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Flood Investigation Report

For a Proposed Child Care

Prepared for: **Jacky Angelovska**

Project address: **Lot 34 (No. 118) Maitland Street, Muswellbrook**

Document No.: **CC230127_FRMP**

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Dated: **26 March 2024**

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VERSION HISTORY

Version	Date	Purpose	Prepared By	Approved By
1.0	26.03.2024	Flood Investigation Report	Isaac Kan/ Nathan Broadbent	

Review Panel	
Division/Office	**Name**

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Annexures

1 Introduction

HYRACOR Consulting Engineers Pty Ltd (HCE) has been commissioned to prepare a Flood Risk Management Plan in accordance with the requirements of Muswellbrook Shire Development Control Plan (DCP) Section 13 – Floodplain Management and Muswellbrook Local Environmental Plan (LEP) 2009 Clause 5.21.

The Flood Investigation Report is supported by a flood study which investigates flood behaviour throughout the mainstream flooding catchment impacting the subject site. This includes the analysis of:

- Surface runoff across the catchment.
- Flooding towards the lower part of the catchment.
- Backwater flooding impact on the subject site.

A two-dimensional computer model of the catchment was obtained from Council to analyse mainstream flood behaviour under existing and proposed catchment conditions. The model provides information on the extent of flood inundation, flood depths and flood velocities throughout the catchment for the 1%, 0.5%, 0.2% AEP and PMF. Results from this study form the technical basis for the subsequent flood risk management plan, which identifies problem areas and investigates options to reduce the risk of flooding.

1.1 Objective

The objective of the study is to define local overland flooding in accordance with the NSW Flood Risk Management Manual (NSW DPE 2023) and Muswellbrook Shire Development Control Plan (DCP) Section 13 – Floodplain Management. It involved the following steps:

- Attend the site to assess the anticipated extent and nature of flooding and identify hydraulic controls likely to impact on flooding behaviour.
- Obtain a copy of Council's current TUFLOW model for the catchment under data share agreement.
- Review flooding behaviour and provide recommendations to ensure that future redevelopment of the site will meet flood compatibility standards.

1.2 Site description

The subject site is known as Lot 34/DP229637 No. 118 Maitland Street, Muswellbrook. The site is located on the eastern side of Maitland Street. The surrounding developments are residential and productivity support.

The subject site is a developed site area comprising an area of 1714 square metres and is zoned R1 General Residential under Muswellbrook Local Environmental Plan (LEP) 2009. Current development on the site consists of a single-storey dwelling.

The site is relatively flat with the natural surface elevations generally ranging within the range RL 150.30 m AHD to RL 150.15 m AHD.

Muscle Creek flows in a generally northerly direction near the northern boundary of the site. The creek channel generally grades from east to west from RL 145.71 m AHD to RL 145.06 m AHD. The channel generally ranges from 4.5 – 5.0 metres in depth. The top of bank within the site typically ranges from RL 150.15 m AHD to RL 150.34 m AHD.

The applicant proposed to demolish the existing dwelling and build a proposed childcare centre. The principal details of the proposed works are depicted in the architectural plans prepared by ArtMade Architects, reference 23714, 37 Sheets, revision A, dated 14 January 2023.

1.3 Flood characteristics

The site is impacted by mainstream floodwaters generated by the Muscle Creek, a tributary of Hunter River Catchment comprising an area of approximately 92 km^2. The mainstream flow impacting the site us the subject of 'Muscle Creek Flood Study' (Royal HaskoningDHV 2017) & 'Muswellbrook Flood Risk Management Study & Plan' (Royal HaskoningDHV 2019).

The behaviour of the existing 1%, 0.5%, 0.2% AEP and PMF flood events in the vicinity of the site is summarised in (Royal HaskoningDHV 2017) with detailed flood maps prepared by HCE, dated 15 March 2024 (copy enclosed under Annexure A).

The 1% AEP floodwaters do not impact the site and is fully contained within Muscle Creek at elevations RL 149.65 m AHD, inundating the creek to depths in up to 4.0m. The 1% AEP floodwater velocities within Muscle Creek generally range from 0.5 m/s to 2.5 m/s. The 1% AEP floodwaters pose high hazard conditions within Muscle Creek.

The 0.5% AEP floodwaters impact the eastern portion of the site directly adjacent to Muscle Creek at elevations RL 149.95 m AHD. We note the floodwaters remain largely contained within the creek banks. The 0.5% AEP floodwater velocities within the site do no exceed 0.5 m/s and are generally within the range of 0.5 m/s to 2.7 m/s within Muscle Creek. The 0.5% AEP floodwaters create high hazard conditions within Muscle Creek and low hazard within the eastern portion of the site (9 m approx. from the rear boundary).

The PMF floodwaters impact the site at approximately RL 153.00 m AHD (Royal HaskoningDHV 2017), inundating the majority of the site and Muscle Creek to depths in excess of 2.9 metres and 6.5 metres respectively. Away from Muscle Creek, PMF floodwater velocities generally range from 1.8 – 2.5 m/s. PMF floodwater velocities reach 3.0 m/s within New England Highway and 6.0 m/s within Muscle Creek. The PMF floodwaters create high hazard conditions.

2 Available Data

This flood study used topographic and flood related data obtained from a number of sources. The origin and types of information underpinning the assumptions used in this study are presented below.

2.1 Published flood data

The flood study has been undertaken using a TUFLOW model for the Muscle Creek catchment provided under data share agreement with Muswellbrook Shire Council. We understand the TUFLOW model provided to HCE formed the basis of the 'Muscle Creek Flood Study' (Royal HaskoningDHV 2017) and informed the preparation of 'Muswellbrook Flood Risk Management Study and Plan' (Royal HaskoningDHV 2019).

2.2 Survey data

Survey information adopted for this study has been collated from the following sources:

- GIS layers of cadastre and satellite imagery provided by NSW Spatial Services
- Site survey prepared by FYFE, Reference No. 90906-1, dated 31 January 2024, Revision 1.
- High resolution aerial imagery provided by Nearmap

3 Flood Model Results

This section summarises the results of the hydrologic and hydraulic modelling of mainstream flooding within the catchment.

3.1 Flood hazard

The degree of provisional hazard attributed to flooding at the subject site is a function of hydraulic hazard (relating to the depth and velocity of floodwaters). The true hazard attributed to flood behaviour is based on provisional hazard ratings which have been adjusted to account for the following factors:

- Size of flood.
- Effective warning time.
- Flood awareness.
- Rate of rise of floodwater.
- Duration of flooding.
- Evacuation problems.
- Effective flood access.
- Type of development.

Provisional flood hazard has been determined using the provisional hydraulic categories described in the Appendix L of Floodplain Development Manual (NSW DIPNR 2005), refer Section 3.1.1, and the hazard vulnerability classification system described in Australian Disaster Resilience Guideline 7-3: Flood Hazard (AIDR 2017), refer Section 3.1.2.

3.1.1 NSW Floodplain Development Manual

The NSW Floodplain Development Manual assigns provisional hazard categories of low, intermediate or high to floodwaters based on the velocity and depth of flows. The relationship between depth, velocity and hazard is presented in Figure L.2 of NSW DIPNR (2005) which is reproduced in Figure 1.

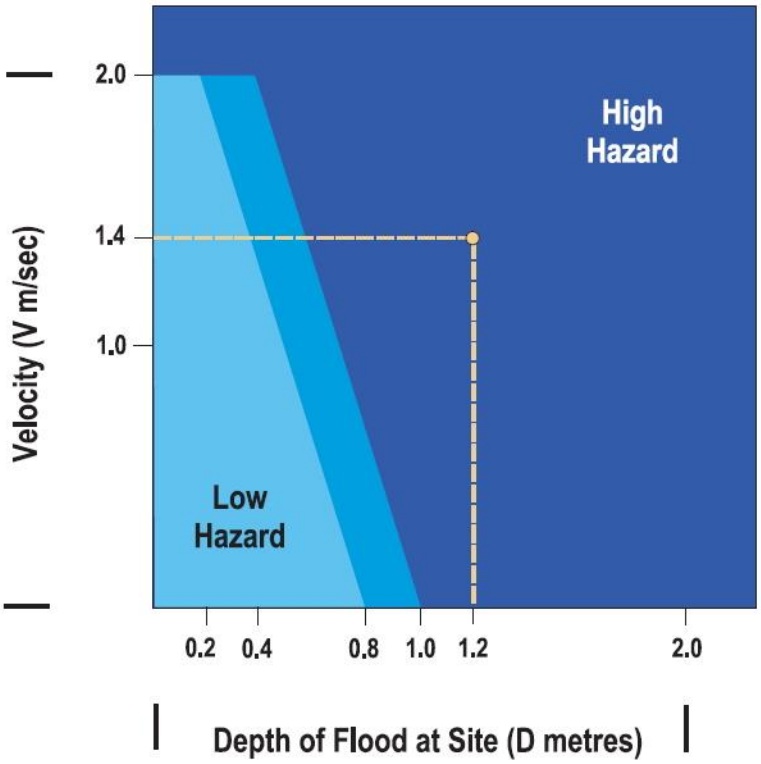

Figure 1: Provisional flood hazard (NSW DIPNR 2005).

3.1.2 AIDR Guideline 7-3

'Australian Disaster Resilience Guideline 7-3: Flood Hazard' (AIDR 2017) assigns hazard vulnerability classifications based on the depth and velocity of floodwaters, accounting for the vulnerability of the community and community assets to damage or danger when interacting with floodwaters. The relationship between depth, velocity and hazard vulnerability classification is depicted in Figure 6 of AIDR (2017), reproduced in Figure 2 and summarised in Table 1.

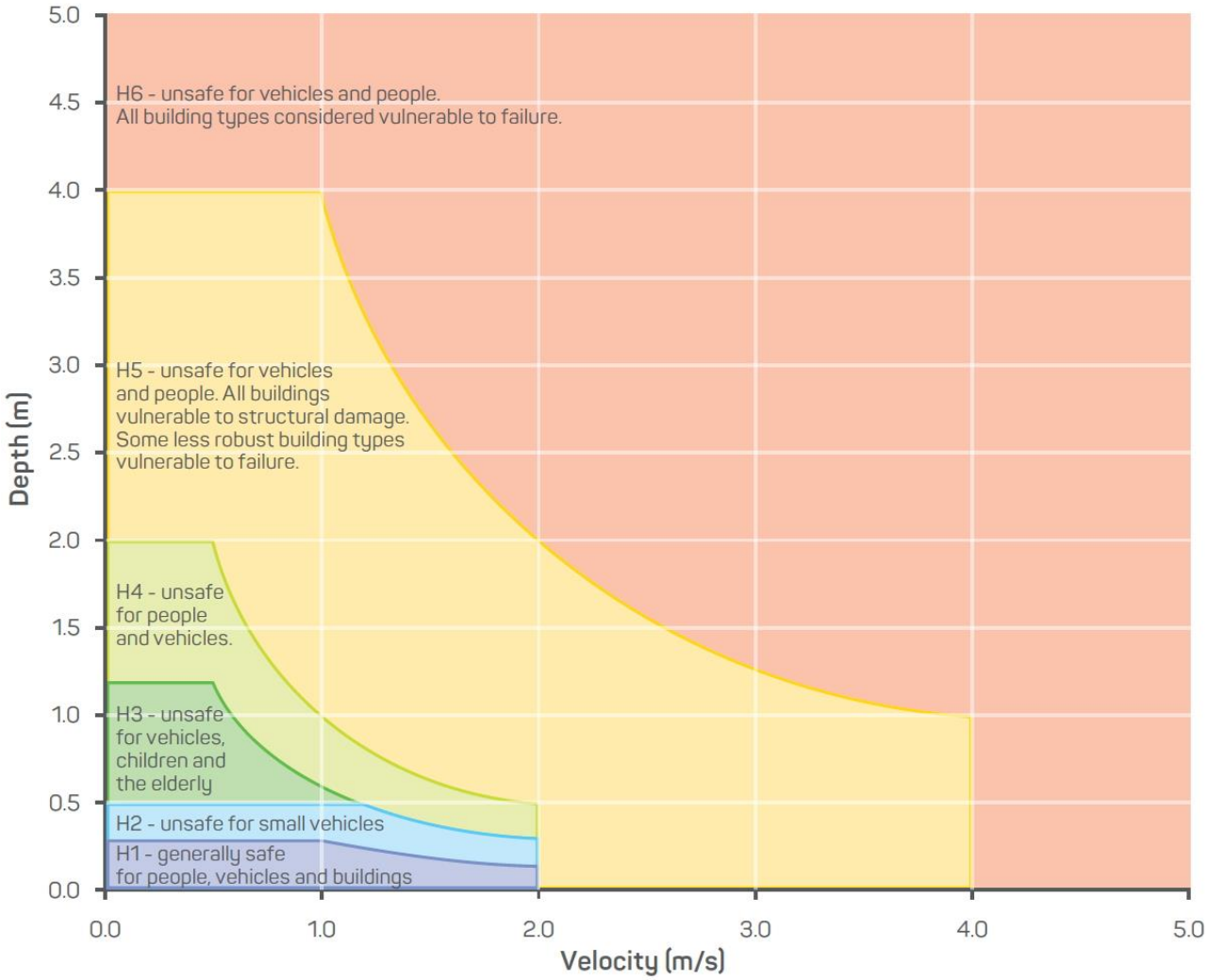

Figure 2: Hazard vulnerability classification (AIDR 2017).

Table 1: Description of hazard vulnerability classifications (AIDR 2017).

Classification	Description
H1	Generally safe for all people, vehicles and buildings.
H2	Unsafe for small vehicles. Generally safe for people and buildings.
H3	Unsafe for vehicles, children and the elderly. Generally safe for able-bodied adults.
H4	Unsafe for vehicles and people.
H5	Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.

3.2 Design flood characteristics

The water level, depth and velocity of the 1% AEP, 0.5% AEP, 0.2% AEP and PMF floodwaters in the vicinity of the subject site were mapped for existing conditions scenarios. The following maps are enclosed under Annexure A :

- Pre-Development 1% AEP flood depth and level plan (Refer CC230127/F1/A)
- Pre-Development 1% AEP flood velocity plan (Refer CC230127/F2/A)
- Pre-Development 0.5% AEP flood depth and level plan (Refer CC230127/F3/A)
- Pre-Development 0.5% AEP flood velocity plan (Refer CC230127/F4/A)
- Pre-Development 0.2% AEP flood depth and level plan (Refer CC230127/F5/A)
- Pre-Development 0.2% AEP flood velocity plan (Refer CC230127/F6/A)
- Pre-Development PMF flood depth and level plan (Refer CC230127/F7/A)
- Pre-Development PMF flood velocity plan (Refer CC230127/F8/A)

3.3 Flood affectation of the site

The site is largely flood free during all flood events up to and including the 0.2% AEP flood event. Under existing conditions, the site experiences 0.2% AEP floodwater depths generally not exceeding 100 mm resulting in Low Hazard (H1) conditions. Evacuation from the site is available during all flood events up to and including the 0.2% AEP Muscle Creek flood event.

During the PMF the site will be completely inundated by High Hazard floodwaters falling within the H6 hazard vulnerability classification. Evacuation from the site will not be possible once floodwaters are visible within Maitland Street adjacent to the site. During a 4 hour duration Muscle Creek PMF event (the design PMF event), floodwaters will begin to enter the basement approximately 1 hour and 45 minutes after the commencement of rainfall and vehicular access to Maitland Road will be lost shortly after when H3 floodwaters occur within the site (approximately 2 hours after commencement of rainfall). Vehicular and pedestrian access to and from the site will be cut for approximately 5 hours and 45 mins during a PMF event.

3.4 Impact of the proposed development

The site is flood free during the 1% AEP and 0.5% AEP flood events and largely flood free during the 0.2% AEP flood event. Subsequently, the proposed development of the site will not result in adverse impact on adjoining properties during these events. We acknowledge the proposal for landscape works within the riparian corridor and note that this work should be limited to minimise riparian impacts.

4 Flood Risk Management

Based on the foregoing, we offer the following response, having due regard for the requirements of Muswellbrook Shire Council DCP Section 13 – Flood Prone Land and the NSW Flood Risk Management Manual.

4.1 Floor level

We acknowledge the requirements of Table 2 of Muswellbrook Development Control Plan Section 13 Table 2 and note that it is preferred that habitable floors for childcare centres be located at or above the PMF level.

In this regard, the probable maximum flood level applicable to the development is 153.00 m AHD.

A minimum habitable ground floor level of RL 153.00 m AHD is not practical as it is approximately 2.8 m above the existing natural surface within the development area. In this regard, we request Council assess the proposed minimum habitable floor level of RL 150.25 m AHD having due regard for the following:

- A floor level of RL 150.25 m AHD is above the 0.2% AEP flood level and provides approximately 600 mm freeboard to the peak 1% AEP flood level near the site.
- The upper floor refuge proposes a finished floor level of RL 153.65 m AHD providing 650 mm to peak PMF floodwaters.
- Approximately 1 hour and 45 minutes warning time is available after the commencement of PMF rainfall. Therefore early evacuation may be achievable subject to receiving an SES order.

4.2 Building components and method

The proposed childcare is to be constructed from flood compatible materials to elevation RL 150.24 m AHD or otherwise flood-proofed to this level. Extensive guidance on flood compatible building materials and methods is provided in 'Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas' (HNFMSC 2006) and 'Construction of Buildings in Flood Hazard Areas' Standard and Information Handbook (ABCB 2012a,b); a selection of the flood compatible materials and practices described in these resources is summarised below.

Steel frames should be constructed from open sections where possible and have holes drilled into the bottom steel plates to allow water to drain from the frame in the event of immersion.

Nails, bolts, hinges and fittings should be made from nylon, brass, stainless steel or hot dipped galvanised steel. Hinges should be of a removable pin type.

Flood compatible building guidelines do not apply in general to household appliances and built-in furniture as they have a high depreciation rate and are expected to be replaced numerous times throughout the life of a building. Occupants should be aware that any items which may not be installed or relocated above the PMF flood level of 153.00 m AHD do have some risk of being damaged by floodwaters. Damage to household appliances such washing machines, fridges and stoves may be minimised by raising them above floodwaters if possible. Built-in furniture such as kitchen and laundry cupboards and built-in wardrobes are often constructed from materials such as particleboard or MDF which are highly susceptible to water damage. Potential damage to built-in furniture may be minimised by installing cupboards on metal or plastic legs which may be covered with removable boards, and avoiding false floors in cupboards and wardrobes.

Ancillary structures such as steps and pergolas shall be constructed of water tolerant materials such as masonry sealed hardwood and corrosion resistant metals. Copper Chrome Arsenate (CCA) treated timber is not a flood compatible material.

Connection to mains power supply, including metering equipment should be located above RL 150.24 m AHD. All electrical wiring, switches and outlets should, where possible be located above RL 150.24 m AHD. Earth core leakage systems or safety switches are to be installed. All electrical installations below RL 150.24 m AHD, including wiring, connections and conduit, should be suitable for submergence in water or appropriately waterproofed. Conduits shall be installed so they will be self-draining in the event of flooding.

Heating and air-conditioning systems, including fuel supply and ducting, should be installed above RL 150.24 m AHD. Where this is not possible, they should be installed in such a manner as to minimise damage from submersion. This may be achieved through measures such as access for cleaning and draining of water after flood events, manually operated cut off valves for fuel supply lines and ducts, securely fastening heating equipment and any tanks on the site to prevent buoyancy and movement, and venting of fuel supply tanks at an elevation of 153.00 m AHD.

4.3 Structural soundness

The proposed upper floor is to be constructed to withstand the loads imposed by the PMF event floodwaters, including hydrostatic, hydrodynamic, buoyancy and debris impact forces. The structural design should be

certified by a practicing Structural Engineer with relevant experience designing structures on flood prone lands.

Any structures attached to the proposed upper floor are to be structurally adequate and not reduce the structural capacity of the upper floor structure during the PMF flood event. Structural Engineer should source the design flood depth and velocity from a suitably qualified civil engineer with experience in flood modelling and floodplain management.

4.4 Car parking and driveway access

The proposed basement carpark entry is not impacted by floodwaters during any local flood events up to and including the 0.2% AEP flood event. The proposed entry level is positioned approximately 600 mm above the peak 1% AEP Muscle Creek flood level.

4.5 Warning of flood events

Warning of flood events and the potential consequences of flooding are available from a number of sources. The different flood warning products available for the site are described below, along with appropriate actions to take upon the receipt of each warning type.

4.5.1 Weather warnings

The Bureau of Meteorology (BoM) issues a number of weather warnings which provide advance notice of weather events which may cause flooding at the site. Weather warnings are publicly available on the BoM website (http://www.bom.gov.au/nsw/warnings/) or through the BoM Weather app.

4.5.1.1 Severe Weather Warning

A Severe Weather Warning is issued whenever severe weather is occurring, is expected to occur or is expected to move into an area. Severe Weather Warnings are issued for events including one or more of the following:

- Sustained gale force winds
- Strong wind gusts
- Heavy rainfall which may lead to flash flooding.
- Abnormally high tides
- Dangerous surf

Severe Weather Warnings including advice for heavy rainfall that may cause flash flooding generally to provide 6 to 24 hours warning of weather events which may produce flooding within the catchment.

If a Severe Weather Warning for heavy rainfall which may lead to flash flooding is issued, occupants of the site should prepare in accordance with the Flood Emergency Management procedures and check their Emergency Kit (refer Section 4.6). Occupants of the site should routinely check the BoM warnings page or the BoM Weather app for updated Severe Weather Warnings.

4.5.1.2 Severe Thunderstorm Warning

A Severe Thunderstorm Warning is issued when severe thunderstorms are occurring or expected to occur in an area. Severe Thunderstorm Warnings are issued when a storm is expected to or is producing one or more of the following conditions:

- Hail larger than 2 cm in diameter.
- Damaging or destructive wind gusts
- Tornados

- Heavy rainfall which may lead to flash flooding.

A Severe Thunderstorm Warning may be issued for a broad area, showing where severe thunderstorms may develop up to 3 hours in advance.

The BoM also issues Detailed Severe Thunderstorm Warnings for the Sydney area when individual severe thunderstorms are detected on radar. Detailed Severe Thunderstorm Warnings usually provide less than 1 hour advance warning of severe thunderstorms and include a forecast storm track map.

If a Severe Thunderstorm Warning for heavy rainfall which may lead to flash flooding is issued, occupants of the site should prepare in accordance with the Plan of Management and Flood Emergency Response Plan and check their Emergency Kit (refer Section 4.6). The BoM warnings page or the BoM Weather app should be checked regularly for updated Severe Thunderstorm Warnings

4.6 Flood readiness

To increase the flood-readiness of the occupants of the site, owners/occupiers of the site should be made aware of FloodSafe kits developed by the NSW SES which aid occupants and staff on the site during a flood. Information regarding FloodSafe kits is available from https://www.ses.nsw.gov.au/flood-resources/before-a-flood/things-you-can-do-before-a-flood/. We note that a Flood Emergency Response Plan should be provided at Construction Certificate stage and included in the operational management plan for the site.

In addition to the Flood Emergency Plan, owners/occupiers of the site should prepare an Emergency Kit containing a portable radio with spare batteries, a torch with spare batteries, candles and waterproof matches, and a first aid kit. Advice on preparing an Emergency Kit is available at https://www.ses.nsw.gov.au/storm-resources/before-a-storm/put-together-an-emergency-kit/.

4.7 Evacuation

The NSW SES is responsible for providing flood updates and issuing Evacuation Warnings and Evacuation Orders. Evacuation Warnings are issued when the NSW SES issues a “Watch and Act: Prepare to evacuate” warning and provide advance notice of a possible need to evacuate and give residents time to prepare for evacuation. Evacuation Orders are issued when the NSW SES issues an “Emergency Warning: Evacuate now” or “Emergency Warning: Evacuate [before time]” warning, and notify residents that evacuation is necessary, and they must leave now in order to reach safety before roads are cut. Evacuation Orders are not always preceded by an Evacuation Warning.

Flood information issued by the NSW SES may be received by local, radio and television news, SMS messaging, Facebook and door-knocking in affected communities, or through the NSW SES website. The timing for evacuation of persons is to be established in consultation with the NSW SES.

Occupants of the site are able to evacuate the site if required via Maitland Street during all flood events up to and including the 0.2% AEP flood event.

During a 4 hour duration Muscle Creek PMF event (the design PMF event), floodwaters will begin to enter the basement approximately 1 hour and 45 minutes after the commencement of rainfall and vehicular access to Maitland Road will be lost shortly after when H3 floodwaters occur within the site (approximately 2 hours after commencement of rainfall). Vehicular and pedestrian access to and from the site will be cut for approximately 5 hours and 45 mins during a PMF event. If evacuation has not occurred under instruction from the SES prior to access being lost to Maitland Street, occupants of the site should seek refuge in the upper floor until floodwater recede. This should be identified in a Trigger Action Response plan prepared as part of the FERP for the site.

The site is identified in Royal HaskoningDHV 2017 to have rising road egress in the event of evacuation due to flooding is required.

In the event that the 1% AEP flood event is expected to be exceeded, strategies should be adopted in accordance with the Flood Emergency Response Plan the NSW Government operational guidelines and NSW SES Emergency Evacuation operational guidelines.

5 Conclusion

A childcare centre is proposed on the site known as Lot 34/DP229637 No. 118 Maitland Street, Muswellbrook. The site shares its rear boundary with Muscle Creek and is impacted by floodwaters from Muscle Creek during flood events exceeding the 0.2% AEP flood event.

The site is severely impacted by floodwaters during the Muscle Creek PMF event. However, measures are proposed to address flood risk on the site. Recommended flood risk management measures include providing a minimum habitable floor level above the 0.2% AEP flood level of RL 150.24 m AHD, providing an upper floor refuge where occupants may shelter in place during a local PMF event, and preparation of a Flood Emergency Response Plan to be prepared prior to issue of Construction Certificate documentation which is to be included in an operational Plan of Management for the development.

During a 4 hour duration Muscle Creek PMF event (the design PMF event), floodwaters will begin to enter the basement approximately 1 hour and 45 minutes after the commencement of rainfall and vehicular access to Maitland Road will be lost shortly after when H3 floodwaters occur within the site (approximately 2 hours after commencement of rainfall). Vehicular and pedestrian access to and from the site will be cut for approximately 5 hours and 45 mins during a PMF event. If evacuation has not occurred under instruction from the SES prior to access being lost to Maitland Street, occupants of the site should seek refuge in the upper floor until floodwater recede. These actions should be identified in a Trigger Action Response plan prepared as part of the Flood Emergency Response Plan for the site.

The proposed upper floor refuge shall be structurally certified to withstanding the forces of PMF loading.

Flood compatible materials are recommended for any structures located below RL 150.24 m AHD.

The proposed development will not result in flood impacts on adjoining properties during any Muscle Creek flood event up to and including the 0.2% AEP flood event.

Based on the foregoing, we are of the view that the proposed development meets the intent of the requirements of Muswellbrook Shire Development Control Plan (DCP) Section 13 – Floodplain Management and the principles outlined in the Floodplain Risk Management Manual in relation to management of flood risk.

Yours faithfully,
HYDRACOR Consulting Engineers Pty Ltd

Nathan Broadbent
BEng (Civil) MIEAust, CPEng, NER

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7 Glossary

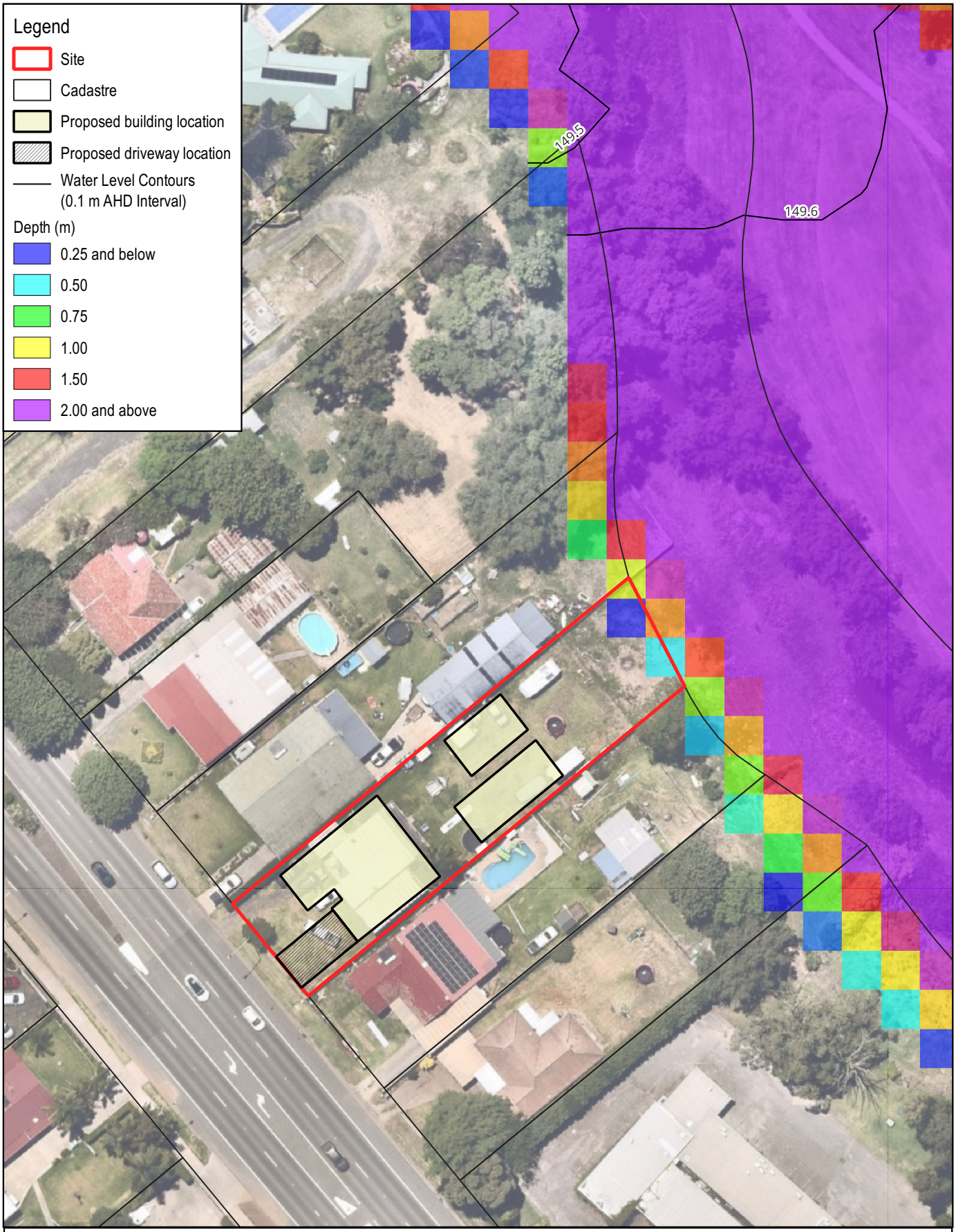
Terminology in this Glossary has been derived or adapted from the Floodplain Development Manual (NSW DIPNR 2005), where appropriate.

Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, expressed as a percentage.
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
Average recurrence interval (ARI)	The long-term average number of years between the occurrence of a flood as big as or larger than the selected event.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
Design flood	A flood event to be considered in the design process.

Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
Flood hazard	A measure of the floodwaters potential to cause harm or loss. Full definitions of hazard categories are provided in Appendix L of the Floodplain Development Manual (NSW Government, 2005). In summary: ▪ High: conditions that pose a possible danger to personal safety; evacuation by trucks difficult; able-bodied adults would have difficulty wading to safety; potential for significant structural damage to buildings. ▪ Low: conditions such that people and their possessions could be evacuated by trucks; able-bodied adults would have little difficulty wading to safety.
Flood planning area	The area of land below the FPL and thus subject to flood related development controls.
Flood planning levels (FPLs)	Combinations of flood levels (derived from significant historical flood events or floods of specific ARIs) and freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans.
Floodplain, flood-prone land	Land susceptible to inundation by the probable maximum flood (PMF) event, i.e. the maximum extent of flood liable land.
Floodplain risk management options	The measures that might be feasible for the management of a particular area of the floodplain.
Freeboard	Provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the FPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc.
Geographical information systems (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.
Hydraulics	The term given to the study of water flow in a river, channel or pipe, in particular, the evaluation of flow parameters such as stage and velocity.

Hydraulic category	A classification of floodwater hydraulic behaviour. The categories are: ▪ Floodway: those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood levels. ▪ Flood storage: those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. Loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. ▪ Flood fringe: remaining area of flood-prone land after floodway and flood storage areas have been defined.
Hydrograph	A graph that shows how the discharge changes with time at any particular location.
Hydrology	The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
Local overland flooding	Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.
Mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
Peak discharge	The maximum discharge occurring during a flood event.
Probable maximum flood (PMF)	The PMF is the largest flood that could conceivably occur at a particular location.
Probable Maximum Precipitation (PMP)	The PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location.
Probability	A statistical measure of the expected frequency or occurrence of flooding.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. For this study, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
Runoff	The amount of rainfall that actually ends up as stream or pipe flow, also known as rainfall excess.

Annexure A HYDRACOR Consulting Engineers Flood mapping, reference CC320127, Sheets F1 to F8, Revision A, dated 26 March 2024.



Title: PRE-DEVELOPMENT 1% AEP FLOOD DEPTH AND LEVEL PLAN (building overlay)

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Project: PROPOSED CHILDCARE DEVELOPMENT
Lot 34 (No. 118)
MAITLAND STREET
MUSWELLBROOK

Client: JACKY ANGELOVSKA

North:

Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
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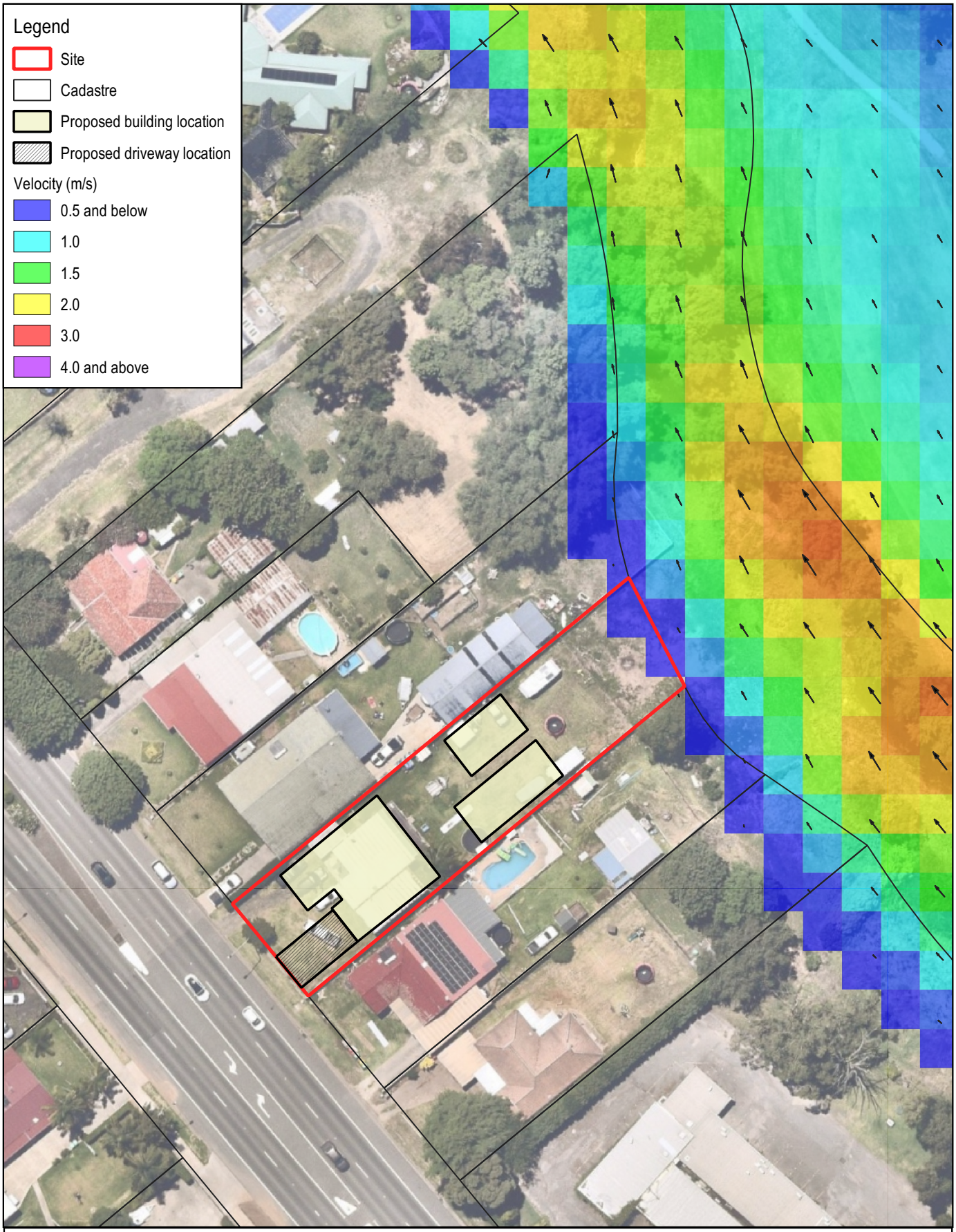

Title: PRE-DEVELOPMENT 1% AEP FLOOD VELOCITY PLAN (building overlay)

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Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
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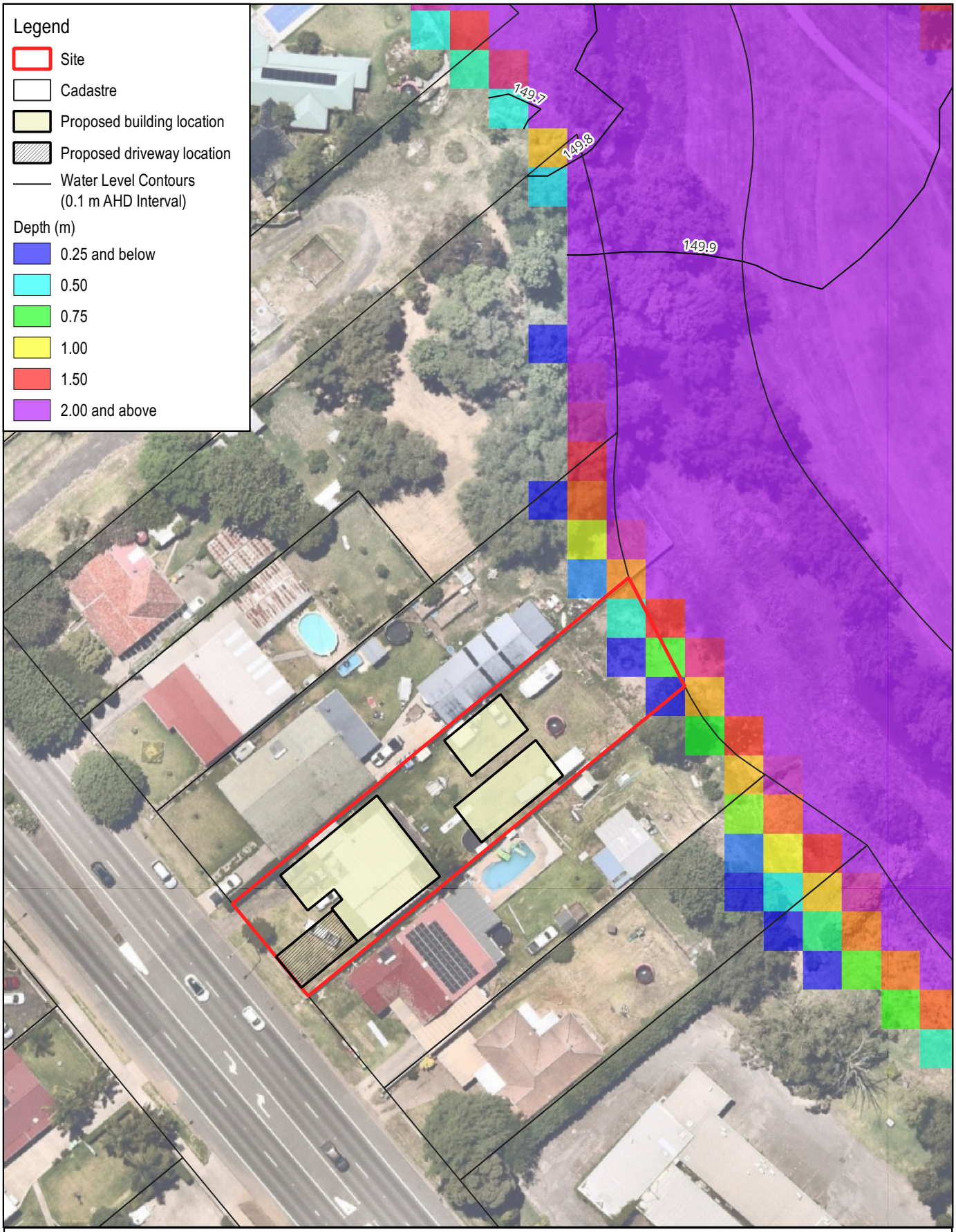

Title: PRE-DEVELOPMENT 0.5% AEP FLOOD DEPTH AND LEVEL PLAN (building overlay)

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Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
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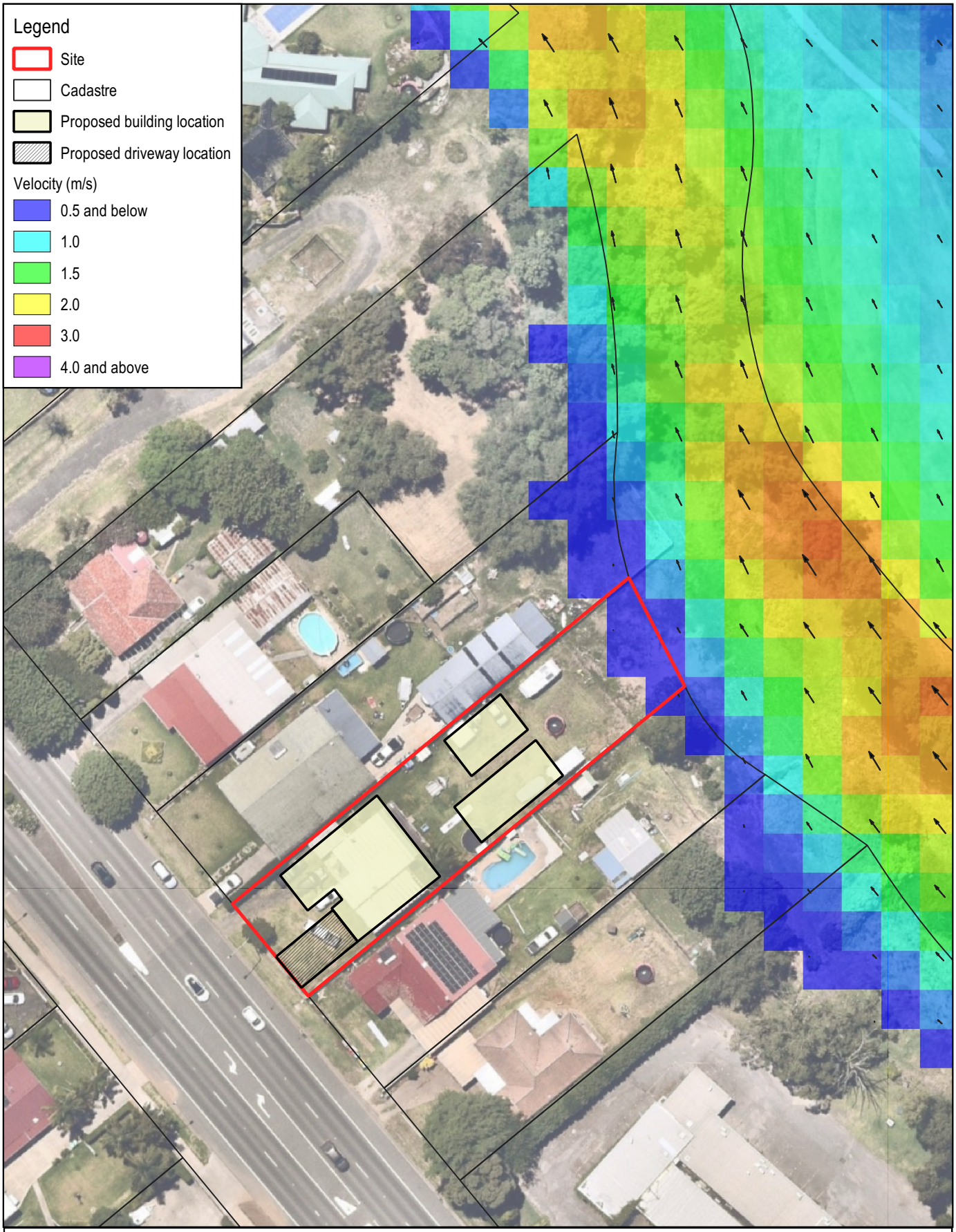

Title: PRE-DEVELOPMENT 0.5% AEP FLOOD VELOCITY PLAN (building overlay)

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Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
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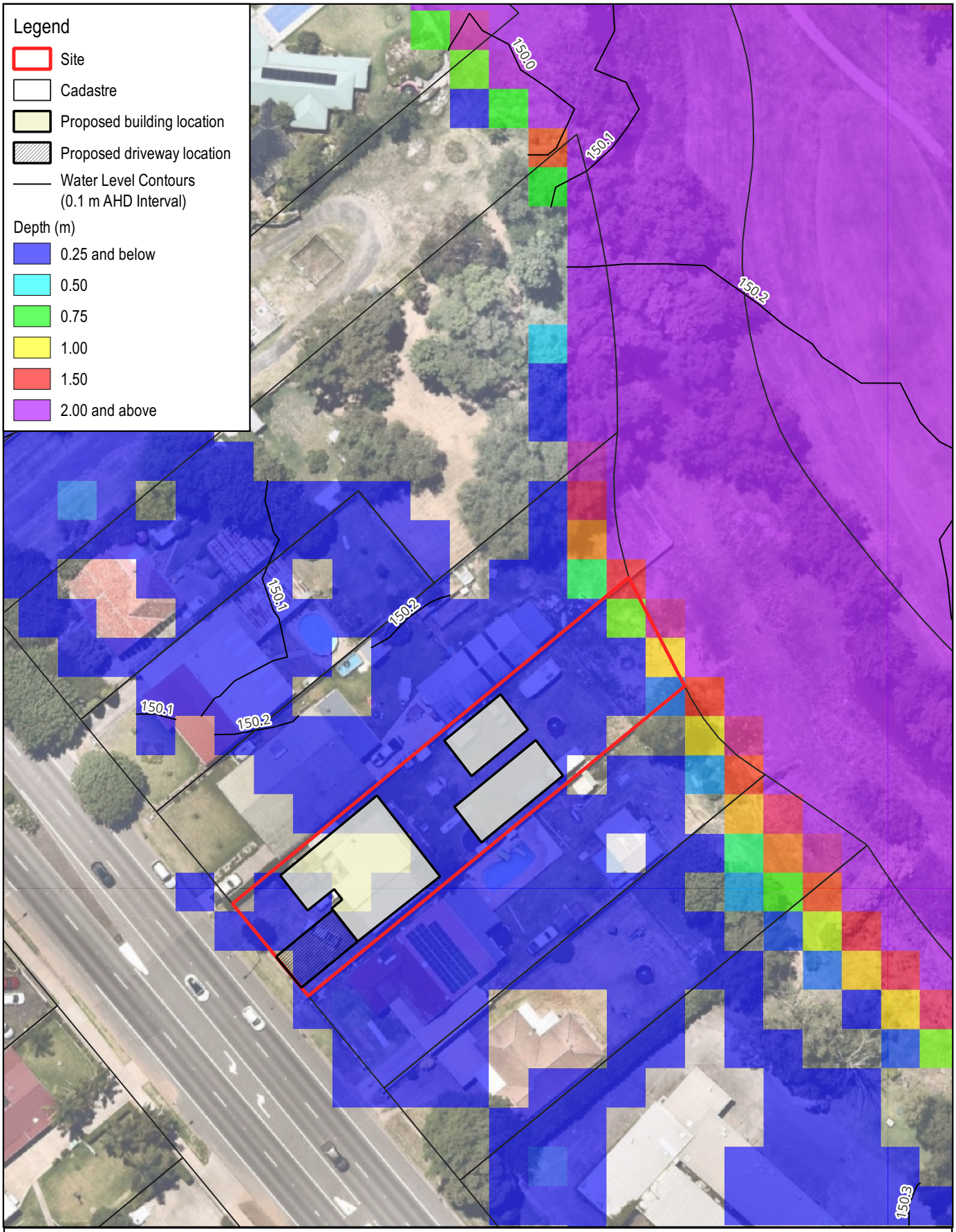

Title: PRE-DEVELOPMENT 0.2% AEP FLOOD DEPTH AND LEVEL PLAN (building overlay)

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Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
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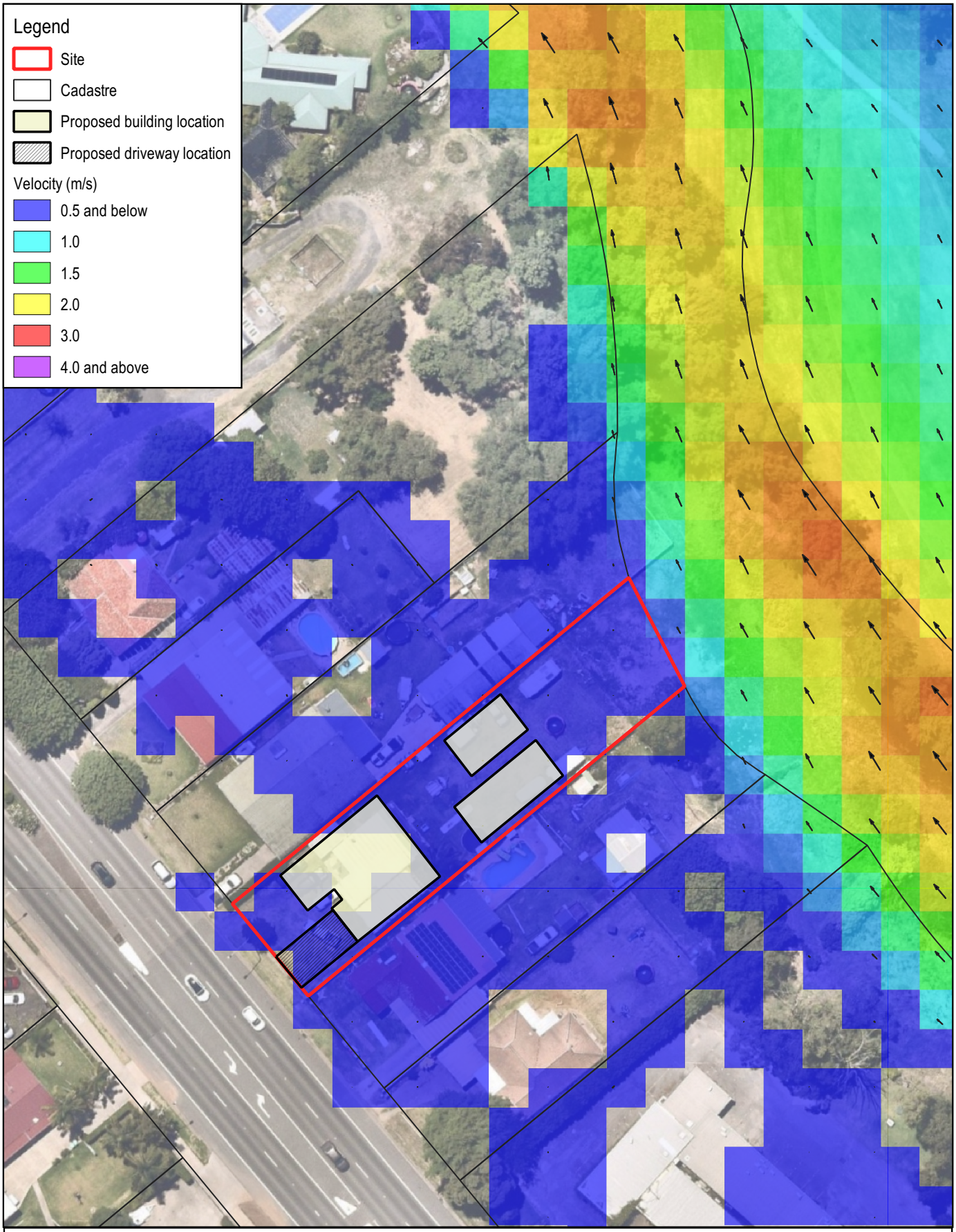

Title: PRE-DEVELOPMENT 0.5% AEP FLOOD VELOCITY PLAN (building overlay)

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Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
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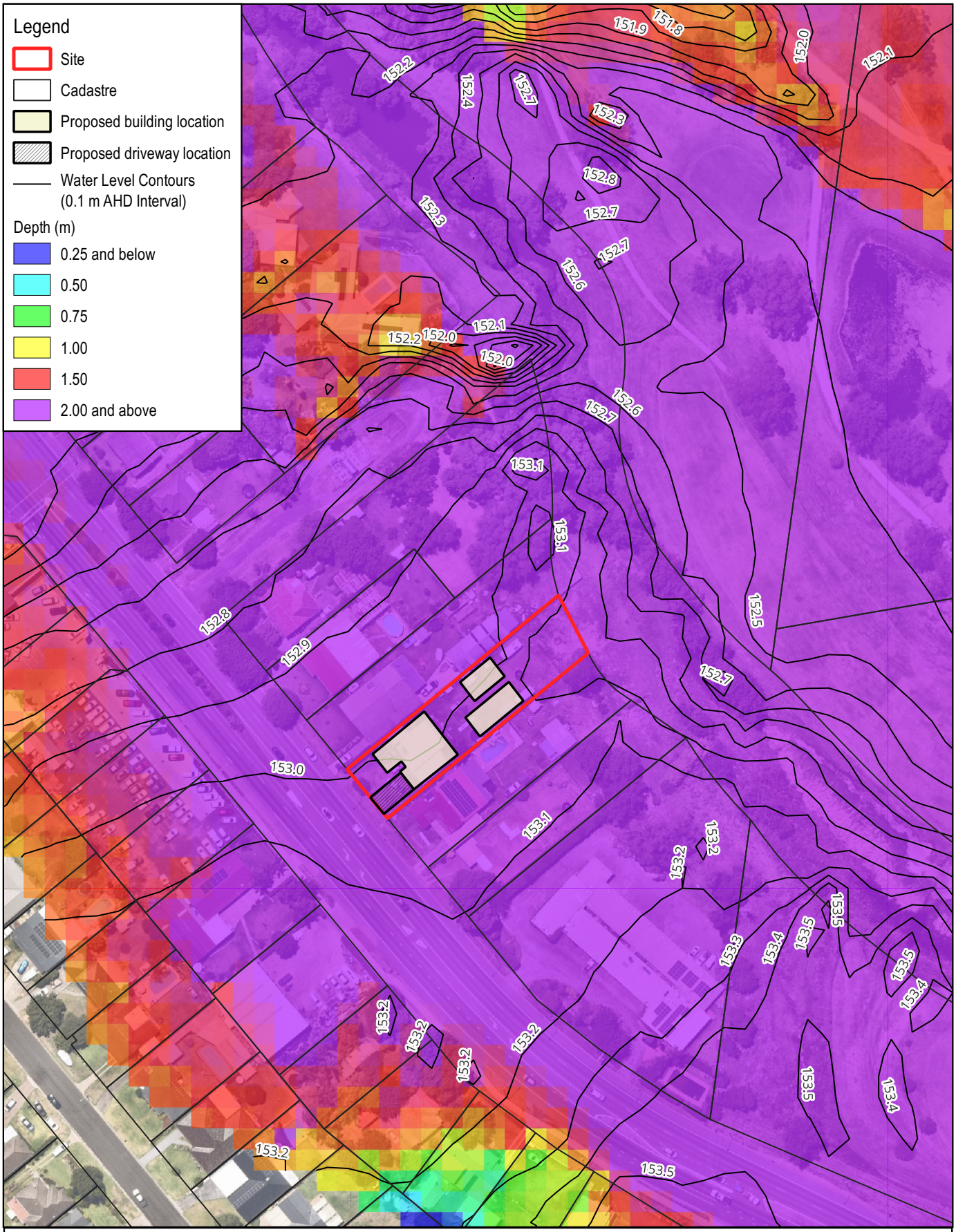

Title: PRE-DEVELOPMENT PMF DEPTH AND LEVEL PLAN (building overlay)

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Job Number:	Sheet:	Revision:	Date:	Designed:	Drawn:	Scale:
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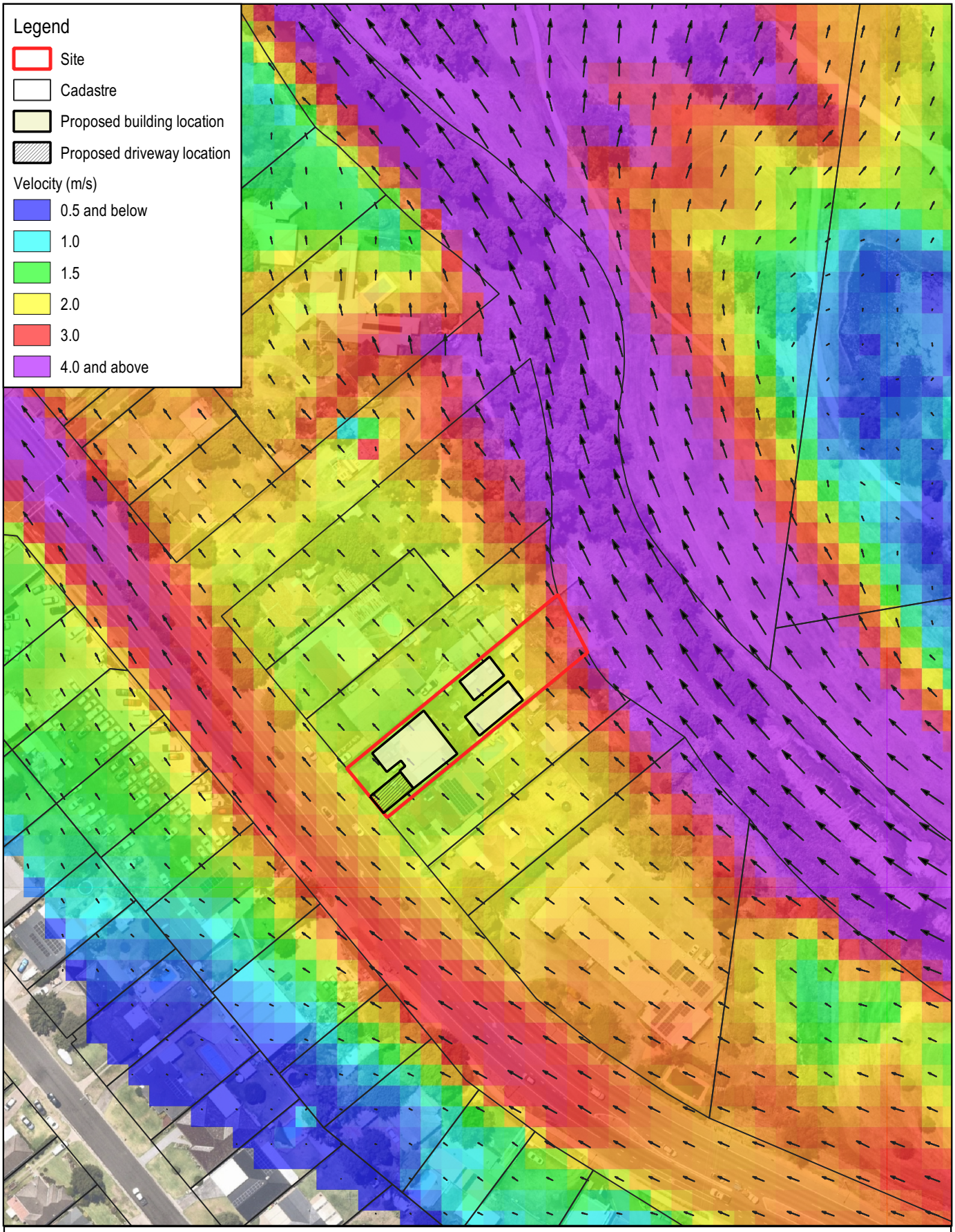

Title: PRE-DEVELOPMENT PMF VELOCITY PLAN (building overlay)

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CC230127	F8	A	26.03.2024	BK	NB	1:800