NY CIVIL ENGINEERING

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No.42 Bix Road, Dee Why

Our Ref: E220534

FLOOD STUDY REPORT

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ISSUE A – For DA Submission

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GLOSSARY

Annual Exceedance Probability (AEP)
The chance of a flood of a given or a larger size occurring in any one year, usually expressed as a percentage.

Australian Height Datum (AHD)
A common national surface level datum approximately corresponding to mean sea level.

Average Recurrence Interval (ARI)
The long-term average number of years between the occurrence of a flood as big as or larger than the selected event.

Catchment
The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.

Flood
Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse.

Flood Liable Land or Flood Prone Land
Land susceptible to flooding by the PMF.

Flood Planning Levels (FPLs)
Are the combinations of flood levels and freeboards selected for floodplain risk management purposes.

Freeboard
Is a factor of safety typically used in relation to the setting of floor levels.

Habitable Room
In industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to damage in the event of a flood.

Peak Discharge
The maximum discharge occurring during a flood event.

Probable Maximum Flood
PMF is the largest flood that could conceivably occur at a location, usually estimated from probable maximum precipitation.

Probable Maximum Precipitation
PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year.

Runoff
The amount of rainfall which actually ends up as stream flow.

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1 INTRODUCTION

1.1 Brief

In accordance with Northern Beaches City Council Policy, NY Civil Engineering has been engaged to prepare a Flood Study Report to accompany the Development Application submitted for No. 42 Bix Road, Dee Why. The following documents pertaining to the proposed development and applicable Council requirements:

- Architectural Plans by Peter Zavaglia design studio
- NSW Government Floodplain Development Manual – The management of Flood Liable Land (2005)
- Engineers Australia, Australian Rainfall & Runoff (AR&R 1999) and (AR&R 2016 and Revision Projects)

This report is intended solely for the client of NY Civil Engineering and no liability will be accepted for use of the information contained in this report by other parties than this client. This report is limited to visual observations and to the information including the referenced documents made available at the time when this report was written.

1.2 Scope

The scope of this study covers:

a) Hydrology calculation to establish the peak flow rate during all storm events including up to 1 in 100-year ARI event;
b) Hydraulic calculation establishing the respective flood levels within the property, and adjoining properties;
c) Pre-development flood behaviour, including the flood inundation line marked on 2d result mapping;
d) Loss of flood storage within the subject lot due to the proposed development;
e) Post-development flood behaviour, including the flow path construction details and the flood inundation line, marked on 2d result mapping;
f) The flood impact on adjoining properties (upstream and downstream) in the locality;
g) Design measures including maintaining an unobstructed flow path, raising the building with appropriate freeboard and flood proofing the walls that form part of the flow path;

The report has been prepared in accordance with Northern Beaches City Council Guidelines. Its contents include, but are not limited to:

i. 1 in 100 years ARI flood level;
ii. Catchment plan;
iii. 2d Difference mapping of the overland flow path; and
iv. Hydrological analysis of the catchment, showing all existing drainage infrastructure and flow regime.

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2. SITE INFORMATION

42 Bix Road, Dee Why is located 150m South west of Stoddart Reserve and approx. 450m North east of Alamein Reserve. The overall grade of the site is falling from the South boundary (side boundary) towards the North boundary (side boundary). The general nature of the surrounding development is primarily residential. See Figure 1.

Figure 1: Subject Site – 42 Bix Road, Dee Why

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3. PROPOSED DEVELOPMENT

The proposed development is the alterations and additions to an existing single dwelling and the construction of an inground pool and carport. The site plan is shown in the figure below (refer to Architectural plan by Peter Zavaglia.)

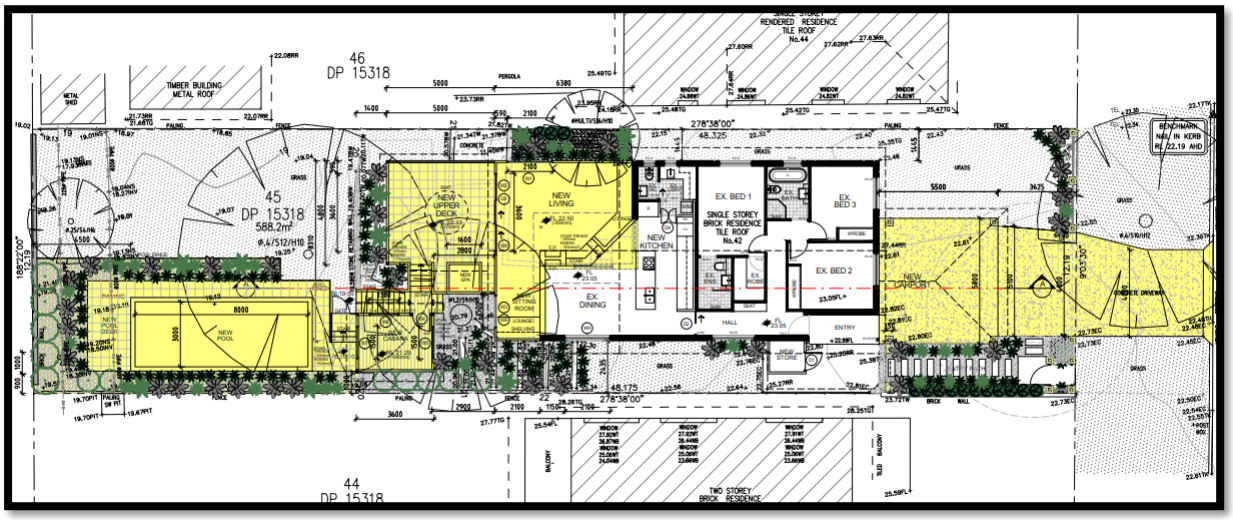

Figure 2: Site Plan

4. FLOOD STUDY

4.1 Methodology

Northern Beaches City Council have identified that the proposed development site is subject to flood related development controls due to overland flooding. To assess the potential impact of the proposed development the following methodology has been adopted to undertake the flood study, which is based on Northern Beaches City Council's requirements on modelling drainage systems for flooding and reporting.

- Use topographic map to establish contributing catchment extents;
- Use current satellite imagery to establish percentage impervious/pervious surface;
- Obtain existing drainage catchment information from Council Online Maps for assessing the contributing catchment;
- Utilise ILSAX program to construct network model of existing overland flow paths;
- Run the DRAINS network model and establish overland flow for the 1:100yr ARI storm event across the site;
- Input determined flow into the HEC-RAS model and determine relevant TWL for the 1:100yr ARI storm event;
- Utilise determined TWL to set relevant floor levels

4.2 Catchment Analysis

There are 2 sub catchments which contribute to the overland through the subject site. Each Catchment has been modelled in DRAINS to attain the overland flows. It should be noted that the total overland flow from the sub catchments are reflected in the HEC-RAS model as inflow 1 and 2.

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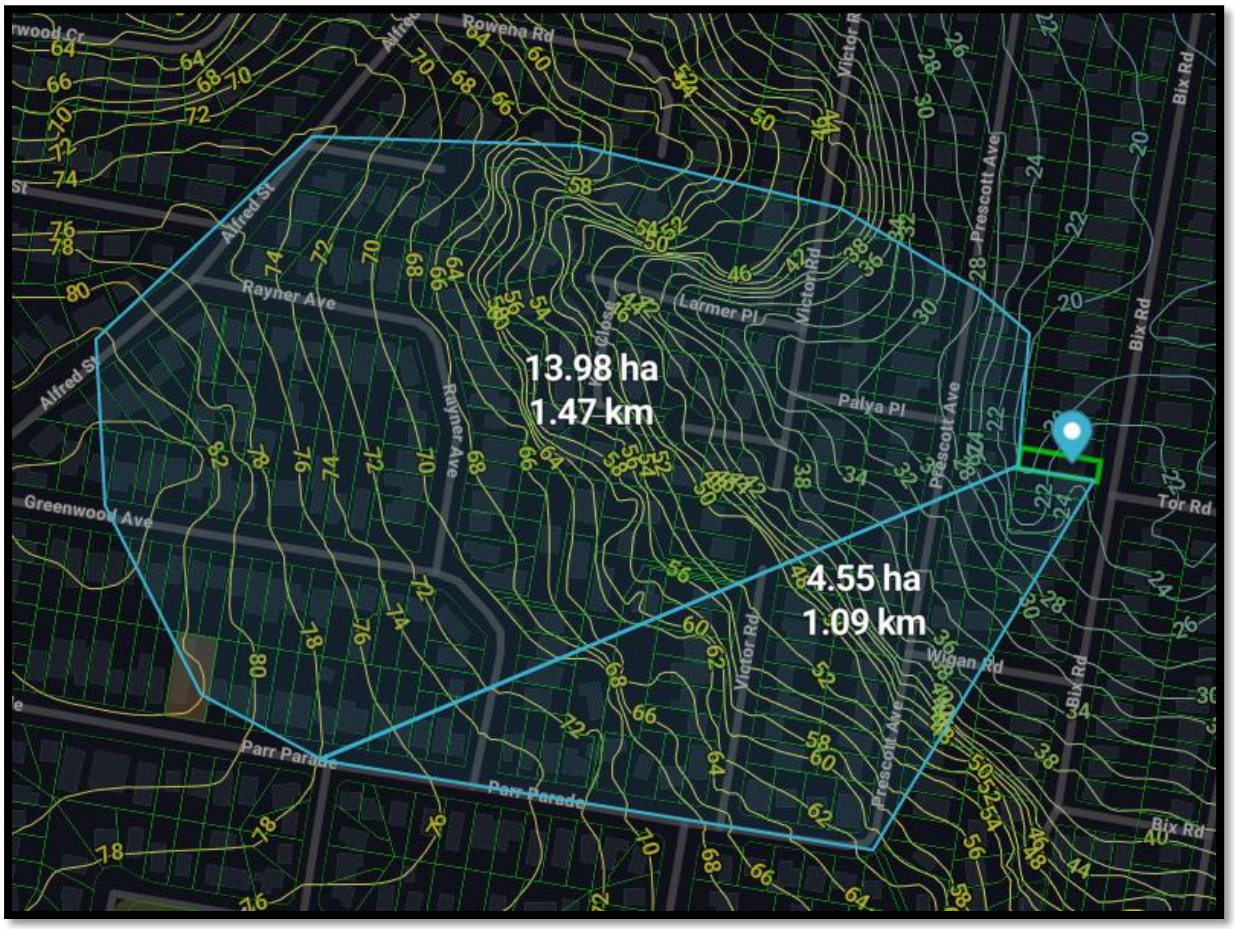

Figure 3: Upstream Catchment Plan

Catchment	Total Area (Ha)	Impervious Area (%)	Pervious Area (%)	Avg Tc (min)	Pipe size (mm)
Cat 1	13.98	70	30	10	900
Cat 2	4.55	70	30	11	375

Table 1: Catchment Table

4.3 Modelling Assumptions

The modelling assumptions can be distinguished in to two (2) key components being hydrological and hydraulic. The hydrological component addresses assumptions related to the generation of the stormflow runoff, whilst the hydraulic component addresses assumptions related to how the determined flow acts within the pit & pipe network or channel/street.

A lumped DRAINS model has been set up with upstream catchment area calculated above. Underground pits and pipe data have been extracted from council's flood enquiry application. Existing stormwater pipes have been modelled in accordance with Northern Beaches City Council requirements.

Following further assumptions were then made in order to run DRAINS hydrological model and HEC RAS hydraulic model in align with various Council policies and Stormwater Code, NSW floodplain development manual and best practice guidelines on flood modelling.

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4.3.1 Hydrological

The hydrological assumptions for the model have been based on the Australian Rainfall and Runoff file supplied by ARR Data Hub for the rainfall intensities. Times of concentration for each sub catchment have been calculated using rational method by utilising the slope, length and Mannings 'n' for each sub catchment.

4.3.2 Hydraulic

The hydraulic assumptions for both the DRAINS model and HEC-RAS model are as follows and based on a combination of Council nominated values and engineering judgement.

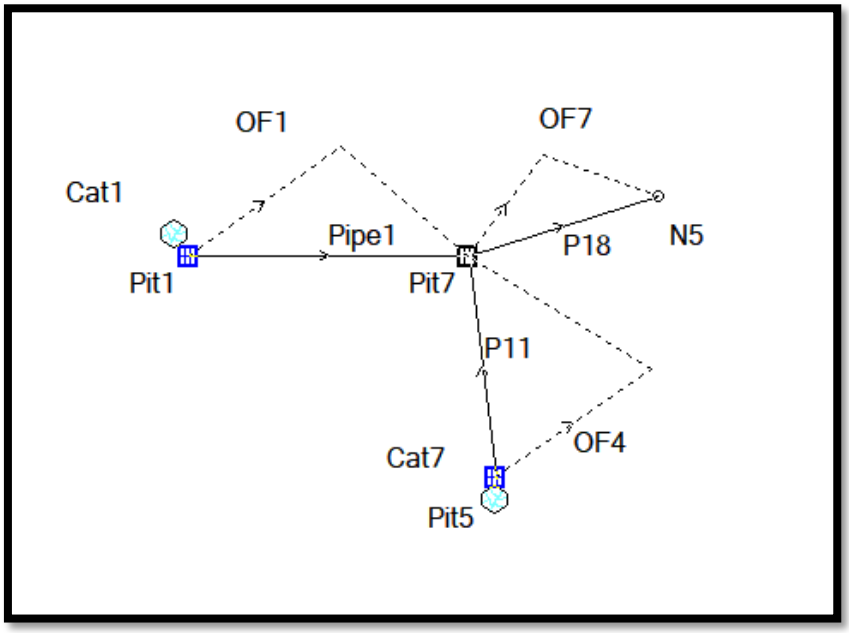

Figure 4: Drains Model Layout

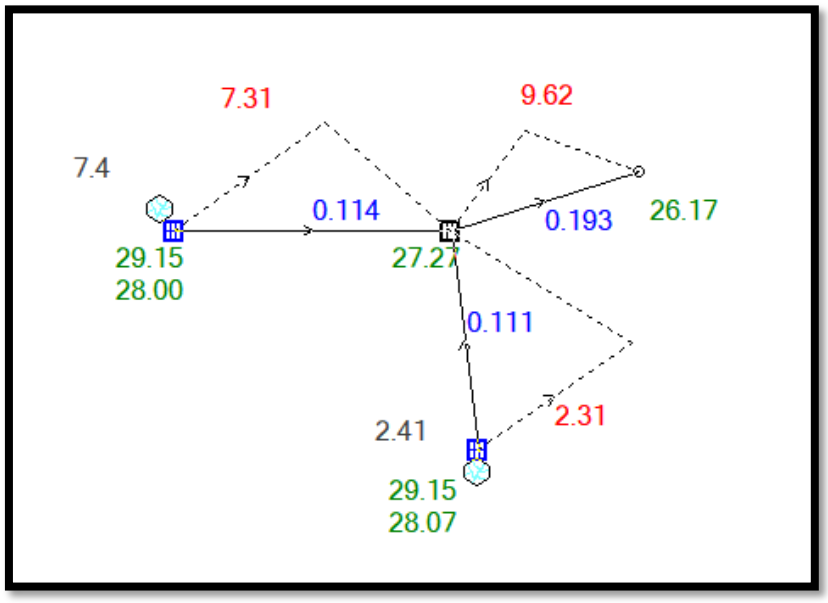

Figure 5: Drains Model Results

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The total overland flow from upstream catchments extracted from DRAINS overland Hydrographs:

$Q_{\text{Overland Flow 1}} = 7.31 m^3/s$
$Q_{\text{Overland Flow 2}} = 2.31 m^3/s$

4.3.2.1 HEC-RAS Model

Following modelling inputs/assumptions were made during HEC-RAS modelling:

- No obstructions are present within the Road reserve i.e. cars, trees etc.
- Proposed development will be modelled as a blockage.
- Only a handful of upstream and downstream properties to be modelled as blockages
- Outflow Boundary Conditions: Critical Depth
- Inflow Boundary 1 Condition: Hydrograph $Q_{\text{Overland Flow 1}} = 7.31\ m^3/s$
- Inflow Boundary 2 Condition: Hydrograph $Q_{\text{Overland Flow 2}} = 2.31\ m^3/s$
- Average Mannings 'n' value of taken as 0.06

4.4 Rainfall Data

The rainfall data have been obtained from Intensity-Frequency-Duration table from Bureau of Meteorology 2016. Rainfall data for 1.00% AEP from 5 mins to 3 hours have been adopted for DRAINS modelling.

5. FLOOD MODEL

5.1 Model Establishment

The HEC-RAS model was established in order to determine the theoretical 100-year ARI water levels for the new development at 42 Bix Road, Dee Why. A comparison between the pre and post-development modelling determines the impact that the proposed development may have on the flow rate, depth and velocity of the overland flow regime. The results of the HEC-RAS modelling will help in adopting the Flood Planning Level based on the 1% AEP Flood level and allow us to determine the flood hazard in order to ensure safety to the inhabitants and the integrity of the developed structure.

It should be noted that the two-dimensional HEC-RAS model developed by NY Civil Engineering and the results may have a slight variance in comparison to any present & future flood levels documented by Northern Beaches Council. These differences may be the result of different assumptions of Manning's 'n' values, the accuracy of the digital terrain model (DTM) and a number of other factors. However, identical models have been used to assess the pre-development and post-development scenarios, with the only difference being the building footprint, in order to gauge the impact of the proposed development to adjoining properties. The proposed building has been modelled as an entire blockage without being raised on piers.

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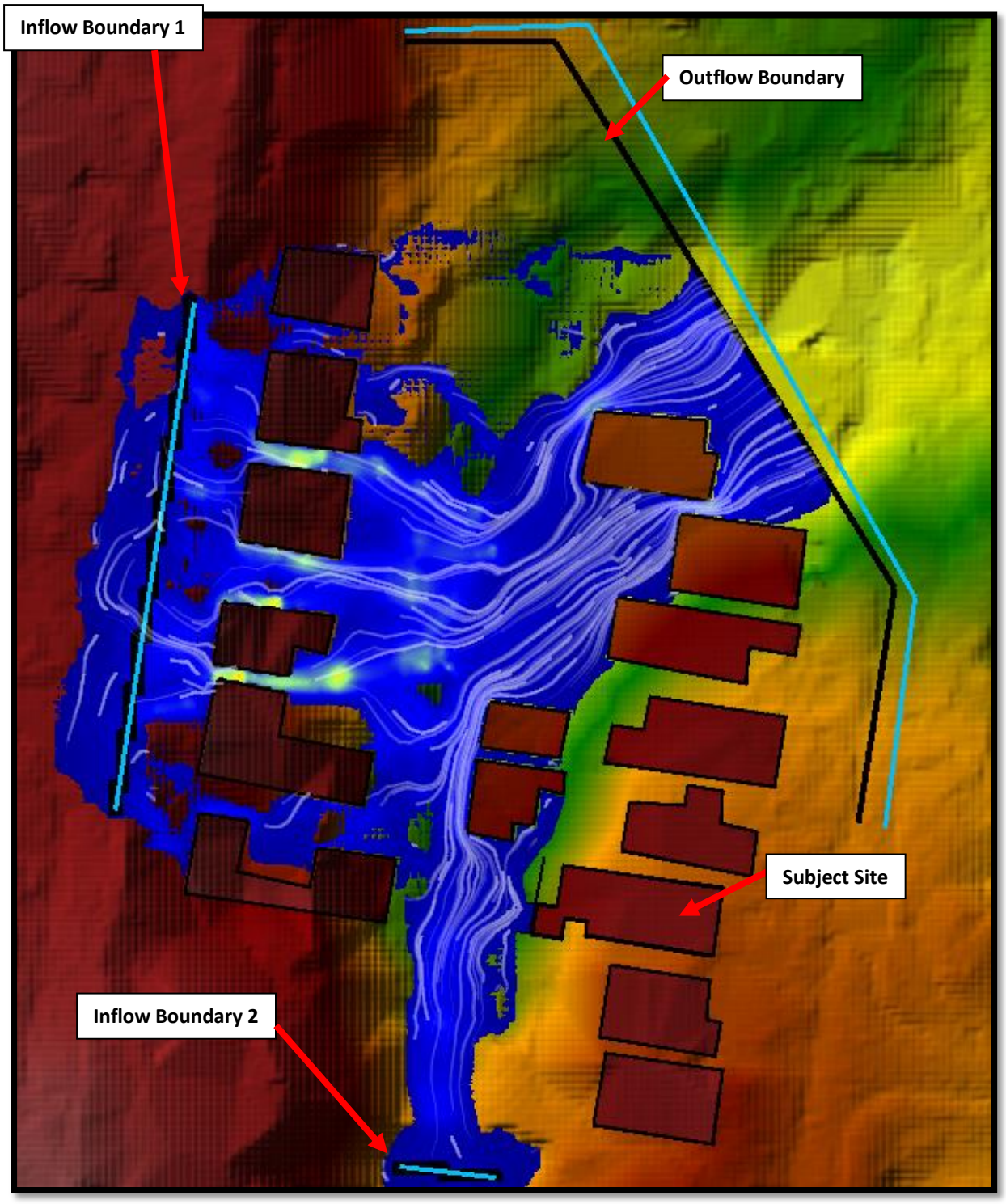

Figure 6a: Hec-Ras 2d Model Boundary Conditions

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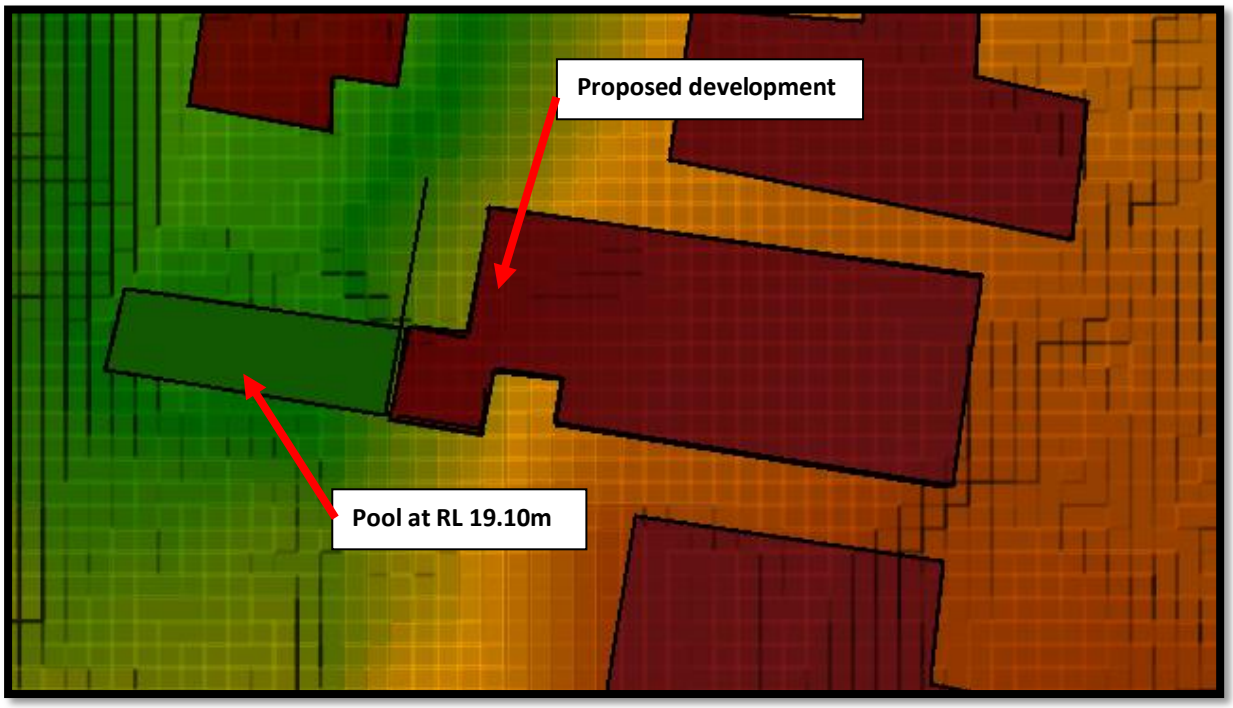

Figure 6b: Hec-Ras 2d Model Proposed Development

5.2 Modelling Outputs

The peak overland flow in 1:100yr ARI storm event has been determined by establishing a DRAINS model and has been calculated as 2.31 -7.31m3/s towards 42 Bix Road, Dee Why. Flooding is found to be critical for 20min burst duration.

Modelling Outputs for the HEC-RAS model are located in figures 7-14. These outputs include the following:

- HEC-RAS pre and post development flooding scenarios for Depth, Velocity, Depth x Velocity Product WSE and Difference Mapping.

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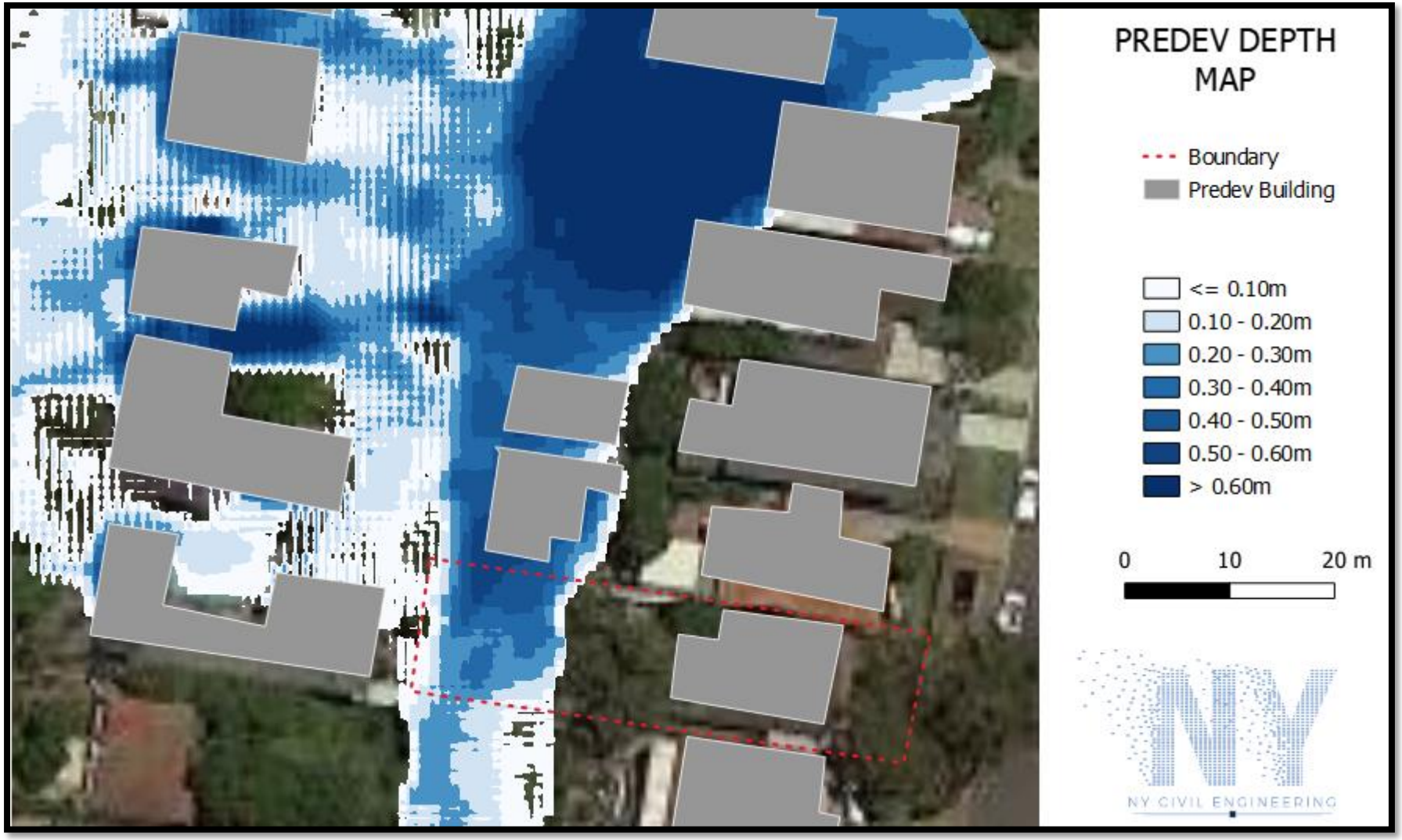

Figure 7: Pre-Developed Depth Map

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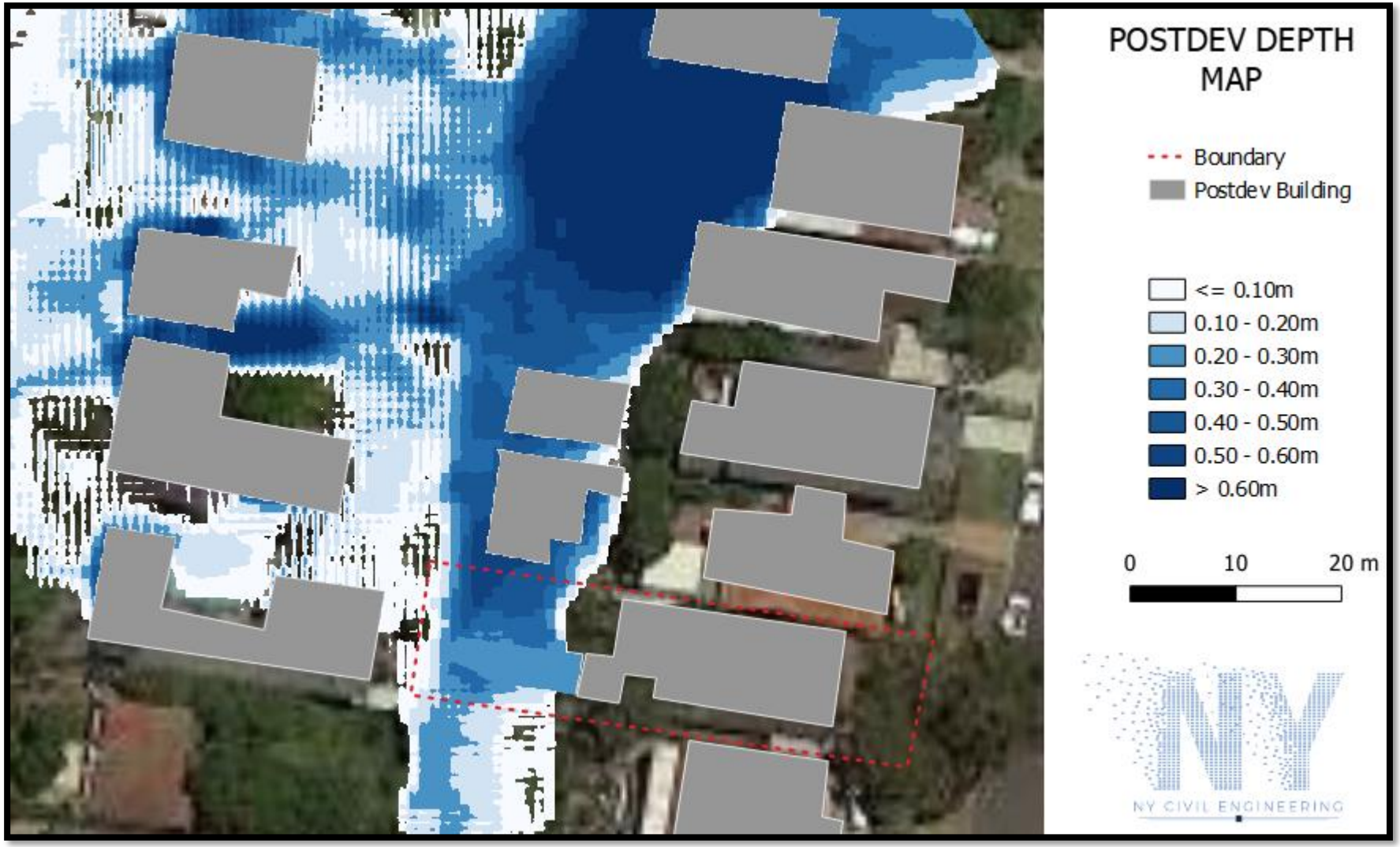

Figure 8: Post-Developed Depth Map

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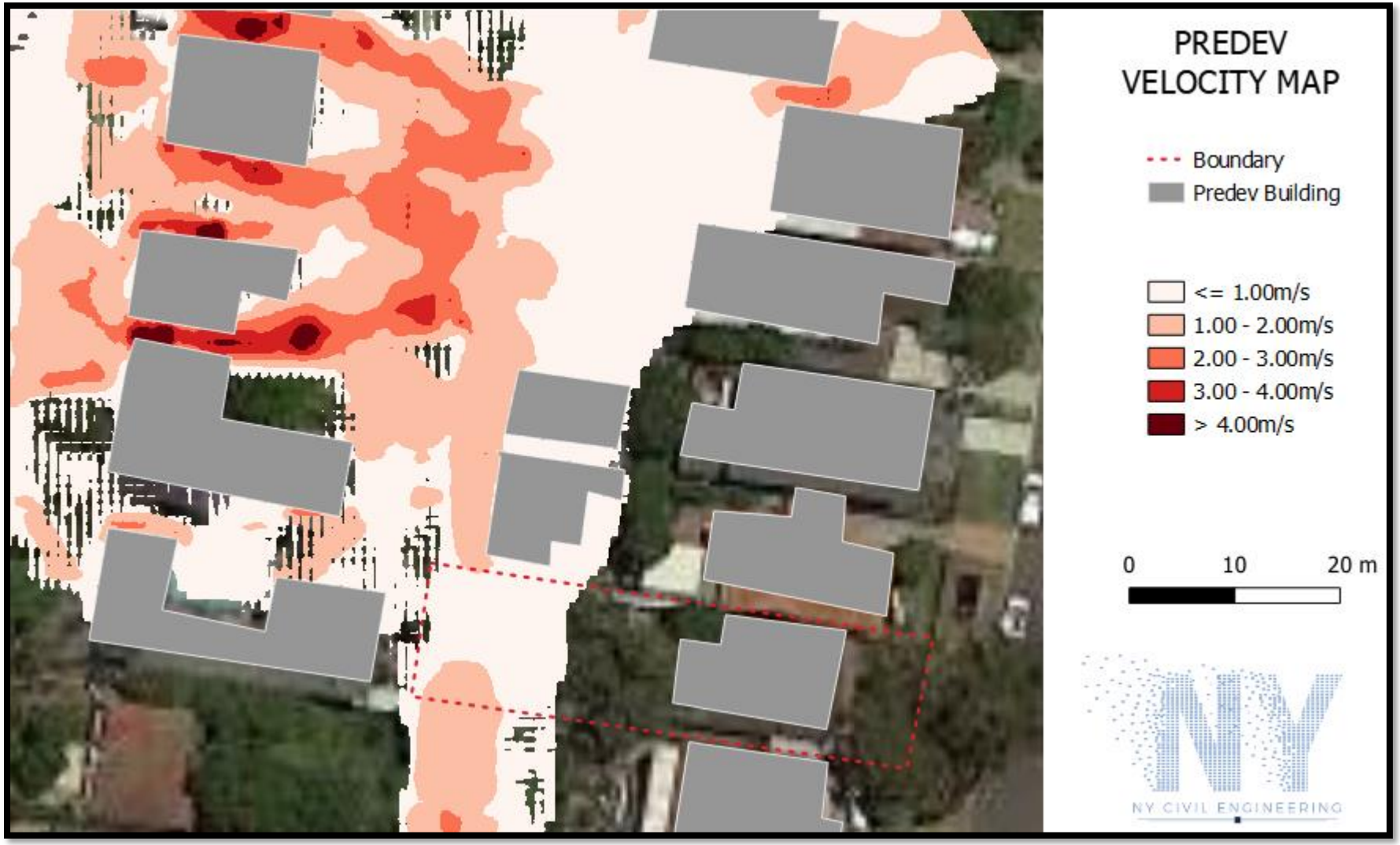

Figure 9: Pre-Developed Velocity Map

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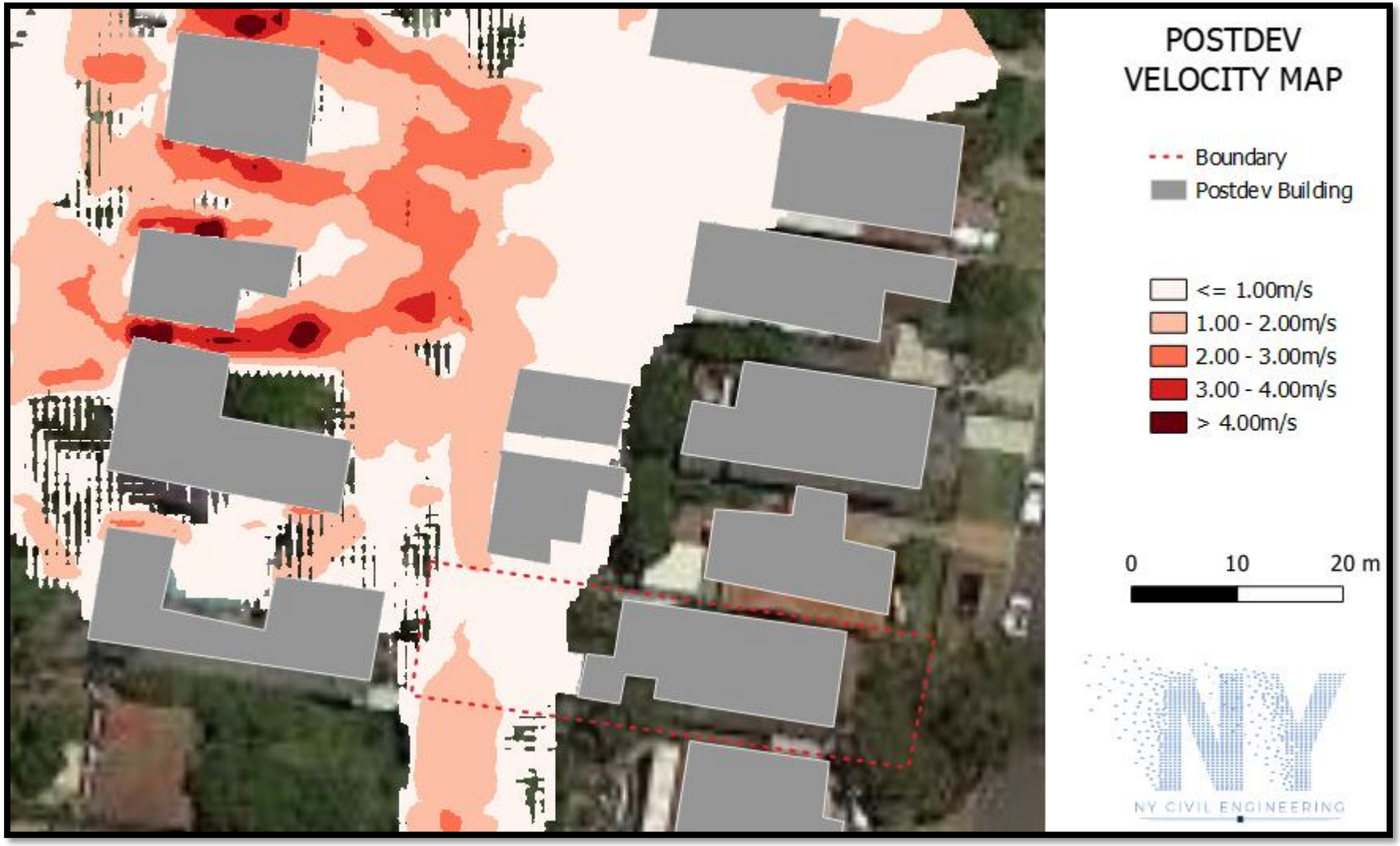

Figure 10: Post-Developed Velocity Map

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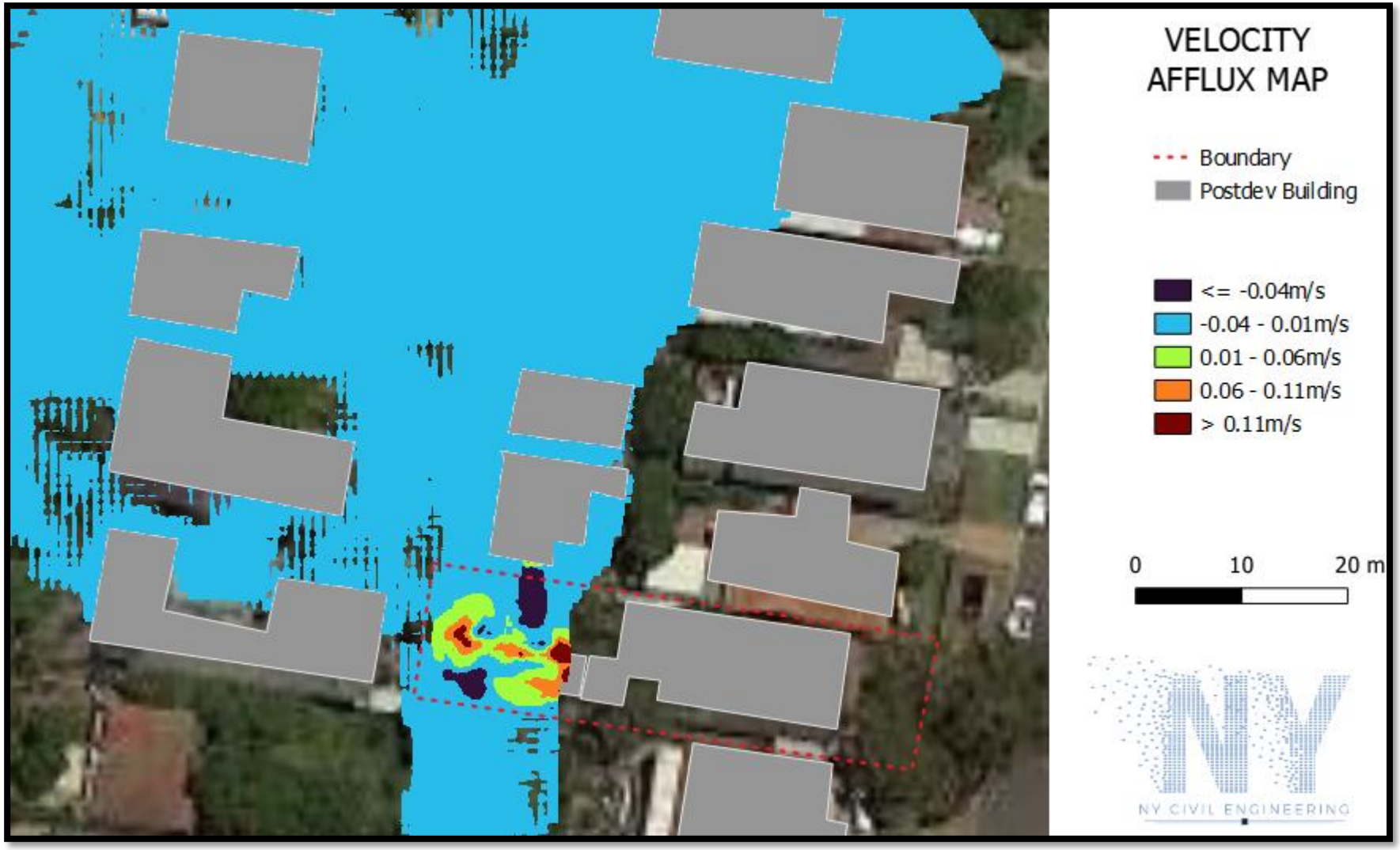

Figure 11: Pre-Post-Difference Velocity Map

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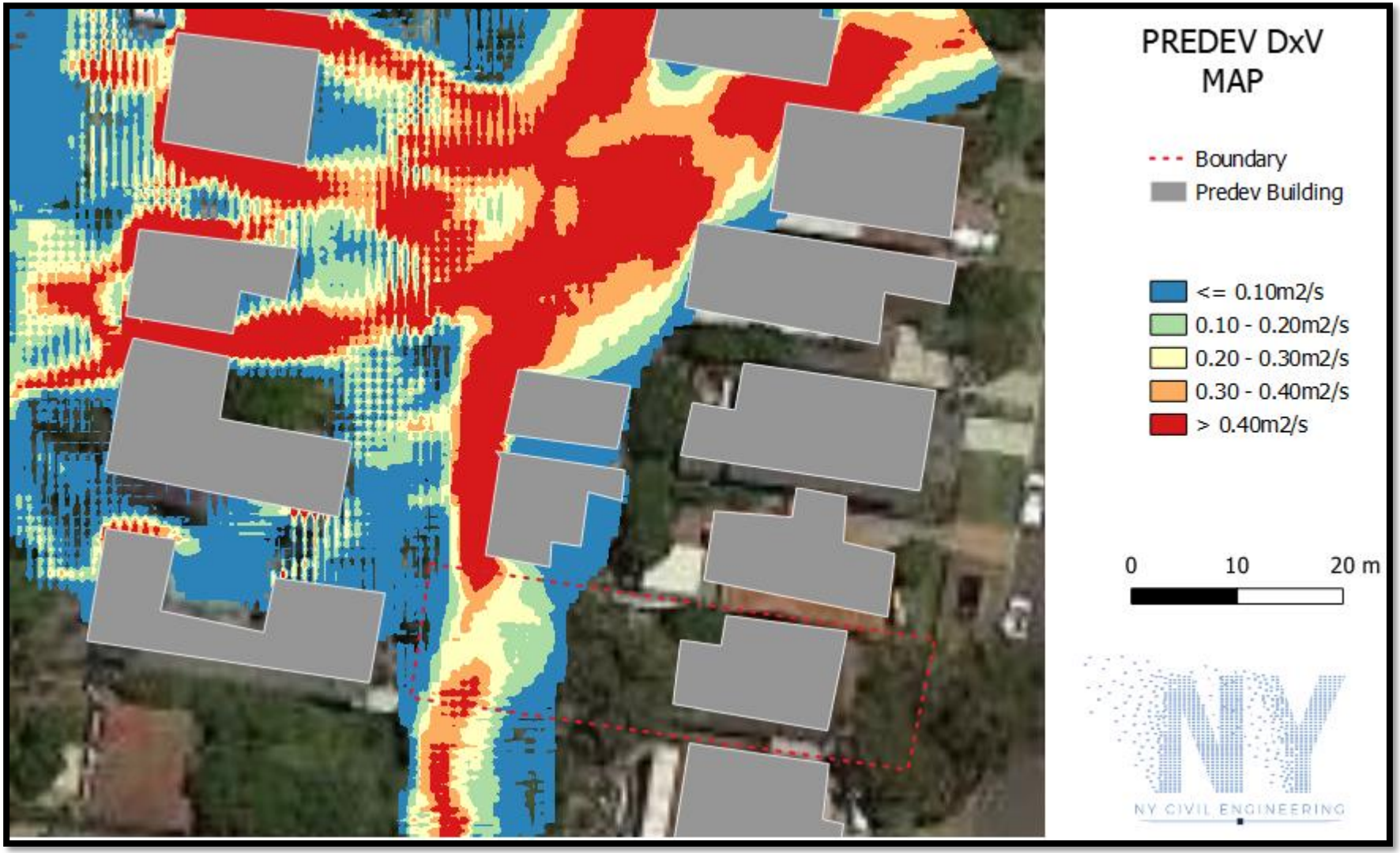

Figure 12: Pre-Developed Velocity x Depth Product Map

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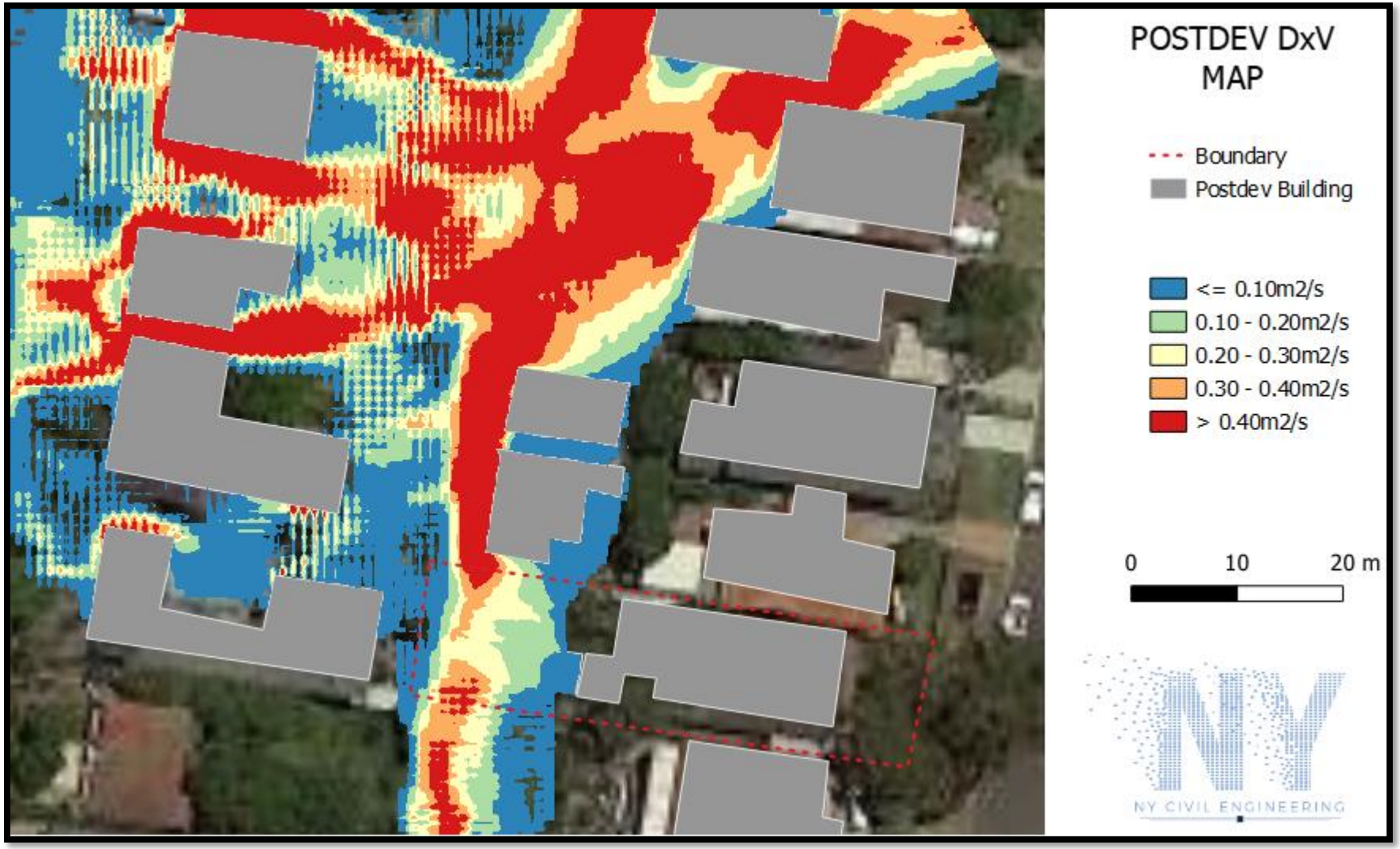

Figure 13: Post-Developed Velocity x Depth Product Map

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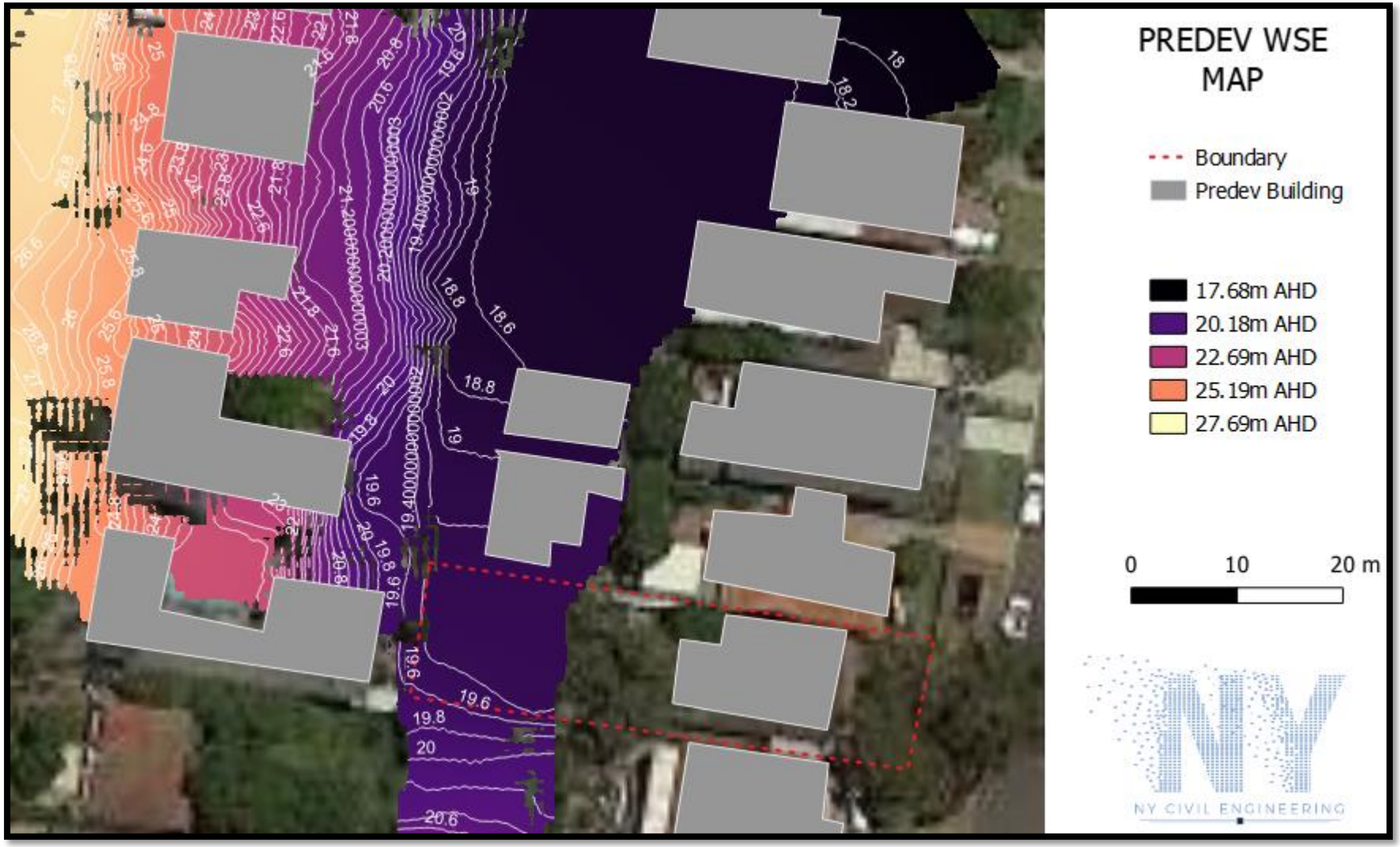

Figure 14: Pre-Developed WSE Map

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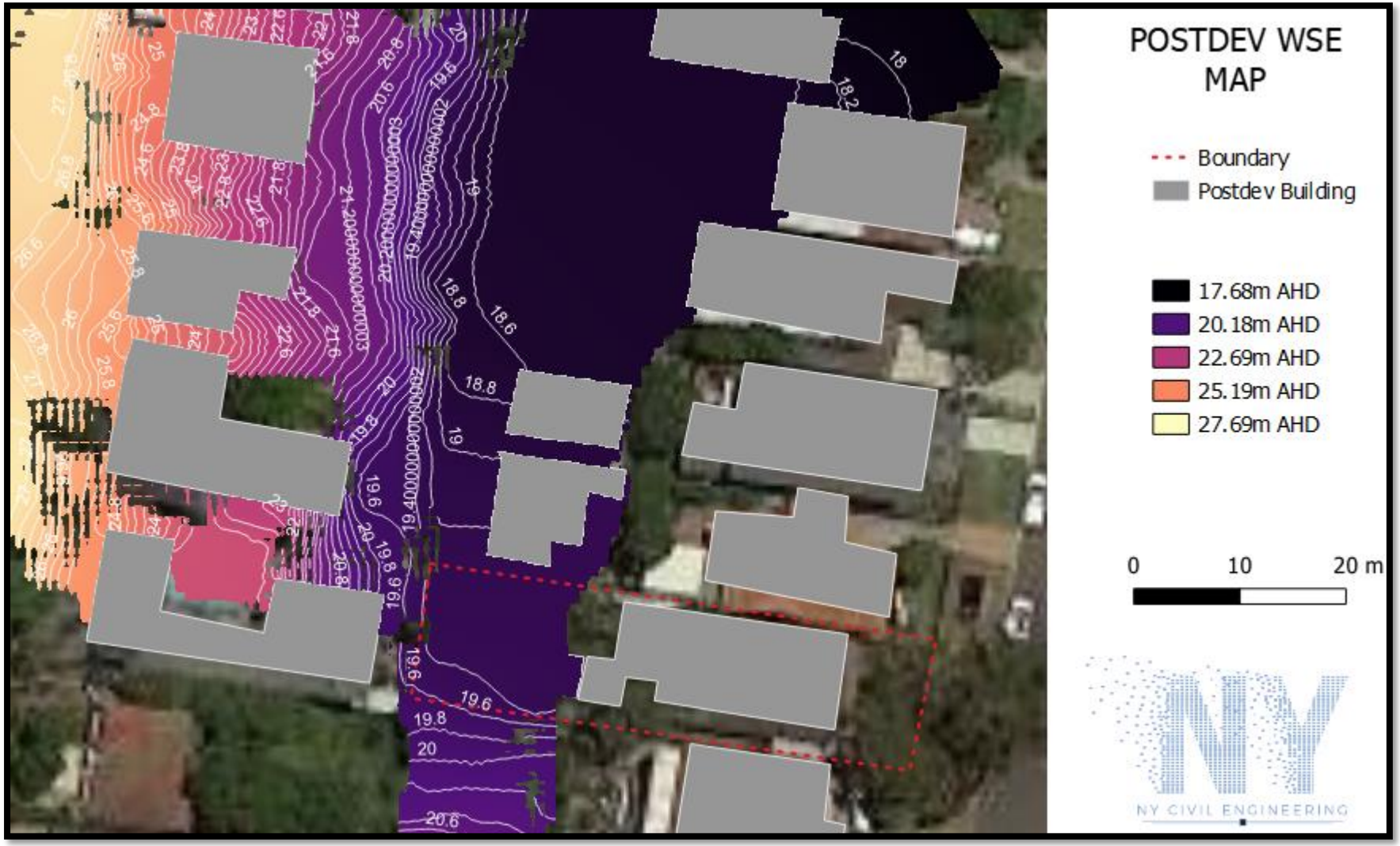

Figure 15: Post-Developed WSE

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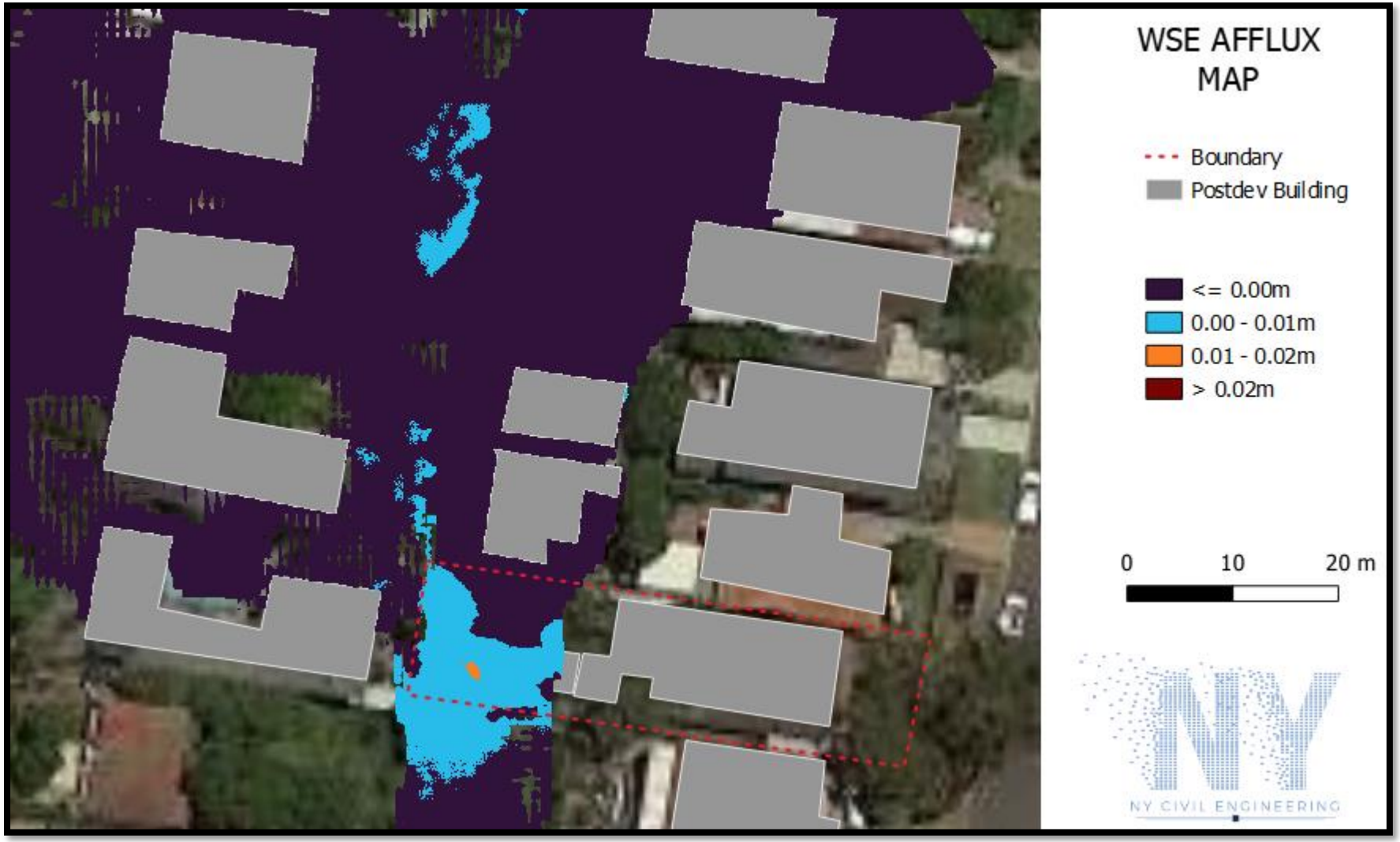

Figure 16: Pre-Post-Difference WSE Map

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6. DISCUSSION

As previously mentioned, the HEC-RAS model developed by NY Civil Engineering and the results may have a slight variance in comparison the flood levels documented by Northern Beaches Council. These differences may be the result of different assumptions of Manning's 'n' values, the accuracy of the digital terrain model (DTM) and a number of other factors. However, identical models have been used to assess the pre-development and post-development scenarios, with the only difference being the building footprint, in order to gauge the impact of the proposed development to adjoining properties.

The objective of this report is to determine the overland flow characteristics and review the impact that the proposed development will have on the existing drainage infrastructure and surrounding properties and address council flood control requirements.

Figures 11 and 16 show difference between the pre and post-developed scenarios for Velocity and WSE. Standard engineering practice requires that the change in Top Water Level (TWL) from pre-development to post-development does not increase by more than 10mm and the '*velocity x depth*' product does not exceed 0.4m^2/s for safety reasons.

Figure 16 shows that the maximum increase in water level due to the proposed dwelling is approximately 10-20mm which is concentrated in the centre of the proposed pool. footprint of the development is mainly within the existing footprint with the exception of the garage and entry

Figure 17 is taken from the NSW Floodplain development manual and indicates flood hazard based on depth and velocity values.

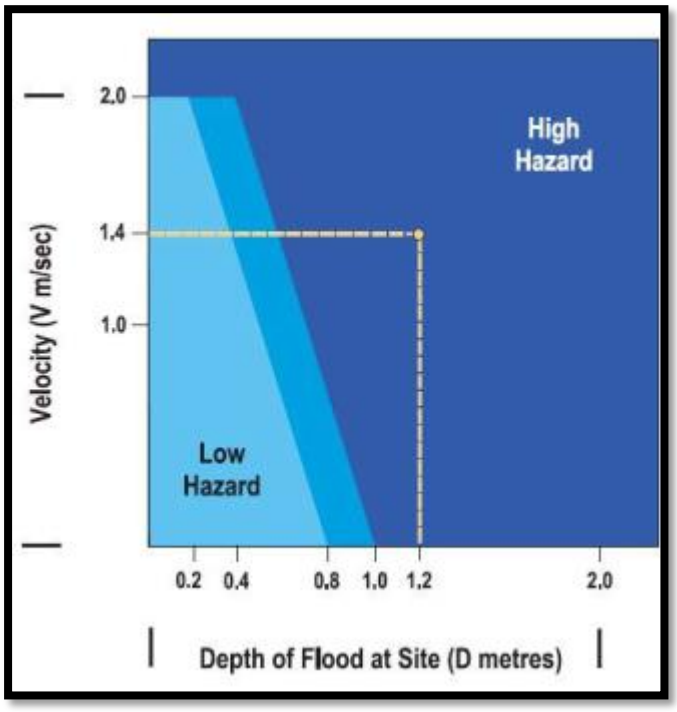

Figure 17: Hazard Definition Table

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Flood Risk Precinct (definitions):
High Flood Risk: This is area within the 100-year ARI flood extents subject to high hydraulic hazard (in accordance with the criteria set out in Figure 17). This may also be considered to be area within the 20-year ARI flood extents subject to more frequent risk of inundation in lower storm events.
Medium Flood Risk: This is area within the 100-year ARI flood extents that is not subject to high hydraulic hazard.
Low Flood Risk: This is area beyond the 100-year ARI flood extents however within the PMF flood extents.

High Hazard: Possible danger to personal safety; evacuation by trucks difficult; able-bodied adults would have difficulty in wading to safety; potential for significant structural damage to buildings.
Low Hazard: Should it be necessary; truck could evacuate people and their possession; able-bodied adults would have very little difficulty wading to safety.

Figures 12 & 13 represent the VxD product for both pre and post-developed scenarios. The only area above 0.4 (considered dangerous) is concentrated at the southern and northern boundary.

NY Civil Engineering flood mapping has identified flood extents and depths with excerpts shown in figures 7-8. High flood risk areas occur within the areas defined as over 1m in flood depth, in excess of 2m/s flow velocity, or as determined by the diagrammatic relationship between velocity and depth as depicted in Figure 13. It can be seen from figure 13 that flows traversing through the site defines the site as Medium-High Risk/Hazard**.**

It is thus deemed that the proposed development has negligible effect on the upstream and downstream flood regime.

7. DCP COMPLIANCE

The proposed single dwelling has triggered the flood controls for residential development under Northern Beaches Council DCP E11 Flood Prone Land. As such, NY Civil Engineering have undertaken an assessment of the proposed development's compliance with these requirements under 'Medium' and 'High' Risk categories;

Flood effects caused by Development;

A1. Development shall not be approved unless it can be demonstrated in a Flood Management Report that it has been designed and can be constructed so that in all events up to the 1% AEP event:

(a) There are no adverse impacts on flood levels or velocities caused by alterations to the flood conveyance; and

(b) There are no adverse impacts on surrounding properties; and

(c) It is sited to minimise exposure to flood hazard.

Major developments and developments likely to have a significant impact on the PMF flood regime will need to demonstrate that there are no adverse impacts in the Probable Maximum Flood.

An assessment of the proposal's compliance with the requirements of Council's Flood Prone Land Design Standard has been undertaken in this report.

A2. Development shall not be approved unless it can be demonstrated in a Flood Management Report that in all events up to the 1% AEP event there is no net loss of flood storage. Consideration may be given for exempting the volume of standard piers from flood storage calculations. If Compensatory Works are proposed to balance the loss of flood storage from the development, the Flood Management Report shall include detailed calculations to demonstrate how this is achieved

As mentioned in this report, the proposed development is largely located within the existing footprint with the exception of the garage and entry. The 2d HEC-RAS model mentioned in this report has demonstrated that the difference in water surface elevations is mainly located within the property boundary. See figure 16.

Building Components & Structural;

B1. All buildings shall be designed and constructed as flood compatible buildings in accordance with Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas, Hawkesbury-Nepean Floodplain Management Steering Committee (2006).

Flood compatible material has been noted in Appendix A

B2. All new development must be designed and constructed to ensure structural integrity up to the Flood Planning Level, taking into account the forces of floodwater, wave action, flowing water with debris, buoyancy and immersion. Where shelter-in-place refuge is required, the structural integrity for the refuge is to be up to the Probable Maximum Flood level. Structural certification shall be provided confirming the above.

A suitably qualified structural engineer to certify at Construction Certificate stage that the structural integrity of the proposed development is maintained to the flood planning level of 20.10m AHD.

B3. All new electrical equipment, power points, wiring, fuel lines, sewerage systems or any other service pipes and connections must be waterproofed and/or located above the Flood Planning Level. All existing electrical equipment and power points located below the Flood Planning Level must have residual current devices installed that turn off all electricity supply to the property when flood waters are detected.

Pool equipment to be waterproofed.

Floor Levels;

C1. New floor levels within the development shall be at or above the Flood Planning Level

Achieved – Minimum FFL to be 20.10m AHD.

C2. All floor levels within the development shall be at or above the Probable Maximum Flood level or Flood Planning Level, whichever is higher.

Achieved – Minimum FFL to be 20.10m AHD.

C3. All new development must be designed and constructed so as not to impede the floodway or flood conveyance on the site, as well as ensuring no net loss of flood storage in all events up to the 1% AEP event.

For suspended pier/pile footings:

- ***a) The underfloor area of the dwelling below the 1% AEP flood level is to be designed and constructed to allow clear passage of floodwaters, taking into account the potential for small openings to block; and***
- ***b) At least 50% of the perimeter of the underfloor area is of an open design from the natural ground level up to the 1% AEP flood level; and***
- ***c) No solid areas of the perimeter of the underfloor area would be permitted in a floodway***

The proposed development has been modelled as a blockage in order to closely resemble the existing conditions. The pool RL has been set at 19.10m AHD to mitigate any adverse impacts.

C4. A one-off addition or alteration below the Flood Planning Level of less than 30 square metres (in total, including walls) may be considered only where:

(a) it is an extension to an existing room; and

(b) the Flood Planning Level is incompatible with the floor levels of the existing room; and

(c) out of the 30 square metres, not more than 10 square metres is below the 1% AEP flood level.

This control will not be permitted if this provision has previously been utilised since the making of this Plan.

The structure must be floodproofed to the Flood Planning Level, and the Flood Management Report must demonstrate that there is no net loss of flood storage in all events up to the 1% AEP event.

N/A – Existing FFL's are above the flood planning level of 20.10m AHD.

C5. The applicant must demonstrate that future development following a subdivision proposal can be undertaken in accordance with this Development Control Plan.

N/A – No subdivision proposed.

C6. Consideration may be given to the retention of an existing floor level below the Flood Planning Level when undertaking a first-floor addition provided that:

- ***a) it is not located within a floodway; and***
- ***b) the original foundations are sufficient to support the proposed final structure above them. The Flood Management Report must include photos and the structural certification required as per Control B2 must consider whether the existing foundations are adequate or should be replaced; and***
- ***c) none of the structural supports/framing of existing external walls of are to be removed unless the building is to be extended in that location; and***
- ***d) the ground floor is floodproofed.***

N/A – Existing FFL's are above the flood planning level of 20.10m AHD.

C7. Consideration may be given to a floor level below the Flood Planning Level within the first 5 metres from the street front in an existing business zone provided it can be demonstrated that:

- ***a) The minimum floor level is no lower than the adjacent footpath level, and***
- ***b) The maximum internal distance from the front of the building is 5 metres, which can only apply to one side of an individual premises, and***
- ***c) The maximum area for the floor area to be below the Flood Planning Level for an individual premises is 30 square metres, and***
- ***d) There is direct internal access between areas above and below the Flood Planning Level for each individual premises***

N/A – the proposal is residential.

Car Parking;

D1. Open carpark areas and carports shall not be located within a floodway.

N/A - No open carparking is proposed.

D2. The lowest floor level of open carparks and carports shall be constructed no lower than the natural ground levels, unless it can be shown that the carpark or carport is free draining with a grade greater than 1% and that flood depths are not increased.

N/A - No open carparking is proposed.

D3. Carports must be of open design, with at least 2 sides completely open such that flow is not obstructed up to the 1% AEP flood level. Otherwise, it will be considered to be enclosed. When undertaking a like-for-like replacement and the existing garage/carport is located on the street boundary and ramping is infeasible, consideration may be given for dry floodproofing up to the 1% AEP flood level.

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N/A - No open carparking is proposed.

D4 Where there is more than 300mm depth of flooding in a car park or carport during a 1% AEP flood event, vehicle barriers or restraints are to be provided to prevent floating vehicles leaving the site. Protection must be provided for all events up to the 1% AEP flood event

N/A – Existing parking/garage outside flood extents.

D5. Enclosed Garages must be located at or above the 1% AEP level

N/A – Existing parking/garage outside flood extents.

D6. All enclosed car parks (including basement carparks) must be protected from inundation up to the Flood Planning Level. All access, ventilation, driveway crests and any other potential water entry points to any enclosed car parking shall be above the Flood Planning Level. Where a driveway is required to be raised it must be demonstrated that there is no net loss to available flood storage in any event up to the 1% AEP flood event and no impact on flood conveyance through the site. Council will not accept any options that rely on electrical, mechanical or manual exclusion of the floodwaters from entering the enclosed carpark

N/A – Existing parking/garage outside flood extents.

D7. All enclosed car parks must be protected from inundation up to the Probable Maximum Flood level or Flood Planning Level whichever is higher. For example, basement carpark driveways must be provided with a crest at or above the relevant Probable Maximum Flood level or Flood Planning Level whichever is higher. All access, ventilation and any other potential water entry points to any enclosed car parking shall be at or above the relevant Probable Maximum Flood level or Flood Planning Level whichever is higher.

N/A – Existing parking/garage outside flood extents.

Emergency Response;

E1. If the property is affected by a Flood Life Hazard Category of H3 or higher, then Control E1 applies and a Flood Emergency Assessment must be included in the Flood Management Report. If the property is affected by a Flood Life Hazard Category of H6, then development is not permitted unless it can be demonstrated to the satisfaction of the consent authority that the risk level on the property is or can be reduced to a level below H6 or its equivalent. If the property is flood affected but the Flood Life Hazard Category has not been mapped by Council, then calculations for its determination must be shown in the Flood Management Report, in accordance with the "Technical Flood Risk Management Guideline: Flood Hazard", Australian Institute for Disaster Resilience (2012). Where flood-free evacuation above the Probable Maximum Flood level is not possible, new development must provide a shelter-in-place refuge where:

- ***a) The floor level is at or above the Probable Maximum Flood level; and***
- ***b) The floor space provides at least 2m2 per person where the flood duration is long (6 or more hours) in the Probable Maximum Flood event, or 1m2 per person for less than 6 hours;***
- ***c) It is intrinsically accessible to all people on the site, plainly evident, and self-directing, with sufficient capacity of access routes for all occupants without reliance on an elevator; and***
- ***d) It must contain as a minimum: sufficient clean water for all occupants; portable radio with spare batteries; torch with spare batteries; and a first aid kit***

Class 10 classified buildings and structures (as defined in the Building Codes of Australia) are excluded from this control. In the case of change of use or internal alterations to an existing building, a variation to this control may be considered if justified appropriately by a suitably qualified professional. Note that in the event of a flood, occupants would be required to evacuate if ordered by Emergency Services personnel regardless of the availability of a shelter-in-place refuge.

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As per the HEC-RAS results, the sites Hazard ranges from H2-H5 with H5 mainly concentrated along the southern building line. A flood emergency management plan is attached to Appendix C.

Fencing;

F1. Fencing, (including pool fencing, boundary fencing, balcony balustrades and accessway balustrades) shall be designed so as not to impede the flow of flood waters and not to increase flood affectation on surrounding land. At least 50% of the fence must be of an open design from the natural ground level up to the 1% AEP flood level. Less than 50% of the perimeter fence would be permitted to be solid. Openings should be a minimum of 75 mm x 75mm

All proposed fencing is to be 'open form'.

Storage of Goods;

G1. Hazardous or potentially polluting materials shall not be stored below the Flood Planning Level unless adequately protected from floodwaters in accordance with industry standards

No storage area is proposed below the flood planning level.

Pools;

H1. Pools located within the 1% AEP flood extent are to be in-ground, with coping flush with natural ground level. Where it is not possible to have pool coping flush with natural ground level, it must be demonstrated that the development will result in no net loss of flood storage and no impact on flood conveyance on or from the site.

Pool to be located at RL 19.10m AHD and all electrical equipment associated with the pool (including pool pumps) is to be waterproofed

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8. CONCLUSIONS AND RECOMMENDATIONS

Based on our assessment of the flood information and the proposed development, we have concluded and summarise as follows:

1. **The proposed development meets all freeboard and finished floor level requirements.**

2. **The proposed development has no material impact on the upstream and downstream flood regime.**

3. All existing and new electrical equipment, power points, wiring, fuel lines, sewerage systems or any other service pipes and connections must be waterproofed and/or located above the Flood Planning Level of 20.10m AHD.

4. A suitably qualified structural engineer to certify at Construction Certificate stage that the structural integrity of the proposed development flat is maintained to the flood planning level of 20.10m AHD, accounting for forces of floodwater, debris and buoyancy.

5. Any proposed fencing is to be 'open form'.

6. The natural ground levels for the pre-development state are to be maintained for the post-development state of the site except where minor scraping of topsoil is required.

7. A laminated copy of the Flood Emergency Response Plan is to be provided to the residents.

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APPENDIX A

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Building Component	Flood compatible material	Building Component	Flood compatible material
Flooring and Sub-floor Structure	Concrete slab-on-ground monolith construction Suspension reinforced concrete slab.	**Doors**	Solid panel with water proof adhesives Flush door with marine ply filled with closed cell foam Painted metal construction Aluminium or galvanised steel frame
Floor Covering	Clay tiles Concrete, precast or in situ Concrete tiles Epoxy, formed-in-place Mastic flooring, formed-in-place Rubber sheets or tiles with chemical-set adhesives Silicone floors formed-in-place Vinyl sheets or tiles with chemical-set adhesive Ceramic tiles, fixed with mortar or chemical-set adhesive Asphalt tiles, fixed with water resistant adhesive	**Wall and Ceiling Linings**	Fibro-cement board Brick, face or glazed Clay tile glazed in waterproof mortar Concrete Concrete block Steel with waterproof applications Stone, natural solid or veneer, waterproof grout Glass blocks Glass Plastic sheeting or wall with waterproof adhesive
Wall Structure	Solid brickwork, block work, reinforced, concrete or mass concrete	**Insulation** **Windows**	Foam (closed cell types) Aluminium frame with stainless steel rollers or similar corrosion and water resistant material.
Roofing Structure (for Situations Where the Relevant Flood Level is Above the Ceiling)	Reinforced concrete construction Galvanised metal construction	**Nails, Bolts, Hinges and Fittings**	Brass, nylon or stainless steel Removable pin hinges Hot dipped galvanised steel wire nails or similar

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Article II. Electrical and Mechanical Equipment **Article III.** For dwellings constructed on land to which this DCP applies, the electrical and mechanical materials, equipment and installation should conform to the following requirements.	**Heating and Air Conditioning Systems** **Article IV.** Heating and air conditioning systems should, to the maximum extent possible, be installed in areas and spaces of the house above the relevant flood level. When this is not feasible every precaution should be taken to minimise the damage caused by submersion according to the following guidelines.
Main power supply **Article V.** Subject to the approval of the relevant authority the incoming main commercial power service equipment, including all metering equipment, shall be located above the relevant flood level. Means shall be available to easily disconnect the dwelling from the main power supply.	**Fuel** **Article VI.** Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off.
Wiring Article VII. All wiring, power outlets, switches, etc., should, to the maximum extent possible, be located above the relevant flood level. All electrical wiring installed below the relevant flood level should be suitable for continuous submergence in water and should contain no fibrous components. Earth core linkage systems (or safety switches) are to be installed. Only submersible-type splices should be used below the relevant flood level. All conduits located below the relevant designated flood level should be so installed that they will be self-draining if subjected to flooding.	**Installation** **Article VIII.** The heating equipment and fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line. All storage tanks should be vented to an elevation of 600mmabove the relevant flood level.
Equipment **Article IX.** All equipment installed below or partially below the relevant flood level should be capable of disconnection by a single plug and socket assembly.	**Ducting** **Article X.** All ductwork located below the relevant flood level should be provided with openings for drainage and cleaning. Self-draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a watertight wall or floor below the relevant flood level, the ductwork should be protected by a closure assembly operated from above relevant flood level.
Reconnection **Article XI.** Should any electrical device and/or part of the wiring be flooded it should be thoroughly cleaned or replaced and checked by an approved electrical contractor before reconnection.	**Article XII.**

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APPENDIX B

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FLOOD RESPONSE MANAGEMENT PLAN – 42 Bix Road, Dee Why

SITE INFORMATION

Council has advised that this property is subject to potential flooding. This means runoff from the upstream catchment may the site in a 100-year storm event. This is due to the geographically low location of the site, allowing flows to travel overland in the vicinity of the site.

PROCEDURE IN CASE OF FLOODING

1. During floods, many local streets and Roads will be cut off by floodwaters that may make the escape by vehicle difficult. Travelling through floodwaters on foot or in a vehicle can be dangerous as obstructions can be hidden under the floodwaters, or you could be swept away, even if in a car, or the water may be polluted. Stay within the building as much as practical as this is the safest option. In the possible occurrence of a flood event, overland flows will most likely first enter the site through the front boundary. The minimum ground floor level for the development is above the possible 100-year ARI overland flow levels, however it may be necessary to evacuate the proposed development in a storm event greater than the 100-year storm. **It should be noted that if overland flows are entering the rear of the site, it may be unsafe for pedestrian/vehicular evacuation. In such case, staying indoors in the safer option unless otherwise instructed by the SES or relevant authorities.**

100-year ARI Flood Level	RL 19.10m AHD
Habitable floor Level	RL 22.50m AHD

During a major storm event refuge should be sought within the first floor in the master bedroom. The room is to have sufficient clean water for all occupants; portable radio with spare batteries; torch with spare batteries; and a first aid kit.

2. Develop your own family flood plan and be prepared if flooding should occur while the kids are coming home from school, or when you are returning from work. Make arrangements with neighbours or family members to look after children if there are no adults at home.

3. As flood levels appear to approach the ground floor level of the residence:
    (a) move important documents, personal effects, precious photographs and vital medical supplies to a safe and easily accessible place with your emergency flood kit
    (b) gather medicines, special requirements for babies or the elderly, mobile phones, first aid kit, special papers, battery operated torch and radio, fresh water, canned food and opener, water proof clothing and small valuables into a backpack or bag in one location
    (c) locate your pets and gather any special requirements for them
    (d) put on strong shoes, raise any items within the home that may be damaged by water to as high a level as possible, with electrical items on top. Turn off any large electrical items at the power point such as a TV that cannot be raised.

    Note: Suitable storage areas may be on top of desks/tables/bench tops/attics/beds.

4. In the rare event that flood waters appear that they may enter the dwelling:
    (a) switch off electricity at switchboard

(b) turn off gas at the meter
(c) turn off water at the meter
(d) block toilet bowls with a strong plastic bag filled with earth or sand
(e) cover drains in showers, baths, laundries etc with a strong plastic bag filled with earth or sand

5. In the event that flood waters have risen up to the building, do not evacuate the building at this time unless instructed to do so by the SES or the Police. Floodwaters are much deeper, run much faster and are more dangerous outside.

6. Continue to monitor Bureau of Meteorology forecasts and warnings, listen to ABC 702 radio.

7. In the case of a medical or life-threatening emergency ring 000 as normal, but explain about the flooding.

8. A laminated copy of this flood plan should be permanently attached to an inside cupboard door in the kitchen and/or laundry of the main house and to the inside of the electrical meter box.

9. This flood management plan should be reviewed every 5 years, particularly with the potential sea level rise due to the greenhouse effect.

Important Phone Numbers

State Emergency Service: Emergency 132 500 General Enquires: 4251 6111

Police, Fire, Ambulance: Emergency 000

Bureau of Meteorology (Website): http://www.bom.gov.au/weather

Land, Weather and Flood Warnings, phone: 1300 659 215

DR/Hospital: .....

Family: .....

Friends: .....

Other: .....

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IF YOU NEED TO EVACUATE

- Pack warm clothing, essential medications, valuables, personal papers, mobile phones, photos and mementos in waterproof bags to be taken with your emergency kit
- Decide on how to look after your pets if you cannot take them with you
- Raise furniture, clothing and valuables on bed, tables and into roof spaces
- Empty freezers and refrigerators, leaving doors open
- Turn off power, water and gas
- Whether you leave or stay, put sandbags in the toilet bowl and over all laundry/bathroom drain holes to prevent sewage back-flow
- Lock your home and proceed to Forestville Montessori School
- Don't drive in water of unknown depth and current
- Remember that walking through floodwaters is very dangerous

AFTER THE FLOOD

- Stay tuned to ABC 702 on a battery powered radio for official advice and warnings
- Don't return home until authorities have said it is safe to do so
- Don't allow children to play in or near flood waters
- Avoid entering flood waters, it is dangerous. If you must, wear solid shoes and check depth and current with a stick
- Stay away from drains, culverts and water over knee-deep
- Don't turn on your gas and electricity until it has been checked by a professional/licensed repairer
- Avoid using gas or electrical appliances which have been in flood water until checked for safety
- Don't eat food that has been in flood waters
- Boil tap water until supplies have been declared safe
- Watch for trapped animals
- Beware of fallen power lines
- Take many photos for all damage for insurance purposes
- Notify family and friends of your whereabouts