

Civil SSDA Flood Impact Assessment Report

Eden Street Site Redevelopment

Prepared for Arncliffe Eden Property Pty Ltd / 8 February 2022

201609CAAC

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1.0 Introduction

This Flood Impact Assessment Report is submitted to the Department of Planning, Industry and Environment (DPIE) in support of a State Significant Development Application (SSDA-11429726) for the development of land identified at 26-42 Eden Street and 161-179 Princes Highway, Arncliffe (the site) for the purposes of a mixed-use precinct with open space, retail, and residential uses, comprising social and market housing as part of the NSW Land and Housing Corporation (LAHC)'s 'Communities Plus' program.

SSDA-11429726 seeks approval for the following development:

- Demolition of all existing buildings and structures on the site;
- Site preparation works, excavation and tree removal;
- The construction of a mixed-use development comprising:

744 apartments across (4) buildings between 19-23 storeys in height, as follows:

- 186 market housing apartments in Building A;
- 202 market housing apartments in Building B;
- 180 social housing apartments in Building C; and
- 176 market housing apartments in Building D;

- 3,113m² retail gross floor area;
- 240m² for a future childcare centre;
- 3,706m² of communal open space;
- 813 spaces of lower ground and basement car parking; and

4,870m² of publicly accessible open space including a 4,000m² park, an 870m² public plaza (meeting space), and through site link connecting Eden Street and the Princes Highway.

Taylor Thomson Whitting Pty. Ltd. (TTW) has been commissioned by Arncliffe Eden Property Pty Ltd to prepare a Flood Impact Assessment Report for the above mentioned redevelopment in accordance with section 4.39 of the Environmental Planning & Assessment Act 1979 (EP&A Act), the Secretary's Environmental Assessment Requirements (SEARs) for SSDA-11429726 were issued on 18 December, 2020.

This report has been prepared to respond to the following SEARs:

SEAR	Relevant section of report
<p>key issue 15. Flooding:</p> <ul style="list-style-type: none">Identify any flood risk on-site having regard to adopted studies for the development site, consideration of any relevant provisions of the NSW Floodplain Development Manual and the potential effects of climate change, sea level rise and increase in rainfall intensity.Assess the impacts of the development, including any changes to flood risk on-site or off-site, and detail design solutions to mitigate flood risk where required.	<ul style="list-style-type: none">Section 4 to Section 9.Section 6.2.

1.1 Project Objectives and Methodology

The objective of this report is to addresses the flooding requirements of the SEARs (key issue 15).

The report will also address the flooding requirements stated in Bayside Council's response to SEARs (ref: 20/328941 dated 15 Dec. 2020) as follows:

Bayside Council Technical Comments / Strategic Floodplain Engineering:

- Basement driveways shall be designed with a crest in the driveway to prevent street runoff from entering the driveway access.

Bayside Council Technical Comments / Section 14 – Flooding:

- Provide evidence that there are no flooding impacts from the development on surrounding properties.

In addition to above, the report is prepared in line with the requirements of Rockdale Development Control Plan (DCP, 2011), Part 4, Section 4.1.3. Water Management – Flood Risk Management.

following steps are involved to assess the local overland flooding of the site in existing and proposed conditions:

- Obtain catchment hydraulic model (TUFLOW) from Bayside Council and determine site flood characteristics for the 1% annual exceedance probability (AEP) and probable maximum flood (PMF) events.
- Incorporate site survey data and increase TUFLOW model resolution to allow detailed hydraulic modelling of the site in existing and proposed conditions.
- Review flooding behaviour and impacts as well as provide recommendations to ensure the proposed development will meet flood compatibility standards.
- 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.
- Prepare a flood risk management plan for the proposed childcare based on Council requirements.
- Compliance assessment in accordance with the requirements of SEARs and Bayside Council.

1.2 Site

The proposed development is at 26-42 Eden Street & 161-179 Princess Highway, Arncliffe, NSW 2205 (include Lot 1/DP447649, Lot 10-12/DP23701, Lot 1-3 DP23701, Lot 7-9/DP23701, Lot 25-26/DP1228031, Lot 3/DP1094906) and falls within the Bayside Council Local Government Area (LGA).

The site area is approximately 1.34 ha bordered by Eden Street to the west, Princess Highway to the east and residential lots to the south and north. The site location and surrounding area is shown in Figure 1.

The site land zone is B4 (Mixed Use) based on Rockdale Local Environmental Plan (LEP, 2011) located within a fully urbanised area with current land use of residential.

The site in existing conditions is comprised of 14 (three-storey) residential buildings with multiple open parking lots and associated egresses to Eden Street as well as multiple pedestrian accesses and footpaths through Eden Street and Princes Highway.

The site generally falls towards north in existing conditions with highest level of 27.75m AHD at southern boundary falling to lowest level of 18.30m AHD at northern boundary with average grade of 4.5%. The site draining mechanism in existing conditions is through Eden Street.



Figure 1 - Site Location and Surrounding area (Open Street Map)

2.0 Proposed Development

Proposed redevelopment consists of demolition of all existing buildings and structures on the site, site preparation works, excavation and tree removal and construction of a mixed-use development comprising

the following:

- 744 apartments across (4) buildings between 17-21 storeys in height (not including upper and lower ground levels), including:
 - 186 market housing apartments in Building A;
 - 202 market housing apartments in Building B;
 - 180 social housing apartments in Building C; and
 - 176 market housing apartments in Building D;
- 3,113m² retail gross floor area;
- 3,706m² of communal open space;
- 813 spaces of lower ground and basement car parking; and

of publicly accessible open space including a 4,000m² park, an 870m² public plaza (meeting space), and through site link connecting Eden Street and the Princes Highway.

Figure 2 shows the proposed architectural plan provided by Group GSM.



Figure 2 – Proposed Architectural Plan (Upper Ground Floor) – Group GSM

2.1 Relevant Guidelines

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

- Australian Rainfall and Runoff – A Guide to Flood Estimation, Commonwealth of Australia (Geoscience Australia), 2019.
- NSW Government's Floodplain Development Manual, NSW Department of Infrastructure Planning and Natural Resources, 2005.
- Rockdale Development Control Plan (DCP), 2011.
- Rockdale Environmental Plan (LEP), 2011.

3.0 Catchment Description

The site lies within Bonnie Doon Creek catchment which is a minor tributary of Cooks River. Bonnie Doon catchment itself breaks up into upper catchment (upstream of Illawarra railway) and lower catchment (downstream of Illawarra railway) with total area of approximately 270 ha.

The site is located downstream of Illawarra railway hence, within the lower catchment. Bonnie Doon catchment is heavily urbanised with residential, commercial and industrial developments.

The site is partly affected by shallow low hazard overland flows at northern side due to floodwaters overtopping the Princes Highway (road) reserve onto the site and flowing towards Eden Street.

4.0 Available Data

This flood study uses 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.

4.1 Previous Flood Studies

A review of available flood studies within Bayside Council revealed that WMAwater has completed the Bonnie Doon, Eve Street / Cahill Park Pipe & Overland 2D Flood Study (2017) on behalf of Bayside Council. As part of the study WMAwater has developed a detailed TUFLOW model which includes the site.

TTW has acquired the WMAwater TUFLOW model from Bayside Council subject to a Model and Data Licence Agreement (Document Number: 18/92924) and used this model as the basis for undertaking detailed hydraulic modelling at the site.

In addition, Bayside Council provided a Flood Advice Letter for the site in response to TTW request and summarised the existing flood conditions of the site and flood related considerations for the proposed development. Refer Appendix A for the Bayside Council flood advice letter.

4.2 Survey Data

Survey data for the site and its proximity provided by Cardno on behalf of NSW Land & Housing Corporation was used to refine the model surface in existing conditions.

5.0 Hydraulic Model

The TUFLOW hydraulic model developed by WMAwater (called Council's model, hereafter) was used as the basis and further refined 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.

5.1 2D Model Domain

The Council's model domain covers an area of 245.7ha including upper catchment (upstream of Illawarra railway) and lower catchment (downstream of Illawarra railway) with grid cell size of 2m².

For the current flood study, TTW reduced the model domain to 29.6ha. TTW's model domain is bounded to Illawarra railway line to the west, Botany Street to the east and M5 East Road to the north. TTW adopted the model boundary along with the WMAwater upper and lower catchment boundaries as are shown in Figure 3.

Furthermore, the grid cell size was reduced to 1m² in order to allow for more accurate model results at the site proximity.

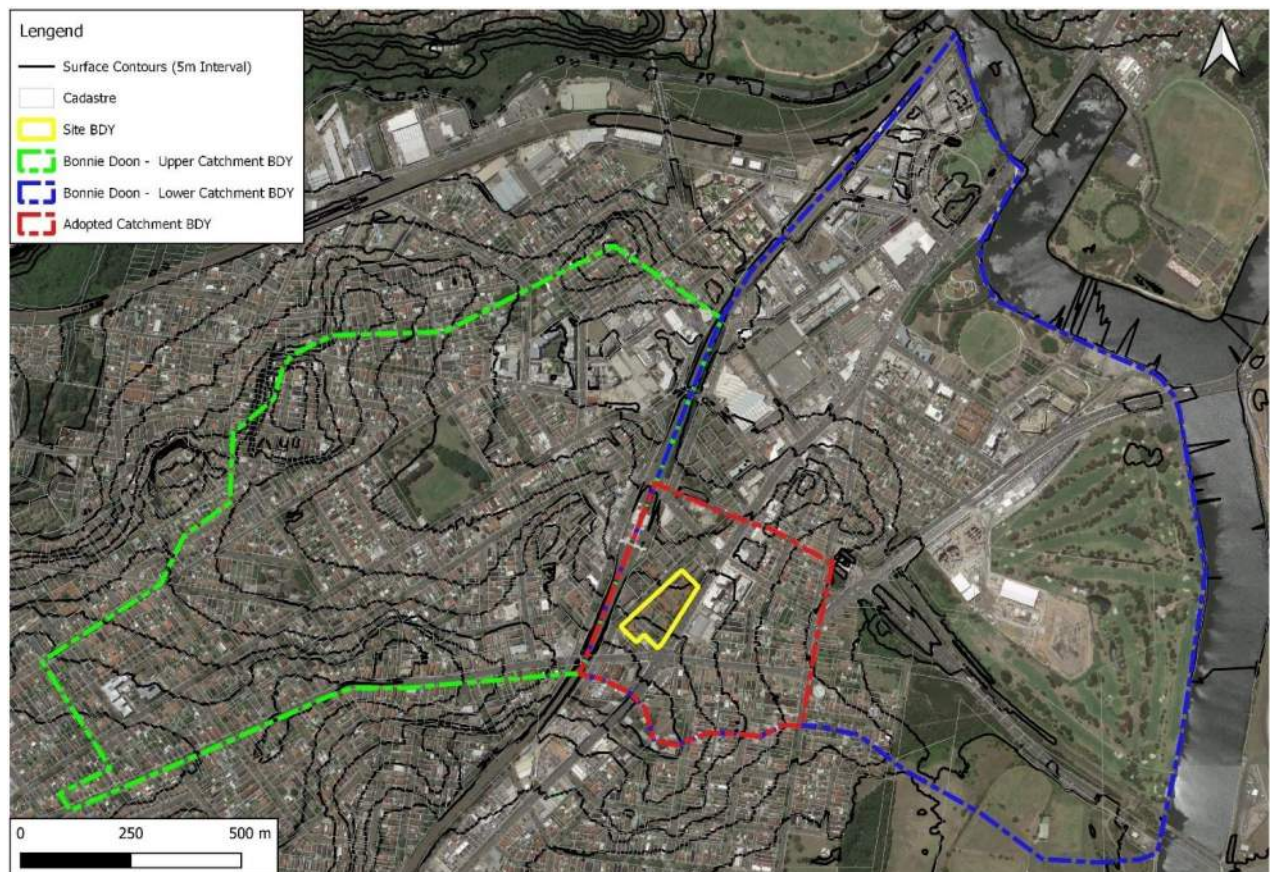


Figure 3 - Adopted model boundary vs WMAwater model boundaries

5.2 TUFLOW 1D Model Domain

Existing 1D network was retained inside the model consistent with the Council's model. Inflows were extracted from Council's model and added at upstream of 1D network to replicate the Council's 1D model flows.

Pipe blockages were also retained consistent with the Council's model (20% blockage).

5.3 Topography

Existing TufLOW model surface (WMAwater, 2017) was merged with site survey DTM triangles data to increase the accuracy of existing model surface for the site as well as for a part of Princes Highway and Eden Street adjacent to the site.

5.4 Boundary Conditions

5.4.1 Model Inflows

Council's model inflows are based on the flow hydrographs extracted from a DRAINS model (developed by WMAwater for the catchment) and applied directly to the respective inlet pit locations within the TUFLOW model. In this way if the inflow at an inlet pit exceeds the capacity of the inlet pit, then the inflows will surcharge at the pit and enter the 2D overland flow domain of TUFLOW (refer Bonnie Doon, Eve Street / Cahill Park Pipe & Overland 2D Flood Study 2017, Section 6.3.1.).

Model inflows were retained consistent with the Council's model across the new model domain. In addition, upstream inflows to the new model domain were extracted from Council's model (as hydrographs) and then applied to upstream of the new model as inflow boundaries to replicate the Council's 2D model flows.

Model initial water level was retained consistent with Council's model in the 1% AEP storm event (with and without climate change) as well as the PMF.

5.4.2 Downstream boundary

Based on the available survey data, the site's lowest surface level is 13.30m AHD, whilst Cook's River water levels would raise lower than 2.0m AHD during major flood events (refer Bonnie Doon, Eve Street / Cahill Park Pipe & Overland 2D Flood Study 2017, Section 6.3.2.). Therefore, the site is not affected by Cooks River tailwater.

Downstream boundary was defined approximately 160m north the site (along southern side of M5 East Road) and approximately 290m east of the site (along eastern side of W Botany Street). Stage-discharge (water level versus flowrate) curves were adopted as the downstream boundary conditions. The stage-discharge relationship was generated by TUFLOW by specifying downstream boundary slopes.

5.5 Hydraulic Roughness and Losses

The hydraulic roughness of a material is an estimate of the resistance to flow and energy loss due to friction between a surface and the flowing water. A higher hydraulic roughness indicates more resistance to the flow. Roughness in TUFLOW is modelled using the Manning's (n) roughness co-efficient. Manning's roughness materials are consistent with the Council's model as detailed in Table 1.

Manning zones were further refined for the site and its proximity in existing conditions based on available survey data and recent aerial imagery.

Manning zones were also adjusted based on architectural plans for proposed model conditions.

Table 1 Adopted roughness Manning's

Land use category	Manning's 'n'
Parks and grassed areas	0.040
Commercial buildings	0.060
Residential	0.040
Road reserve	0.013
Buildings	0.018
Dense Trees	0.030

5.6 Building Footprint

Footprints of the buildings within the model domain were defined as inactive cells to act as blockage and

prevent the water to flow through. Building outlines for existing conditions were refined based on the site survey and aerial photographs. Building outlines for proposed conditions were also based on architectural plans.

6.0 Flood model results

According to the Council's flood study (WMAwater, 2017), the critical 1%AEP and PMF event duration for the catchment is 60 minutes.

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.

6.1 Existing Conditions

The peak flood levels depths, velocities and hazards in the critical duration 1%AEP event for existing site conditions are shown in Figure 4, Figure 5 and Figure 6 respectively.

Flood results show that the site is generally flood free during both 1%AEP and PMF events and upstream overland flows are majorly contained within the Princes Highway and Eden Street reserves.

There are only minor overland flows overtopping the Princes Highway onto the site during major events. Minor overland flows to the site are very shallow (typical depths of less than 5mm in the 1%AEP event and less than 10mm in the PMF) and are of low hazard based on NSW provisional hazard categories.

The peak flood levels depths, velocities and hazards in the critical duration PMF event for existing site conditions are shown in Figure 7, Figure 8 and Figure 9 respectively.



Figure 4 - Flood Levels & Depths (1%AEP) – Existing Conditions

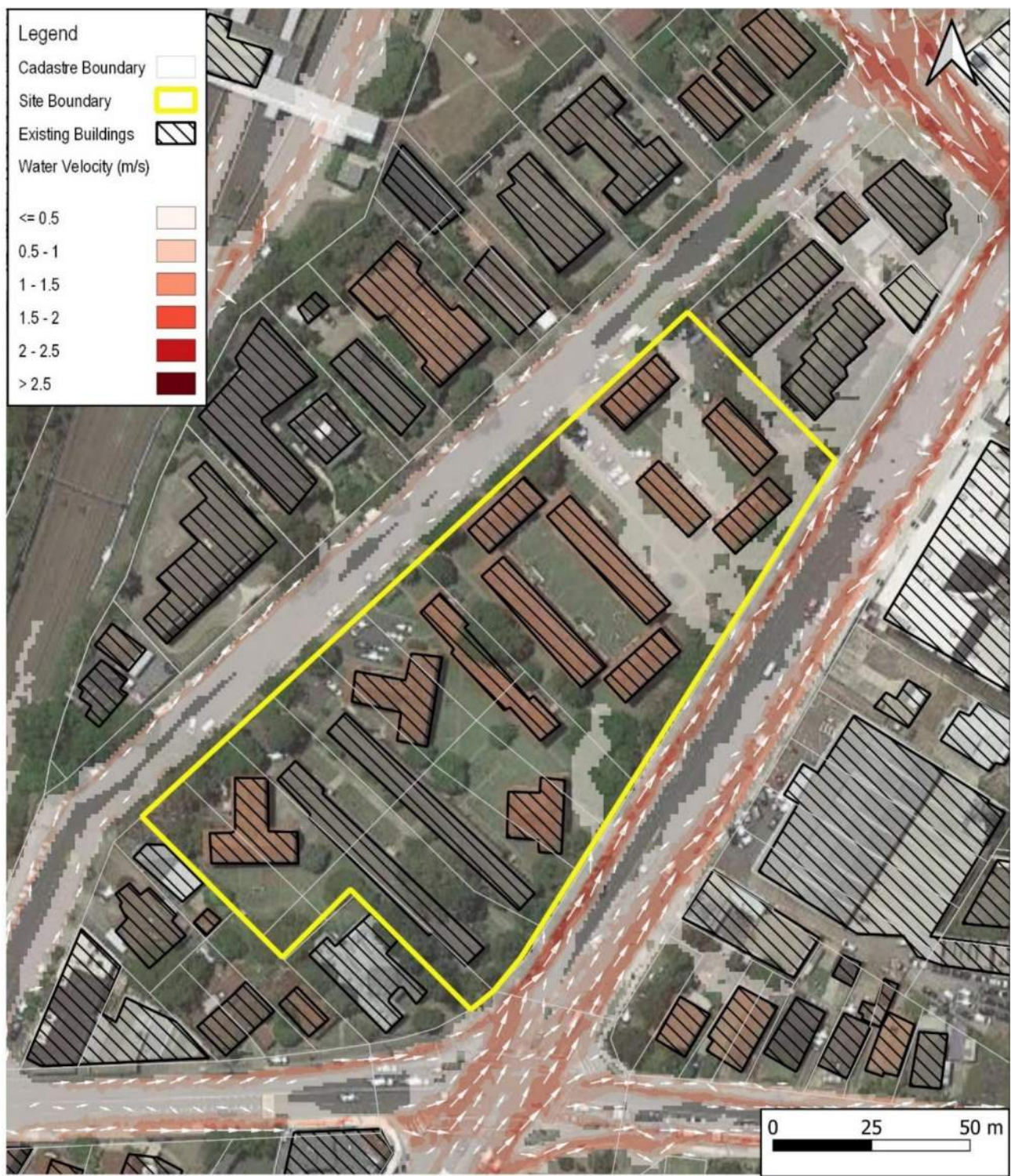


Figure 5 - Flood Velocities (1%AEP) – Existing Conditions



Figure 6 - Provisional Flood Hazards (1%AEP) – Existing Conditions

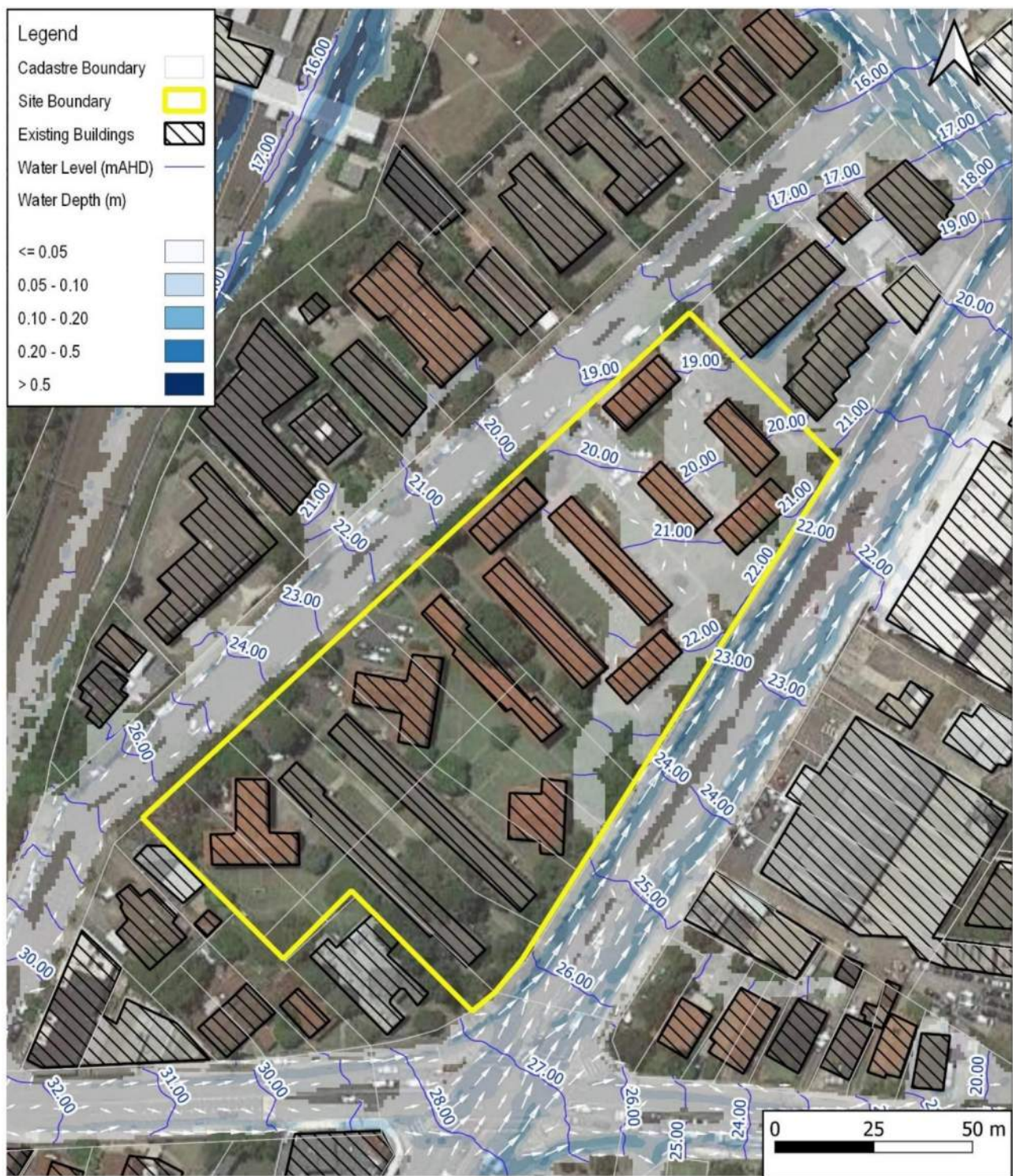


Figure 7 - Flood Levels & Depths (PMF) – Existing Conditions

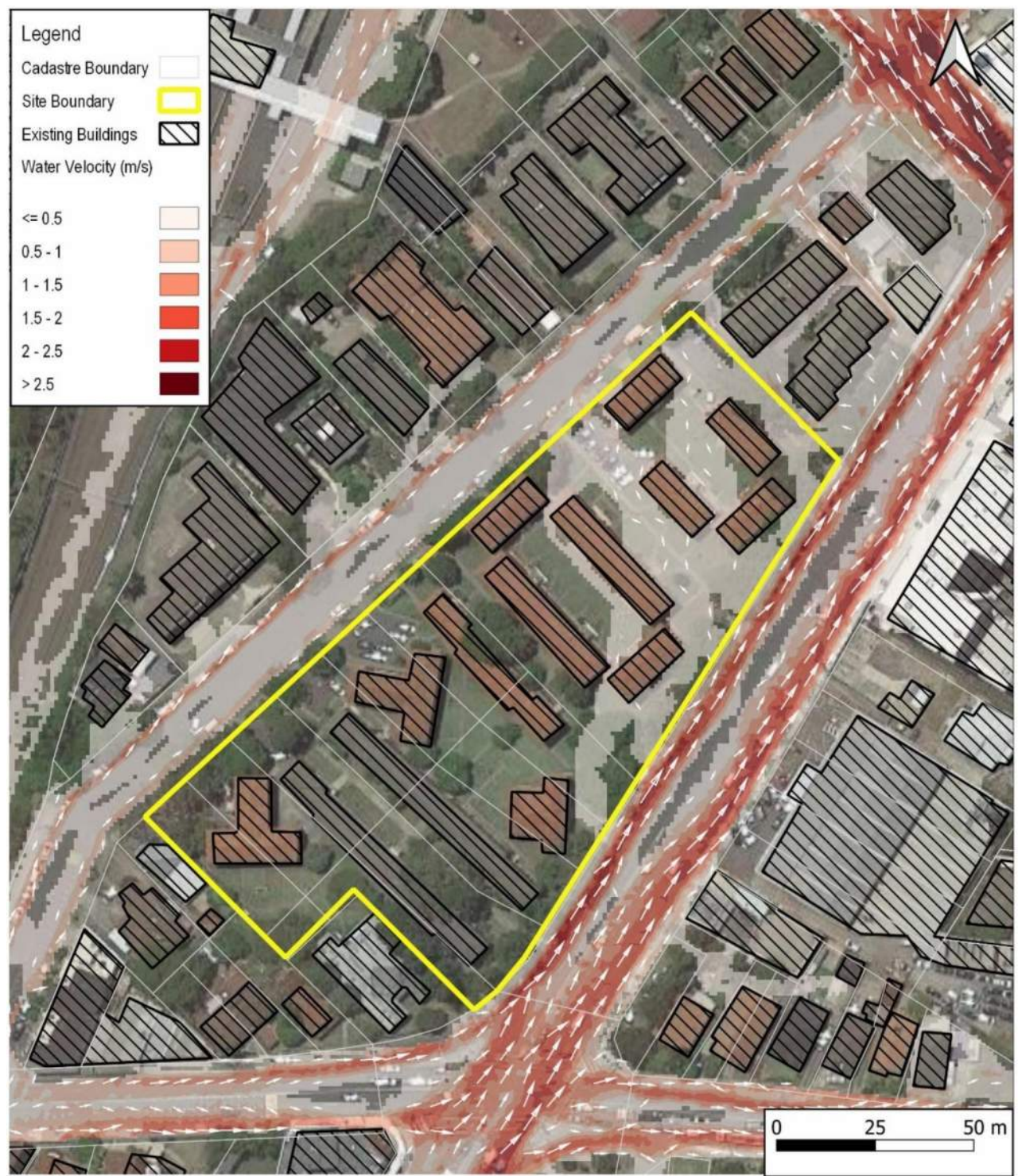


Figure 8 - Flood Velocities (PMF) – Existing Conditions



Figure 9 - Provisional Flood Hazards (PMF) – Existing Conditions

6.2 Proposed Conditions (without vehicular access to Princes Highway)

To simulate the proposed conditions:

- Existing structures onsite removed from the model and replaced with the proposed buildings.
- The model surface in existing conditions was updated to include the proposed vehicular access to Princes Highway.
- Manning's zones adjusted based on the proposed development.

Peak flood levels, depths, velocities and hazards for proposed site conditions in the critical duration 1%AEP event are shown in Figure 10, Figure 11 and Figure 12 respectively.

Overland flow behaviour in the proposed conditions is relatively consistent with the existing conditions. The site is generally flood free in the proposed conditions during both 1%AEP and PMF events.

Minor overland flows from Princes Highway through the site remain shallow (typical depths of less than 5mm in the 1%AEP event and less than 10mm in the PMF) and low hazard during both 1%AEP and PMF events.

Peak flood levels, depths, velocities and hazards for proposed site conditions in the critical duration PMF event are also presented in Figure 13, Figure 14 and Figure 15 respectively.

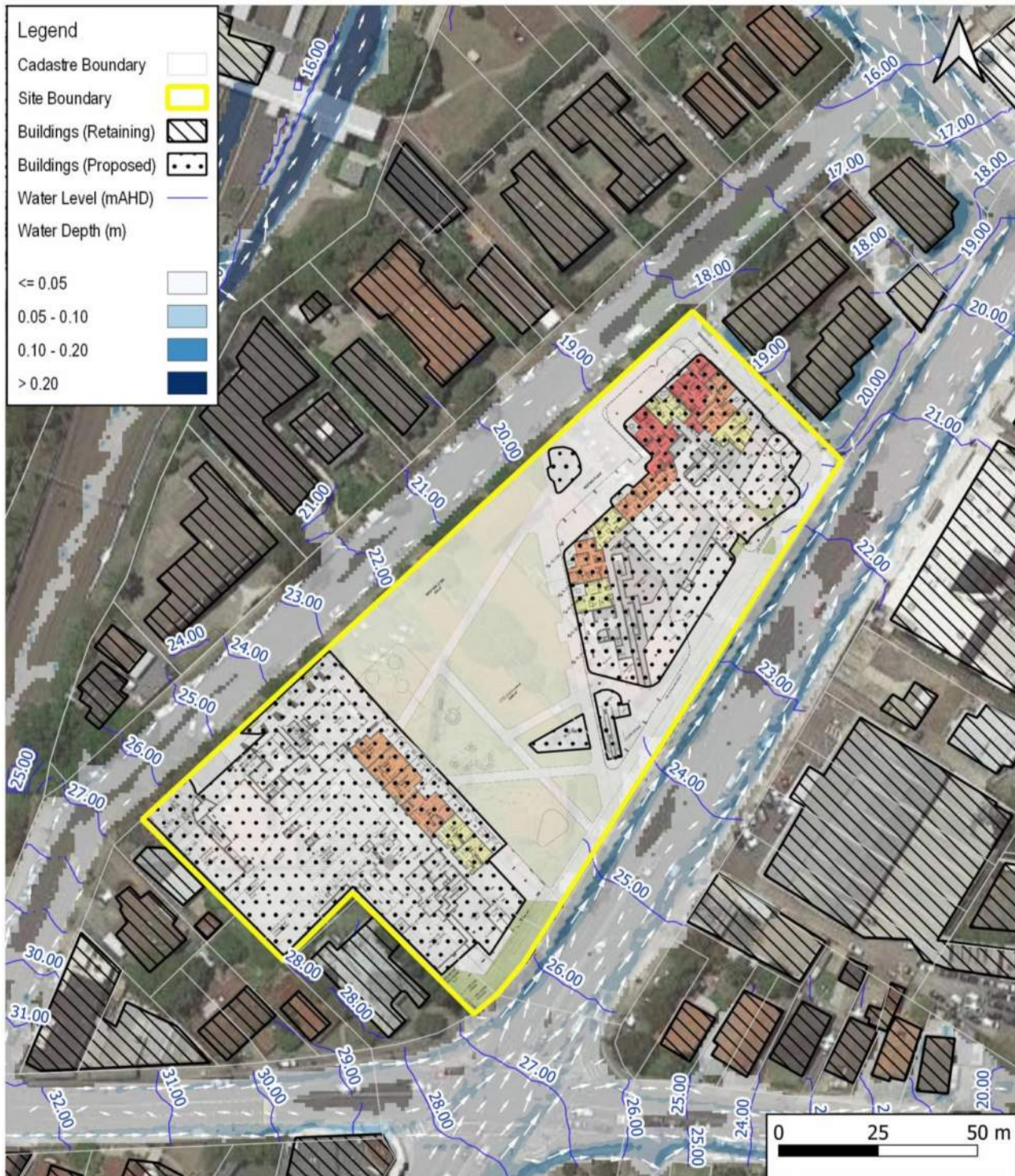


Figure 10 - Flood Levels & Depths (1%AEP) – Proposed Conditions

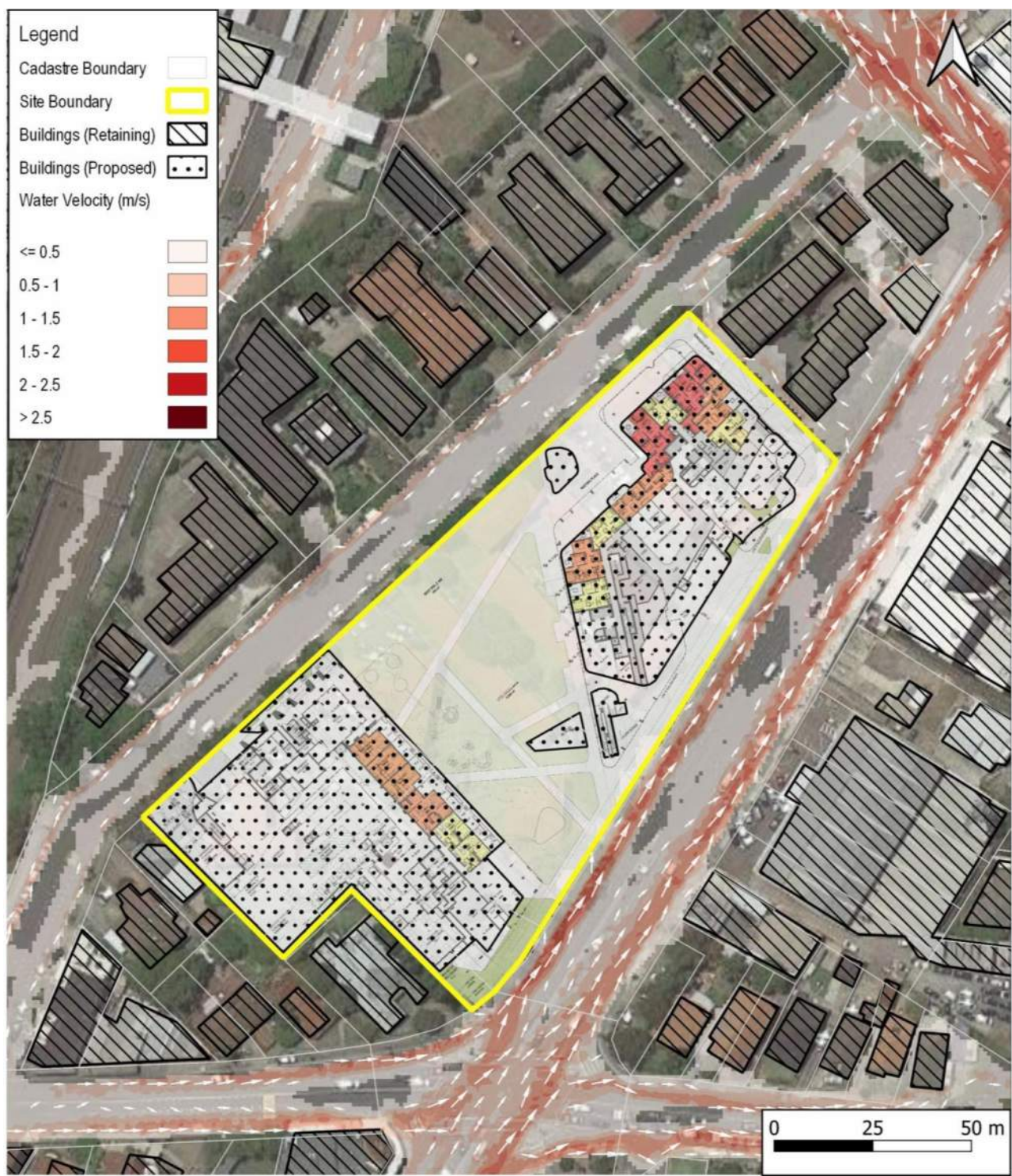


Figure 11 - Flood Velocities (1%AEP) – Proposed Conditions



Figure 12 - Provisional Flood Hazards (1%AEP) – Proposed Conditions

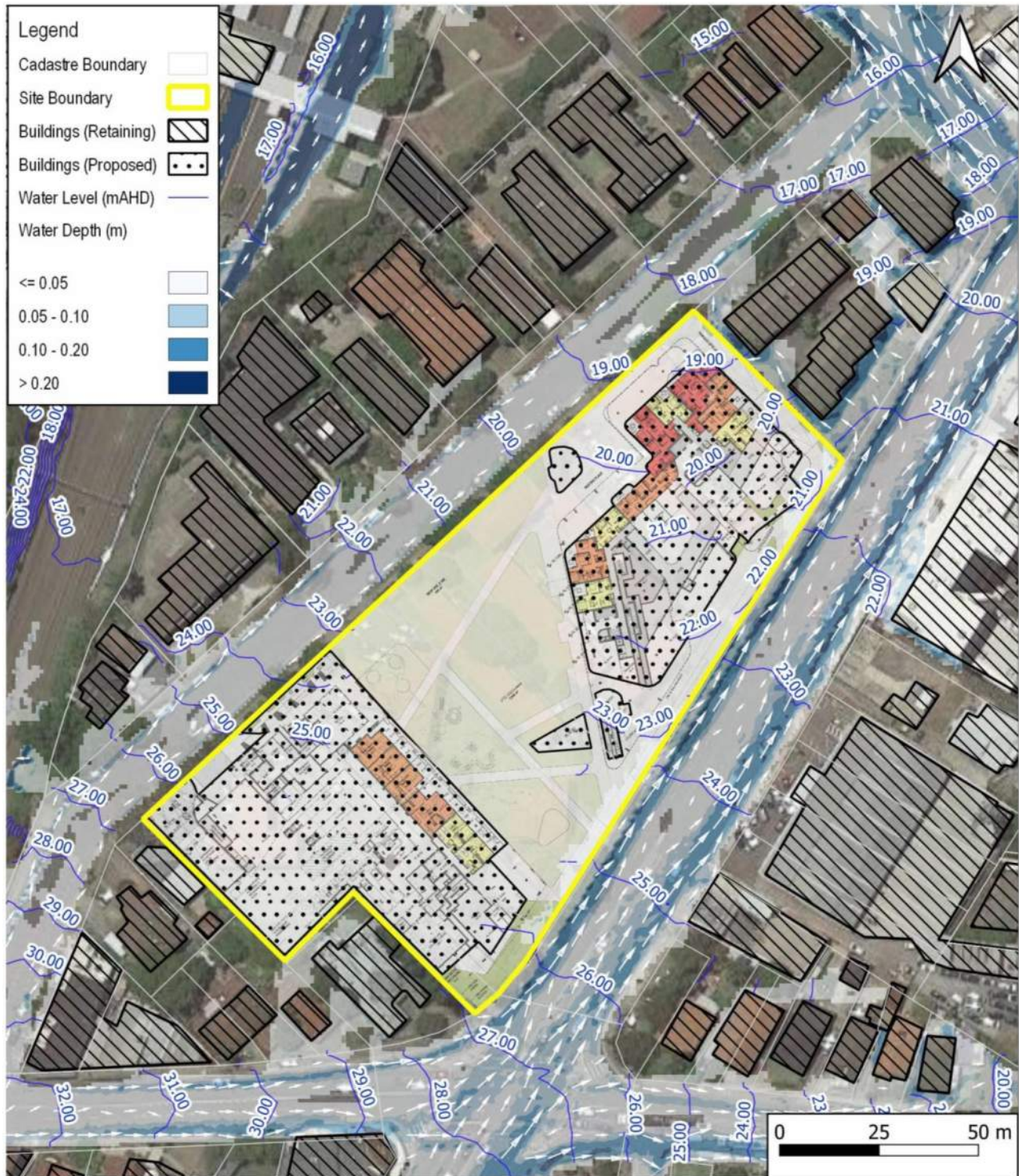


Figure 13- Flood Levels & Depths (PMF) – Proposed Conditions

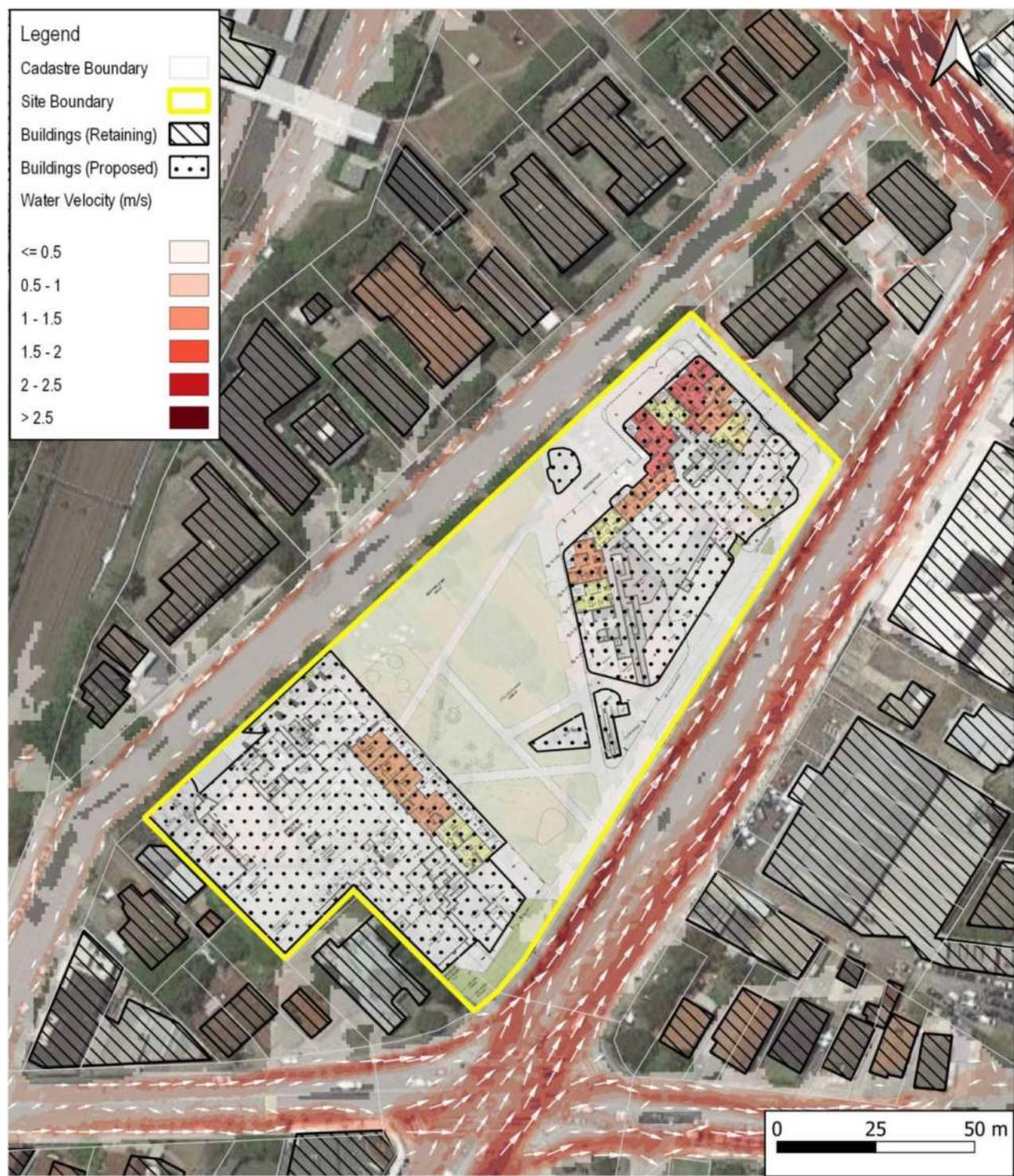


Figure 14 - Flood Velocities (PMF) – Proposed Conditions

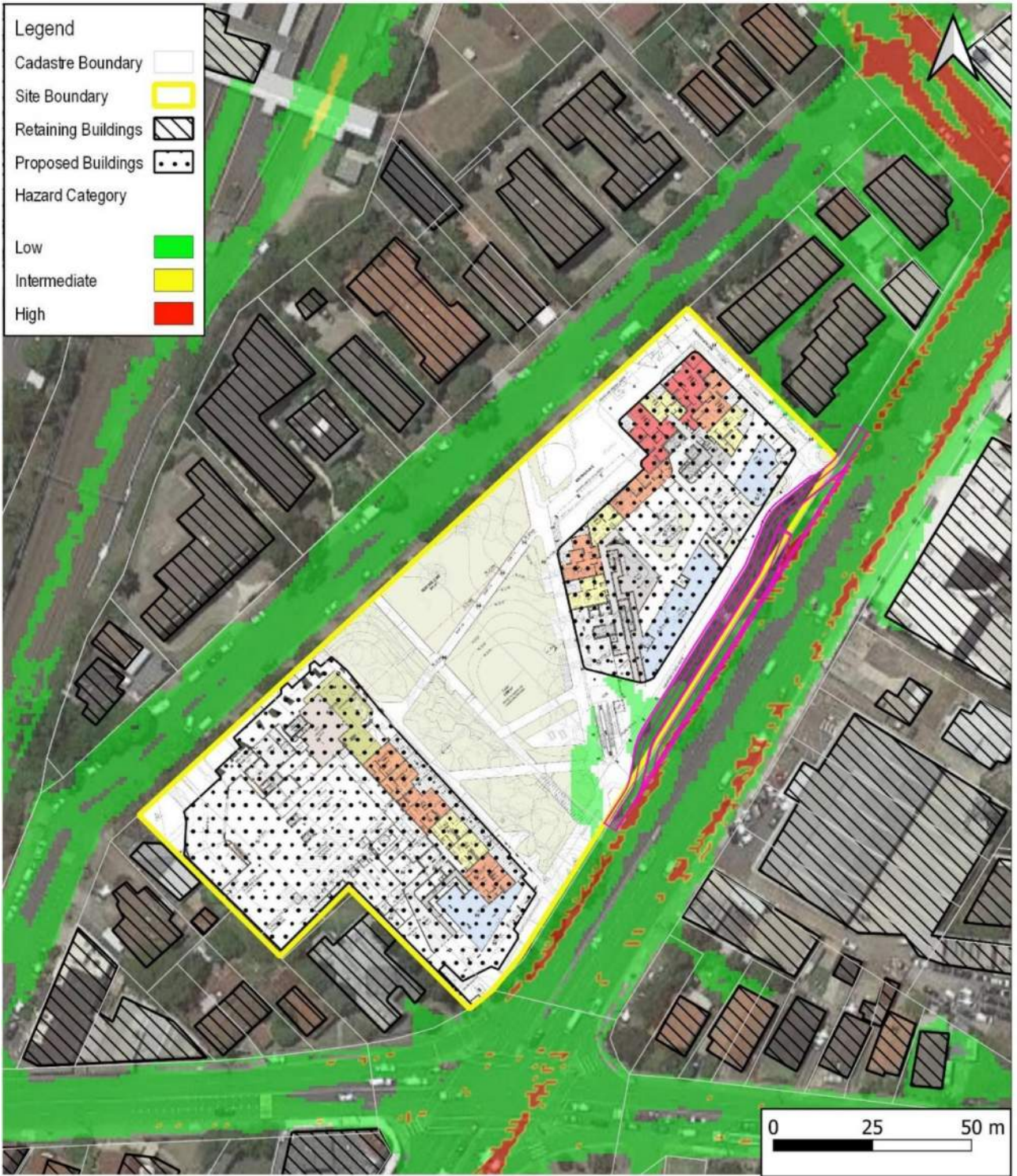


Figure 15 - Provisional Flood Hazards (PMF) – Proposed Conditions

6.3 Proposed Conditions (with vehicular access to Princes Highway)

Additional flood assessment was undertaken to investigate the flood conditions where the proposed development incorporates a vehicular access from the underground car park to Princess Highway.

To simulate the later conditions, 3D design TIN of the proposed vehicular access was merged into the model surface. Also, Manning's zones were further modified to suit. Model was subsequently run for the critical duration 1% AEP and PMF events as explained in Section 6.0.

Model results show that the proposed vehicular access does not considerably alter the existing flood conditions on Princes Highway neither in the 1%AEP nor in the PMF event.

According to the flood modelling results, the proposed vehicular access to Princess Highway must incorporate a crest up to the adjacent PMF level of 22.70m AHD to prevent overland flows on Princes Highway entering the ground car park for all storms up to the PMF event and ensure compliance with the Council flood planning requirements.

Peak flood levels, depths, velocities, and hazards for the proposed site conditions (including vehicular access to Princes Highway) in the critical duration 1% AEP as well as the PMF events are shown in Figures 16 to 21.

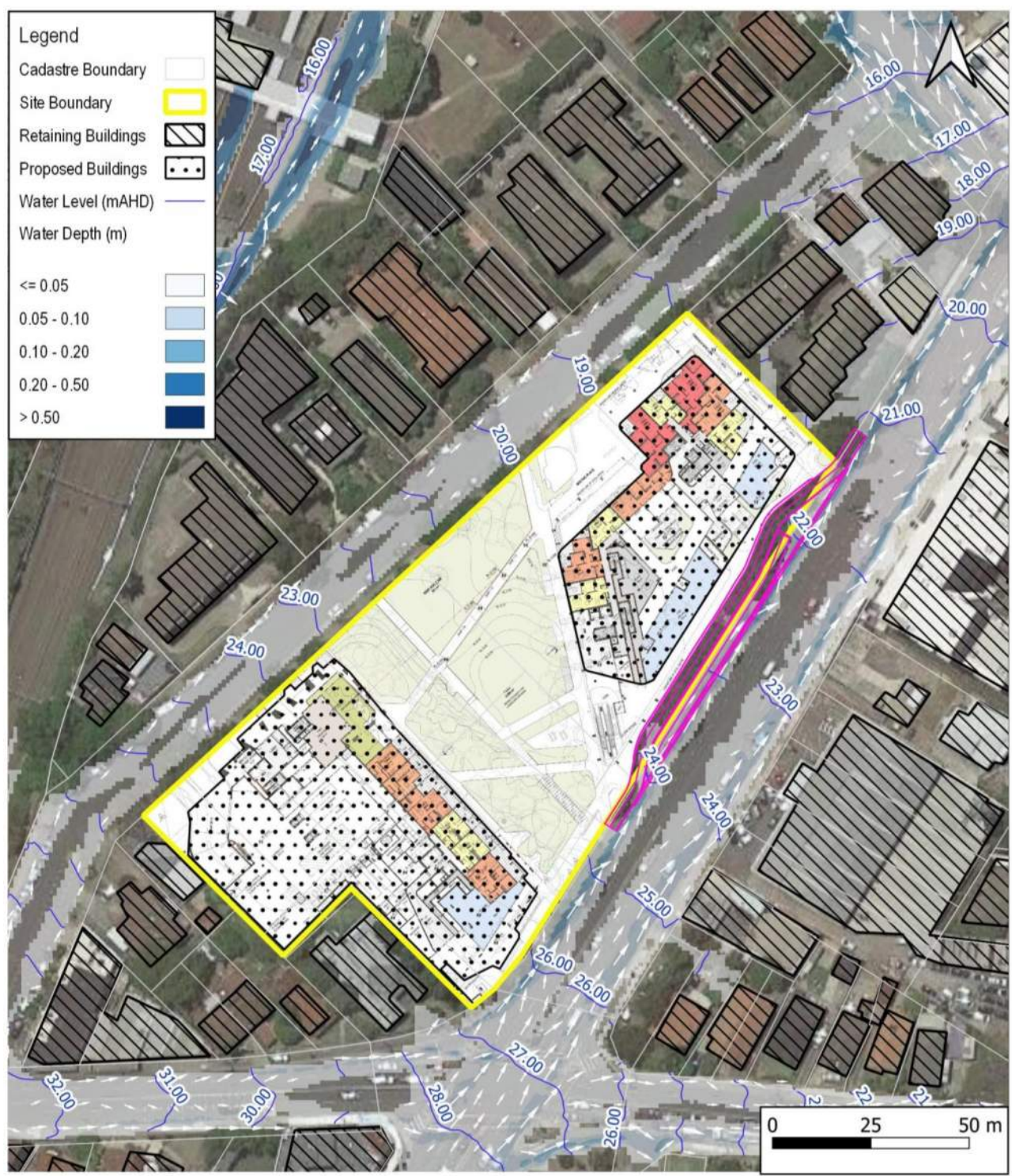


Figure 16 - Flood Levels & Depths (1%AEP) – Proposed Conditions (Including Access to Princes Highway)

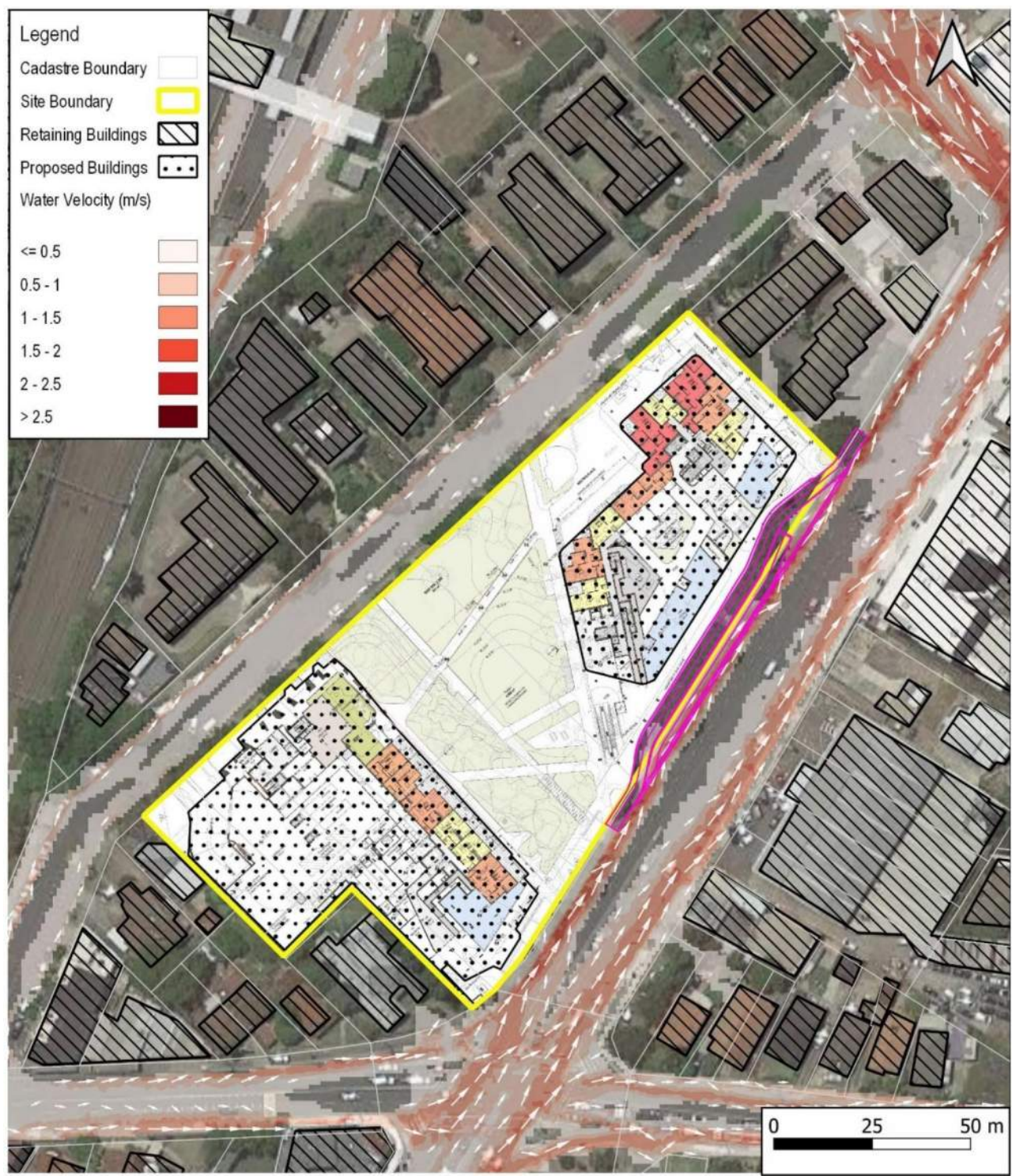


Figure 17 - Flood Velocities (1%AEP) – Proposed Conditions (Including Access to Princes Highway)

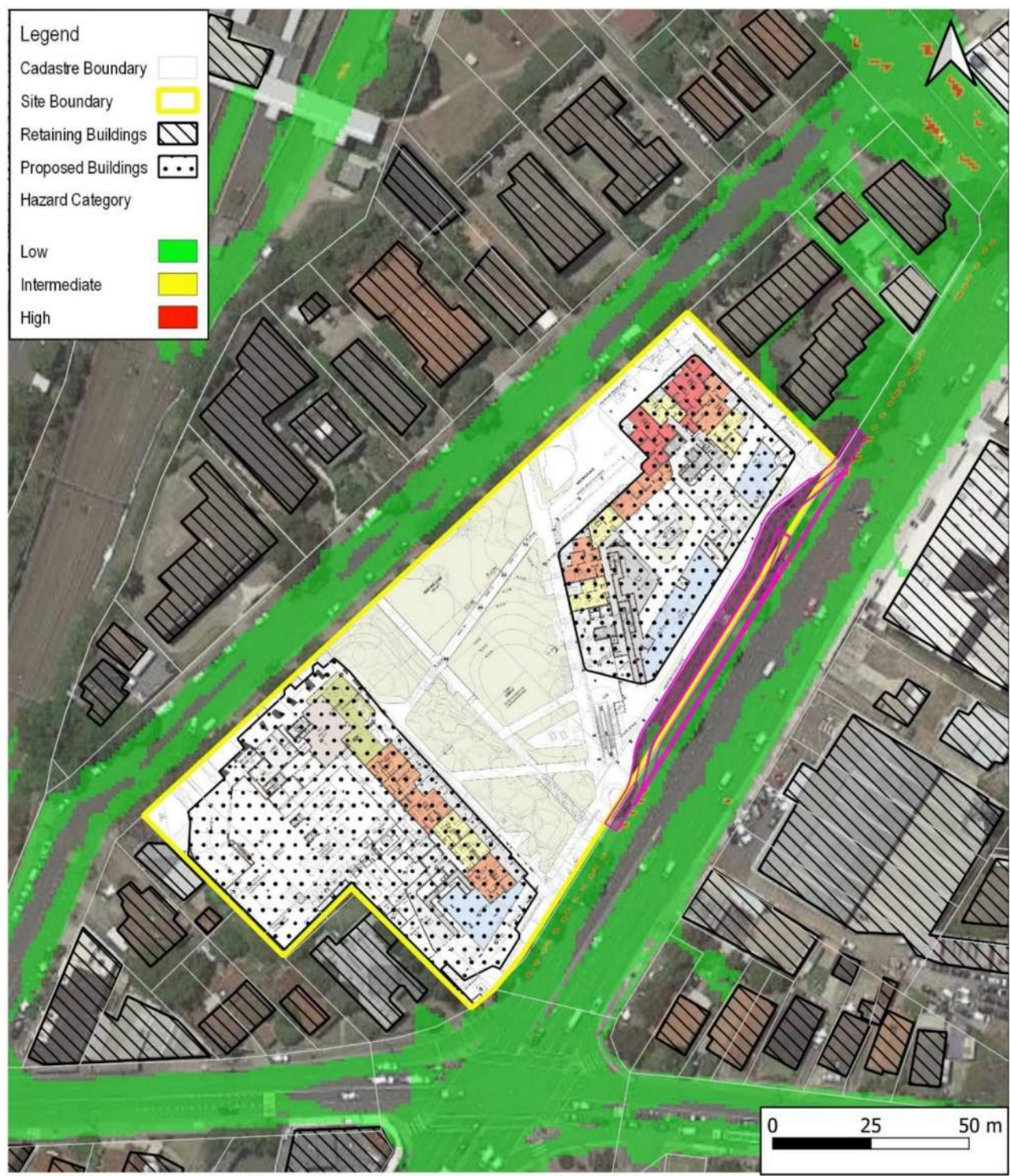


Figure 18 - Provisional Flood Hazards (1%AEP) – Proposed Conditions (Including Access to Princes Highway)

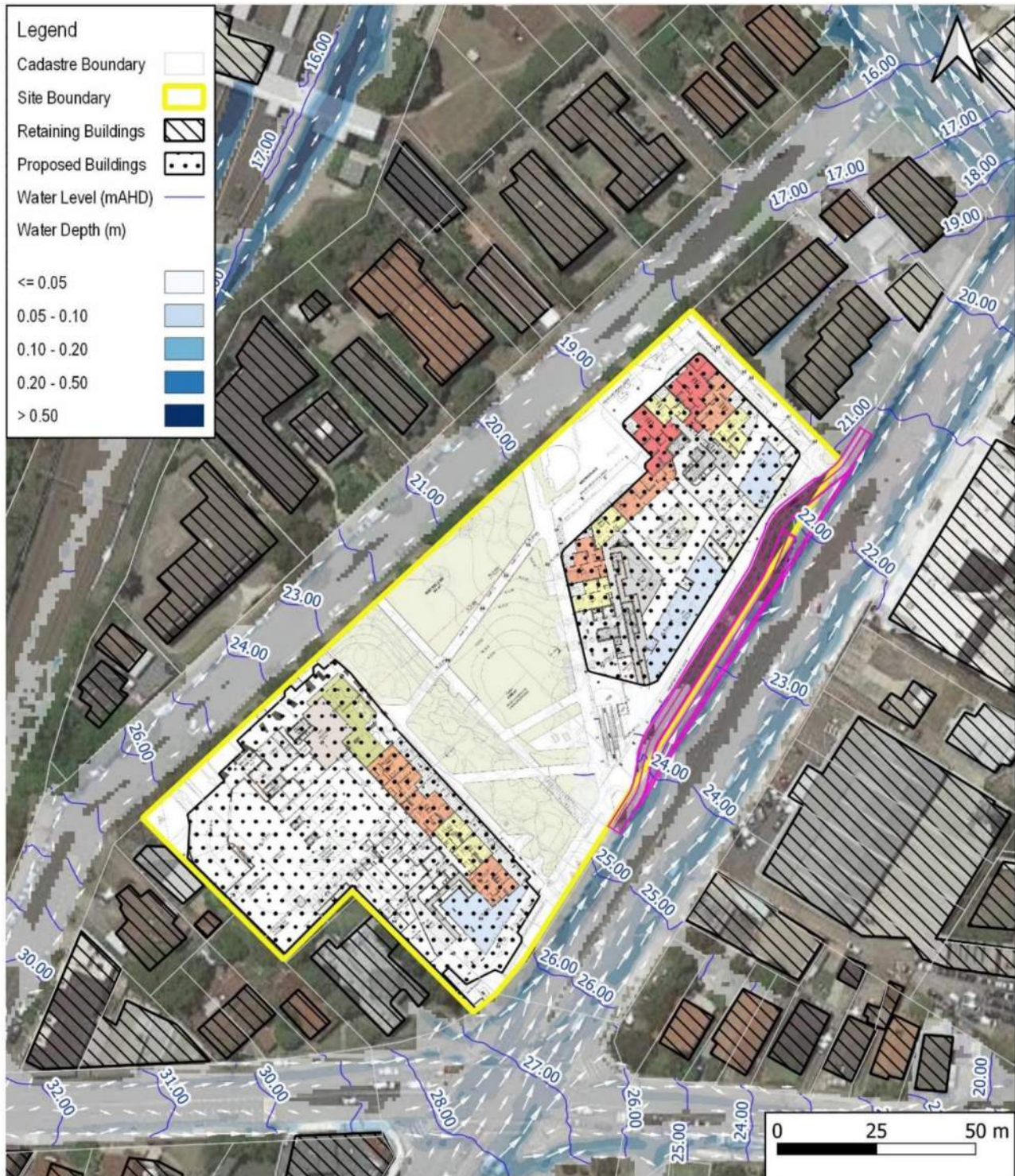


Figure 19- Flood Levels & Depths (PMF) – Proposed Conditions (Including Access to Princes Highway)

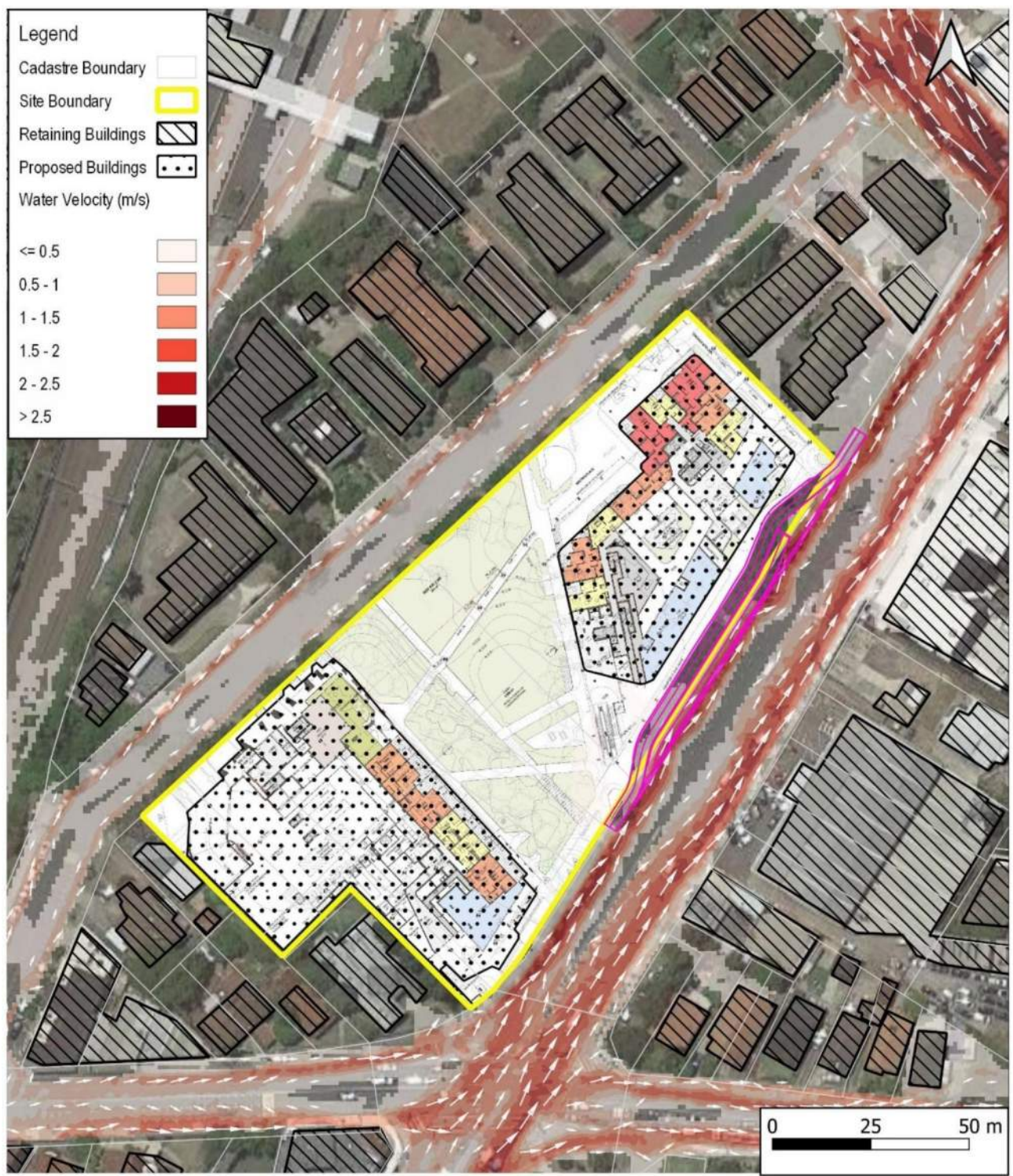


Figure 20 - Flood Velocities (PMF) – Proposed Conditions (Including Access to Princes Highway)

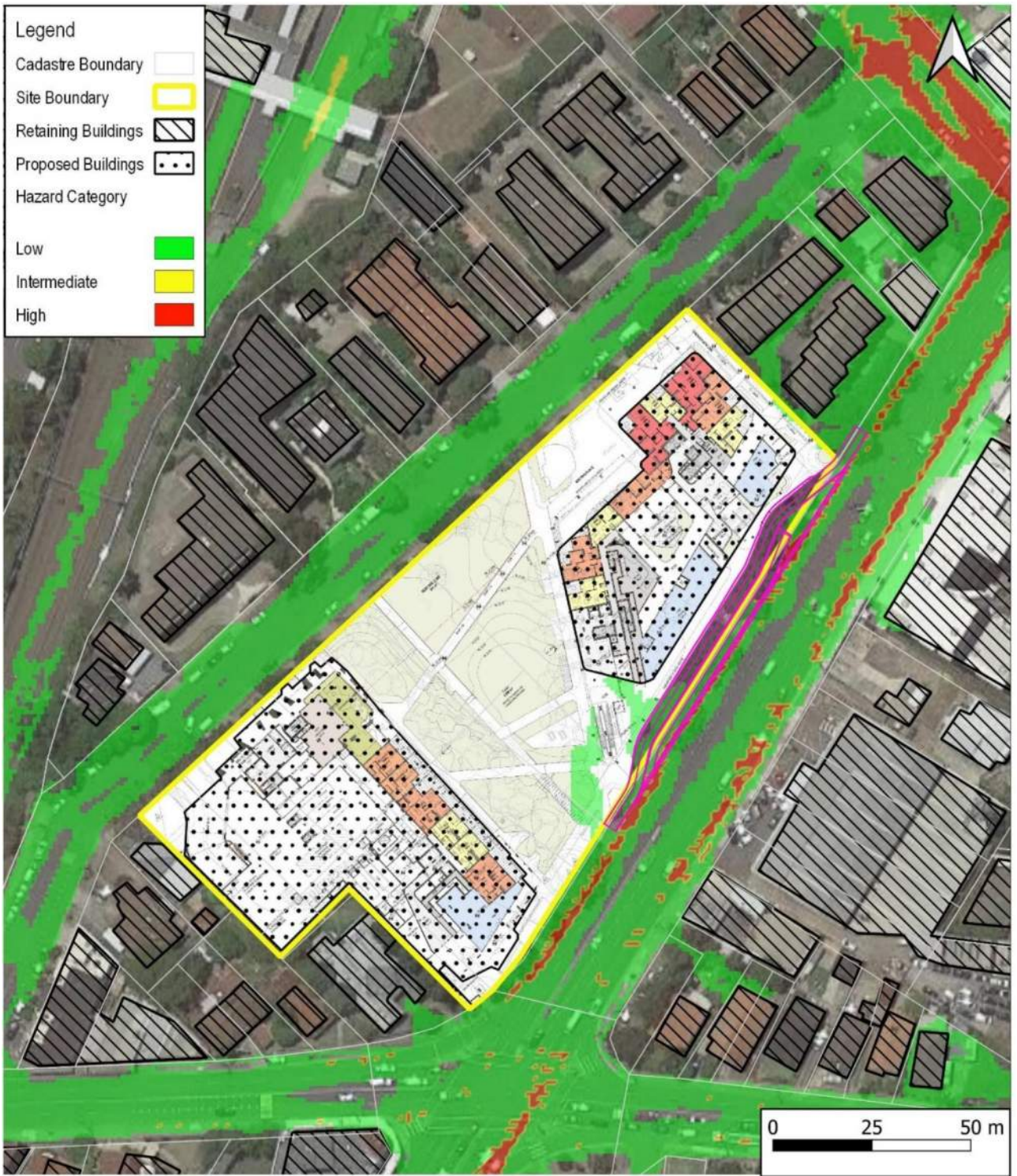


Figure 21 - Provisional Flood Hazards (PMF) – Proposed Conditions (Including Access to Princes Highway)

6.4 Flood Impact Assessment

During large storm events, Illawarra railway corridor acts as a trunk drainage line, effectively redirecting the floodwaters upstream of the railway towards north and away from the site.

What is more, the site is almost located at upstream of the lower catchment (refer Section 3.0) and therefore, is only affected by a relatively small upstream catchment generating shallow overland flows through Princes Highway and Eden Street during both 1%AEP and PMF events.

Hence, based on the foregoing the proposed development will generally result in negligible offsite impact on the surrounding properties in the 1% AEP flood event. There is a small area of water level increase (up to 30mm) on Princes Highway which is limited to 10 m².

Flood water level impacts due to the proposed development during the critical 1% AEP event are shown in Figure 22.

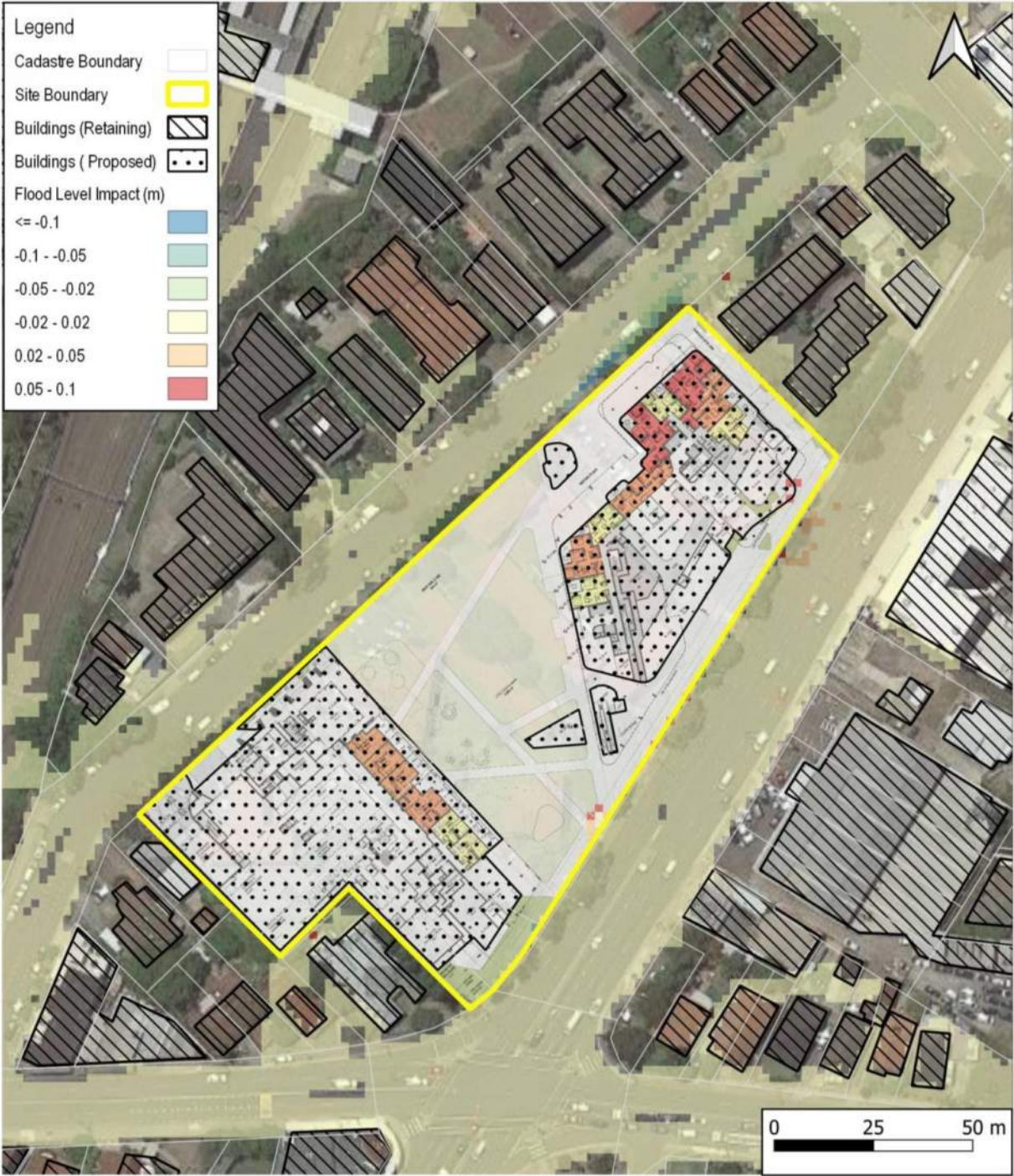


Figure 22 Flood Level Impact (1% AEP) – Proposed Conditions

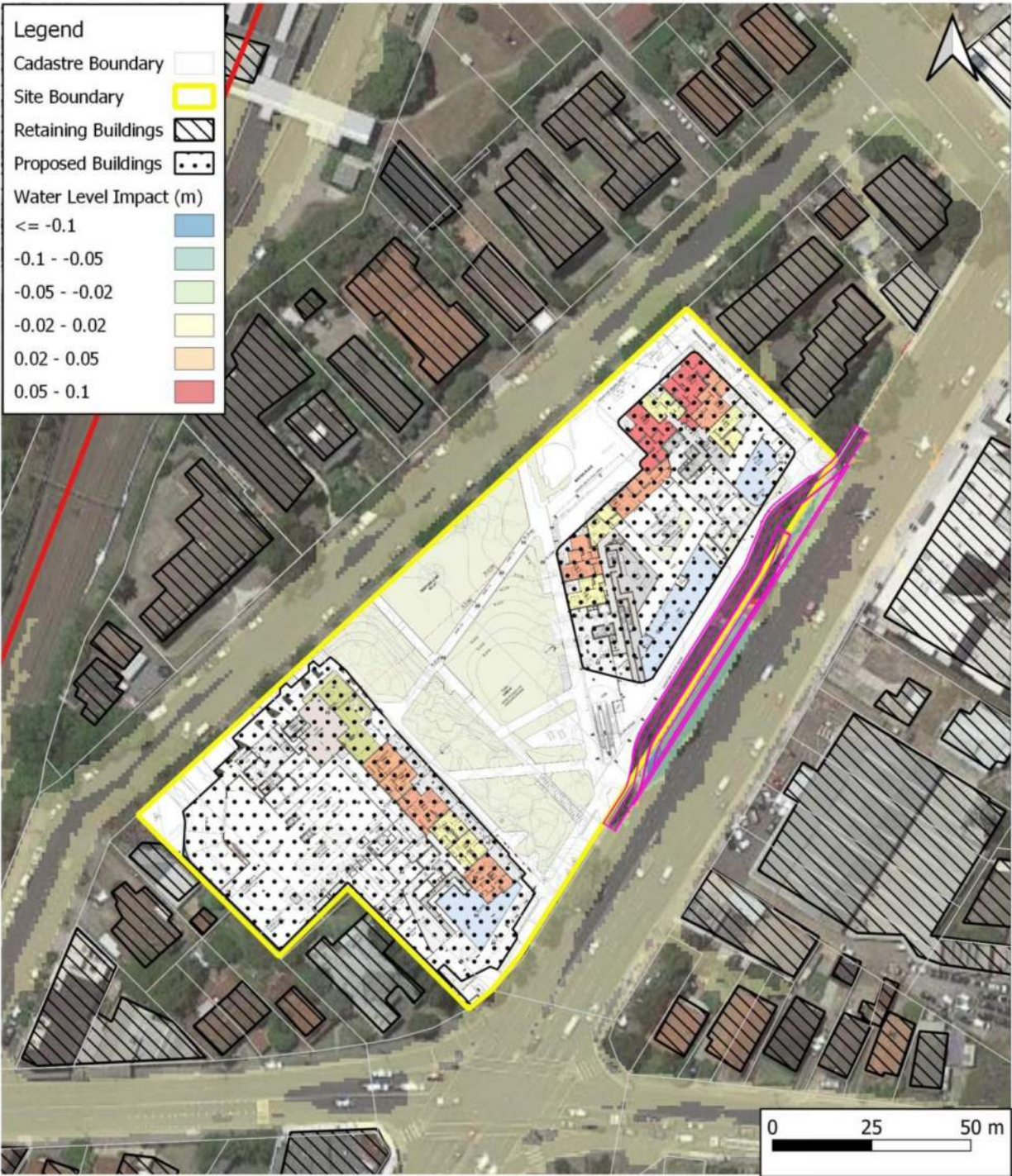


Figure 23 Flood Level Impact (1% AEP) – Proposed Conditions (Including Access to Princes Highway)

7.0 Effect of Climate Change

WMAwater (2017) has investigated the effect of climate change on Bonnie Doon catchment through increasing rainfall intensities by 10%, 20% and 30% and increasing the tailwater levels to 0.4m and 0.9m in order to model the possible sea level rise.

TTW model inflow boundary conditions were set up based on according to Wmawater model to run the model under worst case climate change scenario (30% rainfall increase) and assess the impacts of proposed development under the climate change effect.

Peak flood levels, depths, velocities and hazards for proposed site conditions in the critical duration 1%AEP event are shown in Figure 8, Figure 9 and Figure 10 respectively.

The results show that minor overland flows from Princes Highway through the site would increase due to climate change effect however, overland flows remain shallow and low hazard in vicinity of the site.

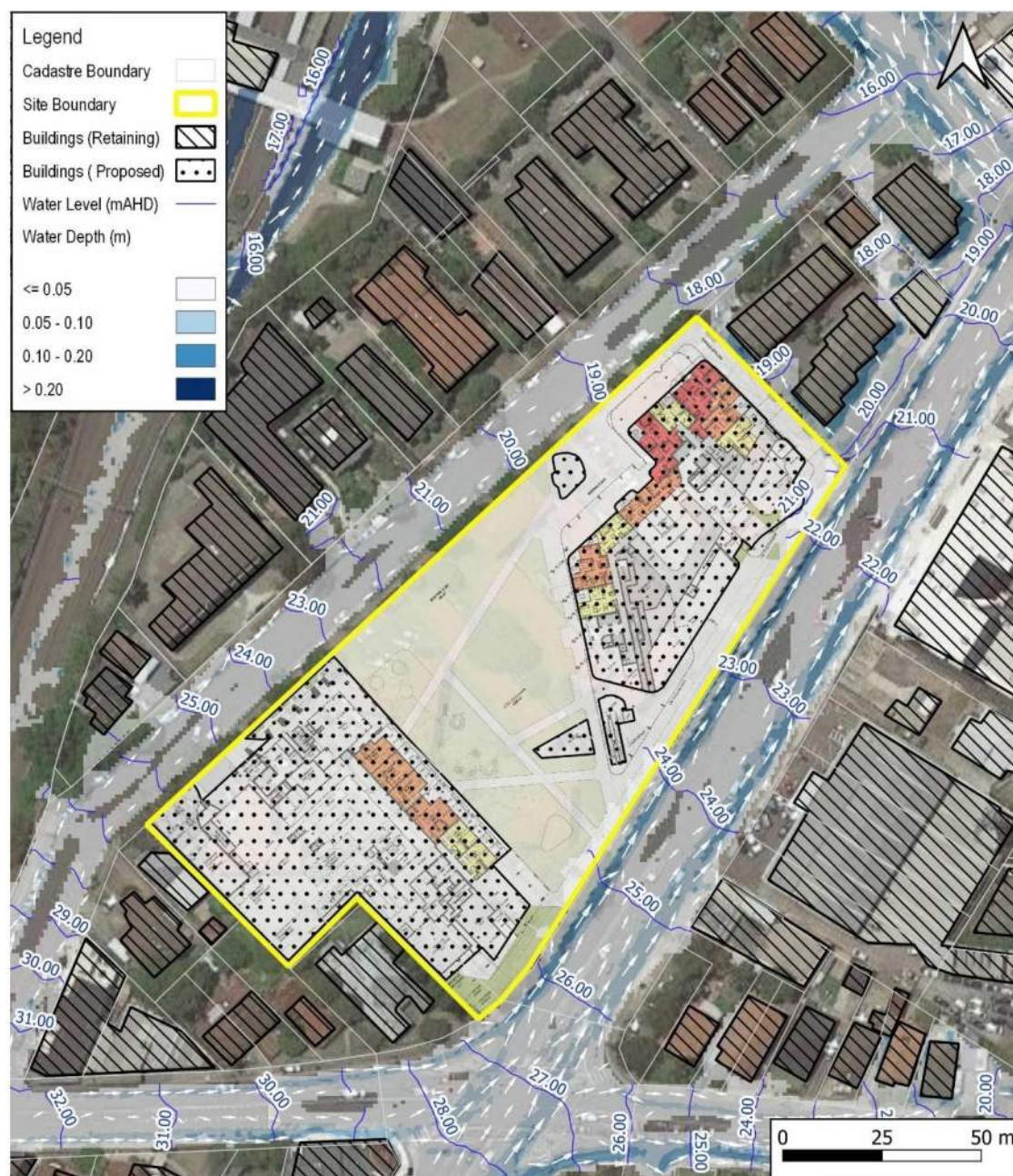


Figure 24- Flood Levels & Depths (1%AEP) with climate change – Proposed Conditions

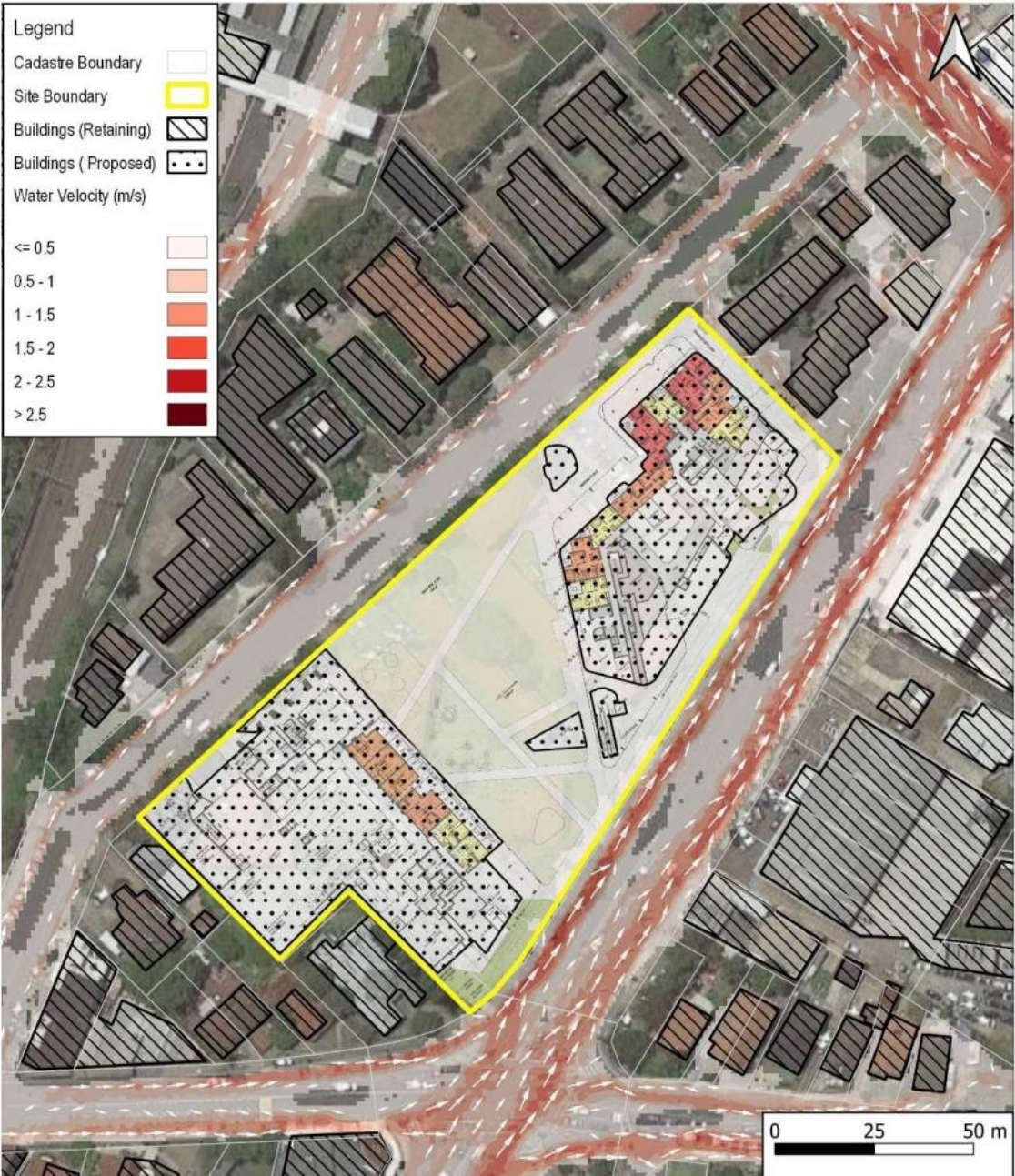


Figure 25 - Flood Velocities (1%AEP) with climate change – Proposed Conditions



Figure 26 - Provisional Flood Hazards (1%AEP) with climate change – Proposed Conditions

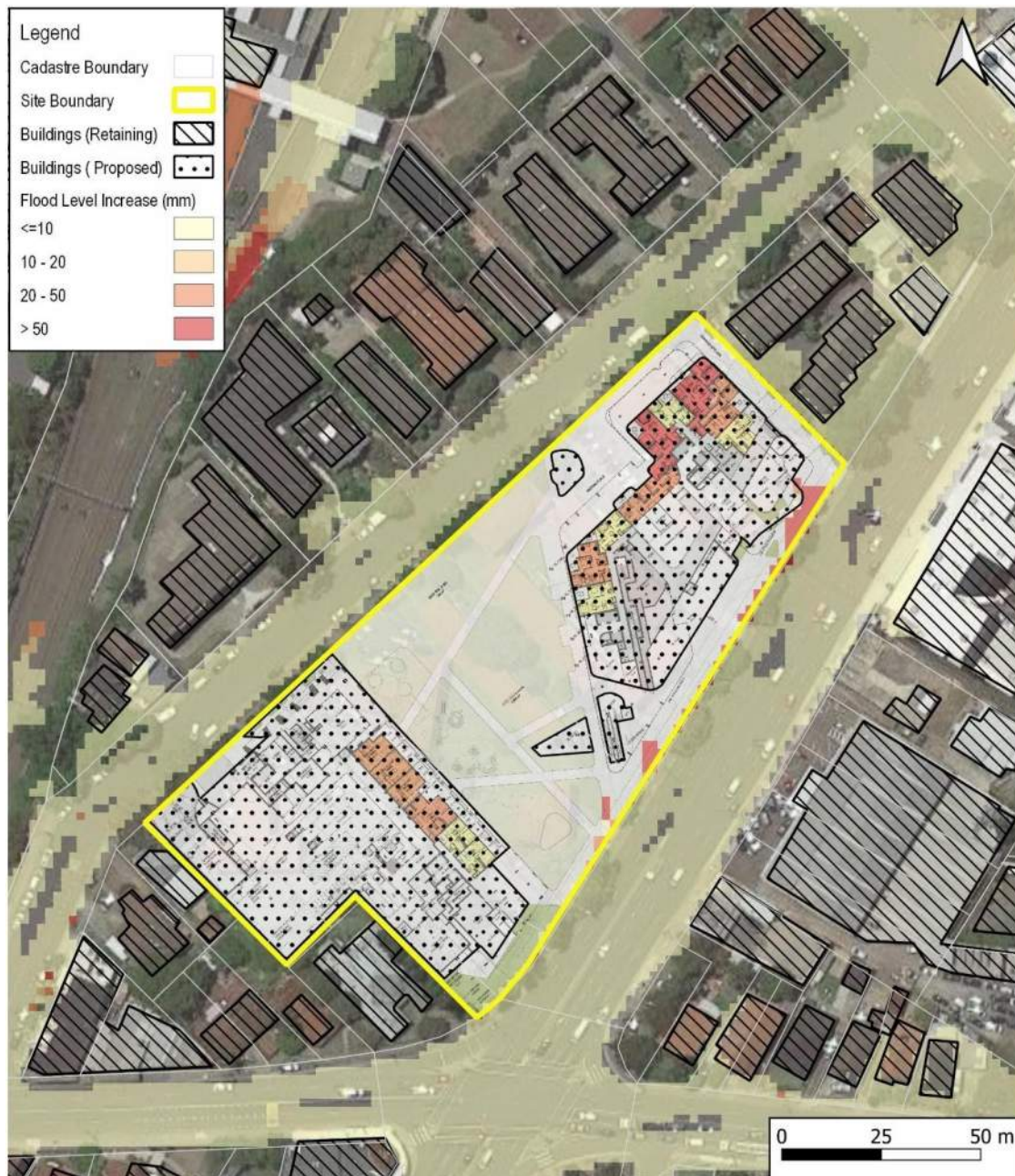


Figure 27 – Flood Level Increase (1%AEP) due to climate change effect – Proposed Conditions

8.0 Flood Risk Management Plan (FRMP)

Bayside Council has required that a Flood Risk Management Plan up to the PMF flood level is to be prepared for the proposed childcare centre (response to draft SEARs letter - ref: 20/328941 dated 15 Dec. 2020).

This section also addresses the flood risk management requirements of the Rockdale DCP (2011), Part 4.1.3.

- The site is not considered to be located within the floodway nor flood storage areas based on Bonnie Doon, Eve Street / Cahill Park Pipe & Overland 2D Flood Study, 2017.
- The site is not within the flood planning land based on the Rockdale LEP (2011) flood planning map.
- Flood modelling results show that floodwaters during the PMF event are contained predominantly within the Princes Highway and Eden Street Road reserves (refer Figure 13). The proposed childcare centre as

a result, is flood free during the PMF event.

- Flood hazards are low along the Eden Street as well as adjacent to the site pedestrian and vehicular egresses to Eden Street (see Figure 15). Therefore, reliable pedestrian and vehicular access are available from the site to Eden Street during all storm events up to and including the PMF.

8.1 Minimum Finished Floor Level (FFL)

The finished floor level (FFL) for the proposed childcare centre is to be at or above the PMF level of 26.8m AHD.

8.2 Shelter-in-Place

The proposed childcare finished floor level is located above the PMF flood level of 26.8m AHD (see Section 8.1). This would enable shelter-in-place as a flood emergency response for the children and staff.

The shelter-in-place duration would be around 1 hour based on the critical duration PMF. Evacuation to other buildings onsite (with higher floor levels) or out of the site is however possible during the PMF event as flood flows are safe through the site and through Eden Street.

Childcare Centre management should maintain an emergency kit including torch with spare batteries, portable radio with spare batteries, first aid kit, high visibility vest, non-slip foot ware and megaphone.

9.0 Compliance Assessment

Based on Bayside Council's flood advice letter for the site (Appendix A), no flood control is applicable to the site however, it is advised that:

- any new habitable floor level shall be designed a minimum 300mm above the ground level to avoid shallow surface water entering the building.
- any new low-level driveway to basement garage shall be designed a minimum 200mm above the top of road kerb level to prevent street water flow entering the driveway.

A compliance assessment in accordance with the requirements of SEARs and Bayside Council for the proposed development is provided in Table 5 to ensure compliance with requirements.

Table 2 - Compliance with the requirements of SEARs and Bayside Council

Requirement	Compliance Assessment
Rockdale DCP (2011) – Part 4, Section 4.1.3. Water Management – Flood Risk Management	
Clause 3. Development must comply with Council's – Flood Management Policy which provides guidelines of controlling developments in different flood risk areas. It should be read in conjunction with the NSW Government's 'Floodplain Development Manual 2005'.	<ul style="list-style-type: none"> - The site falls within Bonnie Doon Catchment based on Bayside Council Floodplain Management. - There is no Flood Risk Management Plan specific to the site available from Council. - Council approved TUFLOW model (prepared by WMAwater, 2017) was used to investigate flood behaviour of the site. - The flood assessment was done in accordance with the NSW Government's 'Floodplain Development Manual 2005'.
Clause 4. The filling of land up to the 1:100 Average Recurrence Interval (ARI) flood level (or flood storage area if determined) is not permitted, unless specifically directed by Council in very special and limited locations. Filling of land above the 1 in 100 year ARI up to the Probable Maximum Flood (PMF) (or in flood fringe) is discouraged however it will be considered providing it does not adversely impact upon flood behaviour.	<ul style="list-style-type: none"> - The proposed development is outside the flood planning area based on the Rockdale LEP (2011) flood planning map. - The site is partly affected by shallow and low hazard overland flows during both 1%AEP and PMF events (refer Section 6.2). - The proposed development would have no material adverse impact on local flood behaviour (refer Section 6.4).
Clause 5. Development should not adversely increase the potential flood affectation on other development or properties, either individually or in combination with the cumulative impact of similar developments likely to occur within the same catchment.	<ul style="list-style-type: none"> - The proposed development is outside the flood planning area based on the Rockdale LEP (2011) flood planning map. - The site is partly affected by shallow and low hazard overland flows during both 1%AEP and PMF events (refer Section 6.2). - The proposed development would have no material adverse impact on local flood behaviour (refer Section 6.4).
Clause 6. The impact of flooding and flood liability is to be managed, to ensure the development does not divert the flood waters, nor interfere with flood water storage or the natural functions of waterways. It must not adversely impact upon flood behaviour.	<ul style="list-style-type: none"> - The proposed development is outside the flood planning area based on the Rockdale LEP (2011) flood planning map. - The site is almost located at upstream of the lower catchment (refer Section 3.0) and therefore, is only affected by a relatively small upstream catchment. - The proposed development would have no material adverse impact on local flood behaviour (refer Section 6.4).

Requirement	Compliance Assessment
Clause 7. A flood refuge may be required to provide an area for occupants to escape to for developments where occupants require a higher standard of care. Flood refuges may also be required where there is a large difference between the PMF and the 1 in 100 year flood level that may place occupants at severe risk if they remain within the building during large flood events.	<ul style="list-style-type: none"> - The site is partly affected by shallow and low hazard overland flows during both 1%AEP and PMF events (refer Section 6.2). - Difference between the PMF and 1%AEP flood levels are negligible (refer Figure 10 and Figure 13). - Flood refuge will be available on higher levels via internal stairs as well as proposed open areas onsite.
Bayside Council requirements - flood advice letter (Appendix A)	
Any new habitable floor level shall be designed a minimum 300mm above the ground level to avoid shallow surface water entering the building.	<ul style="list-style-type: none"> - All proposed habitable floor levels are to be 300mm above the existing ground level. - All openings and penetrations to the lower ground levels are to be protected up to 200mm above the top of Princes Highway kerb level to prevent street water flow entering to lower levels.
Any new low-level driveway to basement garage shall be designed a minimum 200mm above the top of road kerb level to prevent street water flow entering the driveway.	<ul style="list-style-type: none"> - All openings and penetrations to the lower ground levels are to be protected up to 200mm above the top of Princes Highway kerb level to prevent street water flow entering to lower levels. - The proposed vehicular access to Princess Highway must incorporate a crest of up to adjacent PMF level of 22.70m AHD to avoid floodwaters from Princess Highway to enter the underground basement.
SEARs (SSD 1142726) Section 15 - Flooding:	
Identify any flood risk on-site having regard to adopted studies for the development site, consideration of any relevant provisions of the NSW Floodplain Development Manual and the potential effects of climate change, sea level rise and an increase in rainfall intensity.	<ul style="list-style-type: none"> - Effect of climate change has been investigated in line with the NSW Floodplain Development Manual (refer Section 7.0).
Assess the impacts of the development, including any changes to flood risk on-site or off-site, and detail design solutions to mitigate flood risk where required.	<ul style="list-style-type: none"> - The site is partly affected by shallow and low hazard overland flows during both 1%AEP and PMF events (refer Section 6.2). - Flood refuge will be available on higher levels via internal stairs as well as proposed open areas onsite. - All proposed habitable floor levels are at or above the existing ground level plus 300mm.

Requirement	Compliance Assessment
	<ul style="list-style-type: none"> - All openings and penetrations to the lower ground levels are to be protected up to 200mm above the top of Princes Highway kerb level to prevent street water flow entering to lower levels. - The proposed vehicular access to Princess Highway must incorporate a crest of up to adjacent PMF level of 22.70m AHD to avoid floodwaters from Princess Highway to enter the underground basement.
Bayside Council – Response to Draft SEARs	
<p>Section 14 – Flooding:</p> <p>Provide evidence that there are no flooding impacts from the development on surrounding properties.</p>	<ul style="list-style-type: none"> - Refer Section 6.4 of this report.
Bayside Council – Response to Draft SEARs – Strategic Floodplain Engineering:	
Part of the development site is affected by PMF flooding with a flood depth in the PMF event of approximately 200mm.	<ul style="list-style-type: none"> - The site is almost flood free in both existing and proposed conditions during all events up to and including the PMF based on latest flood modelling completed by TTW for the site (see Section 5.0 & Section 6.0 of this report for details).
Basement driveways shall be designed with a crest in the driveway to prevent street runoff from entering the driveway access.	<ul style="list-style-type: none"> - The proposed basement driveway at south-western site boundary is to have a crest with minimum RL level of 26.3mAHD (1%AEP flood level). - The proposed basement driveway at north-western site boundary is to have a crest with minimum RL level of 18.3mAHD (1%AEP flood level).
A flood Risk Management Plan up to the PMF flood level is to be prepared for the proposed childcare centre.	<ul style="list-style-type: none"> - Flood Risk Management Plan up to the PMF level is prepared for the proposed childcare centre (See Section 8.0).

10.0 Conclusions and Recommendations

The proposed development is outside the flood planning area based on the Rockdale LEP (2011) flood planning map.

A detailed hydraulic model has been developed based on available Bayside Council TUFLOW flood model prepared by WMAwater (Bonnie Doon, Eve Street / Cahill Park Pipe & Overland 2D Flood Study 2017) to assess local flood characteristics for the site in the 1% AEP (with and without climate change) and PMF events under both existing and proposed conditions. Modelling concluded that:

1. The site is generally flood free during both 1%AEP and PMF events.
2. The site is partly affected by shallow, low hazard overland flows that overtop the Princes Highway reserve during both 1%AEP and PMF events.
3. Proposed flood characteristics are largely consistent with existing conditions, and differences due to the proposed development are negligible.
4. Overland flows from Princes Highway through the site would increase due to climate change effect, however, remain shallow and low hazard.
5. All proposed habitable floor levels are to be 300mm above the existing ground level.
6. All openings and penetrations to the lower ground levels are to be protected up to 200mm above the top of Princes Highway kerb level to prevent street water flow entering to lower levels.
7. Flood refuge will be available on higher levels via internal stairs as well as proposed open areas onsite.
8. The proposed basement driveway at south-western site boundary is to have a crest with minimum RL level of 26.3m AHD (1%AEP flood level).
9. The proposed basement driveway at north-western site boundary is to have a crest with minimum RL level of 18.3m AHD (1%AEP flood level).
10. The proposed vehicular access to Princess Highway must incorporate a crest up to the adjacent PMF level of 22.70m AHD to avoid floodwater from Princess Highway entering the underground basement.
11. The finished floor level (FFL) for the proposed childcare centre is to be at or above the PMF level of 26.8m AHD.
12. Compliance with the requirements of SEARs and Bayside Council for the proposed development are achieved.

Prepared by
TAYLOR THOMSON WHITTING (NSW) PTY LTD
in its capacity as trustee for the
TAYLOR THOMSON WHITTING NSW TRUST

Authorised By
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TAYLOR THOMSON WHITTING NSW TRUST

ALI ATTAR

Nemesio Biason Jr/Associate Director

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Appendix A - Bayside Council Flood Advice Letter

30 November 2020

Our Ref: FA-2020/256
Contact: Pulak Saha



Taylor Thomson Whitting (Nsw)
48 Chandos St, ST LEONARDS NSW 2065

Dear Taylor Thomson Whitting (Nsw)

Re: Flood Advice Letter for 161 Princes Highway, ARNCLIFFE

When lodging a Development Application you must enclose a copy of this letter.

**FLOOD
NOTATION**

Lot 1 DP 447649

Council has **not** notated this property as being affected by the 1% Annual Exceedance Probability (AEP) flood.

The 1% AEP flood means there is a 1% chance of a flood of this height, or higher occurring in any one year.

Council has notated this property as being affected by a Probable Maximum Flood (**PMF**) flood.

The PMF is the largest flood that could conceivably occur at a particular location. Generally, it is not physically or economically reasonable to provide complete protection against this event.

Lot 1 to 3 & 7 – 12 DP 23701 and Lot 1 to 3 DP 1094906

Council has **not** notated this property as being affected by the 1% Annual Exceedance Probability (AEP) flood and Probable Maximum Flood.

FLOOD STUDY

The Council Flood Study applicable to the property is:
Bonnie Doon, Eve Street, Cahill Park Pipe and Overland 2D Flood Study by WMA Water, 2017

FLOOD DEPTH

1% AEP Flood Depth:
120mm (shallow overland flow)
Probable Maximum Flood (PMF) Depth: (refer to figure 1)
200mm

**FLOOD RISK
EXPOSURE**

The Flood Risk Exposure of the site has been assessed as

Low Hazard: Land partly below the probable maximum flood.

**FLOOD
COMMENTARY**

No accurate information is recorded regarding the impact of tsunamis in the Bayside Local Government area.

Eastgardens Customer Service Centre
Westfield Eastgardens
152 Bunnerong Road
Eastgardens NSW 2036, Australia
ABN 80 690 785 443 Branch 004

Rockdale Customer Service Centre
444-446 Princes Highway
Rockdale NSW 2216, Australia
ABN 80 690 785 443 Branch 003
DX 25308 Rockdale

Phone 1300 581 299
T (02) 9562 1666 F 9562 1777
E council@bayside.nsw.gov.au
W www.bayside.nsw.gov.au

Postal address: PO Box 21, Rockdale NSW 2216



Telephone Interpreter Services - 131 450

Τηλεφωνικές Υπηρεσίες Διερμηνέων

خدمة الترجمة الهاتفية

電話傳譯服務處

Служба за преведување по телефон

**FLOOD
RELATED
DEVELOPMENT
CONTROLS**

Nil.

While no flood control is applicable to this site, it is advised that any new habitable floor level shall be designed a minimum 300mm above the ground level to avoid shallow surface water entering the building.

It is also advised that any new low level driveway to basement garage shall be designed a minimum 200mm above the top of road kerb level to prevent street water flow entering the driveway.



Figure 1: Probable Maximum Flood Extent

Council considers that this is the best information currently available on flooding in the area, but Council cannot comment on the accuracy of the result.

Should you require any further information, please contact Council's Strategic Floodplain Engineer, Pulak Saha on 02 95621617

Yours faithfully

Gill Dawson
/COORDINATOR POLICY & STRATEGY