Peninsula Consulting
Civil & Structural Engineers

Peninsula Consulting Engineers

39 McKillop Rd
Beacon Hill NSW 2100

PO Box 6186
Narraweena NSW 2099

M 0424 253 818
E bruce@peninsulaconsulting.com.au

ABN 60 493 390 399

Alterations & Additions to Residence at:

1 Bakers Road, Church Point

OVERLAND FLOW REPORT

#24-0916-L001/draft

December 2024

Prepared for Northern Beaches Council

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M 0424 253 818
E bruce@peninsulaconsulting.com.au

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1. Executive Summary

Peninsula Consulting Engineers was engaged to assess the proposed development at 1 Bakers Road, Church Point, in reference to potential impacts arising from localised overland flow. This report provides an assessment of overland flow information specific to the subject site and supports the proposed development.

Based on the evaluation of the proposed design and HECRAS flood model, the:

Proposed development has a negligible impact on flooding of the surrounding properties.

Provisional Hazards remain unchanged when comparing pre and post development scenarios.

Proposed development is not likely to increase the flood risk to the surrounding area.

Proposed development is compatible with the flood hazard of the land.

As the residence was originally constructed some 20 years ago, with the surrounds being virtually level, and only one step down from the interior finished floor level, we believe it would be inappropriate to raise the extensions above this elevation, to accord with current Council requirements. We believe that we can comply with the intent of the DCP in keeping the workshop/garage at the existing FFL and the lift shaft base at the existing FFL.

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2. Introduction

At the request of Peter Byford, John Lewis of Peninsula Consulting Engineers conducted a consultation in October 2024 at the above-mentioned address. The purpose was to assess the risk to life and flood hazard at the site and determine if floor levels for the proposed development can be safely set at a minimum of the Flood Planning Level [FPL].

The proposed development consists of an external elevator, and a garage/workshop on the southern side of the existing residence. Refer Appendix F for details of the proposed development. The building will be used for residential purposes.

3. Location & Description of Development

Figure 1 Site Location – Red Marker

The site is an 1195.6m^2 block, with a single 3 storey dwelling on the site. The site is on the low side of Bakers Road, and is on the intersection of Pittwater Road. The

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improvements to the site are at least 20 years old, and have sustained no previous flooding (based on prior owners accounts).

4. Flood Planning Controls Applicable

The proposed definitions of the flood risk precincts are set out below:

Low Flood Risk Precinct means all flood prone land (i.e. subject to inundation by the PMF) not identified within the High or Medium flood risk precincts.

Medium Flood Risk Precinct means all flood prone land that is (a) within the 1% AEP Flood Planning Area; and (b) is not within the high flood risk precinct.

High Flood Risk Precinct means all flood prone land (a) within the 1% AEP Flood Planning Area; and (b) is either subject to a high hydraulic hazard or is within the floodway.

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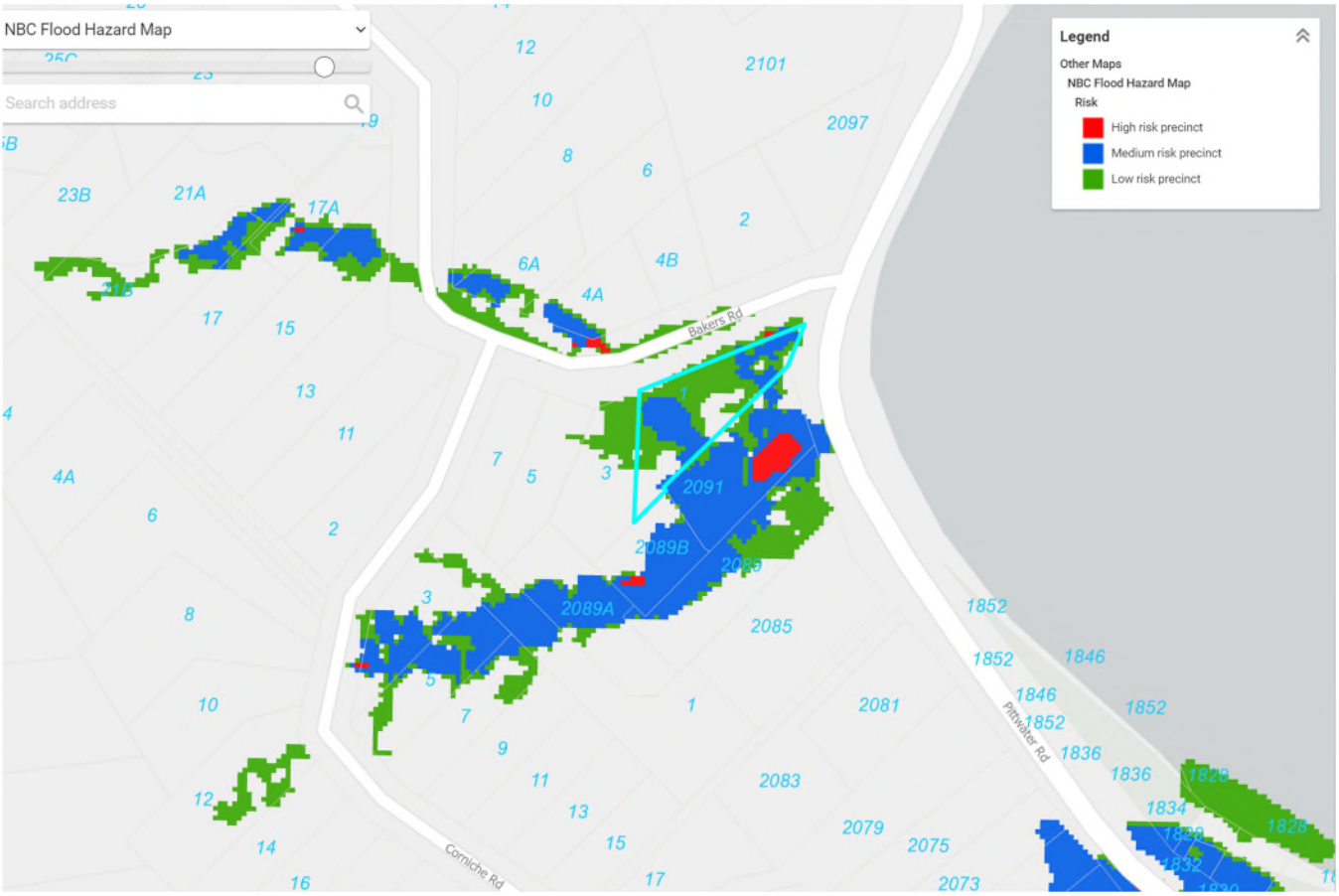

Figure 2 Flood Hazard Map for #1 Bakers Road

All the site is within the Low & Medium Risk Flood Hazard Zone, with the following controls applicable.

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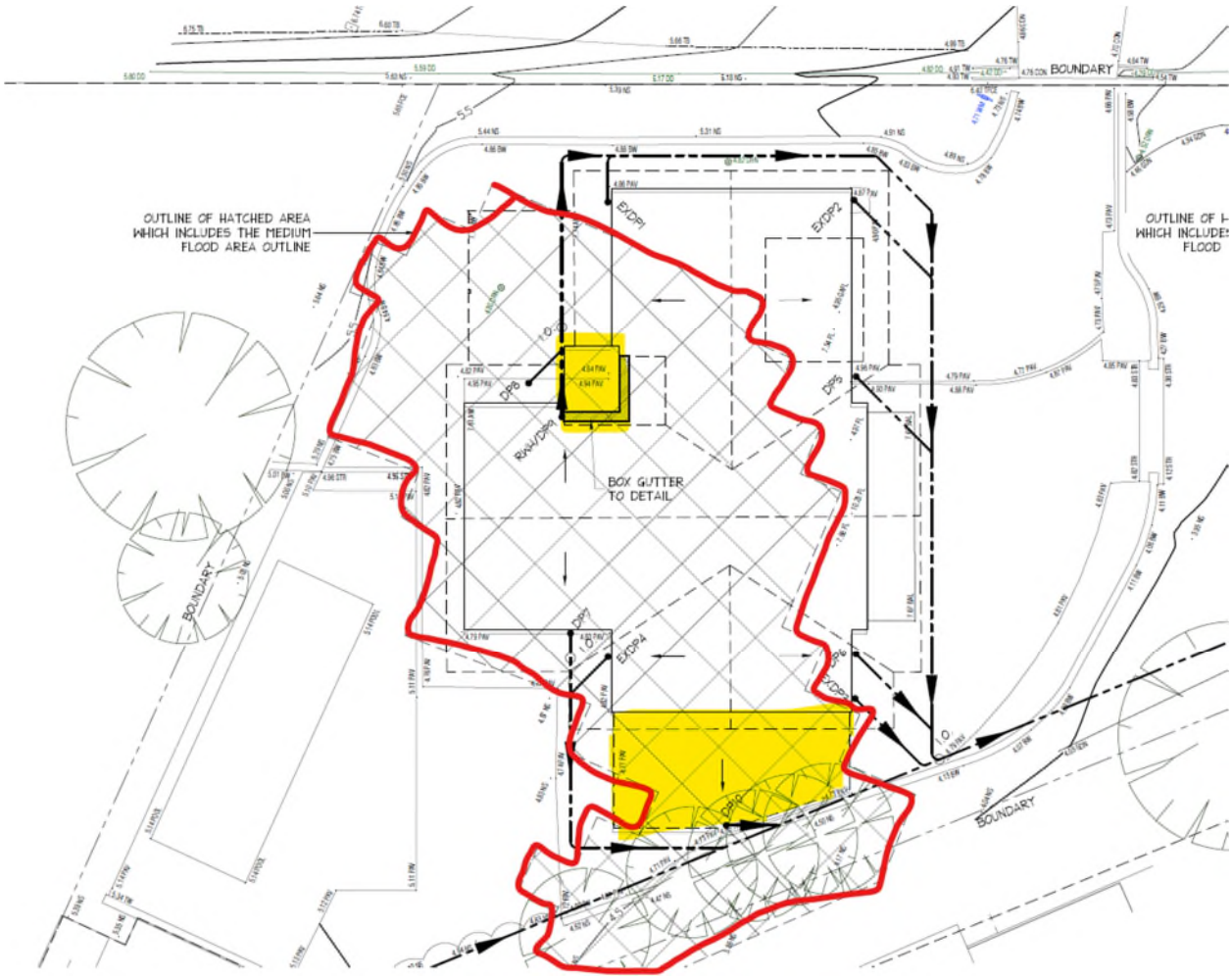

Figure 3 Flood Hazard Map for #1 Bakers Road with proposed works superimposed. Yellow areas are proposed works. Red outline of hatched area is the medium flood risk area boundary taken from NBC mapping

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5. Flood Risk Matrix

		Medium Flood Risk Precinct				
		Vulnerable & Critical Use	Residential Use	Business & Industrial Use	Recreational & Environmental Use	Subdivision & Civil Works
A	Flood effects caused by Development	A1 A2	A1 A2	A1 A2	A1 A2	A1 A2
B	Building Components & Structural	B1 B2 B3	B1 B2 B3	B1 B2 B3	B1 B2 B3	
C	Floor Levels	C2 C3	C1 C3 C4 C6	C1 C3 C4 C6 C7	C3	C5
D	Car Parking	D1 D2 D3 D4 D7	D1 D2 D3 D4 D5 D6	D1 D2 D3 D4 D5 D6	D1 D2 D3 D4 D5 D6	D1
E	Emergency Response	E1 E2	E1	E1	E1	E3
F	Fencing	F1	F1	F1	F1	F1
G	Storage of Goods	G1	G1	G1	G1	
H	Pools	H1	H1	H1	H1	H1

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		Low Flood Risk Precinct				
		Vulnerable & Critical Use	Residential Use	Business & Industrial Use	Recreational & Environmental Use	Subdivision & Civil Works
B	**Building Components & Structural**	B1 B2 B3				
C	**Floor Levels**	C2 C3				C5
D	**Car Parking**	D2 D7				
E	**Emergency Response**	E1 E2				E3

A. 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 alterati (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.
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.

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B. BUILDING COMPONENTS AND STRUCTURAL SOUNDNESS

B1	All buildings shall be designed and constructed with flood compatible materials in accordance with "Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas", Hawkesbury-Nepean Floodplain Management Steering Committee (2006).
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.
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 within the subject structure must have residual current devices installed that turn off all electricity supply to the property when flood waters are detected.

C. FLOOR LEVELS

C1	New floor levels within the development shall be at or above the Flood Planning Level.
C2	All floor levels within the development shall be at or above the Probable Maximum Flood level or Flood Planning Level, whichever is higher.
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
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:

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

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D. CAR PARKING

D1	Open carpark areas and carports shall not be located within a floodway.
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.
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.
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
D5	Enclosed Garages must be located at or above the 1% AEP level
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
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.

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E. 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 $2m^2$ per person where the flood duration is long (6 or more hours) in the Probable Maximum Flood event, or $1m^2$ 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.
E2	If a shelter-in-place refuge is required, it must contain as a minimum: sufficient clean water for all occupants; portable radio with spare batteries; torch with spare

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	batteries; a first aid kit; emergency power; and a practical means of medical evacuation.
E3	It must be demonstrated that evacuation or a shelter-in-place refuge in accordance with the requirements of this DCP will be available for any potential development arising from a Torrens title subdivision.

F. 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.

G. 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.

H. 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. All electrical equipment associated with the pool (including pool pumps) is to be waterproofed and/or located at or above the Flood Planning Level. All chemicals associated with the pool are to be stored at or above the Flood Planning Level.

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6. Responses to Flood Planning Controls Applicable

A1 – Incorporated

A2 – Compensatory works are not necessary as total flood storage change is minimal due to small footprint of new works <30m$^{2.}$ Actual increase in external area 25.9m^2 Depth of inundation 100mm – volume 2.6m^3.

B1-B3 – Incorporated

C1 – New Floor Levels above the Flood Planning Level cannot be achieved as

[a] the Lift area must be at existing floor level to service the dwelling. We believe that the lift should be assessed as an extension to the existing room as it is not suitable to have steps up to a lift that is most likely to be used for people with a disability. The lift can be programmed so that it returns to the upper level when not used so that if inundation occurs, the lift car is not damaged.

[b] the Workshop is non-habitable room and we believe should be treated as a garage/parking area. As a garage, it can be situated at or above the 1%AEP level. Storage can be limited to a level at or above the FPL to limit damage occurring to the stored goods. The FPL according to the flood information report (at ID#4) is RL 4.89. The proposed FFL of the garage is RL 4.97

C3 – Minimal reduction in floodway/flood storage – volume as above 2.6m^3.

C4 – The Flood Planning Level is inconsistent with existing finished floor level existing – 4.97m AHD. Top Water Level in 1%AEP Storm is 4.89m AHD – 80mm below finished floor level existing. The lift shaft base meets the requirements as it is less than 30m2 and is connected to/(part of) an existing room. The workshop meets the requirements as it is to be treated as a garage and thus only needs to be above the 1%AEP level.

C6 - Not Applicable as no upper floor proposed

D1 - Not Applicable as not a floodway

D2,3,4 - Not Applicable as not an open carport

D5 – The proposed workshop/garage is to be located above the 1%AEP Storm level.

D6 – Not Applicable as no change in driveway levels

D7 – Not Applicable as not an enclosed car park.

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E1 – Flood Life Hazard Category – refer Appendix D. H1 category – velocity 0.26m/sec depth <100mm in most areas of site. Also shelter in place in extreme events is available & recommended.

F1 - Not Applicable as no fencing proposed

G1 – Incorporated

H1 - Not Applicable as no pool proposed

The construction of the proposed extensions to the residence will be constructed from flood compatible materials.

7. Flood Behavior at Present

Local Overland flooding from uphill from Corniche Road & Bakers Road & within the catchment up to Minkara Road.

8. Impact of Proposed Development

Council requires that the development in a flood zone has minimal impact on the existing flood behavior. This is to ensure that the development will not be detrimental in raising flood levels in the surroundings. The property downstream will also not be detrimentally affected by the development, as the outflow from the site will not change, as there is no increase in impervious surfaces.

9. Flood Planning Level Applicable

The Flood Planning Level [FPL] is a Council derived elevation that stipulates the habitable floor level for the proposed development. It is derived from the 100 Year ARI flood elevation at the site, with an added freeboard to account for uncertainties in flood estimation, and the possibility of waves. The FPL is RL 4.89+0.5m = RL 5.39m AHD.

Draft Flood Emergency Evacuation Plan.

1. Route of evacuation - In the event of a PMF flood it is envisaged that water levels will rise slowly upwards above habitable floor level. This will provide time for the occupants to evacuate in an orderly manner, to first floor area (shelter in place).
2. Flood warning systems will initially be visual, where the occupants can view the flooding from habitable rooms. Possibly weather forecasts & radio bulletins will provide further information.
3. The owner/occupiers will be aware of potential of flooding from this report. [E1]

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10. Check of Overland Flows

INTRODUCTION

This section of the report aims at investigating the water surface profile for the 100-year ARI (Average Recurrence Interval) and outlines the methods used. The general information regarding pipe locations & sizes was obtained from Council's Stormwater Map. This was overlaid in an Autocad drawing and scaled up, to show sub catchments for each pit. A *DRAINS* computer model was then used to determine corresponding catchment runoff and overland flows through the subject site.

Details of existing stormwater infrastructure and a contributing catchment area was assessed on site and obtained from Council website information. This information was utilised to determine catchment flows. The HEC-RAS computer program was used to determine the 100-year ARI water surface profile for the existing situation and to determine the impact that the proposed new dwelling will have on the predicted overland flow path at the subject property. All calculations in this report have been prepared in accordance with Australian Rainfall and Runoff and Council's drainage manual – Water Management for Development Policy.

PROPERTY DESCRIPTION

The site is located on the low side (south side) of Bakers Road. There currently exists a two storey dwelling on the property. There also currently exists a Council 525mm & 675mm diameter drainage pipelines on each side of Bakers Road.

EXISTING COUNCIL DRAINAGE INFRASTRUCTURE

Refer Appendix A - The Pipes & Pits shown were observed on site, and most are in good condition, and effective, although a 100% blocking factor was applied to the *DRAINS* calculations. The area under assessment includes a catchment of 6.87 Hectares as shown on Appendix B.

DIRECTION & EXTENT OF CATCHMENT FLOWS.

In this case, direction & extent of catchment is complicated. Overflows from pits will generally flow from the intersection of Corniche & Bakers Road, towards the subject property. Flows will then bifurcate, and the majority of flow will enter #3 Bakers Road through the front boundary & driveway. Flows will then enter #1 through its front boundary and the boundary between #3 & #1, and some flow will travel along the small 'v' – drain along the northern boundary of the subject property, crossing externally the driveway of #1. It is considered that this v-drain, although, it will certainly conduct flows away from

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entering the subject property, is ineffective in conveying the 1% AEP flows, away from the site. Consequently, this v-drain will not be considered in the calculations. Pipe overflows from pits on Corniche Road outside the catchment boundary [see Appendix A] will also not be considered, as the majority of these flows will travel sideways off Corniche Road into #1 Corniche area, south of the subject property. In addition, the effect of pipe flows of 50% of pipe capacity will be considered. These pipes convey water from the catchment considered and are situated in the road reserve, in front of #1. They are 675mm & 525mm diameter, with the following capacity, according to Manning Formula, at 9% gradient.

675mm --- 2521L/sec

525mm --- 1290L/sec

If we assume 50% flow capacity to be available, we will have a reduction in overland flows of 1.9m^3/sec

DRAINS ANALYSIS

The site was subdivided into 8 sub catchments, with the following criteria:-

- 40% impervious for each sub catchment, as many are rural 5 acre blocks
- Synthetic Storms as per AR&R requirements for ARI 100 years
- Overland flows running down the road from pit to pit.
- Sag & on-grade pits as observed on site.
- Antecedent Moisture Content value 3
- Soil Type 3
- Paved area depression storage 1mm
- Supplementary area depression storage 1mm
- Grassed area depression storage 5mm

DRAINS RESULTS

The *DRAINS* results concluded that around 2.79m^3/sec in a 1%AEP Storm, would overflow from the catchment. Reducing this flow by the capacity of the installed pipes [50%] would result in a net overland flow of 0.89m^3/sec through the subject property.

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HEC RAS ANALYSIS

The HEC-RAS computer program (US Army Corp of Engineers, V 5.0 Feb 2016) was used to determine the water surface levels along the overland flow path for the 100-year ARI. The model included 5 cross-sections for the overland flow path in order to determine the water surface levels along the full length of the flow path. A Manning's roughness 'n' of 0.035 was adopted for the grass flow path, and 0.013 for concrete path.

An analysis with the predicted overland flow of 0.89m^3/s was carried out. The predicted water surface level varied throughout the flow path and the results can be found below. Refer Appendix C for HEC RAS output. These spreadsheets show the location of each cross section.

It was considered not necessary to incorporate pre- and post- HEC RAS information, as the post- development proposal was insignificant, compared to the existing size of the block.

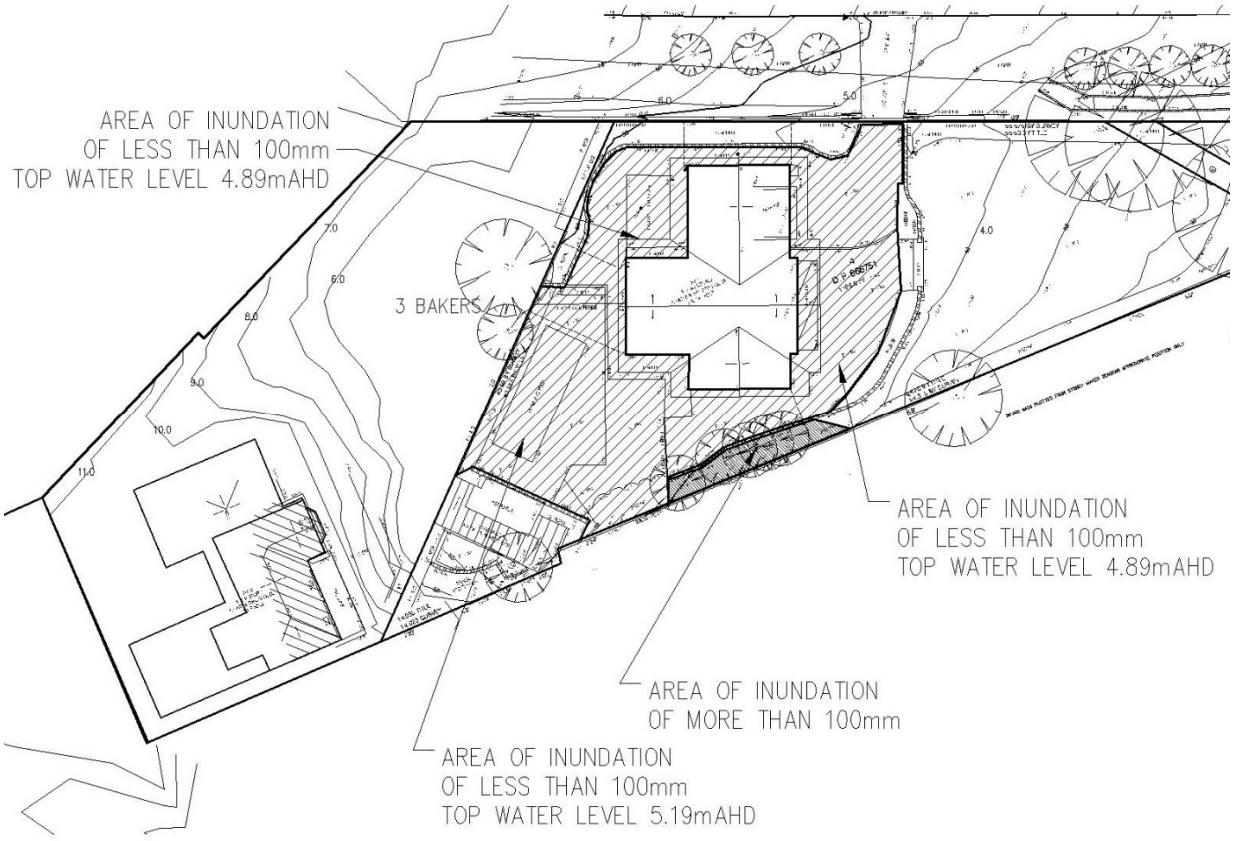

Figure 4 Extent of Inundation – 1%AEP

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11. Recommendations

The following recommendations are required, considering that the additions proposed are relatively minor in size.

As the residence was originally constructed some 20 years ago, with the surrounds being virtually level, and only one step down from the interior finished floor level, we believe it would be inappropriate to raise the extensions above this elevation, to accord with current Council requirements. We believe that we can comply with the intent of the DCP in keeping the workshop/garage at the existing FFL and the lift shaft base at the existing FFL.

1. Floodwaters do not enter the residence from the catchment above, in the 1% AEP Storm.

2. The new workshop/garage, which will be a non-habitable room, should be constructed to the finished floor level of the existing residence, 4.97mAHD (above the 1% AEP flood level).

3. The new workshop/garage shall be designed structurally for a flood velocity of 0.26m/sec, for the catchment overflow flood.

4. The new garage/workshop shall be considered and constructed as a garage, to satisfy the Response to Planning Controls Applicable. The FFL of the garage should be above the 1%AEP flood level.

5. The building will be constructed from flood compatible materials. [B1]

6. 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 (FPL).

7. Storage of polluting goods should be at a minimum of the FPL.

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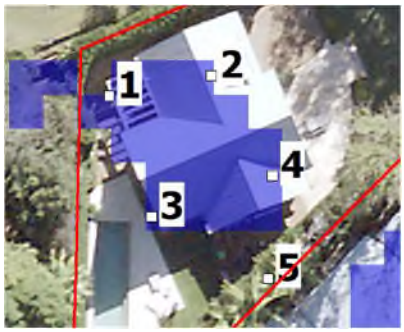
Narraweena NSW 2099
M 0424 253 818
E bruce@peninsulaconsulting.com.au
ABN 60 493 390 399

12. Council's Comprehensive Flood Information Report

After completing this overland flow report, Council's representative Mike Soltysiak recommended obtaining a Comprehensive flood information report. We have attached this flood information to the appendix of the report. Refer to Appendix G.

We believe that our report takes into account the actual topography of the site as we have been very specific about the information used for the report.

Our site derived 1%AEP level is very similar to that of the Councils flood information as shown on the key points diagram, refer to the extracts below: ID1 is a similar location to the proposed lift shaft, ID4 is a similar location to the proposed workshop/garage.



Flood Levels

ID	5% AEP Max WL (m AHD)	5% AEP Max Depth (m)	1% AEP Max WL (m AHD)	1% AEP Max Depth (m)	1% AEP Max Velocity (m/s)	Flood Planning Level (m)	PMF Max WL (m AHD)	PMF Max Depth (m)	PMF Max Velocity (m/s)
1	5.23	0.27	5.26	0.30	0.19	5.16	5.42	0.46	0.65
2	N/A	N/A	4.96	0.18	0.11	4.96	5.18	0.40	0.29
3	4.98	0.26	5.00	0.28	0.19	5.03	5.20	0.48	0.29
4	N/A	N/A	4.90	0.17	0.18	4.89	5.07	0.34	0.36
5	N/A	N/A	N/A	N/A	N/A	5.16	4.91	0.31	0.37
6	N/A	N/A	3.03	0.35	0.25	3.07	3.26	0.58	0.43
7	N/A	N/A	3.64	0.27	0.26	3.63	3.80	0.44	0.43
8	N/A	N/A	2.84	0.19	0.53	2.72	3.00	0.35	0.83

Peninsula Consulting
Civil & Structural Engineers

Peninsula Consulting Engineers

39 McKillop Rd
Beacon Hill NSW 2100

PO Box 6186
Narraweena NSW 2099

M 0424 253 818
E bruce@peninsulaconsulting.com.au

ABN 60 493 390 399

13. Report's Author & Reviewer

This Report's Author and Reviewer have had a combined 70 years experience in the engineering profession, including periods of employment in the Consulting, Government Instrumentalities, and Construction areas. The author's last full time employment was as Principal Technical Specialist [Stormwater] with Kellogg, Brown & Root, International Consulting Engineers. He carried out recent investigations for:

- Sydney Desalination Pipeline
- Victorian Highways
- Pilbara Railway
- NSW Railways

Peninsula Consulting Engineers has carried out Flood Risk Assessment Reports on a residential scale for Councils, Including Northern Beaches, Warringah, Pittwater, Willoughby, Wollongong, & Manly. Bruce Lewis, our Principal is - B.E. (Civil), CP Eng, NPER.

For any questions or queries on this report, please contact Peninsula Consulting Engineers.

Bruce Lewis (Reviewer)
M: 0424 253 818 or

E: Bruce@peninsulaconsutling.com.au.

Yours Faithfully,

Bruce Lewis
Principal BE(Civil) Cpeng NPER
Peninsula Consulting Engineers

Peninsula Consulting
Civil & Structural Engineers

Peninsula Consulting Engineers

39 McKillop Rd
Beacon Hill NSW 2100

PO Box 6186
Narraweena NSW 2099

M 0424 253 818
E bruce@peninsulaconsulting.com.au

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14. References

Flood Information for the property available on Council Website

NSW Floodplain Development Manual

Mc Carrs Creek, Mona Vale and Bayview Flood Study Review - Royal Haskoning DHV Dated 7th July 2017

Council Flood Study Requirements

Building Code of Australia

Reducing the Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas [2007] Prepared for the Hawkesbury Nepean Floodplain Management Steering Committee.

15. Appendices

Appendix A – Catchment of Overland Flow.

Appendix B – *DRAINS* Model.

Appendix C – Hec Ras Results.

Appendix D – Flood Life Hazard Thresholds.

Appendix E– Architectural Drawings.

Appendix F – Survey Drawing.

Peninsula Consulting
Civil & Structural Engineers

Peninsula Consulting Engineers

39 McKillop Rd
Beacon Hill NSW 2100

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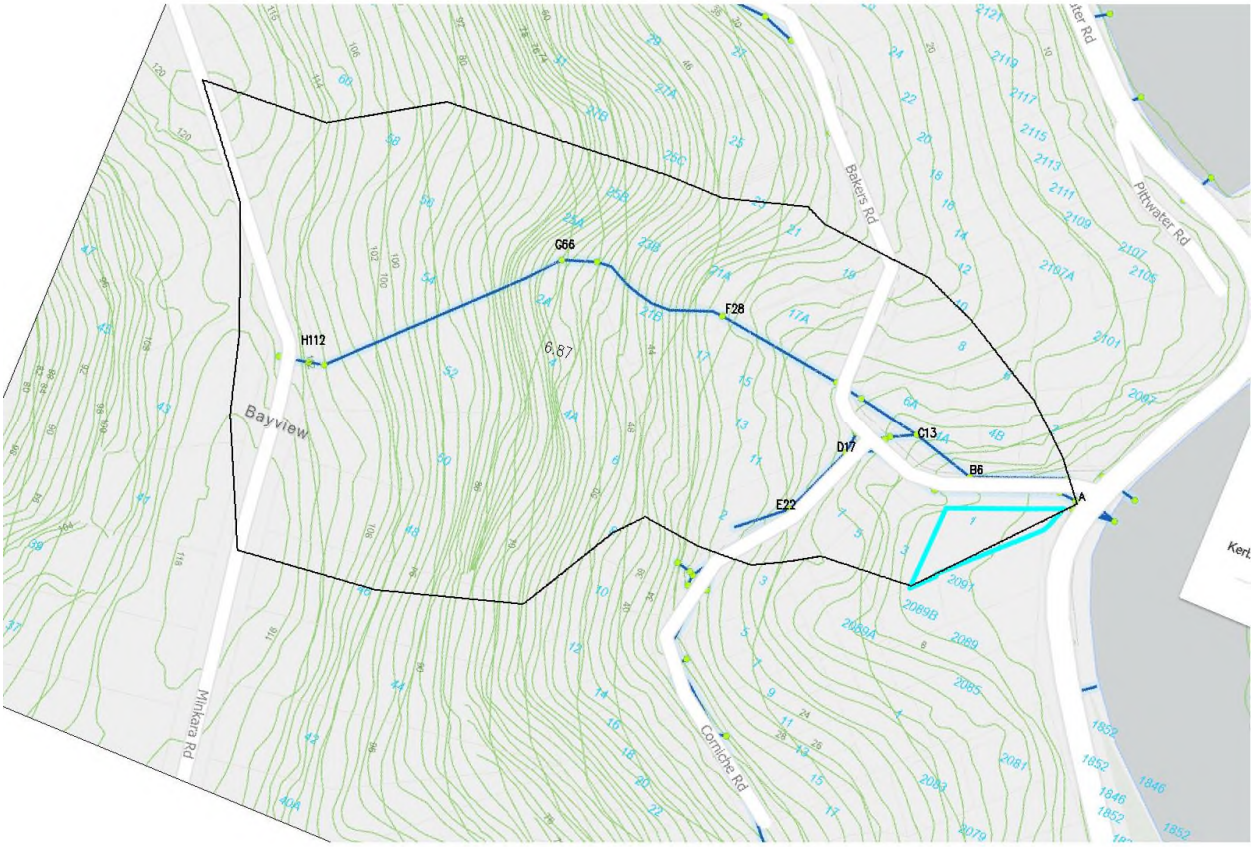
Narraweena NSW 2099

M 0424 253 818
E bruce@peninsulaconsulting.com.au

ABN 60 493 390 399

16. Appendix A - Catchment of Overland Flow



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Civil & Structural Engineers

Peninsula Consulting Engineers

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Beacon Hill NSW 2100

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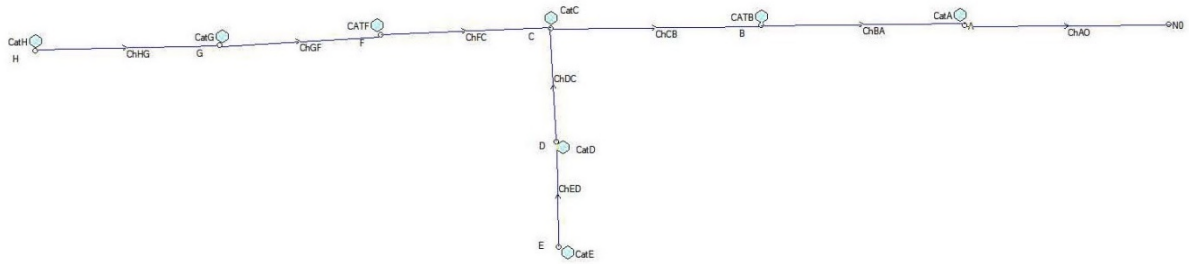
Narraweena NSW 2099

M 0424 253 818
E bruce@peninsulaconsulting.com.au

ABN 60 493 390 399

17. Appendix B - *DRAINS* Model



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Civil & Structural Engineers

Peninsula Consulting Engineers

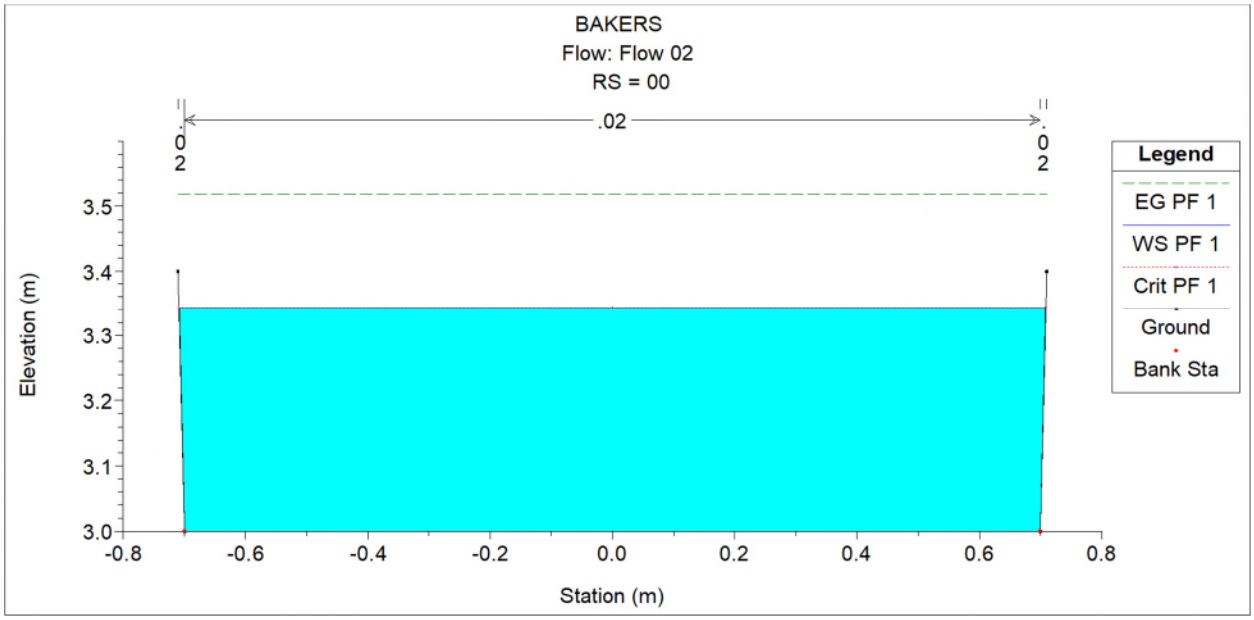
39 McKillop Rd
Beacon Hill NSW 2100

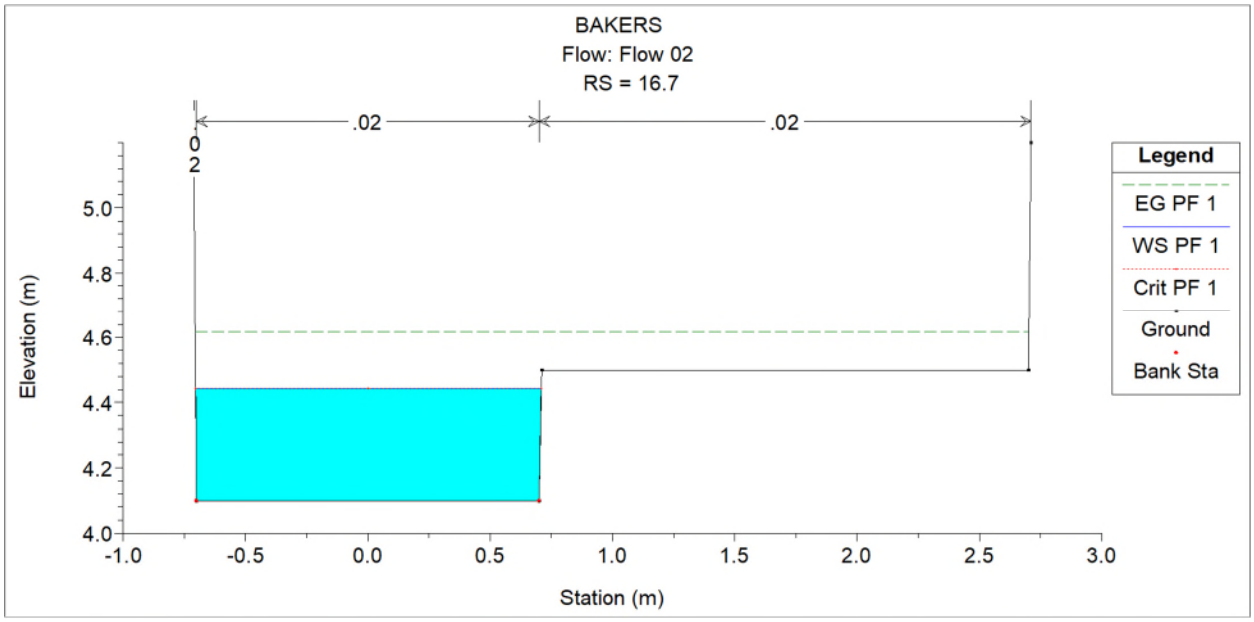
PO Box 6186
Narraweena NSW 2099

M 0424 253 818
E bruce@peninsulaconsulting.com.au

ABN 60 493 390 399

18. APPENDIX C - HEC RAS RESULTS CROSS SECTIONS





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Civil & Structural Engineers

Peninsula Consulting Engineers

39 McKillop Rd
Beacon Hill NSW 2100

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Narraweena NSW 2099

M 0424 253 818
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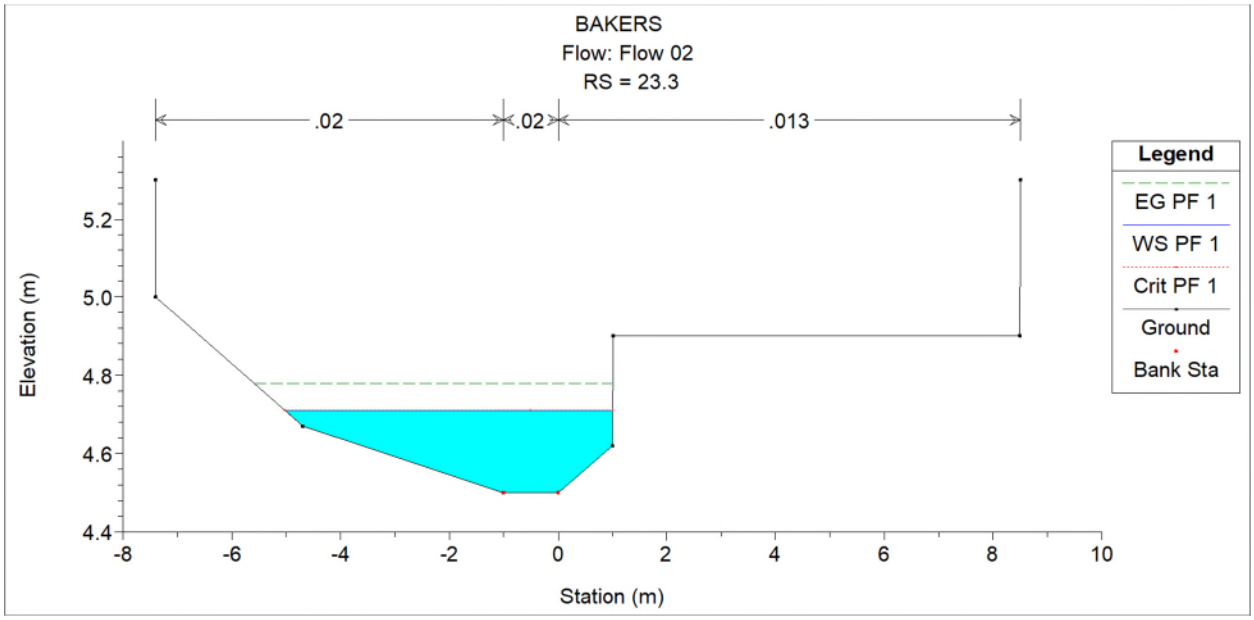

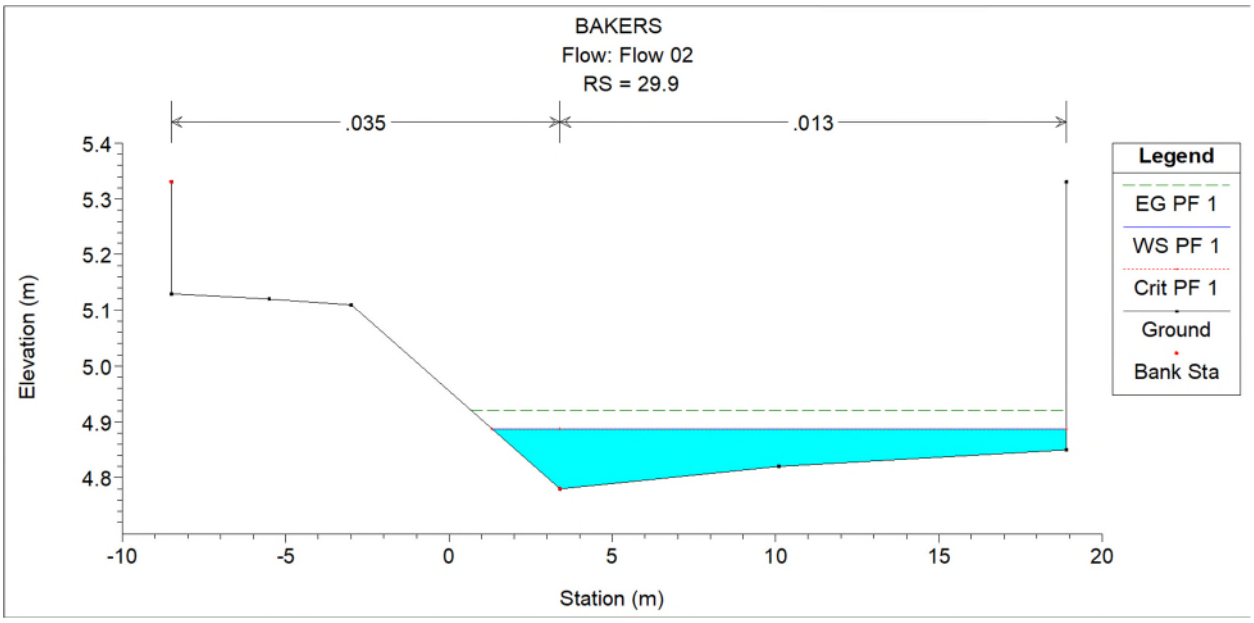

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Civil & Structural Engineers

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39 McKillop Rd
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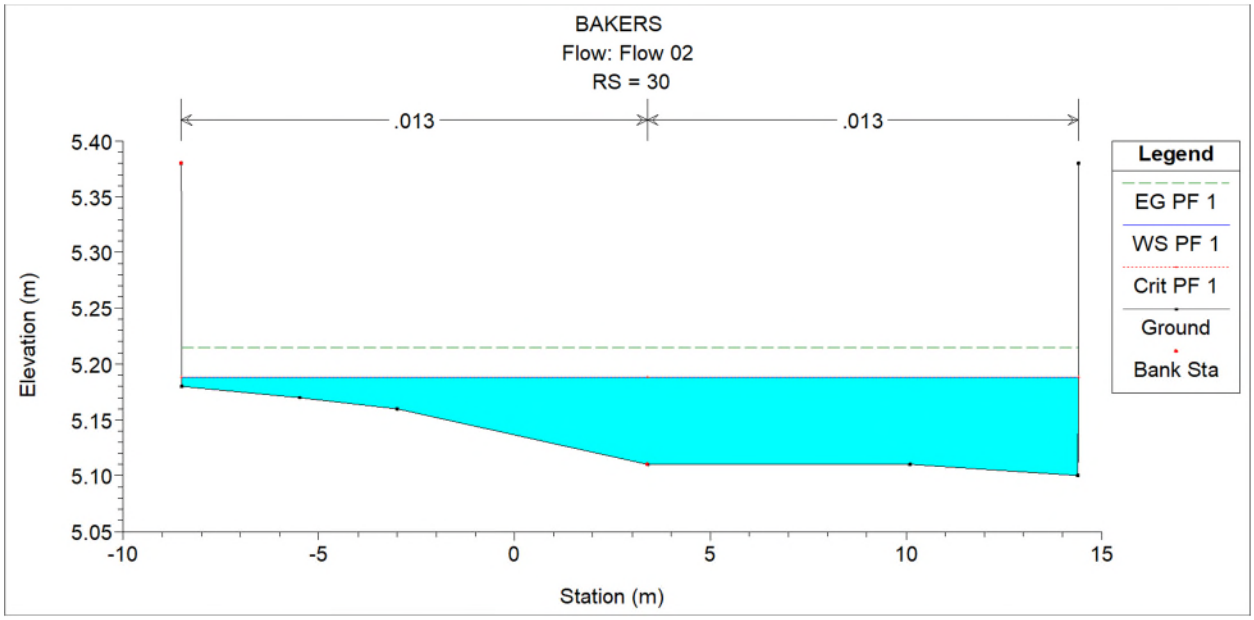
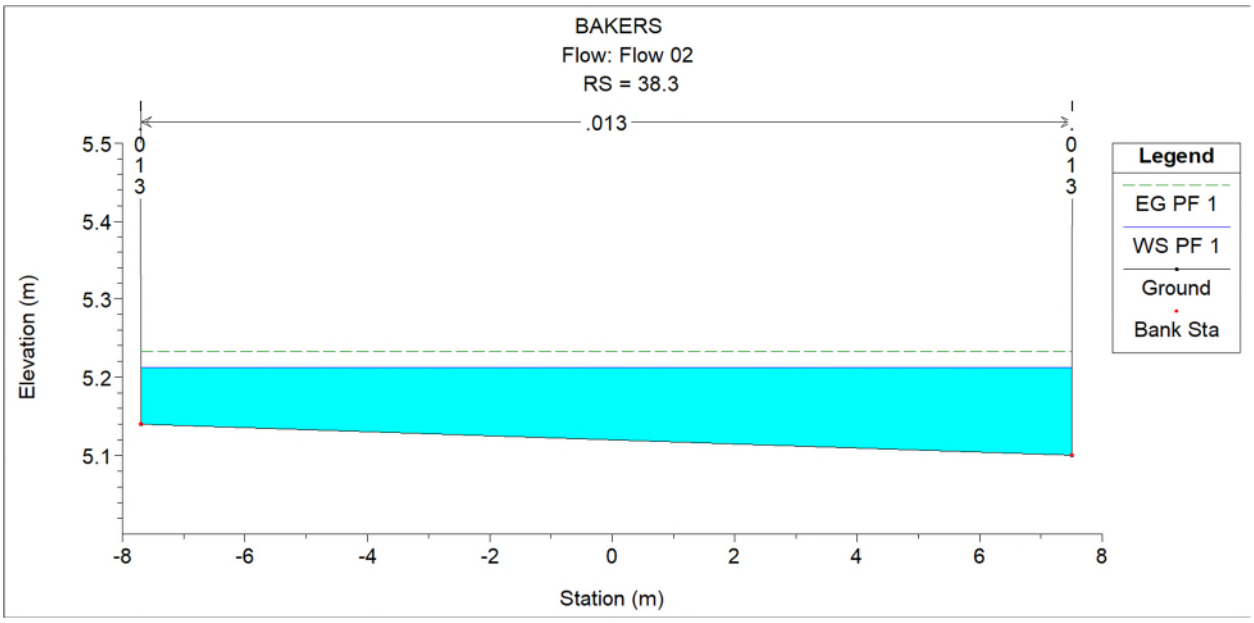
ABN 60 493 390 399





Peninsula Consulting
Civil & Structural Engineers

Peninsula Consulting Engineers

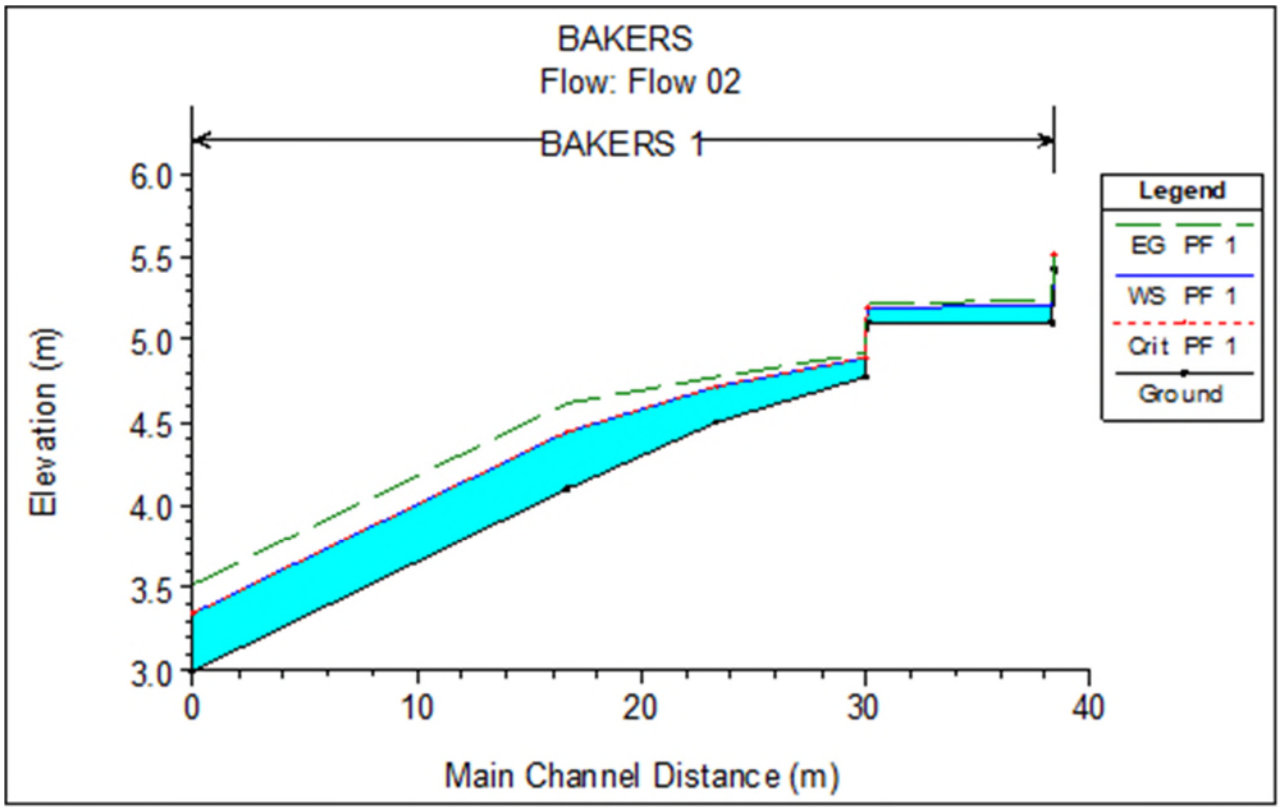
39 McKillop Rd
Beacon Hill NSW 2100

PO Box 6186
Narraweena NSW 2099

M 0424 253 818
E bruce@peninsulaconsulting.com.au

ABN 60 493 390 399

19. Appendix C - HEC RAS Results Long Section



Peninsula Consulting
Civil & Structural Engineers

Peninsula Consulting Engineers
39 McKillop Rd
Beacon Hill NSW 2100
PO Box 6186
Narraweena NSW 2099
M 0424 253 818
E bruce@peninsulaconsulting.com.au
ABN 60 493 390 399

20. Appendix C - HEC RAS Numerical Results

River Station	Flow Total (m^3/s)	Minimum Channel Elevation (m)	Water Surface Elevation (m)	Depth (m)	Velocity Channel (m/s)	Flow Area (m^2)	Top Width (m)	Froude Number Channel	V x D safe < 0.4
38.4	0.89	5.43	5.51	0.08	0.28	1.42	24.42	0.39	0.02
38.3	0.89	5.1	5.21	0.11	0.63	1.41	15.2	0.66	0.07
30	0.89	5.11	5.19	0.08	0.47	1.32	22.9	0.78	0.04
29.9	0.89	4.78	4.89	0.11	0.26	1.16	17.59	0.36	0.03
23.3	0.89	4.5	4.71	0.21	1.27	0.83	6.03	0.88	0.27
16.7	0.89	4.1	4.44	0.34	1.85	0.48	1.41	1.01	0.63
0	0.89	3	3.34	0.34	1.85	0.48	1.42	1.01	0.63

Peninsula Consulting
Civil & Structural Engineers

Peninsula Consulting Engineers

39 McKillop Rd
Beacon Hill NSW 2100

PO Box 6186
Narraweena NSW 2099

M 0424 253 818
E bruce@peninsulaconsulting.com.au

ABN 60 493 390 399

21. Appendix D – Flood Life Hazard Thresholds

3. Flood hazard thresholds

The relative vulnerability of the community and its built assets to flood hazard can be assessed by using flood velocity and depth thresholds. The thresholds are related to the stability of both people and vehicles in flood waters, and to buildings affected by flooding.

These thresholds have been derived in research (discussed in Smith, Davey and Cox 2014), with later work on full-scale testing of vehicle floatation (Smith, Modra and Felder 2019) supporting the findings of this work.

Figure 1 and Table 1 identify thresholds that enable categorisation of flood hazard across the floodplain and for flood events of different scales using information readily derived from hydraulic models into 6 categories. These are H1 to H6, which range from least to most hazardous conditions.

In addition, Figure 2 presents separate curves of thresholds for the stability of people. Figure 3 and Figure 4 provide separate curves for vehicles and buildings, which may be useful when looking at these individual aspects more closely.

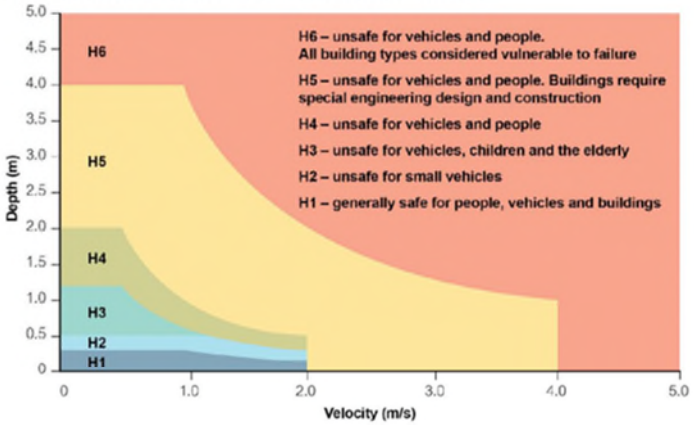


Figure 1 General flood hazard vulnerability curve

Note: Categories H1 to H4 in this guideline are equivalent to low hazard and H5 to H6 equivalent to high hazard in the 2005 *Floodplain development manual* (DIPNR 2005).

Source: Figure 6 AIDR 2017b.

3 Department of Planning and Environment

Peninsula Consulting
Civil & Structural Engineers

Peninsula Consulting Engineers

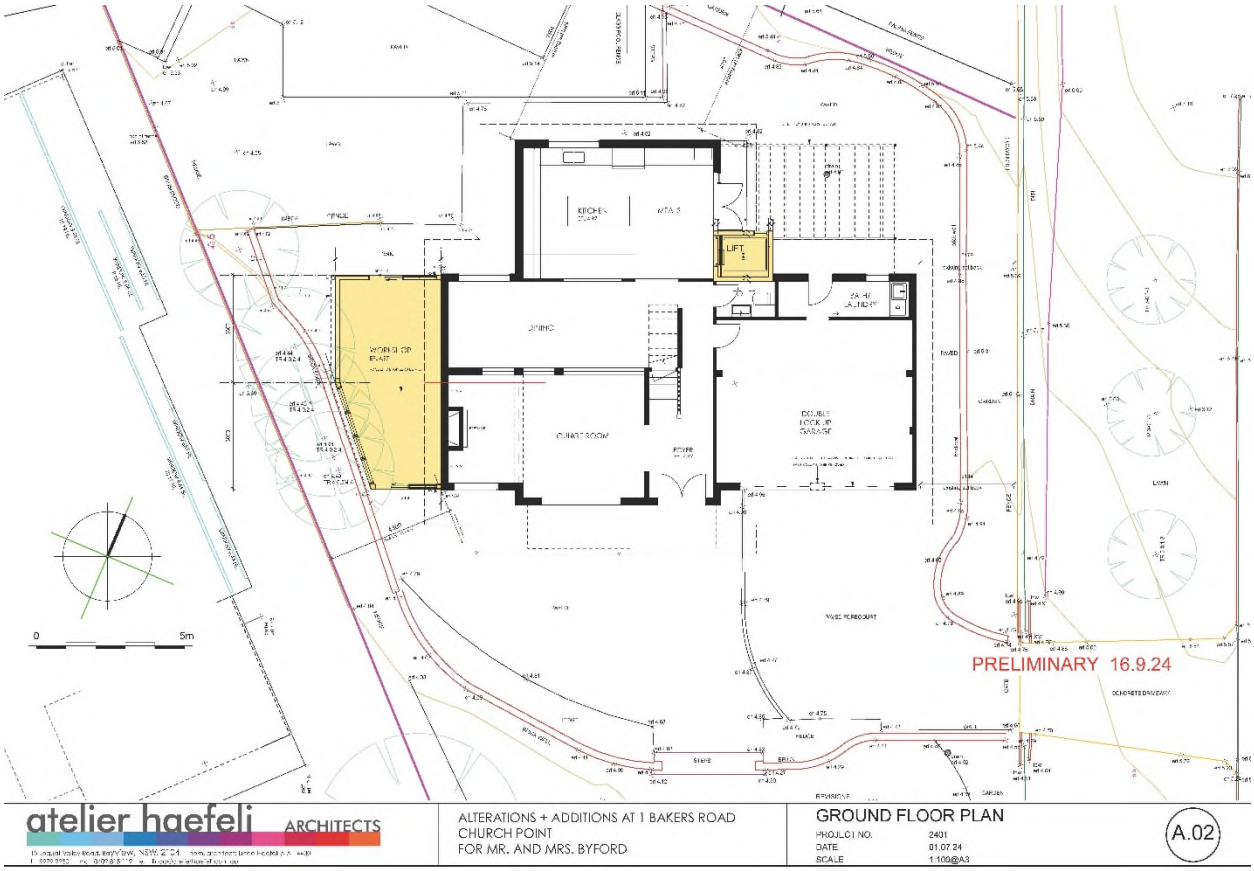
39 McKillop Rd
Beacon Hill NSW 2100

PO Box 6186
Narraweena NSW 2099

M 0424 253 818
E bruce@peninsulaconsulting.com.au

ABN 60 493 390 399

22. Appendix E - Architectural Drawings Referenced



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Civil & Structural Engineers

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39 McKillop Rd
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PO Box 6186
Narraweena NSW 2099

M 0424 253 818
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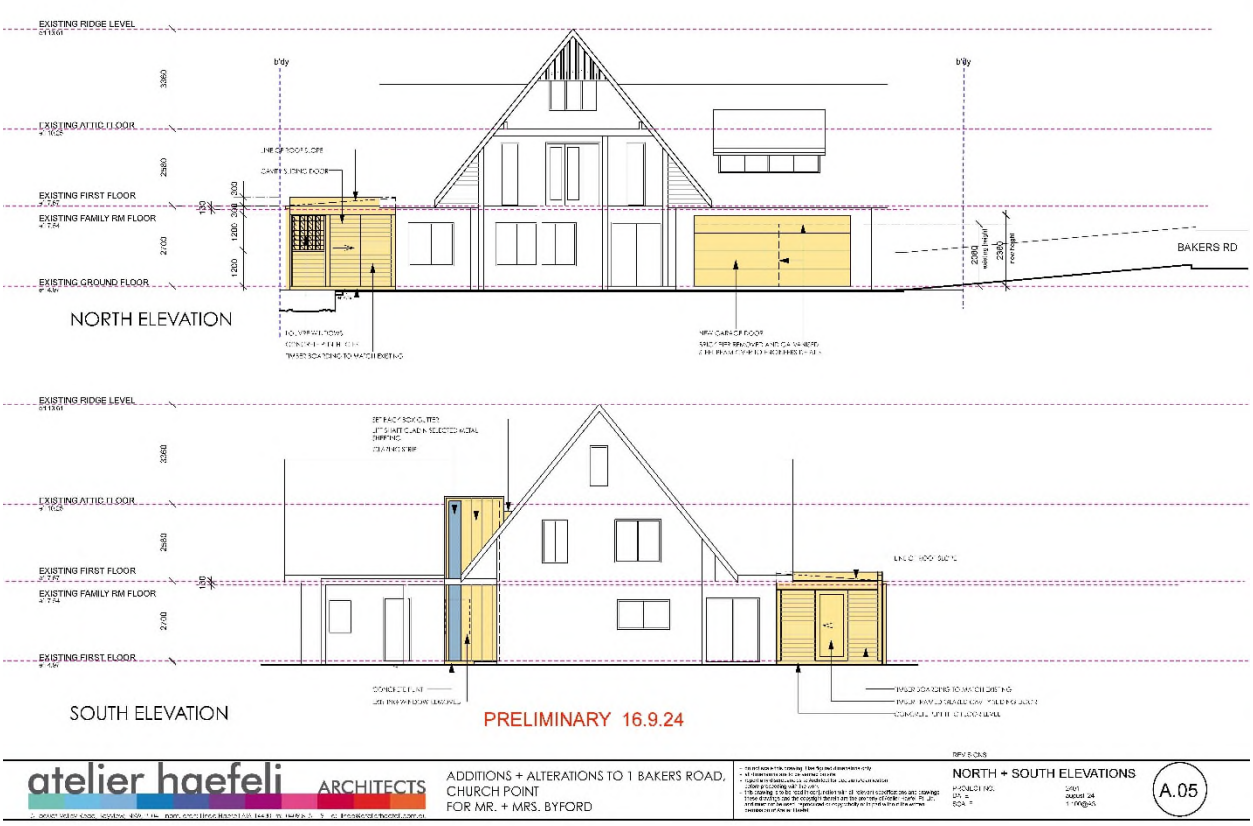

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Civil & Structural Engineers

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39 McKillop Rd
Beacon Hill NSW 2100

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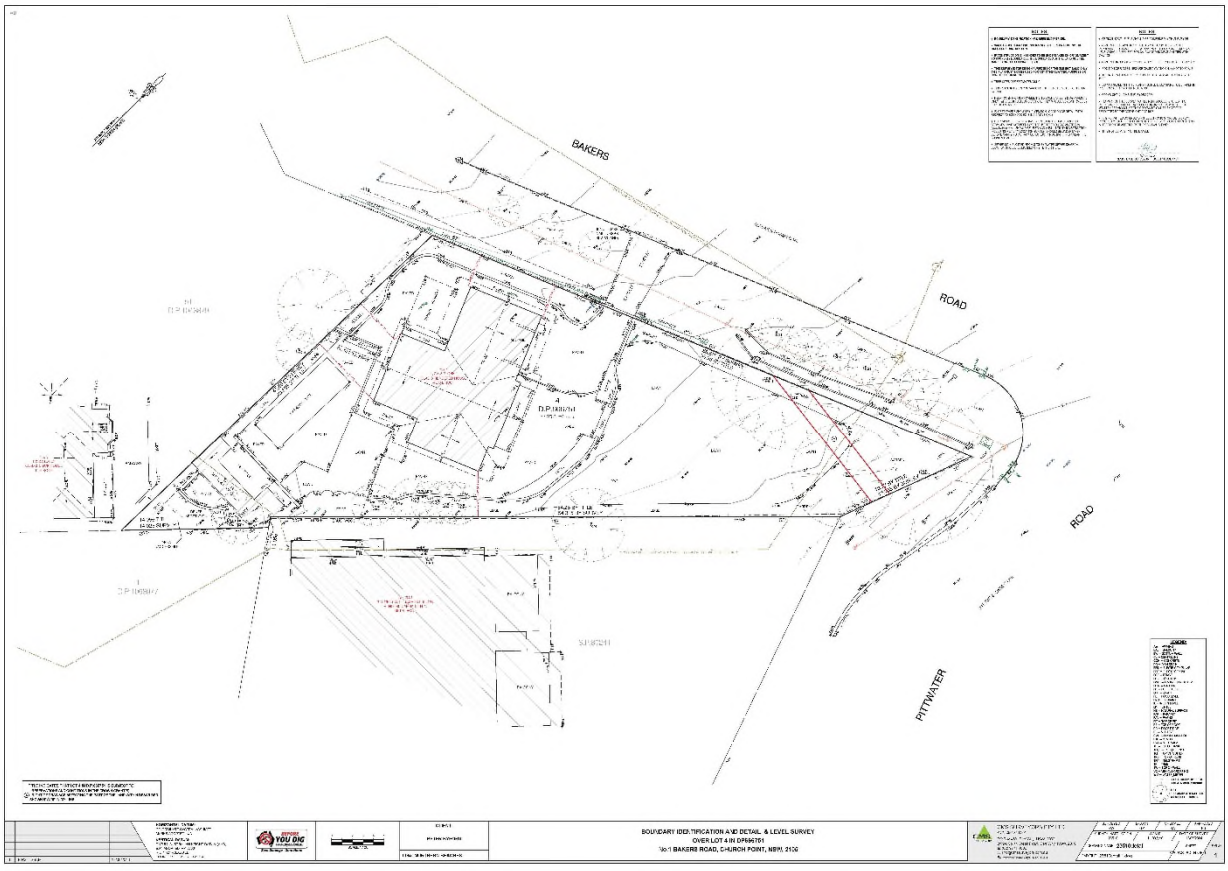
M 0424 253 818
E bruce@peninsulaconsulting.com.au

ABN 60 493 390 399

23. Appendix F - Survey Drawing Referenced



24. Appendix G - Flood Information Report

northern beaches council

COMPREHENSIVE FLOOD INFORMATION REPORT

Property: 1 Bakers Road CHURCH POINT NSW 2105
Lot DP: Lot 4 DP 666751
Issue Date: 09/10/2024
Flood Study Reference: McCarrs Creek, Mona Vale and Bayview Flood Study Review 2017, Royal HaskoningDHV

Flood Information[1]:

Map A - Flood Risk Precincts
Maximum Flood Planning Level (FPL) [2, 3, 4]: 5.76 m AHD

Map B - 1% AEP Flood & Key Points
1% AEP Maximum Water Level [2, 3]: 5.26 m AHD
1% AEP Maximum Depth from natural ground level[3]: 0.68 m
1% AEP Maximum Velocity: 2.35 m/s

Map C - 1% AEP Hydraulic Categorisation
1% AEP Hydraulic Categorisation: Floodway, Flood storage, Flood fringe

Map D - Probable Maximum Flood
PMF Maximum Water Level (PMF) [4]: 7.63 m AHD
PMF Maximum Depth from natural ground level: 0.99 m
PMF Maximum Velocity: 3.20 m/s

Map E - Flooding with Climate Change
1% AEP Maximum Water Level with Climate change [3]: 7.63 m AHD
1% AEP Maximum Depth with Climate Change[3]: 0.72 m

Map F - Flood Life Hazard Category in PMF

Map G - Indicative Ground Surface Spot Heights

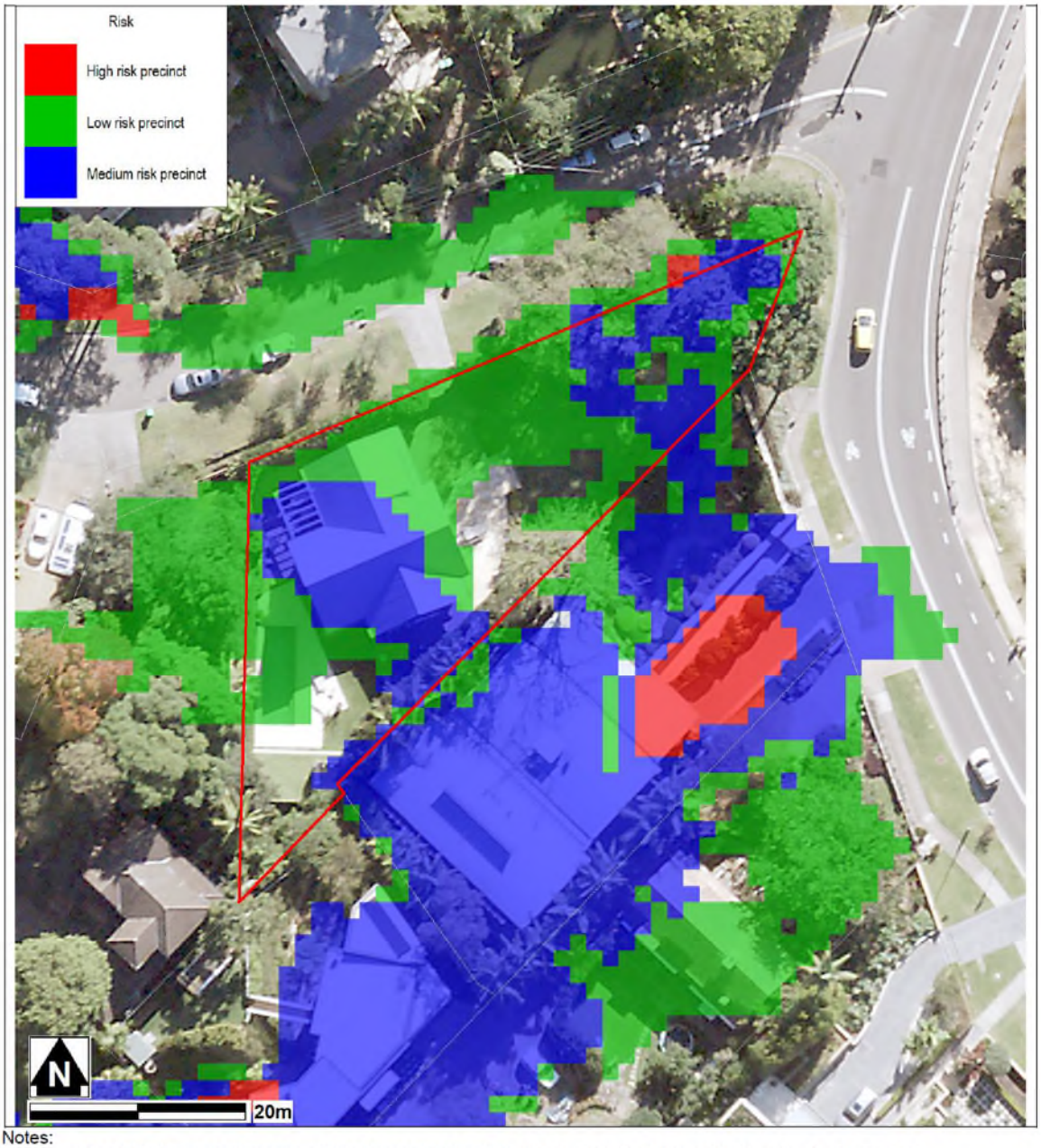
(1) The provided flood information does not account for any local overland flow issues nor private stormwater drainage systems.
(2) Overland flow/mainstream water levels may vary across a sloping site, resulting in variable minimum floor/ flood planning levels across the site. The maximum Flood Planning Level may be in a different location to the maximum 1% AEP flood level.
(3) Intensification of development in the former Pittwater LGA requires the consideration of climate change impacts which may result in higher minimum floor levels.
(4) Vulnerable/critical developments require higher minimum floor levels using the higher of the PMF or FPL

Notes

General

- All levels are based on Australian Height Datum (AHD) unless otherwise noted.
- This is currently the best available information on flooding; it may be subject to change in the future.
- Council recommends that you obtain a detailed survey of the above property and surrounds to AHD by a registered surveyor to determine any features that may influence the predicted extent or frequency of flooding. It is recommended you compare the flood level to the ground and floor levels to determine the level of risk the property may experience should flooding occur.
- Development approval is dependent on a range of issues, including compliance with all relevant provisions of Northern Beaches Council's Local Environmental Plans and Development Control Plans.
- Please note that the information contained within this letter is general advice only as a detail survey of the property as well as other information is not available. Council recommends that you engage a suitably experienced consultant to provide site specific flooding advice prior to making any decisions relating to the purchase or development of this property.
- The Flood Studies on which Council's flood information is based are available on Council's online Flood Study Reports webpage.
- If the FPL is higher than the PMF level, then the FPL should still be used as the FPL, as it includes freeboard which the PMF does not.
- If the property is affected by an Estuarine Planning Level (EPL) which is higher than the FPL, then the EPL should be used as the FPL.
- Areas affected by an EPL in the former Pittwater LGA are mapped on Council's online Estuarine Hazard Map. Note that areas in the former Manly LGA affected by an EPL have been identified and will be soon added to this map.
- Council's drainage infrastructure is mapped on Council's Stormwater Map. Note that locations are indicative only and may not be exactly as shown.

MAP A: FLOOD RISK PRECINCTS



Notes:

- **Low Flood Risk precinct** means all flood prone land not identified within the High or Medium flood risk precincts.
- **Medium Flood Risk precinct** means all flood prone land that is (a) within the 1% AEP Flood Planning Area; and (b) is not within the high flood risk precinct.
- **High Flood Risk precinct** means all flood prone land (a) within the 1% AEP Flood Planning Area; and (b) is either subject to a high hydraulic hazard, within the floodway or subject to significant evacuation difficulties (H5 or H6 Life Hazard Classification).
- The **Flood Planning Area** extent is equivalent to the Medium Flood Risk Precinct extent and includes the High Flood Risk Precinct within it. The mapped extent represents the 1% annual Exceedance Probability (AEP) flood event + freeboard.
- None of these mapped extents include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: McCarrs Creek, Mona Vale and Bayview Flood Study Review 2017, Royal HaskoningDHV) and aerial photography (Source: NearMap 2014) are indicative only.

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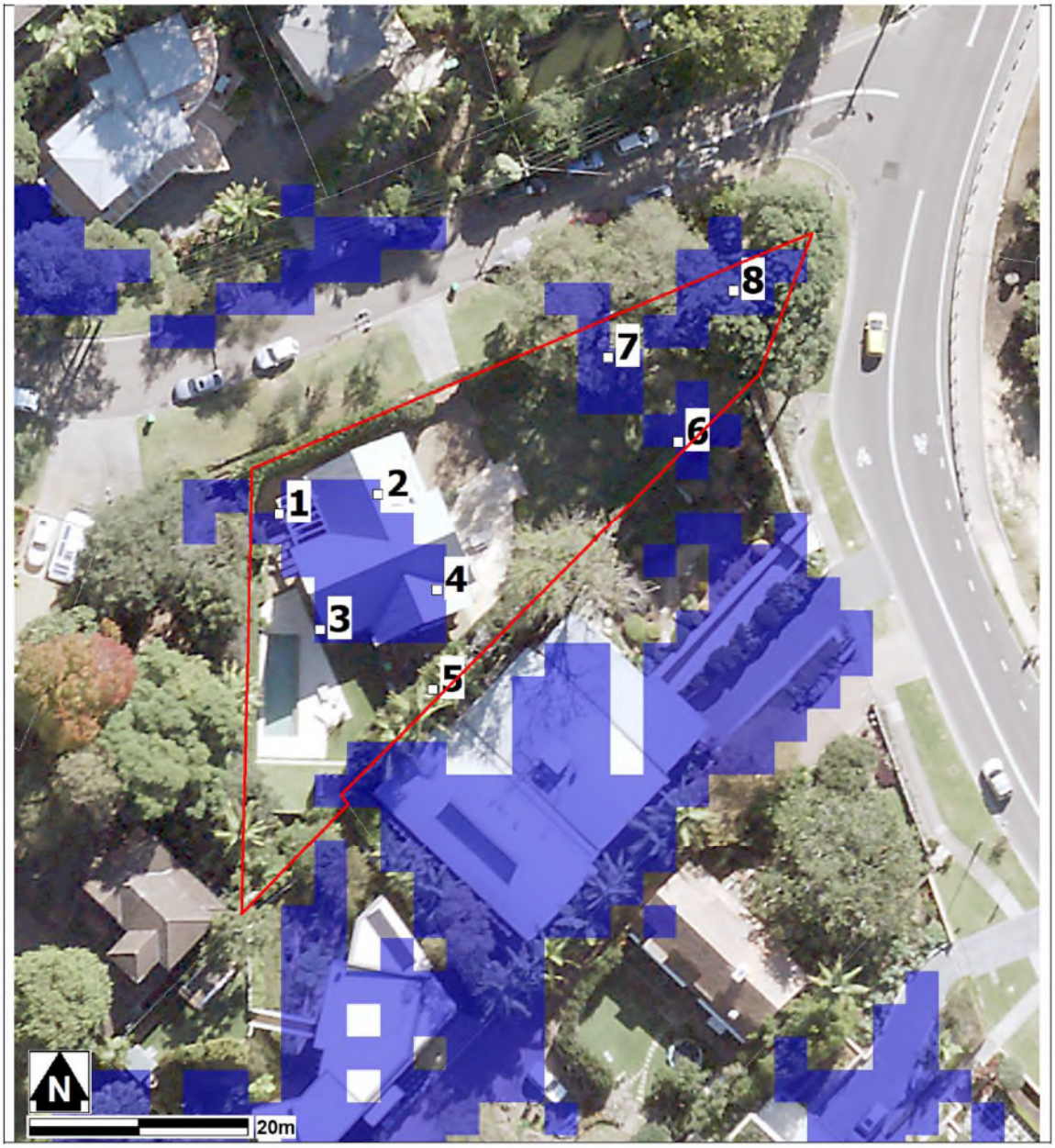
MAP B: FLOODING - 1% AEP EXTENT & KEY POINTS



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: McCarrs Creek, Mona Vale and Bayview Flood Study Review 2017, Royal HaskoningDHV) and aerial photography (Source Near Map 2014) are indicative only.

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Flood Levels

ID	5% AEP Max WL (m AHD)	5% AEP Max Depth (m)	1% AEP Max WL (m AHD)	1% AEP Max Depth (m)	1% AEP Max Velocity (m/s)	Flood Planning Level (m)	PMF Max WL (m AHD)	PMF Max Depth (m)	PMF Max Velocity (m/s)
1	5.23	0.27	5.26	0.30	0.19	5.16	5.42	0.46	0.65
2	N/A	N/A	4.96	0.18	0.11	4.96	5.18	0.40	0.29
3	4.98	0.26	5.00	0.28	0.19	5.03	5.20	0.48	0.29
4	N/A	N/A	4.90	0.17	0.18	4.89	5.07	0.34	0.36
5	N/A	N/A	N/A	N/A	N/A	5.16	4.91	0.31	0.37
6	N/A	N/A	3.03	0.35	0.25	3.07	3.26	0.58	0.43
7	N/A	N/A	3.64	0.27	0.26	3.63	3.80	0.44	0.43
8	N/A	N/A	2.84	0.19	0.53	2.72	3.00	0.35	0.83

Climate Change Flood Levels (30% Rainfall intensity and 0.9m Sea Level Rise)

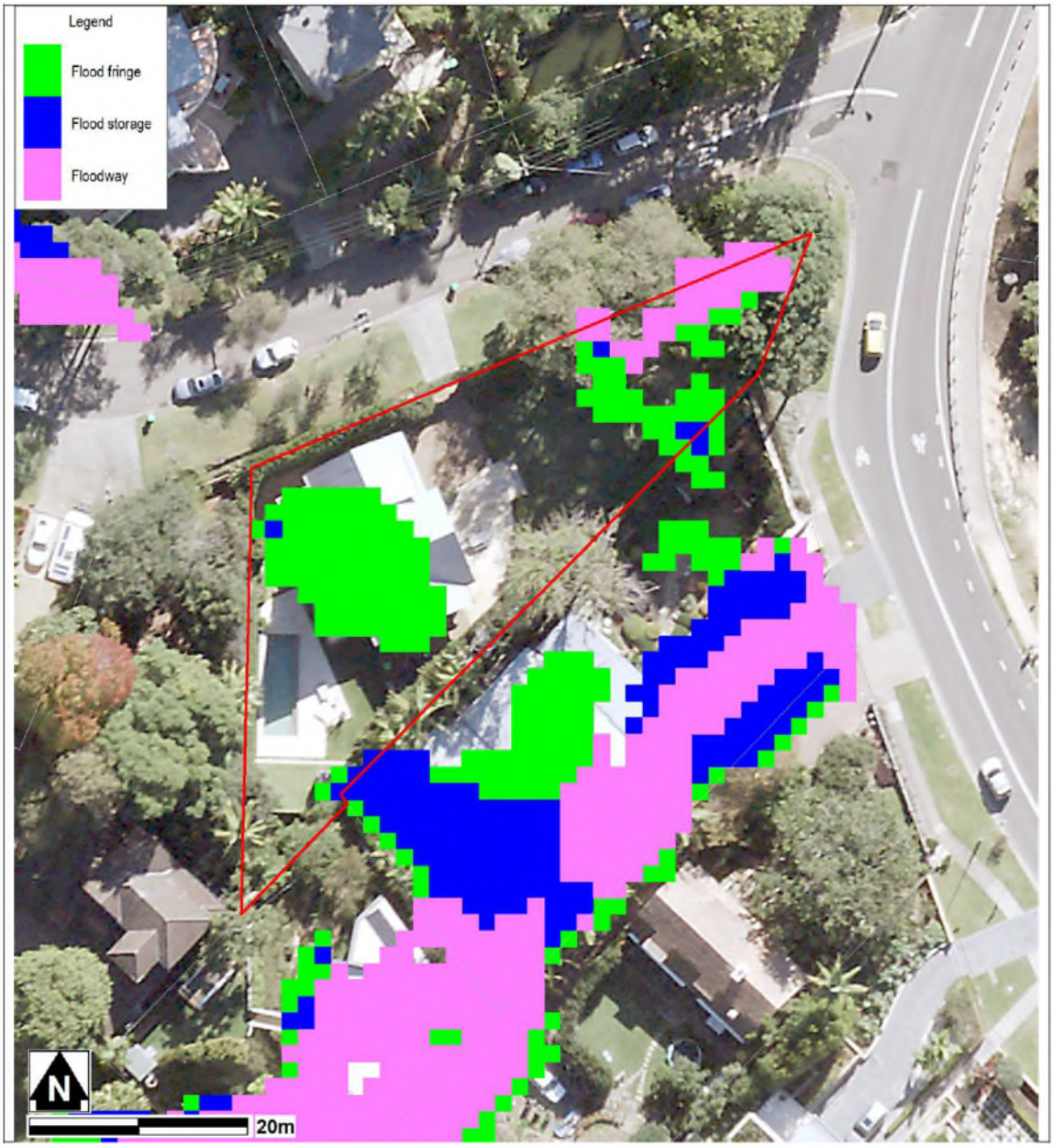
ID	CC 1% AEP Max WL (m AHD)	CC1 % AEP Max Depth (m)
1	5.28	0.32
2	4.99	0.21
3	5.03	0.30
4	4.93	0.19
5	N/A	N/A
6	3.09	0.41
7	3.68	0.31
8	2.88	0.23

WL – Water Level
PMF – Probable Maximum Flood
N/A - No Peak Water Level/Depth/Velocity Available.

Notes:

- The flood planning levels above are calculated by adding a 0.5m freeboard to the 1% AEP water level. However, if the depth of flow is less than 0.3m and a Velocity X Depth product is less than $0.3m^2/s$, a freeboard of 0.3m may be able to be justified for development.

MAP C: 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: McCarrs Creek, Mona Vale and Bayview Flood Study Review 2017, Royal HaskoningDHV) and aerial photography (Source: NearMap 2014) are indicative only

Issue Date: 09/10/2024

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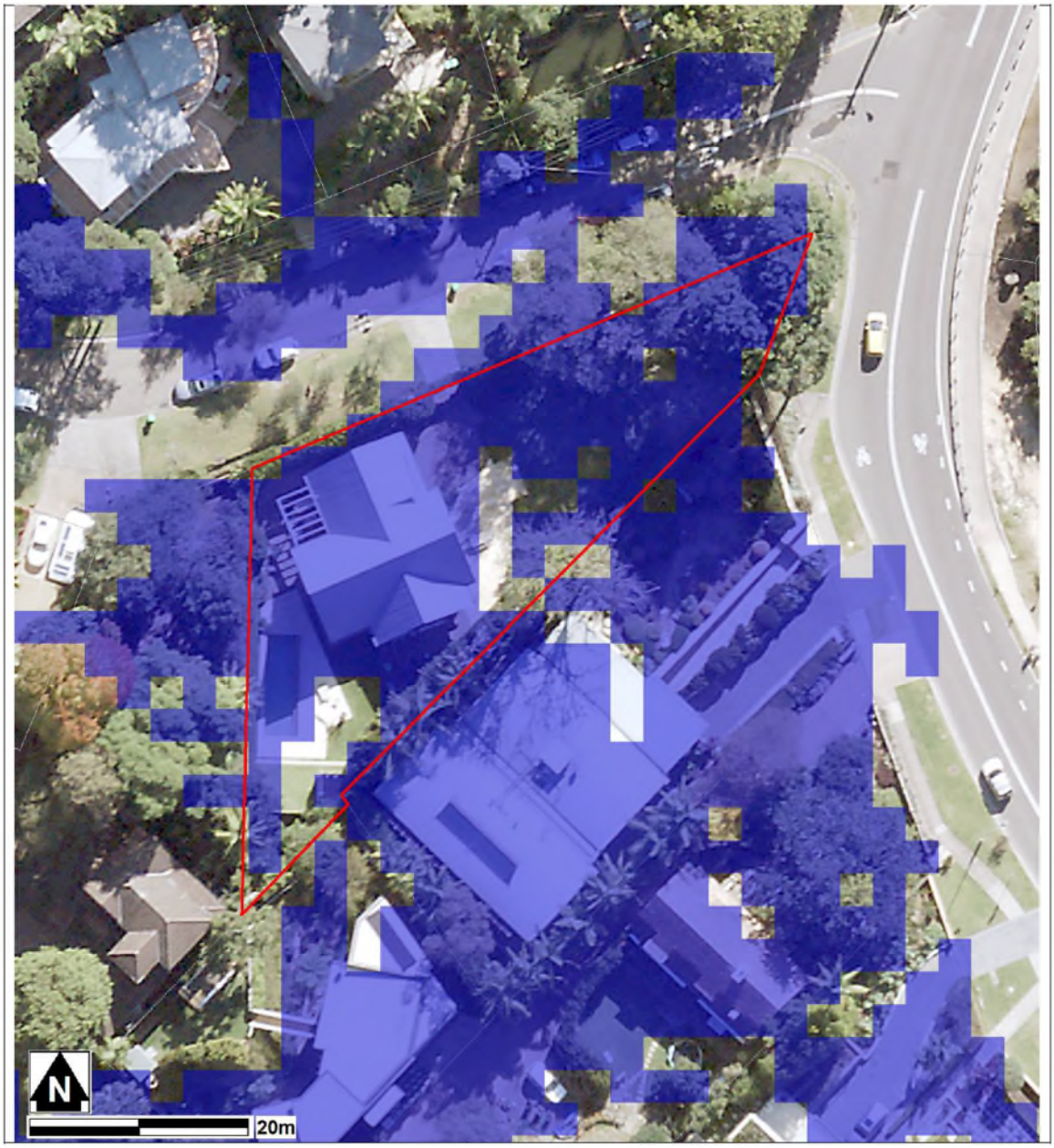
MAP D: PMF EXTENT MAP



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: McCarrs Creek, Mona Vale and Bayview Flood Study Review 2017, Royal HaskoningDHV) and aerial photography (Source: NearMap 2014) are indicative only

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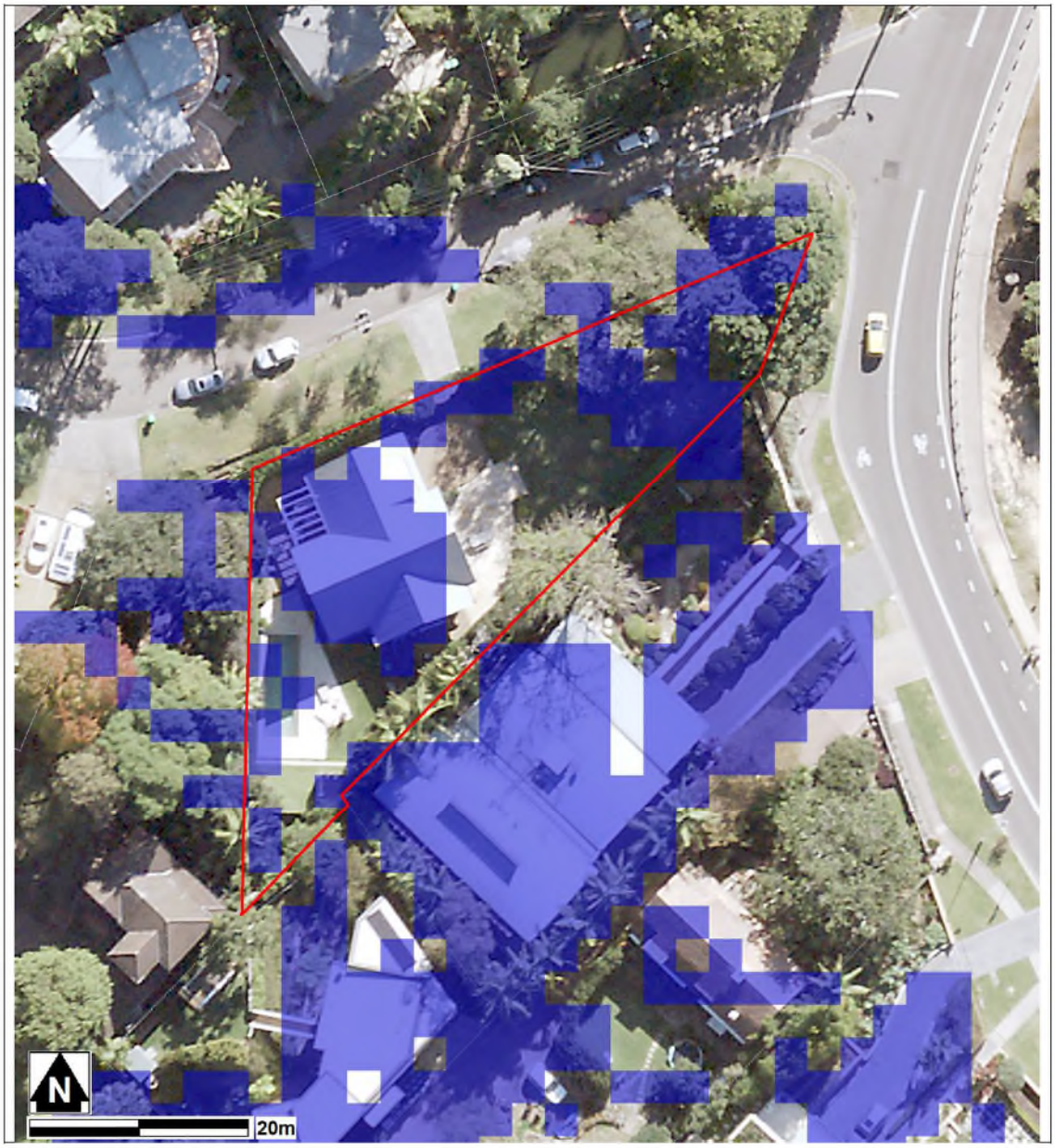
MAP E: FLOODING – 1% AEP EXTENT PLUS CLIMATE CHANGE



Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event including 30% rainfall intensity and 0.9m Sea Level Rise climate change scenario
- Flood events exceeding the 1% AEP can occur on this site.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: McCarrs Creek, Mona Vale and Bayview Flood Study Review 2017, Royal HaskoningDHV) and aerial photography (Source: NearMap 2014) are indicative only

Issue Date: 09/10/2024

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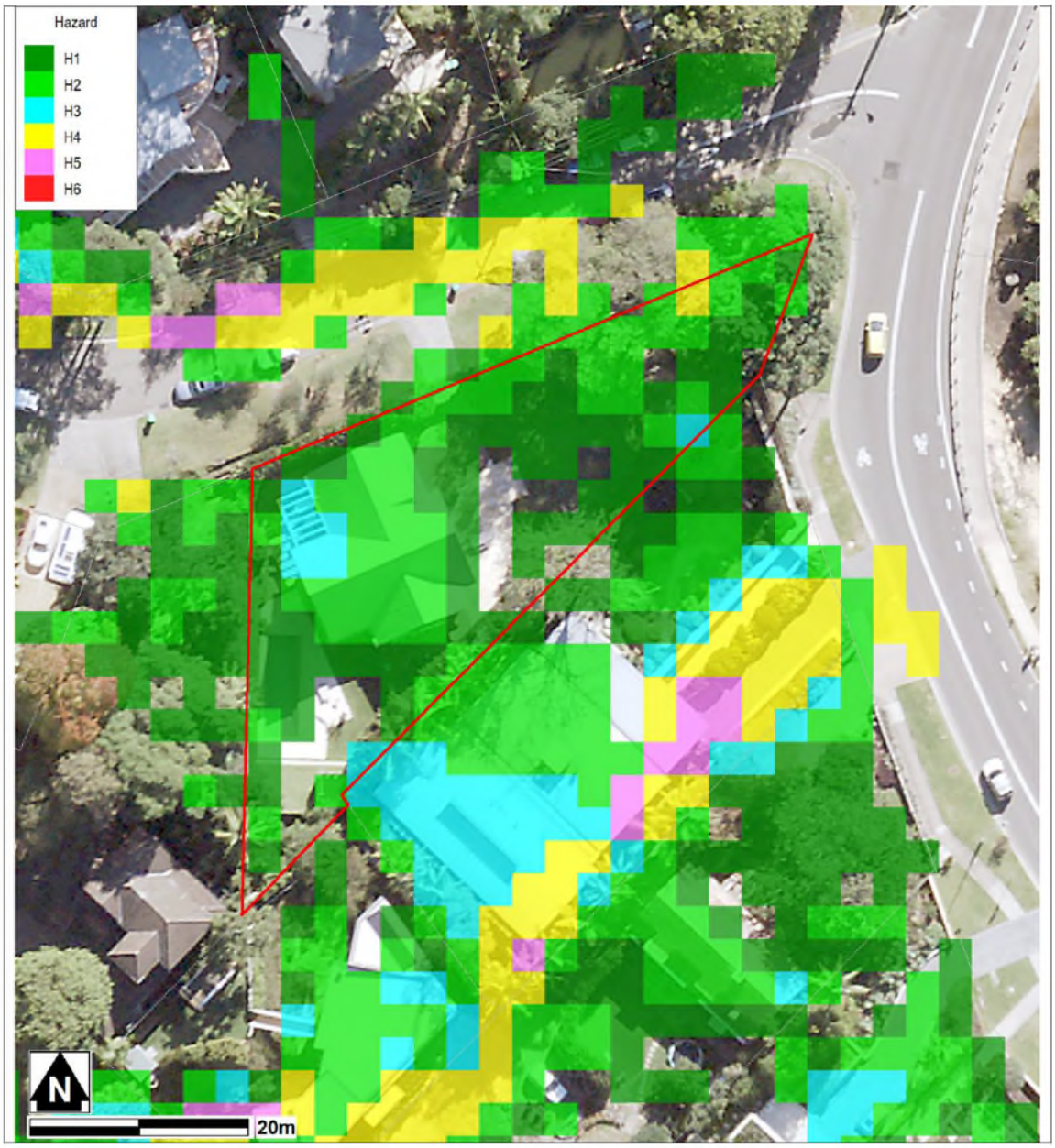
MAP F: FLOOD LIFE HAZARD CATEGORY IN PMF



Notes:

- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: McCarrs Creek, Mona Vale and Bayview Flood Study Review 2017, Royal HaskoningDHV) and aerial photography (Source Near Map 2014) are indicative only.

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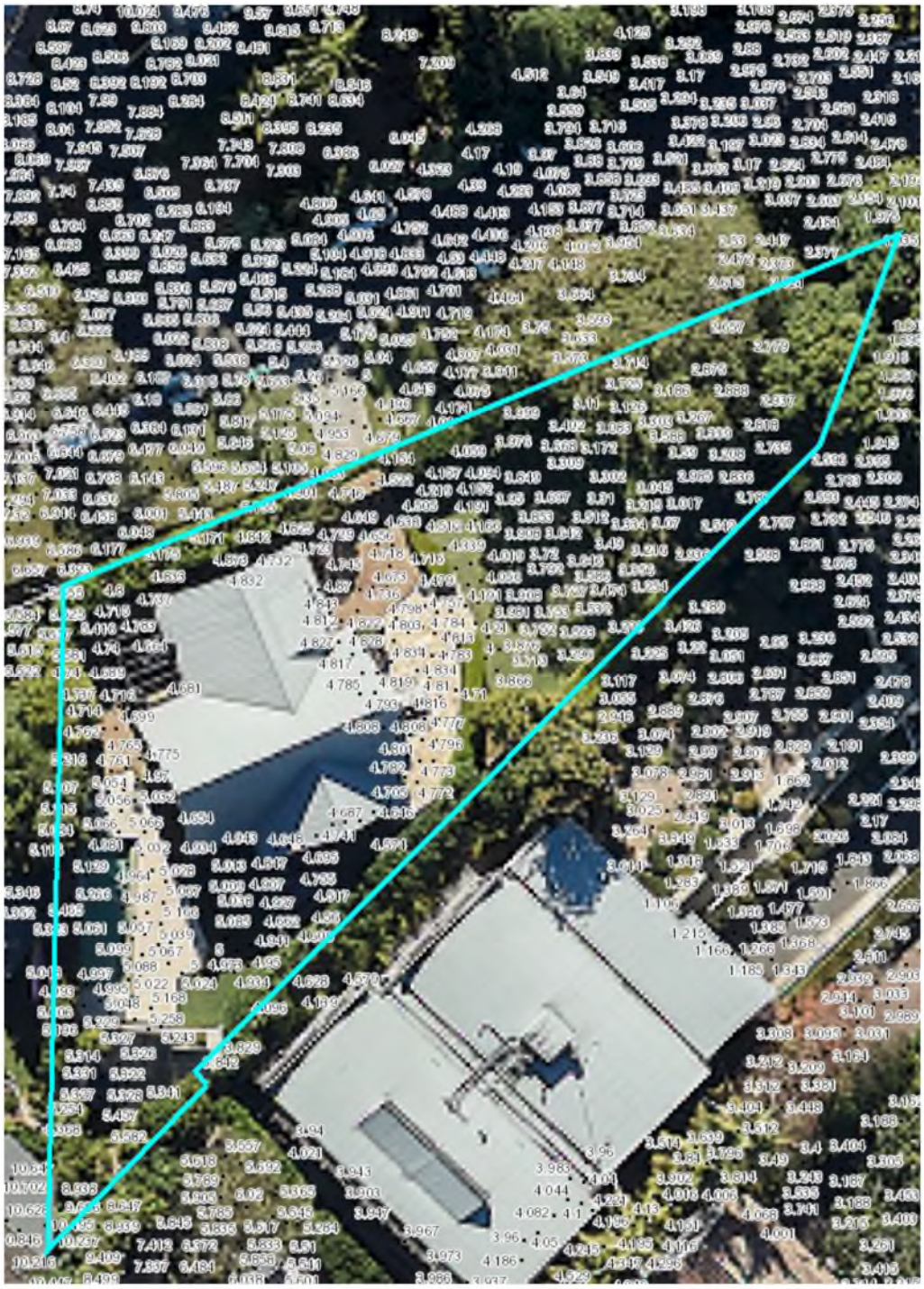
MAP G: INDICATIVE GROUND SURFACE SPOT HEIGHTS



Notes:

- The surface spot heights shown on this map were derived from Airborne Laser Survey and are indicative only.
- Accuracy is generally within ± 0.2m vertically and ± 0.15m horizontally, and Northern Beaches Council does not warrant that the data does not contain errors.
- If accuracy is required, then survey should be undertaken by a registered surveyor.

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