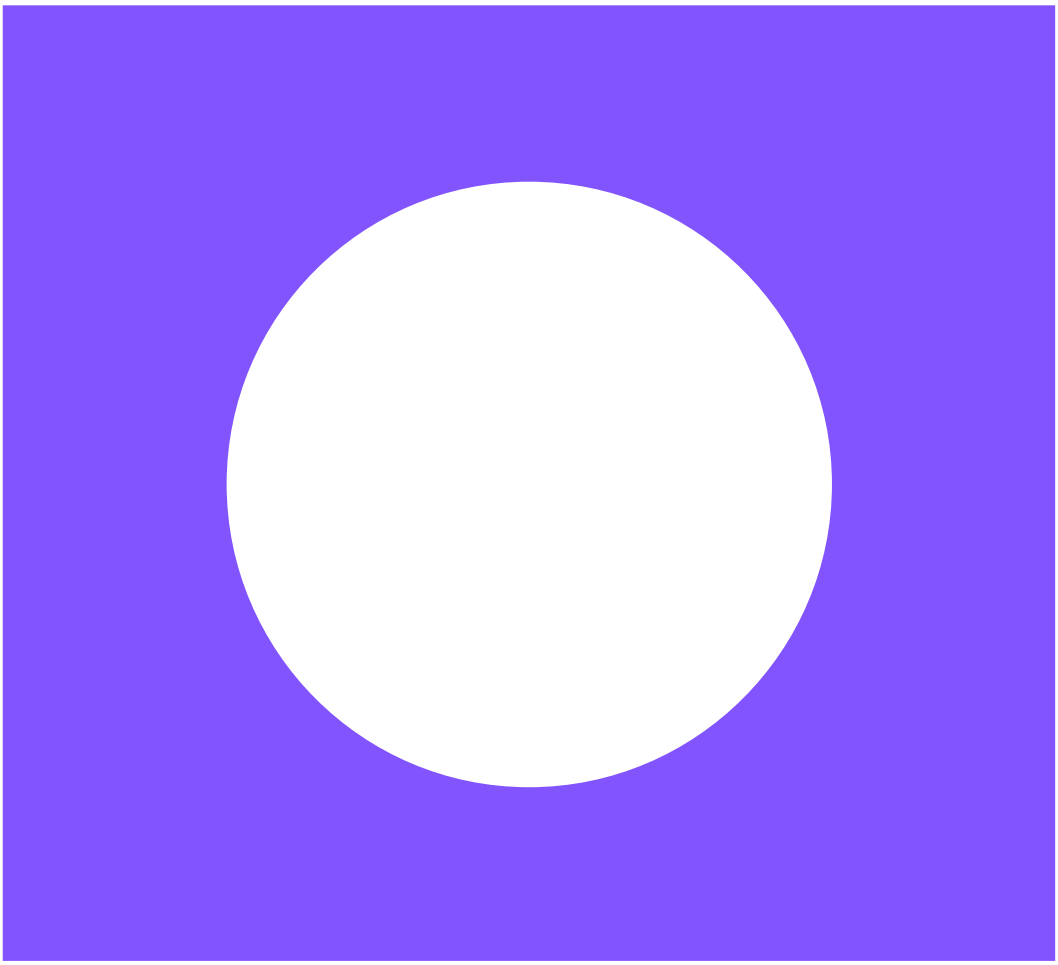
MOTT MACDONALD



29 Florida Street, Sylvania

Flood Impact and Risk Assessment

December 2025

Acknowledgment of Country

On behalf of Mott MacDonald, we would like to begin by acknowledging the Traditional Custodians of the land on which we meet today, and pay our respects to their Elders past and present.

We recognise and respect their cultural heritage, beliefs, continued connection to the land and water and commit to building a brighter future together.

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Flood Impact and Risk Assessment

December 2025

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	31/10/2025	J. Daly	J. Mail	A. Tarshan	Initial Draft
B	24/11/2025	J. Daly	J. Mail	A. Tarshan	Amended Based on Comments
C	5/12/2025	J. Daly	J. Mail	A. Tarshan	Amended Based on Comments

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Executive summary

This Flood Impact and Risk Assessment (FIRA) has been prepared by Mott MacDonald as part of the Environmental Impact Statement (EIS) for a State Significant Development Application (SSDA) for proposed residential development at 29 Florida Street, Sylvania (the Site).

The Site is located at 29 Florida Street, Sylvania in the Sutherland Local Government Area (LGA) and comprises 14 lots with a combined Site are of approximately 21,792sqm. It is currently occupied with two storey terrace buildings and 3-4 storey apartment buildings.

The SSD application seeks approval for demolition of all existing structures and construction of eight residential buildings across the Site comprising a total of 505 dwellings, including 159 social housing dwellings.

The report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued for the project (SSD-8358708) on 2 May 2025 as detailed in the table below.

Table 1.1: Relevant SEARs considered

Issue	SEARs requirement	Section reference
19. Flood Risk	Identify the flood planning area (FPA) and level as set out in the relevant EPI and other supporting documents to determine. *	Section 6.1
	The flood extent and velocity up to the Probable Maximum Flood and risk on-Site having regard to adopted flood studies and, floodplain risk management studies	Section 5.2
	The Site access and egress routes	Section 6.3
	The potential effects of climate change,	Section 5.3
	Any relevant provisions of the NSW Flood Risk Management Manual, and any other relevant guidelines	Section 3
19. Flood Risk	Where the development is occurring on flood prone land a flood impact and risk assessment (FIRA) must be prepared having regard to the Flood Impact and Risk Assessment – Flood Risk Management Guide LU01. When determining the scope and category of the FIRA the requirements outlined in the FIRA guide must be considered.	This report
19. Flood Risk	Detail any flood risk management measures that are to be incorporated as part of the development having regard to relevant guidelines (including any design solutions, flood modification measures, property modification measures, operational procedures or Flood Emergency Response Plan)	Section 6

* Noting the Council FPA extent has limited relevance to this development due to limitations in the hydrological method implemented. An updated flood model has been developed, and consultation with Council has been undertaken regarding these changes.

This report concludes that the proposed residential development appropriately considers issue 19. Flood Risk subject to the implementation of the mitigation measures outlined in section 6, which includes but not limited to Floor level adjustments, internal overland flow channels and basement protections.

The primary advisable flood emergency strategy proposed is to follow all directions given by emergency responders, including but not limited to the SES. This may include, but is not limited to, early evacuation

during a storm. In the absence of these directions, shelter-in-place has also been assessed as a suitable flood emergency management strategy.

1 Introduction

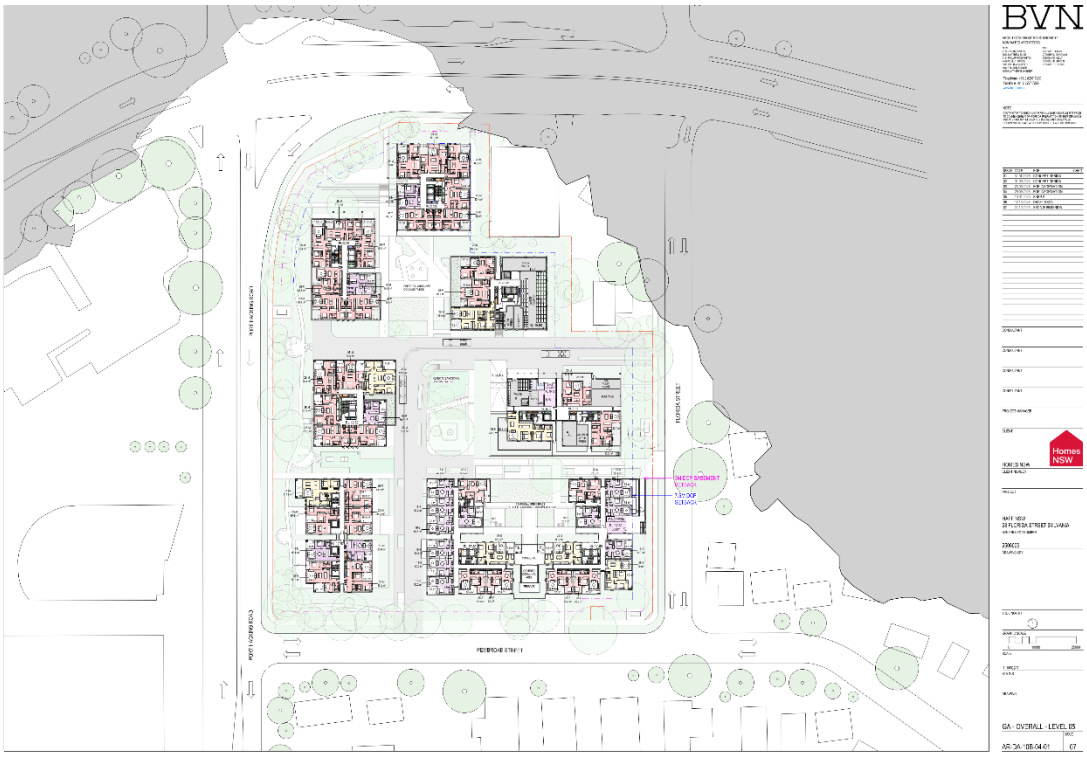
1.1 Background

This Flood Impact and Risk Assessment (FIRA) has been prepared for Homes NSW to assist the redevelopment for Sites within 29 Florida Street, Sylvania. The aim of this FIRA is to support the proposed redevelopment where specific elements of the design may alter flood behaviour or introduce additional flood risk. This includes to identify and analyse:

- The impacts of the proposed development on the flood risk to the existing community.
- The impacts and risk of flooding on the development and its users.
- How these impacts can be managed to minimise the growth in risk to the community due to the development.

The layout of the proposed development is shown in Figure 1.1.

Figure 1.1: Proposed Site Plan



Source: BVN Architecture

1.2 Project Context

The subject Site is located within the Southerland Shire Council Local Government Area (LGA) and is subject to flooding during major and extreme storms. This is based upon a Council endorsed flood study, being the Gwawley Bay Catchment Floodplain Risk Management Study and Plan (2015), which identified the Site, or proposed development, is within the 1% Annual Exceedance Probability (AEP) and the Probable Maximum Flood (PMF), flood extents.

Subsequently, an SSDA for this Site requires a FIRA to address flooding constraints and controls for the Site.

This assessment describes the nature of flooding that impacts the subject Site and outlines planning requirements related to flooding that currently apply to the Site. This study provides flooding advice which will support the preparation of the redevelopment for Department of Planning, Housing and Infrastructure (DPHI) and Homes NSW.

The final detailed design is subject to details across multiple disciplines and is subject to conditions placed upon the development based on the agency's advice from the SSDA stage.

1.3 FIRA Requirements

The FIRA will demonstrate the compatibility of the development with any existing relevant State Environmental Planning Policies (SEPPs), Local Environmental Plans (LEPs), Development Control Plans (DCPs) or policies, as well as existing industry guidance, government guidance and reference documents.

Consequently, for this FIRA to meet desired aims based on guidance it requires an understanding of:

- A range of flood risk examining minor, major and extreme storm events
- The constraints that flood places on the (Floodways, flood storage, flood hazard and emergency response issues).
- The appropriateness of the development or development types for the location based on the flood constraints on the land.
- The adequacy of management measures and controls to:
    - Effectively address these constraints to ensure the flood risks to the proposed development and its users are acceptable.
    - Manage flood and associated Emergency Management (EM) impacts to the existing community due to the development.
- Climate change impacts. Both existing and post-development flood behaviour needs to consider climate change impacts on flood behaviour so the robustness of decisions over time can be understood.

Further statutory and local requirements that this design must satisfy with regard to flooding are summarised in Section 3.

2 Background

2.1 Study Area

Proposed Development

The proposed development includes Site preparation works, tree removal and demolition of all structures, and the construction of eight (8) residential buildings up to nine (9) storeys across the Site, including basement parking, construction of a new access street, associated landscaping and public domain works, and infrastructure servicing.

A detailed description of the project is included in the EIS.

Subject Site

The Site is located at 29 Florida Street, Sylvania. The Site comprises 14 lots and has a total combined Site area of 21,792sqm and is legally described as Lot X DP411212, Y DP411212, Lots 2-9 & Lots 10-13 DP22661, Lot 104 DP733063.

The Site falls within the block bounded by the Princes Highway to the North, Port Hacking Road to the west, Pembroke Street to the south and Florida Street to the east. The Site has access from Florida Street via an internal roadway (Coral Tree Place).

The Site Comprises the majority of the street block, except for properties located directly to the north and west at the corner of Florida Street and Princes Highway. This land comprises a car dealership and adjacent vacant land, a dwelling house on Florida Street, and a telecommunications facility zoned SP2 Infrastructure.

The Site is currently occupied with two storey terrace buildings and 3-4 storey apartment buildings.

To the west of the Site is Southgate Shopping Centre providing access to a wide range of retail and services. To the south and east the Site is surrounded by low density residential areas within the wider suburb of Sylvania. To the north across Princes Highway are commercial uses including retail shops, childcare and a car dealer.

2.2 Known Flood Behaviour

The subject Site is located within the Gwawley Bay Catchment. The topography of the catchment is varied, with no defined channel present upstream of the Site. This results in overland flooding during existing major storms when the drainage network is unable to convey the flows. There is a degree of tidal influence downstream of the Site, but due to the topography of the catchment and position of the site (relatively high) within the catchment, this does not have a significant influence upon the Site. The Site is positioned at the convergence of two overland flow paths. The most significant of these originating from the west and running along Pembroke Street which impacts the southern portion of the Site. The other originates north of the Site, which runs along the Princes Highway and heads south directly through the Site where it converges with the other flow path. These converged paths continue heading south east through residential properties where they discharge into the Gwawley Creek.

2.3 Flood History

A desktop assessment of flooding within the catchment observed that the catchment faced significant flooding on the 13th of May 2003. Despite this, no specific complaints from residents

for the proposed Site of development have been recorded and catchment rainfall gauges are quite remote from the Site, making it difficult to accurately determine the magnitude of this rainfall event for the Site from these gauges.

2.4 Emergency Management

NSW State Emergency Service (SES) provides community advice for local areas, with Sylvania forming part of the larger Sydney Southern Region. Advice for residents living in the Gwawley Bay catchment that are at risk of flooding is provided under the Sutherland Shire Local Flood Plan. Additionally, general advice has also been summarised from the NSW SES FloodSafe guide for Flash Floods and the StormSafe guide.

2.4.1 Sutherland Shire Flood Emergency Sub Plan

The NSW SES Sutherland Shire Flood Emergency Sub Plan (SSFESP) is a sub plan of the Sutherland Shire Local Emergency Management Plan (EMPLAN). Which was endorsed by Sutherland Shire Emergency Management Committee as of March 2023. The purpose of this plan is to set out the multi-agency arrangements for the emergency management of flooding in the Sutherland Shire Local Government Area (LGA).

The primary goals for flood emergency management in NSW as defined in this sub plan area:

a. Protection and preservation of life.
b. Establishment and operation of flood warning systems.
c. Issuing of community information and community warnings.
d. Coordination of evacuation and welfare of affected communities.
e. Protection of critical infrastructure and community assets essential to community survival during and emergency incident.
f. Protection of residential property.
g. Protection of assets and infrastructure that support individual and community financial sustainability and aid assisting a community to recover from an incident; and
h. Protection of the environment and conservation values considering the cultural, biodiversity and social values of the environment.

With the key principles to achieve these goals being:

1. The protection and preservation of human life (including the lives of responders and the community) is the highest priority.
2. Evacuation is the primary response strategy for people impacted by flooding.

2.4.2 NSW SES Flash FloodSafe

The Flash FloodSafe guide outlines risks, impacts and the safest response to take when flash flooding occurs.

The NSW state Flood Plan (SFP) describes flash flooding as *"flooding which is sudden and often unexpected because it is caused by sudden local or nearby heavy rainfall and typically occurs in small catchments. Technically, flash flooding means any flooding of short duration with a relatively high peak discharge in which the time interval between the observable causative event and the flood is less than six hours."* It also states that *"larger urban drainage systems are overwhelmed by intense rainfall and roads become "rivers" with flooding occurring at their low points."* These descriptions match the nature of flooding around the Site.

The advice provided in the Flash FloodSafe guide includes (but is not limited to):

- Leave low-lying homes and businesses well before flooding begins, but only if it is safe to do so.
- Seek refuge in the highest part or story of a building if you are trapped by rising floodwater.
- Remain within the building and contact emergency services if rescue is required.
- Stay clear of flash flood areas when severe weather is forecasted.

2.4.3 NSWS SES StormSafe

The StormSafe guide outlines storm risks, impacts and the safest response to take when severe weather occurs. These include but are not limited to:

- Move indoors when Severe Weather warnings and Severe Thunderstorm Warnings are issued but only before the storm arrives.
- Never enter or travel through floodwater.
- Stay indoors and clear of windows.
- When flash flooding is likely, leaving low-lying homes and business well before flash flooding beings is the best course of action to take, But only if safe to do so.

3 Flood Related Requirements

The following guidelines and standards relate to civil works as they potentially influence flood behaviour and form the basis of engineering decisions regarding stormwater management and the provision for overland flow within and surrounding the Site.

3.1 Australian Rainfall and Runoff (2019)

Prepared by the Institution of Engineers, Australia Rainfall, and Runoff – A guide to Flood Estimation (AR&R) was written to provide *"Australian designers with the best available information on design flood estimation."* It contains procedures for estimating stormwater runoff for a range of catchments and rainfall events as well as design methods for urban stormwater drainage systems. The document has been updated from the previously published 2001 version with a more refined methodology for hydrological analysis based on the latest hydrological data gathered.

3.2 Sutherland Shire Council Documents

3.2.1 Sutherland Shire Local Environmental Plan (2015)

The Sutherland Shire Local Environmental Plan (LEP) 2015 provides the main legal (or statutory) framework for planning and development within the Sutherland Shire Council LGA. This LEP outlines flood planning provisions in *Clauses 5.21 Flood Planning* and *5.22 Special Flood Considerations.*

3.2.1.1 Sutherland Shire LEP Clause 5.21 Flood Planning

As per *Clause 5.21 – Flood Planning* the consent authority must be satisfied that all proposed development adequately protects the safety of life and property, and avoids adverse impacts on stormwater drainage, flood behaviour and the environment. This includes:

- To minimise the flood risk to life and property associated with the use of land,
- To allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a result of climate change,
- To avoid adverse or cumulative impacts on flood behaviour and the environment,
- To enable the safe occupation and efficient evacuation of people in the event of a flood.

Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development:

- Is compatible with the flood function ad behaviour on the land, and
- Will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and
- Will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuations routes for the surrounding area in the event of a flood, and
- Incorporate appropriate measures to manage risk to life in the event of a flood, and
- Will not adversely affect the environment or cause avoidable erosion, siltation, destruction or riparian vegetation or a reduction in the stability of riverbanks or watercourse.

In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following maters:

- The impact of the development on projected changes to flood behaviour as a result of climate change.
- The intended design and scale of buildings resulting from the development,
- Whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,
- The potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.

3.2.1.2 Sutherland Shire LEP Clause 5.22 Special Flood Considerations

The objectives of this clause are as follows:

- To enable the safe occupation and evacuation of people subject to flooding,
- To ensure development on land is compatible with the land's flood behaviour in the event of a flood,
- To avoid adverse or cumulative impacts on flood behaviour,
- To protect the operational capacity of emergency response facilities and critical infrastructure during flood events,
- To avoid adverse effects of hazardous development on the environment during flood events.

This clause is applicable to:

- For sensitive and hazardous development – land between the flood planning area and the probable maximum flood, and
- For development that is not sensitive and hazardous development – land the consent authority considers to be land that, in the event of a flood, may:
    - Cause a particular risk to life, and
    - Require the evacuation of people or other safety considerations.

Development consent must not be granted to development on land to which this clause applies unless the consent authority has considered whether the development:

- Will affect the safe occupation and efficient evacuation of people in the event of a flood, and
- Incorporates appropriate measures to manage risk to life in the event of a flood, and
- Will adversely affect the environment in the event of a flood.

3.2.2 Sutherland Shire Development Control Plan (2015)

An integral part of the planning process for developments, the *Sutherland Shire Development Control Plan (DCP) 2015* provides the necessary controls and guidance for redevelopment within the LGA in relation to flooding. This DCP first outlines their criteria for flood prone landing, to which the following controls are applicable, as being:

1. Where a Site is flood prone or potentially flood prone and a proposed development is confined to a particular part of the Site which is flood free (as identified by Council's Flood Risk Management Map or a Site specific flood study prepared by an appropriately qualified engineer in accordance with Council requirements), it may be considered to satisfy the objectives of this chapter. In these circumstances no flood related development controls will be imposed other than those relating to Site evacuation.

2. Despite subclause 1, flood related development controls will apply is any excavation associated with a development is considered likely to increase flood inundation such that the proposed development would become vulnerable to flooding below the FPL.
3. Where development is proposed on land within a floodway, the floodway is to be retained as a natural waterway. If the floodway comprises a man-made system, it is to be converted to a natural waterway wherever practical.

Controls for Development on Land Mapped 'Initial Assessment Potential Flood Risk'

1. Where land is mapped as "Initial Assessment Potential Flood Risk", Council has determined that there is likely to be flood risk, however, a flood study has not yet been adopted by Council and the specified flood risk boundaries are yet to be established.
2. In the absence of a flood study Council may specify an appropriate 1% AEP Flood level and determine the level of risk. This determination will be made having regard to:
    a. Local flooding history
    b. Topography, likely flood behaviour and depth of flood waters, and
    c. The estimated 1% AEP flood level and area of inundation as shown on the Flood Risk Management Map
3. Alternatively, Council may require an applicant to prepare a flood study. The flood study shall be undertaken by appropriately qualified and experienced engineer in accordance with the methodology set out in Council's DA Guide submission requirements. The level of risk is to be determined in accordance with the NSW State Government Floodplain Development Manual.
4. The design and siting of development shall not exacerbate flooding on land external to the subject Site.
5. The proposed development will be required to comply with the floor levels determined by the flood study and where the flood study concludes that the Site has a low, medium or high flood risk, the proposal must satisfy the corresponding controls for that level of risk as specified in this plan.
6. Where a proposed residential development is Sited in an area above the flood planning level (1% AEP plus 500mm freeboard), the proposal will be considered to satisfy flood risk management objectives, and no flood related development controls will be imposed

5.5 Development on Land mapped as High Flood Risk

Note:

High flood risk is defined as an area of land below the 1% AEP flood level that is either subject to a high hydraulic hazard or where there are significant evacuation difficulties. On land with high flood risk, there is possible danger to personal safety; evacuation by trucks would be difficult; able-bodied adults would have difficulty wading to safety; and there is a potential for significant structural damage to buildings.

	High Flood Risk							
Unsuitable land Not relevant	**Essential Community Facilities**	**Sensitive uses and facilities**	**Subdivision**	**Residential**	**Commercial and industrial**	**Tourist related development**	**Recreation and non-urban**	**Concessional Development**
Floor Level							1	5,6
Building Components & Method							1	1
Structural Soundness							1	1
Flood Effects							1	1
Car Parking And Driveway Access							3,4, 5,6	4,5,6
Evacuation							4,5,6	2,3 or 4,5
Management and design							2,3,5	2,3,5

5.4 Development on Land mapped as Medium Flood Risk

Note:

Medium Flood Risk is the area below the 100 year flood that is not subject to a high hydraulic hazard and where there are no significant evacuation difficulties. In this precinct there would still be a significant risk of flood damage or risk to life, but these damages and risks can be minimised by the application of appropriate development controls.

	Medium Flood Risk							
Unsuitable land / **Not relevant**	**Essential Community Facilities**	**Sensitive uses and facilities**	**Subdivision**	**Residential**	**Commercial and industrial**	**Tourist related development**	**Recreation and non-urban**	**Concessional Development**
Floor Level				2,4,6	2,4,6	2,4,6	1	5,6
Building Components & Method				1	1	1	1	1
Structural Soundness				1	1	1	1	1
Flood Effects			1	1	1	1	1	1
Car Parking And Driveway Access				1,2,3, 4,5,6	1,2,3, 4,5,6	1,2,3, 4,5,6	4,5,6	4,5,6
Evacuation			7	2,3 or 4,5	1,2,4, 5	2,4,5	4,5,6	2,3 or 4,5
Management and design			1		3,5	3,5	2,3,5	2,3,5

5.3 Development on Land mapped as Low Flood Risk

Note:

Low Flood Risk is all land that could potentially be inundated (i.e. within the extent of the probable maximum flood) but not identified as either a high flood risk or a medium flood risk precinct. The low flood risk precinct is that area above the 100 year flood and most land uses would be permitted within this precinct.

	Low Flood Risk							
Unsuitable land / Not relevant	Essential Community Facilities	Sensitive uses and facilities	Subdivision	Residential	Commercial and industrial	Tourist related development	Recreation and non-urban	Concessional Development
Floor Level		3		2,4	2,4	2,4	1	5
Building Components & Method		2		1	1	1	1	1
Structural Soundness		2		1	1	1	1	1
Flood Effects		1	1	1	1	1	1	1
Car Parking And Driveway Access		1,2,3, 4,5,6		1,2,3, 4,5,6	1,2,3, 4,5,6	1,2,3, 4,5,6	4,5,6	4,5,6
Evacuation		2,4,5, 6	7	2,3 or 4,5	1,2,4, 5	2,4,5	4,5,6	2,3 or 4,5
Management and design		4,5	1		3,5	3,5	2,3,5	2,3,5

Floor Level

1. All Floor Levels to be equal to or greater than the 5% AEP flood level
2. Habitable floor levels to be equal to ore greater than the 1% AEP flood level plus 500mm freeboard.
3. Habitable floor levels shall be no lower than the PMF level or the 1% AEP flood levels plus 500mm freeboard, whichever is higher.
4. Non-habitable floor levels shall be assessed on merit having regard to the 5% AEP level as well as privacy and amenity impacts.
5. Floor levels shall be equal to or greater than the level of the 1% AEP flood level plus 500mm freeboard. Where this is not practical due to compatibility with the height of adjacent buildings, or compatibility with the floor level of existing buildings, or the need for access for person with disabilities, a lower floor level may be considered. In these circumstances, the floor level shall be as high as practical and when undertaking alterations or additions, no lower than the existing floor level.
6. Where a building is elevated to reduce flood hazard, the undercroft area is to remain open to permit the free flow of water under the building.

Building Components & Method

1. All structures to have flood compatible building materials below the 1% AEP flood level plus 500mm freeboard.
2. All structures to have flood compatible building components below the PMF level.

Structural Soundness

1. An engineer's report shall be provided to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood level plus 500mm freeboard.
2. An engineer's report shall be provided to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a PMF.

Flood Effects

1. An engineer's report shall be provided to certify that the development will not increase flood effects elsewhere, having regard to:
   - Loss of flood storage
   - Changes in flood levels, flows and velocities caused by alterations to the flood conveyance

Car Parking and Driveway Access

1. The minimum surface level of open car parking spaces or carports shall be no lower than the 1% AEP flood or the level of the crest of the road at the location where the Site has access to the road.
2. Garages shall have a minimum finished floor level no lower than the 1% AEP flood plus 200mm freeboard
3. The level of the driveway providing access between the road and parking space shall be no lower than 300mm below the 1% AEP flood or such that the depth of inundation during a 1% AEP flood is not greater than either the depth at the road or the depth at the car parking space.
4. Basement garages and car parking areas with floor level below the 5% AEP Flood or more than 0.8m below the 1% AEP flood level, shall have a pump-out system, adequate warning system, signage and exits.
5. Restraints or vehicle barriers shall be provided to prevent floating vehicles leaving a Site during a 1% AEP flood. A flood depth of more than 200mm will cause serious water damage to typical vehicle and a depth of 300mm is sufficient to cause a typical vehicle to float.
6. The crest of the driveway providing access between the road and basement garages shall be a minimum of 200mm above the level of the 1% AEP flood.

Evacuation

1. Reliable access for pedestrians or vehicles shall be provided during a 1% AEP flood.
2. Reliable access for pedestrians or vehicles shall be provided from the building commencing at a minimum level equal to the lowest habitable floor level to an area of refuge above the PMF level.
3. Adequate exits shall be available to allow safe and orderly evacuation without increase reliance upon the SES or other authorised emergency services personnel.
4. Adequate flood warning systems, signage and exits shall be available to allow safe and orderly evacuation without increase reliance upon the SES or other authorised emergency services personnel.
5. The development shall be consistent with any relevant flood strategy, Floodplain Risk Management Plan adopted by Council or similar plan.

6. An engineer's report shall be provided to certify that an area of refuge is available if circumstances are possible where the evacuation of persons might not be achieved within an effective warning time.
7. Applicant shall demonstrate that evacuation in accordance with the requirements of the DCP is available for potential development flowing from the subdivisions proposal.

Management and Design

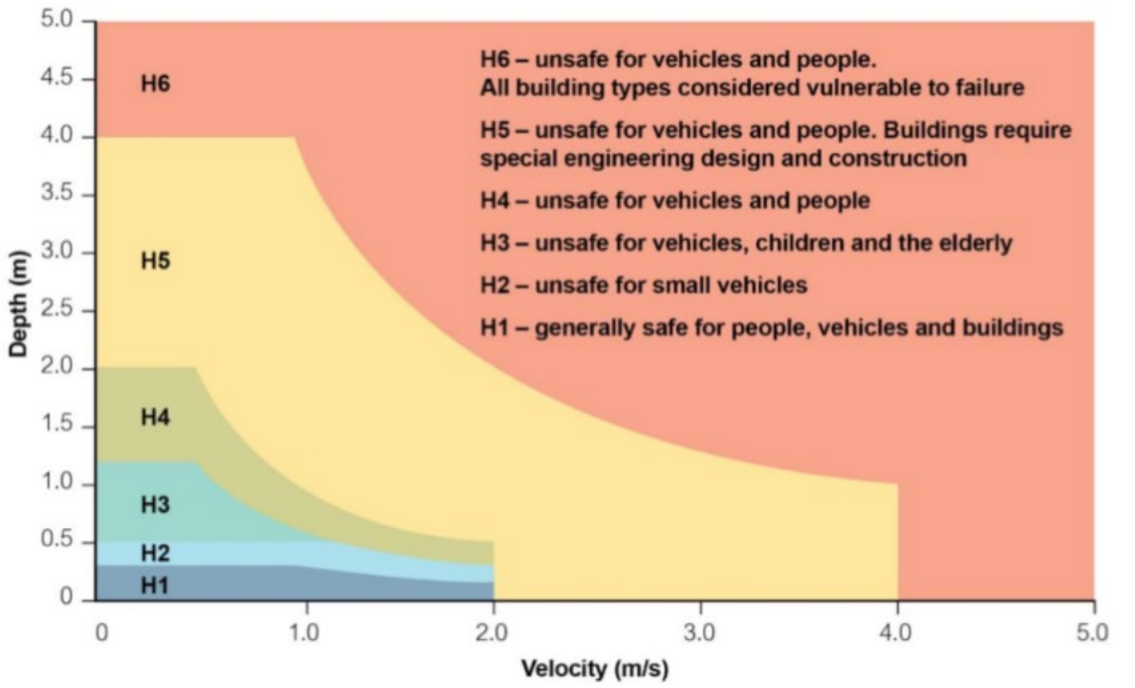
1. Applicant shall demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accordance with this DCP.
2. Site Emergency Response Flood Plan shall be prepared where floor levels are below the minimum floor level requirement.
3. An area shall be available within the dwelling to store goods above the 1% AEP flood level plus 500mm freeboard.
4. Applicant shall demonstrate that area is available to store goods above the PMF level.
5. No storage of materials which may cause pollution or be potentially hazardous during any flood is permitted below the 1% AEP plus 500mm.

3.3 NSW Flood Risk Management Manual (June 2023)

The NSW Government's manual supersedes the previous *Floodplain Development Manual – The Management of Flood Liable Land (2005)* and is concerned with the management of the consequences of flooding as they relate to the human occupation of urban and rural developments. The manual outlines the floodplain risk management process and assigns roles and responsibilities for the various stakeholders.

The manual applies to all development and provides additional guidelines for ensuring safe overland flow paths are provided. These guidelines adopt the hazard categorisation which has been developed by Australian Emergency Management Institute in 2014. These categories range from H1 to H6 and are based on a combination of flow velocity and depth. A chart showing how the categories are defined is shown in Figure 3.1. The NSW Floodplain manual describes High hazard as areas where the '*possible danger to personal safety; evacuation by trucks difficult; able-bodied adults would have difficulty in wading safety potential for significant structural damage to buildings'.* This generally relates to H4 to H6 for the NSW Flood Risk Management Manual hazard categories.

Figure 3.1: General Flood Hazard Vulnerability Curve



3.4 NSW Department of Planning, Housing and Infrastructure Shelter-in-Place Guideline (January 2025)

The NSW Department of Planning, Housing and Infrastructure's Shelter-in-Place guideline (2025) for flash flooding, outlines guidance for councils and consent authorities regarding relevant controls and considerations in relation to when shelter in place can be considered a viable emergency response to a flooding event.

The considerations outlined for shelter in place are as follows:

1. Does shelter-in-place align with existing emergency management strategies for the area, as determined through the flood risk management process and by the NSW SES
2. Has evacuation off-Site (the primary emergency management strategy) been investigated and determined to be unachievable.
3. Does the development include medical centres, emergency services and community facilities, and sensitive and hazardous land uses, some of which may not be suitable for shelter-in-place.
4. Shelter-in-place for greenfield development is not supported
5. Whether there is existing government developed flood warning systems that give advanced detailed forecasts of flash flooding to allow sufficient time to evacuate to the proposed refuge locations.
6. Can the community effectively be informed of the risks associated with the emergency management strategy.

Following the satisfactory considerations of the above issues, the FIRA should include the following for the consent authority to consider the suitability of the Site for shelter-in-place:

7. Detailed assessment of evacuation off-Site (the primary emergency management strategy) to determine that evacuation off-Site is not achievable.

8. The flood behaviour at the Site, with consideration of climate change and assessment of the potential maximum duration of isolation up to and including the PMF to identify that:
    a. Flash flooding is the only flood risk present at the Site, whether it be from overland flooding, local creek or riverine flooding, and
    b. The flooding occurs within less than 6 hours from the commencement of causative rain and the duration of shelter-in-place due to isolation by floodwaters is less than 12 hours from the commencement of rainfall, and
    c. The development is not subjected to high hazard flooding (e.g. floodways, high hazard H5 or H6 areas) or surrounding roadways are not subjected to high hazard flooding.

Following consideration of items 1 to 7, and if items 8a, b and c are met, and the consent authority consent authority considers shelter in place is an appropriate emergency response strategy following items must also be considered through a FIRA:

9. How shelter in place will:
    a. Used as part of the Site's emergency management response, including actions before during and after sheltering in place, and
    b. Communicated to occupants and visitors of the building and how this communication will be maintained for the life of the development.
10. An understanding of the secondary risks and how the proponent proposes they will be managed is outlined in the FIRA. Secondary risks include medical emergencies, building fire, health and wellbeing.
    a. Table 12 of EM01 should be used to consider whether the risks could be effectively managed.

The consent authority should reflect the following design criteria (I to III) in relevant conditions of consent:

I. The floor level of the shelter in place part of the development be above the PMF, and
II. Structural soundness for conditions in a PMF event, considering flood and debris forces, be verified by a suitably qualified structural engineer, and
III. Area and access to the area does not rely on access to electricity, is self-directing, and have clearly marked internal access for all people on Site, including consideration of access for potential occupants and/or visitors.

The consent authority may also consider the following design criteria (IV to X) when setting relevant conditions of consent depending on the scale and type of development:

IV. Protection from weather and appropriate heating and cooling
V. Access to personal hygiene facilities such as a toilet
VI. A minimum floor space of 2 m^2 per person
VII. Items for self-sufficiency that are stored, maintained and are regularly updated in a accessible location above the PMF, including sufficient drinking water and food for occupants, fire extinguishers, radios and torches with spare batteries, and a first aid kit with an automated external defibrillator (AED)
VIII. Centralised communal shelters may be considered but must be freely accessible internally at all times and externally accessible during events
IX. Access is provided to onsite systems that generate power of the shelter in place location during and after the event for a full range of flood events up to the PMF
X. Detail how these requirements will be maintained and enforced for the life of the development.

4 Method and Approach

4.1 Available Information

The following data has been made available for this assessment:

- Gwawley Bay Catchment Floodplain Risk Management Study and Plan (FRMSP) TUFLOW Model – (June 2015)
    - The Gwawley Bay Catchment FRMSP was prepared by Flood Mit on behalf of Sutherland Shire Council to support the final stage of the Flood Risk Management Process within the Gwawley Bay Catchment. This is undertaken within a catchment to identify areas of high risk flood and consider potential flood mitigation measures to alleviate the identified flood risk.
    - The extent to which this FRMSP TUFLOW model is applicable is reflected in Figure 4.1. This extent encompasses a portion of the Site and, subsequently, for this assessment, with minor adjustments required to the model, it is suitable to be used to represent the flooding extent and impact upon this Site and the surrounding area.

Figure 4.1: Existing Model Domain

4.2 Data Gap Analysis

The most significant gap in the available data was how the original TUFLOW model simplified catchments surrounding the Site. This was the case as a significant portion of the upstream catchment to the Site had been condensed downstream, leading to an incomplete representation of flooding expected to occur within the Site. If this were not amended, a detailed assessment of the flooding impacts and the required flood mitigation measures for the Site would be difficult to undertake. Subsequently, the upstream inflows were amended to correctly distribute the water surrounding the Site, which has allowed the assessments undertaken as part of this FIRA to be done so with more validity than if this had not been corrected.

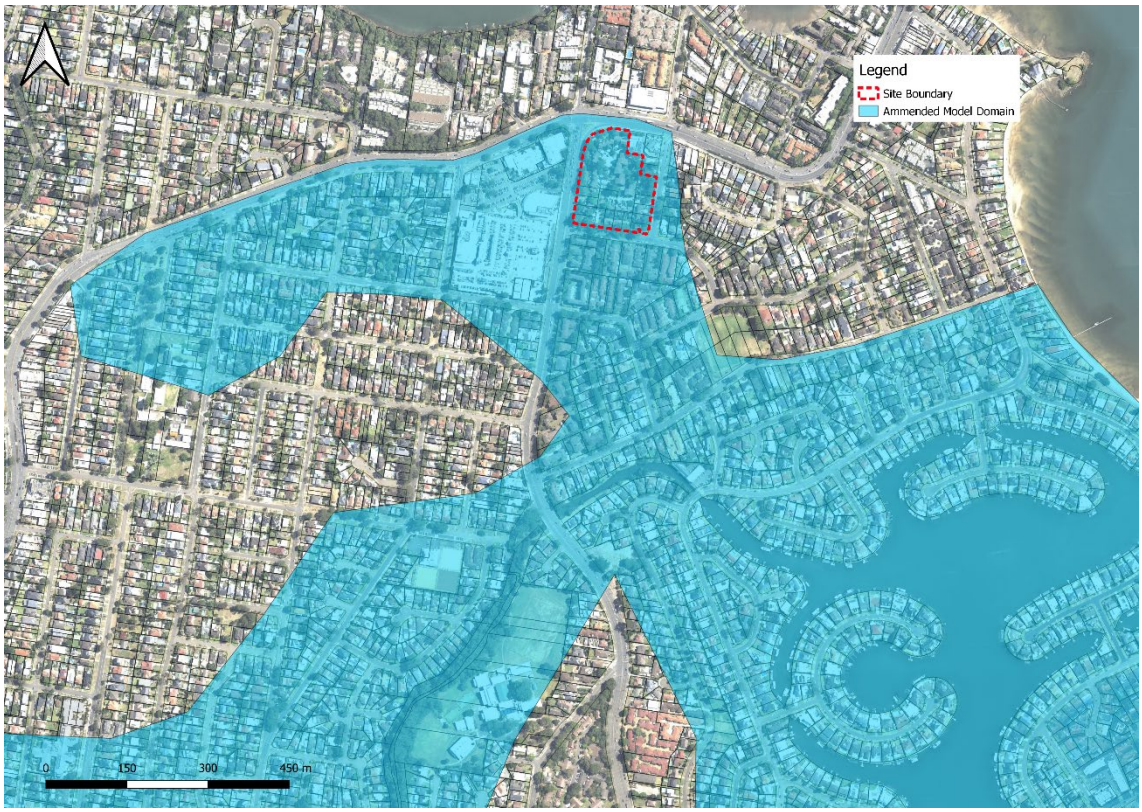
Additionally, the existing flood model was developed prior to the adoption of the most recent AR&R guidelines, being AR&R 2019 and the most recent NSW Flood Risk Management Manual (June 2023). Neither of these constraints dismisses the credibility of the flood model, however, they highlight the need for minor amendments to ensure the model is fit for purpose to allow for an FIRA to meet present day requirements. This includes, but is not limited to, the hazard methodology used in result presentation.

4.3 Modelling Approach

4.3.1 Basis of Flood Model

The existing Gwawley Bay Catchment FRMSP TUFLOW model was used as the basis for the flood model for this assessment. The most significant change to this model was the immediate hydrology surrounding the Site, as the existing model simplified the catchments upstream of the Site and discharged the water downstream of the Site, Figure 4.2. This would have inhibited the ability to undertake a meaningful assessment of the flooding impacts of the development upon the Site. Consequently, the inflows to the surrounding the Site have been amended to reflect what would be expected within and surrounding the Site.

Figure 4.2: Ammended Model Domain



4.3.2 TUFLOW Software Package

TUFLOW is a one and two dimensional (1D/2D) hydraulic modelling program that simulates the flow of water across a landscape and through any conveyance structures such as pipes or culverts.

The 2D component of the TUFLOW software package determines overland flow paths by dividing the landscape into a grid of individual cells. The flow of water between cells is then computed repeatedly at regular time steps by solving two-dimensional shallow water equations to estimate the spread and flow of the water. Flows are routed in the direction water will naturally follow based upon the modelled topography.

The 1D component (called ESTRY) is a separate calculation engine incorporated in TUFLOW to manage flows through structures that cannot be accurately represented with 2d grid cells. ESTRY is a network dynamic flow program suitable for mathematically modelling floods and tides (and/or surges) in a virtually unlimited number of combinations. ESTRY has been developed in conjunction with TUFLOW to resolve complex 1D-2D flows across the floodplain interface.

4.3.3 Modelling Scenarios

Flood model scenarios undertaken to represent flooding conditions throughout the Gwawley Bay Catchment were:

- PMF, with the 15-minute storm duration considered as the critical storm duration for the catchment.
- 1% AEP, with the 2-hour storm duration considered as the critical storm duration for the catchment.

- 5% AEP, with the 2-hour storm duration considered as the critical storm duration for the catchment.
- 20% AEP, with the 2-hour storm duration considered as the critical storm duration for the catchment.

5 Hydraulic Modelling

5.1 Flood Model Development

The flood model utilised for this assessment was an updated version of the TUFLOW flood model developed for the Gwawley Bay Catchment FRMSP.

5.1.1 Digital Terrain Model

The digital terrain model used for the existing scenario was based on the previous LiDAR used within the flood study. For the design scenario, an updated design surface was included to represent the proposed developments within the Site. This included the proposed internal road and courtyards within the Site.

5.1.2 Stormwater Pit and Pipe Network

The stormwater drainage network used within the model was based on the existing proposed drainage network. It is noted that the proposed alignment of the basement area within the Site would interfere with an existing stormwater alignment. Subsequently, it has been considered that this portion of the network would be altered to align with the Site boundary on the western side and then reconnect downstream at the previous connection point.

5.1.3 Critical Storm Durations

The critical storm durations adopted for the existing and design scenarios were based upon a peak flood depth assessment for the Gwawley Bay Catchment.

5.2 Model Results

5.2.1 Existing Flood Behaviour

The flood behaviour across the Site extent can be primarily characterised as overland flows, as the topography of the Site allows for shallow surface flows which are mostly consistent at low depth throughout the Site. There is also minor ponding along the northern side of Pembroke St at the southern boundary of the Site.

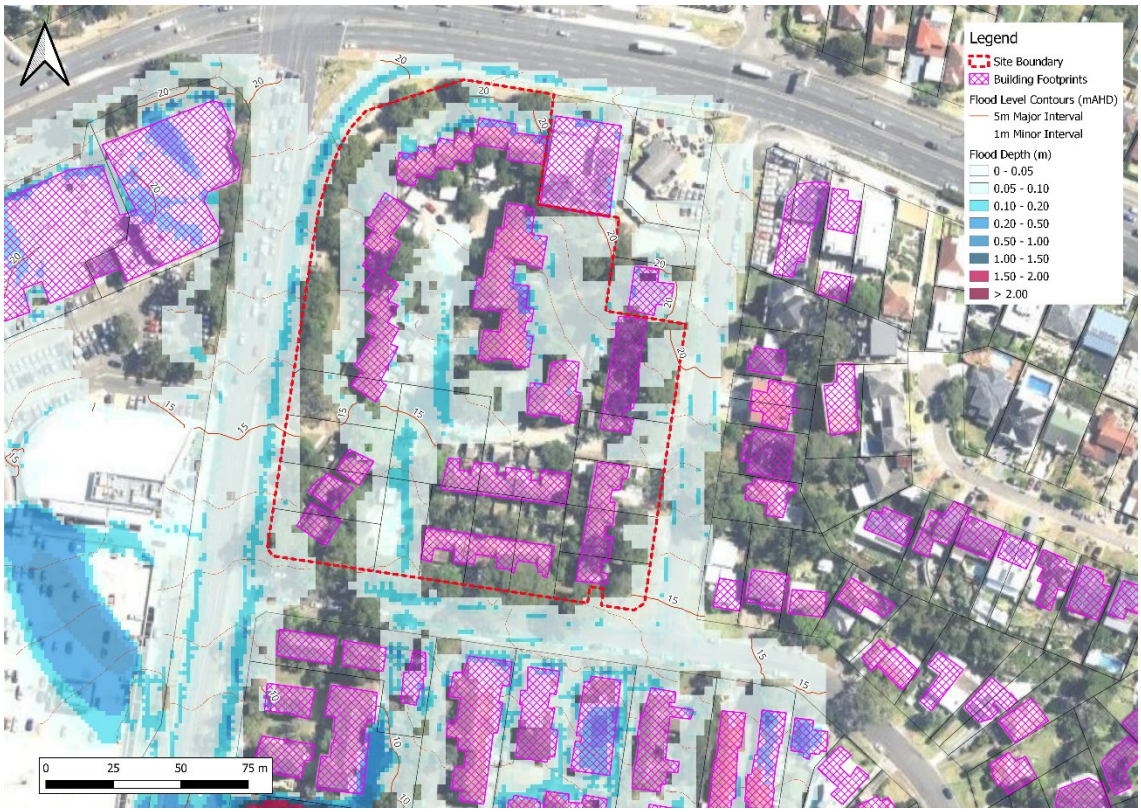
5.2.1.1 20% AEP TUFLOW Results

During the 20% AEP, the Site has a slight degree of flooding, which would mostly be contained to the overland flow paths and the local drainage assets, including the roadways. This is evident as both Port Hacking Road and Pembroke Street are inundated during the peak flooding of the 20% AEP.

The peak flood depths modelled through the Site and the surrounding area are shown in Figure 5.1. Peak flood during the 20% AEP storm at notable locations include:

- A peak depth of 0.21 m along Port Hacking Rd, along the western boundary of the Site.
- A peak depth of 0.19 m within the Pembroke St low point, at a level of 12.58 mAHD.

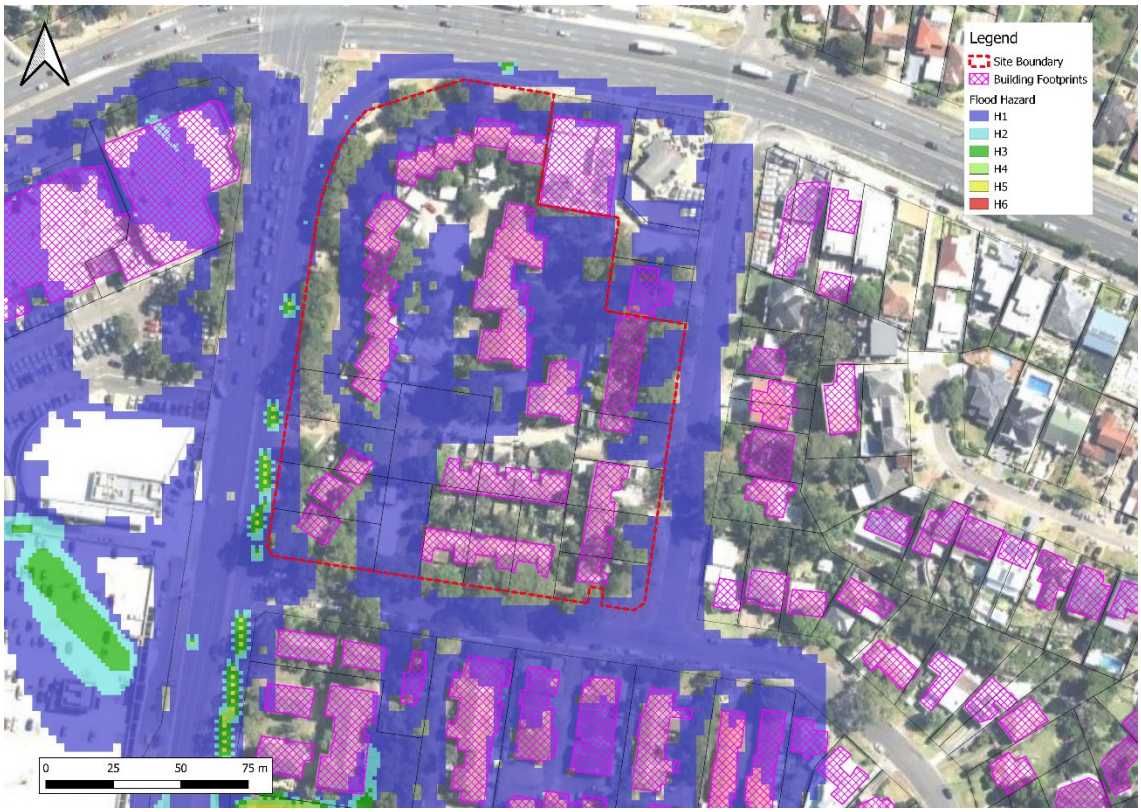
Figure 5.1: Existing Scenario - 20% AEP Flood Depth



The peak flood hazard categorisation during the 20% AEP for the existing Site and the surrounding catchment is shown in Figure 5.2. Peak flood hazard during the 20% AEP storm at notable locations includes:

- Isolated pockets of up to H5 associated with concentrated gutter flows, however, the majority of the flood hazard is H1 within Port Hacking Rd.
- A Peak flood hazard of H1 within Pembroke St.

Figure 5.2: Existing Scenario - 20% AEP Flood Hazard



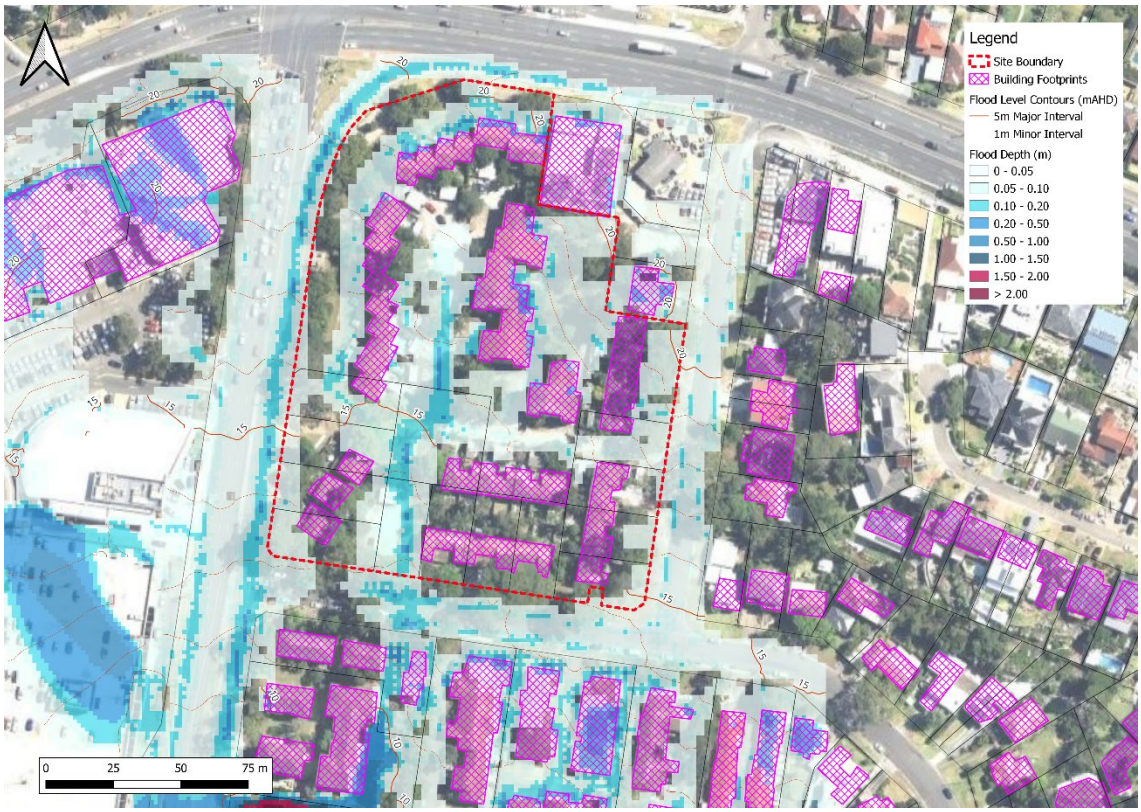
5.2.1.2 5% AEP TUFLOW Results

Similar to the 20% AEP, during the 5% AEP, the Site is impacted by overland flooding, however, the magnitude of flooding increased. This includes both Port Hacking Rd and Pembroke Street, which have both been modelled as inundated during this storm event.

The peak flood depth through the Site and the surrounding catchment is reflected in Figure 5.3. Peak flood depths during the 5% AEP at notable areas include:

- A peak depth of 0.23 m along Port Hacking Rd, along the western boundary of the Site.
- A peak depth of 0.21 m within the Pembroke Street low point, at a level of 12.60 mAHD.

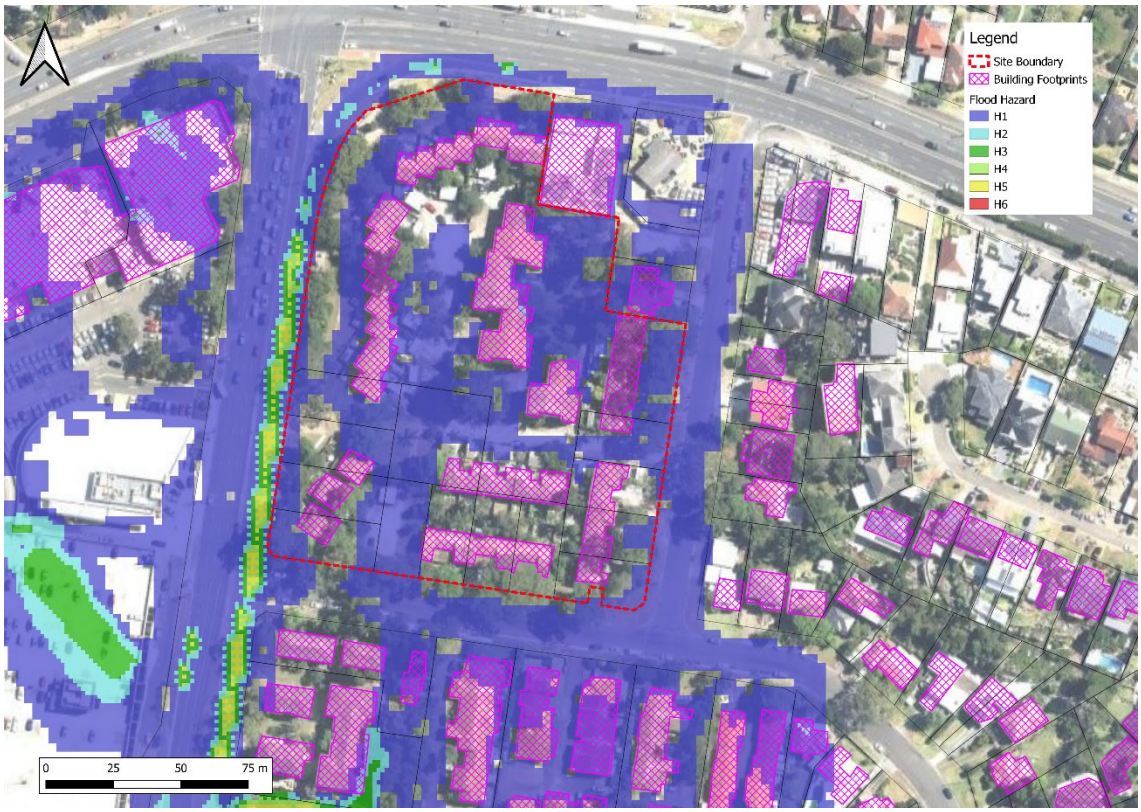
Figure 5.3: Existing Scenario - 5% AEP Flood Depth



The peak flood hazard categorisation during the 5% AEP for the existing Site and the surrounding catchment is shown in Figure 5.4. Peak flood hazard during the 5% AEP storm at notable locations includes:

- Pockets of up to H5 associated with concentrated gutter flows, within Port Hacking Rd.
- A Peak flood hazard of H1 within Pembroke Street, however, the Port Hacking Rd and Pembroke St intersection has flooding up to H5.

Figure 5.4: Existing Scenario - 5% AEP Flood Hazard



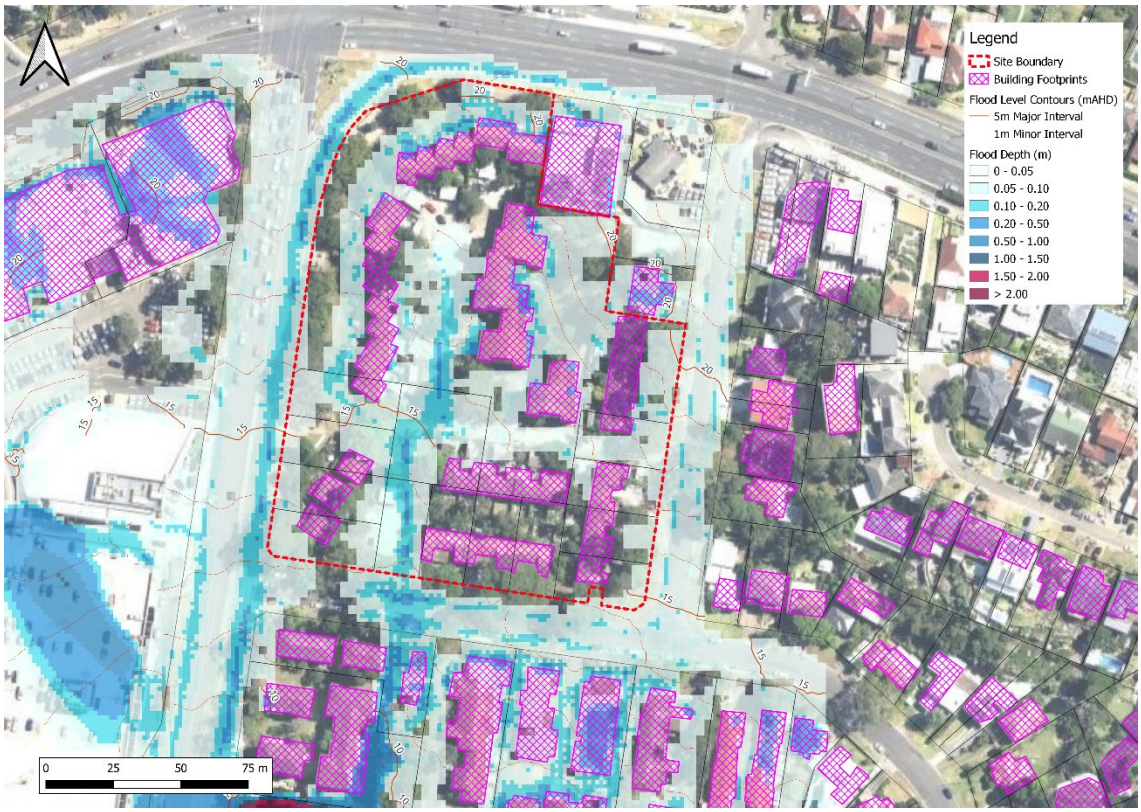
5.2.1.3 1% AEP TUFLOW Results

During the 1% AEP, the Site is impacted by overland flooding. This includes Port Hacking Rd west of the Site, which conveys a significant volume of water along the eastern side of the carriage way. The same applies to Pembroke Street, which conveys a notable volume of water during the 1% AEP scenario. Additionally, an overland flow path is present within the Site, which discharges directly into Pembroke St.

The peak flood depth through the Site and the surrounding catchment is reflected in Figure 5.5. Peak flood depths during the 5% AEP at notable areas include:

- A peak depth of 0.26 m along Port Hacking Rd, along the western boundary of the Site.
- A peak depth of 0.25 m within the Pembroke St low point, at a level of 12.60 mAHD.

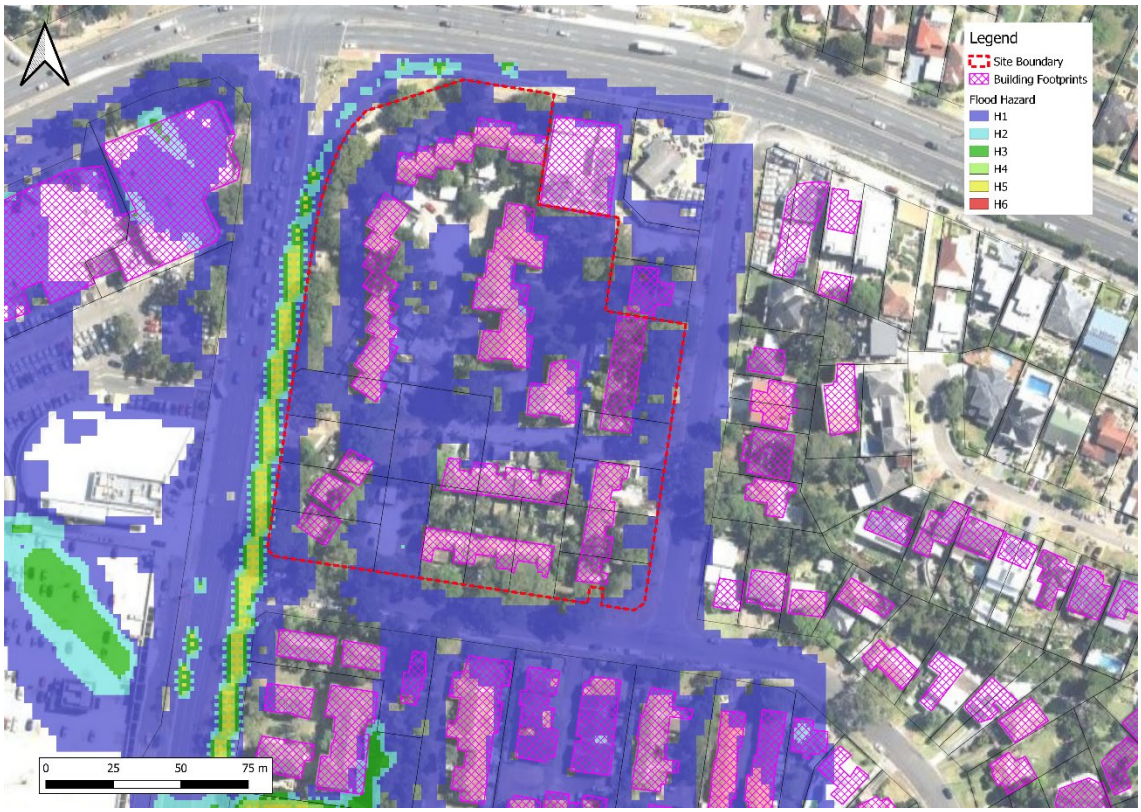
Figure 5.5: Existing Scenario - 1% AEP Flood Depth



The peak flood hazard categorisation during the 5% AEP for the existing Site scenario and the surrounding catchment is shown in Figure 5.6. Peak flood hazard during the 5% AEP storm at notable locations includes:

- A peak flood hazard of H5, along the concentrated gutter flows of the eastern side of Port Hacking Rd, at the western boundary of the Site.
- A Peak flood hazard of H1 within Pembroke St.

Figure 5.6: Existing Scenario - 1% AEP Flood Hazard



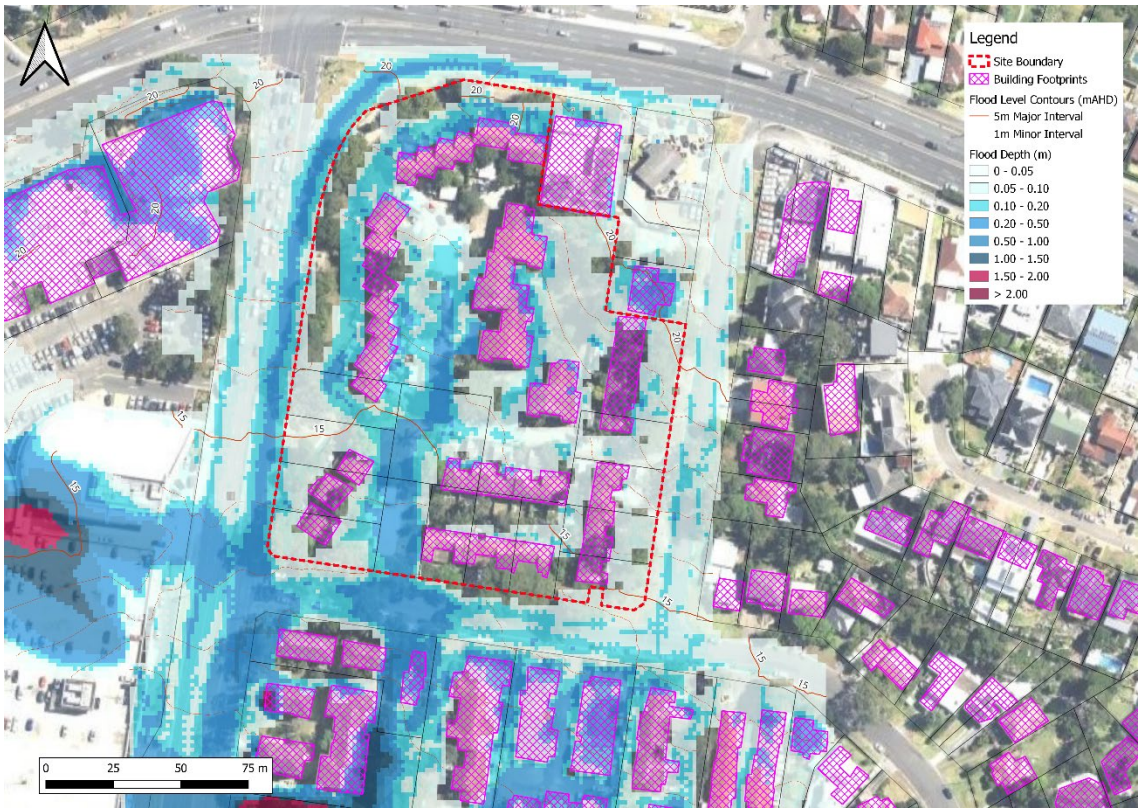
5.2.1.4 PMF TUFLOW Results

During the PMF storm, all previously mentioned overland flow paths experience a significant degree of inundation. This includes the overland flow path within the Site, as it originates within the Northern portion of Florida Street and travels through the Site, leading to significant inundation across the whole Site. During the PMF, ponding within and surrounding the Site is also observed in localised depressions. These ponds can be attributed to the significant volume of water travelling within the Site during this extreme storm event.

The peak flood depths modelled through the Site and the surrounding catchment are shown in Figure 5.7. Peak flood depths during the PMF at notable areas include:

- A peak depth of 0.35 m along Port Hacking Rd, along the western boundary of the Site.
- A peak depth of 0.46 m within the Pembroke St low point, at a level of 12.83 mAHD.

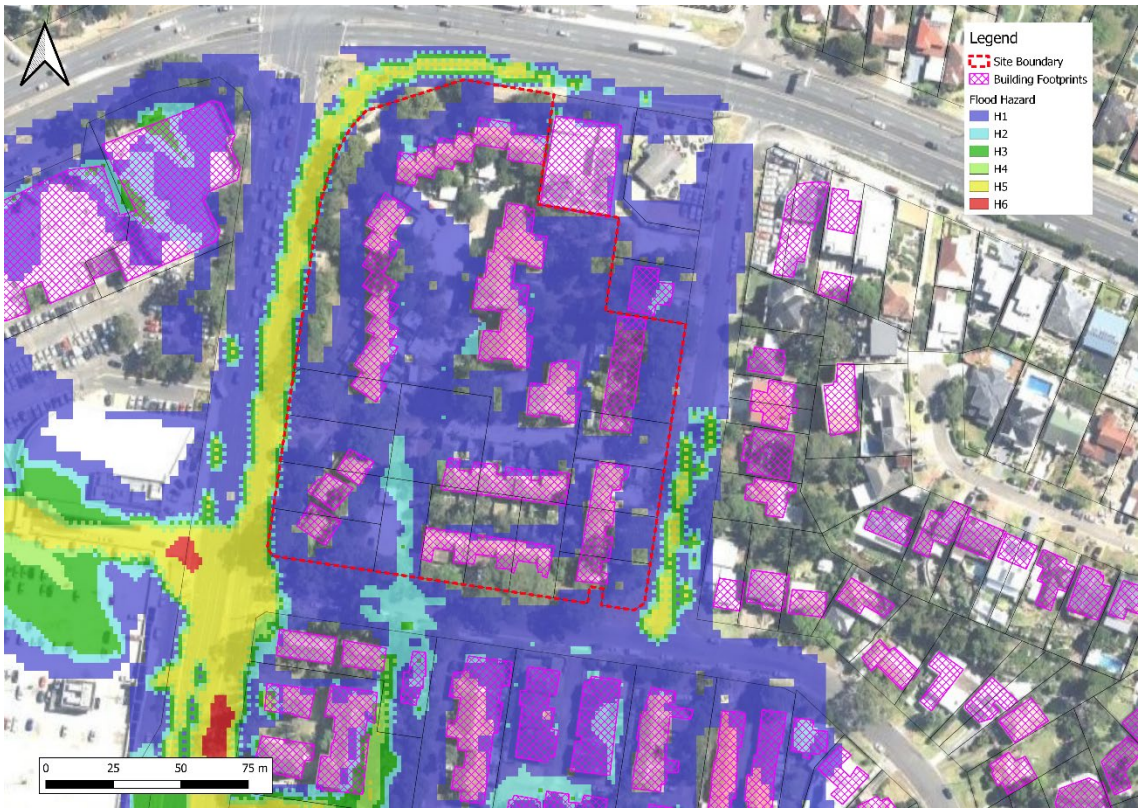
Figure 5.7: Existing Scenario - PMF Flood Depth



The peak flood hazard categorisation during the PMF for the existing Site scenario and the surrounding catchment is shown in Figure 5.8. Peak flood hazard during the PMF storm at notable locations includes:

- A peak flood hazard of H5, along Port Hacking Rd, at the western boundary of the Site.
- A peak flood hazard of H5, to the southern end of Florida Street.
- A peak flood hazard of H3 within Pembroke St.

Figure 5.8: Existing Scenario - PMF Flood Hazard



5.2.2 Post Development Flood Behaviour

A post development or design scenario was developed based upon the existing model. The purpose of this was to allow for a meaningful assessment of the impact of the proposed development upon flooding conditions. This was achieved by including an amended DEM surface for the proposed development landscaping and roadway levels, and amending the building footprints manning layer to reflect the proposed developments instead of the existing. In doing so, this allows for an accurate assessment of the flood impact of the proposed development.

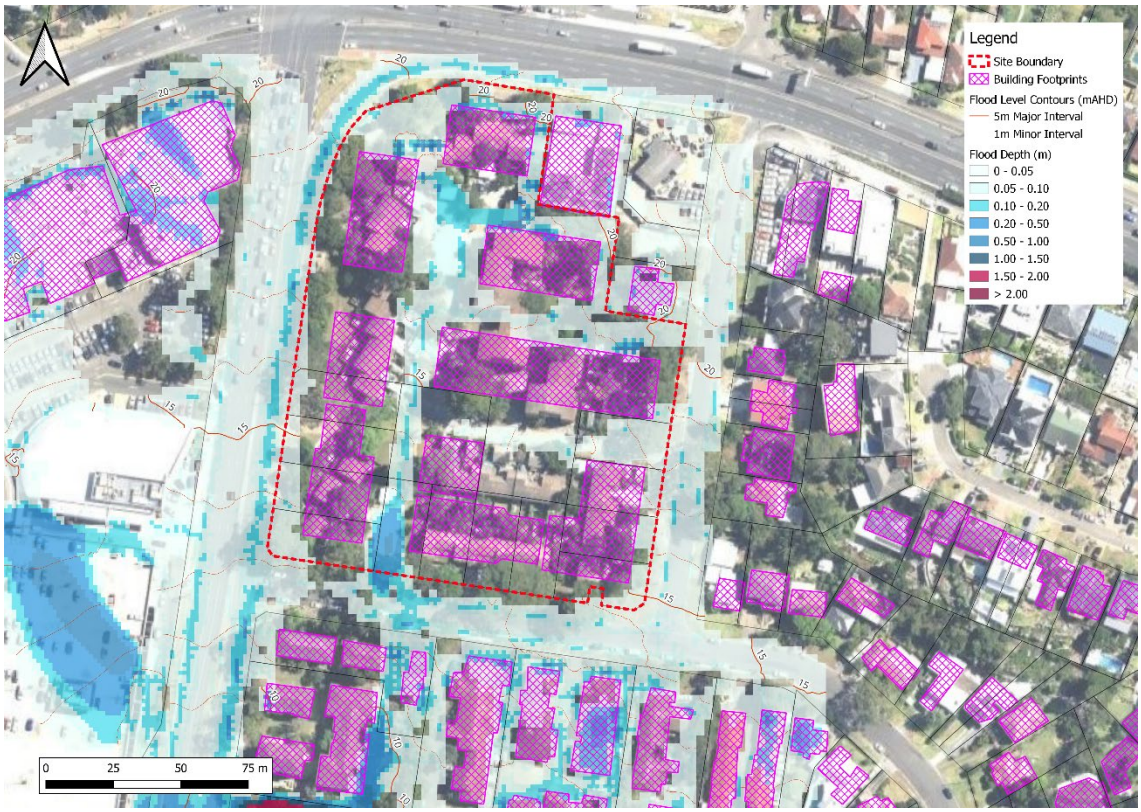
5.2.2.1 20% AEP TUFLOW Results

The 20% AEP Flood Depths and extents for the design scenario are shown in Figure 5.9. Within the Site, the proposed internal roadway channels water through the Site and the building masses divert some of the previous overland flow paths within the Site. It is critical to note that these diverted overland flow paths still have the same rough discharge points from the Site. In the immediate vicinity of the Site both Port Hacking Road and Pembroke Street act as overland flow paths.

Peak flood depths during the 20% AEP storm at notable locations include:

- A peak flood depth of 0.21 m along Port Hacking Rd, along the western boundary of the Site.
- A peak flood depth of 0.53 m within the proposed internal roadway and its intersection with Pembroke St.

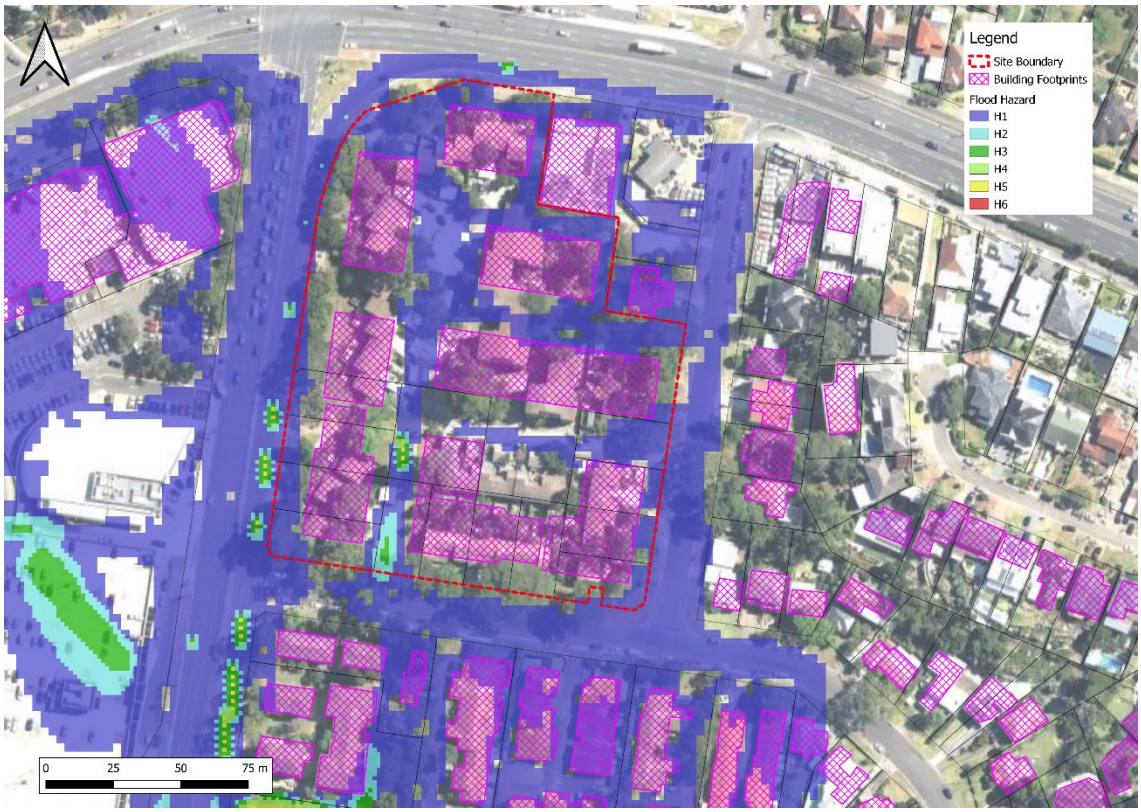
Figure 5.9: Developed Scenario - 20% AEP Flood Depth



The peak flood hazard categorisation during the 20% AEP storm for the design scenario and the surrounding catchment is shown in Figure 5.10. Peak flood hazard during the 20% AEP storm at notable locations includes:

- A peak flood hazard of H5 in isolated pockets along Port Hacking Rd, along the kerb alignment of the carriage way at the western Site boundary.
- A peak flood hazard of H3 within the intersection of the proposed internal roadway and Pembroke St.
- A peak flood hazard of H5 within the internal proposed roadway.

Figure 5.10: Developed Scenario - 20% AEP Flood Hazard



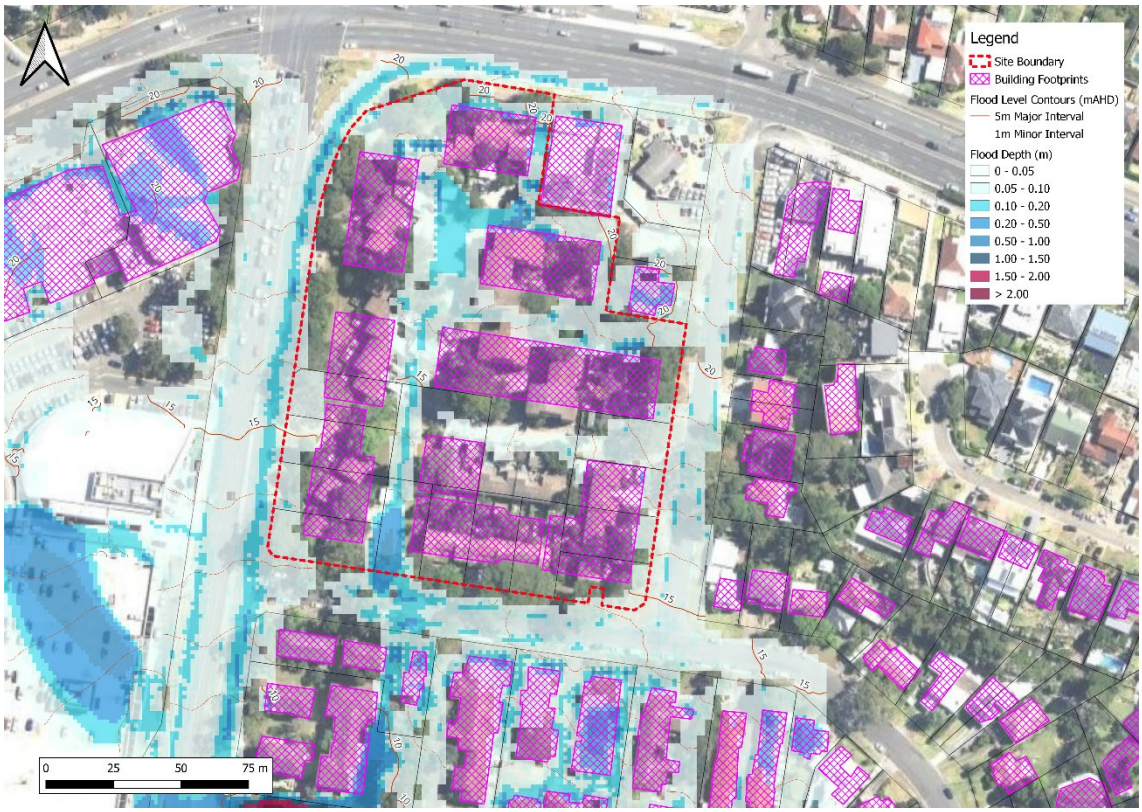
5.2.2.2 5% AEP TUFLOW Results

The 5% AEP storm flood depth and extents for the design scenario are shown in Figure 5.11. Within the Site, the internal roadway conveys a significant component of the internal overland flows. The proposed courtyard within the northern portion of the Site conveys overland flows towards the internal roadway. Additionally, the proposed building footprints intercept overland flowpaths within the Site. Similarly, the overland flowpaths during the 20% AEP, although diverted, still discharge at the same point downstream from the Site.

Peak flood depths during the 5% AEP storm at notable locations include:

- A peak flood depth of 0.23 m along Port Hacking Rd.
- A peak flood depth of 0.56 m within the proposed internal roadway and its intersection with Pembroke St.

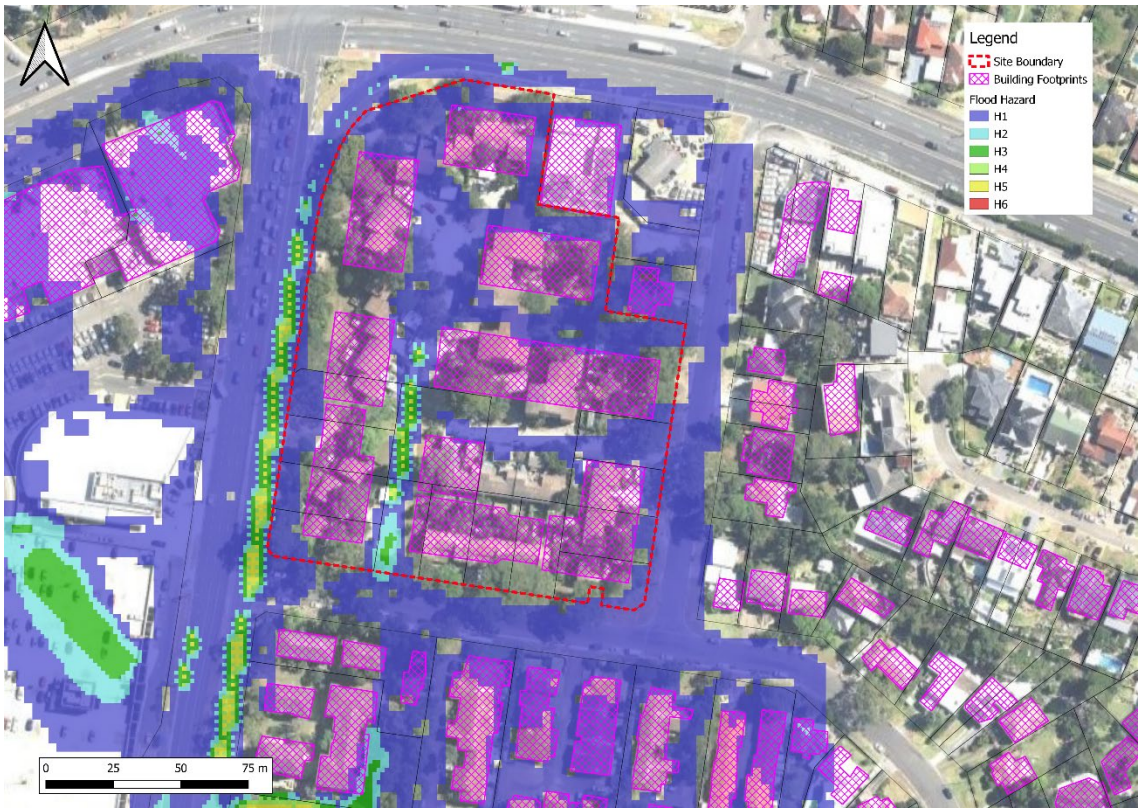
Figure 5.11: Developed Scenario - 5% AEP Flood Depth



The peak flood hazard categorisation during the 5% AEP storm for the design scenario and the surrounding catchment is shown in Figure 5.12. Peak flood hazard during the 5% AEP storm at notable locations includes:

- A peak flood hazard of H5 along the eastern kerb alignment of Port Hacking Rd, along the western Site boundary.
- A peak flood hazard of H3 within the intersection of the proposed internal roadway and Pembroke St.
- A peak flood hazard of H5 within the internal proposed roadway.

Figure 5.12: Developed Scenario - 5% AEP Flood Hazard



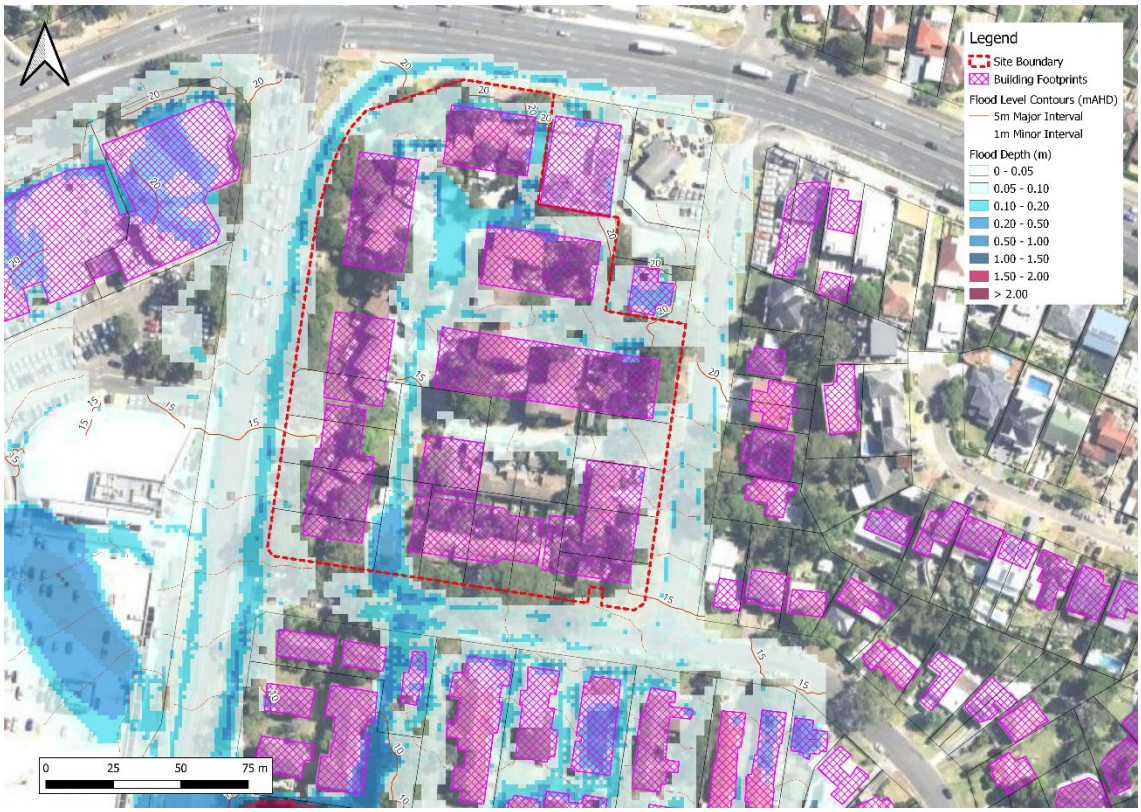
5.2.2.3 1% AEP TUFLOW Results

The 1% AEP storm flood depth and extents for the design scenario are shown in Figure 5.13. Within the Site, the north south courtyard and the proposed roadway both act as notable overland flow routes which direct flows towards the Pembroke St low point. Similar to the smaller magnitude storms, the proposed building intercepts the existing overland flow routes. Additionally, within the vicinity of the Site, Port Hacking Rd and Pembroke St both convey significant overland flow routes.

Peak flood depths during the 1% AEP storm at notable locations include:

- A peak flood depth of 0.25 m along Port Hacking Rd.
- A peak flood depth of 0.58 m within the proposed internal roadway and its intersection with Pembroke St.

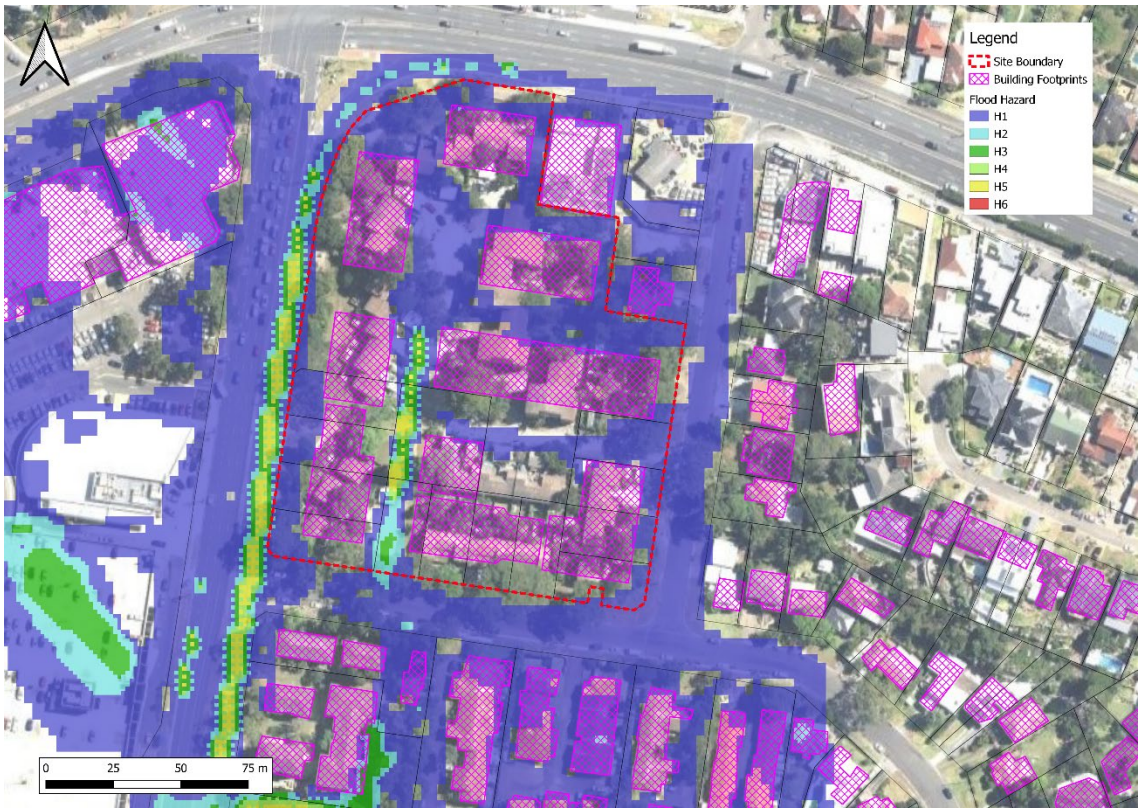
Figure 5.13: Developed Scenario - 1% AEP Flood Depth



The peak flood hazard categorisation during the 1% AEP storm for the design scenario and the surrounding catchment is shown in Figure 5.14. Peak flood hazard during the 1% AEP storm at notable locations includes:

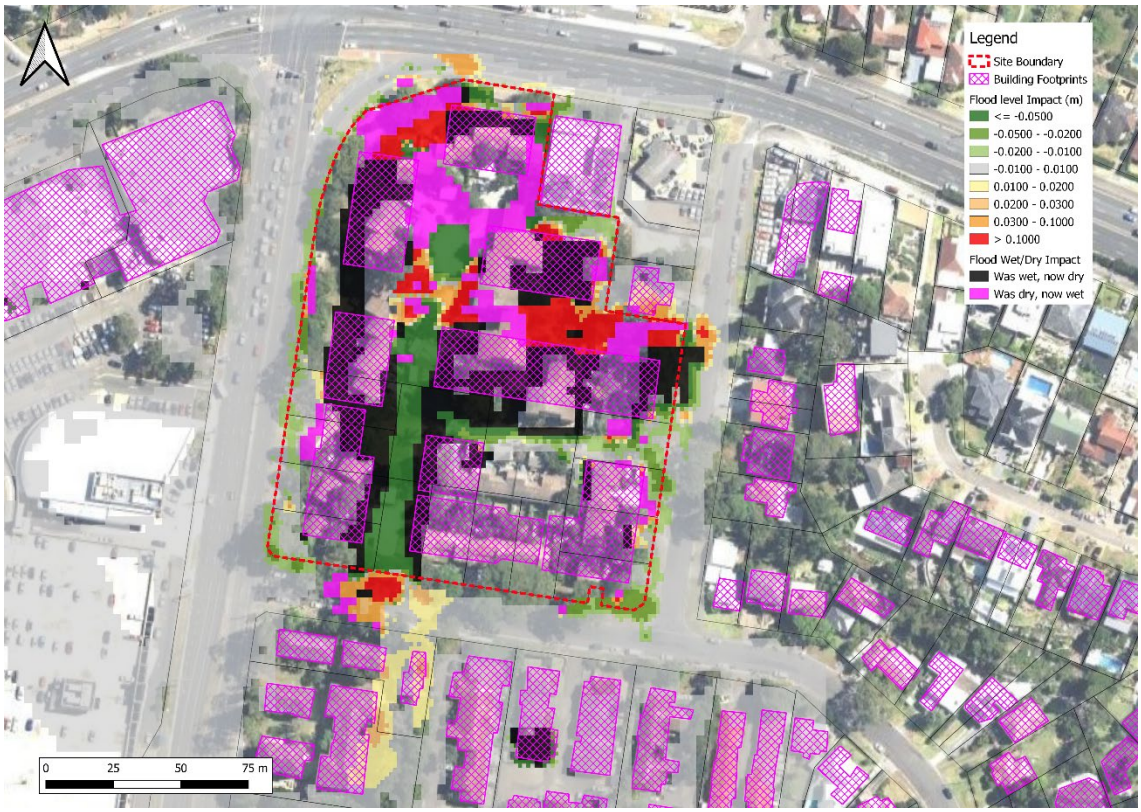
- A peak flood hazard of H5 along the eastern kerb alignment of Port Hacking Rd, along the western boundary of the Site.
- A peak flood hazard of H3 within the intersection of the proposed internal roadway and Pembroke St.
- A peak flood hazard of H5 within the internal proposed roadway.

Figure 5.14: Developed Scenario - 1% AEP Flood Hazard



The post development flooding impacts within the Site and the surrounding area are reflected in Figure 5.15. Flooding impacts are primarily contained within the Site of proposed development and the Pembroke roadway. Additionally, there is an increase in flood level on two properties directly to the south of the proposed Site of development, both of these properties are subject to flooding during the existing and design scenario, and the proposed development does not alter the peak flooding hazard within either of these properties. It has also been modelled that during the existing flooding scenario (at the point of afflux) these properties have a peak flood depth of 0.65 m, and in the design scenario, a peak flood depth of 0.67 m. Subsequently, the modelled flood impacts will not lead to a material impact on the flood outside of the Site of the proposed development.

Figure 5.15: 1% AEP Flood Impact



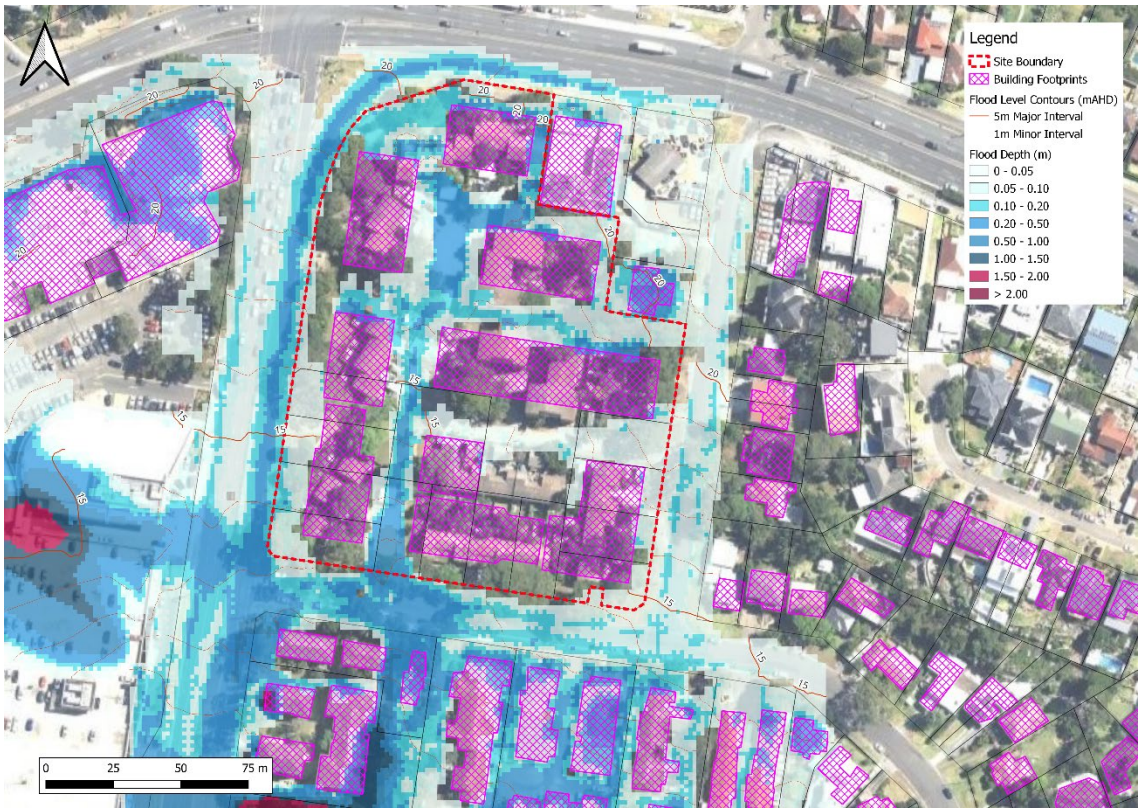
5.2.2.4 PMF TUFLOW Results

The PMF storm flood depth and extents for the design scenario are shown in Figure 5.16. Within the Site, both the internal courtyard and proposed roadway convey significant volumes of floodwater. These overland flow paths are combined within the north south portion of the roadway and are directed towards Pembroke St. Overland flow routes outside of the Site, similar to smaller magnitude storms, would be Port Hacking Rd and Pembroke St.

Peak flood depths during the PMF storm are notable at the following locations:

- A peak flood depth of 0.35 m along Port Hacking Rd.
- A peak flood depth of 0.72 m within the proposed internal roadway and its intersection with Pembroke St.

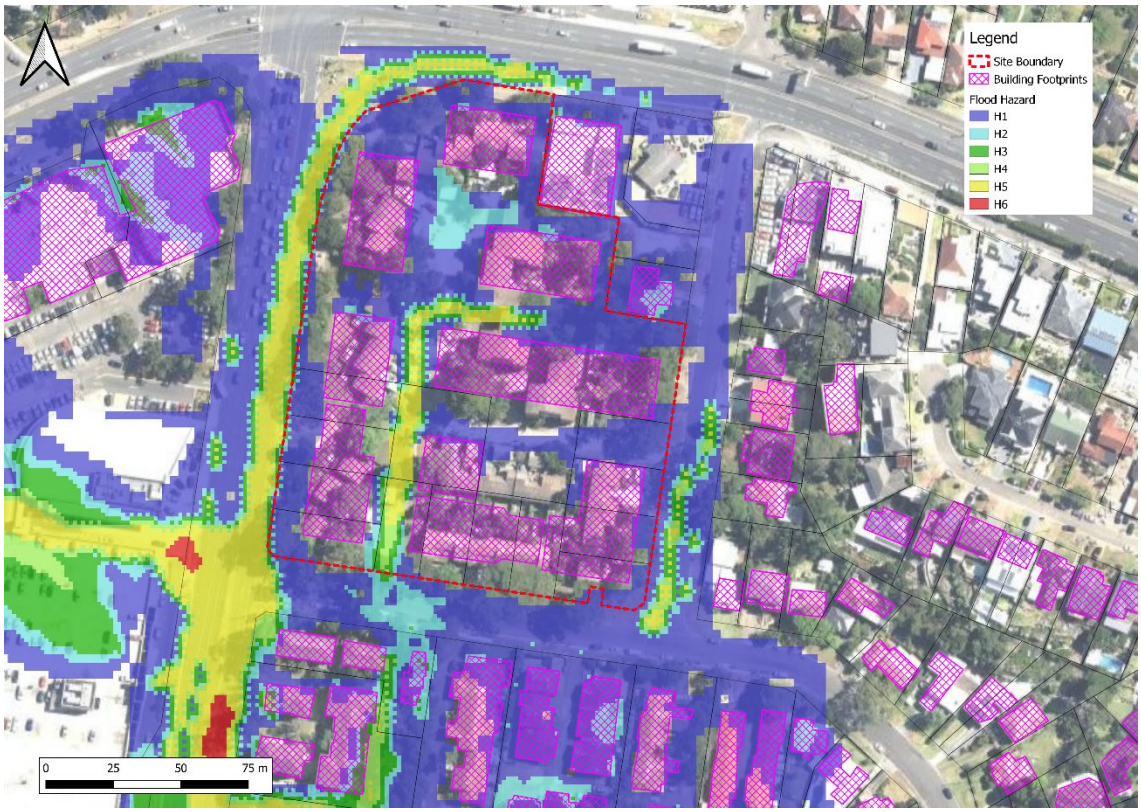
Figure 5.16: Developed Scenario - PMF Flood Depth



The peak flood hazard categorisation during the PMF storm for the design scenario and the surrounding catchment is shown in Figure 5.17. Peak flood hazard during the PMF storm at notable locations includes:

- A peak flood hazard of H5 throughout the eastern carriageway of Port Hacking Rd
- A peak flood hazard of H4 within the intersection of the proposed internal roadway and Pembroke St.
- A peak flood hazard of H5 within the internal proposed roadway.
- A peak flood hazard of H5 within the roadway at the southern end of Florida Street.

Figure 5.17: Developed Scenario - PMF Flood Hazard



5.3 Climate Change

A climate change uplift assessment was also undertaken on the 1% AEP to determine the potential impacts of climate change upon the proposed development. The guidance of the latest version of ARR (v4.2) on applying climate change relates to the consideration of Shared Socioeconomic Pathways (SSP). A range of SSPs are considered in the guidance, which is based on a range of climate modelling futures, reported in the Intergovernmental Panel on Climate Change (IPCC) Assessment Report 6.

In the absence of planning guidance as to which climate change scenario should be adopted, a 30% uplift on the 1% AEP flows was considered. When considering the global warming projects provided by ARR datahub for the Sylvania area, SSP2-4.5 rainfall uplifts for the 2030 to 2100 range of future horizons are 16% to 35%. Subsequently, the implemented rainfall uplift provides a reasonable coverage of ranges of climate futures that are equivalent to the latest projects from ARR v4.2.

The peak flood and depth for the uplifted climate change 1% AEP scenarios do not increase beyond the PMF storm event. Figures for the climate change scenario are included in the appendix.

5.4 Post Development Flood Impacts

The critical flooding impacts of the proposed development, upon the Site and the surrounding catchment, that should be considered are:

- Change in peak 1% AEP water level, depth and velocity:

    - The changes in peak water depth, level, velocity and storage area as a consequence of the proposed development, as outlined in section 3.2.2, should be prevented.
- Change in peak 1% AEP Flood Hazard
- PMF flooding impacts upon the Site and the surrounding catchment

It is these post development flood impacts that any proposed mitigation measures should be considered to assess their effectiveness.

5.5 Mitigation Measures

The most notable flooding mitigation measures for major storms implemented within the proposed design scenario are the proposed internal roadway and the inclusion of a depression within the northern courtyard. Both measures assist in channelising the flows within the Site to limit the impact upon property, as well as ensure preexisting overland flow routes discharge points from the Site are maintained. Subsequently, these measures prevent an alteration in flood extent outside of the Site of proposed development. Additionally, these proposed measures will also provide an increase in formal on-Site flood storage, which would pose less of a risk to people than informal localised depressions acting as flood storage.

6 Design Recommendations

The proposed development has been derived through a coordinated effort to minimise the flood risk on Site and in the surrounding catchment. A critical challenge to be managed within the Site is the consistent fall throughout the Site, and the proposed development is a 'flattening' of the Site. This is most apparent in the northwest section of the Site, as it is proposed to reduce the level within this area and introduce a steep decline upstream. These changes to the Site's topography have offered opportunities to implement flood mitigation measures that prevent undesirable flood impacts outside of the Site's extent.

6.1 Flood Planning Levels

The flood planning level for habitable floors in Residential buildings should be "*equal to or greater than the 1% AEP flood level plus 500mm freeboard*", while basement entrances should be protected adequate so that "*the crest of the driveway providing access between the road and the basement garages shall be a minimum of 200mm above the level of the 1% AEP*", however, given the consequences of basement flooding and the risk this would incur considering the PMF level is recommended. Additionally, the same criteria would apply to all penetrations or openings to the basement, which include conduits and ducts, mechanical vents or access routes.
The suggested emergency management strategy can also have an influence on the proposed floor levels. This is in regard to the implementation of shelter-in-place as a possible emergency management strategy and the subsequent consideration of PMF levels regarding providing protected floor levels. Subsequently, in areas of the proposed development where evacuation is not feasible, vertical evacuation to a safe refuge area above the PMF or 1% AEP + 500mm freeboard (whichever is greater) would be advisable.

6.2 Site Specific Flood Risk Management Opportunities

Some specific flood mitigation measures are implemented within the extent of the Site, being integrated into the design for the re-development. There is also the requirement to realign the existing drainage network and opportunity to optimise the internal roadway which with considerations during detailed design may be able to provide some benefit in mitigation against flooding impacts. The following Table 6.1 provides a summary of the opportunities to assist in mitigating flooding for both minor and major flooding scenarios.

Table 6.1: Proposed Flood Mitigation Measures

Identifier	Description	Location	Benefit
1	Dual purpose courtyard overland flow path channel.	Proposed within the Northern courtyard, directing towards the bend in the internal proposed roadway.	Prevents the potential ponded water extent within the courtyard from reaching the entrance of the buildings in minor storms.
2	Proposed internal roadways.	Connecting Florida St and Pembroke St through the Site.	Intercepts overland flows throughout the Site and channels them towards the previous discharge point. (established historically, represented by existing conditions)
3	Realignment of the existing drainage network.	Underneath the western side of the Site.	The current configuration of the drainage network would be impacted by the proposed basement configuration. Subsequently, there is an opportunity to realign this network and, in doing so, upgrade the network and connect it to another network within the new proposed

Identifier	Description	Location	Benefit
			roadway. In doing so, there is an opportunity to improve the nuisance flooding during minor storms within the Site.
4	Shelter-in-Place FPLs.	Throughout all residential and habitable areas within the Site.	The adoption of PMF FPLs within the Site, or within shared space where all residents would have access to, would help mitigate against the risk of shelter-in-place being implemented as a contingent emergency management strategy.

6.3 Flood Emergency Management

The flood emergency management (EM) strategy for the Site, when developed, should be assessed following advice provided by the Flood Risk Management Guideline EM01 – Support for Emergency Management Planning (DPE 2023) and all other relevant government agencies' plans and policies, such as the SES.

The EM01 guidelines provide advice on how the flood risk management (FRM) framework and process described in the Flood Risk Management Manual: the policy and manual for the management of flood liable land (DPE 2023) can be considered and support flood EM.

The NSW SES leads flood EM planning and has the following legislative responsibilities in accordance with the State Emergency Service Act 1989:

- To protect person from dangers to their safety and health, and to protect property from destruction or damage arising from floods, storms and tsunamis.
- To act as the combat agency for dealing with floods (including the establishment of flood warning systems) … And to coordinate the evacuation and welfare of affected communities.
- The role of the NSW SES includes community education, collation of flood intelligence, flood EM planning and flood response, including the evacuation and welfare of affected communities.

To help minimise the flood risk to future occupants, developments must consider flood emergency response. Two main forms of response may be adopted:

- Evacuation
    - Horizontal evacuation of occupants from the floodplain before the properties and/or evacuation routes become flooded. This is, however, not always feasible during major and extreme storms in urban areas, as surrounding roadways are often inundated and convey floodwaters.
- Shelter-in-place
    - Vertical evacuation of occupants in a building to a level higher than the PMF level, who then shelter from the flood until it is safe to return to the ground floor and external areas

Draft EM Strategy

It is currently suggested that the considered primary flood EM strategy for the proposed redevelopment Site would be to evacuate before the onset of the storm to a safe location. This primary strategy is reliant on SES or emergency services notice and adequate signage to indicate flood risk areas and direct individuals to safe refuge locations. Despite the overall suitability of this flood emergency strategy, additional contingency strategies may be relevant for the Site to provide contingency. These potential strategies could be:

- Evacuation during a storm event could be achieved by utilising low flood hazard roadways, such as Florida Street which is only H1 flood hazard during the PMF event north of the intersection with the proposed roadway and is connected with the Princess Highway offering multiple egress routes. This may be a difficult solution to effectively implement, as the surrounding catchments are likely to have inundated roadways which could prevent evacuation to a designated refuge location. This strategy however would allow for emergency responders to access the Site during a secondary emergency, as from Florida St they would have access to within the Site via routes mostly limited to H1 flood hazard during the PMF event.
- Shelter-in-place may be suitable in some cases where evacuation is not desirable and adequate measures have been considered. These measures will also need to be adopted to provide safe refuge, above the PMF flood level, in any location requiring the implementation of this EM strategy. In all cases across the Site, the 1% AEP flood level plus 0.5m freeboard exceeds or equals the PMF flood level. This floor level requirement of the Shelter-in-place option has been met through achieving Council FPL requirements.

Consequently, evacuation prior to the onset of a storm event under the guidance of SES or emergency services is the primary Flood Emergency Management strategy, with Shelter-in-place acting as a suitable contingency to this plan. Despite egress during a storm being feasible via Florida Street, there is no requirement for a contingency plan beyond the existing contingency plan of Shelter-in-place, as it is suitable for all storm events up to and including the PMF.

7 Conclusion

The proposed Site of development is located within the Sutherland Shire Council LGA, with both the Sutherland LEP (2015) and DCP (2015) outlining the required flooding controls and considerations any development must adhere to or address. Additionally, this proposed development is subject to any existing state SEPPs. It is these planning controls from a flooding perspective that this FIRA aims to address, and the requirements of the SEARs.

Under existing conditions, the Site is prone to flooding during all storms up to and including the PMF. The primary source of this is overland flow paths throughout the Site, which converge at a low point within the northern side of Pembroke Street. This can be attributed to the existing building massing and landscaping within the Site, which do not concentrate flows to a single overland flow channel. The nature of flooding is short duration (less than 6 hours), making the Site vulnerable to flash flooding.

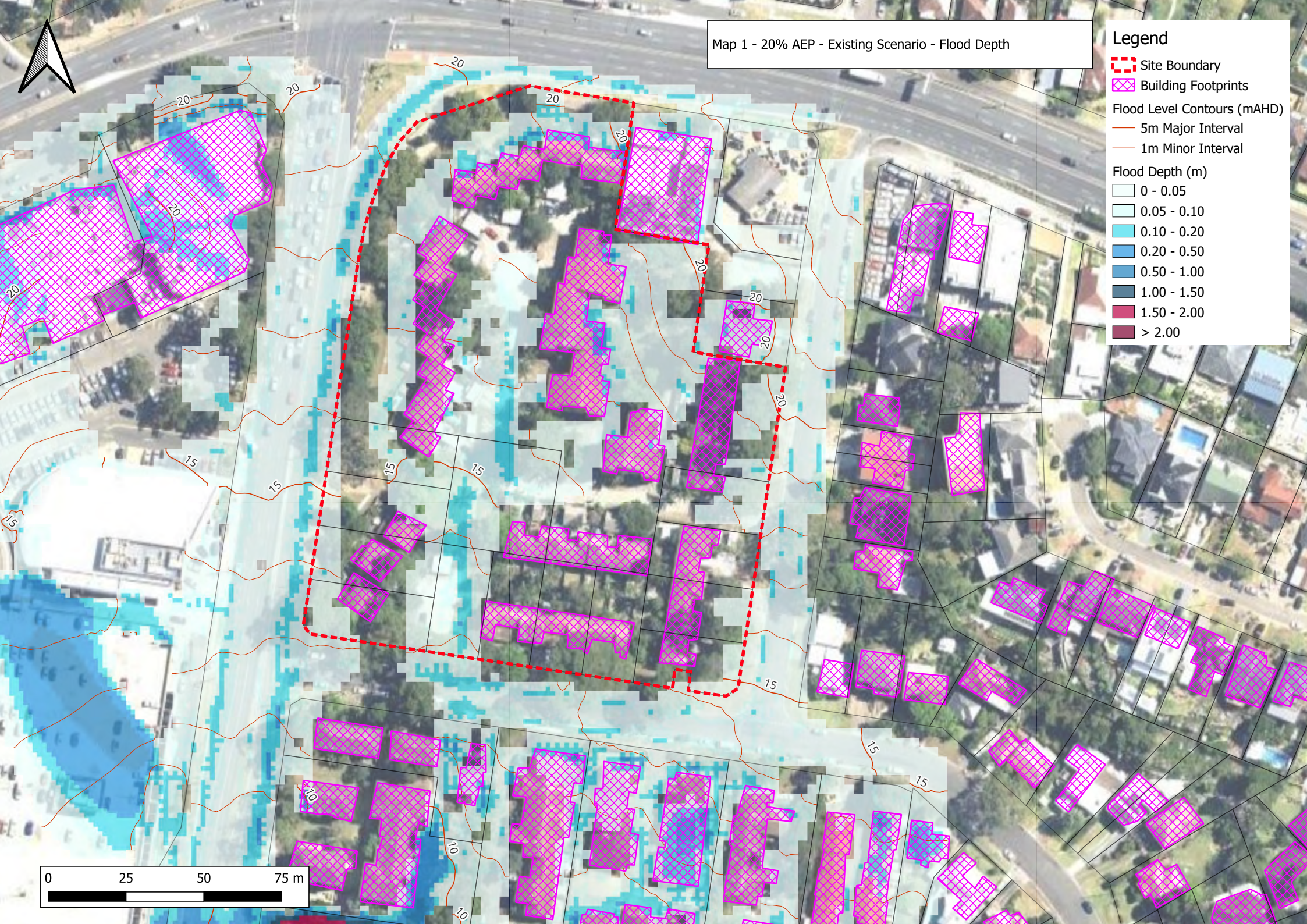
In the flood modelling of the design scenario, the alignment of the proposed building masses and landscape features has been included. This assists in consolidated flows within the Site to the proposed internal roadway and graded open spaces. These flows are still discharged from the Site into Pembroke St, which helps in limiting the downstream impact of the proposed development. Additionally, the western side of the Site in extreme storms is impacted by flooding from Port Hacking Rd, however, there is no ponding observed within the Site during design scenarios.

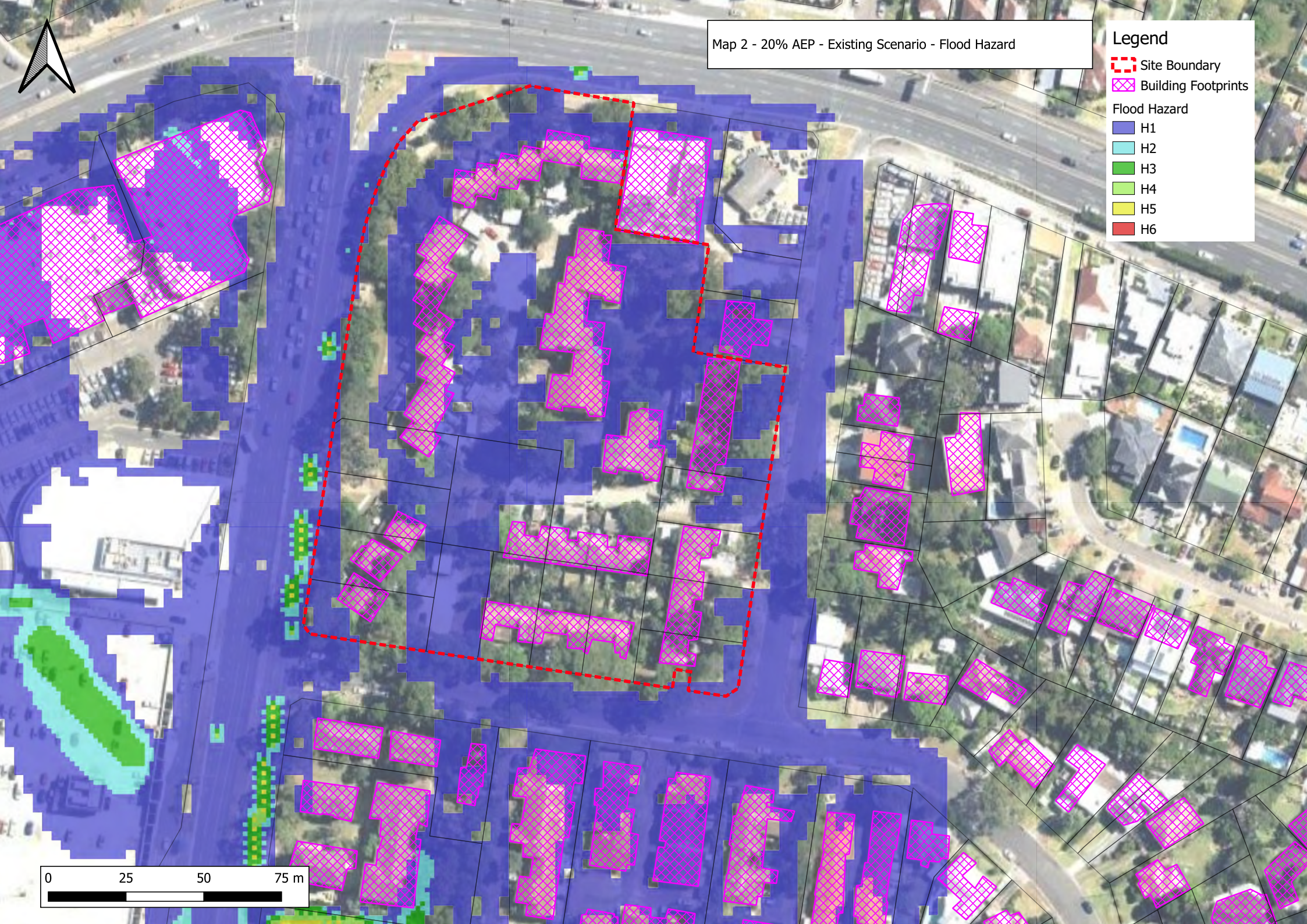
The adverse impacts of flooding caused by the proposed development can be mitigated through the implementation of flood mitigation measures. These measures include the implementation of flood planning levels adjustments to residential levels and basement access levels, the channelisation of overland flows within the Site to the internal roadway and graded open spaces. These flood planning levels have been adopted within the current proposed design. This includes both basement and residential entries, in accordance with DCP and flood emergency management requirements, exceeding both the PMF and the 1% AEP, plus 0.5m freeboard.

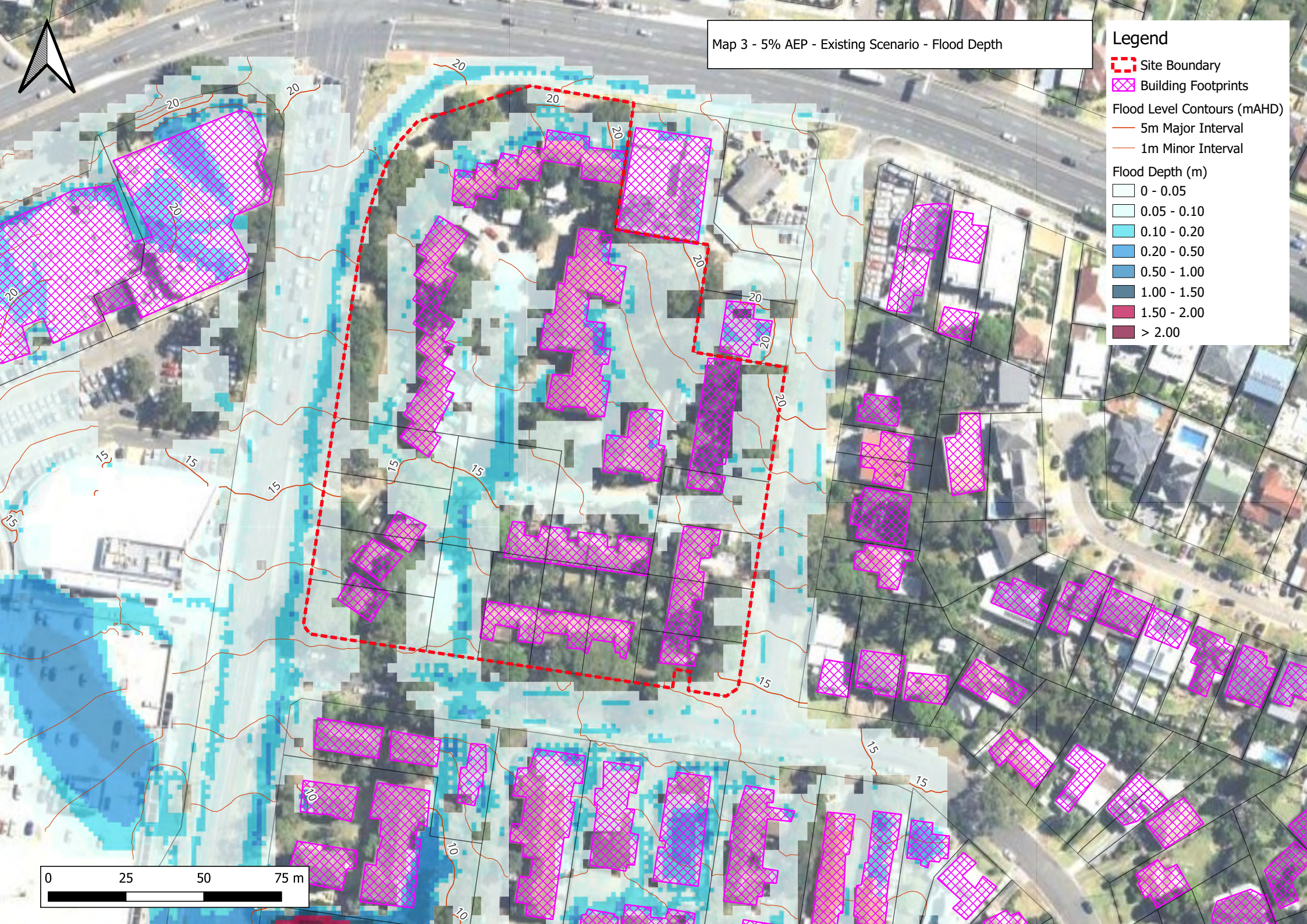
There are opportunities for the implementation of WSUD and stormwater management plans, which could assist in mitigating against nuisance flooding during minor storms. A climate change impact, using a 30% rainfall uplift, was also considered, and it was observed that the material nature of flooding within and surrounding the Site would not change from an emergency management perspective.

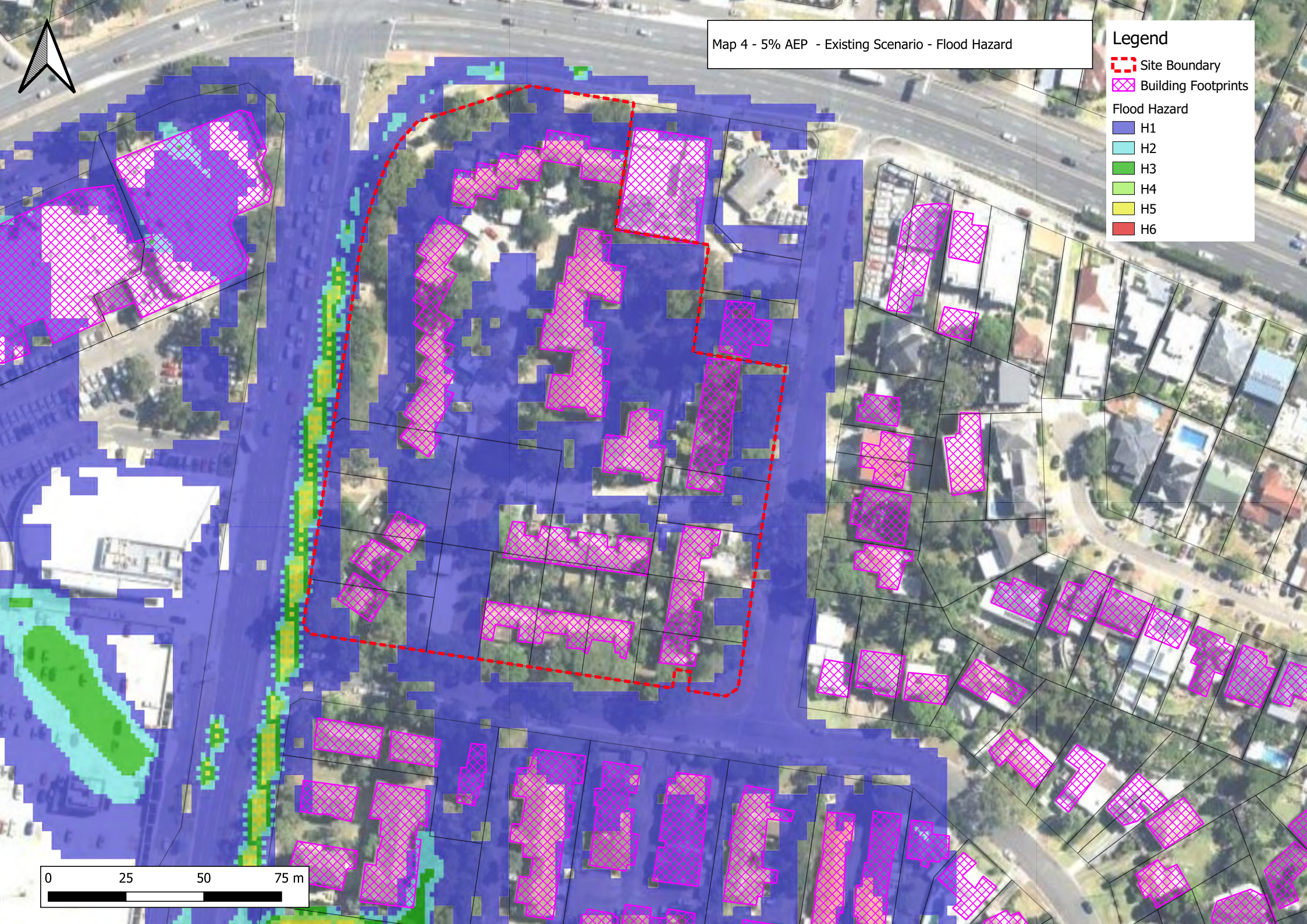
Flood emergency response has also been considered within this FIRA, with the primary advisable plan being to follow all directions given by emergency responders, including but not limited to the SES. In the absence of these directions, shelter in place has also been assessed as a suitable flood emergency management strategy.

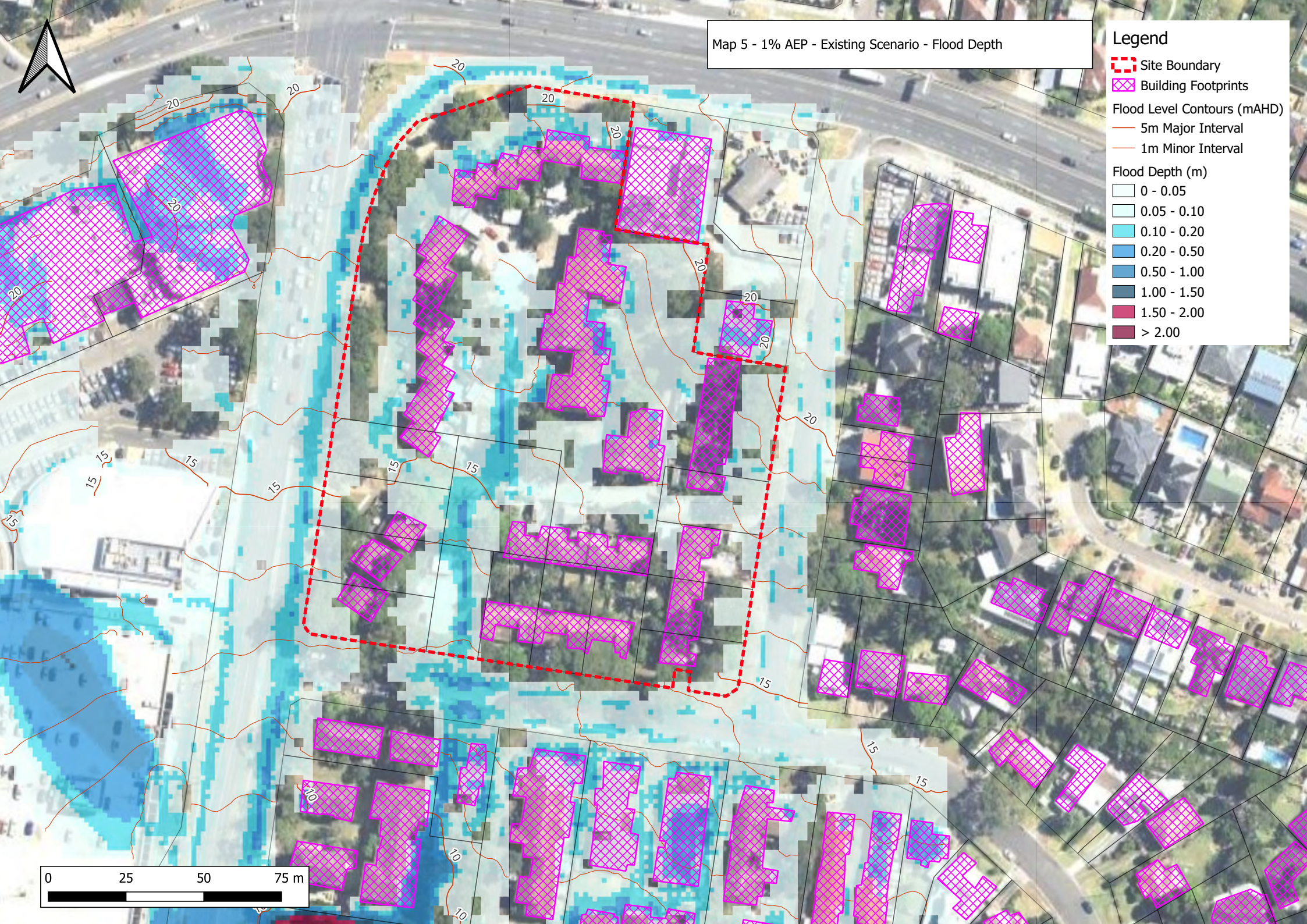
Appendix: Flood Maps

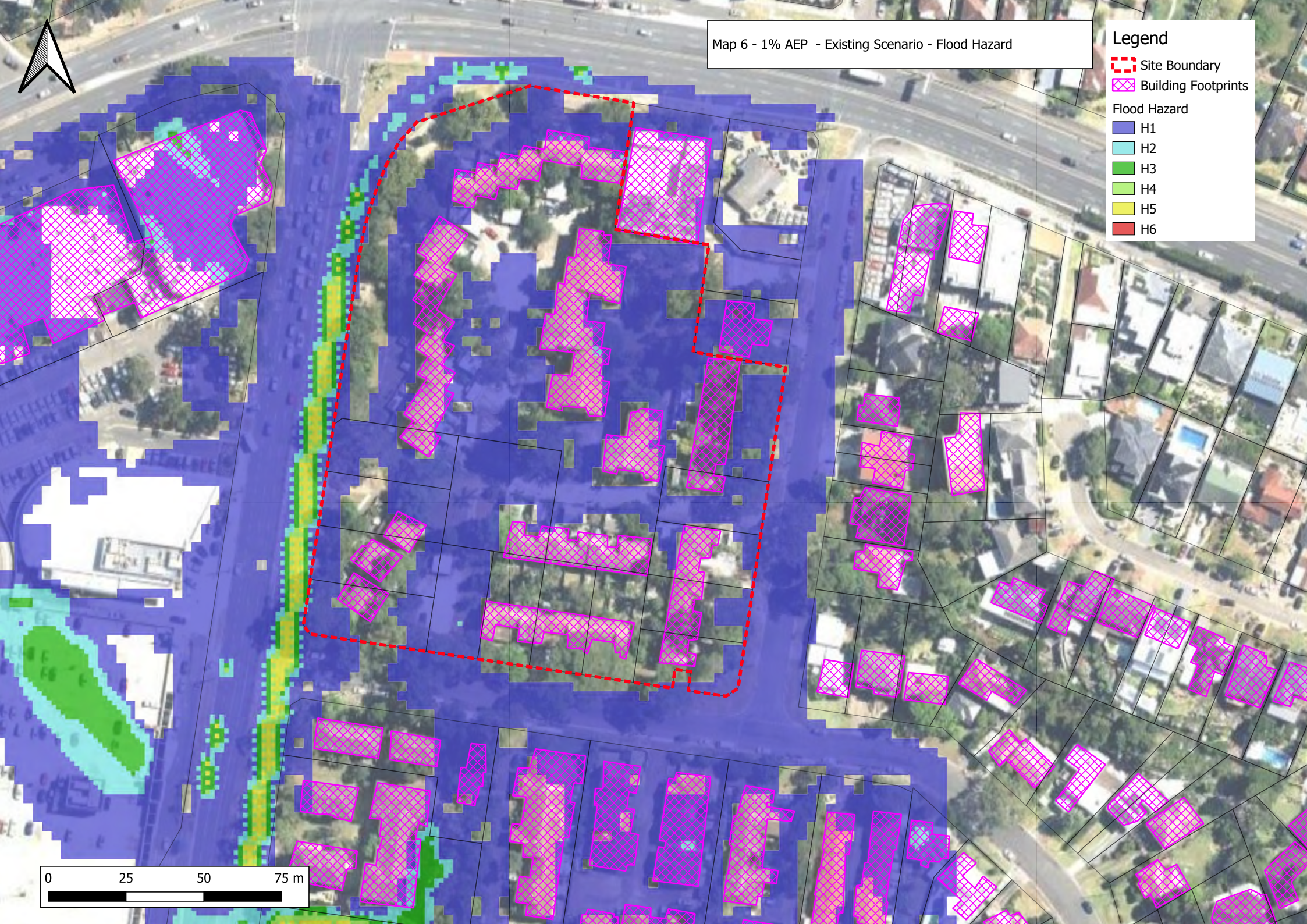

Map 1 - 20% AEP - Existing Scenario - Flood Depth
Legend
Site Boundary
Building Footprints
Flood Level Contours (mAHD)
5m Major Interval
1m Minor Interval
Flood Depth (m)
0 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.50
0.50 - 1.00
1.00 - 1.50
1.50 - 2.00
> 2.00
0
25
50
75 m


Map 2 - 20% AEP - Existing Scenario - Flood Hazard
Legend
Site Boundary
Building Footprints
Flood Hazard
H1
H2
H3
H4
H5
H6
0
25
50
75 m

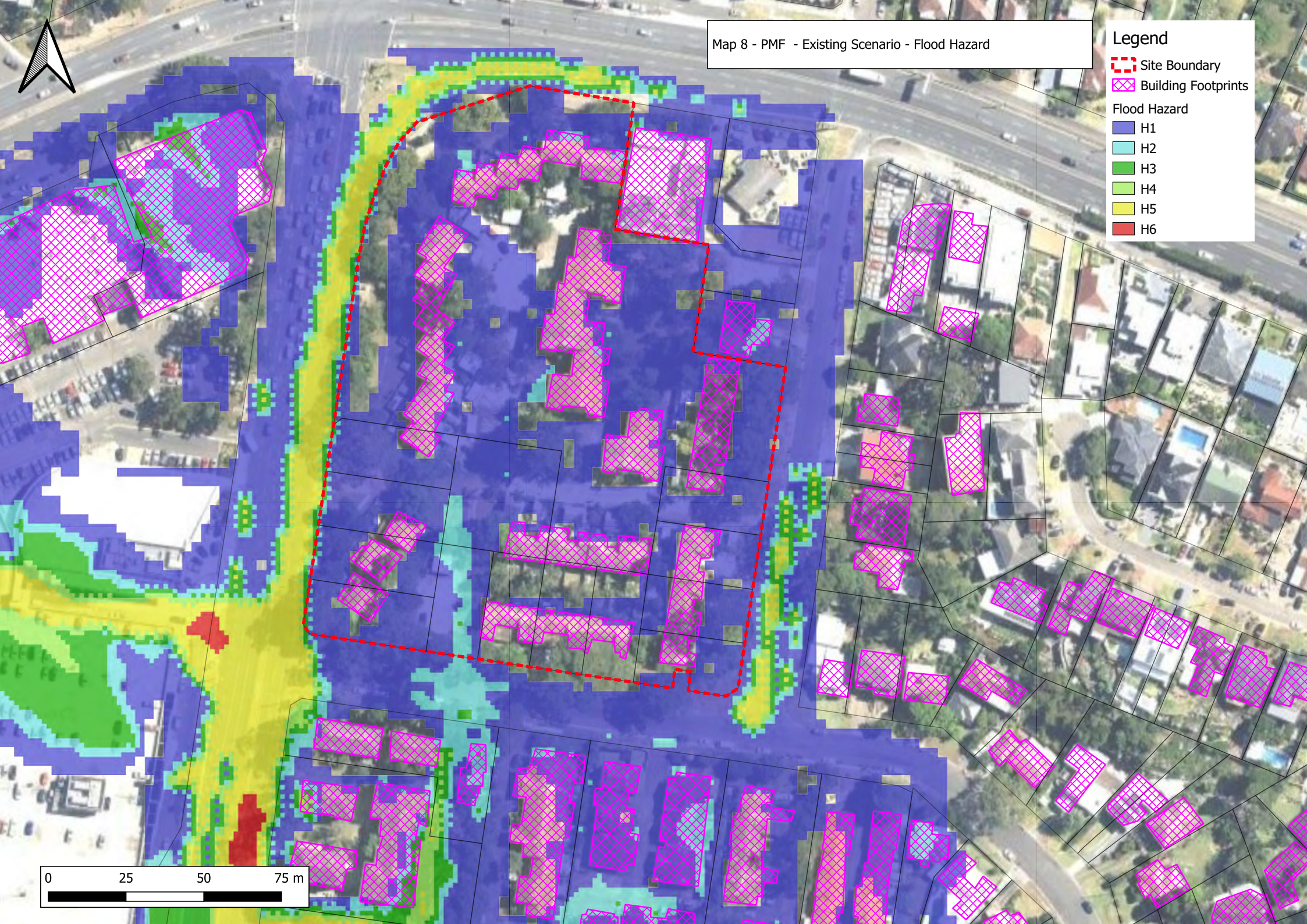

Map 3 - 5% AEP - Existing Scenario - Flood Depth
Legend
Site Boundary
Building Footprints
Flood Level Contours (mAHD)
5m Major Interval
1m Minor Interval
Flood Depth (m)
0 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.50
0.50 - 1.00
1.00 - 1.50
1.50 - 2.00
> 2.00
0
25
50
75 m

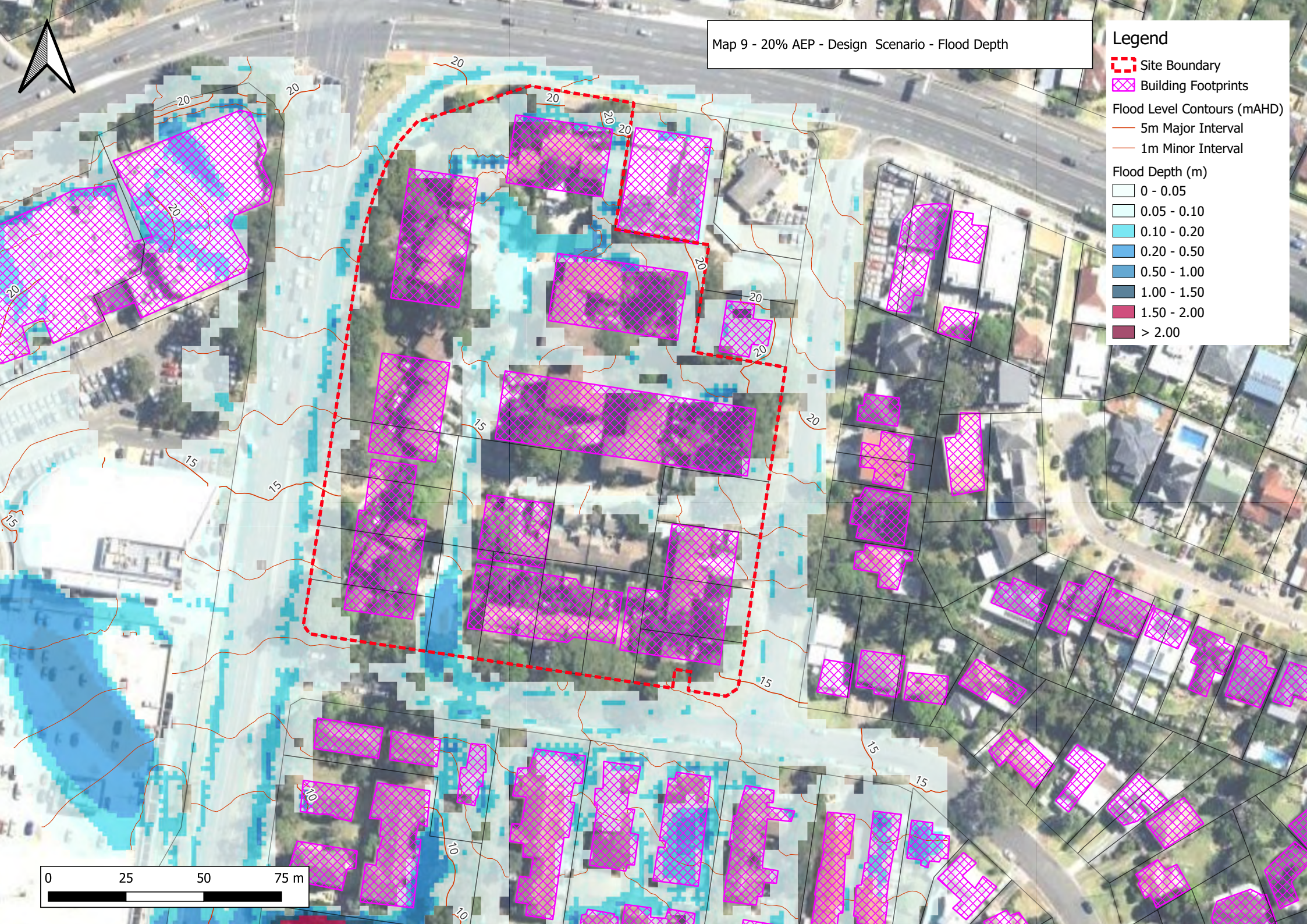

Map 4 - 5% AEP - Existing Scenario - Flood Hazard
Legend
Site Boundary
Building Footprints
Flood Hazard
H1
H2
H3
H4
H5
H6
0
25
50
75 m

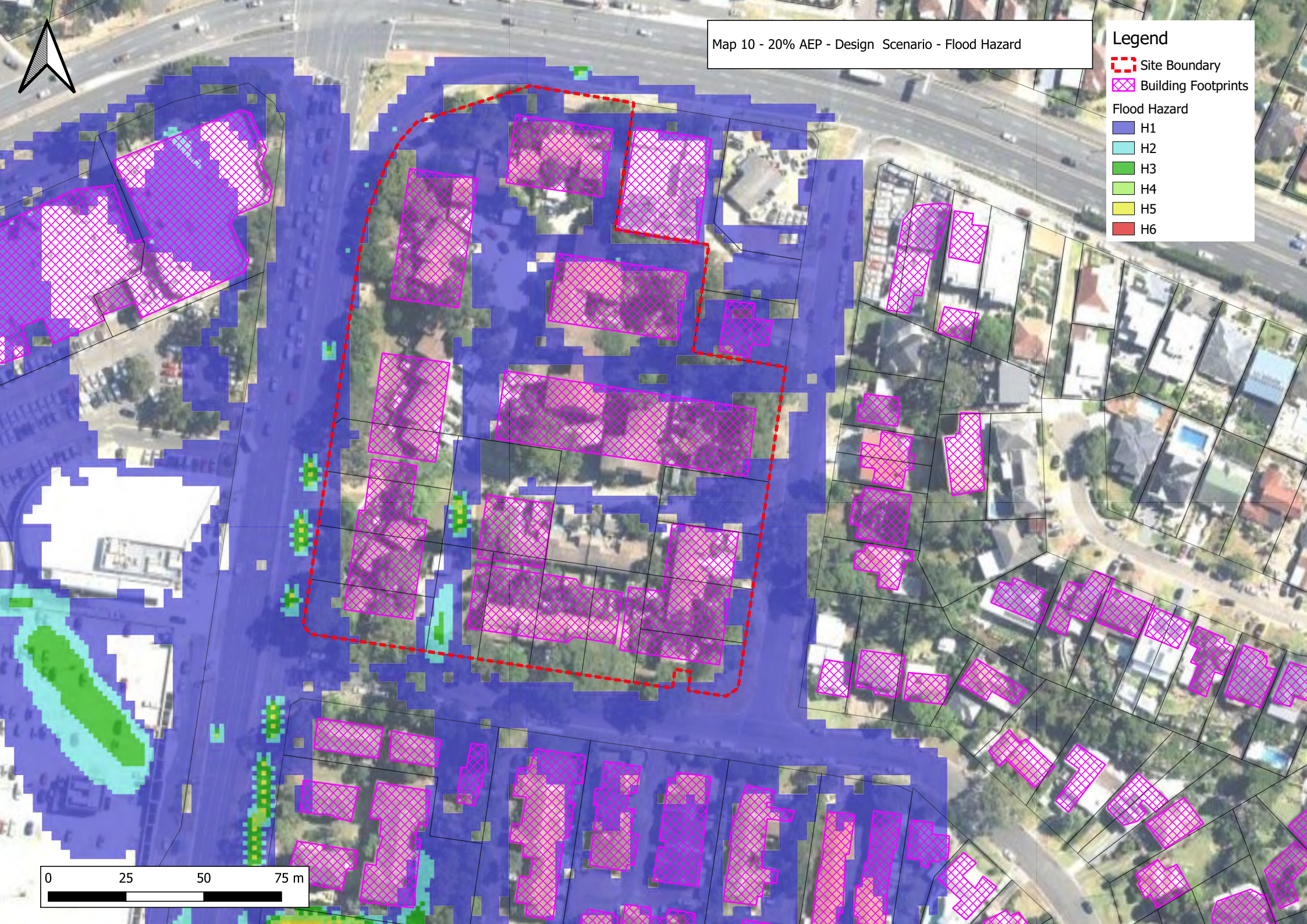

Map 5 - 1% AEP - Existing Scenario - Flood Depth
Legend
Site Boundary
Building Footprints
Flood Level Contours (mAHD)
5m Major Interval
1m Minor Interval
Flood Depth (m)
0 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.50
0.50 - 1.00
1.00 - 1.50
1.50 - 2.00
> 2.00
0
25
50
75 m


Map 6 - 1% AEP - Existing Scenario - Flood Hazard
Legend
Site Boundary
Building Footprints
Flood Hazard
H1
H2
H3
H4
H5
H6
0
25
50
75 m

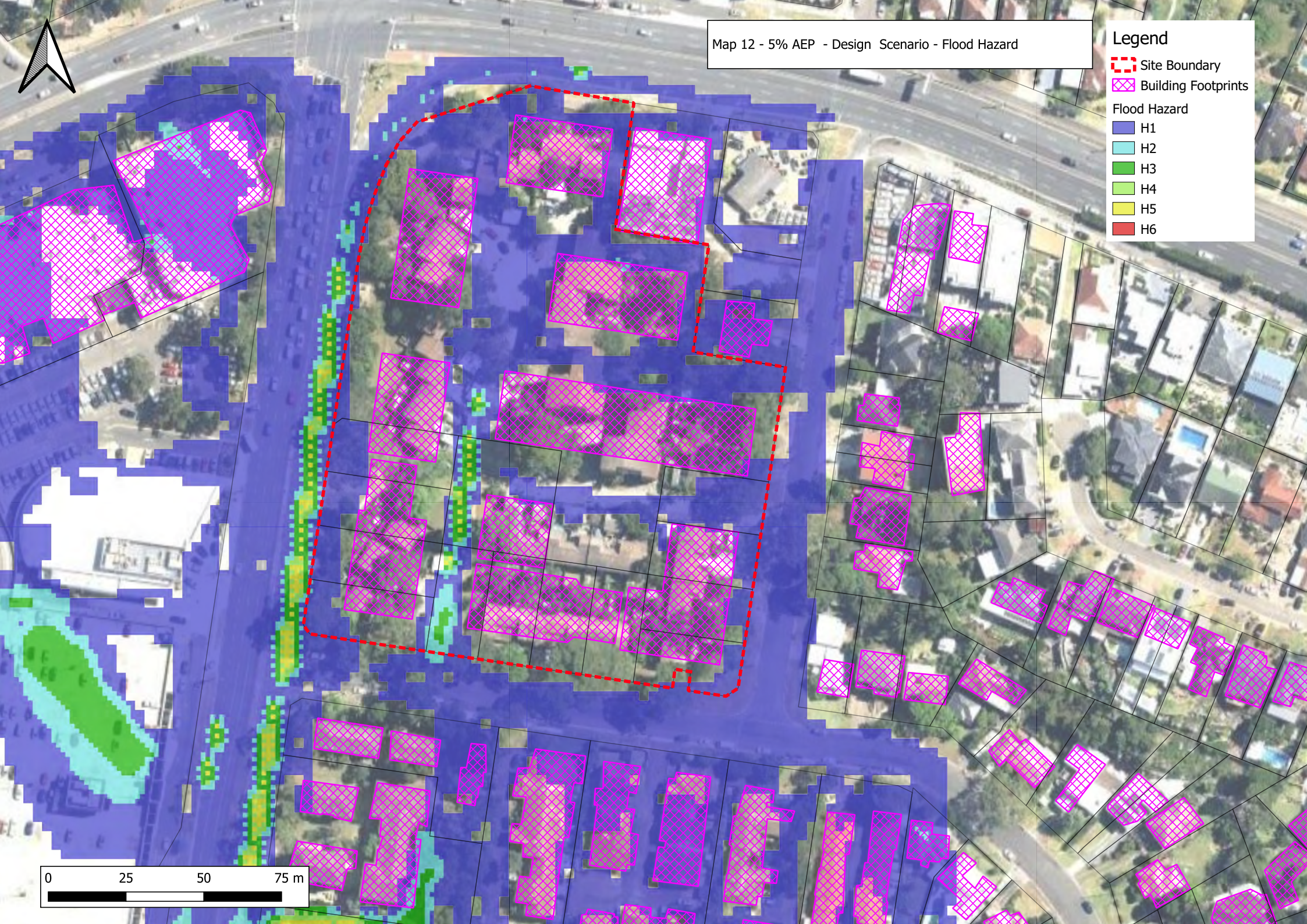

Map 7 - PMF - Existing Scenario - Flood Depth
Legend
Site Boundary
Building Footprints
Flood Level Contours (mAHD)
5m Major Interval
1m Minor Interval
Flood Depth (m)
0 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.50
0.50 - 1.00
1.00 - 1.50
1.50 - 2.00
> 2.00
0
25
50
75 m

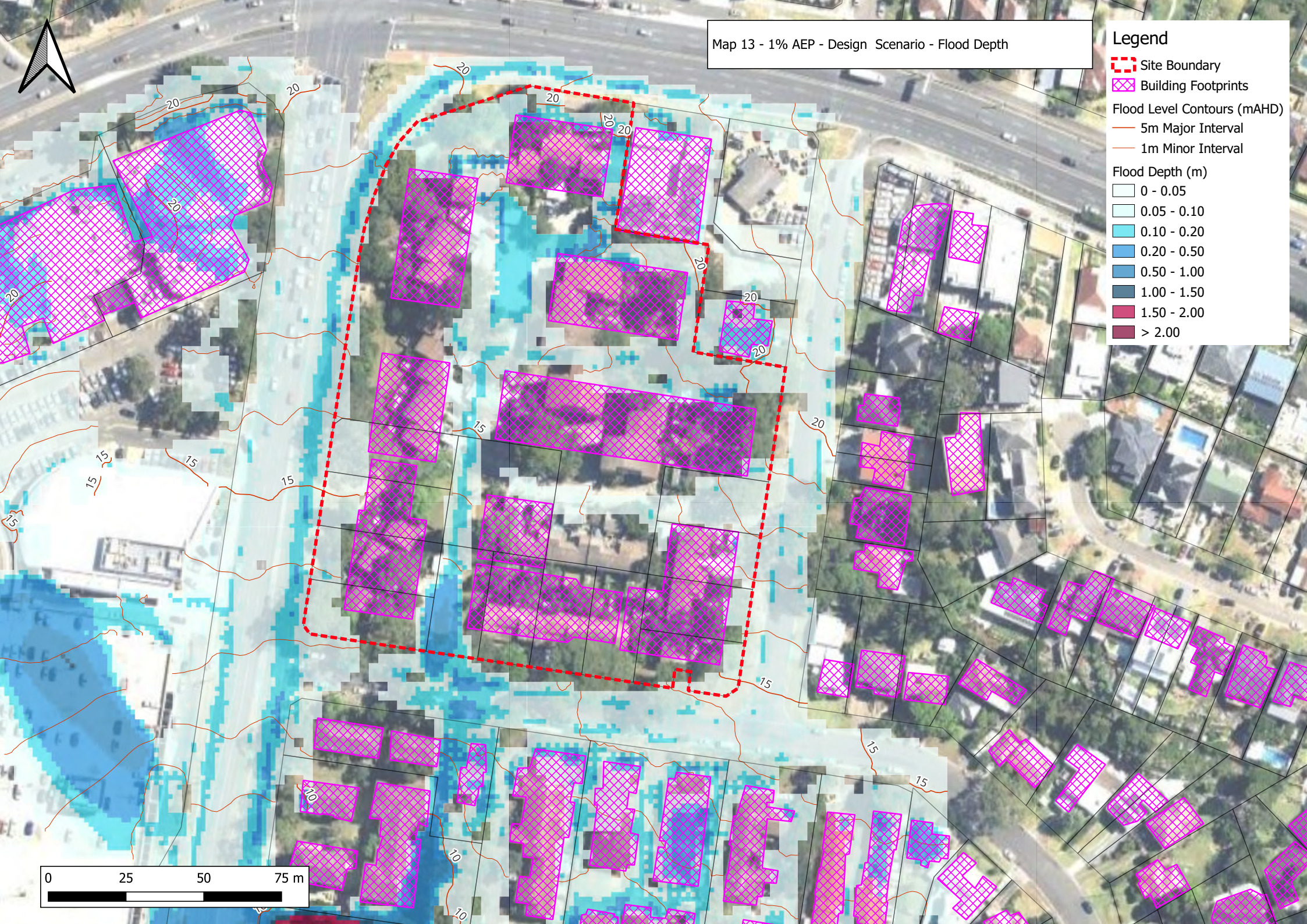

Map 8 - PMF - Existing Scenario - Flood Hazard
Legend
Site Boundary
Building Footprints
Flood Hazard
H1
H2
H3
H4
H5
H6
0
25
50
75 m

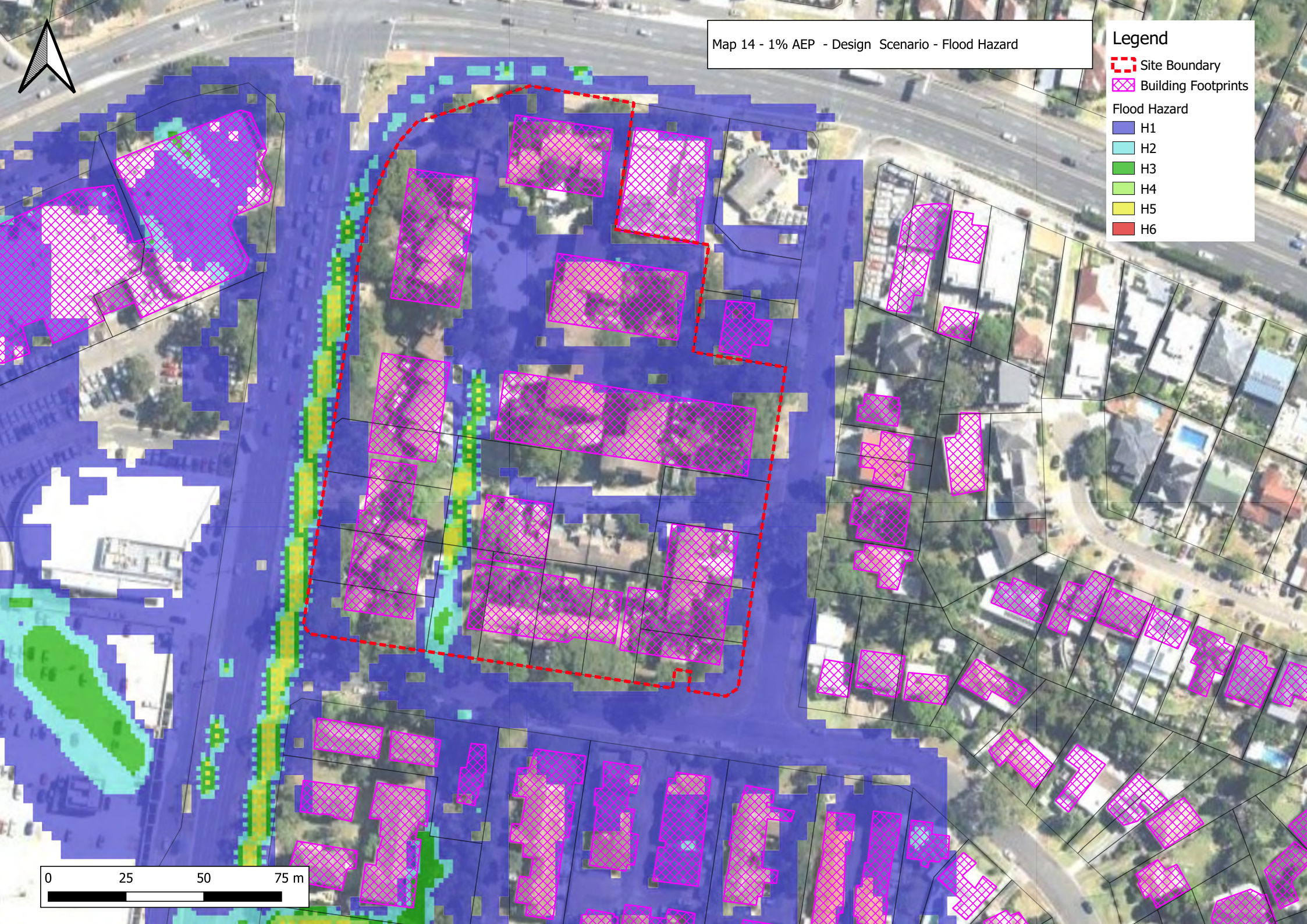

Map 9 - 20% AEP - Design Scenario - Flood Depth
Legend
Site Boundary
Building Footprints
Flood Level Contours (mAHD)
5m Major Interval
1m Minor Interval
Flood Depth (m)
0 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.50
0.50 - 1.00
1.00 - 1.50
1.50 - 2.00
> 2.00
0
25
50
75 m

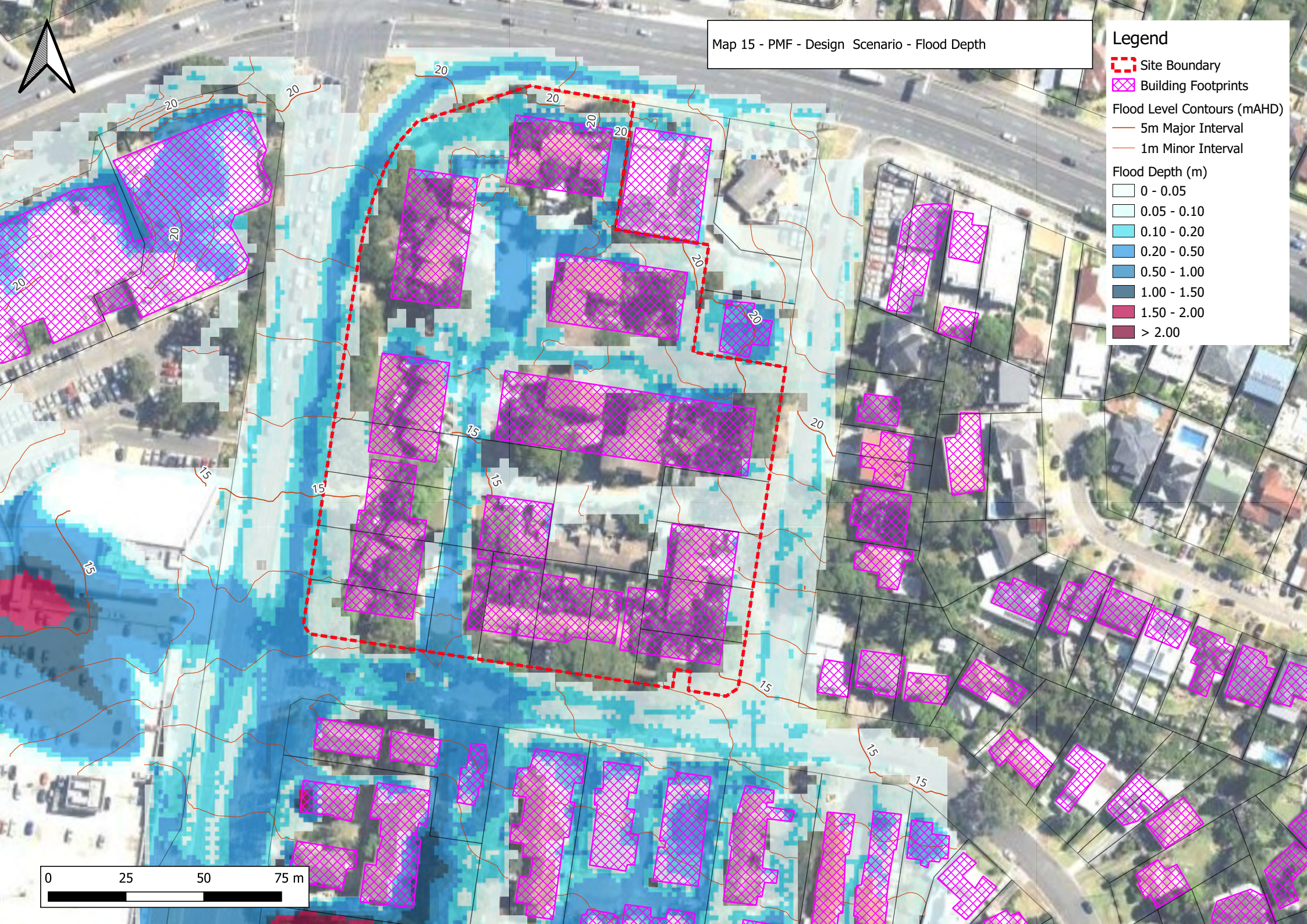

Map 10 - 20% AEP - Design Scenario - Flood Hazard
Legend
Site Boundary
Building Footprints
Flood Hazard
H1
H2
H3
H4
H5
H6
0
25
50
75 m

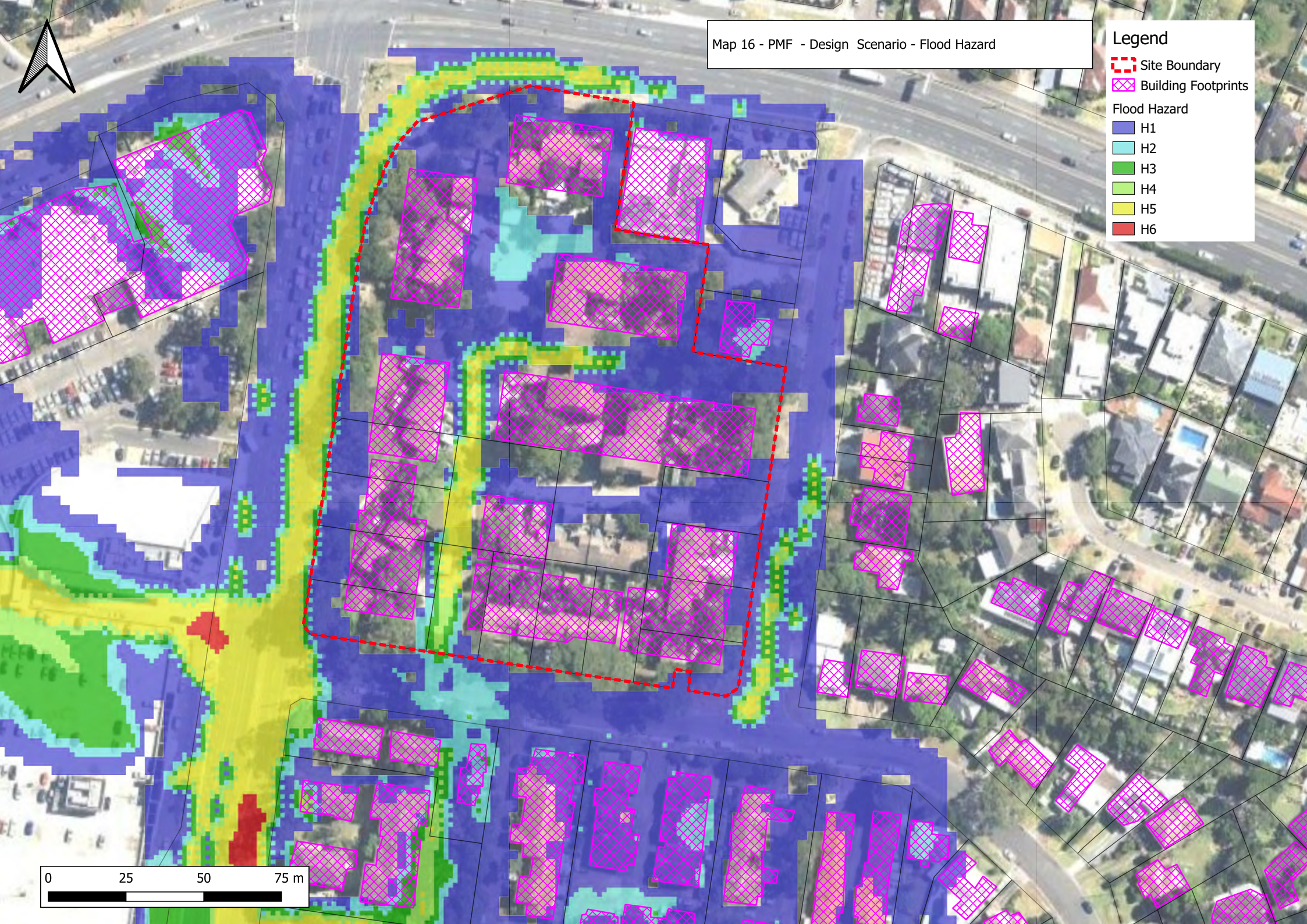

Map 11 - 5% AEP - Design Scenario - Flood Depth
Legend
Site Boundary
Building Footprints
Flood Level Contours (mAHD)
5m Major Interval
1m Minor Interval
Flood Depth (m)
0 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.50
0.50 - 1.00
1.00 - 1.50
1.50 - 2.00
> 2.00
0
25
50
75 m

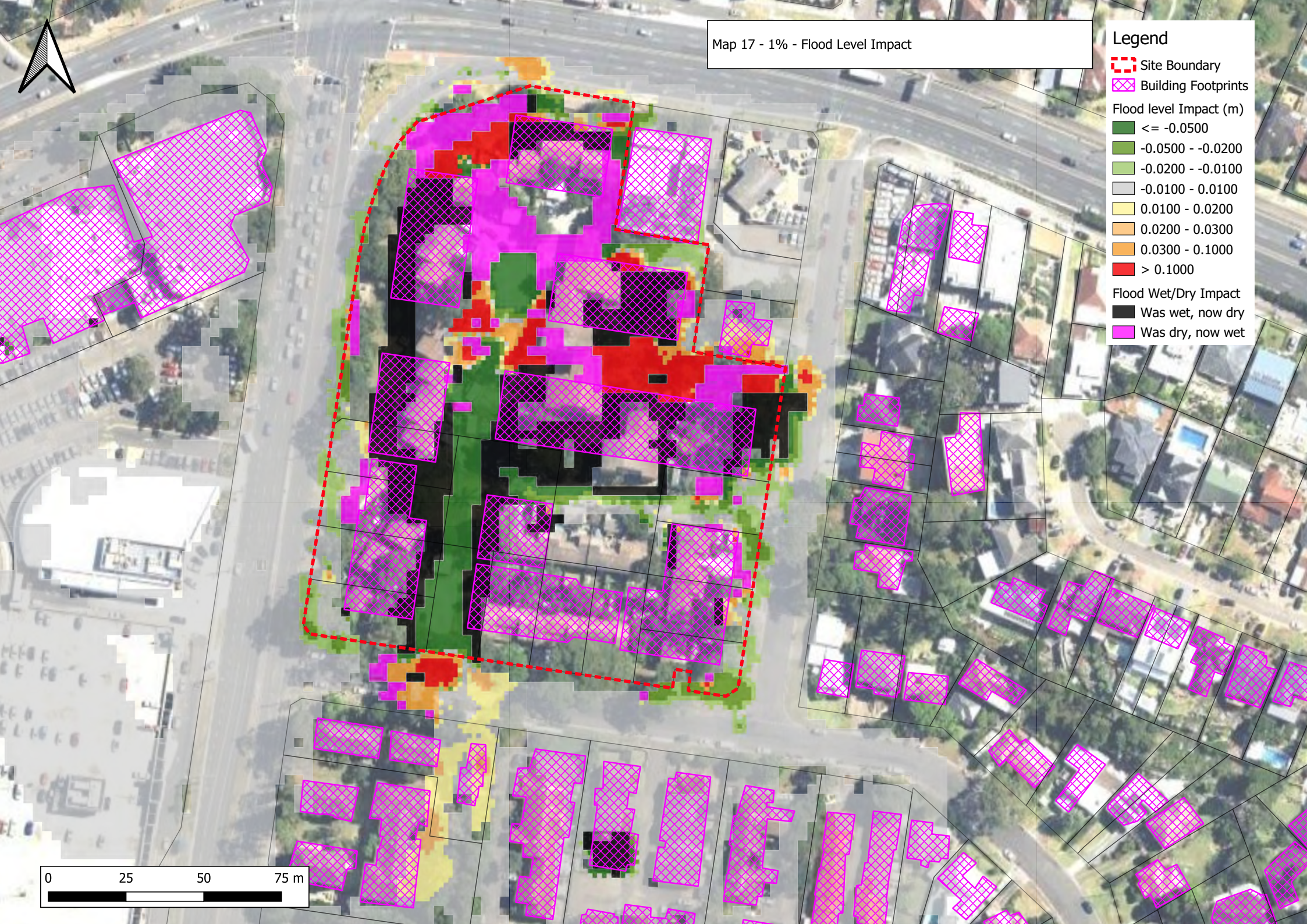

Map 12 - 5% AEP - Design Scenario - Flood Hazard
Legend
Site Boundary
Building Footprints
Flood Hazard
H1
H2
H3
H4
H5
H6
0
25
50
75 m


Map 13 - 1% AEP - Design Scenario - Flood Depth
Legend
Site Boundary
Building Footprints
Flood Level Contours (mAHD)
5m Major Interval
1m Minor Interval
Flood Depth (m)
0 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.50
0.50 - 1.00
1.00 - 1.50
1.50 - 2.00
> 2.00
0
25
50
75 m


Map 14 - 1% AEP - Design Scenario - Flood Hazard
Legend
Site Boundary
Building Footprints
Flood Hazard
H1
H2
H3
H4
H5
H6
0
25
50
75 m

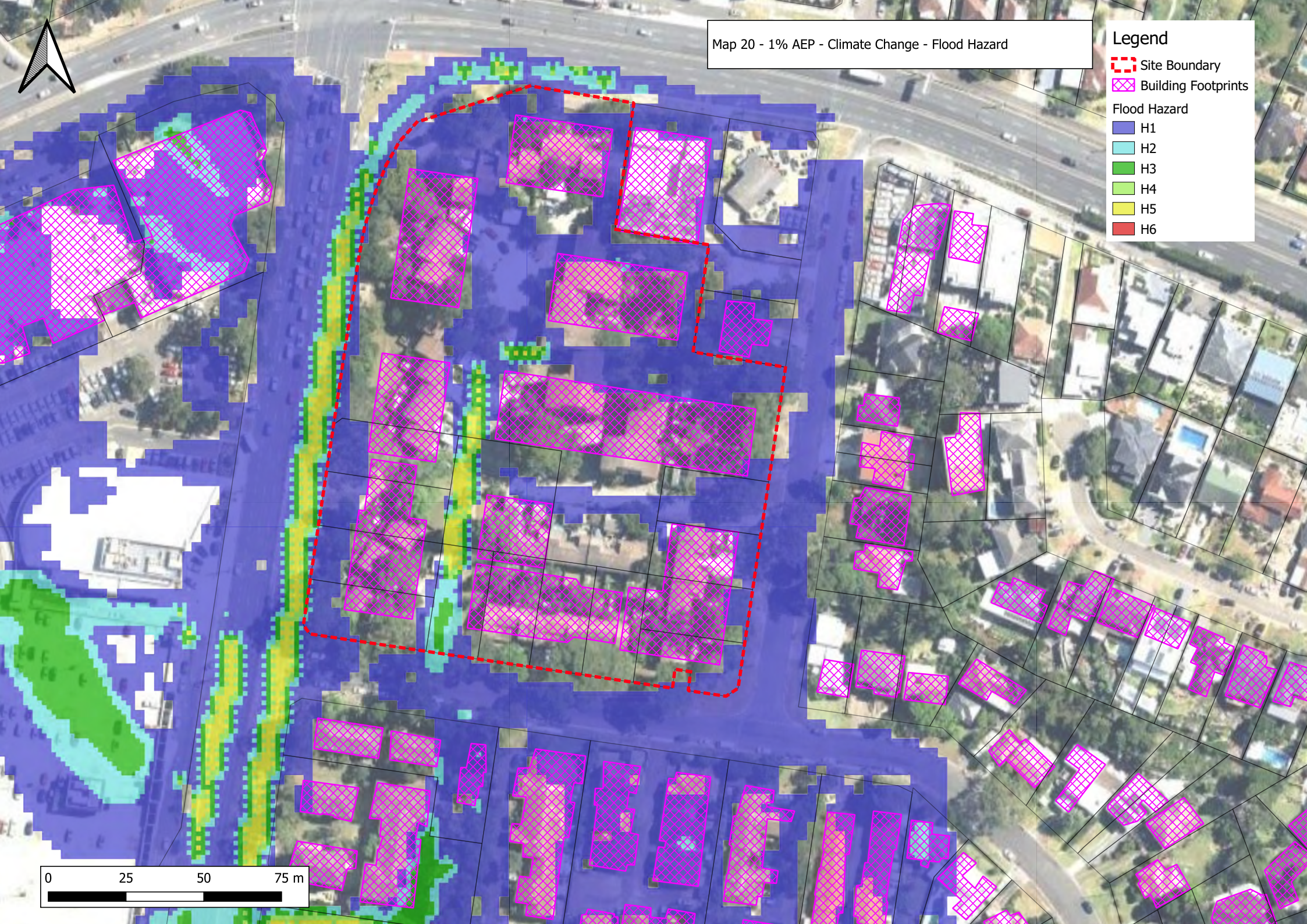

Map 15 - PMF - Design Scenario - Flood Depth
Legend
Site Boundary
Building Footprints
Flood Level Contours (mAHD)
5m Major Interval
1m Minor Interval
Flood Depth (m)
0 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.50
0.50 - 1.00
1.00 - 1.50
1.50 - 2.00
> 2.00
0
25
50
75 m


Map 16 - PMF - Design Scenario - Flood Hazard
Legend
Site Boundary
Building Footprints
Flood Hazard
H1
H2
H3
H4
H5
H6
0
25
50
75 m


Map 17 - 1% - Flood Level Impact
Legend
Site Boundary
Building Footprints
Flood level Impact (m)
<= -0.0500
-0.0500 - -0.0200
-0.0200 - -0.0100
-0.0100 - 0.0100
0.0100 - 0.0200
0.0200 - 0.0300
0.0300 - 0.1000
> 0.1000
Flood Wet/Dry Impact
Was wet, now dry
Was dry, now wet
0
25
50
75 m


Map 18 - 1% AEP - FPL
Legend
Site Boundary
Building Footprints
FPL locations
ID: A
FPL: 17.17
PMF Level: 16.839
ID: B
FPL: 17.182
PMF Level: 16.81
ID: C
FPL: 18.637
PMF Level: 18.177
ID: D
FPL: 19.191
PMF Level: 18.812
ID: E
FPL: 17.478
PMF Level: 16.991
ID: F
FPL: 13.842
PMF Level: 13.364
ID: G
FPL: 13.351
PMF Level: 12.954
ID: H
FPL: 13.593
PMF Level: 13.216
ID: I
FPL: 15.772
PMF Level: 15.388
ID: J
FPL: 16.25
PMF Level: 16.12
ID: K
FPL: 16.62
PMF Level: 16.224
ID: L
FPL: 17.152
PMF Level: 16.809
0
25
50
75 m


Map 19 - 1% AEP - Climate Change - Flood Depth
Legend
Site Boundary
Building Footprints
Flood Level Contours (mAHD)
5m Major Interval
1m Minor Interval
Flood Depth (m)
0 - 0.05
0.05 - 0.10
0.10 - 0.20
0.20 - 0.50
0.50 - 1.00
1.00 - 1.50
1.50 - 2.00
> 2.00
0
25
50
75 m


Map 20 - 1% AEP - Climate Change - Flood Hazard
Legend
Site Boundary
Building Footprints
Flood Hazard
H1
H2
H3
H4
H5
H6
0
25
50
75 m

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