

Overland Flow Study Report

For Proposed Redevelopment of Residential Dwelling

Development Site at:

2 Orana Road, Mona Vale

Lot 29, DP 6195

Prepared by:



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REPORT DESCRIPTION

Overland Flow Study Report for Proposed Redevelopment of Residential Dwelling at 2 Orana Road, Mona Vale

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1. INTRODUCTION

1.1 Background

ACCON Engineers was commissioned by Thuy Hang Le and Tam Duc Tran to carry out site specific overland flow study for the proposed redevelopment of residential dwelling at 2 Orana Road, Mona Vale.

This report has been prepared to accompany a Development Application for the proposed residential dwelling in accordance with Australian Rainfall and Runoff, NSW Floodplain Development Manual 2005 and Northern Beaches Council's flooding requirements. This report describes the existing characteristics of the area, proposed development and quantifies the impact of flooding due to the proposed development.

1.2 Objectives

The main objective of this study is to undertake overland flow study and flood impact assessment due to the proposed residential dwelling at 2 Orana Road, Mona Vale. The scope of this study includes:

- Establish hydraulic model to determine flood levels;
- Prepare flood extent maps at the development site and surrounding area for the 1% AEP storm event for the existing and developed conditions;
- Prepare flood difference map due to the proposed development for 1% AEP storm event;
- Estimate provisional hydraulic hazard category at the development site and
- Setting up finished floor level of proposed dwelling.

2. SITE DESCRIPTION

2.1 Land Details

The site is located at the western side of Orana Road, Mona Vale. The land is identified as 2 Orana Road (Lot 29, DP 6195). A locality plan of the site is shown in Figure 2.1.



Figure 2.1 Location of site (Source: Sixmap)

2.2 Topography

The site is currently developed with single storey residential dwelling and detached garage. A drainage easement exists at the rear of the site. The site falls towards south direction. Based on topography of the development site and surrounding area and the flood information provided by Northern Beaches Council, the site is affected by overland flow in large storm events. This study to determine the depth, extent and levels of overland flow at the site in the 1% AEP storm event. The detail survey plan of the site is provided in Figure 2.2 and Appendix A. Flood information provided by the council is provided in Appendix B.

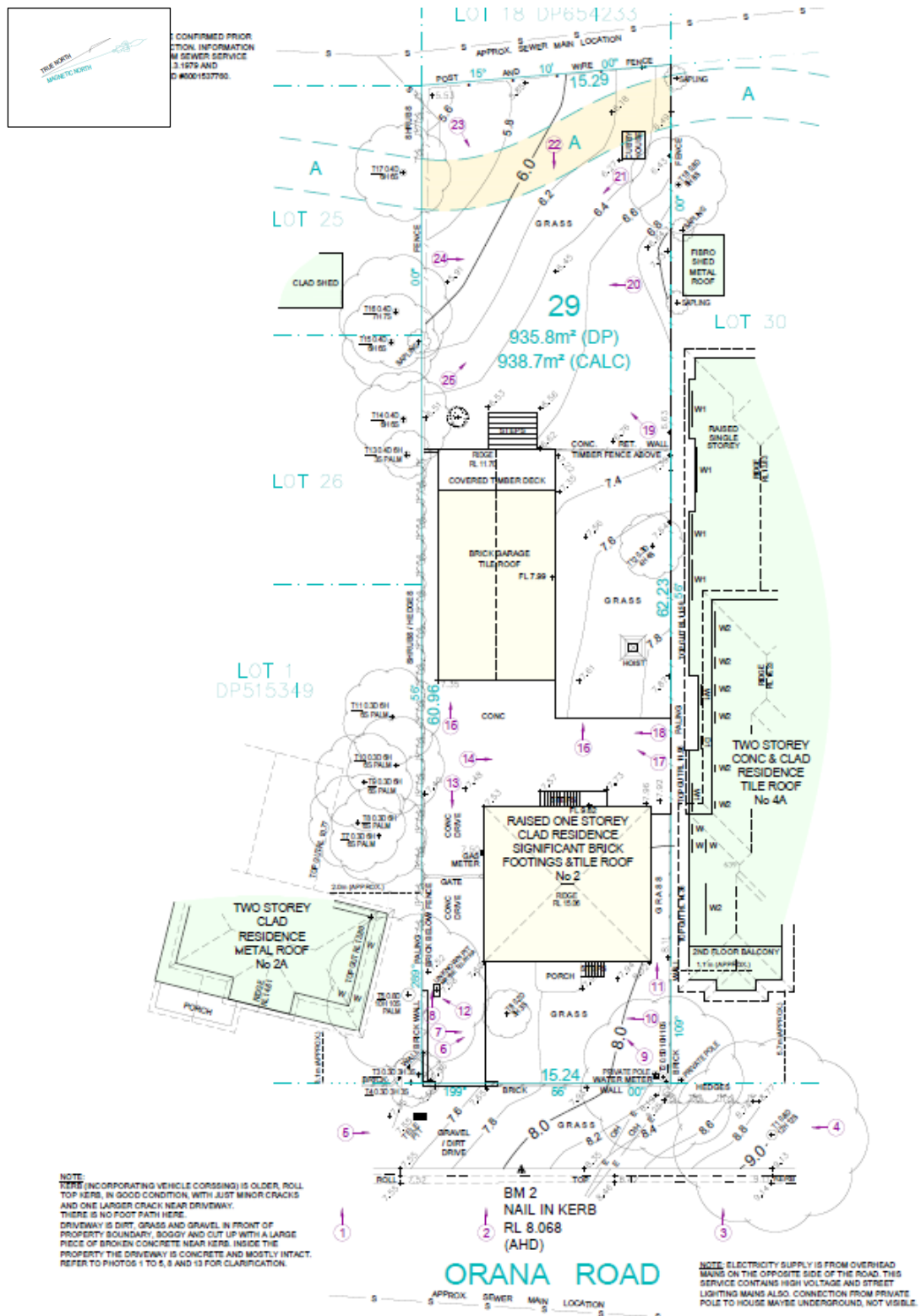


Figure 2.2 General Topography of the Development Site (Source: Residential Engineering)

3. PROPOSED DEVELOPMENT

The proposed development involves demolition of existing infrastructures and construction of new residential dwelling at 2 Orana Road, Mona Vale. The site plan of the proposed dwelling is shown in Figure 3.1. The detail site plan of the development site is provided in Appendix C.

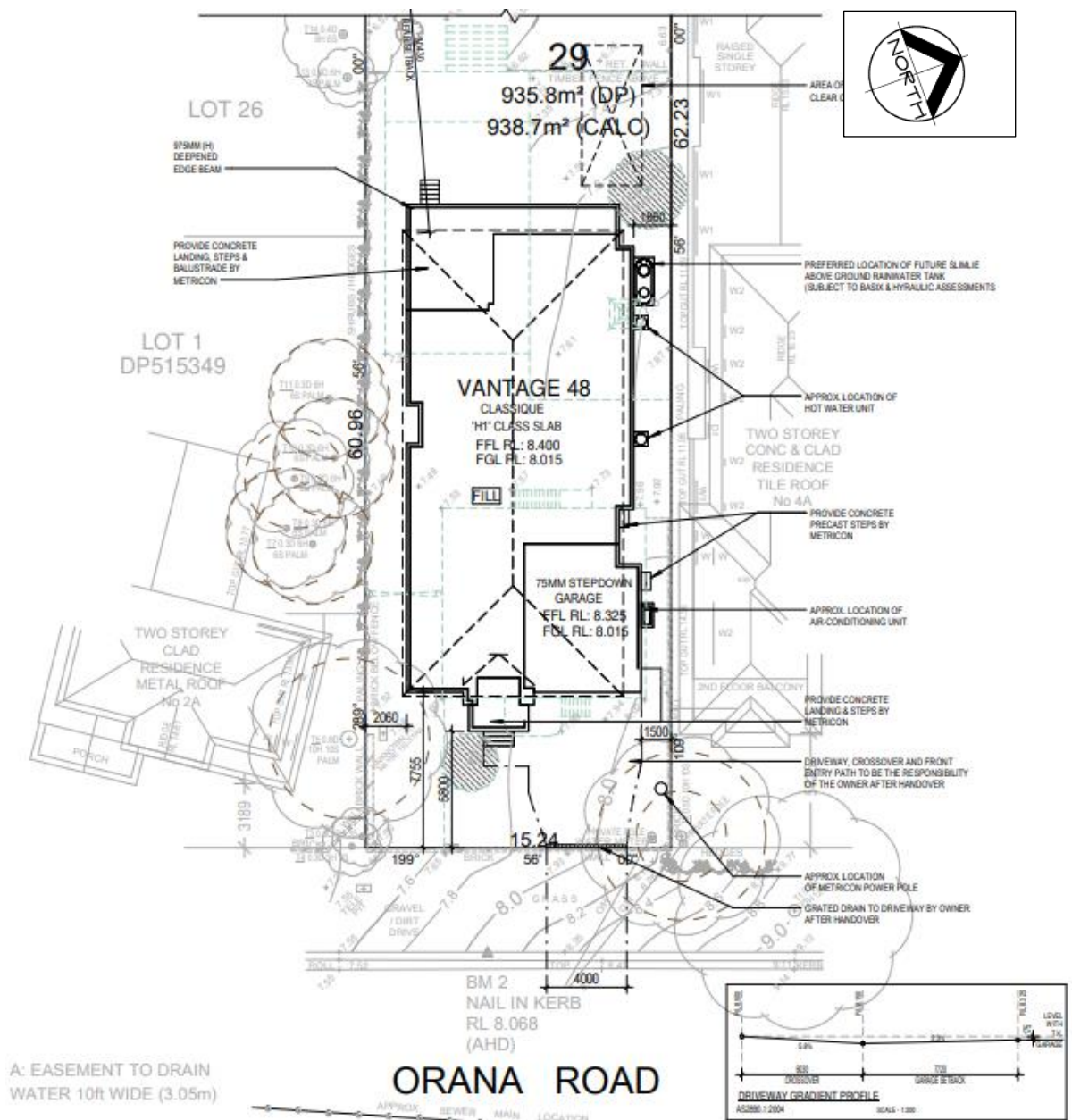


Figure 3.1 Site Plan of Proposed Development (Metrickon Homes)

4. HYDROLOGIC ANALYSIS

4.1 Intensity Frequency Duration (IFD) Design Rainfall Depth

Intensity duration frequency design rainfall depth (IFD) of Mona Vale, NSW obtained from Bureau of Meteorology has been used to determine design precipitation of the study area. Table 4.1 presents IFD of Mona Vale.

Table 4. 1 : IFD Design Rainfall Depth

Duration	Annual Exceedance Probability (AEP)						
	63.2%	50%#	20%*	10%	5%	2%	1%
1 min	2.39	2.68	3.63	4.30	4.98	5.92	6.67
2 min	4.01	4.46	5.90	6.90	7.91	9.24	10.3
3 min	5.55	6.18	8.20	9.62	11.0	13.0	14.5
4 min	6.93	7.74	10.3	12.2	14.0	16.5	18.5
5 min	8.18	9.15	12.3	14.5	16.7	19.8	22.3
10 min	12.9	14.5	19.7	23.5	27.2	32.4	36.6
15 min	16.2	18.2	24.8	29.5	34.2	40.8	46.1
20 min	18.6	20.9	28.5	33.9	39.3	46.9	52.8
25 min	20.6	23.1	31.4	37.3	43.3	51.5	58.0
30 min	22.2	24.9	33.8	40.1	46.4	55.2	62.2
45 min	26.0	29.1	39.1	46.3	53.4	63.3	71.2
1 hour	28.8	32.1	43.0	50.7	58.5	69.1	77.6
1.5 hour	33.0	36.7	48.7	57.3	65.9	77.8	87.4
2 hour	36.3	40.3	53.2	62.4	71.8	84.7	95.2
3 hour	41.5	45.9	60.4	70.9	81.5	96.4	108
4.5 hour	47.7	52.7	69.3	81.4	93.8	111	125
6 hour	52.8	58.4	76.9	90.5	105	125	141
9 hour	61.3	67.9	90.1	107	124	148	168
12 hour	68.4	75.9	102	121	141	169	192
18 hour	79.9	89.2	121	145	170	204	232
24 hour	89.2	100	137	165	194	234	266
30 hour	96.9	109	151	182	215	259	294
36 hour	104	117	163	197	232	280	317
48 hour	114	130	182	221	261	314	355
72 hour	130	148	209	254	300	358	403
96 hour	140	160	226	273	321	383	430
120 hour	147	168	235	284	333	395	443
144 hour	152	173	241	289	337	400	448
168 hour	156	177	243	290	338	400	449

4.2 Rainfall Pattern

The ARR2019 method is used to derive design precipitation at the proposed development site at 2 Orana Road, Mona Vale. Rainfall pattern file of Mona Vale is downloaded from Australian Rainfall and Runoff data hub.

4.3 Catchment Area, Flow Hydrograph and Rainfall Depth

The possible maximum area contributing overland flow at the vicinity of 2 Orana Road, Mona Vale has been estimated from the topographic map of the development site and surrounding area prepared from the DEM obtained from Geoscience Australia and is estimated to be approximately 18 Ha. The catchment of overland flow path at the vicinity of the development site is shown in Figure 4.1.

A preliminary single node DRAINS-ILSAX model has been developed to determine flow hydrograph at the overland flow path at the vicinity of the development site. The preliminary modelling result indicates that the 1% AEP 20 minutes duration Storm 7 produces maximum peak flow from the catchment. This storm has been used in TufLOW model as rain on grid (direct rainfall) as this is more accurate method of determining flood extent and levels for small catchments. Table 4.2 presents 1% AEP 20 minutes rainfall depths.

Table 4. 2 : Rainfall Depth

Time (min)	1% AEP 20 minutes Duration Rainfall Depth (mm)
0	0
5	7.92
10	19.00
15	14.17
20	12.17
25	0
30	0



Figure 4. 1 Catchment Area of the Overland Flow Path at the Vicinity of the Development Site

5. HYDRAULIC MODELLING SETUP AND RESULTS

5.1 Introduction

TUFLOW software was used to develop 2D hydraulic model of the overland flow path at the vicinity of 2 Orana Road, Mona Vale. TUFLOW is a suite of advanced numerical engines and supporting tools for simulating free-surface water flow for urban waterways, rivers, floodplains, estuaries and coastlines. The TUFLOW engines are technically superior and are industry leaders in solving all the necessary physical processes using 1D, 2D and 3D solutions.

5.2 Model Set-up

One metre Digital Elevation Model (DEM) in Esri ASCII Grid (2011) obtained from Australian Government Geoscience Australia has been used to build terrain model of the study area. The terrain model developed from the ASCII Grid file at development location is checked with surveyed spot levels within the development site and found reasonably consistent. Thus, the DEM obtained from Geoscience Australia have been used for this study. The terrain model of the modelled area is presented in Figure 5.1.

The possible maximum catchment area contributing overland flow at the vicinity of the proposed development site and surrounding area has been modelled as rain on grid in TUFLOW hydraulic model. This method is more accurate for the overland flow path study as the flow within the model extent is routed in this method. An initial loss of 5mm and continuing loss of 1mm have been adopted for this study. The downstream boundary of the catchment is modelled as normal depth - HQ boundary and is assigned at Bassett Street at approximately 95m towards south of the development site. Existing underground street stormwater pits and pipes have not been included in the model to be in a conservative side. The grid size of 1.0m has been used in the model to accurately assess the extent of flooding, flood behaviour at the development site and surrounding area and impact of flooding to adjoining properties. Schematic of model layout is presented in Figure 5.2. The footprints of the existing dwellings at the vicinity of the development site have been raised in DEM.

The roughness value of 0.025 for road and 0.05 for other area have been adopted for this study.

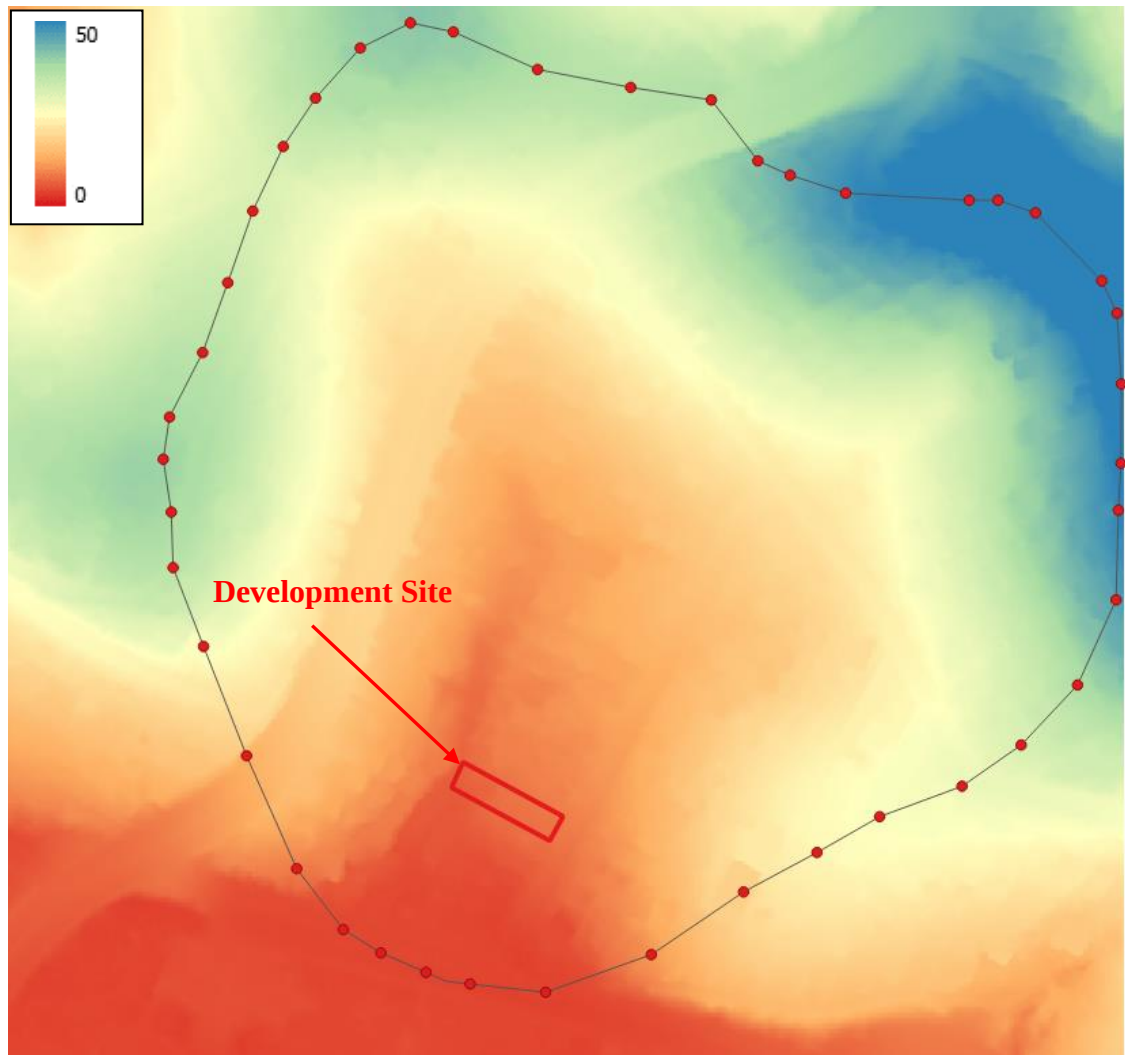


Figure 5. 1 Terrain Model of Study Area

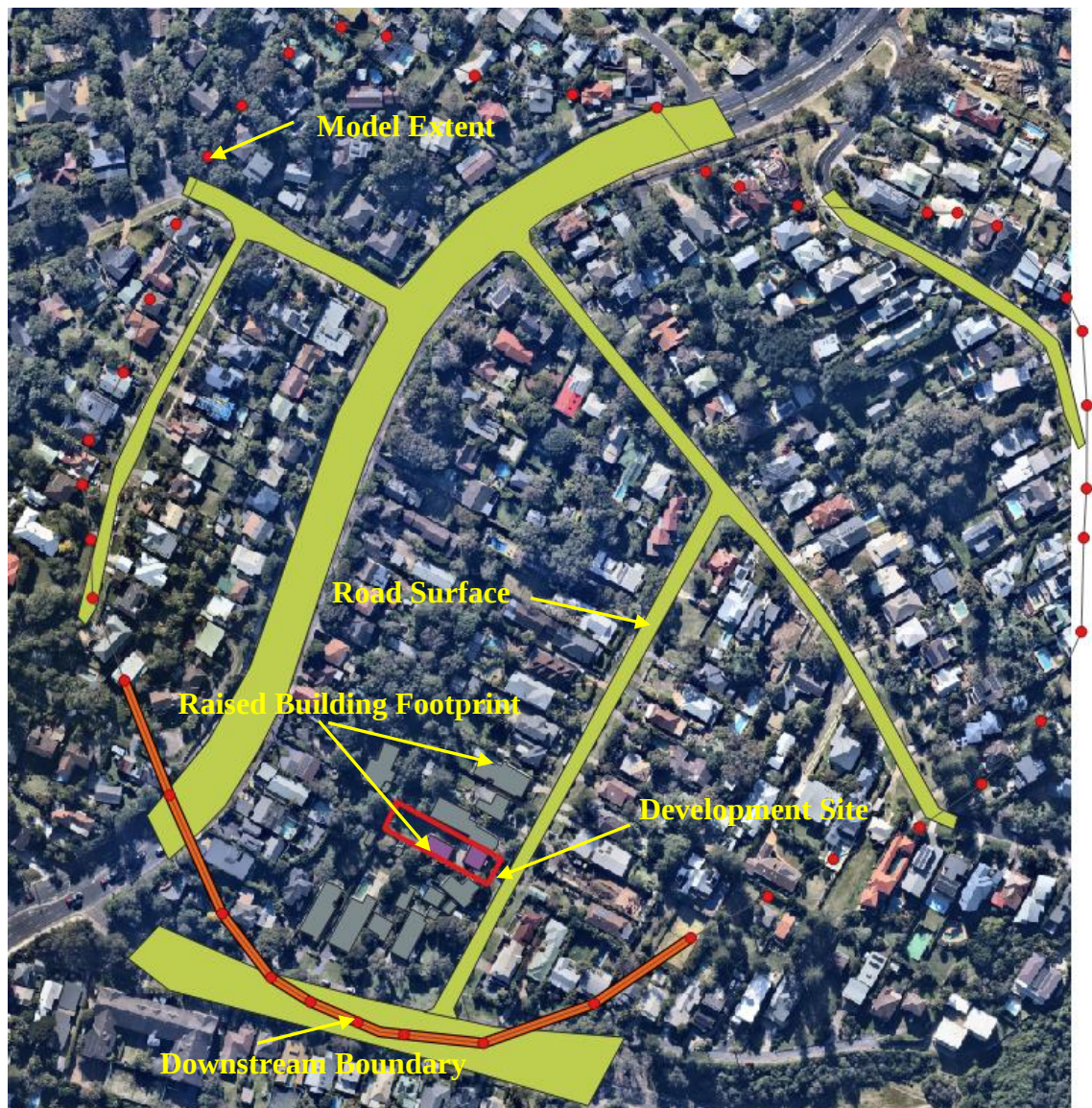


Figure 5. 2 Schematic of Model Layout.

5.3 Model Results

The developed TUFLOW model was used to determine the flood level and extent at the vicinity of the proposed development site at 2 Orana Road, Mona Vale.

5.3.1 Existing Condition

Appendix D presents 1% AEP flood depth with flood level, flood velocity and velocity depth product ($v \cdot d$) maps for the existing condition. Based on modelling result, the

development site is affected by two overland flow paths: one at the front of the existing dwelling and the other adjacent to the rear property boundary. The flood depth at the front of the dwelling is 170mm. The flood depth at the rear of the site adjacent to the rear property boundary is up to 380mm. The flood level at the front of the dwelling ranges between RL 7.6 m ADH to RL 8.4 m AHD. Similarly, the levels at the rear of the site ranges between RL 6.0 m AHD to RL 6.8 m AHD. The flood velocity at the front of the dwelling is up to 1.5 m/s with the maximum value is at the vicinity of the north east corner of the site. Similarly, the flood velocity at the rear of the site is up to 2.5 m/s with the maximum value is being at the vicinity of the north west corner of the site. The velocity depth product at the front overland flow path 0.16 m²/s and rear is up to 0.9 m²/s.

5.3.2 Developed Condition

The footprint of the proposed dwelling has been blocked / raised in DEM to consider developed condition. The DEM of the driveway ramp at the front of the garage has been derived from driveway extent and profile and incorporated in the developed condition DEM.

Appendix E presents 1% AEP flood depth with flood level contour, flood velocity and velocity depth product ($v \cdot d$) maps for the developed condition. These maps are reasonably consistent with existing condition with some localised change in flood extent within the site due to the change in building footprint.

Appendix F presents flood difference maps between the developed and the existing condition. It indicates that there is a localised increase in flood level at the front of the proposed dwelling ie, over the proposed driveway by up to 180 mm due to the driveway level being higher than the natural ground level. However, this increase ceases within the site. **The increase in flood level at the adjoining properties is up to 8mm.** This increase is within the modelling tolerance and hence considered negligible. It proved that the proposed development would have negligible adverse impact of flooding to adjoining properties.

Based on modelling result, the maximum 1% AEP flood level adjacent to the north east corner of the proposed dwelling (near garage) is RL 8.30 m AHD and the southern side of the driveway ie at the front of the entry to the dwelling is RL 8.0 m AHD. The minimum finished habitable floor level is to be 300mm and garage is to be at or above the 1% AEP flood level. **The recommended minimum habitable floor level is RL 8.30 m AHD and garage level is RL 8.30 m AHD.** The minimum finished floor level of the proposed dwelling is RL 8.40 m AHD and garage is proposed at 8.325 m AHD. This complies the requirements.

It is also recommended that any new fencing within the 1% AEP flood extent of the development site is to be of permeable (open) type / louvres to allow free flow of floodwaters and not to cause damage to surrounding land in the event of a flood up to 1% AEP flood level.

6.5 Provisional Flood Hazard Category

Hazard classification plays an important role in informing floodplain risk management in an area. Previously, hazard classifications were binary – either Low or High Hazard as described in the Floodplain Development Manual (2005), Figure 5.3. However, in recent years there have been a number of developments in the classification of hazard. Managing the floodplain: a guide to best practice in flood risk management in Australia (Figure 5.4– Smith et al 2014) provides revised hazard classifications which add clarity to the hazard categories and what they mean in practice. The classification is divided into 6 categories, listed in Table 5.1, which indicate the restrictions on people, building and vehicles.

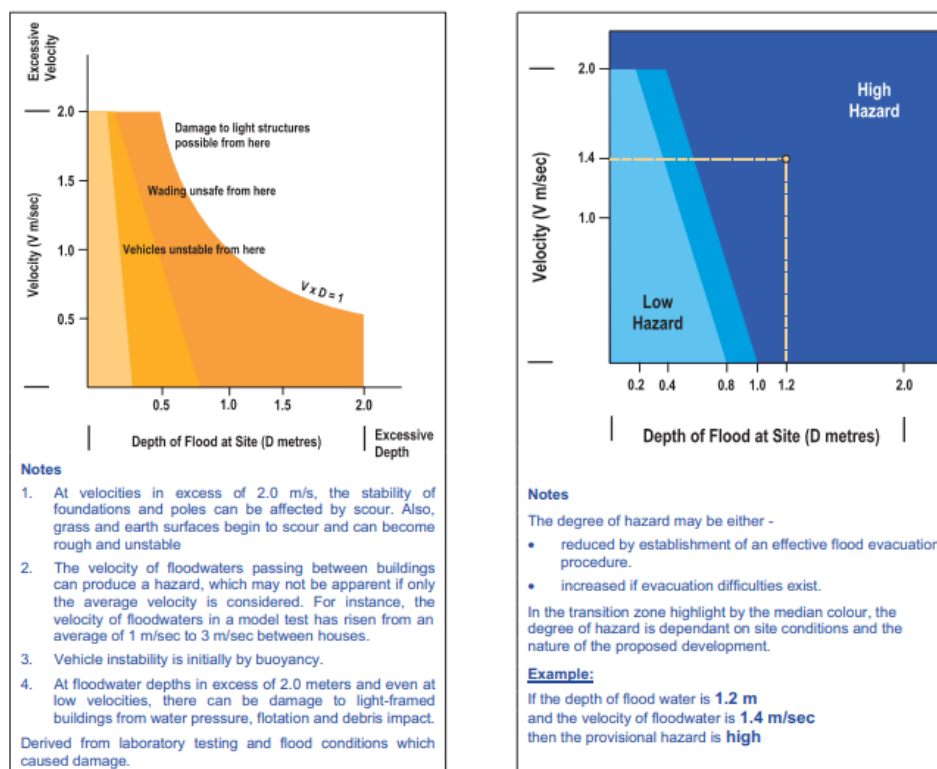


Figure 5. 3 Provisional Flood Hazard Category (Floodplain Development Manual 2005)

Table 5. 1 : Hazard Categories

Category	Constraint to people/vehicles	Building Constraints
H1	Generally safe	No constraints
H2	Unsafe for small vehicles	No constraints
H3	Unsafe for all vehicles, children and the elderly	No constraints
H4	Unsafe for all people and all vehicles	No constraints
H5	Unsafe for all people and all vehicles	Buildings require special engineering design and construction
H6	Unsafe for people and vehicles	All building types considered vulnerable to failure

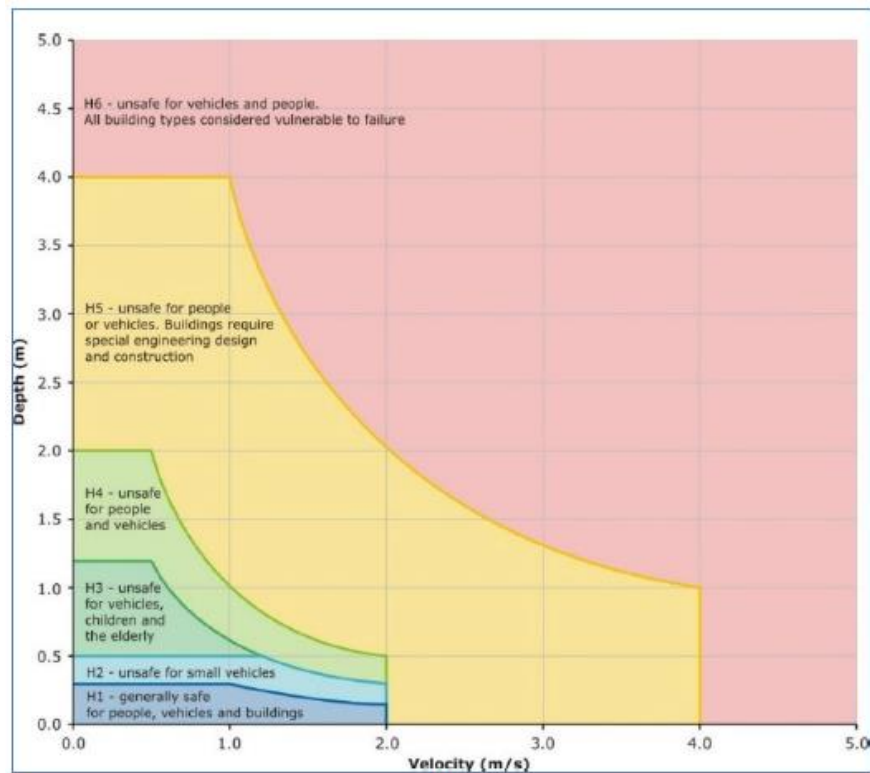


Figure 5. 4 Flood Hazard Classification (Smith et al 2014)

Based on the modelling result, the flood hazard classification of the development site at the location of existing and proposed dwelling is H1- generally safe for people, vehicles and buildings. The hazard classification at the overland flow path at the rear of the site is up to H5 – Unsafe for people or vehicles. However, there is not any development proposed at that location. Appendix G and Appendix H present Flood Hazard Vulnerability Classification for the existing and developed condition.

6. SITE FLOOD EMERGENCY RESPONSE PLAN

2 Orana Road, Mona Vale is affected by local overland flooding in the 1% AEP and large storm event, the occupant of the premises should be aware of Site Flood Emergency Response Plan. The following table provides an outline of the site emergency response plan for the dwelling at 2 Orana Road, Mona Vale, NSW.

Table 6. 1 : Site Emergency Response Plan

Be Aware	• Add mobile phone number to the SES contact list for the issue of SMS alerts for severe weather warnings. • During prolonged or intense rainfall in Sydney region, 2 Orana Road, Mona Vale is prone to local overland flooding. • You should maintain an Emergency Kit containing battery powered radio, spare batteries, torch, first aid kit and emergency contact details for use in the event of a flood.
Prior to an Imminent Flood	• When heavy storms or significant rainfall are forecast: ○ Keep an eye on Bureau of Meteorology flood warnings for this area. ○ Turn your radio to the local ABC station for emergency broadcasts. • Relocate motor vehicles to a higher area with substantially less risk of flooding. • If directed to evacuate, follow Orana Road towards north east to Grandview Parade, then north west to Barrenjoey Road then to the higher flood free area. • Locate emergency kit and have it ready.
During Flood	• The minimum habitable floor level is at least 0.3m above the 1% AEP flood levels. Flood water is less likely to reach to this level. Also, this dwelling has first floor which is significantly above the PMF level (8.75m AHD). Stay within the premises during flooding as much as practical as this is the safest option. • First and second floor level is above the PMF level and can be used as on-site flood refuge. If need to leave the premises do so early in the flood event, before the flood depth reaches to 0.2m at the surrounding streets. • <u>Never drive, ride or walk through floodwater.</u> • For emergency help in floods and storms call SES on 132 500. • Keep listening to emergency radio broadcasts. • Follow advice of emergency services.

After a Flood	• Never drive, ride or walk through floodwater. • Wait for flood water to reduce before leaving building. • Keep listening to emergency radio broadcasts. • Follow advice of emergency services • After floodwater have receded: ○ Take photographs of flood marks and damaged areas, and prepare insurance claim for damaged areas (subject to insurance terms) ○ Arrange for utilities to be inspected and repaired by qualified trades people. ○ Arrange for cleaning and repair of flood affected areas. • Restock and replace your emergency kit.
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7. DEVELOPMENT CONTROL

This study estimated the flood extent and levels for 1% AEP storm event and quantify the impact of flooding at the vicinity of the proposed development site due to the proposed dwelling at 2 Orana Road, Mona Vale.

The proposal of development has been assessed against Northern Beaches Council's DCP requirements. The assessments are presented as under:

7.1 Floor Level

The maximum 1% AEP flood level adjacent to the north east corner of the proposed dwelling (near garage) is RL 8.30 m AHD and the southern side of the driveway ie at the front of the entry to the dwelling is RL 8.0 m AHD. The minimum finished habitable floor level is to be 300mm and garage is to be at or above the 1% AEP flood level. **The recommended minimum habitable floor level is RL 8.30 m AHD and garage level is RL 8.30 m AHD.** The minimum finished floor level of the proposed dwelling is RL 8.40 m AHD and garage is proposed at 8.325 m AHD. This complies the requirements.

7.2 Building Components and Materials

All structures of proposed building will have flood compatible building components below the habitable floor level. The minimum habitable floor level required for the proposed dwelling is provided in section 7.1. All structural components below this level should be constructed with flood compatible materials. All new electrical equipment, power points to be located above habitable floor level. The electrical wiring or any other services and connections shall be waterproofed or installed above habitable floor level.

7.3 Structural Soundness

Engineers report required certifying that the structure can withstand the forces of floodwater debris and buoyancy up to and including 300mm above the 1% AEP flood level.

7.4 Flood Affection

Based on modelling results, the proposed dwelling location is affected by shallow depth flow in the 1% AEP and large storm event.

The modelling result indicates that the proposed redevelopment has no/negligible adverse impact of flooding at the adjoining properties.

7.5 Car Parking and Driveway Access

Based on modelling result, the maximum 1% AEP flood level adjacent to the proposed dwelling (near garage) is RL 8.30 m AHD. The recommended minimum garage floor level is RL 8.3 m AHD. The garage is proposed at 8.325 m AHD. This complies the requirements.

7.6 Evacuation

This lot is affected by shallow depth overland flooding in the 1% AEP storm event. The habitable floor level is at least 300mm above the maximum 1% AEP flood level. This dwelling has first floor which is significantly above the PMF level (8.75m AHD). In case of extreme flood event, first floor level can be used as shelter in place. Hence, evacuation is not warranted for this site. Should the evacuation be required, follow Orana Road towards north east to Grandview Parade, then north west to Barrenjoey Road then to the higher flood free area.

7.7 Fence

Any new fencing within the 1% AEP flood extent is to be of palisade or pool style vertical bars or louvers to allow the free flow of flood waters to allow free flow of floodwaters and not to cause damage to surrounding land in the event of a flood. Fence materials below 1% AEP flood level should be constructed with flood compatible materials.

8. CONCLUSIONS & RECOMMENDATIONS

This study identified the flood extent and levels at the development site at 2 Orana Road, Mona Vale.

Two dimensional TUFLOW model has been developed to assess the impact of flooding at the development site and surrounding area due to the proposed development. One metre Digital Elevation Model in Esri ASCII Grid obtained from Australian Government Geoscience Australia has been used in the model. The terrain model developed from the ASCII Grid file at the development location is checked with surveyed spot levels within the development site and found reasonably consistent.

Modelling results indicates that the development site is affected by two overland flow paths: one at the front of the existing dwelling and the other adjacent to the rear property boundary. The flood depth at the front of the dwelling is 170mm. The flood depth at the rear of the site adjacent to the rear property boundary is up to 380mm. The flood level at the front of the dwelling ranges between RL 7.6 m ADH to RL 8.4 m AHD. Similarly, the levels at the rear of the site ranges between RL 6.0 m AHD to RL 6.8 m AHD. The flood velocity at the front of the dwelling is up to 1.5 m/s with the maximum value is at the vicinity of the north east corner of the site. Similarly, the flood velocity at the rear of the site is up to 2.5 m/s with the maximum value is being at the vicinity of the north west corner of the site. The velocity depth product at the front overland flow path $0.16 \text{ m}^2/\text{s}$ and rear is up to $0.9 \text{ m}^2/\text{s}$. Modelling results for developed condition are reasonably consistent with existing condition with some localised change in flood extent within the site due to the change in building footprint.

Flood level difference map indicates that there is a localised increase in flood level at the front of the proposed dwelling ie, over the proposed driveway by up to 180 mm due to the driveway level being higher than the natural ground level. However, this increase ceases within the site. The increase in flood level at the adjoining properties is up to 8mm. This increase is within the modelling tolerance and hence considered negligible. It proved

that the proposed development would have negligible adverse impact of flooding to adjoining properties.

Based on modelling result, the maximum 1% AEP flood level adjacent to the north east corner of the proposed dwelling (near garage) is RL 8.30 m AHD and the southern side of the driveway ie at the front of the entry to the dwelling is RL 8.0 m AHD. The minimum finished habitable floor level is to be 300mm and garage is to be at or above the 1% AEP flood level. **The recommended minimum habitable floor level is RL 8.30 m AHD and garage level is RL 8.30 m AHD.** The minimum finished floor level of the proposed dwelling is RL 8.40 m AHD and garage is proposed at 8.325 m AHD. This complies the requirements.

It is also recommended that any new fencing within the 1% AEP flood extent is to be of palisade or pool style vertical bars or louvers to allow the free flow of flood waters to allow free flow of floodwaters and not to cause damage to surrounding land in the event of a flood. Fence materials below 1% AEP flood level should be constructed with flood compatible materials.

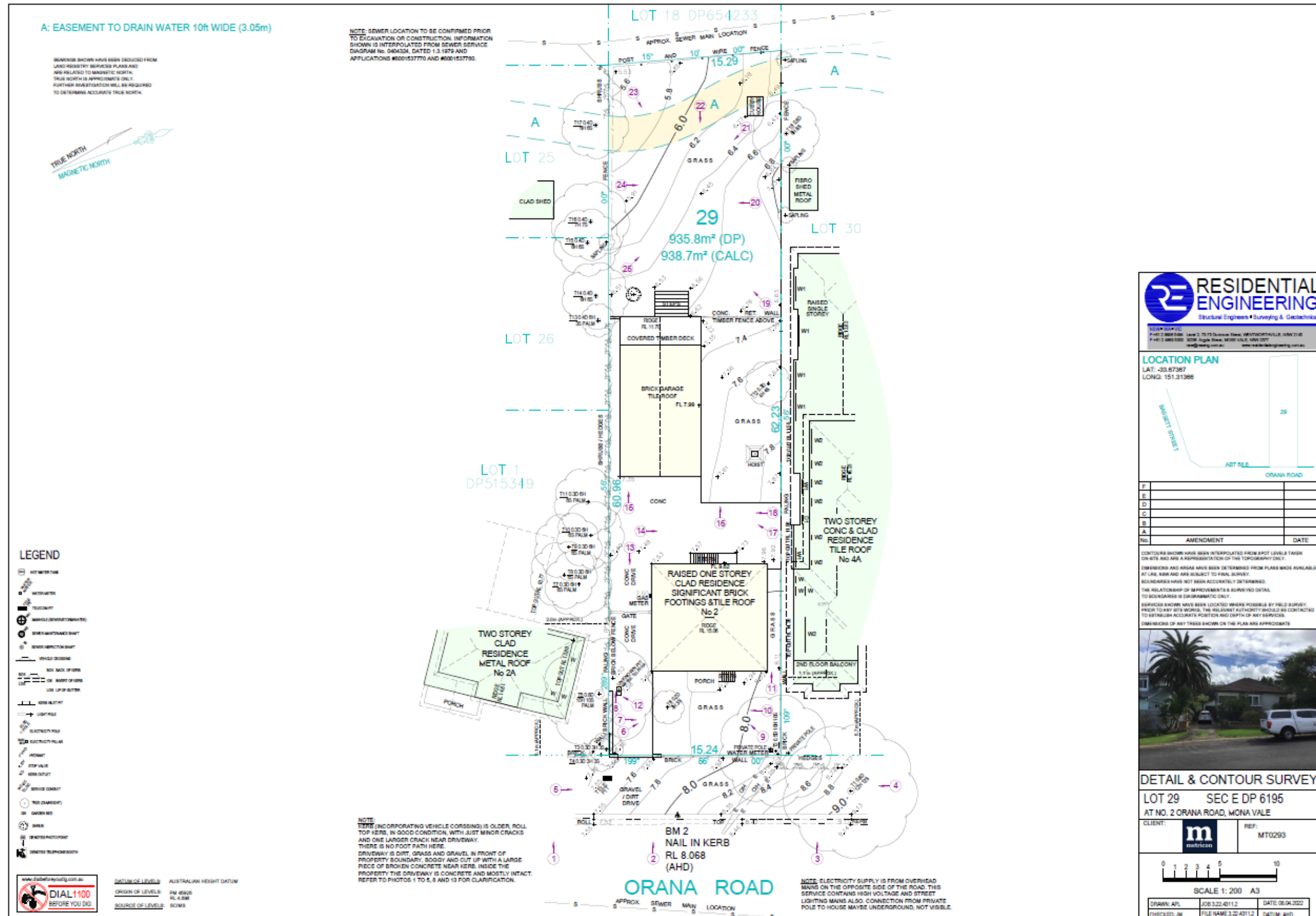
All structures of proposed building should have flood compatible building components below the habitable floor level. All structural components below habitable floor level should be constructed with flood compatible materials. All new electrical equipment, power points and air condition units are to be located above habitable floor level. The electrical wiring or any other services and connections shall be waterproofed or installed above habitable floor level.

Engineers report required certifying that the structure can withstand the forces of floodwater debris and buoyancy up to and including 300mm above the 1% AEP flood level.

The development location is affected by shallow depth overland flooding in the 1% AEP storm event. The habitable floor level is at least 300mm above the maximum 1% AEP flood level. This dwelling has first floor which is significantly above the PMF level. In case of extreme flood event, first floor level can be used as shelter in place. Hence,

evacuation is not warranted for this site. Should the evacuation be required, follow Orana Road towards north east to Grandview Parade, then north west to Barrenjoey Road then to the higher flood free area

APPENDIX A – SURVEY PLAN OF PROPOSED DEVELOPMENT SITE



APPENDIX B – FLOOD INFORMATION PROVIDED BY NORTHERN BEACHES COUNCIL

NORTHERN BEACHES COUNCIL

FLOOD INFORMATION REQUEST – BASIC PURPOSE

Property: 2 Orana Road, Mona Vale

Lot DP: 29/E/6195

Issue Date: 14 February 2017

Flood Study Reference: 2013 Pittwater Overland Flow Flood Study and Draft 2016 McCarrs Creek, Mona Vale and Bayview Flood study.

A property can be impacted by more than one Category of flooding.

Flood Categories defined by the Pittwater 21 Development Control Plan include:

- **Flood Category 1 Areas**- Properties identified on the Flood Hazard Maps and located within Primary Floodplain Areas where the lowest point of the property is affected by the Flood Planning Level (FPL) (1% AEP flood level plus 500mm Freeboard). Flood Category 1 areas are further defined under flood hazard subcategories of high hazard and low hazard.
- **Flood Category 2 Areas**- Properties identified on the Flood Hazard Maps where the lowest point of the property lies above the Flood Planning Level but below the level of the Probable Maximum Flood.
- **Flood Category 3 Areas**- Properties generally located outside or adjacent to the Primary Floodplain Areas that are affected by flooding hazards associated with major stormwater drainage systems, local overland flow paths or drainage easements. Flood Category 3 Areas are further defined under the subcategories of Overland Flow Path – Major and Overland Flow Path – Minor.

Flood Information for lot:

Flood Life Hazard Category – See Map A

Minimum life hazard category: H1-H2

Maximum life hazard category: H5

Flood Category 1 (Mainstream Flooding) – See Flood Map C

Flood Category 3⁵ (Overland Flow) – See Flood Map E

1% Annual Exceedance Probability (1% AEP): See Flood Map B

1% AEP Overland Flow Maximum Water Level^{3&4}: 8.35m AHD

1% AEP Overland Flow Maximum Depth from Natural Ground Level^{3&4}: 0.6m

1% AEP Overland Flow Maximum Velocity: 1.5-2.0m/s

Issue Date: 14 February 2017

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Minimum Floor Level^{1,2 &4}: 0.5m above the 1% AEP overland flow extent with depth above 0.3m and 0.3m above the 1% AEP overland flow extent with depth 0.3m and less

1% AEP Overland Flow Provisional Flood Hazard: See Flood Map F

1% AEP Overland Flow Hydraulic Categorisation: See Flood Map G

Flood Category 2 (PMF) – See Flood Map D

Probable Maximum Flood (PMF) Level²: 8.75m AHD (See Flood Map D)

PMF Maximum Depth from natural ground level: 1.5m

PMF Maximum Velocity: 2.5-3.0m/s

¹Intensification of development requires the consideration of climate change impacts which may result in higher planning levels than those indicated on this flood advice.

²Special Flood Protection developments require a higher planning level using the higher of the PMF or FPL/minimum floor level.

³The flood information does not take into account any local overland flow issues with a depth below 0.15m nor private stormwater drainage systems.

⁴Overland flow water levels may vary across a sloping site, resulting in variable minimum levels across the site.

⁵The applicable Flood Category 3 classification applied for the purpose of development assessment unless otherwise demonstrated in the Flood Risk Management Report that a different classification should apply (dependent on the location of the proposed development).

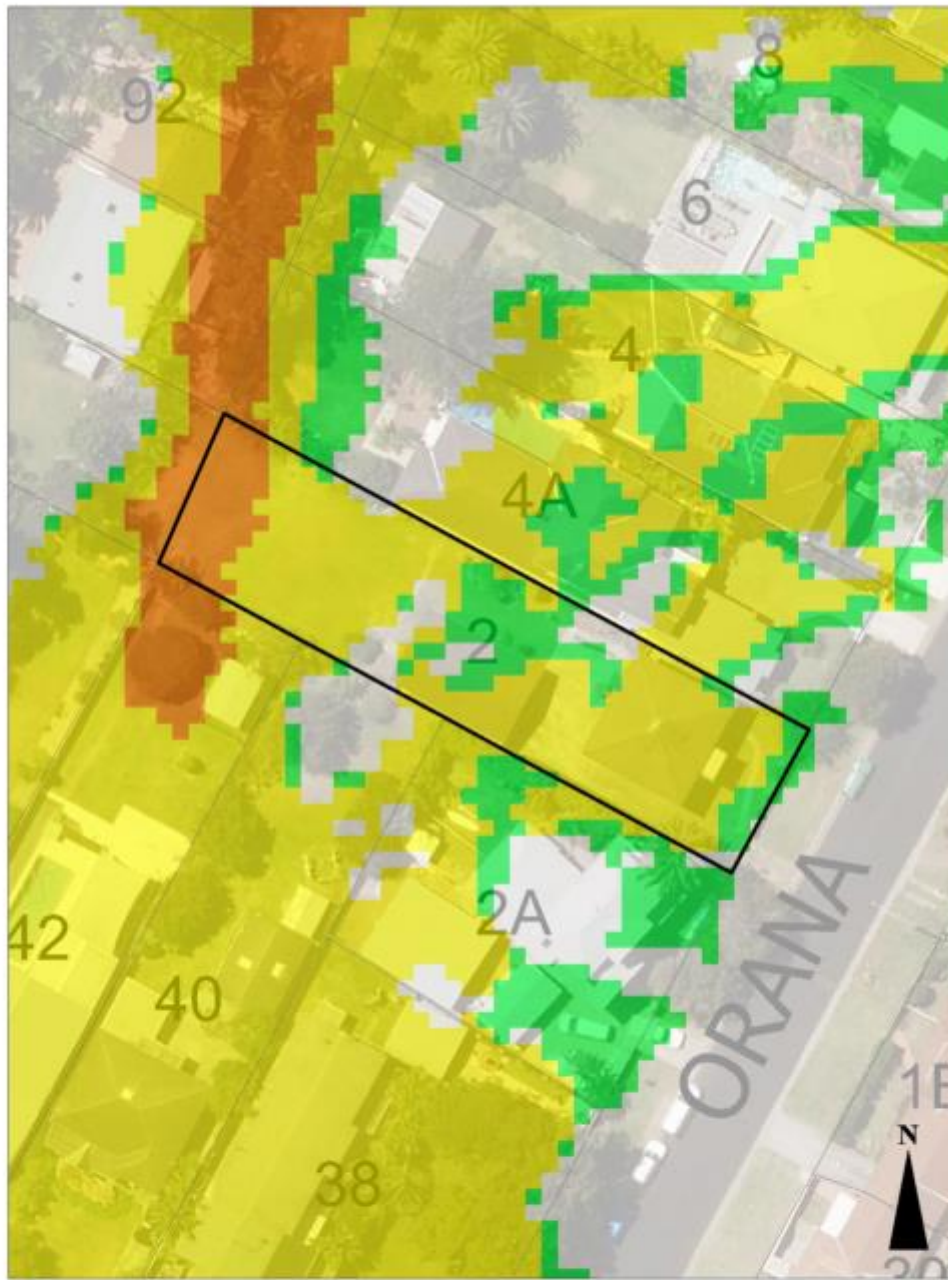
General Notes:

- All levels are based on Australian Height Datum (AHD) unless otherwise noted.
- The source information on this advice was obtained from numeric modelling prepared by consultants for Northern Beaches Council for existing site conditions at the time of the flood study. Separate review and flood model verification has not been undertaken by Council.
- The interpolated information is for the purpose of planning only. Detailed flood data for individual land areas were not determined from the exercise.
- Flood models only approximate flood behaviour. Site specific ground and building survey levels should be used to relate flood levels and to assess the impact of flooding. A site specific flood study/risk assessment may be required for any future development. Care and expertise is required in the interpretation of these flood levels. Engage a suitably qualified engineer to assist you in this matter.
- You need to refer to the Pittwater 21 DCP flood development controls, if you are planning to lodge a Development Application. The advice may be reviewed and amended by Northern Beaches Council in the course of assessment of a specific development application.
- While this advice is periodically updated, it is possible that the Council holds further information dealing with the flooding which has not been incorporated into the above advice.
- Estuarine/coastal inundation has not been taken into account in the flood information.
- Council is currently updating the 2013 Overland Flow Flood Study for this Area and as such the property's flood classification and flood level may be subject to changes as a result of the updated flood modelling.

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FLOOD MAP A: FLOOD LIFE HAZARD CATEGORY



Flood Life Hazard Categories



Map not to Scale

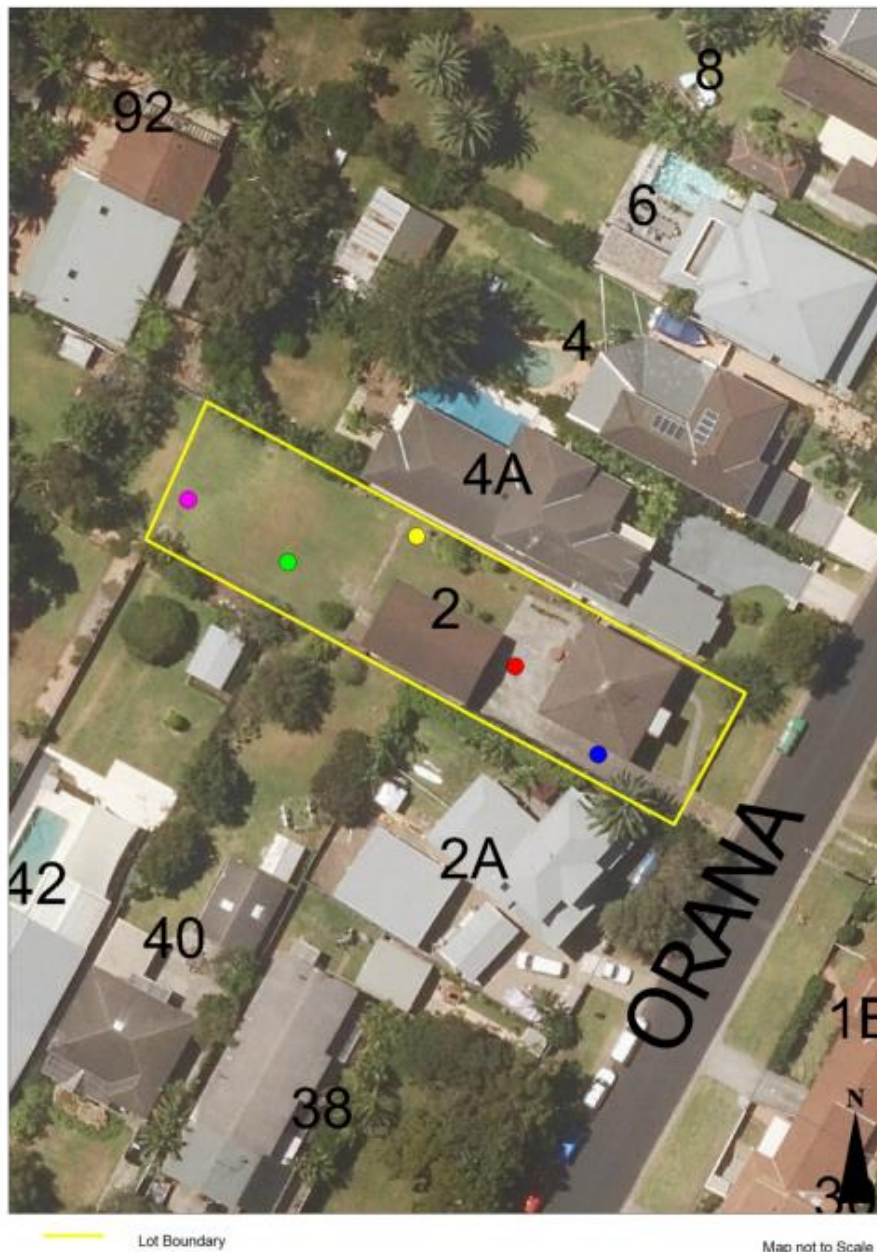
Notes:

- Refer to Pittwater 21DCP for 'Flood Emergency Response Planning for Development in Pittwater Policy (Appendix 15) for additional information on the Flood Life Hazard Categories and Pittwater 21 DCP Control B3.25.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Flood study reference) and aerial photography (Source: Near Map 2014) are indicative only.

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FLOOD LEVEL POINTS



Note: Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Flood study reference) and aerial photography (Source: Near Map 2014) are indicative only

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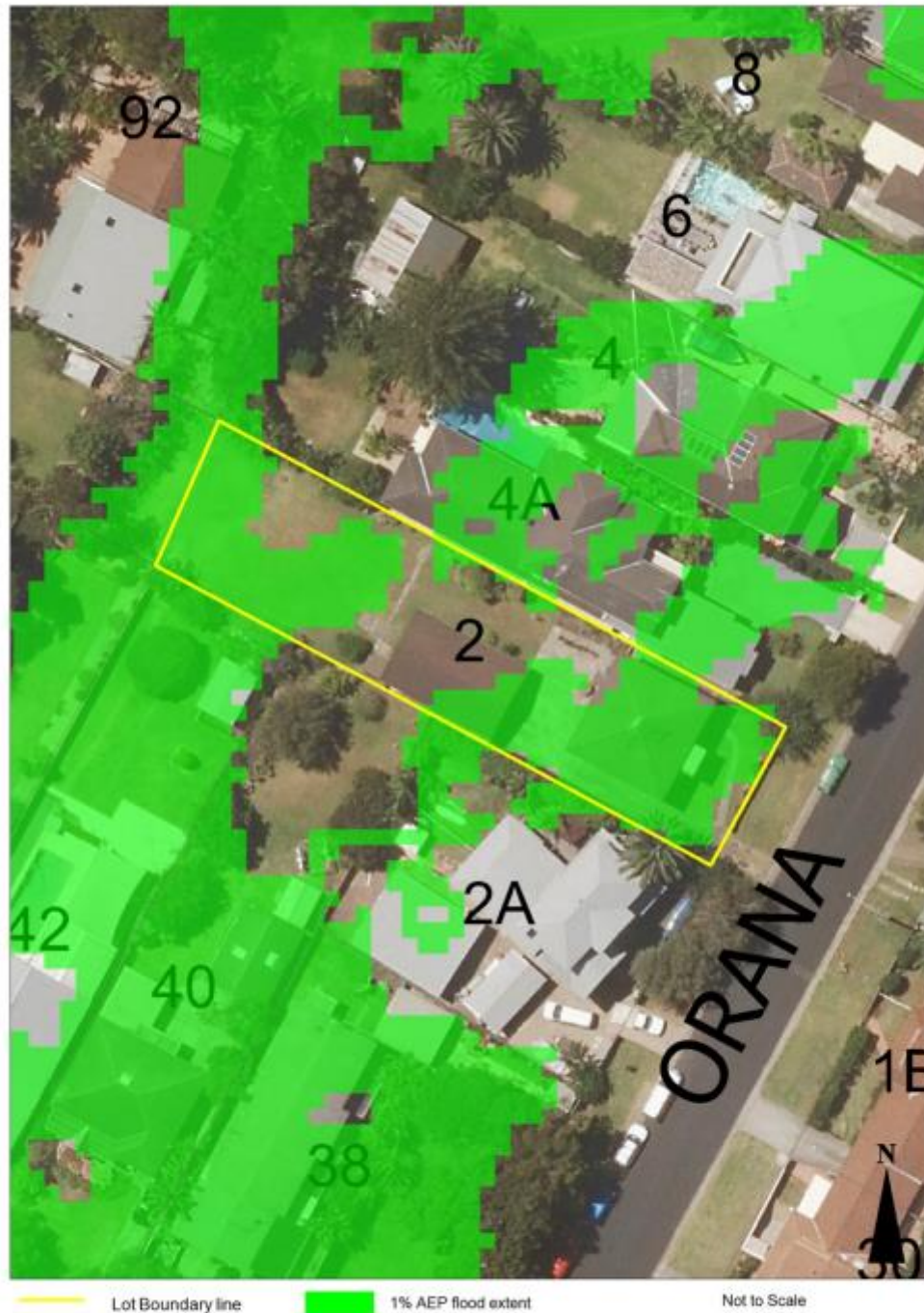
Flood Levels

	1% AEP Max Water Level (m AHD)	1% AEP Max Water Depth (m)	PMF Max Water Level (m AHD)	PMF Max Water Depth (m)
●	7.75	0.30	7.90	0.50
●	7.65	0.15	7.8	0.35
●	7.6	0.15	7.7	0.25
●	6.4	0.2	6.9	0.7
●	6.4	0.5	7.0	1.1

WL – Water Level

PMF – Probable Maximum Flood

FLOOD MAP B: FLOODING - 1% AEP EXTENT



Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event.
- Flood events exceeding the 1% AEP can occur on this site.
- Extent does not include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Flood study reference) and aerial photography (Source: Near Map 2014) are indicative only.

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FLOOD MAP C: MAINSTREAM FLOODING – FPL EXTENT



This Property is currently not identified as being affected by Mainstream flooding based off the 2013 Pittwater Overland Flow Flood Study. Council is however undertaking a review of this model/Flood Study, and as a result this property's flood classification may change because of the update to the mainstream model.

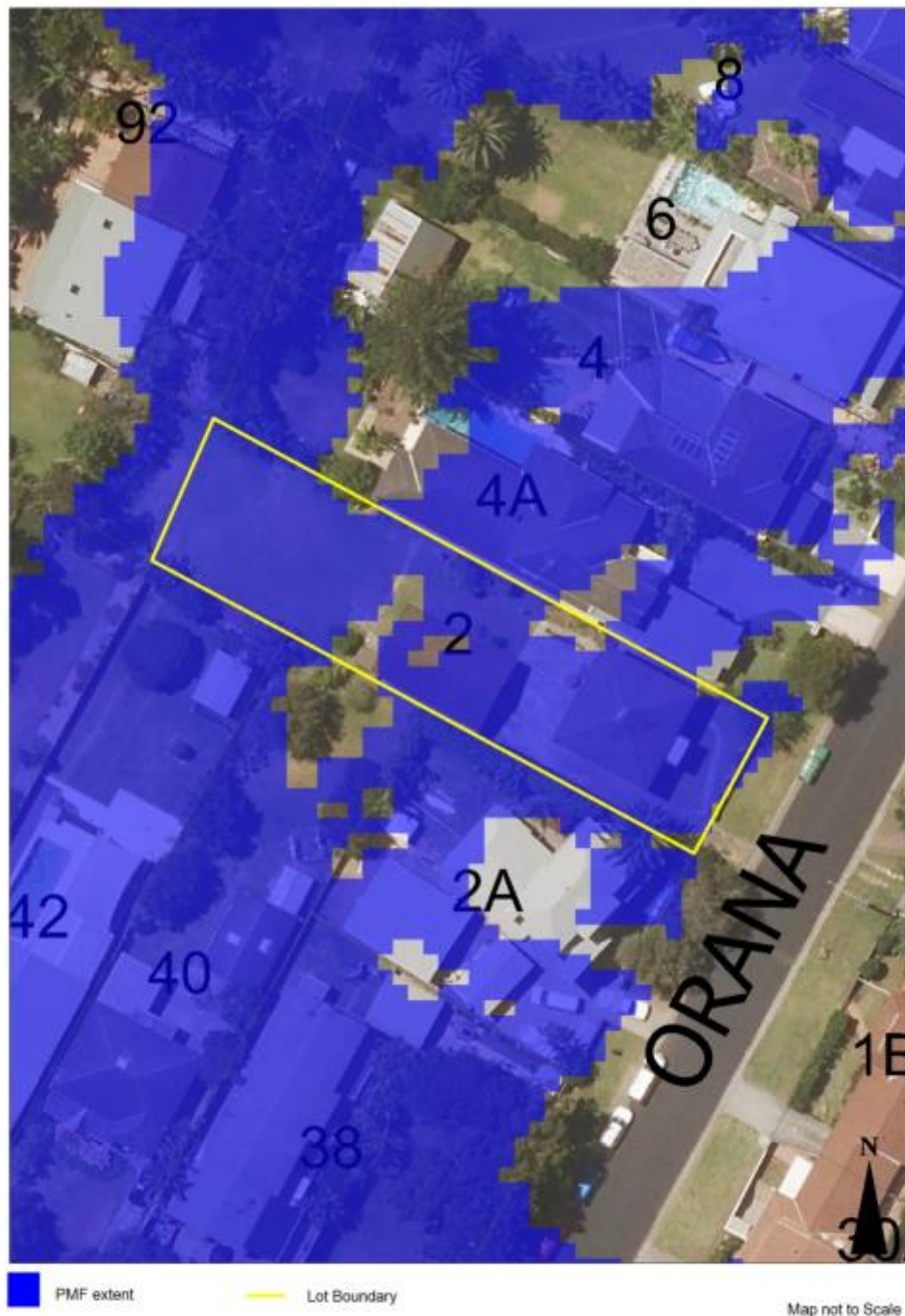
Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event + freeboard.
- Mainstream FPL – Mainstream Flood Planning Level includes the 0.5m freeboard on the 1% AEP extent for planning purposes.
- Extent does not include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Flood study reference) and aerial photography (Source: Near Map 2014) are indicative only.

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FLOOD MAP D: PROBABLE MAXIMUM FLOOD EXTENT



Notes:

- Extent represents the Probable Maximum Flood (PMF) flood event.
- Extent does not include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Flood study reference) and aerial photography (Source Near Map 2014) are indicative only.

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FLOOD MAP E: OVERLAND FLOW EXTENT



Overland Flow flowpath

Lot Boundary

Map not to Scale

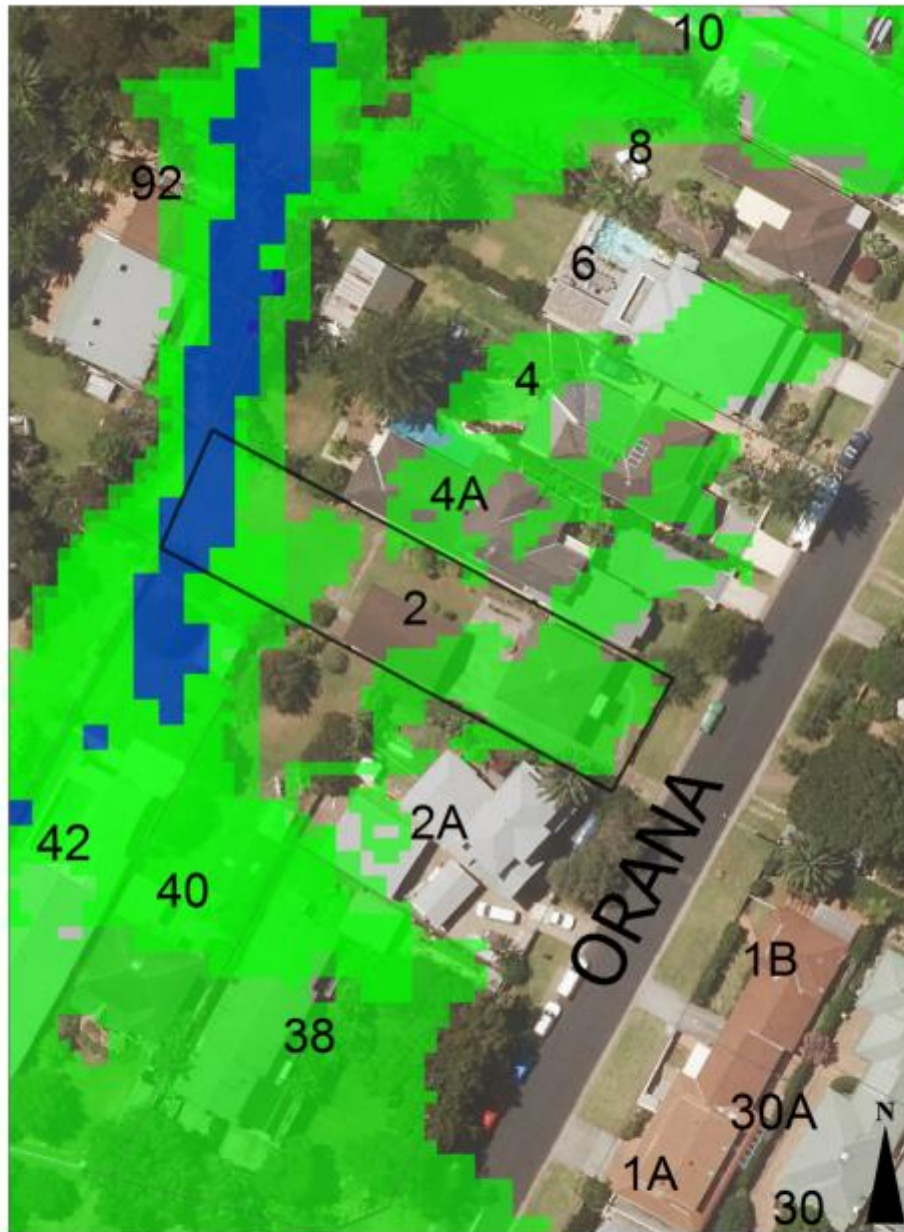
Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event.
- Overland Flow Path Major includes a fixed 5m horizontal planning buffer on the 1% AEP extent for planning purposes.
- Extent does not include climate change.
- Areas not identified on the above Flood Map are likely to experience inundation of depths up to 0.14m.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Flood study reference) and aerial photography (Source Near Map 2014) are indicative only.

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FLOOD MAP F – 1% AEP FLOOD HAZARD EXTENT MAP



High Hazard

Lot Boundary

Low Hazard

Map not to Scale

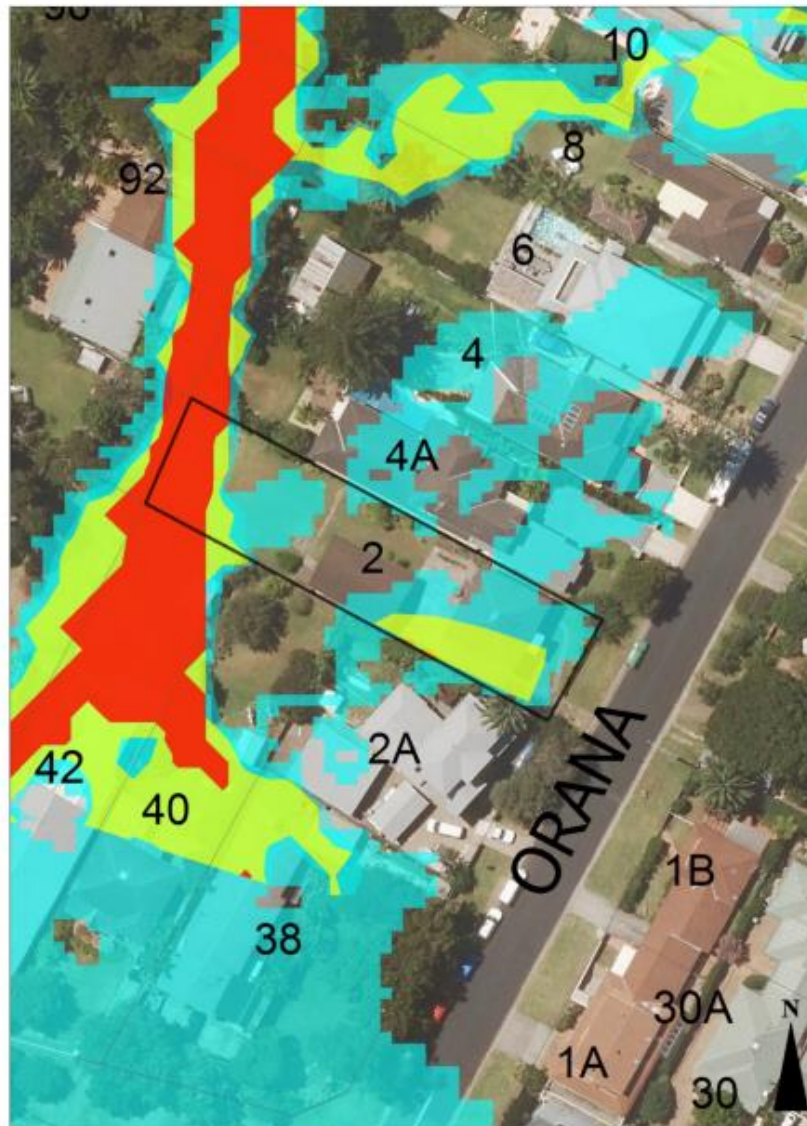
Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event.
- Extent does not include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Flood study reference) and aerial photography (Source: NearMap 2014) are indicative only.

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FLOOD MAP G – 1% AEP FLOOD HYDRAULIC CATEGORY EXTENT MAP



■ Floodway
■ Flood Storage

■ Flood Fringe
— Lot Boundary

Map not to Scale

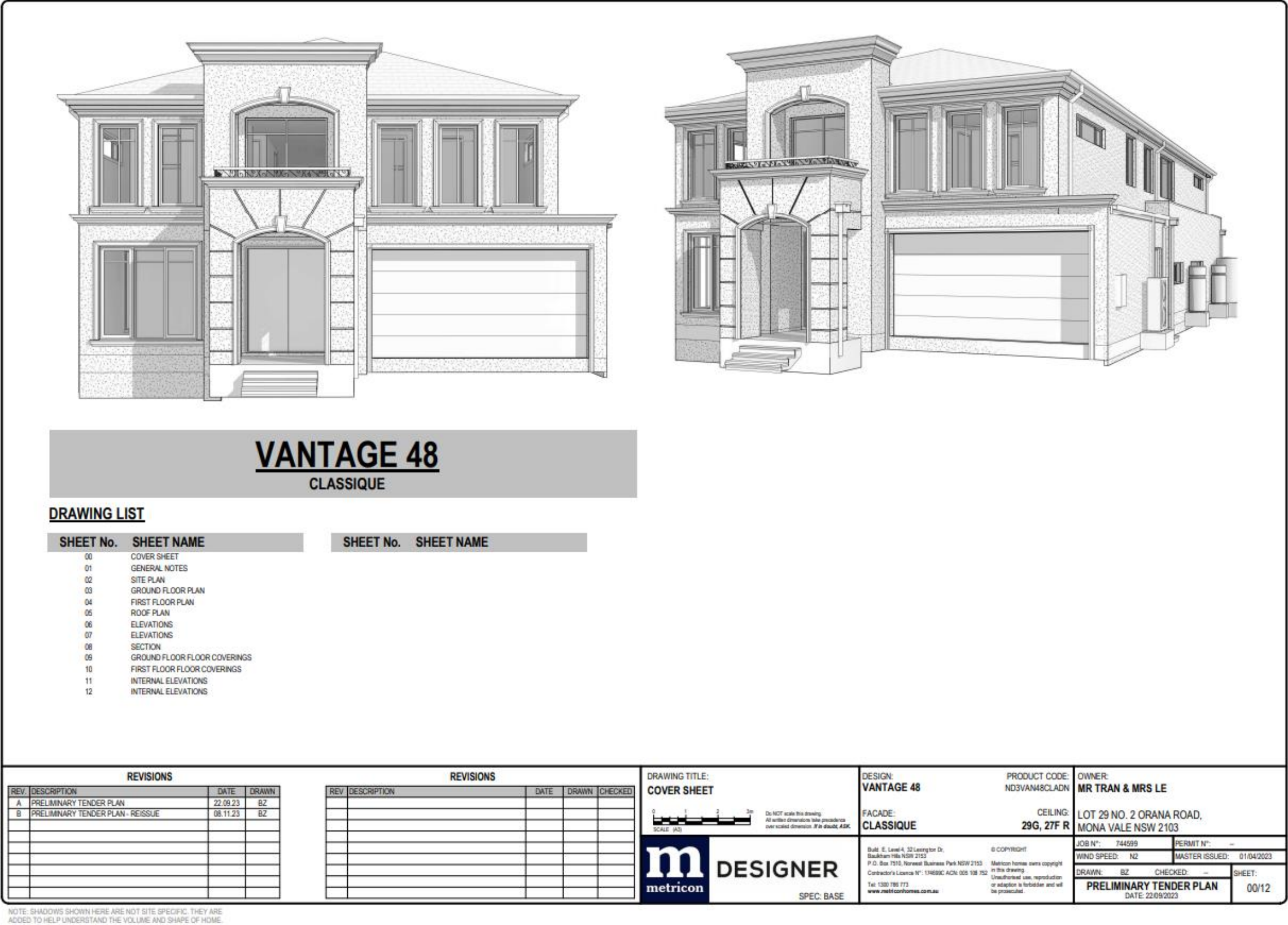
Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event.
- Extent does not include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Flood study reference) and aerial photography (Source: NearMap 2014) are indicative only.

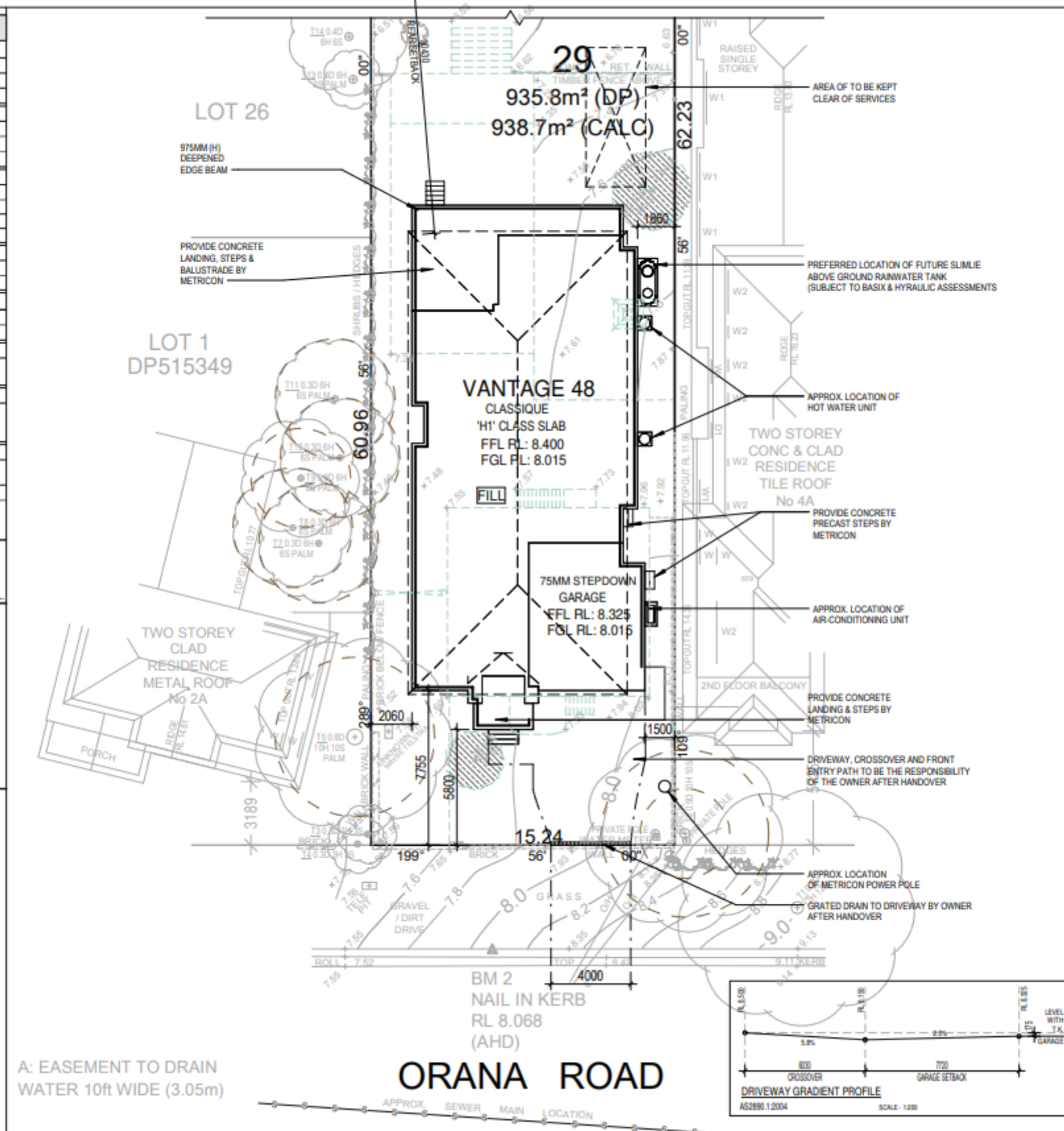
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APPENDIX C – ARCHITECTURAL PLAN OF PROPOSED DEVELOPMENT

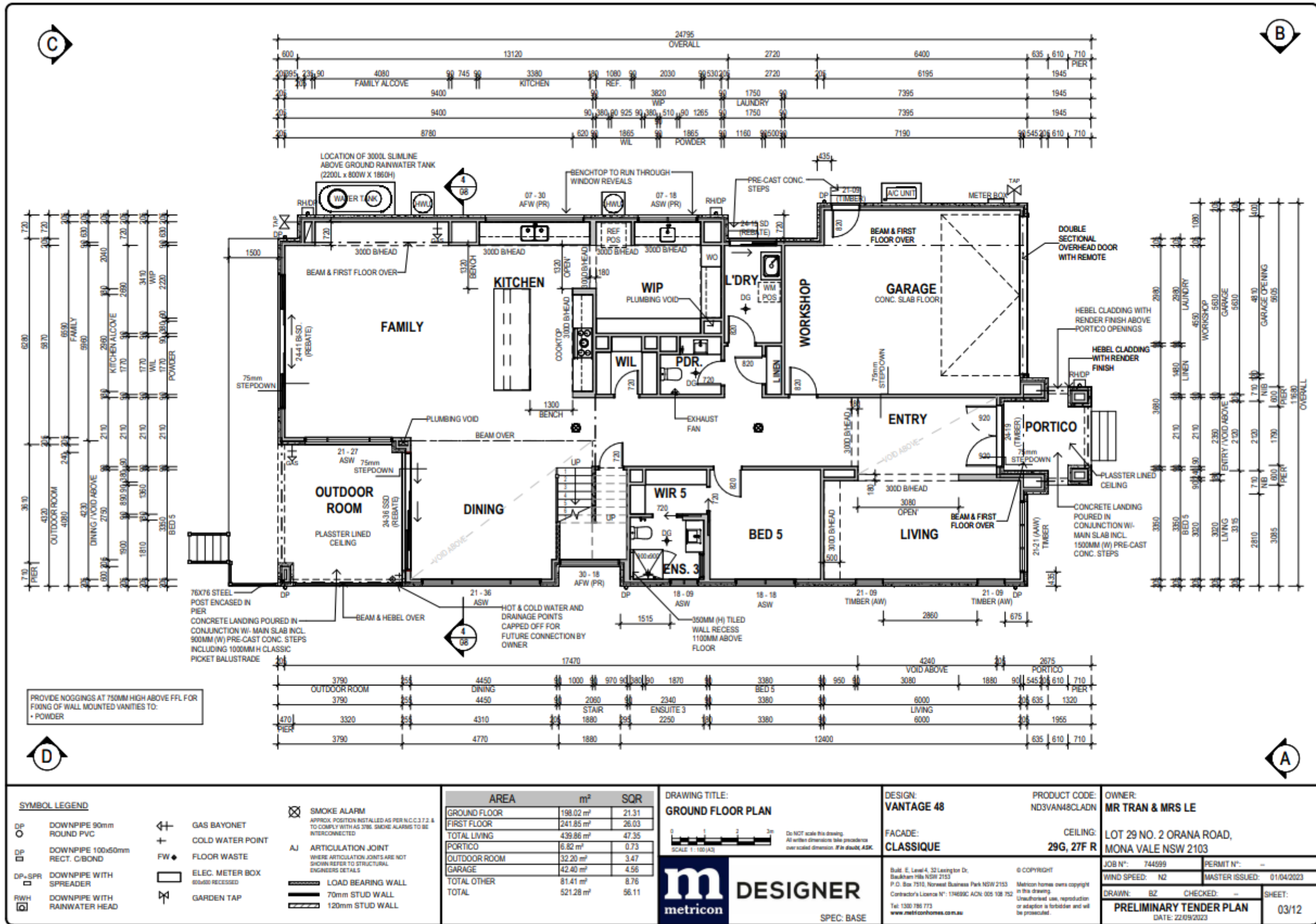


NORTHERN BEACHES COUNCIL	
PITTWATER LEP 2014 / DCP 21	
SITE AREA	935.8SQM
PROPOSED ROOF COVERAGE	298.22SQM
LANDSCAPE AREA	
(Excluding all hard surfaces, min. dim. of 2m.	
564.89SQM	60%
Min. required by Council - 50%	
FRONT YARD LANDSCAPE AREA	
Total front yard area:	111.91SQM
Landscape front yard area:	67.44SQM
Landscape front yard area:	60.26%
Min. required by Council - 60%	
PRIVATE OPEN SPACE	
min. dimension of 3.0m	496.16SQM
min. required by council - 80m²	
BUILDING HEIGHT RESTRICTION	
MAXIMUM 8.5m RIDGE HEIGHT	
(FFL must be accurate to comply)	
EARTHWORK	
- Maximum 1000mm cut - Maximum 1000mm fill	
BUILDING ENVELOPE	
- PROVIDE 45 DEGREE PLAN PROJECTED AT 3.5M HIGH ABOVE SITE BOUNDARY NATURAL GROUND LEVEL.	
STORMWATER CALCULATION	
Hard Landscape area: (incl. roof/driveway/path etc)	324.15SQM
Existing site coverage:	391.66SQM
Maximum allowable by council prior to O.S.D. being required: (Existing site coverage + 50sqm)	441.66SQM
DEMOLITION REQUIREMENTS:	
SITE TO BE CLEARED OF ALL EXISTING STRUCTURES, LEVELED AND ALL SERVICES RELOCATED BY THE OWNER TO THE SATISFACTION OF METRICON HOMES P/L	
	EXISTING TREES TO BE LOPPED / REMOVED BY OWNER:
TREE REMOVAL REQUIREMENTS:	
SITE TO BE CLEARED BY OWNER OF ANY EXISTING TREES AND/OR PRUNE TREES WHICH WILL EFFECT THE BUILDING AREA PRIOR TO CONSTRUCTION	
IT IS THE RESPONSIBILITY OF THE OWNER TO OBTAIN SEPARATE COUNCIL APPROVAL IF REQUIRED.	
IT IS THE RESPONSIBILITY OF THE OWNER TO PROVIDE A GRATED DRAIN ACROSS GARAGE OPENINGS (IF REQUIRED) DUE TO CONSTRUCTION OF DRIVEWAY	
<u>SURVEYOR'S NOTES</u>	
- THIS SURVEY IS SPECIFICALLY FOR CONTOUR PURPOSES ONLY. THE BOUNDARIES OF THE SUBJECT PROPERTY HAVE NOT BEEN INVESTIGATED AND THE POSITION SHOWN IS APPROXIMATE ONLY. - AREAS AND DIMENSIONS ARE SUBJECT TO SURVEY. - SERVICES SHOWN HAVE BEEN DERIVED FROM VISUAL EVIDENCE APPARENT AT THE TIME OF SURVEY. THE RELEVANT SERVICE AUTHORITY SHALL BE CONTACTED TO VERIFY THE EXISTENCE AND POSITION OF ALL SERVICES PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION OR EXCAVATION. - CONTOURS ARE INDICATIVE OF SURFACE TOPOGRAPHY ONLY. SURVETED SPOT LEVELS ARE THE ONLY VALUES TO BE RELIED ON FOR REDUCED LEVELS ON PARTICULAR FEATURES.	



EXCAVATION NOTES			
50MM (±0.1) TOLERANCE TO NOMINATED R/L'S EXCAVATE APPROX. 50mm ON R/L. 8.015 AND RETAIN FILL WITH DEEP EDGE BEAM			
EXCAVATIONS ARE TO START A MINIMUM OF 1000mm FROM THE EDGE OF THE BUILDING AND ARE TO BE BATTERED BACK TO SUIT.			
IT IS THE RESPONSIBILITY OF THE OWNER TO PROVIDE A GRATED DRAIN ACROSS GARAGE OPENINGS (IF REQUIRED) DUE TO CONSTRUCTION OF DRIVEWAY			
EXCAVATION			
SITE CUTS ARE SUBJECT TO COUNCIL APPROVAL & NOT TO BE USED BY ANY OTHER CONTRACTORS OTHER THAN METRICON HOMES PTY LTD			
PRELIMINARY SITE PLAN NOTES			
SITING IS SUBJECT TO THE CONFIRMATION OF COUNCIL'S BUILDING REGULATIONS AND REQUIREMENTS			
TEMPORARY SITE FENCING			
METRICON TO PROVIDE FENCING TO ANY UNFENCED BOUNDARIES			
ALL WEATHER ACCESS			
METRICON TO SUPPLY UP TO 5m SUITABLE ALL WEATHER ACCESS TO BUILDING PLATFORM DURING CONSTRUCTION			
STORMWATER DRAINAGE TO			
EXISTING EASEMENT VIA RAINWATER TANK			
SURVEY LEGEND			
	GULLY PIT		SEWER LINE
	HYDRANT		VEHICLE CROSSING
	SURFACE INLET PIT		STOP VALVE
	SEWER INSPECTION COVER		DEEP EDGE BEAM
	SEWER MANHOLE		GAS METER
	WATER METER		LIGHT POLE
	ELECTRICITY BOX		INVERT
	STORMWATER MANHOLE		TOP OF KERB
	TELSTRA PIT		KERB OUTLET
		approval type: COUNCIL	
MGA		developer approval: N/A	
		zone: R2	
		WIND SPEED N2	
		SLAB CLASS H1	
drawing title: SITE PLAN			
Do Not scale this drawing. All written dimensions take precedence over scaled dimension. If in doubt, ASK.			
		DESIGNER	
design: VANTAGE 48			
facade: CLASSIQUE			
Build: E, Level 4, 32 Lexington Dr, Buckham Hills NSW 2153 P.O. Box 7510, Norwest Business Park NSW 2153 Contractor Licence No: 174 689 - A.C.N. 605 108 752			
Tel: (02)6897-9000 - Fax: (02)8075-5901 www.metricon.com.au			
OWNER: MR TRAN & MRS LE			
LOT 29 NO. 2 ORANA ROAD, MONA VALE NSW 2103			
job no: 744599	DP no: SEC E 6195	date: 22/09/2023	
council/LGA: NORTHERN BEACHES		sheet: 02/12	revision:
drawn: BZ	check: XX	master version: 01/04/2023	
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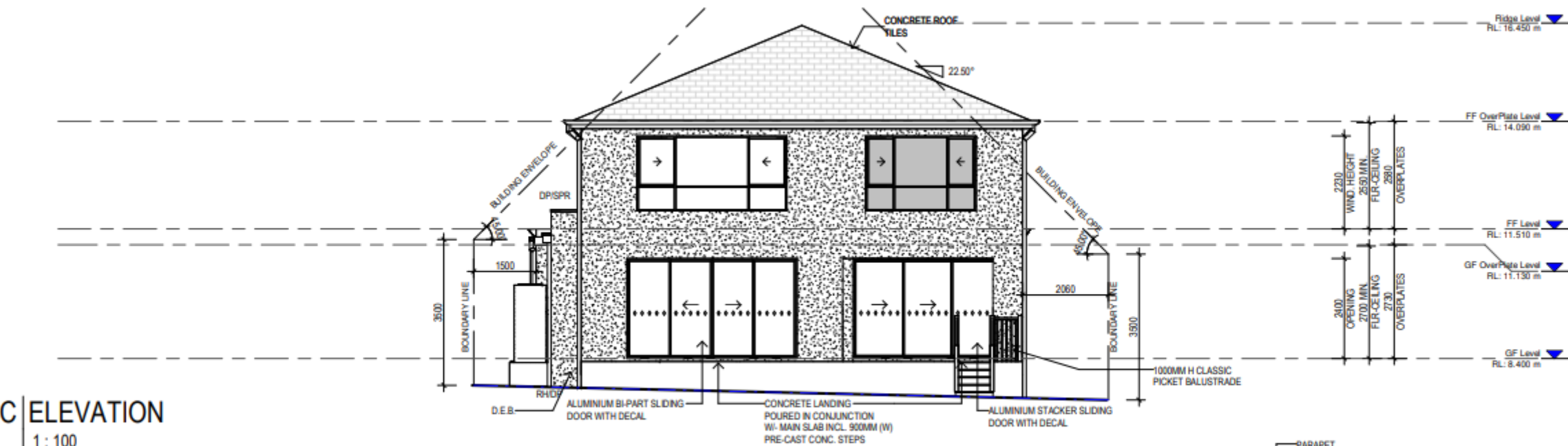
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21/11/2023 10:40:49 AM

C ELEVATION

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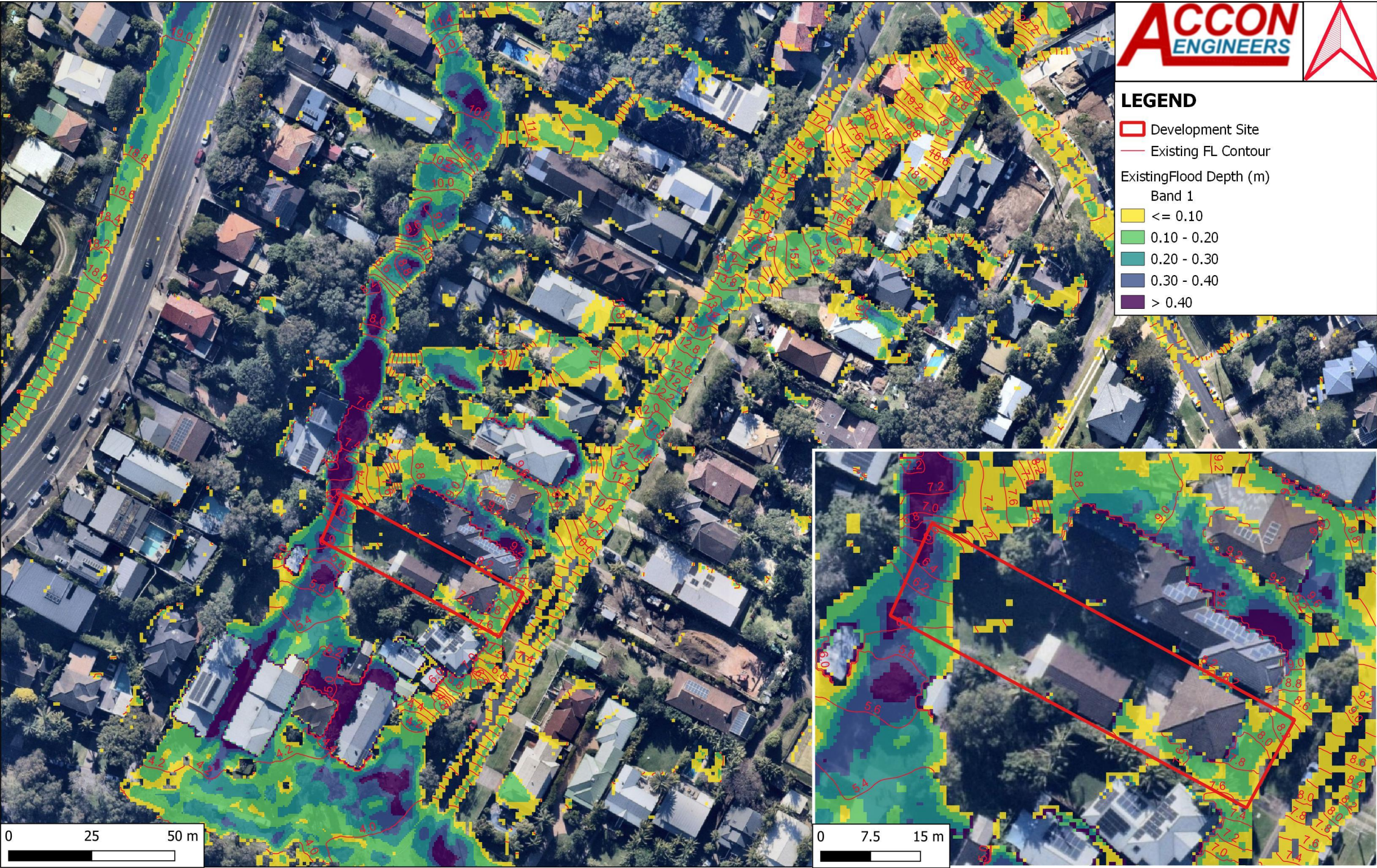
D ELEVATION

1:100



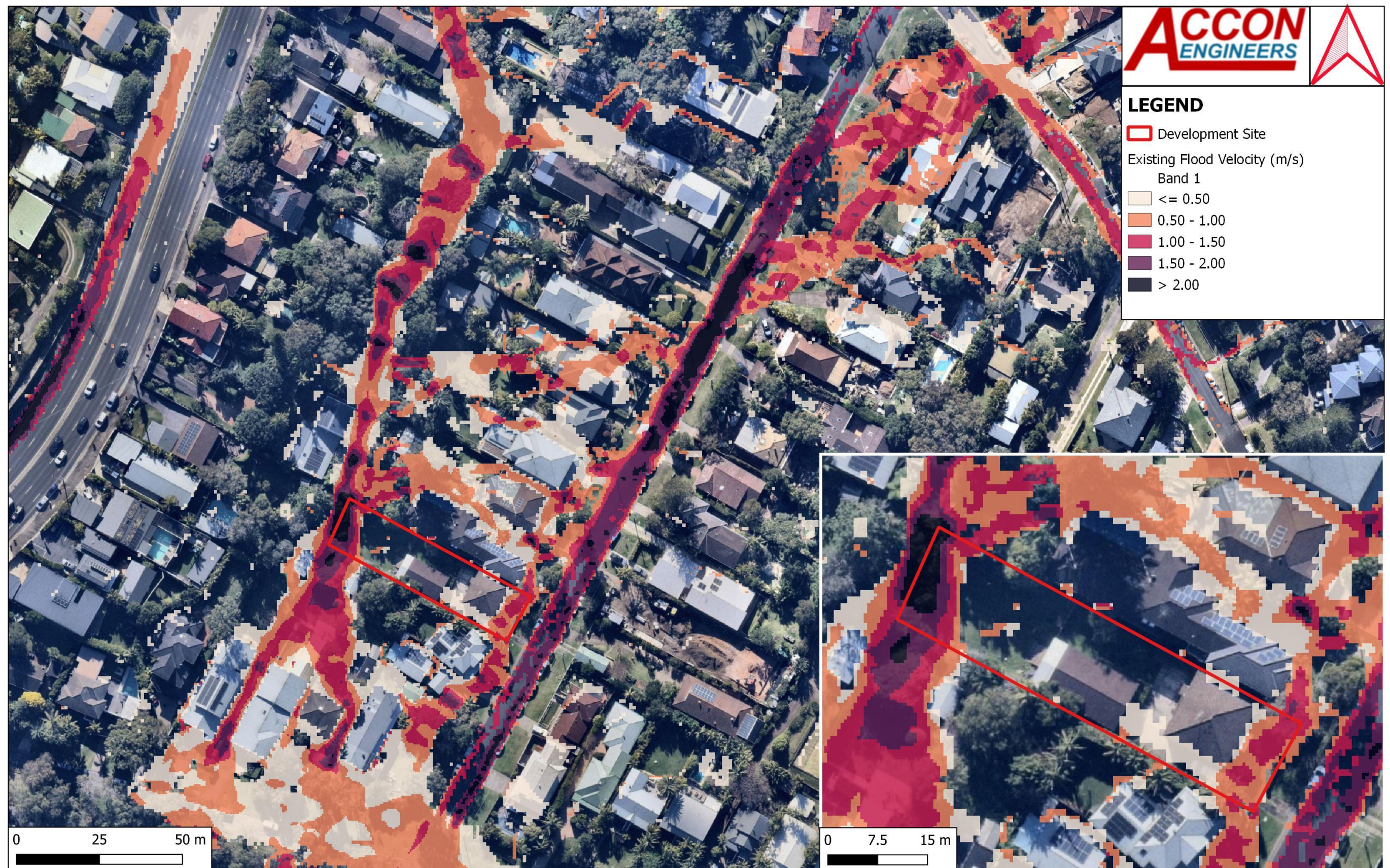
NOTES:		SYMBOL LEGEND		DRAWING TITLE: ELEVATIONS		DESIGN: VANTAGE 48		PRODUCT CODE: ND3VAN48CLADN		OWNER: MR TRAN & MRS LE	
AJ ARTICULATION JOINT WHERE ARTICULATION JOINTS ARE NOT SHOWN REFER TO STRUCTURAL ENGINEERS DETAILS		DENOTES WINDOWS/DOORS WITH 6mm SP10 CLEAR SMARTGLASS		0 1 2 3m SCALE: 1:100 (A3)		FACADE: CLASSIQUE		CEILING: 29G, 27F R		LOT 29 NO. 2 ORANA ROAD, MONA VALE NSW 2103	
DENOTES WINDOWS/DOORS WITH 4mm OBSCURE DECOR SATIN GLAZING		DENOTES WINDOWS/DOORS WITH TRANSLUCENT GLAZING		Do NOT scale this drawing. All written dimensions take precedence over scaled dimension. If in doubt, ASK.		Build: E, Level 4, 32 Lexington Dr, Bankham Hills NSW 2153 P.O. Box 7510, Norwest Business Park NSW 2153 Contractor's Licence N°: 114699G ACN: 005 158 752 Tel: 1300 785 773 www.metriconhomes.com.au		© COPYRIGHT Metricon homes owns copyright in this drawing. Unauthorized use, reproduction or adaptation is forbidden and will be prosecuted.		JOB N°: 744599 WIND SPEED: N2 DRAWN: BZ CHECKED: -- DATE: 22/09/2023	
PROVIDE ACRYLIC RENDER FINISH TO HEBEL PANELS TO ALL ELEVATIONS (UNLESS NOTED OTHERWISE)				m metricon		DESIGNER		SPEC: BASE		PERMIT N°: -- MASTER ISSUED: 01/04/2023 SHEET: 07/12	
										PRELIMINARY TENDER PLAN	

APPENDIX D – FLOOD MAPS FOR EXISTING CONDITION



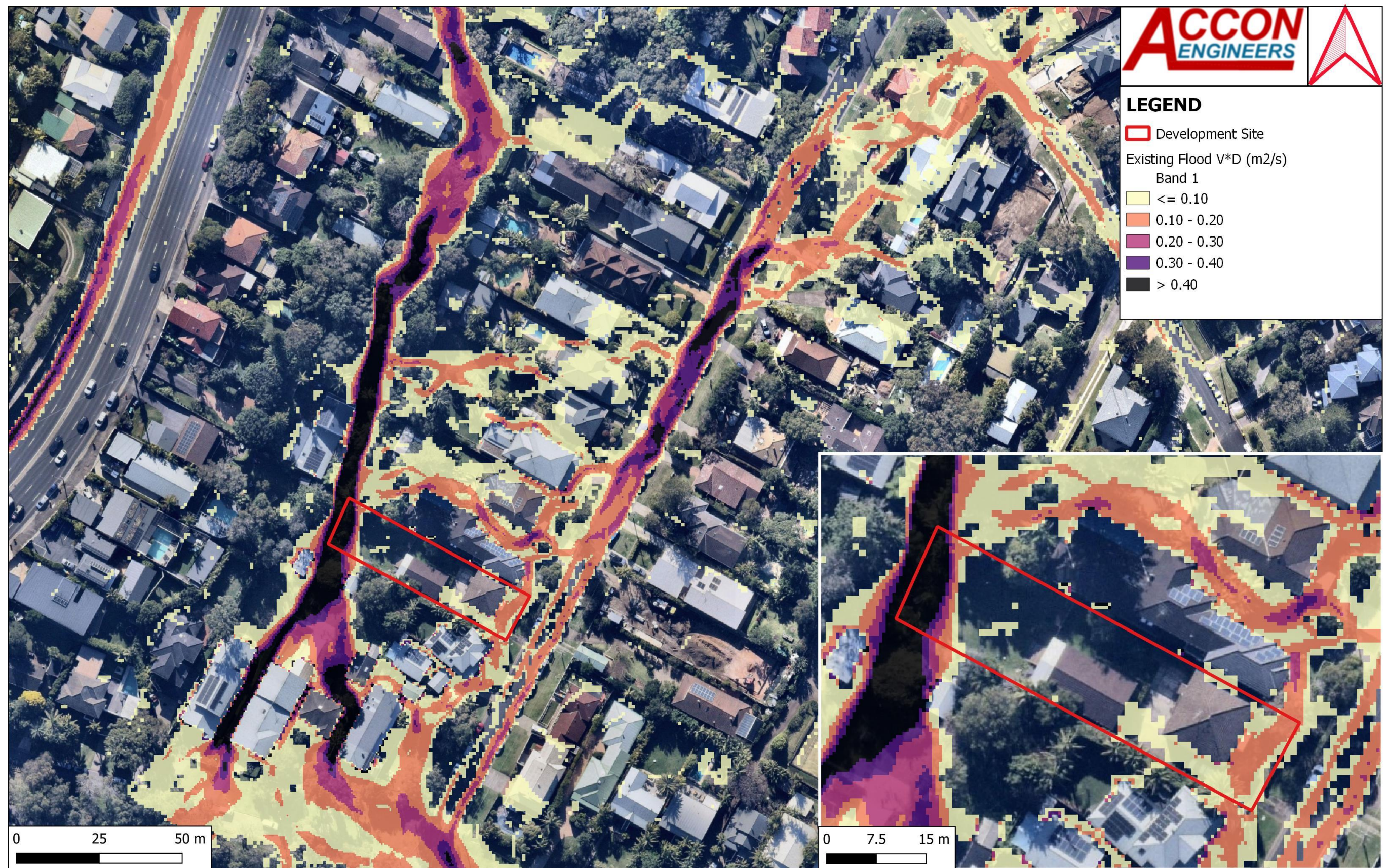
1% AEP Flood Depth Map with Flood Level Contour
Existing Condition

2 Orana Road
Mona Vale



**1% AEP Flood Velocity Map
Existing Condition**

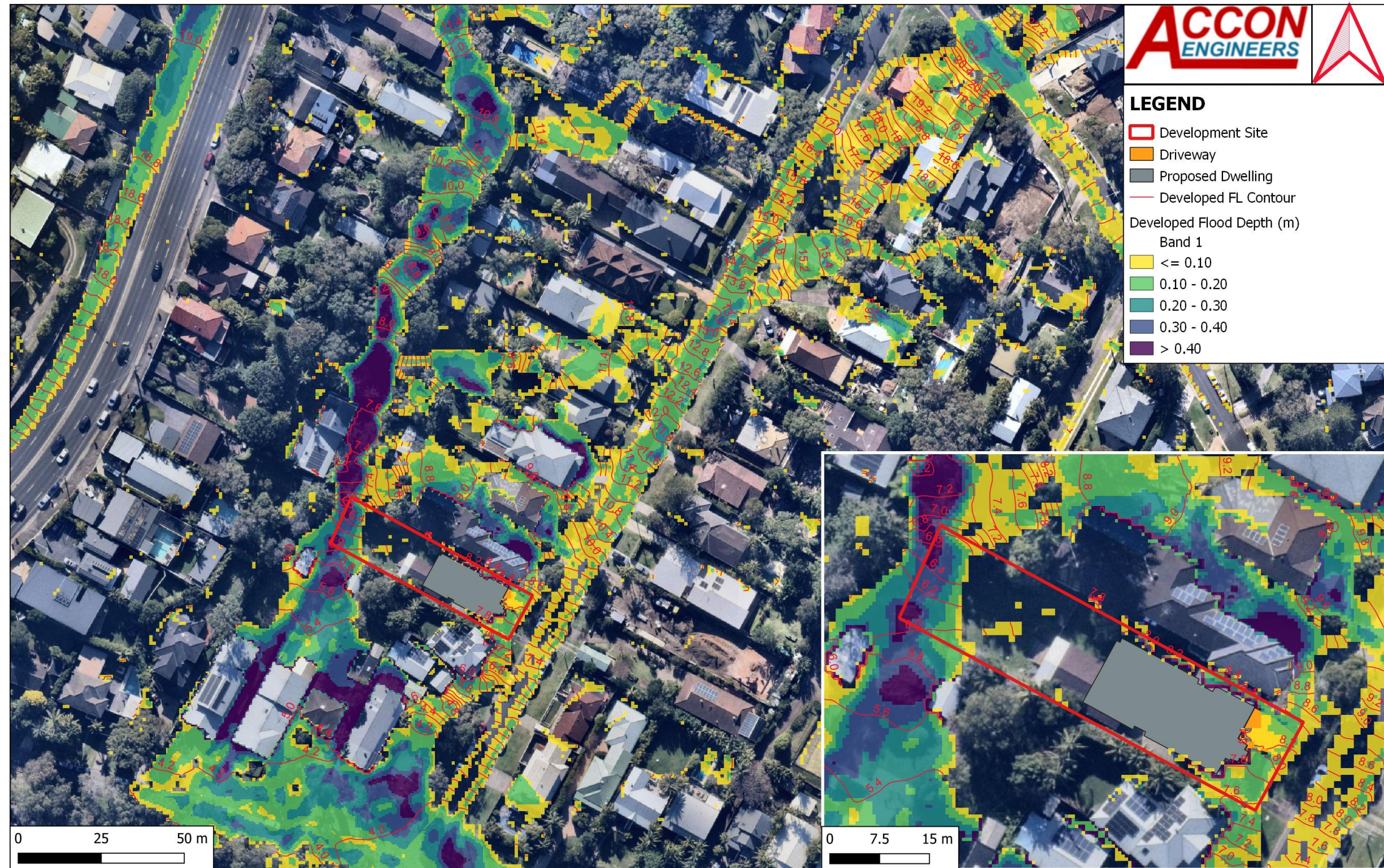
**2 Orana Road
Mona Vale**



**1% AEP Flood Velocity Depth Product (V*D) Map
Existing Condition**

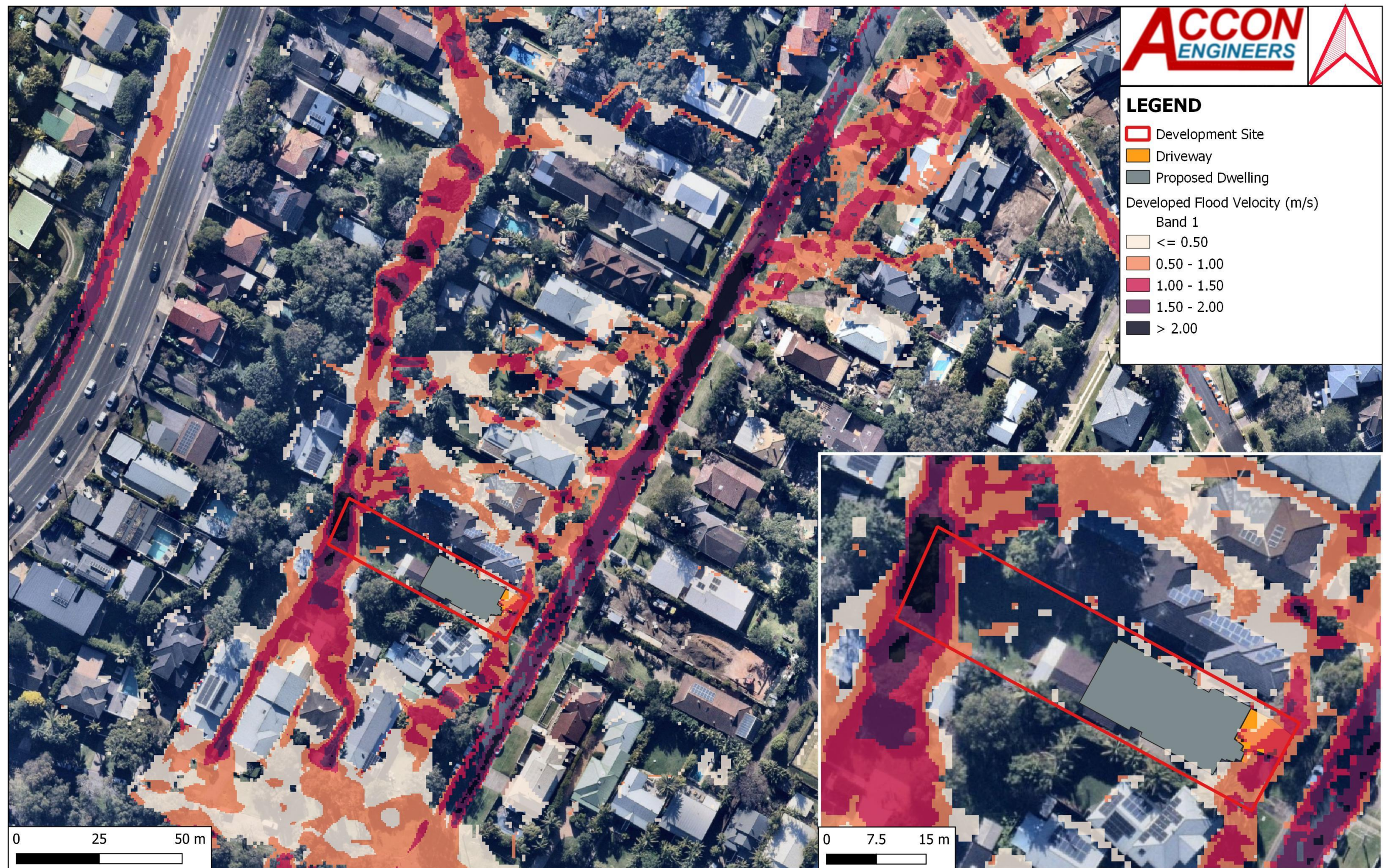
**2 Orana Road
Mona Vale**

APPENDIX E – FLOOD MAPS FOR DEVELOPED CONDITION



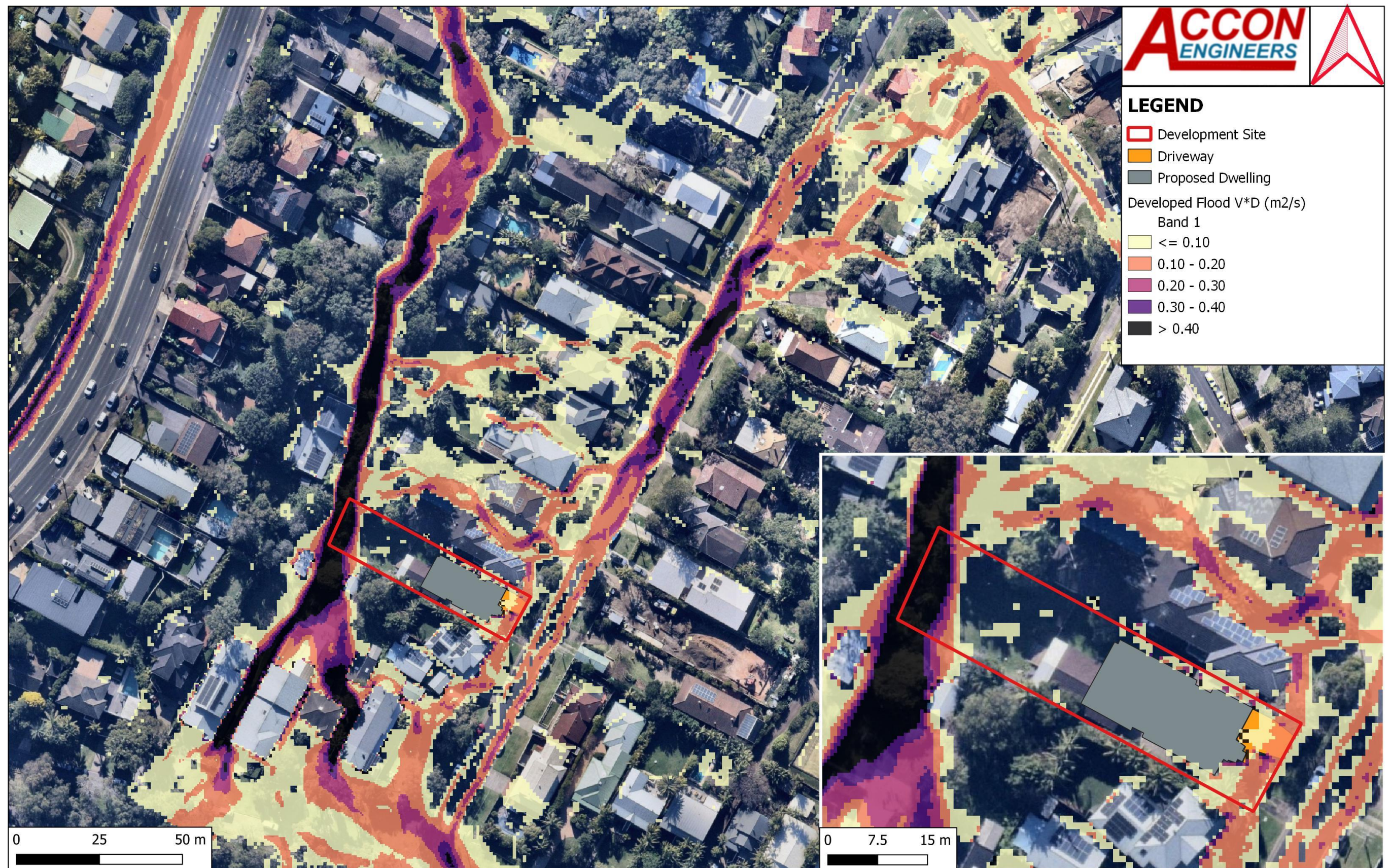
**1% AEP Flood Depth Map with Flood Level Contour
Developed Condition**

**2 Orana Road
Mona Vale**



**1% AEP Flood Velocity Map
Developed Condition**

**2 Orana Road
Mona Vale**



**1% AEP Flood Velocity Depth Product (V*D) Map
Developed Condition**

**2 Orana Road
Mona Vale**

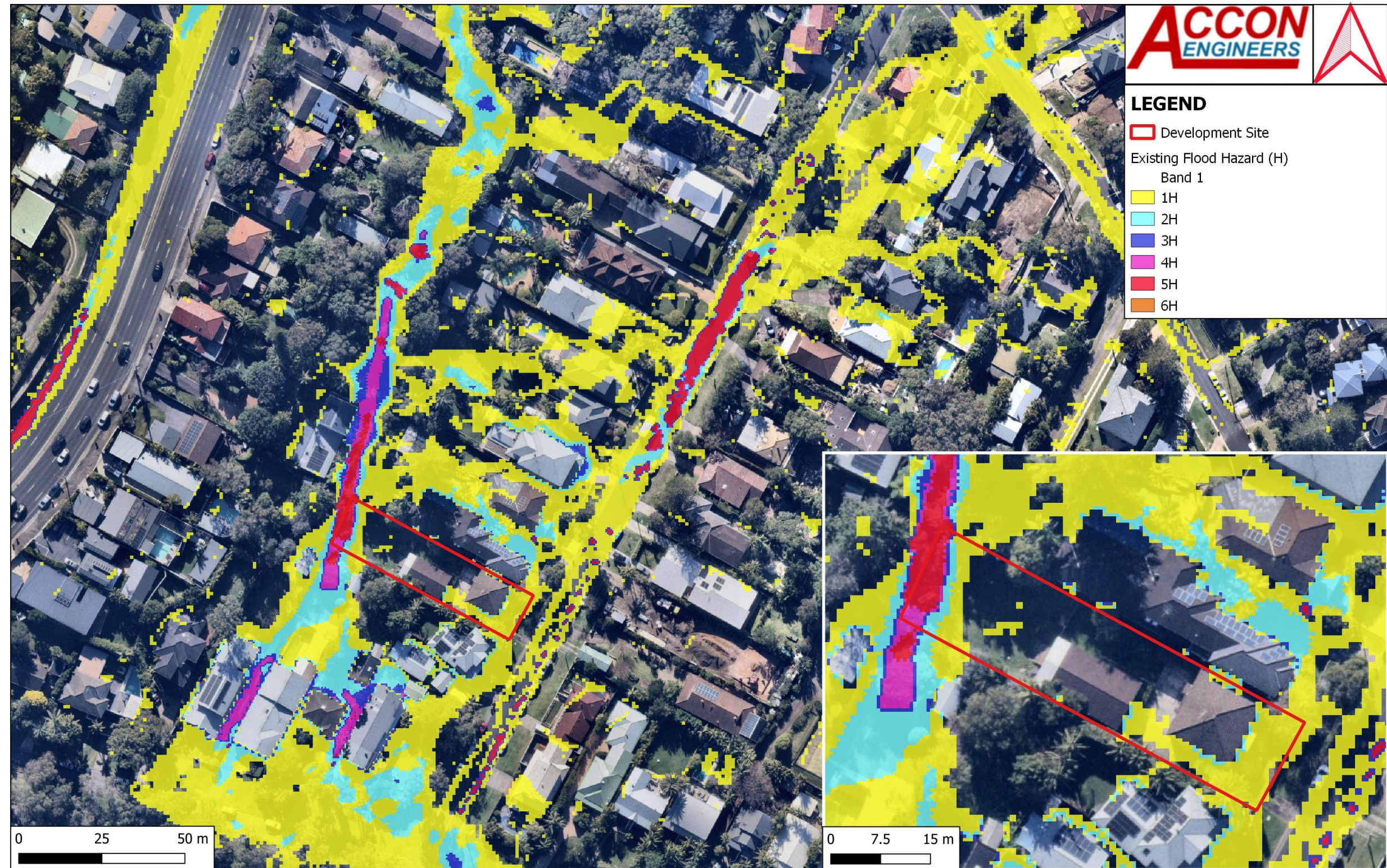
APPENDIX F – FLOOD LEVEL DIFFERENCE MAP



1% AEP Flood Level Difference Map
Developed Condition Vs Existing Condition

2 Orana Road
Mona Vale

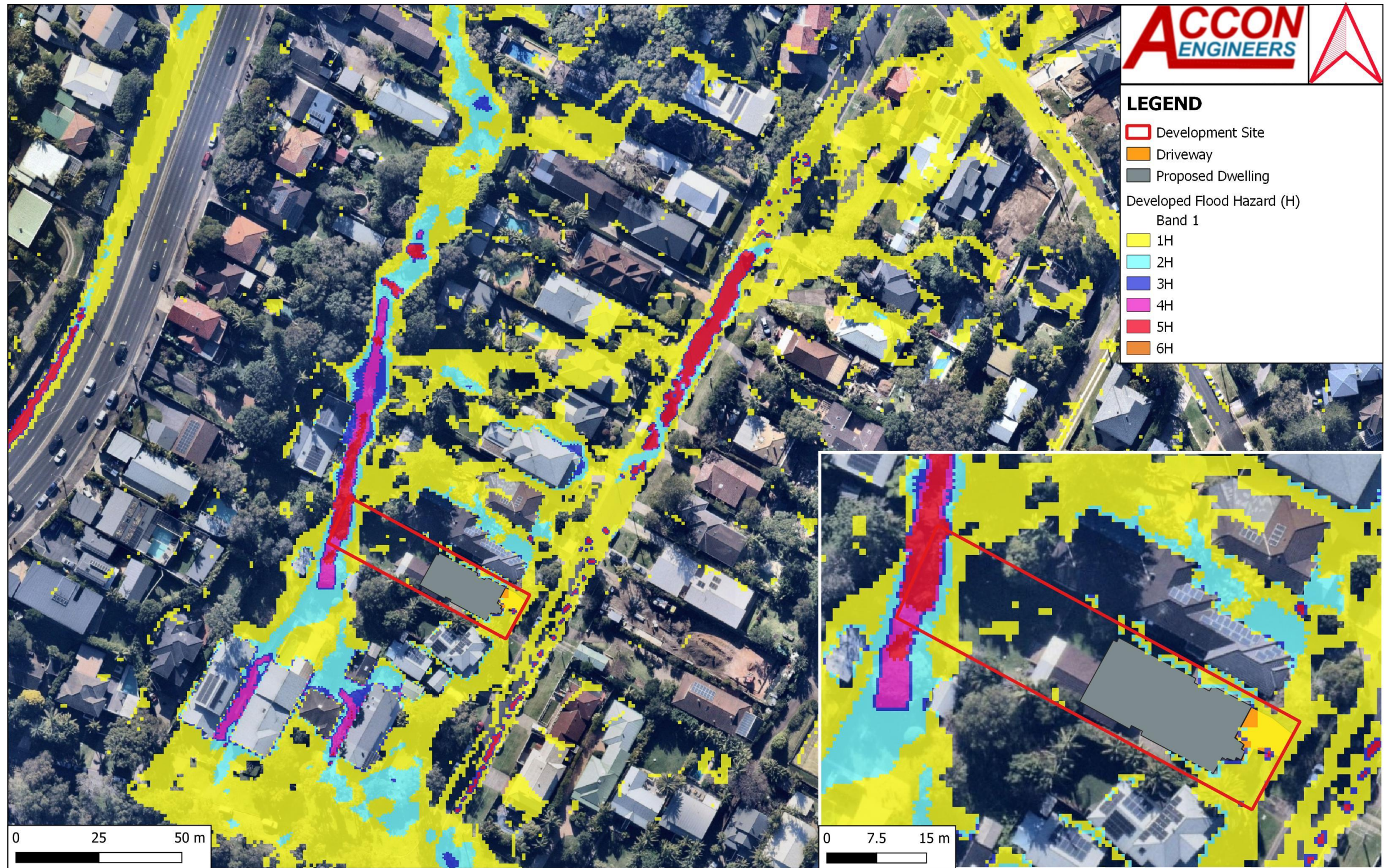
APPENDIX G – FLOOD HAZARD VULNERABILITY MAP FOR EXISTING CONDITION



**1% AEP Flood Hazard Category Map
Existing Condition**

**2 Orana Road
Mona Vale**

APPENDIX H – FLOOD HAZARD VULNERABILITY MAP FOR DEVELOPED CONDITION



**1% AEP Flood Hazard Category Map
Developed Condition**

**2 Orana Road
Mona Vale**