hold water for re-use.
2. Filter Devices: There can be different filter devices that can be implemented for this development, from multiple commercial enterprises that may tailor a solution for each development. For this preliminary analysis the filter devices nominated are a Bioretention Basin, Rocla Cleansall 750 Gross Pollutant Trap (GPT), Jellyfish filter cartridge (JF 1200-1-1) and Oceanguard pit capture baskets. Depending on manufacturers recommendations,

these filtration units can be changed to other items to achieve the pollutant reduction targets set by Northern Beaches Council.

3.3.1 Bioretention basin.

The preliminary analysis on size and location of the Bioretention basin has been determined for two scenarios. The scenarios are provided under Sections 3.3.1.1 and 3.3.1.2. Each scenario has used the stormwater quality modelling tool MUSICX (version 1.1.0) to gauge the approximate scale of treatment works necessary to achieve the reduction targets. MUSICX is widely recognised modelling tool in sizing treatment devices for stormwater quality treatment.

3.3.1.1 Distributed Stormwater Discharge to the Drainage Network in Boondah Road and Warriewood Wetlands

The proposed area of the site that has an RL of 3.9m and above can be discharged to the existing kerb inlet pit in Boondah Road shown in Figure 6 below. The area lower than RL 3.9m may be discharged to Warriewood Wetlands towards the rear of the property, as it likely that it will not be able to freely flow to the kerb inlet pit in Boondah Road.



Figure 6: Boondah Road frontage of the subject site (Google Maps)

The MUSICX model for this scenario has been generated such that the area with surface level of RL 3.9 and higher would discharge to Boondah Road via a Bioretention basin. The area lower than RL 3.9m will discharge to Warriewood Wetlands via Oceanguard pit capture baskets (fitted into the road drainage pits) and a Jellyfish filter device. The indicative location of the Bioretention basins and Jellyfish filter for this arrangement is shown in Figure 7.



Figure 7: Indicative location of the Bioretention basins and Filter device

The proposed Bioretention basins configuration is as summarised in Table 4 below.

Table 4: Summary of the Bioretention basins discharging to Boondah Rd

Basin	Filter Area (m ²)	Extended Detention Depth (mm)	Filter Media Depth (mm)
Bioretention	260	300	600

The layout of the MUSICX Model is presented in Figure 8 below.

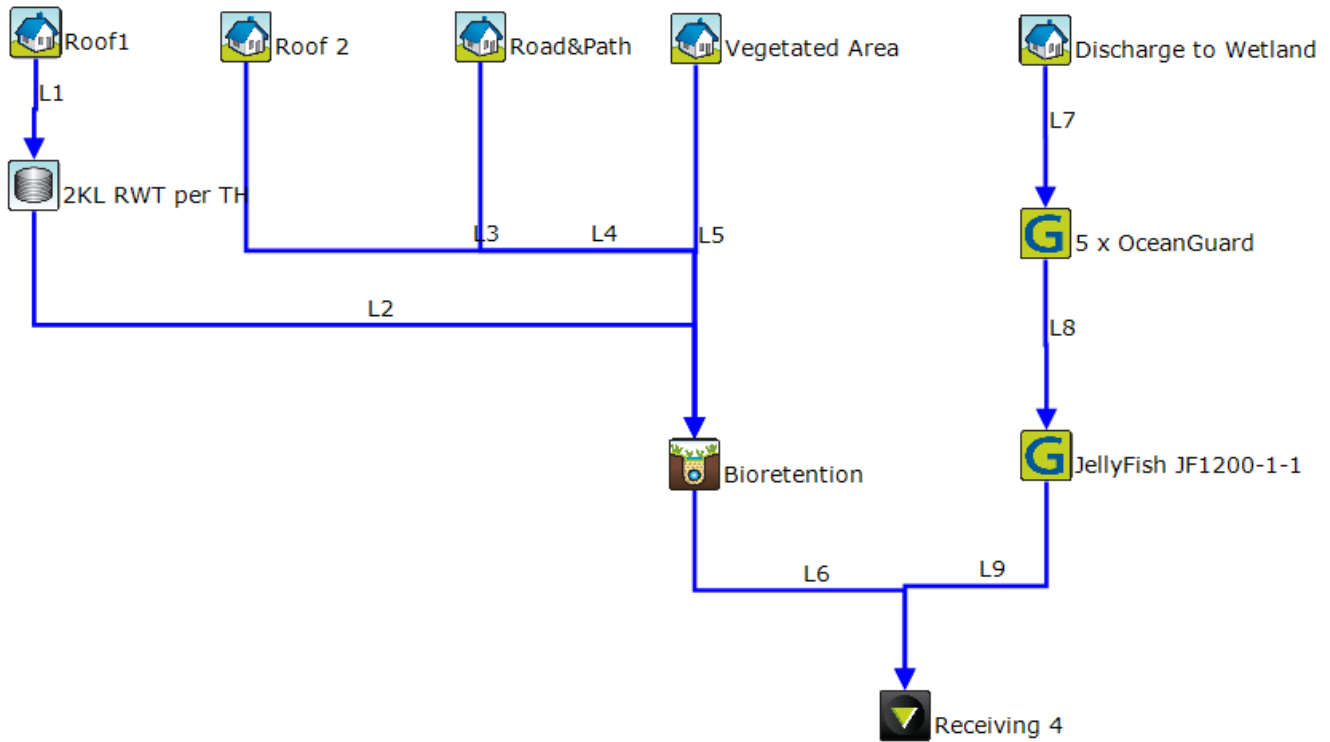


Figure 8: MUSICX Model Layout for distributed stormwater discharged to Wetland and Boondah Rd

The results of this preliminary treatment train for the proposed development at 10 – 12 Boondah Road is shown in Table 5.

Table 5: Result for MUSICX Model for Distributed Stormwater discharge to Wetland and Boondah Rd

Latest Run : Treatment Train Effectiveness : Receiving 4

	Sources	Residual Load	% Reduction
Flow (ML/yr)	14.94	13.17	11.83
Total Suspended Solids (kg/yr)	1482	183.2	87.64
Total Phosphorus (kg/yr)	3.283	1.132	65.52
Total Nitrogen (kg/yr)	30.73	11.85	61.44
Gross Pollutants (kg/yr)	308.5	0.5091	99.83

Table 5 indicates that preliminary treatment train for the development at 10 – 12 Boondah Road will achieve the required reduction targets for Northern Beaches Council, as given in Table 3.

3.3.1.2 Stormwater Discharge to Warriewood Wetlands

If the indicative network in Boondah Road is not available for connection, stormwater runoff from the site may be discharged into Warriewood Wetlands through a Rocla Cleansall 750 GPT and a Bioretention basin. The tentative location of the proposed Bioretention basin is shown in Figure 9 below.



Figure 9: Tentative Location of Bioretention Basin

The proposed Bioretention Basin configuration is as summarised in Table 6 below.

Table 6: Summary of the Bioretention Basin discharging to Warriewood Wetlands

Basin	Filter Area (m ²)	Extended Detention Depth (mm)	Filter Media Depth (mm)
Bioretention	200	300	600

The layout of the MUSICX Model is presented in Figure 10.

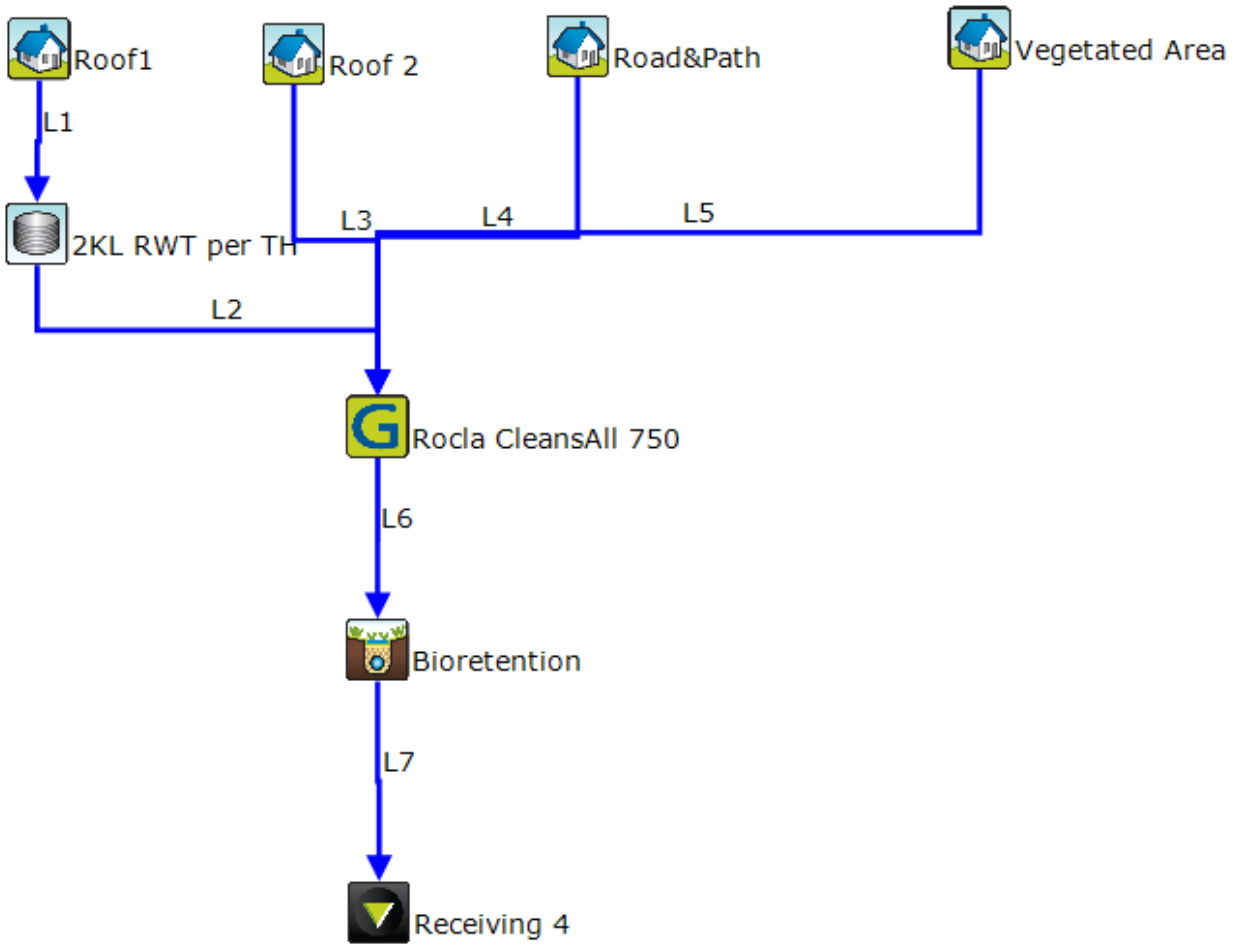


Figure 10: Layout of MUSICX Model for discharge into Warriewood Wetlands

The results of this preliminary treatment train for the proposed development at 10 – 12 Boondah Road is shown in Table 7

Table 7: Result for MUSICX Model for Stormwater discharge to Wetland

Latest Run : Treatment Train Effectiveness : Receiving 4

	Sources	Residual Load	% Reduction
Flow (ML/yr)	14.91	13.04	12.5
Total Suspended Solids (kg/yr)	1467	206.9	85.9
Total Phosphorus (kg/yr)	3.317	1.112	66.47
Total Nitrogen (kg/yr)	30.82	11.98	61.12
Gross Pollutants (kg/yr)	274.2	0	100

Table 7 indicates that the preliminary treatment train for the development at 10 – 12 Boondah Road will achieve the required reduction targets for Northern Beaches Council, as given in Table 3.

3.4 Conclusion on Water Quality Modelling

The results for both scenarios show that the proposed water quality arrangements will meet the water quality reduction target set by Northern Beaches Council. Thus, it is demonstrated that stormwater discharged from the proposed development site will not pollute the downstream watercourse with appropriate measures in place. Suppliers of these products may be consulted for recommendations on measures to suit the local area and development.

4. Flooding Strategy

4.1 Introduction

As mentioned under Section 2.2, Northern Beaches Council requires that proposed land developments be designed according to specific flood level controls, as given in their LEP, DCP and the pre-lodgement notes issued for this development. Calibre has used these controls to determine suitable RLs for each land use of the residential development, as shown in Table 2. This has required a proposed raising of land across the site, as shown in Figure 5.

Calibre raised an inquiry with Northern Beaches Council about use of suitable controls for the flood management strategy of this site, as there was concern that the raising of the land in 10 – 12 Boondah Road may have a negative impact on the surrounding development. Council has confirmed that the residential development is to ensure at a minimum, that no adverse flood impacts on the site and surrounding properties be observed up to and including the PMF event with the effect of climate change (see Appendix A). Calibre has adopted this approach for the flood management strategy.

4.2 Flood Behaviour and Storage Assessment

10 – 12 Boondah Road sits within flood prone land. Calibre acquired the Narrabeen Lagoon Flood Study (2013) from Council to assess the development earthworks against the flooding for all required storm events. The complete strategy and assessment are provided in the report '10 – 12 Boondah Road, Warriewood – Water Management Report' (2/06/22). This assessment included the frequent and minor storms such as the 50% AEP to the very rare and extreme Probable Maximum Flood (PMF).

The Narrabeen flood study depicts the flooding behaviour critical to this development area. The flood behaviour is such that the wetlands, creeks, and areas south of the development site will pond with water in a storm event. As such, the extent of the ponding increases with storm intensity and duration. Any impacts on the flood extents owing to the earthworks will be distributed within the large area of the floodplain. The minimum extent of the floodplain is shown in Figure 11. The extent presented is at timestep zero of a storm event, hence the water extents presented below are ponding.

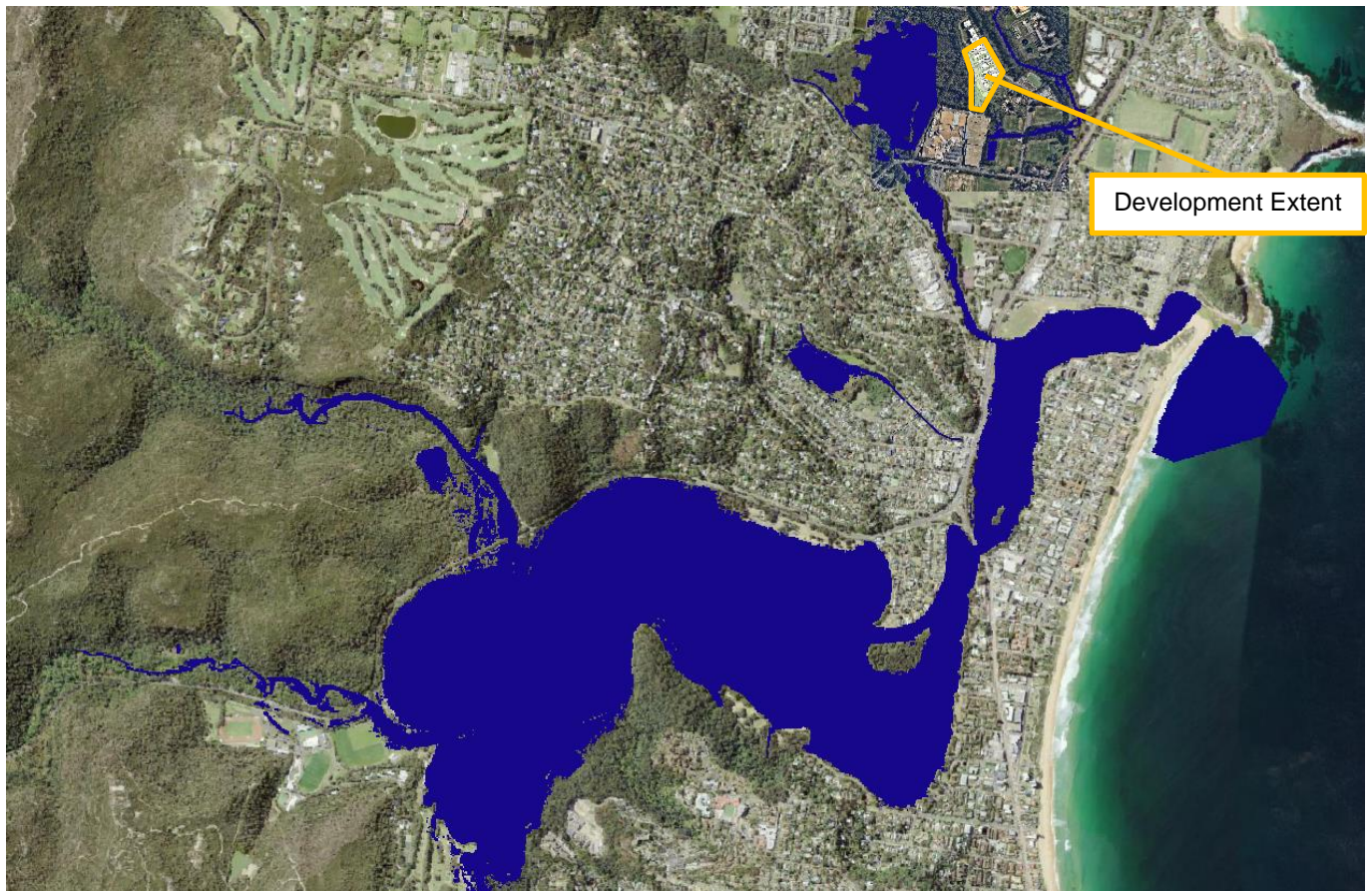


Figure 11: Narrabeen Lakes Floodplain (300 Ha)

Memorandum

The extent of the floodplain where the impact of the development is distributed over is 300 Ha. Any impact on the floodwater extent and height by the development earthworks at 10 – 12 Boondah Road would be distributed across this area; the development fronts onto this floodplain and any extra floodwater runoff will build on this 300 Ha extent. Any loss in local flood storage incurred by the development at 10 -12 Boondah Road will be distributed across a minimum floodplain area.

Council has expressed a concern that development of the site without a balance of flood storage within the property boundaries, could contribute to a cumulative effect. They are concerned the loss of flood storage may impact the possibility of other sites seeking to achieve developable areas through similar earthworks.

Calibre has undertaken a desktop analysis of the possibility of future development of available land within the flood zone. The current land zoning of the Warriewood wetlands and surrounding area has been overlaid against the flood extents. The overlay does not have a georeference associated with it, and hence the alignment shown in Figure 12 is approximate.



Figure 12: 50% AEP Flood Extents and Land Zoning

Generally, the land zoning occupied by the flood extents are SP2 (Infrastructure), R2 and R3 (low and medium density residential), C2 (environmental conservation) and RE1 (public recreation). A desktop search of the zoning plan indicates that the R2 and R3 lands are already developed or show evidence of bulk earthworks taking place. It is assumed that the C2 and RE1 will not be rezoned for future residential purposes. There is some RU2 (rural landscape) available for development (part of which is 10 -12 Boondah Road). The extent of the RU2 land is shown in Figure 13.

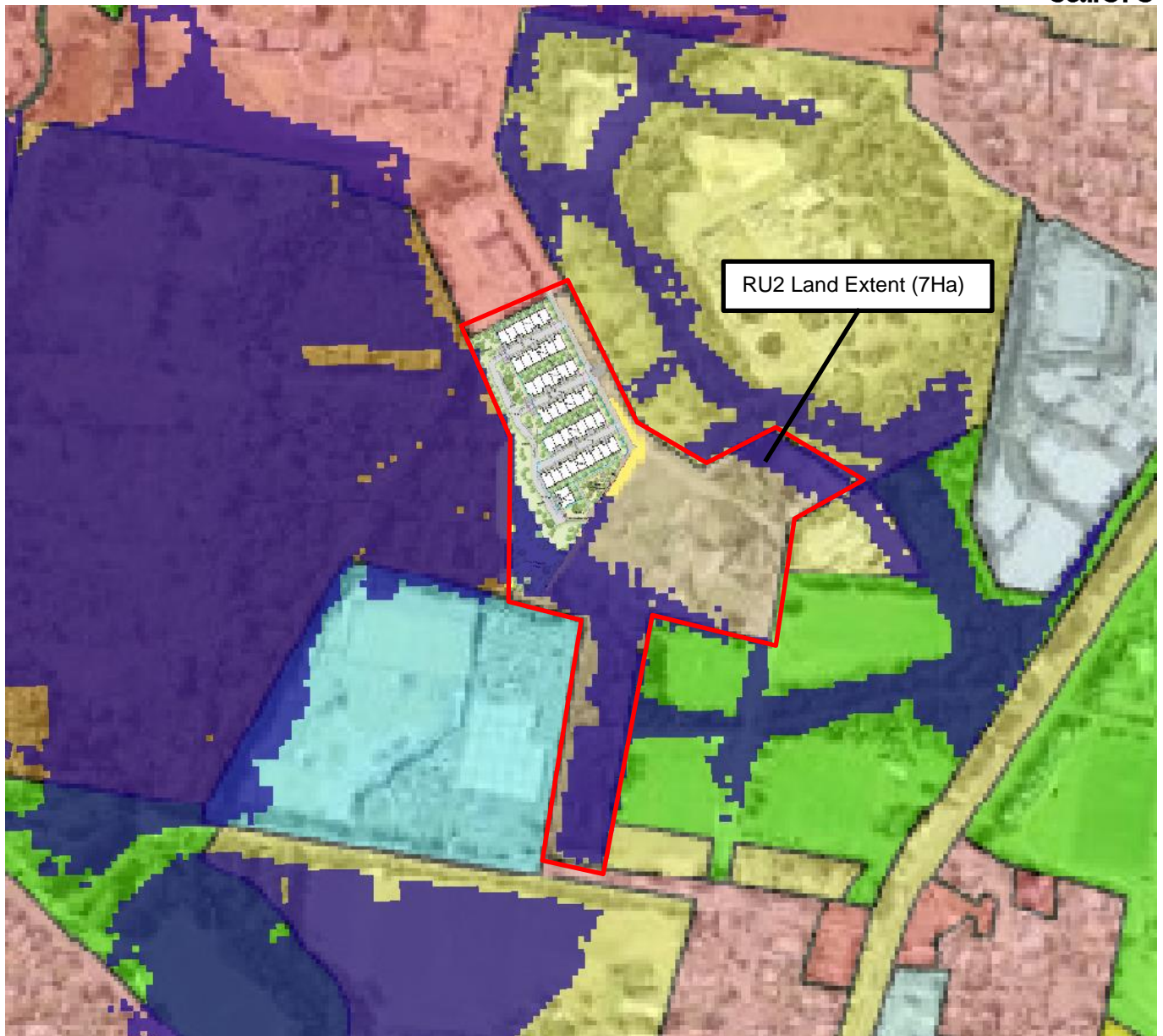


Figure 13: 50% AEP Flood Extents and RU2 land

The extent of the RU2 land is shown outlined in red above. The development at 10 – 12 Boondah Road occupies 2.2 Ha, leaving 4.8 Ha available for development. The land to the south of the subject site and directly east of the shopping complex is densely vegetated and crosses Narrabeen creek. Calibre expects that it is occupied by sensitive/endangered vegetation, and thus may not be suitable for development. The remainder of the RU2 land is further outside the flood extents than the subject site (2.8 Ha). As the current earthworks will be distributed over a floodplain area of 300 Ha, and the afflux increases are acceptable (see Table 8 below), Calibre believes that any future development on the remaining 2.8 Ha will not experience a cumulative impact on loss of flood storage.

4.3 Flood Afflux Assessment

The afflux distribution results over the floodplain, as modelled by Calibre for the Water Management Report, are given in Table 8. Flood maps for each event are in the report.

Table 8: Afflux distribution results over the floodplain

Event	Acceptable Afflux (mm)	Maximum Afflux Observed (mm)	Comment
50% AEP	20	<10	Complies
20% AEP	20	<10	Complies
1% AEP	20	25	The 25mm increase occurs in a non-habitable area, thus persons should not be affected. The remainder of the floodplain remains within acceptable afflux limits. This afflux is due to the proposed raising of Boondah Road and may be reduced to within acceptable afflux limits by placing culverts or pipes under Boondah Road as demonstrated in the Water Management Report.
1% AEP + CC	20	<10	Complies
PMF	50	<10	Complies
PMF + CC	50	<10	Complies

Table 8 summarises that the afflux in all the storm events is acceptable. The 1% AEP event has a peak increase of 25mm, but this is isolated to a non-habitable region where people will not be dwelling. Calibre has also proposed a strategy to reduce the afflux within this affected area to suitable levels (refer to Figure 15 and Page 25 in the report).

The other aspect of adverse impacts are increases in velocity and hazard. The PMF event does demonstrate increases of velocity above 10%, but these are in small, discrete areas away from residential dwellings, and remain within the 0 – 0.5m/s range, which is acceptable for nearly all material types (see Figures 23 – 25 in the report).

4.4 Overland Flow to Wetland

A Plan of Management (POM) was issued by Ecological Australia and the Sydney Metropolitan Catchment Management Authority (CMA) for Warriewood Wetland in 2010. The plan presents a detailed vegetation management program, and study of the topography, geology and water behaviour of the area. Section 4.4.2 of the plan identifies the major sources of surface flow to the wetland as being Mullet Creek and Fern Creek. Both creeks are not being affected by the development at 10 -12 Boondah Road Warriewood. The plan states other minor drains enter from developed areas around the wetland. These developed areas have impacts mitigated onsite by conditions set out in the Warriewood Valley Water Management Specification. Stormwater flows generated from the development site are proposed to be filtered to acceptable levels of pollutant removal (as demonstrated in Section 3.3 of this memo) and may be directed in their entirety to the Warriewood Wetlands.

The Water Management Report demonstrates that the flood afflux at Warriewood Wetland due to the construction of proposed development will be less than 10mm for flood events ranging from 50% AEP to PMF, where the Maximum Afflux limit allowed by council is 20mm. Furthermore, the report illustrates the velocity and flood risk precinct for post development scenario will remain like the pre-development scenario during 50% AEP to PMF flood events. Thus, the proposed development will not worsen the flooding conditions within Warriewood Wetland. Section 4.2 describes the possibility of placing culverts or pipes under Boondah Road and connecting it to the Warriewood Wetland to reduce the flood afflux in Narrabeen Creek. The flood water which will pass onto Warriewood Wetland from upstream of Boondah Road will be distributed within the large area of the floodplain shown in Figure 11 and will result in minimal impact to wetland. Moreover, the wetland is already affected by high flood hazard, and it is evident that diverting the flow from Boondah Road will not further worsen the flood risk in the wetland. Additionally, the culverts under the raised up Boondah Road would preserve any stormwater flows from the eastern side of Boondah Road that currently flow to the wetlands. Therefore, the existing overland flow volumes to the Warriewood wetlands shall be preserved post development.

5. Conclusion

The proposed development at 10 – 12 Boondah Road will be approximately 42 new townhouse dwellings, a children's playground, and pedestrian walkways. Calibre has prepared a stormwater strategy report for this development in June 2022. This memo has been prepared to accompany and supplement this report, and provides preliminary findings for:

- Groundwater analysis; The proposed earthworks cuts will be clear of the groundwater and therefore impacts to groundwater are unlikely. Further groundwater monitoring is proposed at DA Stage to confirm this.
- Stormwater quality treatment: two scenarios have been modelled, and indicative treatment measures and sizes are modelled for each and confirm that satisfactory pollutant reduction may be achieved.
- Overland Flow to the wetland; the flood modelling provided for the water management report demonstrates that the proposed development will not worsen the flood conditions in the wetland for a full range of storm events. Overland flow volumes to the Warriewood Wetlands will be preserved post development.

The flooding strategy from the report has been summarised in this memo. As per council's correspondence attached and in accordance with the DCP controls for the Warriewood Valley Land Release, the criteria for development within a flood prone area regarding adverse impacts has been followed and complied with.

Appendix A

COUNCIL DCP CORRESPONDANCE (25/01/22)

Matthew Cowcher

From: Patrick Stuart <Patrick.Stuart@northernbeaches.nsw.gov.au>
Sent: Tuesday, 25 January 2022 4:06 PM
To: Matthew Cowcher
Subject: RE: Flood Information Report for 10 Boondah Rd Warriewood

CAUTION: This email originated from outside of the organisation. Do not click links or open attachments unless you can verify that the content is safe, even it appears to come from someone you know.

Hi Matthew,

As a minimum you should comply with one of the below points (from section of C6.1 of the Pittwater DCP) for the PMF plus CC (along with all smaller events).

The filling of land will only be permitted where it can be demonstrated within the Water Management Report that:

- there is no net decrease in the floodplain volume of the floodway or flood storage area within the property, for any flood event up to the 1% AEP flood event and the PMF event including climate change considerations for both design events; and/or*
- there is no additional adverse flood impact on the subject and surrounding properties and flooding processes for any flood event up to the PMF event including climate change impacts.*

Don't forget, you still need to comply with the below table from the Warriewood Valley Urban Land Release Water Management Specification. As well as 5.21 of the Pittwater LEP and B3.11 and B3.12 of the Pittwater DCP (which shouldn't be too hard).

Table 4.3 Flood Planning Levels

Design Level	Requirement
50%AEP (1 in 2 year ARI)	<ul style="list-style-type: none">50%AEP flow to be carried in-bank
20%AEP (1 in 5 year ARI)	<ul style="list-style-type: none">The level of walkways and cycleways adjacent to the creeks are to be above the 20%AEP flood level except under special circumstances (and exposed for only short duration's)Water quality control ponds, filter strips and structures are to be above the 20%AEP flood level, and can be below the 1%AEP flood level but must lie within the private buffer area as outlined in Section 4.3.2.
1%AEP (1 in 100 year ARI)	<ul style="list-style-type: none">1%AEP flows are to be carried within the public space corridors, and are to be further designed such that floodplain management and hazard management guidelines are accommodated to minimise risk to lifeFlood extent to be mappedFloor levels for properties adjacent to the creek are to be set at least 0.5 m above the 1%AEP levelObverts of bridge decks of evacuation routes are to be set at least 0.5 m above the 1%AEP level
Probable Maximum Flood	<ul style="list-style-type: none">Evacuation PlanningFlood hazards and risk to lifeFlood extent to be mapped

Regards,

Patrick Stuart
Senior Floodplain Management Officer

Stormwater, Floodplain Engineering
t 02 8495 6649 m 0435 966 850
patrick.stuart@northernbeaches.nsw.gov.au
northernbeaches.nsw.gov.au