Project No: 2016-023
Revision No: 1
Date: 15 July 2016

FLOOD RISK EMERGENCY ASSESSMENT REPORT

Proposed Alterations & Additions to the Existing Dwelling House and New Secondary Dwelling

at

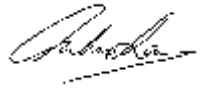
Lot 5 DP 21687 – 38 Elaine Avenue, Avalon

for

Ryan & Gemma Stone

Report Prepared By:

WATERDESIGN CIVIL ENGINEERS
ABN 779 281 667 29



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1 Overview

1.1 Purpose

This report has been commissioned at the request of Ryan and Gemma Stone and prepared in accordance with the Flood Emergency Response Planning for Development in Pittwater Policy as outlined in Appendix 15 and Part B3 Hazard Controls of Pittwater 21 Development Control Plan.

1.2 Proposed Development

The proposed development involves the alterations and additions to the existing dwelling house and the erection of a new secondary dwelling at the rear of the site. Reference shall be made to the architectural drawing by markham-lee architecture reference Garden House DA Issue Drawings dated 06.07.2016.

1.3 Existing Site Conditions

The development site is very flat with less than 0.2 metres fall in all directions. There is currently a single storey dwelling house on the development site with a carport structure to the northern side to the rear of the house.

2 Flood Information Data

2.1 Catchment / Floodplain Characteristics

The development site is affected by mainstream flooding from Careel Creek located to the east of the development site to the rear of 39 and 41 Elaine Avenue. The information has been derived from the 2013 Careel Creek Flood Study by WMA.

2.2 Flood Life Hazard Category

The proposed extension to the existing garage development is located on part of the development site that has been identified as having a Flood Life Hazard Category of **H5.**

2.3 Flood Category 1 – Mainstream Flooding

The property has been identified as being located within the primary floodplain areas from Careel Creek where the lowest point of the property is below flood planning level (1% AEP flood level plus 0.5 m freeboard).

2.4 Flood Category 3 – Overland Flow (Major)

The property is identified as being within a flood category 3 overland flow path area. The subject property is located within the primary flood plain area affected by flood hazards associated with the overland flow path – Major Extent.

2.5 1% AEP Flood Levels

Main Dwelling House

The maximum 1% AEP flood maximum water level at the location of the proposed extensions to the main dwelling house is **RL 3.75 mAHD** with a corresponding maximum water depth of **d = 0.46 metres** and the maximum velocity of **v = 0.30 m/s**. The flood is classified as being **Low Hazard.** The proposed development is located in an area on the property that is identified as being a flood fringe area. The finished floor level of the proposed additions is designed at **RL 4.30 mAHD** and is satisfactorily above the flood planning level **FPL 4.25 mAHD**.

The existing part of the dwelling to remain has a floor level at **RL 3.65 mAHD** which is satisfactorily above the corresponding 1% AEP flood level of RL 3.62 mAHD. The existing structure is required to be flood proofed wet and/or dry up to the flood planning level **FPL 4.12 mAHD** by a qualified structural engineer.

Secondary Dwelling

The maximum 1% AEP flood maximum water level at the location of the proposed granny flat is **RL 3.74 mAHD** with a corresponding maximum water depth of **d = 0.36 metres** and the maximum velocity of **v = 0.24 m/s**. The flood is classified as being **Low Hazard.** The proposed development is located in an area on the property that is identified as being a flood fringe area. The finished floor level of the proposed secondary dwelling is designed at **RL 4.30 mAHD** and is satisfactorily above the flood planning level **FPL 4.24 mAHD**.

Open Car Park Areas & Carports

The depth of flooding in the 1% AEP flood exceeds 0.3 metres in the area of the proposed open car park area and carports and therefore, vehicle barriers or restraints shall be provided to prevent floating vehicles leaving the site.

In-ground Swimming Pool

The proposed swimming pool is designed to be constructed in-ground with finished coping level being at the existing ground level. This satisfactorily ensures that there will be no adverse flooding impacts on surrounding properties and there is no net decrease in floodplain volume as the pool is located in a flood fringe area,

2.6 (PMF) Probable Maximum Flood Levels

Main Dwelling House

The maximum PMF flood maximum water level at the location of the proposed main dwelling house extension is **RL 5.58 mAHD** with a corresponding maximum water depth of **d = 2.91 metres** and maximum velocity of **v = 1.84 m/s**.

Granny Flat

The maximum PMF flood maximum water level at the location of the proposed granny flat is **RL 5.58 mAHD** with a corresponding maximum water depth of **d = 2.26 metres** and maximum velocity of **v = 0.75 m/s**.

3 FLOOD RISK ASSESSMENT

3.1 1% AEP Flood Risk Assessment Matrix Table

Hazard	Likelihood	Consequence	Risk Level
Person in proposed building / dwelling being impacted by floodwaters	**4 - Unlikely**	**D - Minor**	**Low (L)**
Persons entering floodwater on property	**4 - Unlikely**	**D - Minor**	**Low (L)**
Proposed building / dwelling being impacted by floodwaters – structural viability	**4 - Unlikely**	**D - Moderate**	**Low (L)**
Vehicles being impacted by floodwaters	**4 - Unlikely**	**D - Moderate**	**Low (L)**
Floodwater entering carport / garage / basement	**4 - Unlikely**	**D - Moderate**	**Low (L)**
Floodwater entering building / dwelling	**4 - Unlikely**	**D - Moderate**	**Low (L)**

3.2 PMF Flood Risk Assessment Matrix Table

Hazard	Likelihood	Consequence	Risk Level
Person in proposed building / dwelling being impacted by floodwaters	**5 - Rare**	**B - Severe**	**Low (L)**
Persons entering floodwater on property	**5 - Rare**	**B - Severe**	**Low (L)**
Proposed building / dwelling being impacted by floodwaters – structural viability	**5 - Rare**	**B - Severe**	**Low (L)**
Vehicles being impacted by floodwaters	**5 - Rare**	**B - Severe**	**Low (L)**
Floodwater entering carport / garage / basement	**5 - Rare**	**B - Severe**	**Low (L)**
Floodwater entering building / dwelling	**5 - Rare**	**B- Severe**	**Low (L)**

3.3 Flood Risk Assessment Category

The risk assessment for the 1% AEP flood and PMF event has been determined to be a **Low Risk Level**. The flood life hazard category has been identified as being **H5.**

The outcome of the flood risk assessment for the subject site is categorised as being a **Tolerable Risk** – Flood risk to life is considered significant and the flood emergency response planning policy shall apply for the proposed development.

4 FLOOD RISK EMERGENCY PLAN

4.1 Nature of Flooding

The subject site is located in the Careel Creek Floodplain which covers the central low lying area of the suburb of Avalon. The duration of inundation for the Careel Creek catchment is considered to be 'short duration' flooding (less than 6 hours duration in the PMF storm event (flash flooding).

4.2 Evacuation Feasibility

Guidelines for emergency planning in flash flooding events states that evacuation too late may be worse than not evacuating at all due to the potential dangers of moving through flood waters at high velocity. Nevertheless, where available warning time and resources permit, evacuation should be the primary response.

The key advantage of flood evacuation as an emergency response is to eliminate isolation as a potential hazard during the flood event. The potential hazards associated with isolation include the following:

- Isolation from Medical Services – in the event of a medical emergency such as a pre-existing condition, injury or heart attack etc. medical services can be accessed.

- Isolation from Supplies – Isolation from drinking water, food, amenities and communication lines.

Pittwater Council assumes that isolation from medical services poses a greater risk to life and therefore if flood free land does not have access through public land t

4.3 Flood Emergency Response

The evacuation feasibility needs to account for the Flood Emergency Response Planning classification of the development site. The subject site as with a majority of the Pittwater LGA is isolated from a medical service centre and is therefore classified as being a **High Flood Island.** *(Reference: Pittwater LGA Flood Risk to Life Classification Study).*

In this regard, flood evacuation for the subject site is considered a secondary response as evacuation off the site is conducted up to a certain time until this option is no longer available shelter in place is relied upon thereafter to a location on site above the PMF flood level.

4.4 Shelter in Place

For shelter in place to be considered an acceptable emergency response it can be demonstrated that the following development controls listed below have been satisfactorily addressed.

- Minimum Floor Level for Shelter in Place – The minimum floor level of the shelter in place shall be equal to the PMF flood level **RL 5.58 mAHD**. The proposed dwelling house and granny flat is a single storey construction with a proposed finished floor level of RL 4.30 mAHD being below the PMF flood level. It is therefore, recommended that flood refuge be provided within the roof space of the main dwelling house given this is a joint family development. An attic space has been provided above bedroom 2 and 3 compliant with the minimum room heights as specified in the Building Code of Australia.

- Floor Space – The minimum floor space required for shelter in place refuge for short duration flooding is 1 m2 per person. The main dwelling and granny flat is expected to have a maximum occupancy of 6 persons and therefore the flood refuge has a minimum floor area of 6 m2.

- Accessibility – Shelter in place refuge must be intrinsically accessible to all people on the site, plainly evident and self directing with sufficient capacity and fail safe access provided with no reliance on elevators. A compliant attic ladder is proposed and is shown on the architectural drawings.

- Building Stability – The structural stability of the refuge building is to be verified by a suitably qualified structural engineer considering lateral flood flow, buoyancy, suction effects and debris load impact of the 1% AEP design flood depths and velocity. The subject site has a 1% AEP maximum flood depths of 0.51m and maximum velocity of 1.0-1.5 m/s. The flood hazard vulnerability curve would suggest that only small vehicles are unsafe. The flood refuge is required to be designed to comply with the Building Code of Australia requirements, with external components rated appropriately for storm, wind and moisture.

- Serviceability - For short duration flooding shelter in place refuge is to provide the following:

    1. Sufficient clean water for all occupants
    2. Portable radio with spare batteries
    3. Torch with spare batteries
    4. First Aid Kit

5 RECOMMENDATIONS

The proposed development satisfactorily complies with the Flood Emergency Response Planning for Development in Pittwater Policy as outlined in Appendix 15 and Part B3 Hazard Controls of Pittwater 21 Development Control Plan.

The flood risk assessment for the 1% AEP and PMF flood events resulted in a LOW risk level for all hazards.

It is recommended that the shelter in place be adopted as the flood emergency response during PMF storm events as outlined in Section 4.4 of this report It is anticipated that evacuation to shelter in place (flood refuge within the main dwelling house roof space) at a localised level where occupants visually see flooding in the vicinity and respond instinctively. The occupants should also be aware of any Flood Warnings issued by the Bureau of Meteorology.

ANNEXURE A

Pittwater Council General Purpose Flood Information

FLOOD INFORMATION REQUEST – GENERAL PURPOSE

Property: 38 Elaine Ave, Avalon
Lot DP: 5//21687
Issue Date: 22 January 2016
Flood Study Reference: 2013 Careel Creek Flood Study (WMA Water)

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

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

1% AEP Maximum Water Level[3]: 3.8mAHD (See Flood Map B)

1% AEP Maximum Peak Depth from natural ground level[3]: 0.51m

1% AEP Maximum Velocity: 1.0-1.5m/s

Flood Planning Level (FPL)[1,2, 3 &4]: 4.3m AHD or 0.5m above 1% AEP

1% AEP Provisional Flood Hazard: See Flood Map F

1% AEP Hydraulic Categorisation: See Flood Map G

Flood Category 3[5] (Overland Flow) – See Flood Map E

1% AEP Overland Flow Maximum Water Level[3&4]: 3.8m AHD

1% AEP Overland Flow Maximum Depth from Natural Ground Level[3&4]: 0.5m

1% AEP Overland Flow Maximum Velocity: 1.0-1.5m/s

Flood Category 2 (PMF) – See Flood Map D

Probable Maximum Flood (PMF) Level[2]: 5.58m AHD

PMF Maximum Depth from natural ground level: 2.5m

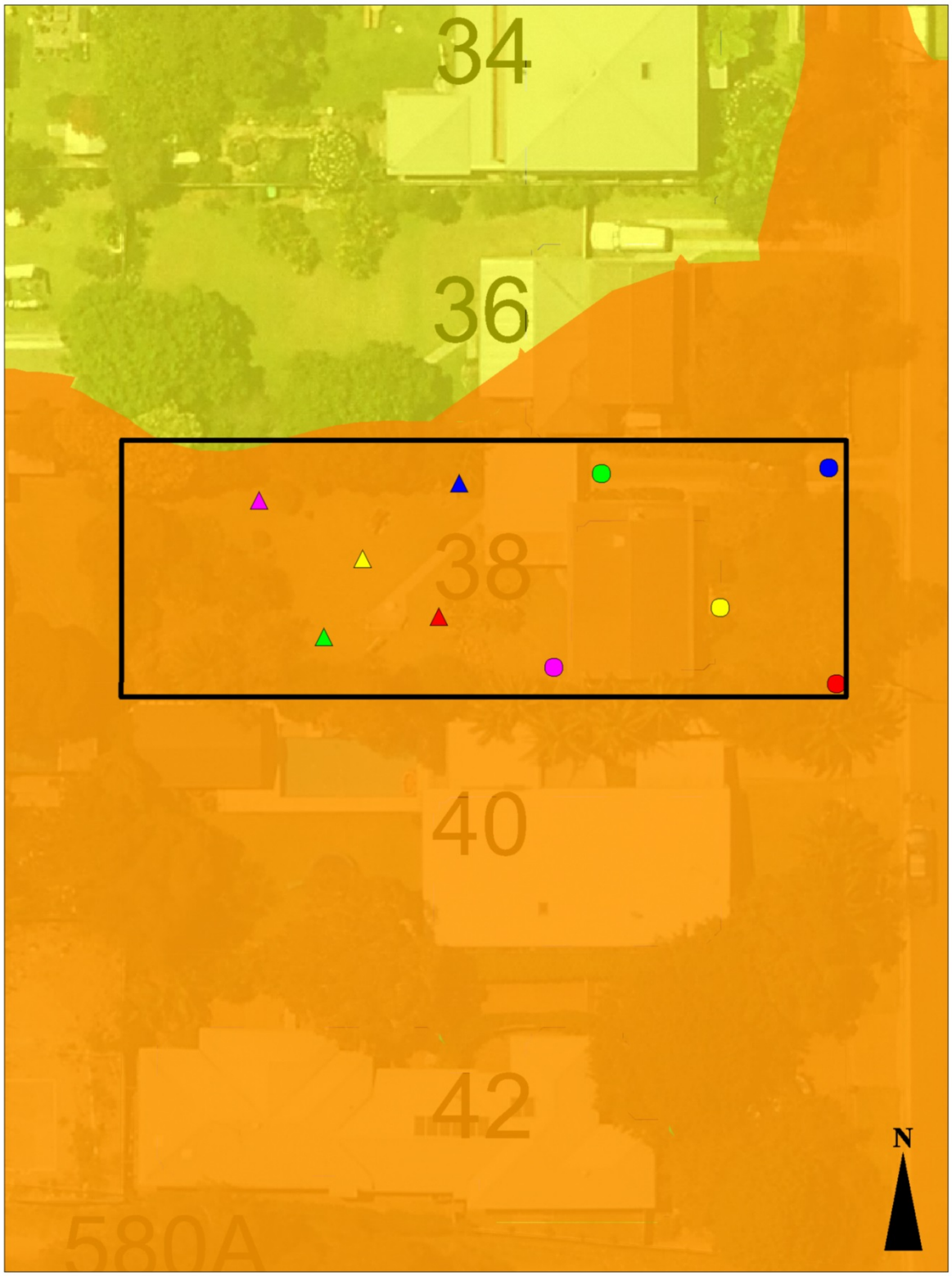
PMF Maximum Velocity: 1.5-2.0m/s

[1]Intensification of development requires the consideration of climate change impacts which may result in higher planning levels than those indicated on this flood advice.
[2]Special Flood Protection developments require a higher planning level using the higher of the PMF or FPL/minimum floor level.
[3]The flood information does not take into account any local overland flow issues with a depth below 0.15m nor private stormwater drainage systems.
[4]Overland flow water levels may vary across a sloping site, resulting in variable minimum levels across the site.
[5]The 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 Pittwater 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 Pittwater 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 reviewing the 2013 Careel Creek Catchment Flood Study and as such the property's flood classification and flood level may be subject to changes as a result of the updated flood modelling.

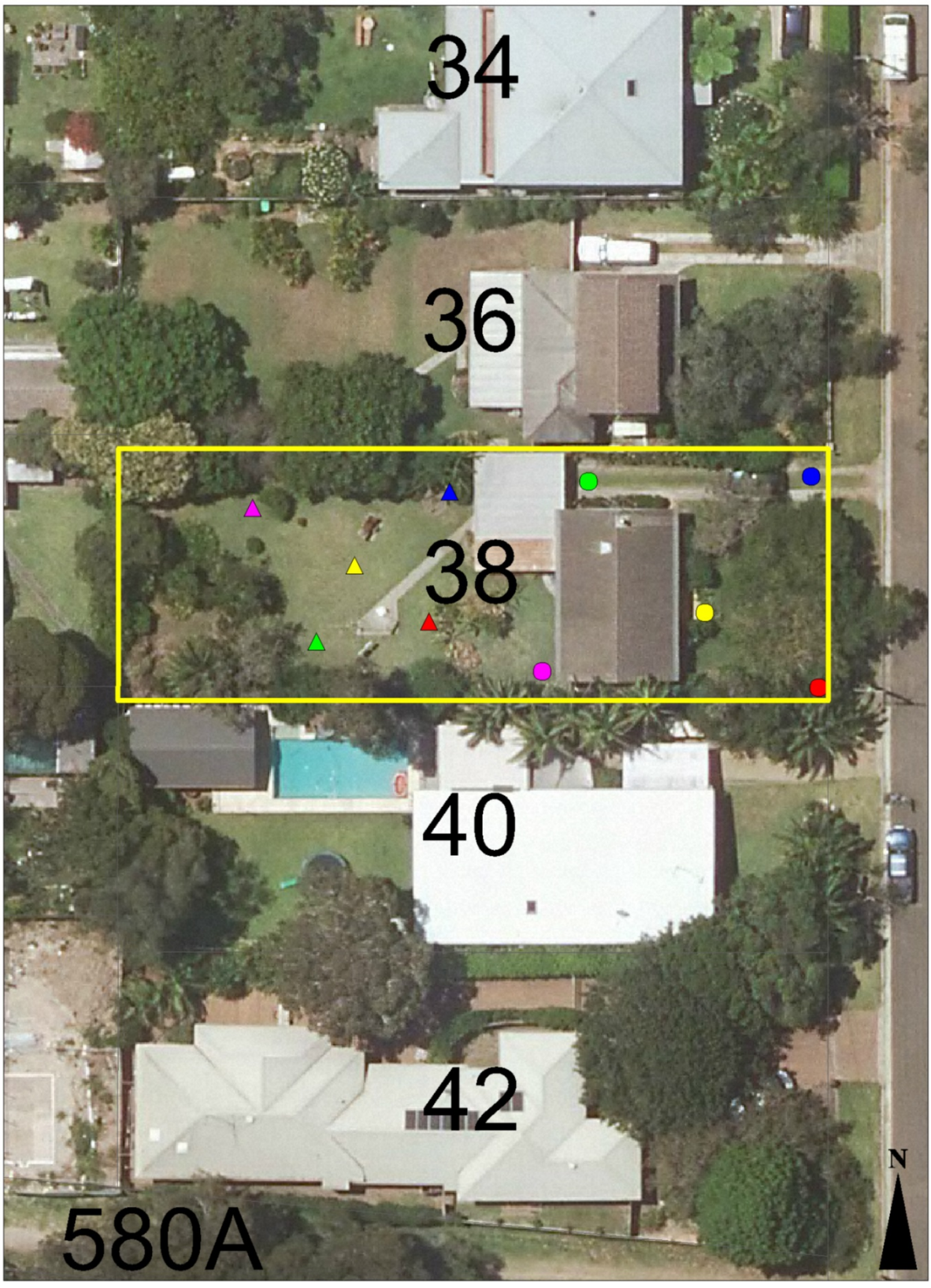
FLOOD MAP A: FLOOD LIFE HAZARD CATEGORY



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.

FLOOD LEVEL POINTS



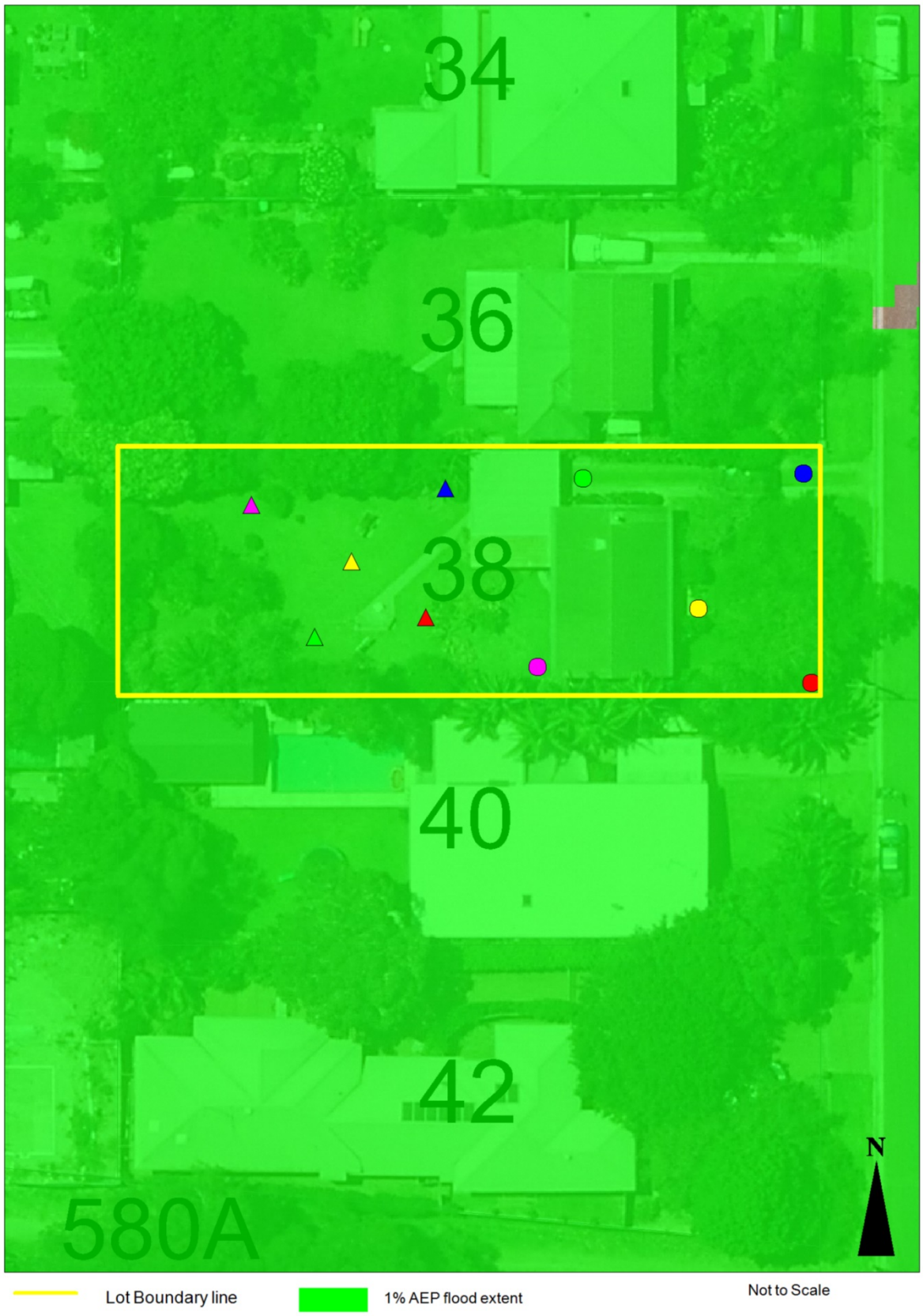
Note: Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Flood study reference) and aerial photography (Source: NearMap 2014) are indicative only

Flood Levels

	5% AEP Max WL (m AHD)	5% AEP Max Depth (m)	5% AEP Max Velocity (m/s)	1% AEP Max WL (m AHD)	1% AEP Max Depth (m)	1% AEP Max Velocity (m/s)	PMF Max WL (m AHD)	PMF Max Depth (m)	PMF Max Velocity (m/s)
●	3.49	0.23	0.27	3.58	0.32	0.26	5.56	2.30	1.02
●	3.43	0.36	0.38	3.58	0.51	0.40	5.57	2.50	0.48
●	3.43	0.16	0.56	3.58	0.30	0.56	5.56	2.28	0.60
●	3.57	0.18	1.01	3.62	0.24	1.19	5.55	2.17	1.84
●	3.68	0.18	0.26	3.74	0.24	0.31	5.57	2.07	1.01
▲	3.68	0.32	0.24	3.74	0.38	0.27	5.58	2.22	0.54
▲	3.69	0.40	0.14	3.75	0.46	0.17	5.58	2.91	0.55
▲	3.69	0.37	0.21	3.74	0.43	0.27	5.58	2.26	0.66
▲	3.69	0.37	0.23	3.75	0.43	0.30	5.58	2.26	0.62
▲	3.69	0.90	0.21	3.74	0.36	0.24	5.58	2.19	0.75

WL – Water Level
PMF – Probable Maximum Flood

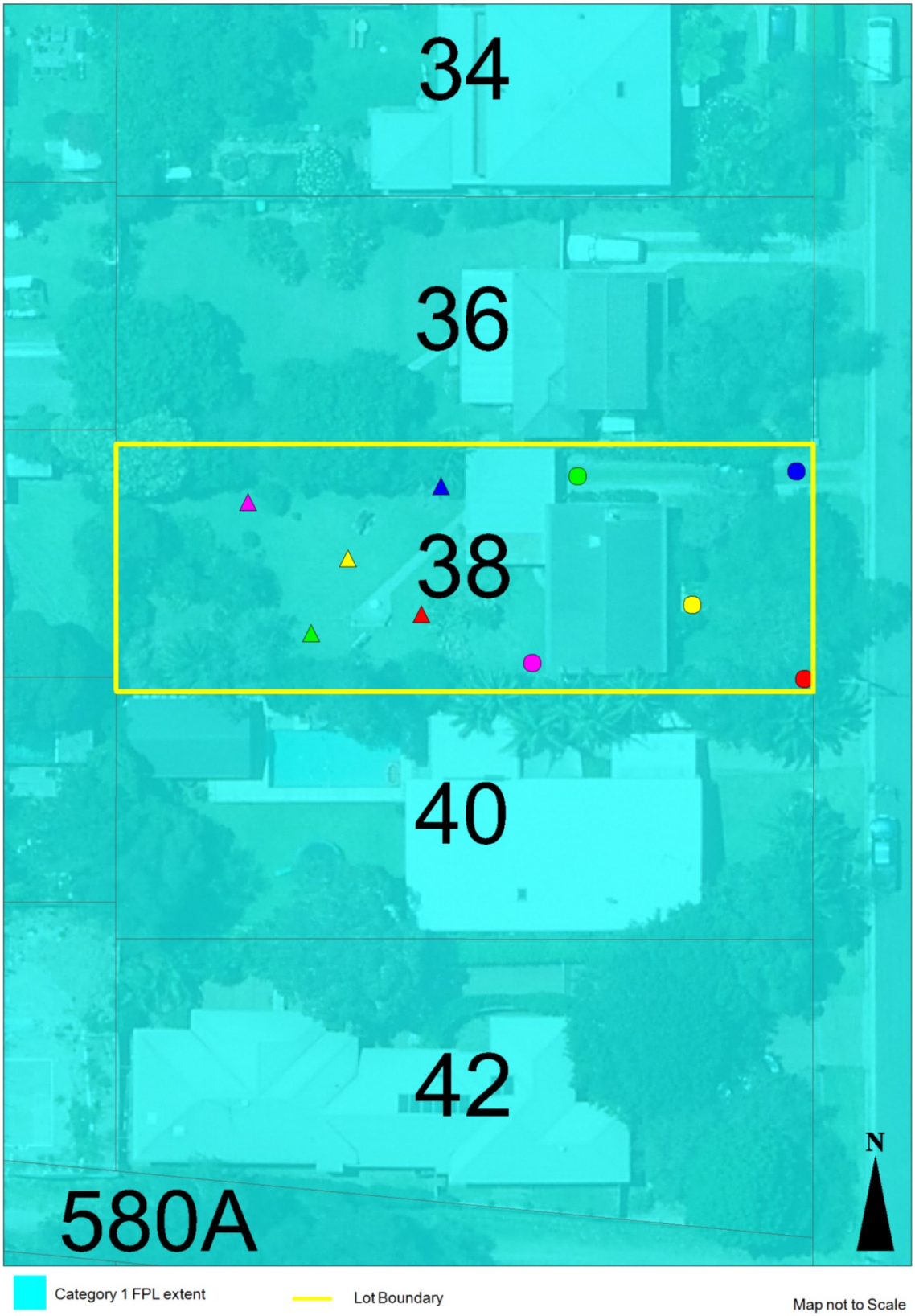
FLOOD MAP B: FLOODING - 1% AEP EXTENT



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.

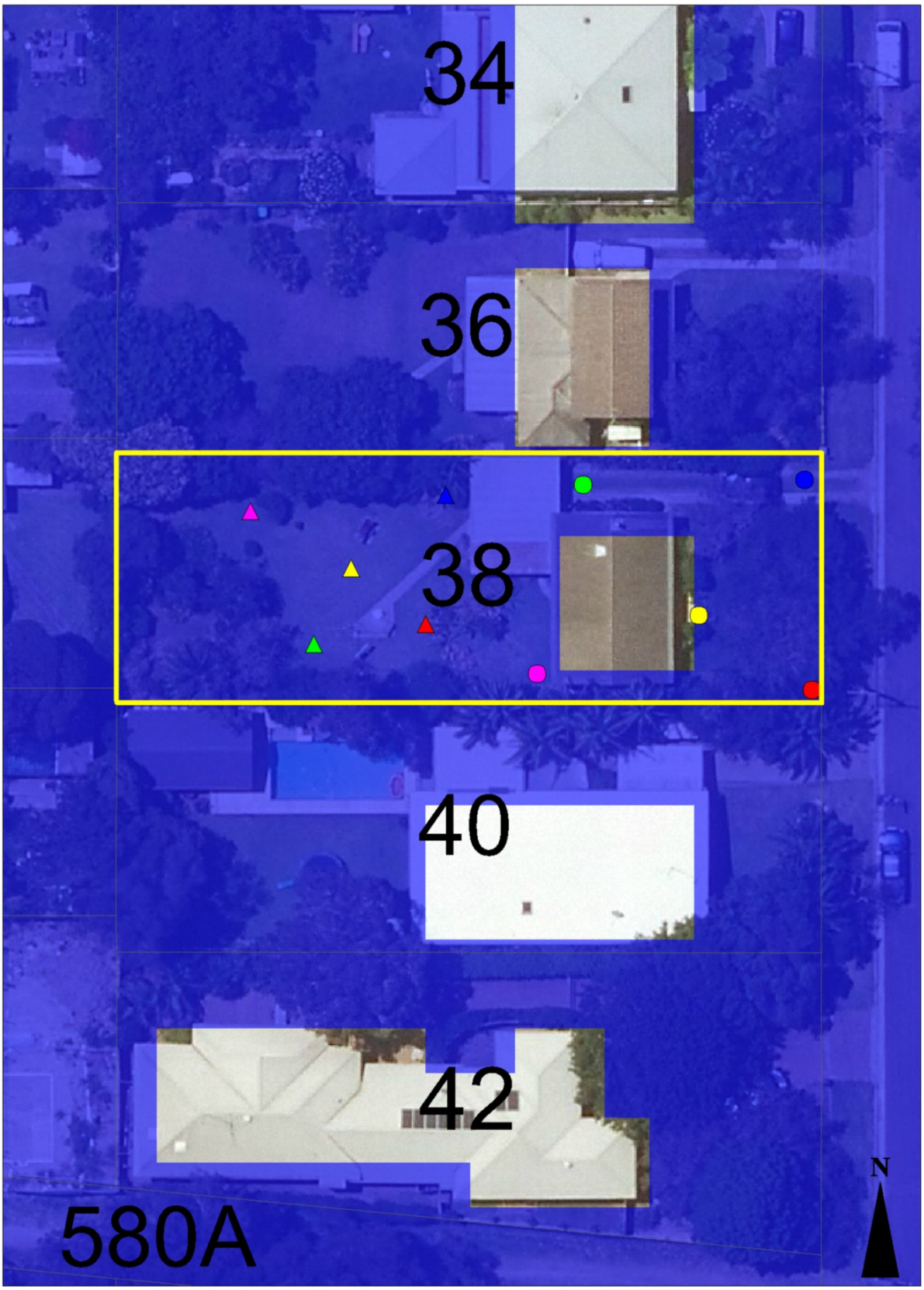
FLOOD MAP C: MAINSTREAM FLOODING – FPL EXTENT



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.

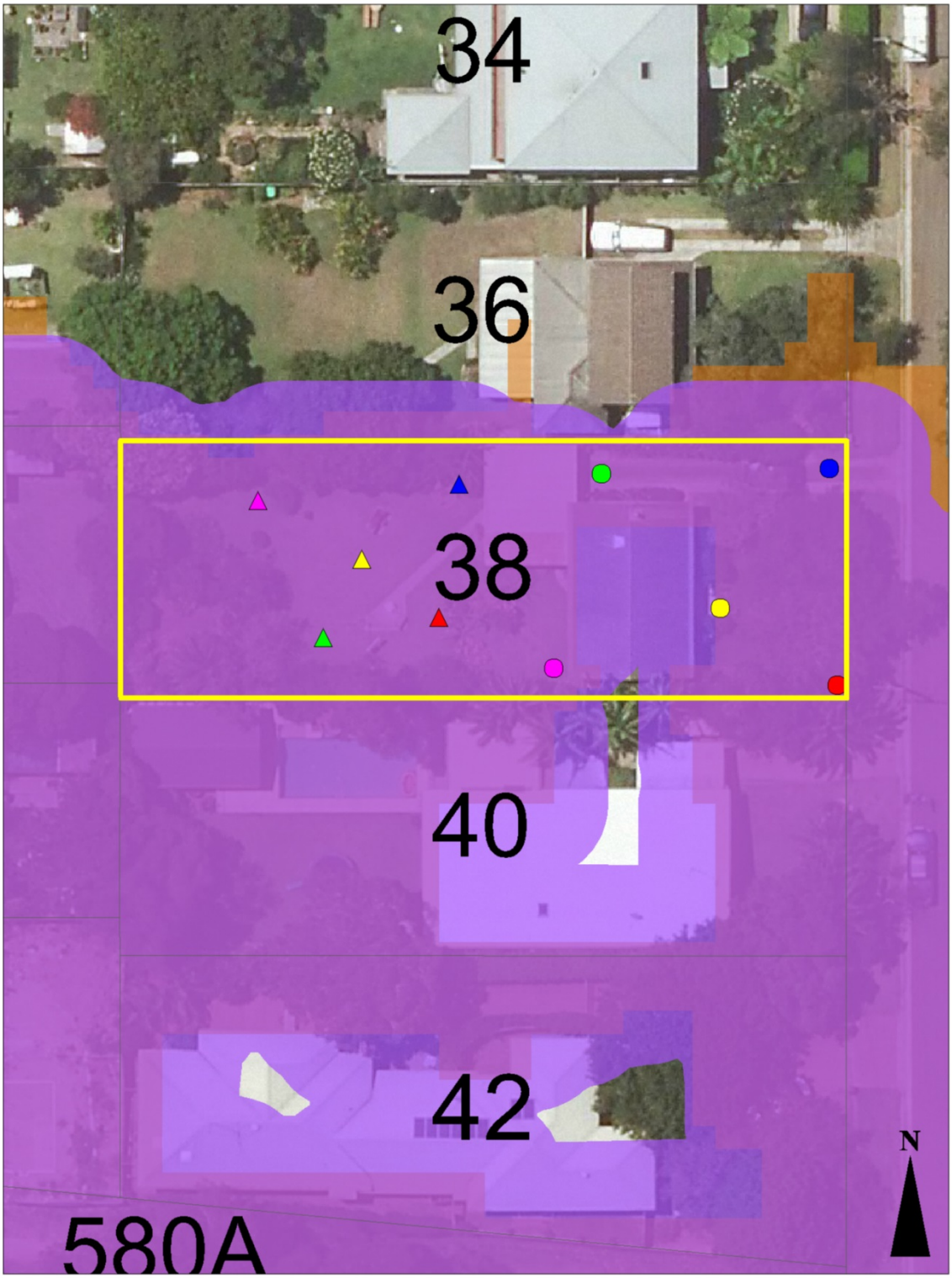
FLOOD MAP D: PROBABLE MAXIMUM FLOOD EXTENT



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.

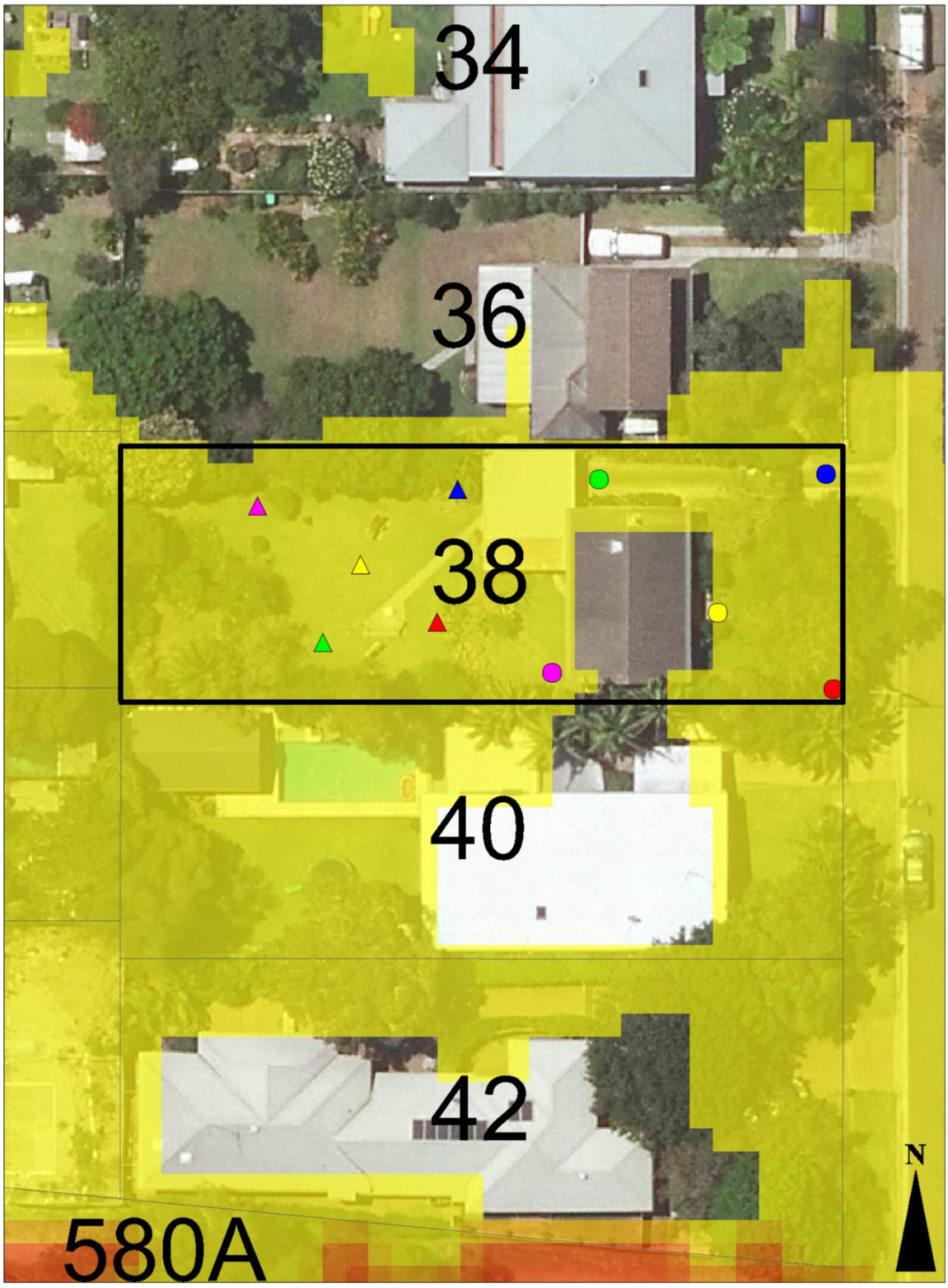
FLOOD MAP E: OVERLAND FLOW EXTENT



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.

FLOOD MAP F – 1% AEP FLOOD HAZARD EXTENT MAP



High Hazard

Low Hazard

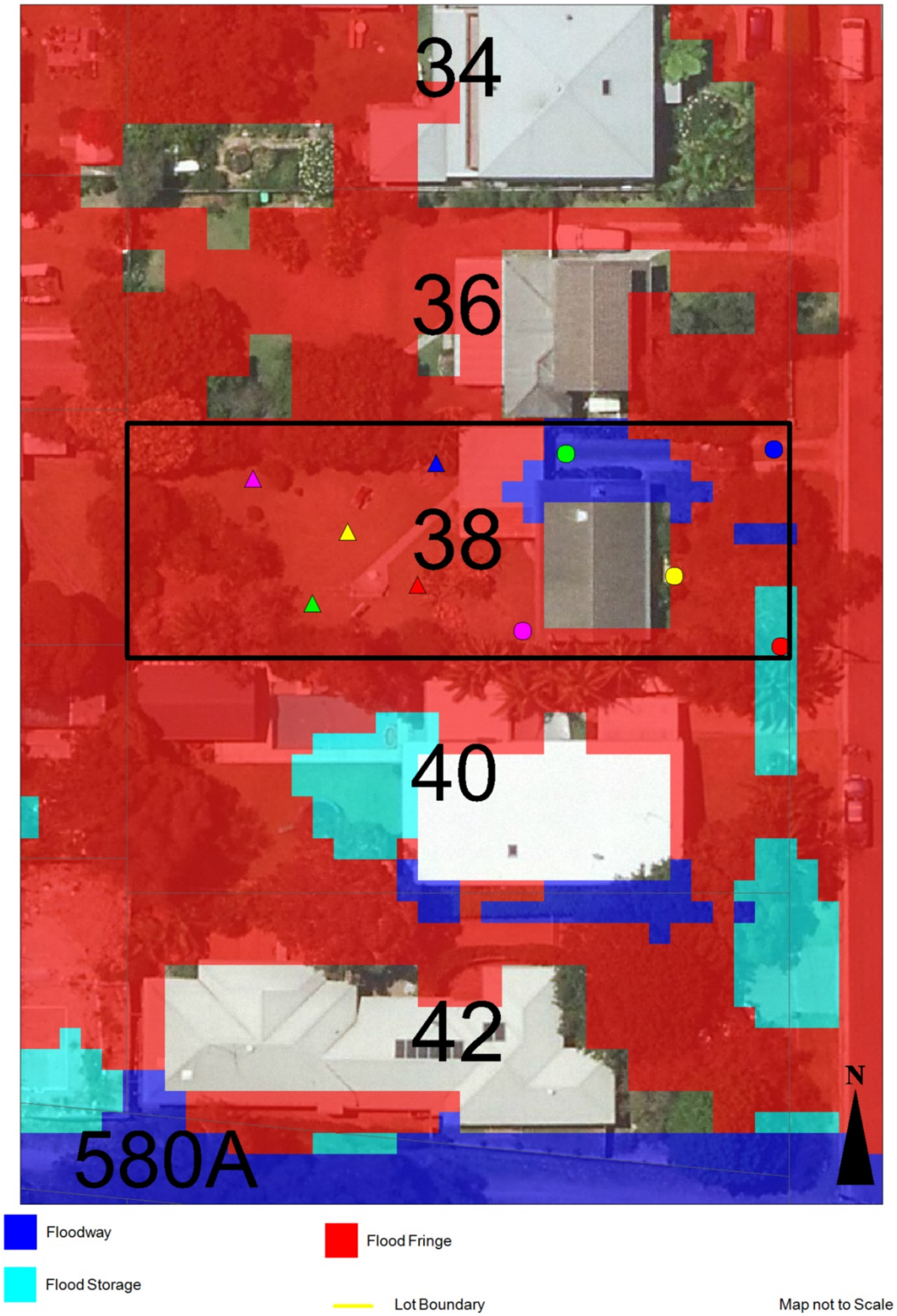
Lot Boundary

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.

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



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.

ANNEXURE B

Flood Emergency Response Planning (FORM NO.1)

EPC 184

FLOOD EMERGENCY RESPONSE PLANNING FOR DEVELOPMENT IN PITTWATER POLICY
FORM NO. 1 – To be submitted with Development Application

Development Application for

RYAN & GEMMA STONE
(Name of Applicant)

Address of site: 38 ELAINE AVENUE, AVALON

Declaration made by hydraulic engineer or engineer specialising in flooding/flood emergency response as part of a Flood Risk Emergency Assessment:

I, ANDREW LAM (Insert Name) on behalf of WATERDESIGN ENGINEERS (Trading or Business/ Company Name)

on this the 15 JULY 2016 (Date) certify that I am a hydraulic engineer or engineer specialising in flooding/flood emergency response and I am authorised by the above organisation/ company to issue this document and to certify that the organisation/ company has a current professional indemnity policy of at least $2million.

Flood Risk Emergency Assessment Details:

Report Title:

FLOOD RISK EMERGENCY ASSESSMENT REPORT - ISSUE 1

Report Date: 15 JULY 2016

Author: ANDREW LAM

Author's Company/Organisation: WATERDESIGN ENGINEERS

I: ANDREW LAM
(Insert Name)
Please tick appropriate box (more than one box can be marked)

☑ have prepared the Flood Risk Emergency Assessment referenced on Form 1 in accordance with Council's guidelines and the Flood Emergency Response Planning for Development in Pittwater Policy.

☑ am willing to technically verify that the detailed Flood Risk Emergency Assessment referenced on Form 1 has been prepared in accordance with Council's guidelines and the Flood Emergency Response Planning for Development in Pittwater Policy.

☐ have examined the site and the proposed development in detail and have carried out a risk assessment (which has been attached to this form), and can confirm that:

- ☐ The addition/dwelling/building is located outside of the extents for Flood Life Hazard Categories H3-H4, H5 and H6 and a Flood Risk Emergency Assessment in not required.

☐ confirm that the results of the risk assessment for the proposed development are in compliance with the Flood Risk Management Policy for Development in Pittwater and a detailed risk assessment is not required for the subject site.

☐ have examined the site and the proposed development/alteration/addition in detail and I am of the opinion (after carrying out a risk assessment) that the Development Application does not require a Flood Risk Emergency Assessment and I have attached the risk assessment to this form.

☐ have reviewed (provide details of Report) the Flood Risk Emergency Assessment previously prepared for this property and can confirm it is up to date and is still current.

Documentation which relate to or are relied upon in report preparation:

☑ I am aware that the Flood Risk Emergency Assessment referenced on Form 1, prepared for the abovementioned site is to be submitted in support of a Development Application for this site and will be relied on by Pittwater Council as the basis for ensuring that the Flood Risk Management aspects of the proposed development have been adequately addressed to achieve an "Acceptable or Tolerable Risk" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Hydraulic engineer or engineer specialising in flooding/flood emergency response details:

Signature .....

Name ANDREW LAM

Chartered Professional Status MIEAUST

Membership No. 2338558

Company WATERDESIGN ENGINEERS

Number of years specialising in flooding/emergency response 17 YEARS