ATT: Anne-Marie Young
Northern Beaches Council
via email
22 March 2021

BigCity Design
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Dear Anne-Marie

RE: DA2021/0004 – OVERLAND FLOW ASSESSMENT AS REQUESTED

Please find attached, the Overland Flow Assessment prepared by TTW, as per your request, dated 10 March 2021.

Council's Engineering Referral Response, dated 25 February 2021, notes the following:

- "onsite stormwater detention is not required"
- "the existing rear carpark has an abandoned 900mm stormwater pipe which will need to be removed for the development to proceed"

We confirm that the OSD tank will be deleted from the proposed works as per Council's comment.

Regarding the existing abandoned 900mm stormwater pipe, we have discussed this with our civil engineers and provide the following information for your consideration:

- The pipe will have no impact upon the proposed development if it remains in place
- We are concerned that removal of a significant volume of soil, in order to access and remove the 900mm diameter SPI, would adversely affect the existing site and adjacent site, and specifically the heritage building's foundations
- We have minimised excavation to the existing site to avoid impact upon the existing heritage building
- Removal of this pipe would impose a significant unnecessary additional cost to our client who has, as a tenant, committed to the adaptive reuse of this heritage item

We would be happy to discuss the above with Council further if required. We look forward to your response.

Kind Regards

Dimitra Lomis
BigCity Design Pty Ltd

OVERLAND FLOW ASSESSMENT

1121 PITTWATER ROAD, COLLAROY

Prepared for Collaroy Veterinary Hospital/ 19 March 2021

201557

Taylor Thomson Whitting (NSW) Pty Ltd (ACN 113 578 377)
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Your Partner in Engineering

Contents

1.0 Introduction

Taylor Thomson Whitting Pty. Ltd. (TTW) has been engaged by BigCity Design Pty Ltd to prepare an Overland Flow Assessment in accordance with the Northern Beaches Council requirements to support a Development Application (DA) for the proposed redevelopment at 1121 Pittwater Road, Collaroy NSW 2097 (the site).

The report provides an assessment on overland flow conditions of the site and summarises the flood modelling results for both existing and proposed site conditions in the 1% AEP and PMF events. The report also provides an impact assessment on neighbouring properties due to the proposed development.

1.1 Scope and Objectives

Project scope and objectives are as follows:

- Prepare a hydraulic model (TUFLOW) for the site under existing and proposed conditions.
- Determine site flood characteristics for the 1% annual exceedance probability (AEP) flood and probable maximum flood (PMF) events.
- Prepare relevant flood maps including flood extents, depths, levels, velocities, hazards and impacts.
- Comment on flood characteristics and model outcomes in existing and proposed conditions.

1.2 The Site

The site is located at 1121 Pittwater Road Collaroy NSW 2097 (Lot 1 of DP 528546) and is bounded by Pittwater Road to the east, Collaroy Street to the south and residential dwellings at 1-5 Collaroy Street to the west as well as a commercial business at 1125 Pittwater Road to the north. The site's general location is shown in Figure 1.

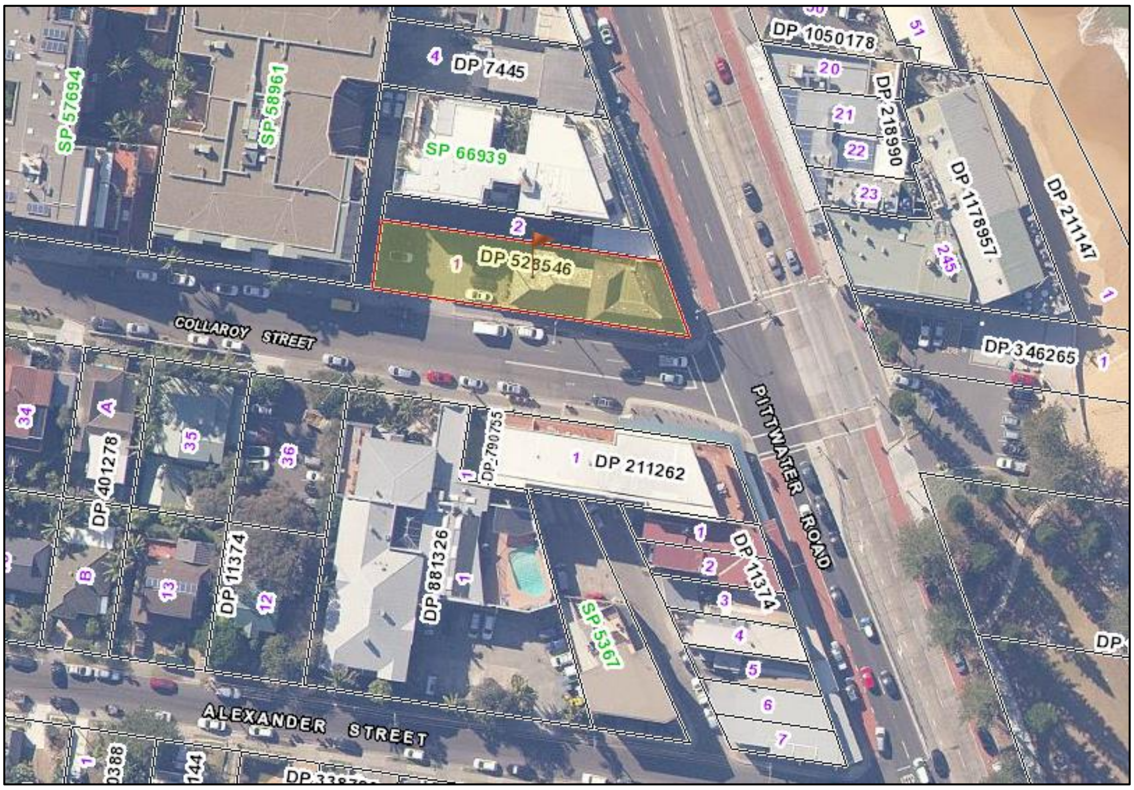

Figure 1. Location of the Site – Six Maps

The site area is 663.9 m^2 based on the survey completed by Shepherd Surveys (18 November 2020) and typically grades towards a centralised depression onsite with highest levels of 4.66m AHD at south-eastern boundary and 4.30m AHD at south-western boundary, falling to 3.29m AHD at northern boundary.

The site falls within the Northern Beaches Council LGA and is part of Warringah land zoning based on the Northern Beaches Council planning policies. The site's current land zone is Local Centre (B2) based on Warringah LEP (2011).

The site's current land use is commercial and includes a two-storey building as well as an open carpark in existing conditions.

1.3 Proposed Development

Architectural drawings prepared by BigCity Design indicate that the proposed development is a Veterinary Hospital and involves alteration and addition to the existing two-storey building. The proposed development architectural plan is shown in Figure 2.

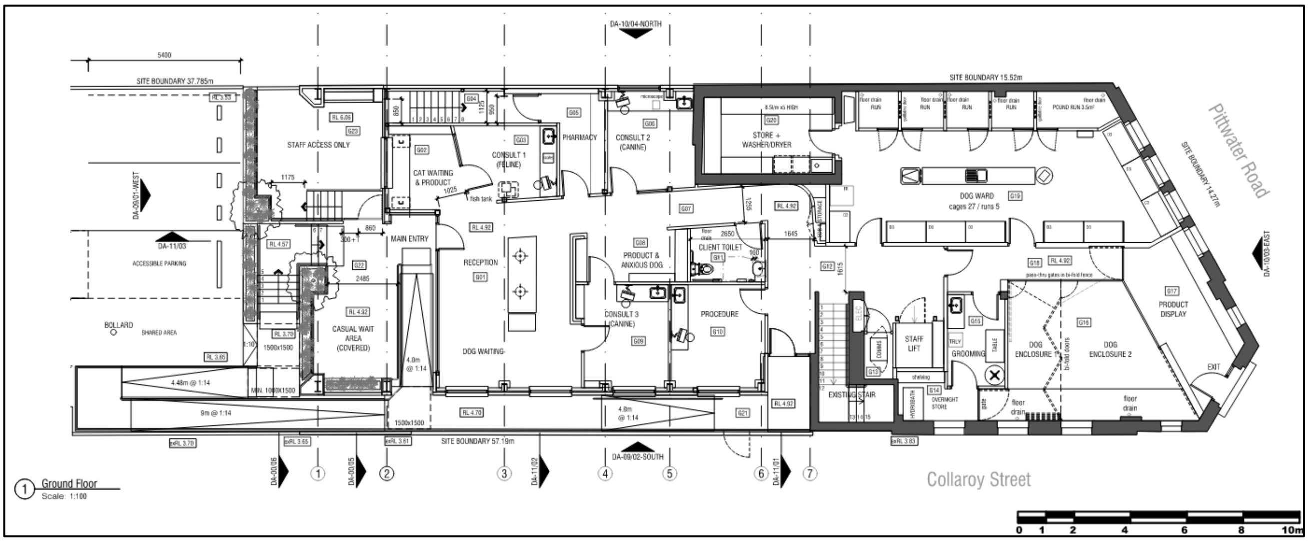

Figure 2. Proposed Architectural Plan

1.4 Relevant Guidelines

This report has been prepared in accordance with the following guidelines and policies:

- Commonwealth of Australia (Geoscience Australia) (2016), Australian Rainfall and Runoff – A Guide to Flood Estimation.
- NSW Department of Infrastructure, Planning and Natural Resources (2005), Floodplain Development Manual.
- Warringah Local Environmental Plan (LEP, 2011).
- Warringah Development Control Plan (DCP, 2011).

2.0 Available Data

This overland flow study used topographic and flood related data obtained from a number of sources. The origin and types of information underpinning the assumptions used in this study are presented below.

2.1 Previous Flood Studies

The site is part of Collaroy catchment which is located halfway between Narrabeen Lagoon catchment (to the north) and Dee Why Lagoon North catchment (to the south). A review of previous flood investigations was undertaken to assess likely local flood behaviour and characteristics for the site. This review did not identify any flood studies adopted by the Northern Beaches Council which would cover the site.

2.2 Survey Data

Survey information adopted for this study has been collated from the following sources:

- ALS survey provided by the NSW Land and Property Information Department (NSW LPI).
- GIS layers of cadastre and satellite imagery provided by the NSW LPI.
- Site survey prepared by Shepherd Surveys, dated 18.11.2020.

3.0 Hydraulic Model

The TUFLOW hydraulic model with direct rainfall method was used to determine flood extents, levels, depths, velocities and hydraulic hazard during the critical 1% AEP and PMF events for the site in existing and proposed conditions.

3.1 2D Model Domain

The model domain was defined using Lidar data. Model boundary extents were generally placed along catchment ridgelines and / or connecting catchment high points surrounding the study area. Total model domain area is 80 ha (approx.) as shown in Figure 3. A square grid was utilised for this study, with the grid size of 2m x 2m.

The grid cell size of $2m^2$ is considered to be sufficiently fine to appropriately represent the variations in topography and land use within the study area. It should be noted that TUFLOW samples elevation points at the cell centres, mid sides and corners, therefore a 2 m^2 cell size results in surface elevations being sampled every 1m.

3.2 Model Topography

A 1 m grid Digital Elevation Model (DEM) was generated for the catchment using ALS survey data. This DEM was used to represent ground elevations throughout the catchment.

3.3 Building Footprints

The footprints of buildings surrounding critical flow paths are modelled as blocked elements within the 2D domain. Building footprints were digitised and raised 4 m above surrounding ground level to prevent floodwaters entering buildings. Building outlines were determined from aerial photographs and site survey. In general, buildings far away from the subject site or far from critical flow paths were modelled at ground level with other landform disturbances by adjusting the Manning's 'n' hydraulic roughness value (see Section 3.4).

3.4 Hydraulic Roughness

Manning's zones based on Nearmaps aerial photography of the study area with roughness coefficients adopted as per Table 2.

Table 2: Adopted roughness parameters

Land use category	Manning's 'n'
Buildings	n = 0.015 when D < 0.1 m n = 10.000 when D > 0.3 m Otherwise interpolate n
Residential land	0.20
Road and car park areas	0.02
Grass lands and parks	0.045
Bushlands	0.08

Figure 3.TUFLOW Model Domain

3.5 Boundary Conditions

- Direct Rainfall: A direct rainfall boundary condition was applied to the model domain. The direct rainfall method is described in Section 3.7.

- Downstream Boundary: Downstream model boundary was defined along the Collaroy Coastline. Downstream water level is predominantly controlled by ocean water levels. Therefore, downstream water levels of 2.6 mAHD and 2.9 mAHD were adopted for the 1%AEP and PMF events, respectively. Peak ocean water levels were based on Council's Narrabeen Lagoon Flood Study (2013).

3.6 Hydrologic Modelling Approach

Hydrologic modelling was undertaken within TUFLOW using the Direct Rainfall methodology. In the hydraulic model, rainfall is applied directly to the 2D terrain, and the hydraulic model automatically routes the flow as determined by the elevation and roughness applied to the model grids.

Direct rainfall modelling is generated over the entire catchment, rather than the more traditional approach of calculating an inflow hydrograph and lumping this in at an assumed location(s). The 'direct rainfall' approach means the whole catchment will be 'wet' and the hydraulic modelling results need to be filtered to show only those cells that genuinely represent areas of catchment flooding. This was achieved by only mapping inundation at cells with flood depths of greater than 0.05 metres.

Direct rainfall was applied to the catchment area of 80 ha, indicated as '2D model domain' in Figure 3. The design storm events (as described in Section 3.7) applied to the catchment area. During hydrologic and hydraulic modelling of the catchment 100% blockage of Council's pipe drainage system was assumed.

3.7 Design Storm Events and Rainfall Data

The Warringah DCP (2011) requires the flood impact assessment to be completed for both the critical 1% AEP and PMF events.

Design rainfall data for the site was derived from Australian Rainfall & Runoff Data Hub. Uniform areal distribution of 1% AEP design storms has been assumed for the catchment due to its relatively small area. Rainfall depths and temporal patterns were developed for the 1% AEP design storm events using techniques described in Australian Rainfall and Runoff (Book 2). Estimated average design storm rainfall intensities for a range of 1% AEP storm events from 10 minutes to 3 hours are presented in Table 1.

Table 1 – Average design rainfall intensities (BOM 2016)

Duration	Intensity (mm/hr)	Duration	Intensity (mm/hr)
10 min	206	45 min	91.4
15 min	172	1 hour	76.3
20 min	148	1.5 hour	59
25 min	130	2 hour	49.4
30 min	117	3 hour	38.7

Probable Maximum Precipitation (PMP) intensities and temporal distributions were also determined using the Generalised Short-Duration Method (2006).

3.8 Rainfall Losses

The catchment assumed to be wet and saturated at the beginning of all storm events. In addition, continuing losses deemed to be negligible and therefore, rainfall losses were conservatively assumed zero.

3.9 TUFLOW 1D Model Domain

There is an existing pipe culvert drainage line running along the western site boundary under the existing access driveway which connects to a major trunk drainage at Collaroy Street. Figure 4 shows the location of existing trunk drainage line at site proximity.

During any given storm event, overland flows arriving to the site from upstream would be majorly picked up and transferred to downstream through this existing trunk drainage line and associated pit and pipe network. Nevertheless, the existing pipe culvert was conservatively assumed 100% blocked.

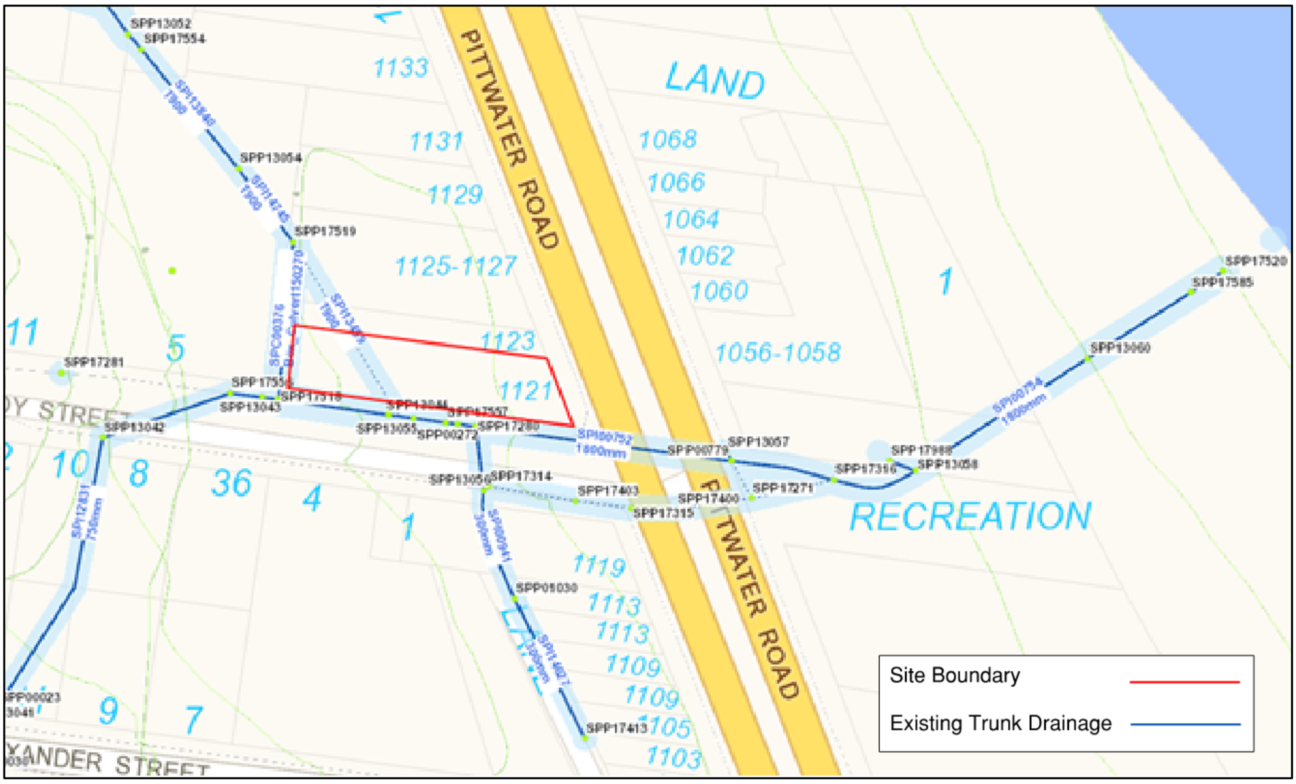

Figure 4. Location of Existing Trunk Drainage Line at Site Proximity

4.0 Model Results

The model was run for a range of 1%AEP flood durations as well as for a range of PMF durations. Critical 1%AEP and PMF storm durations were determined to be 25 minutes and 30 minutes, respectively.

The behaviour of the overland floodwaters across the site and in the vicinity of the site during the critical 1% AEP and PMF events for the existing and proposed site conditions are described in general terms, and offsite flood impacts due to the proposed development are investigated.

4.1 Existing Conditions

The peak flood levels depths, velocities and hazards for the critical duration 1%AEP event for existing site conditions are shown in Figure 5 to Figure 7 and for the critical duration PMF in Figure 8 to Figure 10.

The site is majorly affected by local overland flows. The catchment geometry upstream of the site is rather steep (10% average) with change of levels from 110m AHD at Collaroy Plateau Park falling to less than 5m AHD at the site proximity. The catchment geometry then undergoes a rapid transformation immediately upstream of Pittwater Road which creates a rather flat area with multiple sag points along the western side of Pittwater Road. Overland flows arriving from the upstream will back up at this area, before overtopping the

Pittwater Road and flow towards the ocean.

As a result, water depths at the site raise up to more than 1.2m in the 1%AEP and up to 1.6m in the PMF event. Peak overland flow levels at the site are 4.5m AHD and 5.0m AHD during critical 1%AEP and PMF, respectively.

Overland flows across the site are typically slow moving (< 0.4 m/s) during both 1%AEP and PMF events, with exception of the centralised depression area adjacent to the existing sag point at Collaroy Street.

Flow hazards though, tend to be high over the site car park during the 1%AEP as well as PMF for both existing and proposed conditions.

It is noteworthy that the existing major stormwater network running along the western and southern site boundaries (not modelled here) would largely attenuate the flow depths by effectively conveying the stormflows to downstream and therefore, water levels are expected to be noticeably lower at and around the site.

Figure 5. 1%AEP Water Level & Depth – Existing Conditions

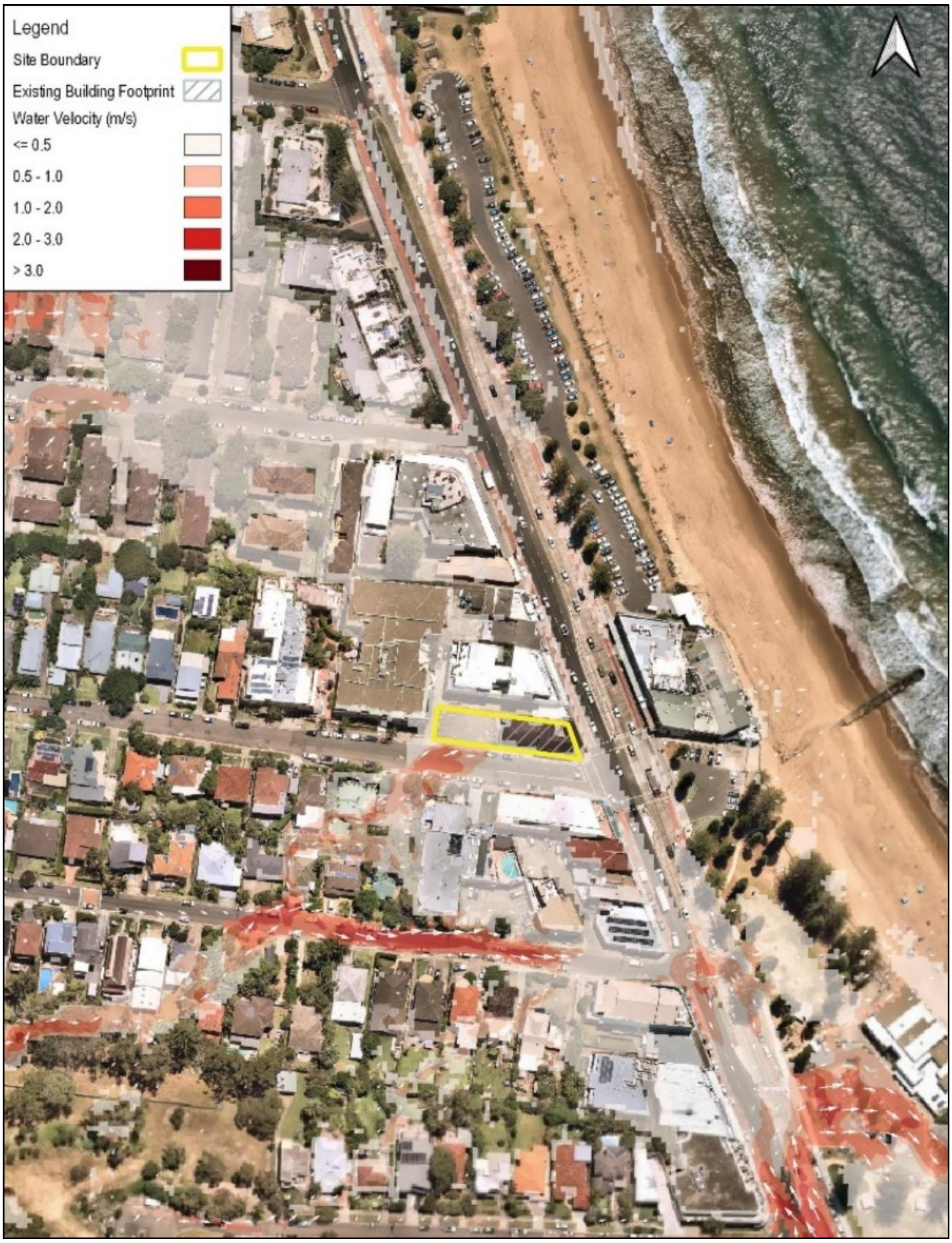

Figure 6. 1%AEP Water Velocity – Existing Conditions

Figure 7. 1%AEP Provisional Hazard – Existing Conditions

Figure 8. PMF Water Level & Depth – Existing Conditions

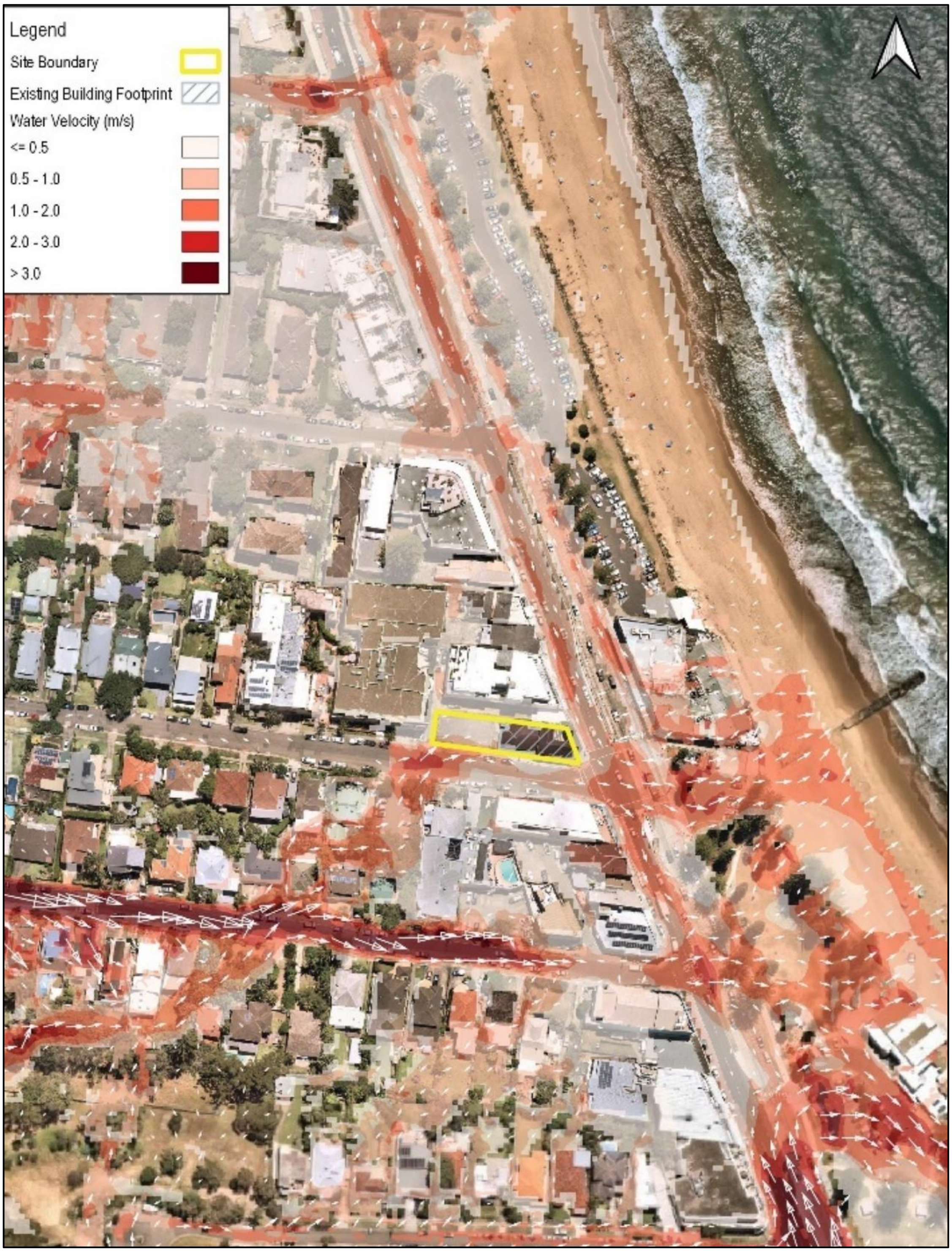

Figure 9. PMF Water Velocity – Existing Conditions

Figure 10. PMF Provisional Hazard – Existing Conditions

4.2 Proposed Conditions

The existing building footprint was replaced with the proposed building footprint and Manning's roughness adjusted accordingly to simulate the post development conditions.

The peak flood levels depths, velocities and hazards for the critical duration 1%AEP event for proposed site conditions are shown in Figure 11 to Figure 13 and for the critical duration PMF in Figure 14 to Figure 16.

Flood conditions in proposed conditions remain largely unchanged compared to existing conditions and the proposed building blockage would not materially affect the local flood characteristics.

The proposed is a veterinary hospital which is a commercial development. Based on Warringah DCP (2011) flood planning requirements, finished ground floor level is to be at or above 5.0m AHD (1%AEP flood level of 4.5m AHD plus 500mm freeboard).

Proposed ground finished floor level is 4.92m AHD which provides at least 420mm of freeboard in the 1%AEP flood level. The flood conditions of the site are expected to be lower than shown in this report during major events as a result of the existing major stormwater network (See Section 4.1).

Finished first floor level is at 8.97m AHD which is above PMF level of 5m AHD. Therefore, shelter-in-place is available for staff and visitors at first floor during major events.

Figure 11. 1%AEP Water Level & Depth – Proposed Conditions

Figure 12. 1%AEP Water Velocity – Proposed Conditions

Figure 13. 1%AEP Provisional Hazard – Proposed Conditions

Figure 14. PMF Water Level & Depth – Proposed Conditions

Figure 15. PMF Water Velocity – Proposed Conditions

Figure 16. PMF Provisional Hazard – Proposed Conditions

5.0 Assessment of Flood Impact

Figure 17 and Figure 18 illustrate the water laver impact of the development in the 1%AEP and PMF events. Results indicate that the proposed development cause no offsite impacts above 20mm in the 1%AEP event and no offsite impacts above 50mm in the PMF event. Therefore, the proposed development has negligible offsite impacts on the floodplain environment in both 1% AEP and PMF events.

Figure 17. 1%AEP Water Level Impact

Figure 18. PMF Water Level Impact

6.0 Building Components and Structural Soundness

It should be noted that flood compatible flood compatible building materials should be used where the development is not flood protected to a level at or above the FPL. Extensive guidance on flood compatible building materials and methods is provided in 'Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas (HNFMSC 2006); a selection of the flood compatible materials and practices described in this resource, supplemented with additional guidance provided in Warringah DCP Part E11, is summarised below.

- Flood compatible deflection wall materials include reinforced or mass concrete and masonry.
- Connection to mains power supply, including metering equipment should be located above the FPL.
- All electrical wiring, switches and outlets which are not flood protected by the deflection and wave barrier walls should, where possible be located above the FPL (refer Figure 19 for the FPL level). All wiring, connections and conduit below the FPL should be suitable for submergence in water. Conduits shall be installed so they will be self-draining in the event of flooding.
- Heating and air-conditioning systems, including fuel supply and ducting, should be installed above the FPL. Where this is not possible, they should be installed in such a manner as to minimise damage from submersion.

If the above structural soundness requirements and flood compatible building guidelines are adhered to, it is our view the proposed development will comply with the requirements of Warringah Council DCP Part E11.

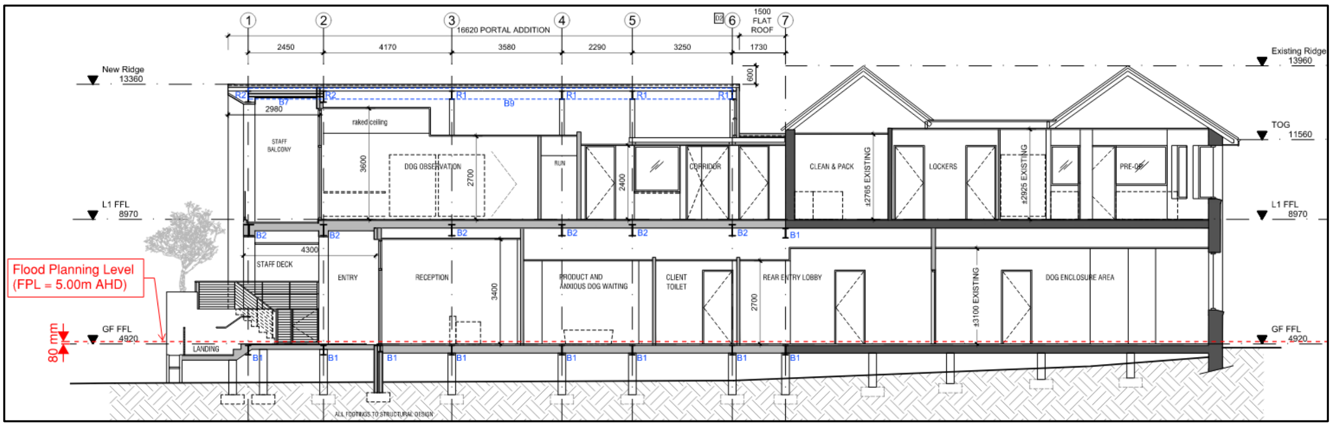

Figure 19. Flood Planning Level (FPL) Line

7.0 Conclusions

Detailed overland flow model has been developed for the site to assess local flood characteristics in the 1%AEP and PMF events under both existing and proposed conditions. Modelling concluded that:

- Proposed flood characteristics are largely consistent with existing conditions, and differences due to the proposed development are negligible in both 1%AEP and PMF events.
- The site is typically affected by flow depths of up to 1.2m, low velocity and a low to high hazard during the 1%AEP event.
- The site is typically affected by flow depths of up to 1.6m, low to moderate velocity and a high hazard during the PMF event.
- The proposed development would have negligible offsite impacts in both 1%AEP and PMF events.
- Proposed ground finished floor level is 4.92m AHD which provides at least 420mm of freeboard in the 1%AEP flood level.
- The flood conditions of the site are expected to be lower than shown in this report during major events as a result of the existing major stormwater network.

- Shelter-in-place is available onsite above the PMF levels.

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