Waterloo South – Flood Impact and Risk Assessment



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Waterloo South Flood Impact and Risk Assessment

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EXECUTIVE SUMMARY

This report has assessed flood behaviour and flood planning controls for the Waterloo South development. The site is affected by overland flow flooding from a small upstream catchment. Flooding at the site and surrounding areas has been investigated previously by catchment-wide Council studies, and two site specific flood investigations.

The project consists of the redevelopment of ten (10) blocks of land in Waterloo to provide high density residential buildings alongside community uses. This Flood Impact and Risk Assessment (FIRA) is part of the site-wide concept State Significant Development Application (SSDA). It assesses the proposed site-wide design, with subsequent assessments to be prepared for individual block SSDAs.

The site lies in the Alexandra Canal catchment in the City of Sydney (CoS) Local Government Area and is affected by flooding in the existing/pre-development case. This flood assessment describes flood behaviour in the vicinity of the site, before assessing the development's compliance with City of Sydney's Interim Floodplain Management Policy, as well as the Local Environment Plan (LEP), and the Planning Secretary's Environmental Assessment Requirements (SEARs). Key features of flooding at the site include:

- Most streets and lots have either negligible or shallow overland flow in the full range of flood events, up to the Probable Maximum and inclusive of climate change. However, Wellington Street and some other areas experience shallow but high velocity runoff that is classified as hazardous in a flood.
- Flood risk at the site is largely concentrated at two sag points. George Street near McEvoy Street experiences flooding, which then forms a shallow overland flowpath into the Cope Street sag point, located on the western boundary of the site. In rare to extreme flood events, the Cope Street sag point experience deep, widespread flooding that affects Cope Street properties as well as some neighbouring streets, depending on the severity of the flood event.
- The overall approach of the civil, landscape and architectural design with regards to flooding is to maintain existing flood behaviour but locate entrances to new buildings above adjacent flood levels. The surrounding area is heavily urbanised and there is no opportunity to significantly modify the flood behaviour. The design proposes to maintain overall road grading and to construct new pit and pipe drainage that will improve stormwater drainage but not significantly change flood behaviour.
- Assessment found that large-scale evacuation offsite is not feasible during a flood; therefore, occupants would adopt a shelter in place strategy. Buildings can be designed to provide refuge areas which in many cases may simply be any internal space within the building. Emergency access provisions will be maintained to manage potential secondary risks that could arise during flooding.

The assessment finds the development can be carried out without impacting existing flood behaviour, and that the proposed building designs can meet the flood planning levels. The development is compliant with both City of Sydney policy requirements and the SEARs. Further FIRAs will assess design features of each building as they become available.

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1. INTRODUCTION

This Flood Impact and Risk Assessment is submitted to the Department of Planning, Housing and Infrastructure (the Department) on behalf of Stockland and NSW Land and Housing Corporation (the Applicant) in support of a concept State Significant Development Application (SSDA) for the redevelopment of the site within the Waterloo Estate (South) Precinct Area, hereby known as "Waterloo South".

In this report reference to "Homes NSW" or "the Applicant" shall also be taken to mean "New South Wales Land and Housing Corporation (LAHC)" who is the registered owner of 93 per cent of land within the Waterloo South Precinct Area. Any reference to "Waterloo South" in this report should be read as the redevelopment of land owned by LAHC and associated public land (such as roads) throughout the Precinct Area.

The concept development is categorised as State Significant Development (SSD) as per Section 26, Schedule 1 of State Environmental Planning Policy Planning Systems 2021 (Planning Systems SEPP) as the project includes housing development carried out by or on behalf of the LAHC, with an estimated development cost (EDC) of more than $30 million.

The concept, in summary, aims to deliver:

- High quality mixed tenure housing in the context of a rapidly transforming area.
- Approximately 3,300 new dwellings, of which a minimum 30% will be social housing, approximately 20% will be affordable housing, and a maximum 50% will be market housing (measured as a percentage of the total residential gross floor area).
- Publicly accessible open space and public realm activation.
- An authentic mixed-use precinct, with housing co-located with non-residential uses, community facilities, essential services, and access to public transport.

The concept SSDA will guide the detailed design of future buildings, open spaces, and the public realm within the Waterloo South site. The concept SSDA seeks development consent for key planning metrics, including maximum building envelopes, building heights, setbacks, vehicular access points and road network, and the distribution of floor area across different land uses and residential tenure types.

The state-assessed rezoning application has also been prepared and submitted concurrently to facilitate determination of the concept SSDA. The state-assessed rezoning application seeks amendments to the Sydney Local Environmental Plan 2012 (SLEP 2012) and the Waterloo Estate (South): Design Guide 2022 (2022 Design Guide) to align with the maximum building envelopes sought under the concept SSDA. Notably no additional gross floor area (GFA) or density is sought under the state-assessed rezoning application than is currently permissible on the site under the SLEP 2012.

1.1 Relevant SEARs and SARP Study Requirements

This Flood Impact and Risk Assessment addresses the following relevant Secretary's Environmental Assessment Requirements (SEARs) set out in Table 1 below, as well as the State Assessed Rezoning Proposal (SARP) requirements in Table 2.

Table 1: SEARs Compliance Table

SEARS Request	Response / Location in Report
Identify the flood planning area and level as set out in the relevant EPI and other supporting documents to determine: • 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 and plans • the site access and egress routes • the potential effects of climate change any relevant provisions of the *NSW Flood Risk Management Manual* and any other relevant guidelines,	The flood planning area is assumed to apply to all lots in the subject site on the basis that City of Sydney is currently updating their FPA, and CoS apply flood planning controls to lots outside of the PMF extent. Access and egress routes are set out in Section 7. The potential effects of climate have been assessed and are set out in Section 3.8
Provide a flood impact and risk assessment (FIRA) that is 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.	A FIRA has been prepared (this document) with regard to guide LU01.
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).	The main risk management measure is ensuring protection of new buildings via Flood Planning Levels (see Section 6.1) and providing emergency access arrangements (see Section 7).

In addition to the SEARs presented above, consideration has been given to the comments received from the City of Sydney and DCCEEW on the request for SEARs, and the response to each comment is given in Section 8 of this report.

Table 2: SARP Compliance Table

Rezoning Study Requirements	Response / Location in Report
1. Statutory Context	
Detail all proposed changes to both the Sydney LEP 2012 and the Waterloo Estate (South) Design Guide dated November 2022	Proposed changes have been outlined in the Public Domain Approach and Design Guidelines. The relevant comparison maps are provided in the Public Domain and Landscape report, illustrating the proposed amendments to the Sydney LEP 2012 mapping and the Design Guide mapping. It is noted that most maps/diagrams, and the changes shown, have no bearing on flooding or flood risk

	management at the site. The overall layout change is shown in Section 1.5 of this report.
2. Relevant Issues	
Technical analysis is required to identify any additional environmental impacts resulting from the proposed new planning controls. It is not intended to duplicate the requirements of the SEARs. Issues including, but not limited to the following: - Environmental -Flooding	Technical analysis of the proposed layout and planning controls has not identified any additional environmental impacts related to flooding. Management of overland flow through the site, which broadly consists of maintain the existing roads and other areas that convey flow, and ensuring new buildings are suitably protected from flooding, is unchanged by the proposed new planning controls. Technical analysis of the structure plan is included in Section 5 (flood impact assessment), Section 6 (flood planning levels and policy requirements), and Section 7 (evacuation strategy).
In the case where there are any additional environmental impacts, technical studies will need to demonstrate a clear comparison between the impacts of the existing approved controls and the new proposed controls.	As described, additional environmental impacts were not identified.
Provide details of consultation undertaken with Government agencies, council or other authorities, and community consultation that is to be undertaken during the exhibition.	With regard to flooding, City of Sydney and NSW DCCEEW CPHR have provided input via the SEARs process. They will then review this report, as will the NSW SES and the local community, as part of the exhibition process.

1.2 The Site

The Waterloo South Precinct Area comprises approximately 123,149m^2 across 10 street blocks in the City of Sydney Local Government Area (LGA), generally bounded by Cope, Raglan, George, Wellington, Gibson, Kellick, Pitt and McEvoy streets. The Waterloo South site area, excluding any privately owned properties within the Waterloo South Precinct Area, comprises approximately 114,822m^2, or just over 93 per cent of the land within the Precinct Area. The legal description of Waterloo South Precinct Area is detailed in Table 3.

Table 3: Legal Description of Waterloo South

Address	Lot/DP
Lots owned by NSW Land and Housing Corporation (land is subject to both the rezoning and the concept SSDA)	
209-219 Cope Street, Waterloo	Lot 1 DP 217386, Lot 1 DP 225159
238-246 George Street, Waterloo	Lot 1 DP 225159
229-231 Cope Street Waterloo	Lot 3 DP 10721
6 John Street, Waterloo	Lot 1 DP 533762
97-109 Cooper Street, Waterloo	Lot A DP 105916, Lot B DP 105916, Lot C DP 105916, Lot 14 DP 10721,
248-254 George Street, Waterloo	Lot 2 DP 533678
232 Pitt Street, Waterloo	Lot 11 DP 635663, Lot 10 DP 635663
74-76 Wellington Street, Waterloo	Lot 1 DP 224728
331-337 George Street, Waterloo	Lot 3 DP 533680

247-251 Cope Street, Waterloo	Lot 1 DP 533679
339-341 George Street, Waterloo	Lot 1 DP 77168
250 Pitt Street, Waterloo	Lot 313 DP 606576
Cooper Street, Waterloo	Lot 3 DP 217386
Lots owned by others (land that does not form a part of the concept SSDA)	
221-223 Cope Street, Waterloo	Lot 6 DP 10721, Lot 7 DP 10721, Lot 9 DP 10721, Lot 8 DP 1147179
225-227 Cope Street, Waterloo	Lot 5 DP 10721, Lot 4 DP 10721
233 Cope Street, Waterloo	Lot 12 DP 1099410, Lots 1-41 SP 79210
116 Wellington Street, Waterloo	Lot 10 DP 10721, Lot 11 DP 10721
111 Cooper Street, Waterloo	Lot 15 DP 10721
291 George Street, Waterloo	Lot 10 DP 1238631, Lots 1-20 SP 96906
110 Wellington Street, Waterloo	Lot 101 DP 1044801, Lots 1-58 SP 69476
336 George Street, Waterloo	Lot 3 DP 10686
213-215 Cope Street, Waterloo	Lot 2 DP 217386

1.2.1 Site and Surrounding Context

The suburb of Waterloo is located with the City of Sydney Local Government Area (LGA) and is located 3km south of Sydney CBD. The site is part of the broader Waterloo Estate, which comprises the northern, central, and southern precincts and accommodates a significant community residing in social housing.

The Waterloo South Precinct Area is predominantly owned by LAHC, however, as outlined in Table 3, the site, the subject of this report, excludes several privately owned lots located within the boundary of the broader Waterloo South precinct outlined in Image 2. The privately owned lots are currently used for residential, office, light industrial, and infrastructure uses. The LAHC owned sites are currently used almost exclusively for the provision of social housing, with ancillary offices and Community Uses). Overall, Waterloo South currently contains a total of 750 social housing dwellings and 120 private dwellings.

As shown in Image 1, surrounding suburbs include Redfern to the north, Green Square to the south, Alexandria to the west and Zetland to the east. This broader area has been subject to significant change over the last 10 years with projects such as South Eveleigh, Redfern North Eveleigh Precinct Renewal, Waterloo Metro Quarter and over station development (OSD) all contributing to the changing character of the area.

These broader renewal projects are supported by proximity to a range of public transport services, including Redfern Station, Green Square Station, and Waterloo Metro Station, all of which are within walking distance of Waterloo South.



Image 1: Aerial view of the Waterloo Estate and the Waterloo South precinct

Source: Six Maps, modified by Beam Planning



Image 2: Waterloo South Project Area

Source: SJB

1.3 Project Vision and Intended Outcomes

The vision for the site is to create a unique and vibrant mixed-tenure housing precinct that supports the needs of the community and delivers much needed housing in response to National and State Government priorities. The Vision is:

To create a new and unique urban village on the Project Land (Gadigal Land) which: delivers new homes, community places and green spaces with diverse housing choice and amenity; prioritises the health and wellbeing of residents; and offers an authentic sense of place and mixed and more sustainable local and mixed communities.

The proposed redevelopment seeks to respond to this vision by creating a unique and vibrant neighbourhood that can deliver significant social benefits to residents, visitors, and workers in the Waterloo area and broader City of Sydney LGA. The co-location of community uses with housing and employment will ensure the redevelopment is an integrated, accessible and connected precinct that supports the social needs of community.

1.4 Proposed Concept SSDA

The concept SSDA seeks concept approval in accordance with section 4.22 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the comprehensive redevelopment of the Waterloo South site. The concept proposal, if approved, will guide the detailed design of future buildings, public open spaces, and the public realm within Waterloo South. It will seek concept development consent for key planning metrics for the precinct as generally described in Table 4 (indicative figures).

Table 4: Key development metrics

Descriptor	Project Details
Project Area	• Waterloo South has a developable site area of 114,822sqm / 11.5ha • The broader Waterloo South Precinct Area, which includes all LAHC owned and privately owned properties and roads within the precinct, has a site area of 123,149sqm / 12.3ha
Project Description	• Maximum building envelopes, including maximum building heights, street-wall heights and setbacks. • Distribution of gross floor area (GFA) across the Waterloo South development blocks. • Indicative allocation of floor space between social, affordable and market housing, as well as non-residential and community uses across the Waterloo South Precinct Area. • Loading, vehicular, pedestrian, and active transport access arrangements. • Public domain upgrades and new public domain and publicly accessible areas. • Indicative subdivision plan, staging plan and delivery sequencing for development. • Approval of the following management plans and strategies to inform future stages of the development: - Updated Design Excellence Strategy - Design with Country Strategy - Preliminary Public Art Strategy - Contamination Strategy

	- Flood Management Strategy - Stormwater Management and Drainage Strategy - ESD Strategy - Strategies for utilities and service provision including service infrastructure lead-in enabling works - Tree Retention Strategy
Land Uses	Residential • Social housing: no less than 30% of residential GFA • Affordable housing: ~20% of residential GFA (balance between the delivery of minimum 30% social housing and the maximum 50% market housing) • Market housing: no greater than 50% of residential GFA Non-residential • A total of 15,000m2 of GFA, of which at least 5,000m2 of GFA is to be delivered as 'Community Uses' (which can include childcare, health, education or community facilities).
Gross Floor Area	Up to 282,485m^2
Building Heights	Between 2 and 33 storeys
Car Parking	Up to 1,500 spaces (across all land uses), excluding on-street car parking spaces
Staging/ Phasing	It is expected that the redevelopment will occur in seven (7) stages (inclusive of the delivery of the large park on Block 1), however this staging remains indicative.

1.5 Amendments to the Waterloo Estate (South) Design Guide 2022

Amendments are proposed to the 2022 Design Guide to ensure alignment with the planning framework under the Sydney LEP 2012 and to reflect the proposed concept SSDA. A comparison between the 2022 Design Guide Urban Strategy or 'structure plan' for the renewal of Waterloo South and the proposed amendment to the Design Guide structure plan is provided in the following figure.



Image 3: Comparison between 2022 Structure Plan (left) and proposed 2026 Structure Plan (right)

Source: Design Report prepared by SJB

The proposed amendments arise from urban design analysis, stakeholder engagement and detailed feasibility testing undertaken since the Design Guide was finalised in 2022. This work has identified a number of limitations within the 2022 Design Guide that compromise amenity outcomes, limit the delivery of social and affordable housing, and constrain development feasibility. In addition, there is a demonstrated misalignment between the 2022 Design Guide building envelopes and the statutory height and floor space controls under the Sydney LEP 2012, creating uncertainty in interpretation and future application.

Collectively, the proposed amendments:

- Respond to the need to align the Design Guide building envelopes with amended LEP height and floor space controls;
- Enhance the public domain, ground-level amenity, and environmental performance;
- Accommodate an updated tenure mix and maximise the delivery of social and affordable housing within the permissible floor space;
- Embed a strengthened approach to Designing with Country informed by engagement with the local Aboriginal community; and
- Improve development efficiency and feasibility through supporting more standardised residential typologies.

The proposed Design Guide updates include amendments to building envelopes, residential typologies, street wall heights, building layouts, and communal open space configuration to improve solar access, ventilation, pedestrian comfort, and opportunities for tree retention. The amendments also support a more equitable distribution of amenity across housing tenures and reduce unnecessary complexity in future delivery of the precinct created by the inconsistencies within the existing planning framework.

1.6 Flooding Overview of Waterloo South Site

The area is located in the Alexandra Canal catchment area in the City of Sydney (CoS) Local Government Area (LGA). Development of the site is required to be in accordance with CoS flood planning controls as well as state government policies including the NSW Flood Risk Management Manual. Pre-development flooding at the site was previously assessed by City of Sydney as part of catchment-wide studies, as well as site-specific studies by AECOM in 2020 (Waterloo South Flooding and Stormwater Study) and GHD in 2021 (Waterloo Estate (South) Planning Proposal Flooding Stormwater Climate Change).

1.7 Report Abbreviations and Terminology

The report contains the following flood-related terminology:

- AEP: Annual Exceedance Probability, which refers to the probability of a flood
- PMF: Probable Maximum Flood, which is the largest flood that can theoretically occur
- ARR: Australian Rainfall and Runoff, the national technical guideline for flood estimation
- FPL: Flood Planning Level, the minimum floor level set for new development by City of Sydney
- Shelter-in-place: a response strategy to flooding whereby building occupants shelter in the building until flooding passes

2. SITE DESCRIPTION

The subject site consists of approximately ten urban blocks located in the western portion of Waterloo. The site is bound by Cope Street to the west, McEvoy Street to the south, Pitt Street and Gibson Street to the east, and Wellington Street to the north. The site slopes down from east to west with elevations ranging from 42 mAHD near Kellick Street to 15 mAHD along the western boundary of the site on Cope Street. The western half of the site is relatively flat with elevations of around 15 to 18 mAHD.

The site is located near the centre of the Alexandra Canal catchment. Flooding in the catchment occurs when the piped stormwater capacity is exceeded and runoff from the suburbs of Chippendale, Zetland, Redfern, Waterloo, Alexandria and Kensington drains to the south and west, before being drained to the Cooks River by Alexandra Canal. The catchment is fully urbanised and flooding includes numerous overland flowpaths, and topographic depressions on roads and property where runoff accumulates. A new large-scale stormwater drain was installed in recent years to alleviate flooding in the Green Square area.

In the vicinity of the site, flooding occurs as shallow overland flow generally moving east to west towards Cope Street. Flood depths are shallow on the steeper east half of the site, due to the topography and small catchment area. On the west half of the site, runoff collects at two topographic depressions, at Wellington/Cope Street and also at George Street near McEvoy Street. An overview of the flooding mechanisms is shown in Image 4while detailed design flood information is presented in figures later in this report (see the following section for additional details).

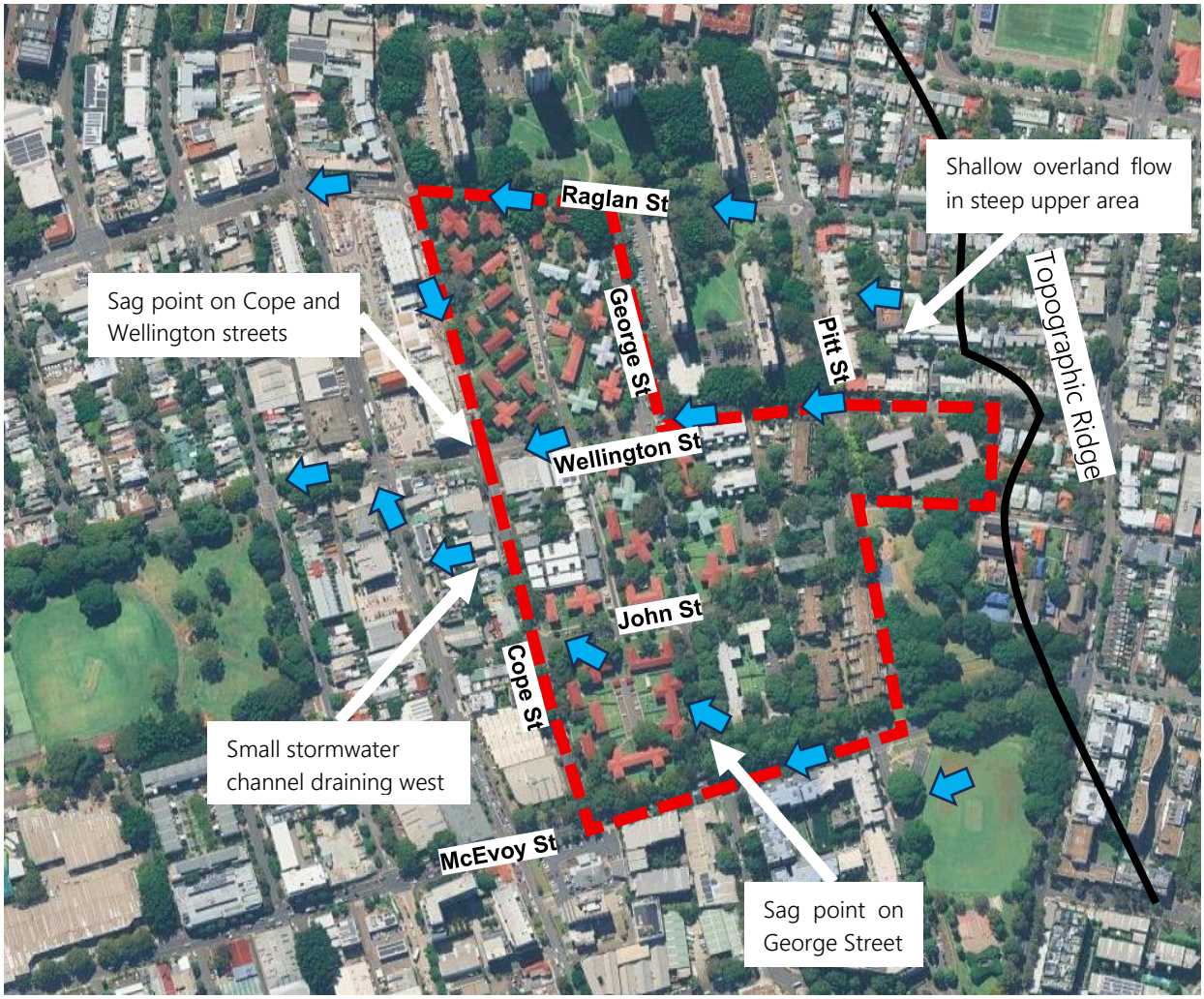


Image 4: Overview of site catchment, overland flow direction, and two sag points

The site has a stormwater network of pits and pipes that drains flow to the west and eventually to Alexandra Canal. The pipe network is shown on Figure A01 (figures are located at rear of report) and the main features of the network are:

- Drainage running west on Wellington Street, up to 0.9 m diameter pipe size
- Drainage running west on Raglan Street, up to 0.45 m diameter pipe size
- Multiple drainage lines on Cope Street, all draining to the small open channel flowing west, with pipes of various sizes.
- The George Street low spot is drained by multiple pipes connecting to a 0.3 m diameter pipe running south from McEvoy Street

The pits and pipes have limited function during a 1% AEP design flood event, when the majority of runoff flows overland. The most recent Council study that assessed drainage capacity (Alexandra Canal Catchment Flood Study Model Update ARR2019 Hydrology, 2020) found that virtually all pipes within the site are full (i.e. at capacity) in a 0.5 EY event (roughly equivalent to a 50% AEP event).

3. FLOOD BEHAVIOUR – EXISTING CASE

3.1Flood Model and Data Sources

Information on flooding at the site has been sourced from the most recent Council flood model, which was subsequently updated by GRC Hydro to include site survey data and recent developments. The model was originally setup as part of the Alexandra Canal Flood Study (2010) and has undergone multiple updates since. The latest update, completed in 2023 by City of Sydney, to include various developments in the wider catchment ("Alexandra Canal Flood Model Update" WMAwater for City of Sydney). As this update did not include new mapping, the 2020 flood maps were also referenced, noting that results remained largely unchanged between 2020 and 2023.

Updates to the model's existing case included site survey integration and the addition of the recently built Waterloo metro station. Image 5 below shows the new model layers for the metro works, namely regrading of Cope Street on the western edge of the subject site, and slightly modified pit and pipe drainage. Testing of the pre- and post-metro works showed that these changes do not materially change flood behaviour. The over-station development was no included in the model update on the basis that it is located in the footprint of a 'building' in the model that is not flooded, and therefore won't impact on flood behaviour. In the 1% AEP there were some localised decreases in flood level, of up to 0.01 m, while in the PMF there was some localised increase and decrease of less than 0.01 m change.



Image 5 Waterloo Metro Updates

3.2 Design Flood Depths and Levels

The updated TUFLOW model was used to produce design flood depths and levels for the subject site, for the existing (pre-development) case. These are shown in Figures A01 to A06 for the design events of 20% AEP, 5% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and Probable Maximum Flood (PMF). The figures also show proposed case modelling, for side-by-side comparison, which is further detailed in Section 5.

The figures describe the specific depths of overland flow that occur along the flowpaths and two sag points previously set out in Image 4. In most flood events, there is shallow flooding at the site, except at the two sag points located on George Street and Cope Street. Depths and levels in the deepest part of the two sag points are shown below in Table 5. The table shows that while depths of 0.6 m occur on George Street in a common flood, they are 1.0 m or less in an extreme flood, and so protection against flooding is achievable. For Cope Street, there is more scaling between flood events, with the PMF level being around 0.9 m higher than the 1% AEP, which itself is 0.6 m above the 20% AEP.

Table 5: Design depths and levels at site sag points (taken at deepest point)

Design Event	George Street		Cope Street	
	Depth (m)	Level (mAHD)	Depth (m)	Level (mAHD)
20% AEP	0.6	16.7	0.7	15.1
5% AEP	0.7	16.8	1.1	15.5
1% AEP	0.8	16.8	1.3	15.7
0.5% AEP	0.8	16.8	1.3	15.7
0.2% AEP	0.9	16.9	1.4	15.8
PMF	1.0	17.0	2.2	16.6

Outside of the two sag points, flowpaths are generally shallow, as follows:

- On Wellington Street, there is sheet flow in most events on the very steep eastern portion of the road, with depths generally of 0.05 m or less. Around George St, depths increase to around 0.1-0.3 m on the road in common events, 0.3-0.4 m in the 1% AEP to 0.2% AEP. In the PMF, there is 0.1-0.3 m depth along most of the road section (and deeper in the sag to the west).
- George Street has the sag point described above, and separately has overland flow from Wellington Street, of around 0.2-0.3 m in the kerb.
- Cooper Street is mainly affected by the Cope Street sag point flooding, but also can receive overland flow from Wellington Street in smaller floods.
- John Street is mainly affected by the Cope Street sag point flooding. In addition, it receives flow from the George Street sag point when the water spills out of the sag and through property on George Street. This flowpath is around 0.1 m or less in depth, in a 20% AEP, and expands to a much wider flow of around 0.2 m depth in the 1% AEP.
- Like Wellington Street, McEvoy has very shallow sheet flow on the steeper portion, in most floods, and then greater depths near George Street. McEvoy is generally above the site and has minimal catchment, which means there is only 0.1-0.3 m depth, at most, in the PMF.
- Mead Street, Reeve St and West Street are largely not flooded.

3.3 Design Flow Velocities

Peak flow velocities for the same six design events are presented in Figures A07 to A12, for both the existing (pre-development) and proposed (post-development) cases. Flow velocities on the site are higher in areas of shallow, steep flow, while flatter areas have lower velocities. In a relatively small 20% AEP flood, Wellington Street has velocities of 1-2 m/s throughout the site, as well as some areas of >2 m/s in the steeper section of road. Velocities are similar in the 1% AEP with more areas of >2 m/s.

3.4 Flood Hazard

Flood hazard is defined as the threat that flooding poses to human activity. This study adopts hazard categories consistent with the Australian Emergency Management Handbook 7, which considers threats relative to both person type (children, adults) and activity (pedestrian movement, vehicle use, and building occupancy). These flood hazard categories are presented in Image 6.

The chart divides a flood event into six categories of hazard,:

- H1 – Generally safe for people, vehicles and buildings (corresponding to very shallow and slow flow);
- H2 – Unsafe for small vehicles
- H3 – Unsafe for vehicles, children and the elderly;
- H4 – Unsafe for people and vehicles;
- H5 – Unsafe for people and vehicles. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure; and
- H6 – Unsafe for people and vehicles. All building types considered vulnerable to failure (corresponds to very deep and fast flow).

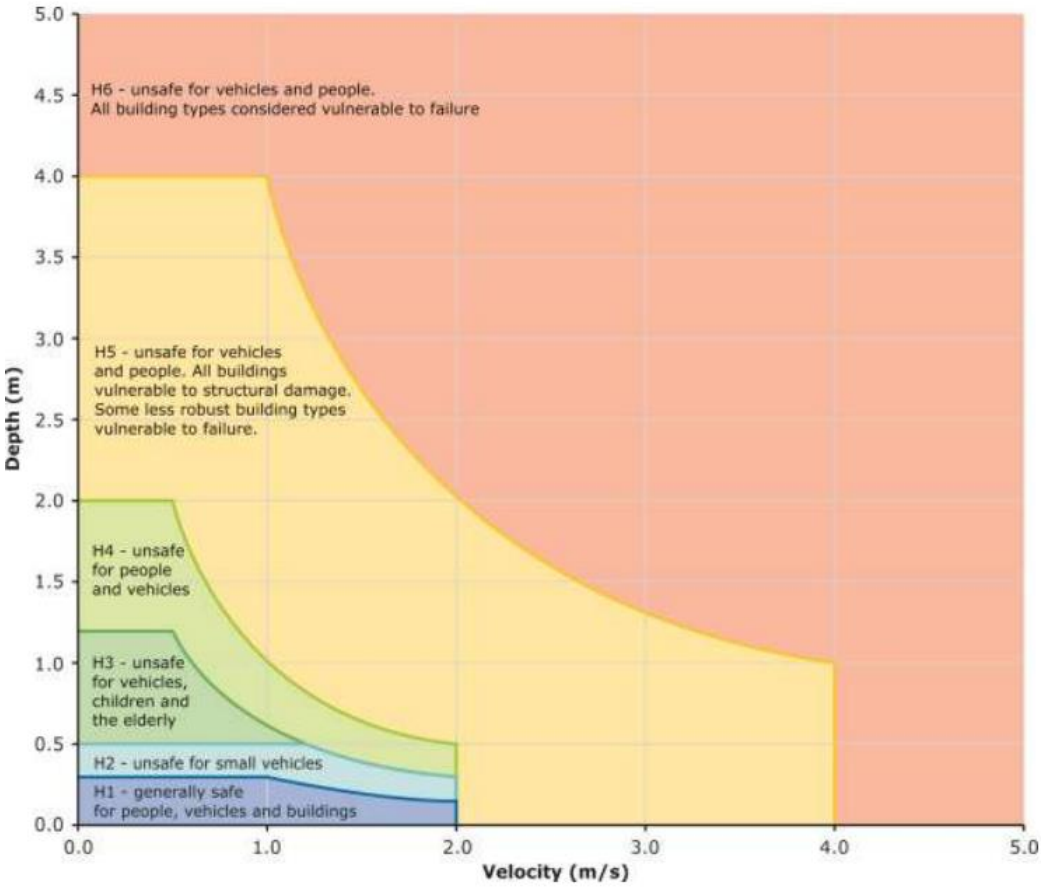


Image 6: Flood Hazard Categories (Australian Emergency Management Handbook 7)

Flood hazard mapping for the site is shown on Figures A13 to A18 for the six design flood events. The mapping shows that in most flood events, the majority of the site experiences low hazard conditions, generally within categories H1 to H3. Key observations from the mapping include:

- At the George Street sag point, there is H1 to H3 hazard in all events from the 20% AEP up to the PMF. This is because the depth and velocity in this area does not increase to > 1.0 m depth, or > 1 m/s velocity.
- The Cope Street sag point has H1 to H3 hazard in events up to the 1% AEP. In a 0.5% or 0.2% AEP flood there is some H4 hazard on the road due to the depth of >1.2 m. In the PMF there is a large area of H4 and H5 hazard.
- On Wellington Street, there is high hazard in the kerb of H5, in a 20% AEP flood and rarer. This is due to velocities of >2 m/s, which is high hazard at any depth. With that said, there is still H1 over a large portion of the roadway (but not the southern kerb) in a 0.2% AEP event. In a PMF, there are large areas of H5 hazard along Wellington Street.
- Besides the roadways, the main area of property flooding is east of the Cope Street sag point, where properties have H3 hazard in a 1% AEP

Hazardous road flooding is typical of urban areas during rare flood events and in extreme events most roads would be expected to have hazardous depth and velocity of flow. Walking or driving is generally hazardous in any very heavy rainfall event, as hazardous runoff on the road is common, visibility is very low, and fallen branches and other debris is common. Under the

Major/Minor drainage design paradigm adopted in Australia since the late 1980s (ARR, 1987), flows exceeding pipe capacity during rare events are generally directed along roadways as the preferred path for excess runoff.

3.5 Flood Behaviour – Flow Rates, Rate of Rise and Duration

Flooding in the area is predominantly overland flow flooding with rapid rate of rise and short duration. Catchment areas are small and the critical duration for overland flowpaths will often be one hour or less. This means flooding can occur almost immediately after heavy rainfall begins, often within minutes.

Flow hydrographs have been extracted from the area's main overland flowpaths with locations shown in Image 7 and the corresponding hydrographs presented in Image 8 to Image 13.



Image 7: Flow Rate Reporting Locations (proposed case PMF flooding shown)

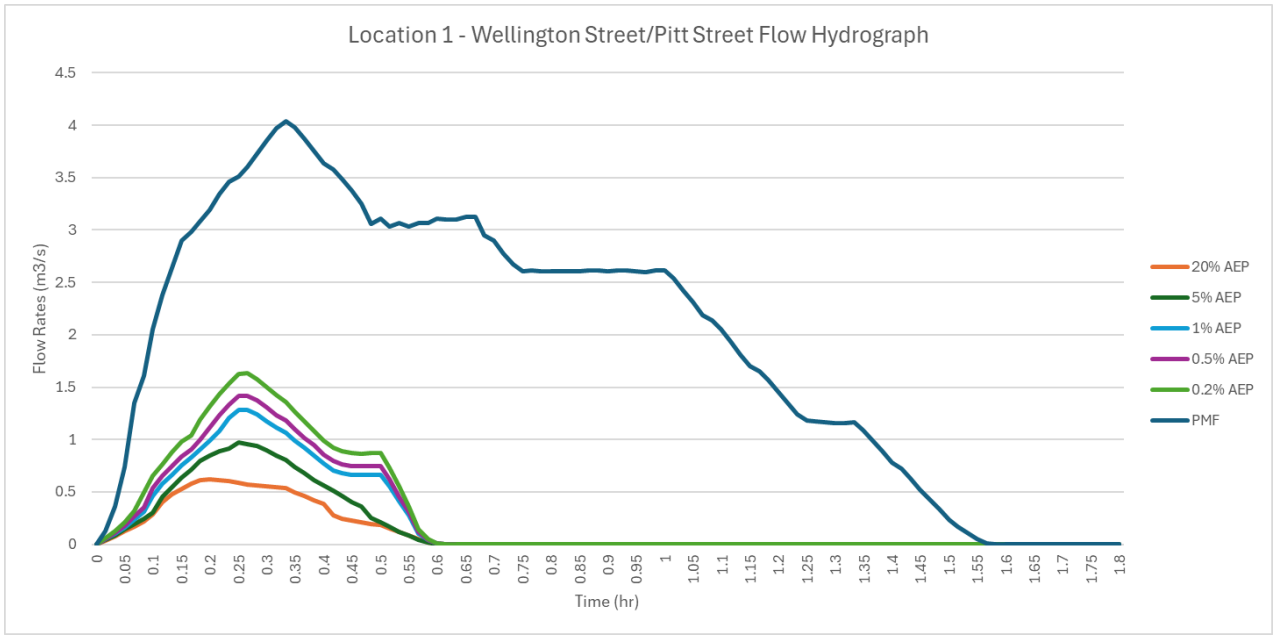


Image 8: Location 1 Flow Hydrograph

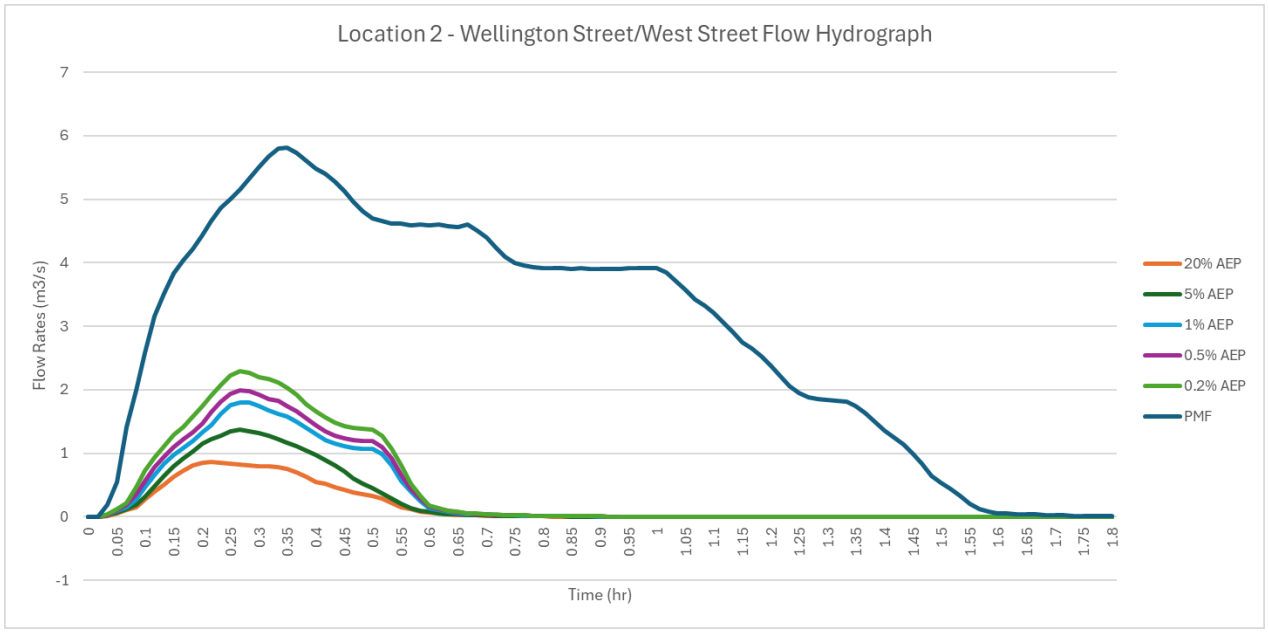


Image 9: Location 2 Flow Hydrograph

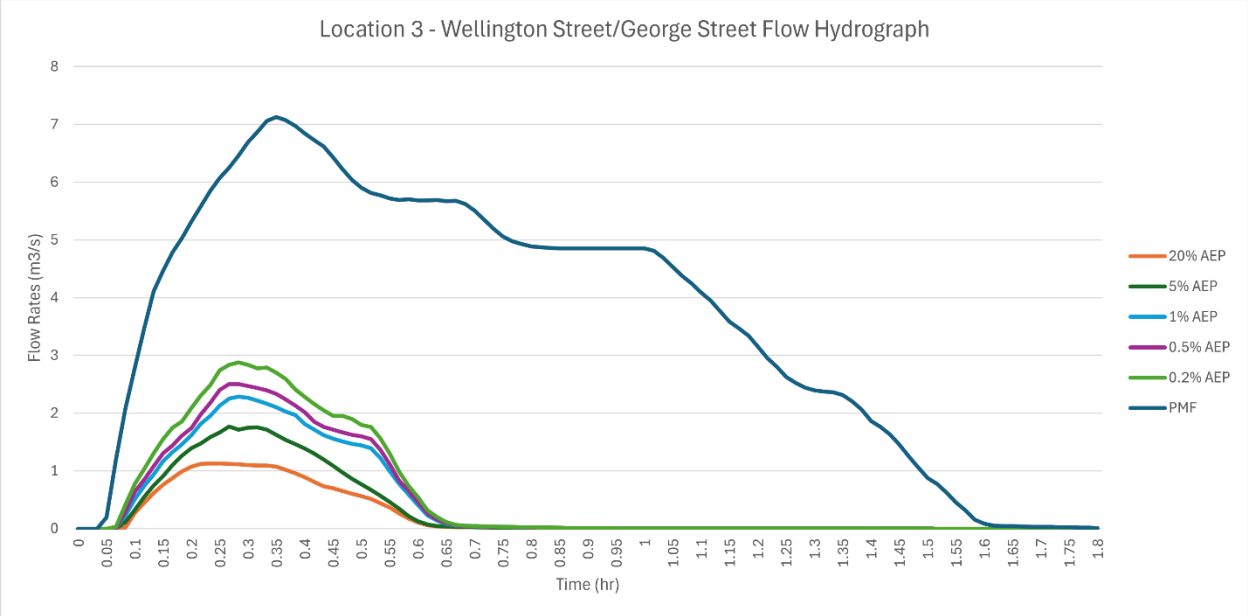


Image 10: Location 3 Flow Hydrograph

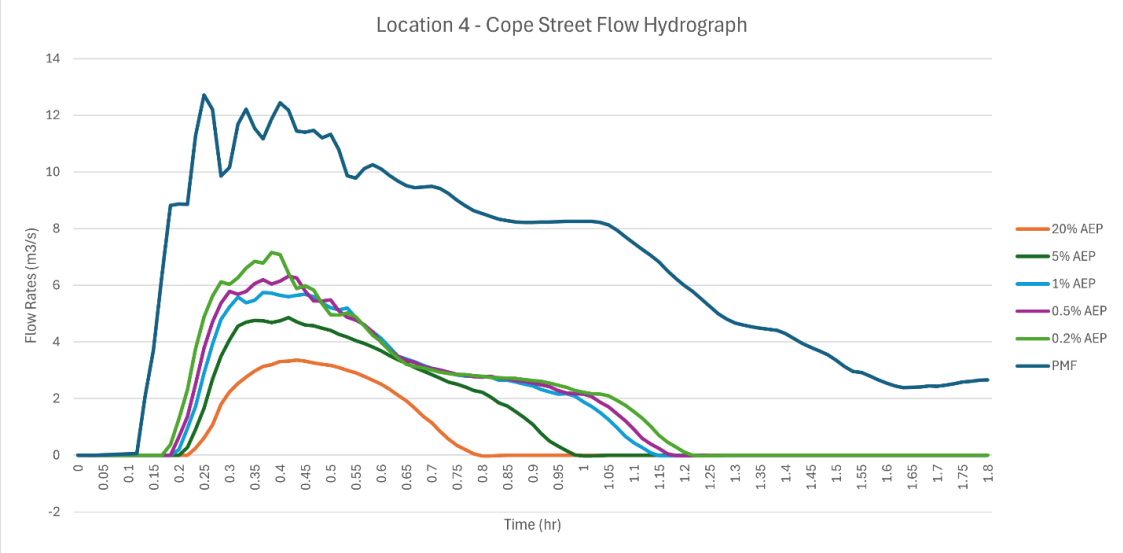


Image 11: Location 4 Flow Hydrograph

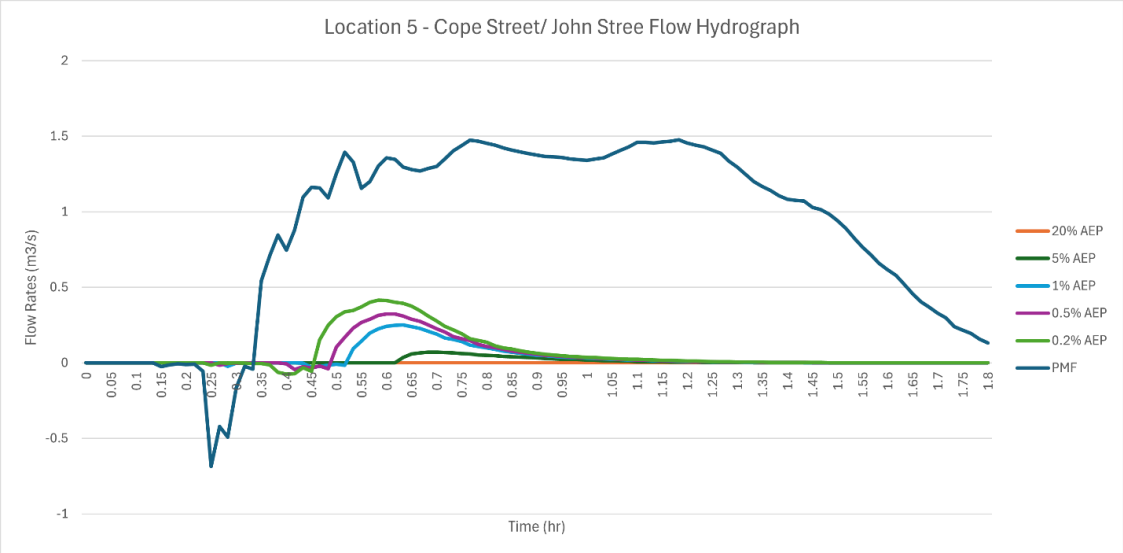


Image 12: Location 5 Flow Hydrograph

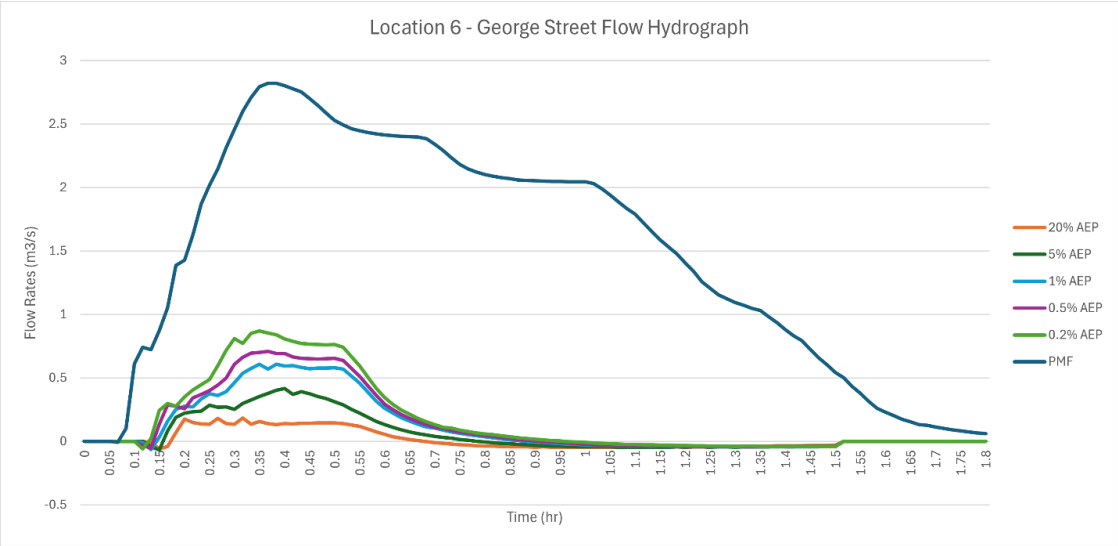


Image 13: Location 6 Flow Hydrograph

The hydrographs show a fast rate of rise with flow beginning around 0-10 minutes into the rainfall event and all design events peaking within approximately 20 minutes of the rainfall occurring. The duration of significant flow when most flooding is occurring is around 1 hour, except for the PMF which modelled a longer duration event and occurs for around 2 hours. These hydrographs are for a particular duration (the 30 minutes storm event, except for the PMF) but are representative of the general duration of flooding in the area. Heavy rainfall of lower intensity over a prolonged period (e.g. 12 or 24 hours) will generally not result in flooding along the overland flowpaths.

3.6 Flood Behaviour – Flood Function

Flood Function, also referred to as Hydraulic Category, classifies floodwaters into three categories: floodway (flow conveyance), flood storage, and flood fringe. These categories describe the nature of flooding across the floodplain and assist in planning and assessing developable areas. According to the Australian Emergency Management Handbook 7, the categories are defined as follows:

- Floodway – the areas where a significant proportion of the floodwaters flow and typically align with defined channels. If these areas are blocked or developed, there will be significant redistribution of flow and increased flood levels across the floodplain. Generally, floodways have deep and/or fast moving floodwaters.
- Flood storage – areas where, during a flood, a significant proportion of floodwaters extend into, water is stored and then recedes after a flood. Significant filling or development in these areas may increase flood levels nearby; and
- Flood fringe – areas that make up the remainder of the flood extent. Development in these areas are unlikely to alter flood behaviour in the surrounding area.

The approach to defining the three categories was established by the City of Sydney Floodplain Risk Management Study and Plan for the catchment. The FRMS defined floodway as any flow

with depth-velocity product of 0.25 m2/s, and velocity >0.25 m/s, or simply if velocity >1 m/s. As previously described, steep areas of the site have high velocities > 1 m/s (but shallow flow) in any flood event. Flood storage is defined as anywhere with depths of >0.2 m. Considering standard kerb heights of around 0.15 m, GRC Hydro observes that this broad definition effectively designates any street experiencing moderate overland flow as flood storage.

The flood function at the subject site is shown on Figure A19 for the 1% AEP and Figure A20 for the PMF. In the 1% AEP, there is floodway on Wellington Street, part of Cope Street, and in one kerb of McEvoy Street, while the two sag points are the main flood storage areas. In the PMF, the same floodways occur but are much wider, and most areas west of George Street are either flood storage or floodway.

3.7 Flood Emergency Response Classification of Communities (FERCC)

Flood Emergency Response Classification of Communities (FERCC) refers to defined categories of flood-affected or indirectly affected land that considers the land's access and evacuation during a flood event. They are used to map areas of development where significant evacuation or isolation risks occur, particularly on larger floodplains where flooding can last days or weeks.

The FERCC at the subject site has been previously defined by the City of Sydney Floodplain Risk Management Study and Plan. The area is defined as 'Areas with Overland Escape Routes' as shown on Figure A21. The site is not located in an area with identified evacuation risks (such as a Low Flood Island or High Flood Island). The emergency response procedures at the site are further discussed in Section 7.

3.8 Sensitivity Tests –Present Day and Future Climate Change (ARR version 4.2)

The City of Sydney hydrologic and hydraulic models were updated to include 'Present Day Climate Change' and future climate change as sensitivity tests. Climate change is expected to worsen flood risk over time as higher greenhouse gas concentrations lead to increases in high-intensity rainfall and sea levels. To account for this change, design rainfall depths are scaled up to represent a climate change scenario for present day conditions, and for future conditions. The design to date has used ARR2019 (which pre-dated the use of 'present day climate change' in ARR version 4.2) and this has been maintained for consistency with the City of Sydney flood levels.

The present day climate change resulted in minor increases to the 1% AEP and PMF flood levels across the site. The increase is shown in Table 6 and the reporting locations are shown in Image 14. The results are shown in figures A29 and A30. The table shows that present day climate change has had a minor affect on flood levels, with 0.11 m increase in the Cope Street sag point (1% AEP), 0.06 m increase at George Street sag point (1% AEP) and other locations having 0.03 m or less increase.



Image 14: Water Level Inspection Point

Table 6: Present Day Climate Change Sensitivity Test

Location	1% AEP Increase (m)	PMF Increase (m)
1	0.11	0.18
2	0.11	0.18
4	0.03	0.18
5	0.01	0.01
6	0.00	0.00
7	0.03	0.04
8	0.06	0.18
9	0.03	0.04
10	0.03	0.03

The change in flood hazard was also tested and the results are shown in Figures A35 and A36. The figures show:

- Hazard in the two sag points in the 1% AEP are largely unchanged, with the exception of a larger H4 hazard area on Cope Street. Hazard categories on other 1% AEP flowpaths are largely unchanged.

- Hazard in the Cope Street sag point is higher in the PMF, with larger areas of H4 and H5 hazard. Other areas are largely unchanged.

For the future climate change sensitivity test, a large range of scenarios are possible with regards to different Shared Socioeconomic Pathways, and different planning horizons. As an upper estimate of the climate change sensitivity, the years 2050, 2100 and the scenario SSP5-8.5 were selected. The future climate change scenarios resulted in more significant increases than the present day climate change, with rainfall factors increased by 29% for the 1% AEP event and 26% for the PMF event in 2050, and by 86% for the 1% AEP event and 77% for the PMF event in 2100.

The resulting increase in flood level is shown in Table 7 and the reporting locations are shown in Image 12. The results are shown in figures A31 to A34. The table shows that under the 2050 climate change scenario, flood level increases are up to 0.18 m at the Cope Street sag point (1% AEP), while other locations are less, with 0.05 m at the George Street sag point (1% AEP), and 0.11 m on John Street near Cope Street. Under the 2100 climate change scenario, the increases are greater, with flood levels rising by 0.40 m at the Cope Street sag point (1% AEP), 0.11 m at the George Street sag point (1% AEP), and 0.33 m on John Street near Cope Street (1% AEP).

The change in flood hazard was also tested and the results are shown in Figures A35 to A40. The figures show:

- Present day scaling shows largely the same hazard in a 1% AEP, with some areas of H2 or H3 slightly larger, while in the PMF there is significantly more H4 and H5 flooding on Cope Street but other areas are generally similar.
- 2050 and 2100 climate change scenarios will see significantly more H4 flooding on Cope Street in the 1% AEP, and likewise more H4 and H5 hazard in the PMF, particularly on Cope Street.

Table 7: Future Climate Change Sensitivity Test

Location	2050 1% AEP Increase	2050 PMF Increase	2100 1% AEP Increase	2100 PMF Increase
1	0.18	0.30	0.40	0.65
2	0.18	0.30	0.40	0.65
3	0.05	0.30	0.11	0.64
4	0.02	0.03	0.05	0.05
5	0.01	0.01	0.01	0.01
6	0.05	0.07	0.11	0.22
7	0.05	0.30	0.24	0.65
8	0.05	0.06	0.11	0.22
9	0.04	0.05	0.08	0.30
10	0.11	0.30	0.33	0.65

4. PROPOSED DEVELOPMENT

The proposed development is described in the introduction (Section 1) of this report. With regards to flood risk, the salient features of the proposed development are its ground floor and basement features. For the new buildings, these consist of the following areas:

- residential dwellings are above ground level and are accessed via elevators and fire stairs. A lobby area is considered non-habitable residential.
- commercial (retail) areas are located on the ground floor with multiple entrances from the street, with additional commercial areas located on higher floors.
- the basement is accessed via vehicle ramps, elevators and stairs, in each building. Basement connection points are both inside the buildings, and access/egress stairs to the street.

The location of each entrance and the Flood Planning Levels are presented in the following section. Note that "commercial" category includes retail, commercial, business and other uses, per City of Sydney policy (see below). An overview of the proposed buildings is as follows (also see Image 15):

- 2B: 'VPA' (assumed to be used as community)
- 2D: Residential with basement
- 3A and 3B: non-residential at ground level, residential above, with basement
- 4B and 4C: non-residential at ground level, residential above, with basement under 4C.
- 5A and 5B: Residential with basement under 5A
- 6A: Residential with basement
- 7A and 7B: Residential with basement
- 8A, 8B and 8C: mix of residential and non-residential, with basement
- 9A: Non-residential on ground, residential above and basement below
- 9B: non-residential at ground level, residential above, with basement
- 10A and 10B: non-residential at ground level, residential above, with basement



Image 15: Waterloo South Project Area Showing Block Numbers

5. FLOOD IMPACT ASSESSMENT – PROPOSED CASE

The Interim Floodplain Management Policy and the Local Environment Plan require that development in the floodplain avoids significant adverse impact on flood behaviour. Adverse impacts occur when there is a significant loss of flood storage or floodway, which leads to increase flood levels in an adjacent area. Where such an increase occurs on or against adjacent property, there is a corresponding increase in flood risk, which the policies seek to prevent.

The site-wide design has been developed to maintain existing flood behaviour outside the site and avoid any significant adverse impacts. Downstream areas to the west and south are fully urbanised, leaving no practical opportunity to substantially improve flood behaviour within the catchment or the subject site. Specifically:

- The two sag points within the site could theoretically be filled/raised to reduce flooding. However, this would increase flood levels downstream and there is no area where this would be acceptable (i.e. there is no park, golf course or similar open space)
- Flow paths within the site could theoretically be reduced in severity through large-scale pit and pipe upgrades to increase the proportion of flow captured by the stormwater network. However, these upgrades would need to connect to the existing downstream stormwater system, which is already at capacity during relatively small flood events. As a result, large-scale upgrades are not feasible, as they would exacerbate flooding where the upgrade terminates. The only other mitigation option would be a trunk drainage upgrade extending to Alexandra Canal or a similar outlet, similar to works undertaken by the City of Sydney and Sydney Water for Green Square. The scope of such works is well beyond the current project.

To maintain existing flood behaviour, the site-wide design incorporates the following measures:

- Largely maintained existing road levels and grades. Roads have been modified as part of the public domain design but the overall grading is unchanged. The two sag points have been retained in the design.
- Included new pit and pipe network where possible, as part of the public domain design, without significantly altering flood behaviour. Pipe sizes and alignments are catered towards local drainage rather than flood mitigation.
- Maintained the overland flowpath that connects the George Street sag point to the Cope Street sag, between new buildings. This is marked as an overland flowpath on the City of Sydney design guide for the subject site. The details of the flowpath levels are to be developed as future design stages.

To assess the design principles set out above, the hydraulic model has been used to schematise a proposed case, which is then modelled for a range of design flood events. The proposed case model incorporates new building footprints, road levels and pit/pipe network, but does not include any change to ground levels between new buildings. These ground levels will be designed as part of subsequent stages for individual blocks, at which point the modelling can be updated. Any change in flood behaviour is then shown on the following flood impact maps:

- Figure A23: 20% AEP Flood Level Impacts
- Figure A24: 5% AEP Flood Level Impacts
- Figure A25: 1% AEP Flood Level Impacts
- Figure A26: 0.5% AEP Flood Level Impacts
- Figure A27: 0.2% AEP Flood Level Impacts
- Figure A28: PMF Flood Level Impacts

The figures indicate that the proposed works generally maintain the site's existing flood behaviour, with no significant increase in flood levels across most areas. Given the large size of the site, flood impacts for specific areas are summarised as follows:

- On Wellington Street, the shallow overland flowpath is slightly modified by the design to remain on the road where in the existing case there is some shallow flow through properties. The flood level along the road and then to the downstream is largely unchanged, with negligible impact to the downstream in all events up to the PMF.
- At the Cope Street sag point, there is no increase in flood level in any event.
- At the George Street sag point, there is a localised impact due to the new building footprints allowing slightly less overland flow through to John Street and Cope Street. These are only interim results as the model assumes existing ground levels between George Street and John Street, as the design for this area is still being progressed. The impacts are around 30 mm in the 1% AEP, affecting one private property (the substation at corner of McEvoy Street and George Street) while in the PMF there is one additional property affected on the south side of McEvoy Street.
- The overall design does not cause any adverse flood impacts that are not readily mitigated (see below).

To ensure the proposed building footprints can be developed without impacting flood behaviour, a test was made of a landscaped area in block 8. Image 16 shows a modification made to the model whereby existing ground levels in two areas were lowered by around 0.1 m to 16.60 mAHD. This was tested and found to achieve compliant flood impact on George Street and McEvoy Street

properties for all events up to the PMF. As with other buildings where overland flow may potentially occur, the flood model will be updated for the corresponding SSDA of each new block or building design. This process will ensure that the George Street overland flow path is thoroughly assessed and that any potential impacts are avoided going forward.



Image 16: Potential regrading for Block 8 that ensures no offsite impacts

6. RELEVANT POLICY AND FLOOD PLANNING LEVELS

City of Sydney has a Local Environment Plan and an Interim Floodplain Management Policy that set flood planning controls for development in the LGA. The LEP sets out objectives for floodplain management while all controls are contained in the policy. The primary considerations for the proposed development are the applicable Flood Planning Levels and the impact on existing flood behaviour.

As reference in the LEP the Flood Planning Level (FPL) for the property is a function of the type of development and flood behaviour. For the purposes of this analysis, these criteria may be applicable for this site:

- Residential habitable rooms: 1% AEP flood level + 0.5m freeboard, or if flooding is not present, then the FPL is the surrounding ground level + 0.3 m.
- Residential non-habitable rooms: 1% AEP flood level
- Schools and childcare: 1% AEP + 0.5 m
- Commercial areas: 1% AEP flood level for small businesses, merits approach presented by the applicant for large businesses
- Below-ground/basement spaces: Entrances from flood-affected streets: 1% AEP flood level + 0.5m freeboard or the PMF flood level (whichever is higher) or if flooding is not present, then the FPL is the surrounding ground level + 0.3 m.

6.1 Floor Level Assessment

The proposed buildings have been assessed in regards to protection against flooding via adoption of Flood Planning Levels. Table 8 presents the flood levels and applicable FPL for various entrances around the site. The assessment is based on the Waterloo Estate South architectural plans dated 02/12/2025 prepared by SJB Architects. The point locations are shown on Image 17, with red colour indicating entrances connecting to basement levels.

For the site-wide concept SSDA, most floor levels have not yet been finalised. For each building, levels for basement-connected lobbies, apartments, and vehicle ramps have been established, while other levels (such as ground-floor retail) remain unset. Basement-connected entries adopt the highest Flood Planning Level, whereas retail levels are expected to be straightforward to determine, as 1% AEP flooding is typically shallow or absent in many locations.



Image 17: Building Entrance ID where a level has been set

Table 8: Flood Planning Level compliance

Building No. and ID	FPL Category	1% AEP/PMF (mAHD)*	Adjacent Ground Level**	FPL	Proposed Level
2D-B1 1	Basement	NF/16.61		16.61	16.75
2D-B1 2	Basement	NF/16.61		16.61	16.75
2D-B1 3	Basement	15.69/16.61		16.61	16.70
2D-B1 4	Residential Non-habitable	15.72/16.61		15.72	15.92
3A-B1 5	Basement	16.81/16.96	16.68	16.98	17.33
3B-B1 6	Basement	NF/16.89		16.89	17.24
3B-B1 7	Basement	NF/16.61		16.61	16.76
4B-B1 8	Residential Non-habitable	NF/17.1		17.1	17.3
4C-B2 9	Basement	NF/NF	17.20	17.50	17.6
4C-B1 10	Residential	NF/NF	18.00	18.30	18.3
4C-B1 11	Basement	NF/NF	19.00	19.30	19.3
4C-B2 12	Basement	NF/NF	20.90	21.20	22.1
5A-B1 13	Basement	NF/NF	TBD	TBD	21.81
5A-B1 14	Basement	NF/NF	27.68	27.98	30.01
5A-B2 15	Residential	NF/NF	TBD	TBD	21.55
6A-B1 16	Residential	NF/NF	31.33	31.63	32.38
6A-B2 17	Residential	NF/NF	22.4	22.7	22.78
7A-B1 18	Basement	NF/NF	TBD	0.3 above ground	40.3
7B-B1 19	Basement	NF/NF	29.55	29.85	30.7
7B-B1 20	Basement	NF/NF	29.9	0.3 above ground	30.7
8A-B1 21	Basement	NF/16.61		16.61	16.91
8A-B1 22	Basement	NF/16.77		16.77	16.91
8A-B2 23	Residential	NF/16.99		N/A	17.39
8A-B3 24	Basement	16.81/16.97		17.31	17.38
8A-B3 25	Basement	16.86/17.07		17.36	17.38
8B-B1 26	Basement	15.68/16.61		16.61	16.76
8B-B1 27	Residential	16.09/16.61		16.61	16.76
8C-B1 28	Basement	NF/16.61		16.61	17.01
8C-B1 29	Basement	16.86/17.05		17.36	17.38
9A-B1 30	Basement	16.86/17.07		17.36	17.39
9B-B1 31	Basement	NF/NF	TBD	0.3 above ground	17.38
9B-B1 32	Residential	NF/NF	TBD	0.3 above ground	0
10B-B1 33	Basement	NF/NF	21.45	21.75	21.75
10B-B1 34	Basement	NF/NF	28.0	0.3 above ground	29.95

*NF = Not Flooded

**Ground level listed when there is no PMF flooding and the basement FPL is then ground + 0.3 m

Table 8 shows that the proposed floor entrance levels are at or above the Flood Planning Level at all locations where flooding is present. At certain locations not subject to flooding, entry levels will need to be raised above the adjacent ground level; the exact heights are yet to be determined. This will ensure the basement is protected from any potential inundation. Subsequent design of individual buildings will ensure the remaining floor levels in each building are suitably protected.

7. EVACUATION STRATEGY – SHELTER IN PLACE

7.1 Site-Wide Strategy

An evacuation strategy for the site has been developed considering land use, flood risk for the site and surrounding areas, and the availability of warning systems. These are:

- Building occupants will include residents, staff of commercial premises, other building staff and community users. It is likely that a significant number of occupants will not be aware of flood risk in the wider Waterloo area.
- Above-floor flood liability will vary between buildings, but all buildings will have flood-free upper levels (level 1 and above), flood-free basement levels (if there is a basement) and most will have flood-free areas on the ground floor.
- Flooding will occur during or immediately after flood-producing rainfall. Flooding is likely to last around one hour or less.
- During and after very heavy rainfall, surrounding roads in the area will be hazardous due to low visibility, flooding in some locations, and potential debris.
- There are no warnings issued by the BOM or SES that would warn of flooding at the site. BOM warnings for severe weather would be limited as when they do warn of flash flooding, it is not specific to Waterloo (e.g. warnings can often cover 20+ suburbs).

Between the two general options of either evacuating off site during a flood, and a shelter in place strategy, the shelter in place evacuation strategy is recommended and is the only feasible approach.

The strategy does not require a detailed plan or procedure for the overall site to follow in the event of a flood. For buildings at the two sag points where flooding occurs, plans and procedures can be developed for individual buildings, if necessary. There will be general warnings issued by the BOM (e.g. Flood Watch, Severe Weather Warning or other) preceding heavy or extreme rainfall that may lead to flooding in the area. It will be sufficient to follow the common-sense advice issued by the BOM and SES. In the event of an extreme flood event, Level 1 or a higher level can be made available to building occupants to vertically evacuate (see further discussion below).

7.2 Site-wide Emergency Access

Emergency access during a flood refers to ambulances or other emergency vehicles having to access a building at the site during a flood event, for a fire, medical emergency or other emergency. This is referred to as a secondary risk as it would occur during the primary risk (the flood). Access routes in the wider area have been considered, based on the PMF hazard, and two

routes to the north are available, as shown in Image 18 and Image 19. The main constraint is that Route 2 uses Wellington Street, which is very steep and has high hazard flow (due to velocity of greater than 2 m/s) in a PMF. If this is occurring, emergency vehicles would need to re-route to Route 1.

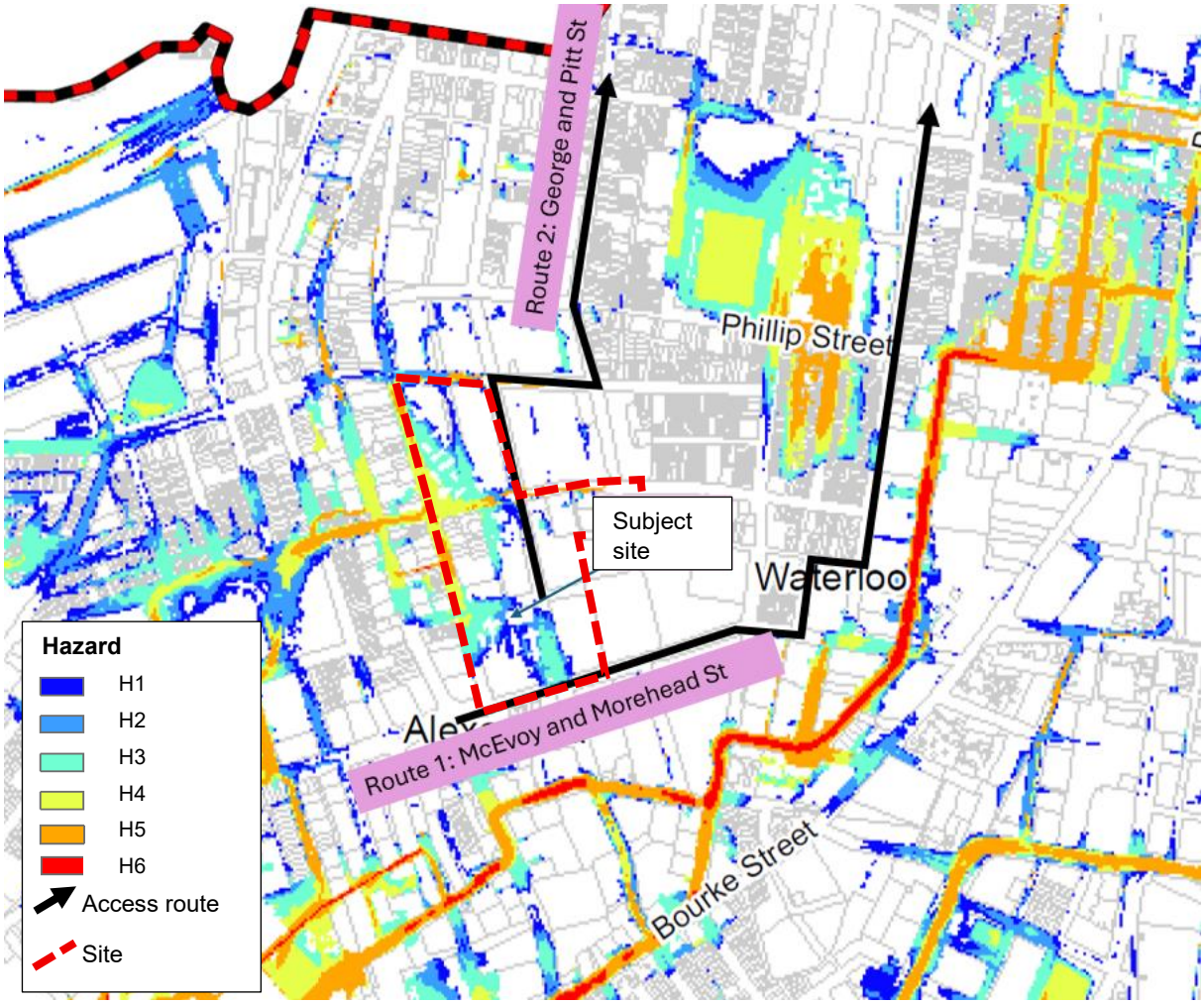


Image 18: Emergency Access Routes (catchment scale) with PMF hazard

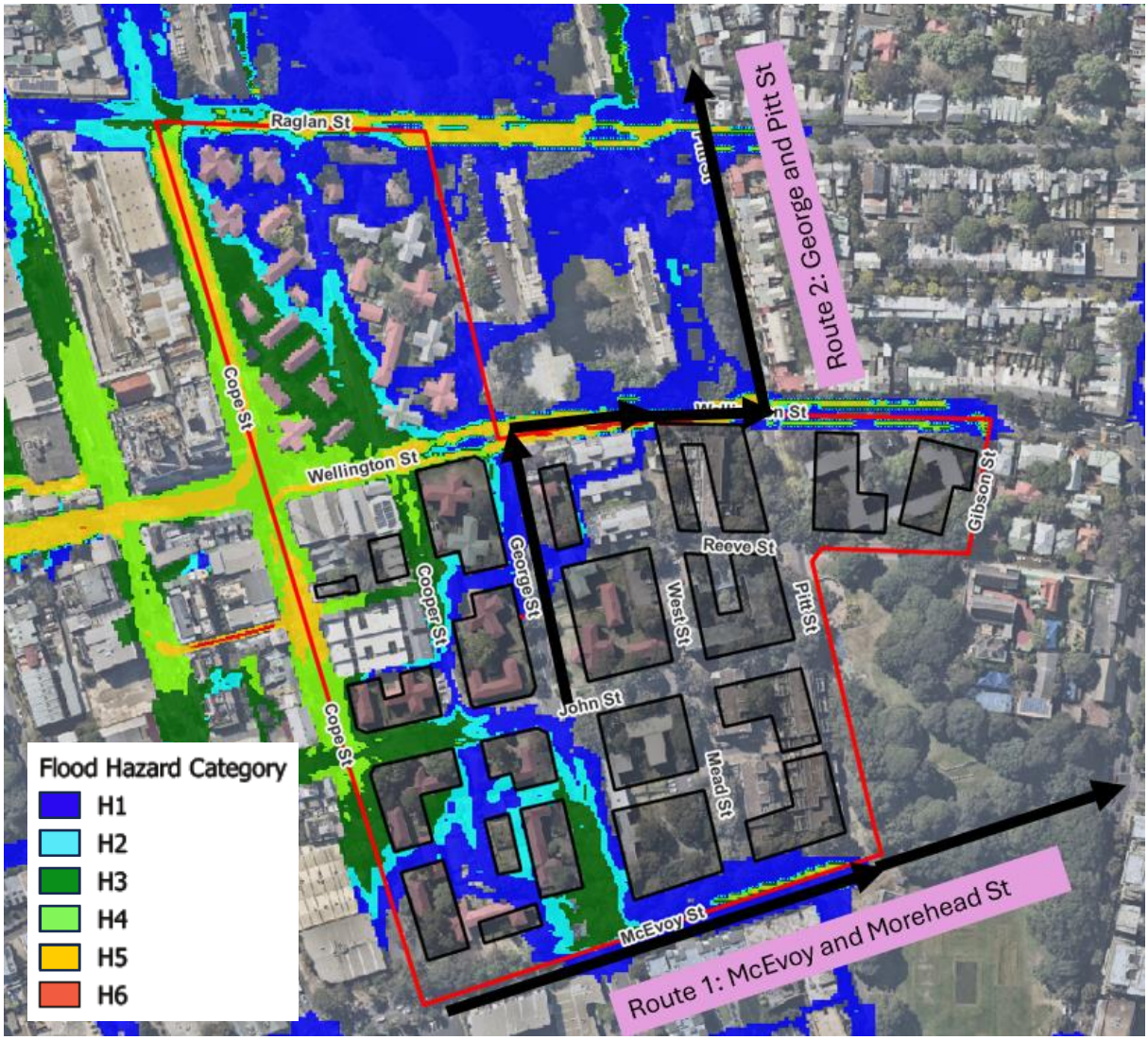


Image 19: Emergency Access Routes (site scale) with PMF hazard

7.3 Individual Building Shelter and Emergency Access

The site-wide strategy will need to be adapted to individual buildings as part of subsequent SSDAs, depending on their proposed use, above-floor flood liability (if any), access to upper levels and emergency access. An overview is given in Table 9 based on the information available at this stage.

Table 9: Individual Building Shelter and Emergency Access

Building	Features	PMF Flood Hazard at Entrances	Comment
2B	'VPA' (assumed to be used as Community Uses)	H3 on Cooper Street	May require building design to allow for shelter-in-place above PMF level via raised ground floor, or access to upper level
2D:	Residential with basement	H3 on John Street	Above PMF and accessible via John Street

Building	Features	PMF Flood Hazard at Entrances	Comment
3A and 3B	Retail/commercial at ground level, residential above, with basement	H1 on George Street	May require upper area accessible for retail occupants, if significant above-floor depth.
4B and 4C	non-residential at ground level, residential above, with basement under 4C.	H1 on George Street	There is only shallow flooding in PMF and accessible via George Street.
5A and 5B	Residential with basement under 5A	H1 on Pitt and H1 on Wellington	Only Wellington Street flooded in PMF
6A	Residential with basement	Not flooded	Not flooded in PMF
7A and 7B	Residential with basement	Not flooded at the entrance, H1 on Gibson St/Pitt St	Only Wellington Street flooded in PMF
8A, 8B and 8C	mix of residential, Community Uses) and retail at ground floor, residential above, with basement	Mix of entrances with between H1 and H3 hazard. George Street sag point is H3.	May require upper area accessible for retail occupants, if significant above-floor depth.
9A:	non-residential on ground, residential above and basement below	H3 on George Street, or not flooded on Mead St (entrances not specified for non-residential areas)	Building will be dry in PMF as the PMF is only 0.2 m above the 1% AEP and the FPL is 1% + 0.5. Likely only shallow flooding in any retail, otherwise, my require upper area accessible.
9B:	non-residential at ground level, residential above, with basement	H2 on George Street	Likely only shallow flooding in any retail, otherwise, my require upper area accessible.
10A and 10B:	non-residential at ground level, residential above, with basement	Not flooded	Not flooded

8. COUNCIL POLICY AND SEARS ASSESSMENT

The proposed development has been assessed against the requirements set out in the City of Sydney LEP, as well as the project SEARs. The LEP requirements are set out in Table 10 while Table 11 contains the SEARs.

Table 10: LEP Flood Planning Controls

LEP Planning Controls	Response / Location in Report
(1) The objectives of this clause are as follows— (a) to minimise the flood risk to life and property associated with the use of land, (b) 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, (c) to avoid adverse or cumulative impacts on flood behaviour and the environment, (d) to enable the safe occupation and efficient evacuation of people in the event of a flood.	Addressed below
(2) 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— (a) is compatible with the flood function and behaviour on the land, and (b) 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 (c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and (d) incorporates appropriate measures to manage risk to life in the event of a flood, and (e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.	a) The flood function and behaviour is described in Section 3. High-density development is compatible with the site's generally low flood risk. b) Flood impacts are described in Section 5. Assessment shows the site can be developed without causing adverse impacts. c) Emergency response is set out in Section 7. The site can be designed to be safely occupied in a flood with available access routes for emergency vehicles. d) The main measures to manage risk to life are protection of all habitable spaces from flooding, and a suitable evacuation strategy which is primarily to shelter in place.. e) No riverbanks or watercourses will be affected.
(3) In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters— (a) the impact of the development on projected changes to flood behaviour as a result of climate change,	a) climate change has been assessed in Section 3.8. b) the design and scale of buildings is presented in the architectural drawings

LEP Planning Controls	Response / Location in Report
(b) the intended design and scale of buildings resulting from the development, (c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood, (d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.	c) The main measures to manage risk to life are protection of all habitable spaces from flooding, and a suitable evacuation strategy which is primarily to shelter in place. D) climate change assessment demonstrates that building relocation or modification is not applicable to this site

Table 11: SEARs Assessment

SEARS Request	Response / Location in Report
Identify the flood planning area and level as set out in the relevant EPI and other supporting documents to determine: • 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 and plans • the site access and egress routes • the potential effects of climate change any relevant provisions of the *NSW Flood Risk Management Manual* and any other relevant guidelines,	The flood planning area is assumed to apply to all lots in the subject site on the basis that City of Sydney is currently updating their FPA, and CoS apply flood planning controls to lots outside of the PMF extent. Access and egress routes are set out in Section 7. The potential effects of climate have been assessed and are set out in Section 3.8
Provide a flood impact and risk assessment (FIRA) that is 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.	A FIRA has been prepared (this document) with regard to guide LU01.
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).	The main risk management measure is ensuring protection of new buildings via Flood Planning Levels (see Section 6.1) and providing emergency access arrangements (see Section 7).
NSW DEECCW CPHR Specific Comments	
The EIS must include a flood impact and risk assessment (FIRA) prepared in accordance with the Flood Risk Management Guideline LU01 Flood impact and risk assessment. The FIRA is to be prepared by suitably qualified engineers with a high level of expertise in flood risk management in NSW. As a minimum the FIRA must:.	A FIRA has been prepared (this document) with regard to guide LU01.
Consider the NSW Flood Prone Land Policy. Address the relevant provisions of the NSW Flood Risk Management Manual (2023) and toolkit, and existing Council flood mapping, planning controls, government studies, information and requirements.	The FIRA has considered the NSW Flood Prone Land Policy, and addresses the FRMM requirements, and uses Council flood mapping. Council planning controls are set out in Table 10.
Identify and describe existing flood behaviour, constraints and risk on the site and its surrounding areas for the full range of events, including the 20% Annual Exceedance Probability (AEP), 5% AEP, 1% AEP, 0.5% AEP or 0.2% AEP floods and Probable Maximum Flood (PMF), as well as the 1% AEP flood and PMF under climate change. The hydrological and hydraulic models developed by the consultant must be generally compatible with the Alexandra Canal Floodplain Risk Management Study and Plan, 2014 and the Alexandra Canal Catchment – Flood Study Model Update ARR2019 Hydrology, 2020 and employ the latest Australian Rainfall and Runoff methodologies.	The full range of events has been modelled and is set out in Section 3. The latest Alexandra Canal modelling from City of Sydney has been used. ARR2019 has been used to be consistent with the Council model, and the sensitivity of results to ARR v4.2 has been tested.

The consultant should verify their model against these studies for the full range of flooding.	
Assess climate change impacts on flood behaviour in accordance with Flood Risk Management Guideline FB01 Understanding and managing flood risk.	The potential effects of climate have been assessed and are set out in Section 3.8
Identify and describe post development scenario(s) for flood behaviour, constraints and risk on the site and its surrounding areas for the full range of abovementioned events. Details of the development must be included in the verified models.	Modelling of the post-development scenario has been carried out for the full range of events, see Section 5
Provide mapping of flood behaviour for existing conditions and post development scenarios for the 20%, 5%, 1%, and 0.5% or 0.2% AEP floods and PMF as well as the 1% AEP flood and PMF behaviour under climate change.	This has been carried out, see Section 3 and Section 5
Identify and describe the flood constraints on the land (floodways, flood storage, flood hazard and emergency response issues) for the full range of abovementioned events.	This has been carried out, see Section 3.6 (flood function), Section 3.4 (hazard) and Section 7 (emergency response)
Identify the impacts of the development on flood behaviour and risk for the abovementioned flood events. Assess the appropriateness of the development or development types for the location based on the flood constraints on the land.	This has been carried out, see Section 5.
Ensure that the rezoning is commensurate with flood behaviour. Address consistency of the emergency response strategy with the existing SES strategy. Address flood-related emergency response issues and site access arrangements without relying on a Flood Emergency Response Plan to inform the development assessment and in accordance with Flood Risk Management Guideline EM01 Support for Emergency Management Planning, including locating carparks above ground where sheltering in place (on the floodplain) is proposed.	The rezoning is suitable for an area with generally low flood risk. Assessment of emergency response is set out in Section 7. Shelter in place is proposed and all car parks are proposed to be protected against the PMF, and no flood barriers or gates are proposed.
If sheltering in place is proposed, assess consistency with the Shelter-in-Place guideline for flash flooding. Identify and assess the adequacy of management measures and controls to: • effectively address flood constraints to ensure the flood risks to the proposed development and its users are acceptable, and • manage flood and associated emergency management impacts due to the development on existing communities and individual property owners and occupiers. Demonstrate the rezoning would not cause a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures.	The shelter in place guideline has been considered. The site meets the criteria for where offsite evacuation is not feasible and a shelter in place strategy will suitably manage risk. The portions of the site to be developed are not particularly flood-prone with all buildings have low hazard road access in a PMF. On this basis, increased government spending is not expected.
City of Sydney comment	
The flood management strategy and precinct-wide stormwater strategy accompanying the EIS are to include relevant information to address Section 12 of the Design Guide. In particular, the flood management strategy needs to demonstrate compliance with City's Interim Floodplain Management Policy and	This report sets out compliance with the Interim policy and specifically flood planning levels for this stage

identify the flood planning levels for each building. This is to ensure the proposed building envelopes respond to and resolve any required flood planning levels, and to inform all subsequent stages of the development.	and future stages of the development.

9. CONCLUSIONS

This report has assessed flood behaviour and flood planning controls for the Waterloo Estate South development. The site is subject to overland flow flooding from a small upstream catchment.

The assessment outlines flood behaviour in the vicinity of the site and evaluates the development's compliance with the City of Sydney Interim Floodplain Management Policy, the Local Environmental Plan (LEP), and the Planning Secretary's Environmental Assessment Requirements (SEARs). The findings confirm that the development can proceed without negatively impacting existing flood behaviour and that the proposed building designs can achieve the required flood planning levels. The development is compliant with both City of Sydney policy requirements and SEARs. Further FIRAs will be undertaken to review design features for individual buildings as they become available.

FIGURES

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

- Major Flood Level Contours (Spacing = 1 m)
- Minor Flood Level Contours (Spacing = 0.2 m)
- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **20% AEP Peak Flood Depths and Levels**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A1**

Existing

Proposed

Raglan St
Wellington St
John St
McEvoy St
Cope St
Cooper St
George St
West St
Pitt St
Reeve St
Gibson St
Mead St

Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

- Major Flood Level Contours (Spacing = 1 m)
- Minor Flood Level Contours (Spacing = 0.2 m)
- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **5% AEP Peak Flood Depths and Levels**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A2**





Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

- Major Flood Level Contours (Spacing = 1 m)
- Minor Flood Level Contours (Spacing = 0.2 m)

- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **1% AEP Peak Flood Depths and Levels**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A3**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

- Major Flood Level Contours (Spacing = 1 m)
- Minor Flood Level Contours (Spacing = 0.2 m)
- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **0.5% AEP Peak Flood Depths and Levels**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A4**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

- Major Flood Level Contours (Spacing = 1 m)
- Minor Flood Level Contours (Spacing = 0.2 m)
- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

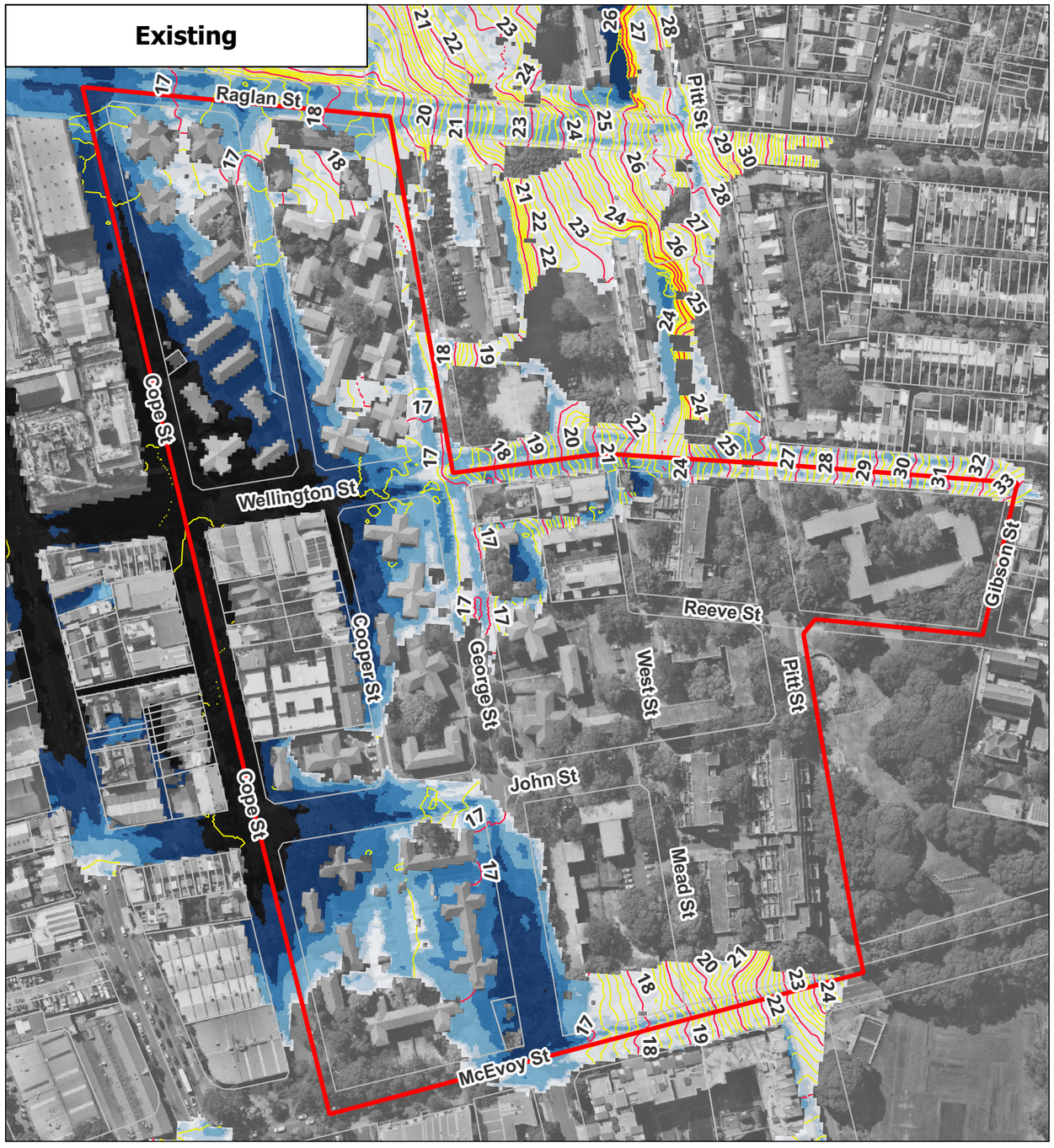
N W E S

0 100 200

grc HYDRO

TITLE: **0.2% AEP Peak Flood Depths and Levels**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A5**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

- Major Flood Level Contours (Spacing = 1 m)
- Minor Flood Level Contours (Spacing = 0.2 m)

- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

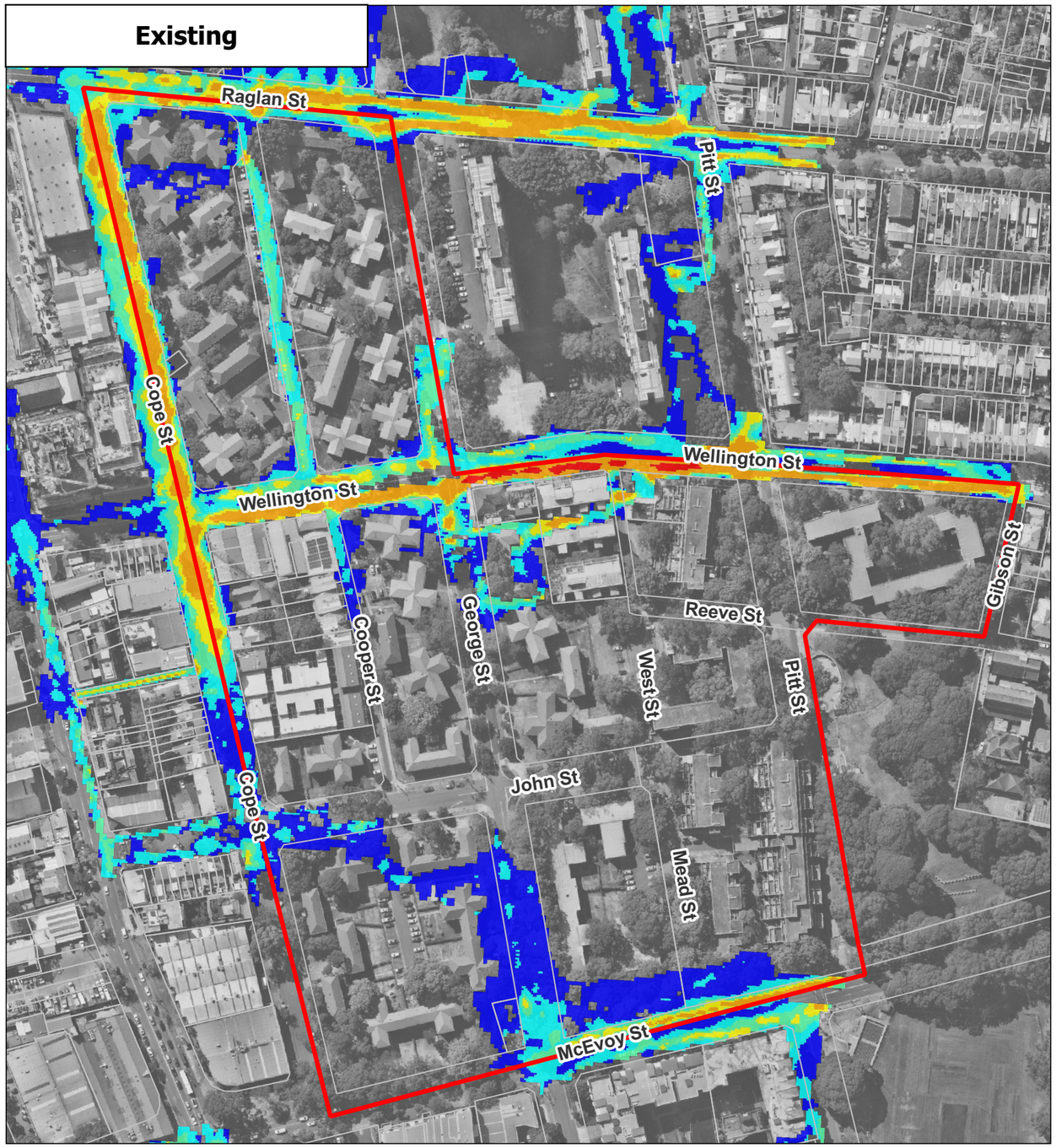
N W E S

0 100 200

grc HYDRO

TITLE: **PMF Peak Flood Depths and Levels**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A6**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Velocity (m/s)

- < 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 2.00
- > 2.00

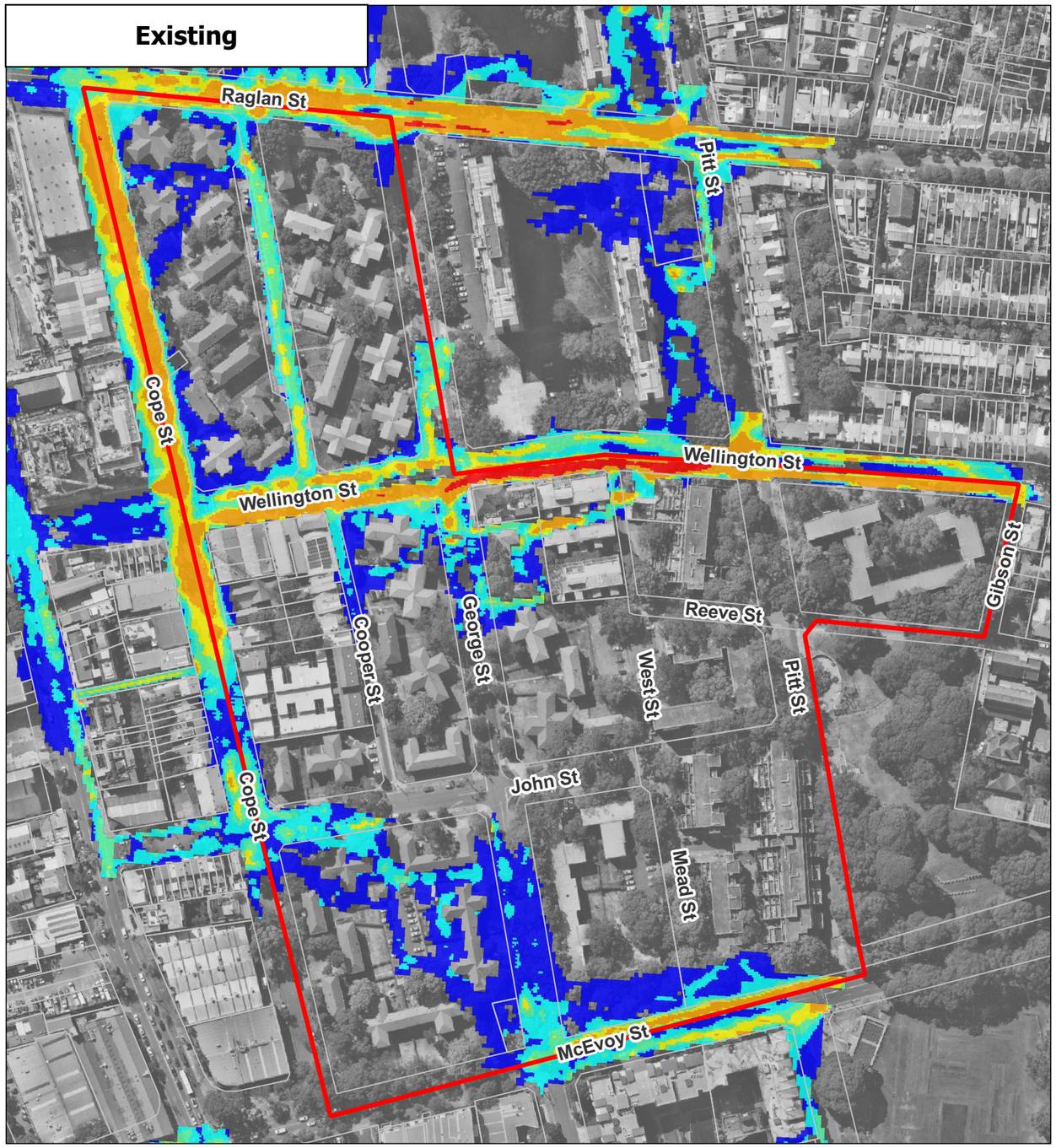
N W E S

0 100 200

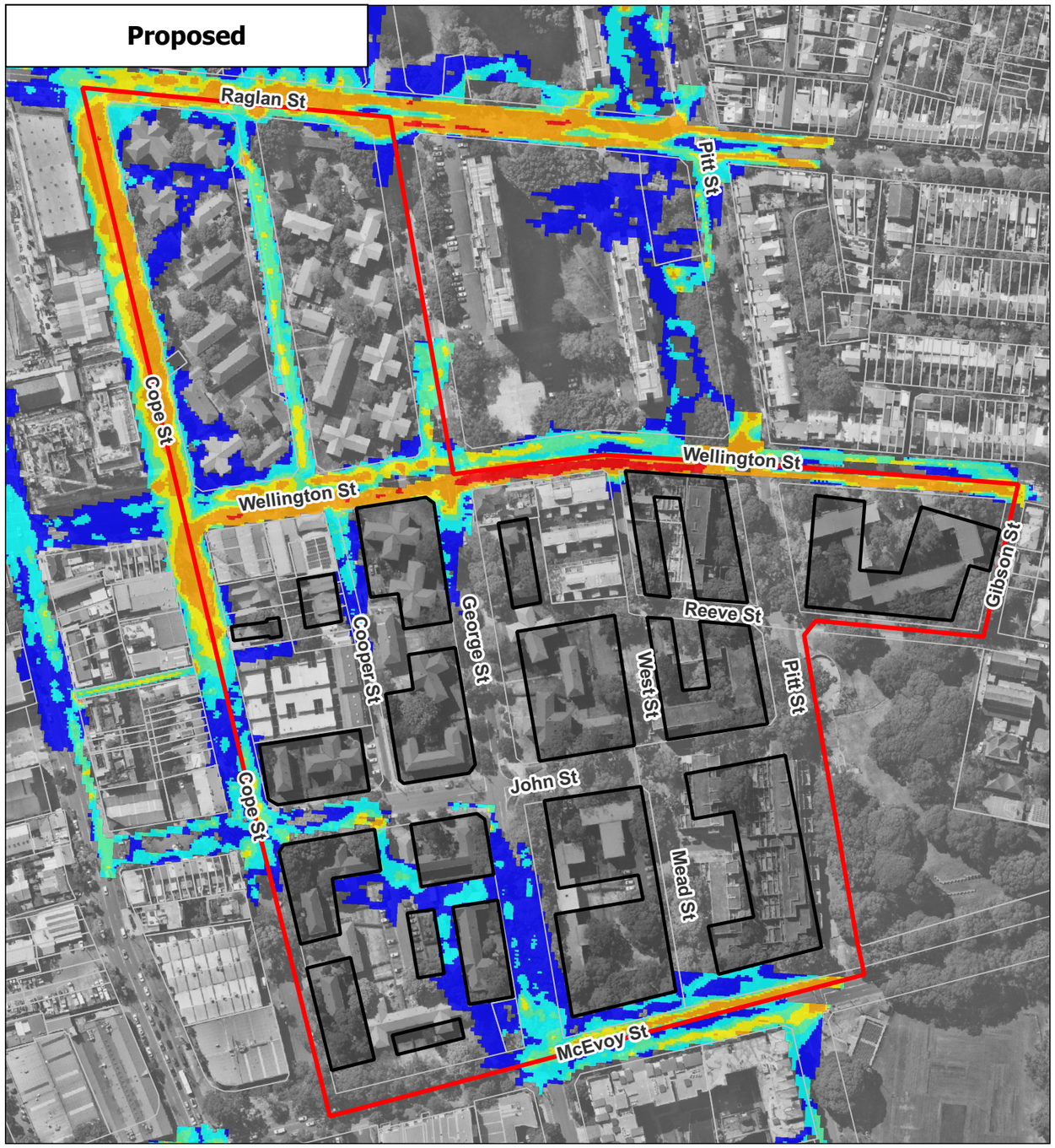
grc HYDRO

TITLE: **20% AEP Peak Flood Velocity**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A7**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Velocity (m/s)

- < 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 2.00
- > 2.00

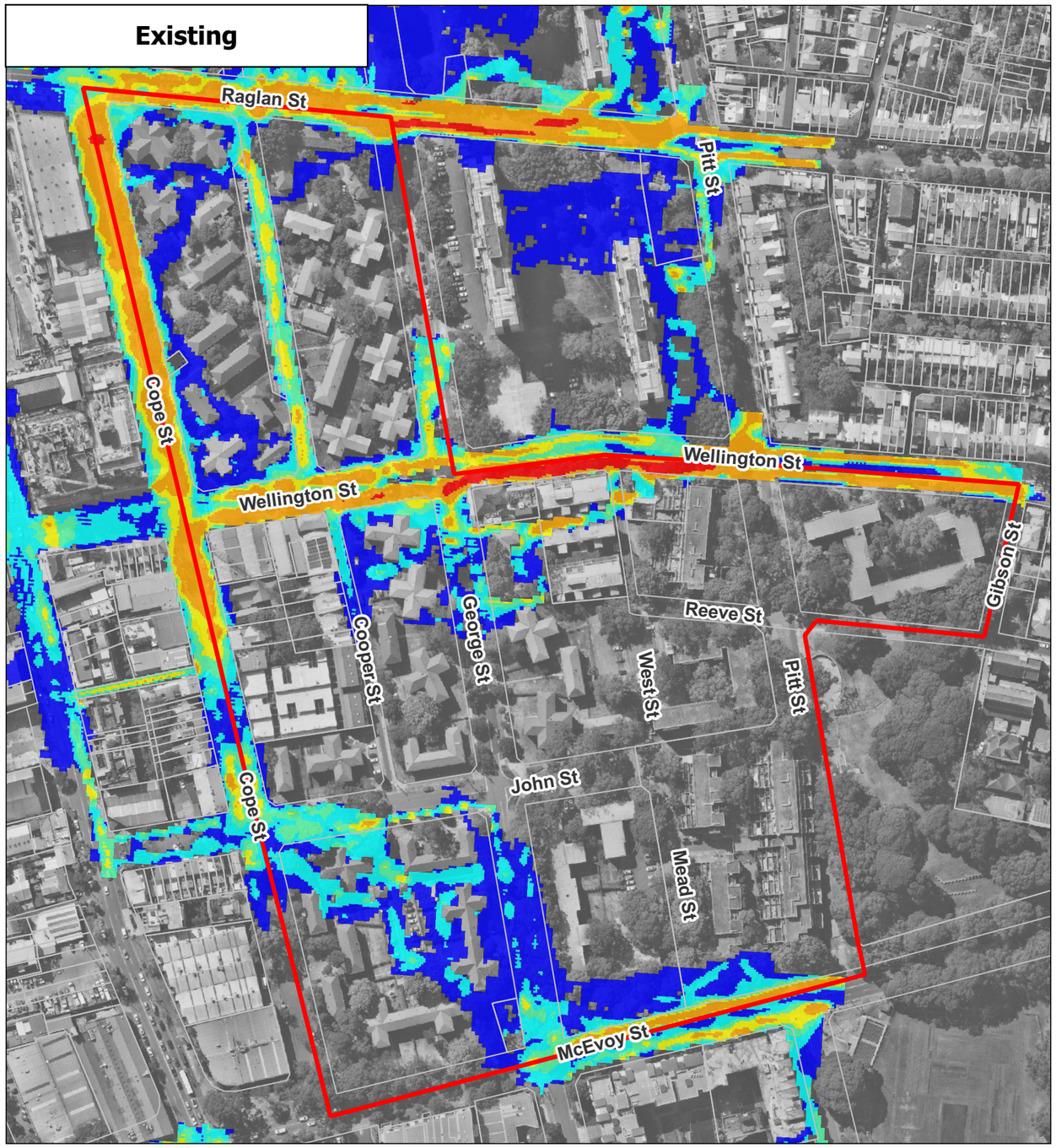
N W E S

0 100 200

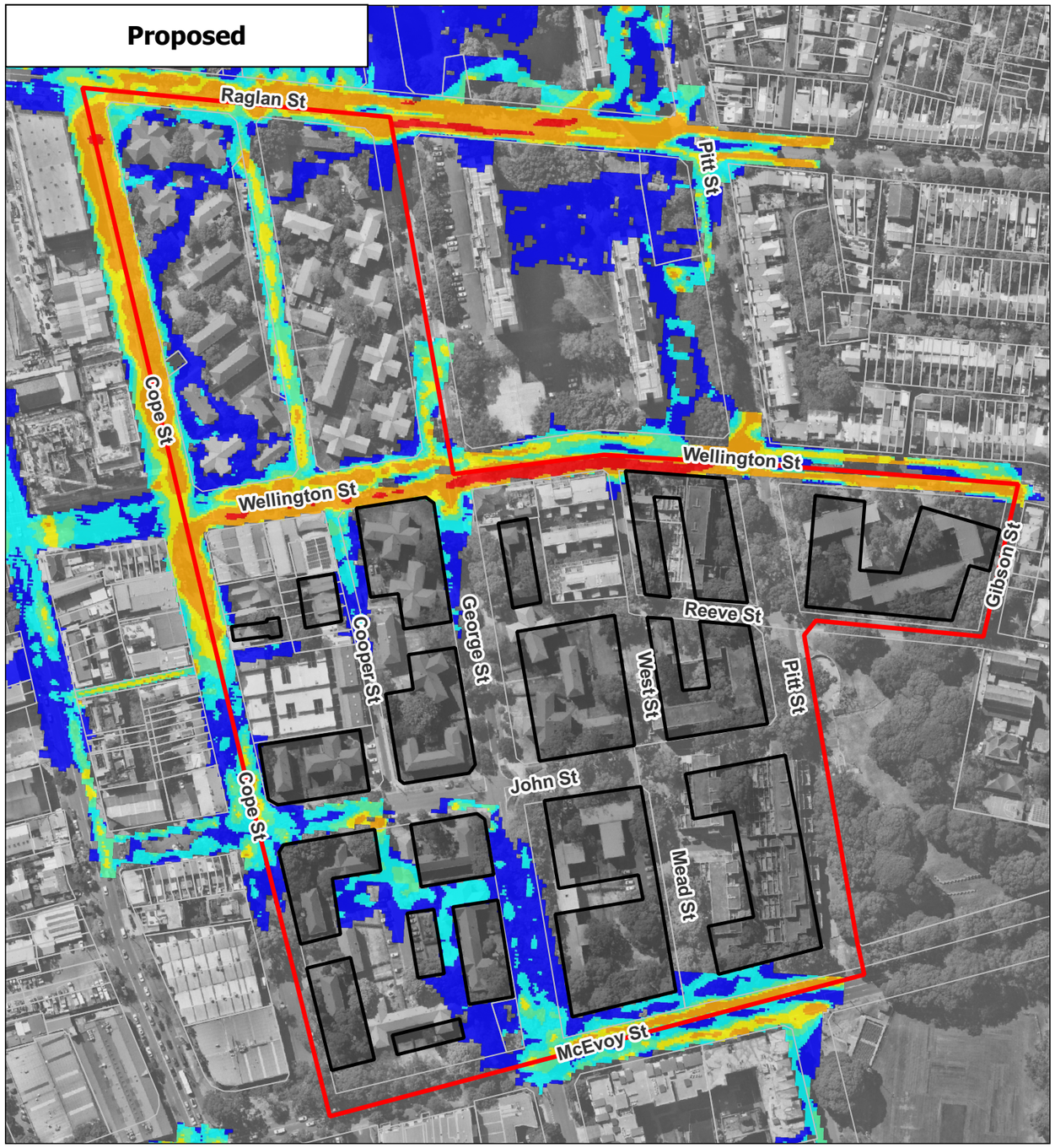
grc HYDRO

TITLE: **5% AEP Peak Flood Velocity**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A8**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Velocity (m/s)

- < 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 2.00
- > 2.00

N W E S

0 100 200

grc HYDRO

TITLE: **1% AEP Peak Flood Velocity**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A9**

Existing

Proposed

Raglan St
Pitt St
Cope St
Wellington St
Gibson St
Cooper St
George St
Reeve St
West St
John St
Mead St
McEvoy St

Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Velocity (m/s)

- < 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 2.00
- > 2.00

N
W
E
S

0 100 200

grc HYDRO

TITLE: **0.5% AEP Peak Flood Velocity**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A10**

Existing

Proposed

Raglan St
Pitt St
Cope St
Wellington St
Gibson St
Cooper St
George St
Reeve St
West St
John St
Mead St
McEvoy St

Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Velocity (m/s)

- < 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 2.00
- > 2.00

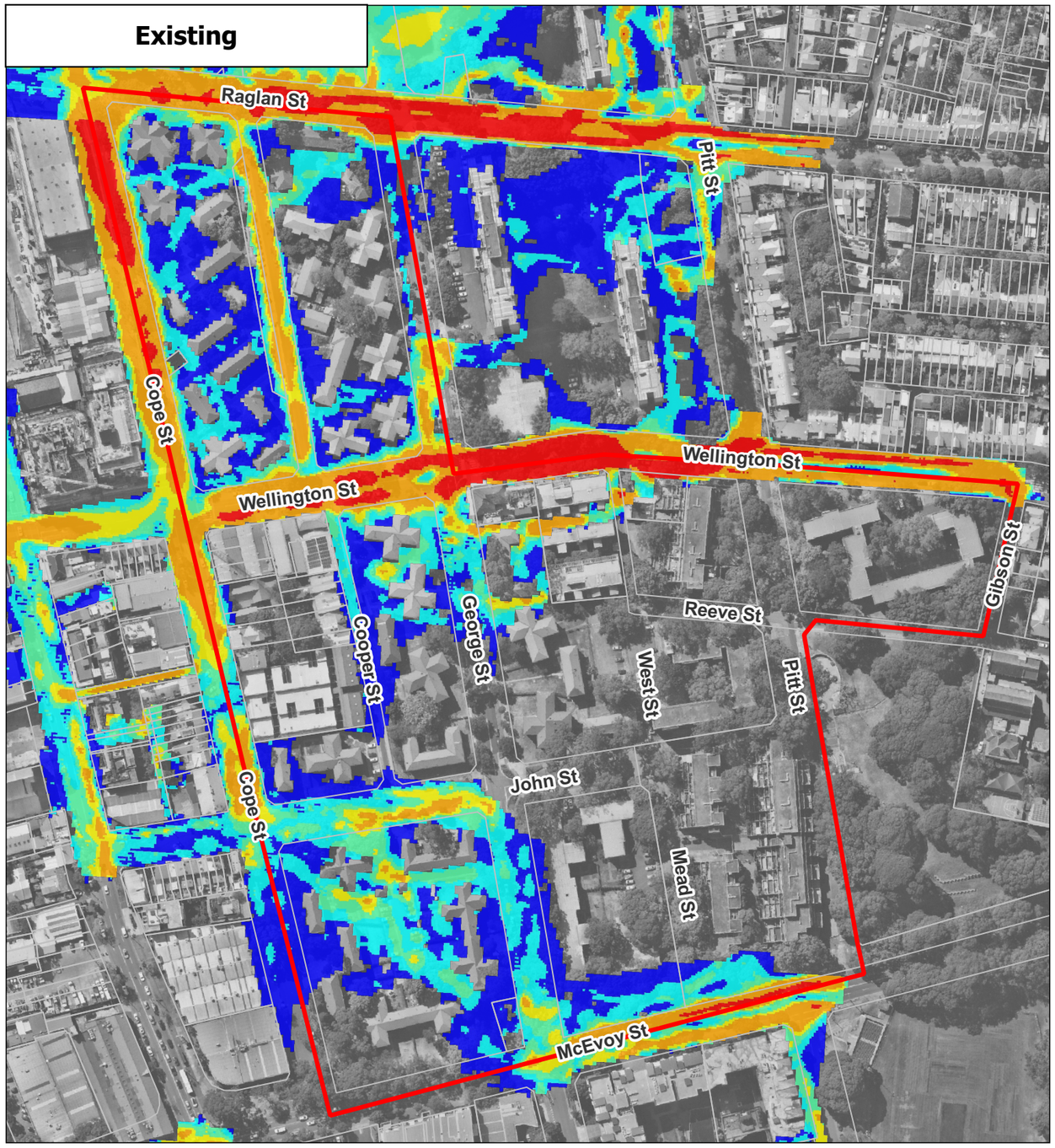
N
W E
S

0 100 200

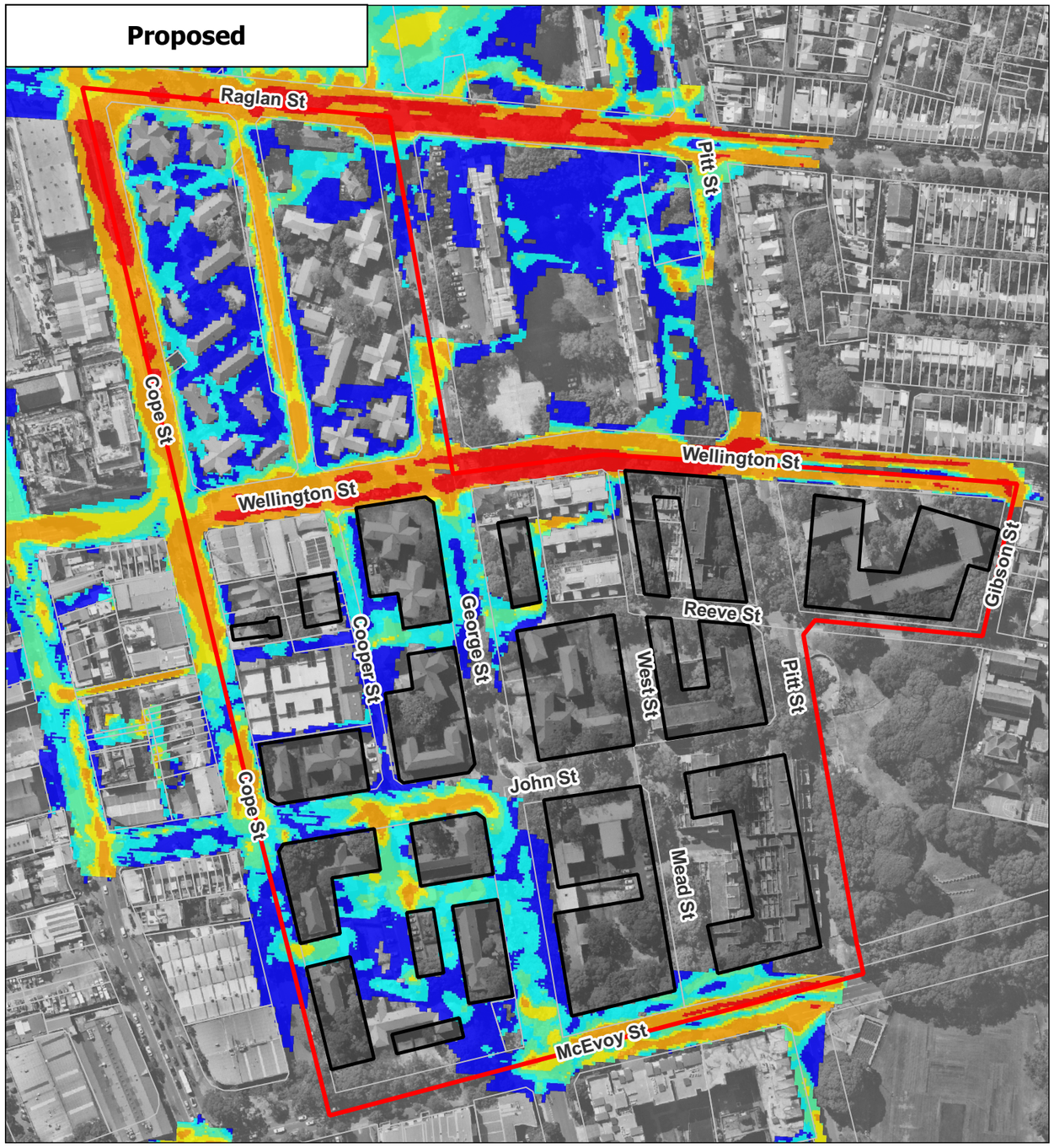
grc HYDRO

TITLE: **0.2% AEP Peak Flood Velocity**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A11**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Velocity (m/s)

- < 0.25
- 0.25 to 0.50
- 0.50 to 0.75
- 0.75 to 1.00
- 1.00 to 2.00
- > 2.00

N W E S

0 100 200

grc HYDRO

TITLE: **PMF Peak Flood Velocity**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A12**

Existing

Proposed

Raglan St
Pitt St
Cope St
Wellington St
Gibson St
Cooper St
George St
Reeve St
West St
John St
Mead St
McEvoy St

Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

N
W E
S

0 100 200

grc HYDRO

TITLE: **20% AEP Peak Flood Hazard**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A13**

Existing

Proposed

Raglan St
Pitt St
Cope St
Wellington St
Gibson St
Cooper St
George St
Reeve St
West St
John St
Mead St
McEvoy St

Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

N
W E
S

0 100 200

grc HYDRO

TITLE: **5% AEP Peak Flood Hazard**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A14**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

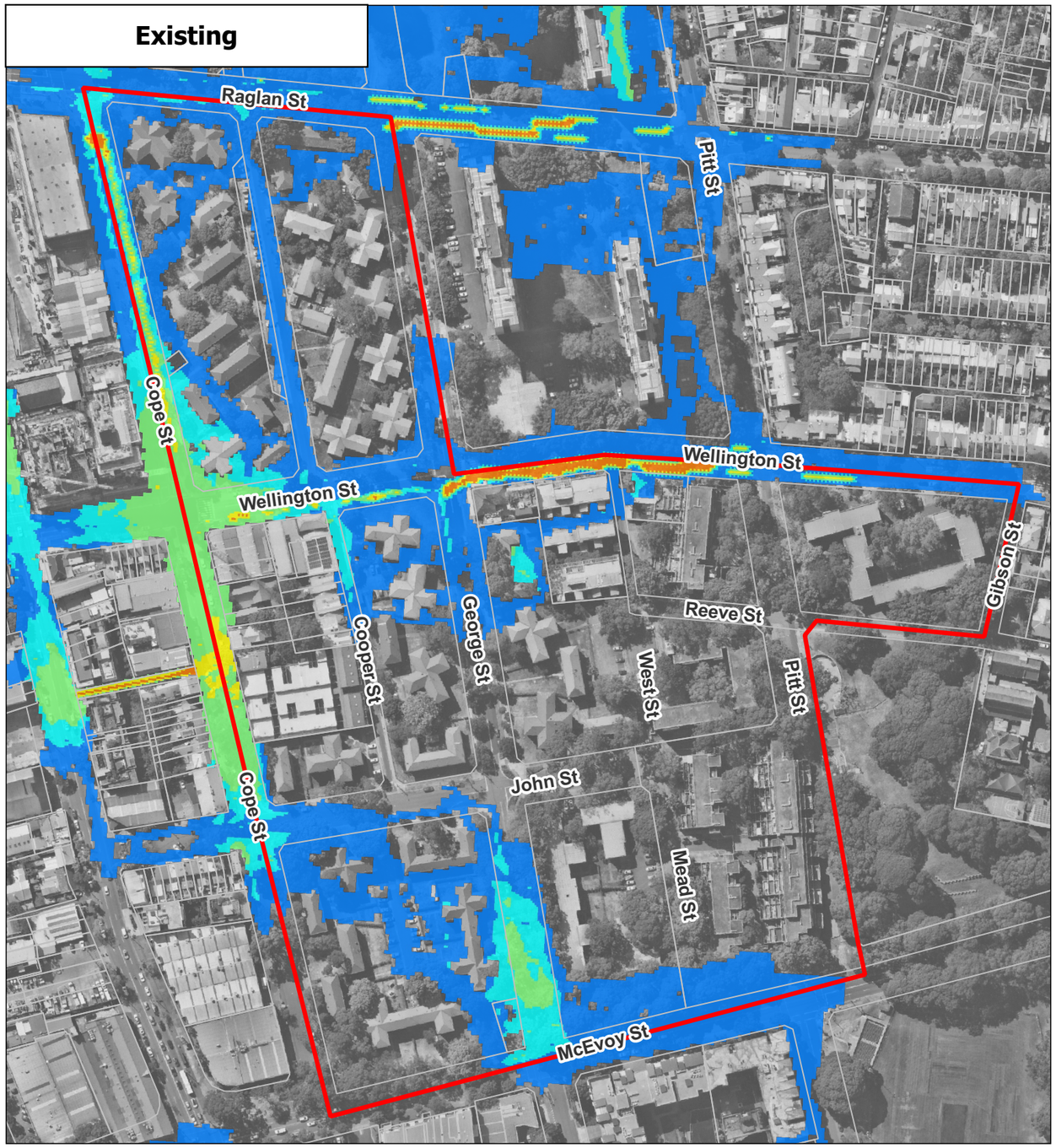
N
W E
S

0 100 200

grc HYDRO

TITLE: **1% AEP Peak Flood Hazard**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A15**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

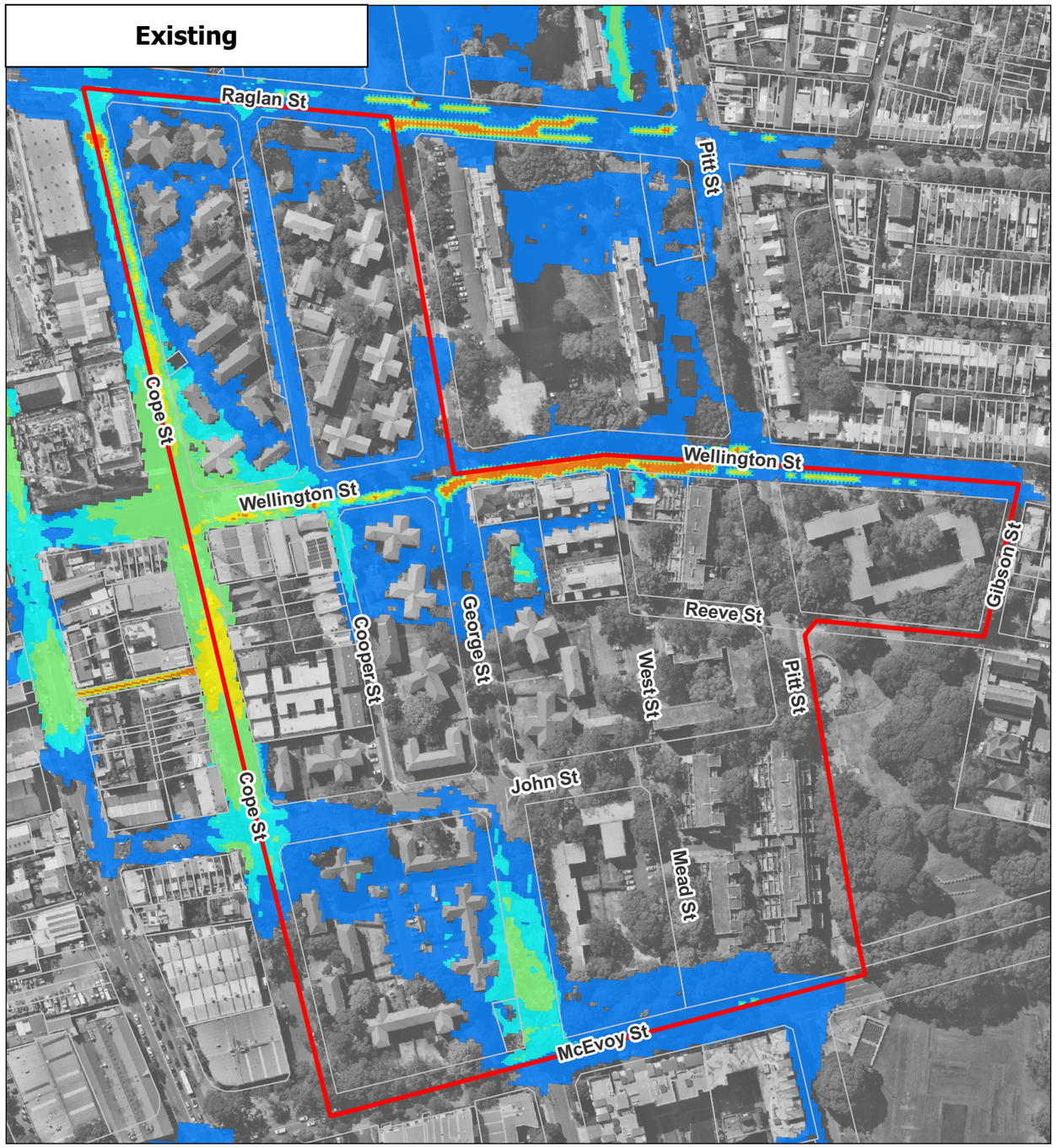
N
W E
S

0 100 200

grc HYDRO

TITLE: **0.5% AEP Peak Flood Hazard**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A16**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

N
W E
S

0 100 200

grc HYDRO

TITLE: **0.2% AEP Peak Flood Hazard**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A17**

Existing

Proposed

Raglan St
Pitt St
Cope St
Wellington St
Gibson St
Cooper St
George St
Reeve St
West St
John St
Mead St
McEvoy St

Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

N
W
E
S

0 100 200

grc HYDRO

TITLE: **PMF Peak Flood Hazard**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A18**



Legend

- Subject Site
- Cadastral Boundaries

Hydraulic Category

- Flow Conveyance
- Flood Storage
- Flood Fringe

N
W E
S

0 100 200

grc HYDRO

TITLE: **Existing Case - 1% AEP Flood Function**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **12-2025**	SCALE: **1:2500**	FIGURE No. **A19**



Legend

- Subject Site
- Cadastral Boundaries

Hydraulic Category

- Flow Conveyance
- Flood Storage
- Flood Fringe

N
W E
S

0 100 200

grc HYDRO

TITLE: **Existing Case - PMF Flood Function**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **12-2025**	SCALE: **1:2500**	FIGURE No. **A20**



Legend

- Subject Site
- Cadastral Boundaries

Flood Emergency Response Classification

- Areas with Overland Escape Routes
- Areas with Rising Road Access

N
W E
S

0 100 200

grc HYDRO

TITLE: **Existing Case - 1% AEP Flood Emergency Response Classification of Communities**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **12-2025**	SCALE: **1:2500**	FIGURE No. **A21**



Legend

- Subject Site
- Cadastral Boundaries

Flood Emergency Response Classification

- Areas with Overland Escape Routes
- Areas with Rising Road Access

N
W E
S

0 100 200

grc HYDRO

TITLE: **Existing Case - PMF Flood Emergency Response Classification of Communities**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **12-2025**	SCALE: **1:2500**	FIGURE No. **A22**



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Impact (mm)

- Was wet - now dry
- > -150
- -150 to -100
- -100 to -50
- -50 to -30
- -30 to -10
- No Change (+/- 10)
- 10 to 30
- 30 to 50
- 50 to 100
- 100 to 150
- > 150
- Was dry - now wet

- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **20% AEP Peak Flood Level Impacts**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2500**	FIGURE No. **A23**



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Impact (mm)

- Was wet - now dry
- > -150
- -150 to -100
- -100 to -50
- -50 to -30
- -30 to -10
- No Change (+/- 10)
- 10 to 30
- 30 to 50
- 50 to 100
- 100 to 150
- > 150
- Was dry - now wet

- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **5% AEP Peak Flood Level Impacts**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2500**	FIGURE No. **A24**



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Impact (mm)

- Was wet - now dry
- > -150
- -150 to -100
- -100 to -50
- -50 to -30
- -30 to -10
- No Change (+/- 10)
- 10 to 30
- 30 to 50
- 50 to 100
- 100 to 150
- > 150
- Was dry - now wet

- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **1% AEP Peak Flood Level Impacts**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2500**	FIGURE No. **A25**



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Impact (mm)

- Was wet - now dry
- > -150
- -150 to -100
- -100 to -50
- -50 to -30
- -30 to -10
- No Change (+/- 10)
- 10 to 30
- 30 to 50
- 50 to 100
- 100 to 150
- > 150
- Was dry - now wet

- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **0.5% AEP Peak Flood Level Impacts**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2500**	FIGURE No. **A26**



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Impact (mm)

- Was wet - now dry
- > -150
- -150 to -100
- -100 to -50
- -50 to -30
- -30 to -10
- No Change (+/- 10)
- 10 to 30
- 30 to 50
- 50 to 100
- 100 to 150
- > 150
- Was dry - now wet

- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **0.2% AEP Peak Flood Level Impacts**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2500**	FIGURE No. **A27**



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Impact (mm)

- Was wet - now dry
- > -150
- -150 to -100
- -100 to -50
- -50 to -30
- -30 to -10
- No Change (+/- 10)
- 10 to 30
- 30 to 50
- 50 to 100
- 100 to 150
- > 150
- Was dry - now wet

- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **PMF Peak Flood Level Impacts**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2500**	FIGURE No. **A28**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

- Major Flood Level Contours (Spacing = 1 m)
- Minor Flood Level Contours (Spacing = 0.2 m)

- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

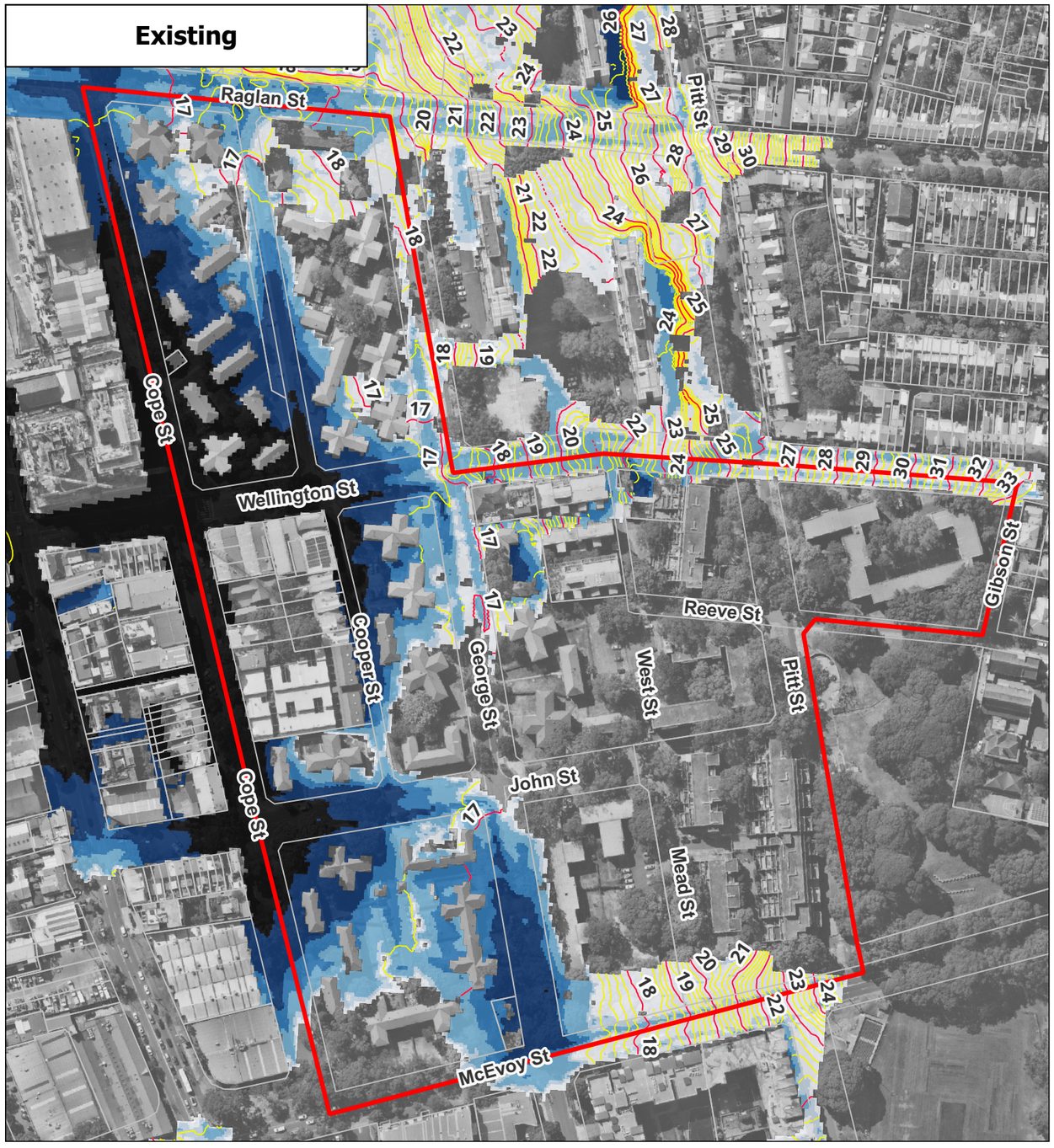
N W E S

0 100 200

grc HYDRO

TITLE: **1% AEP Peak Flood Depths and Levels - Present Day Scaling**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A29**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

- Major Flood Level Contours (Spacing = 1 m)
- Minor Flood Level Contours (Spacing = 0.2 m)

- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **PMF Peak Flood Depths and Levels - Present Day Scaling**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A30**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

- Major Flood Level Contours (Spacing = 1 m)
- Minor Flood Level Contours (Spacing = 0.2 m)
- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

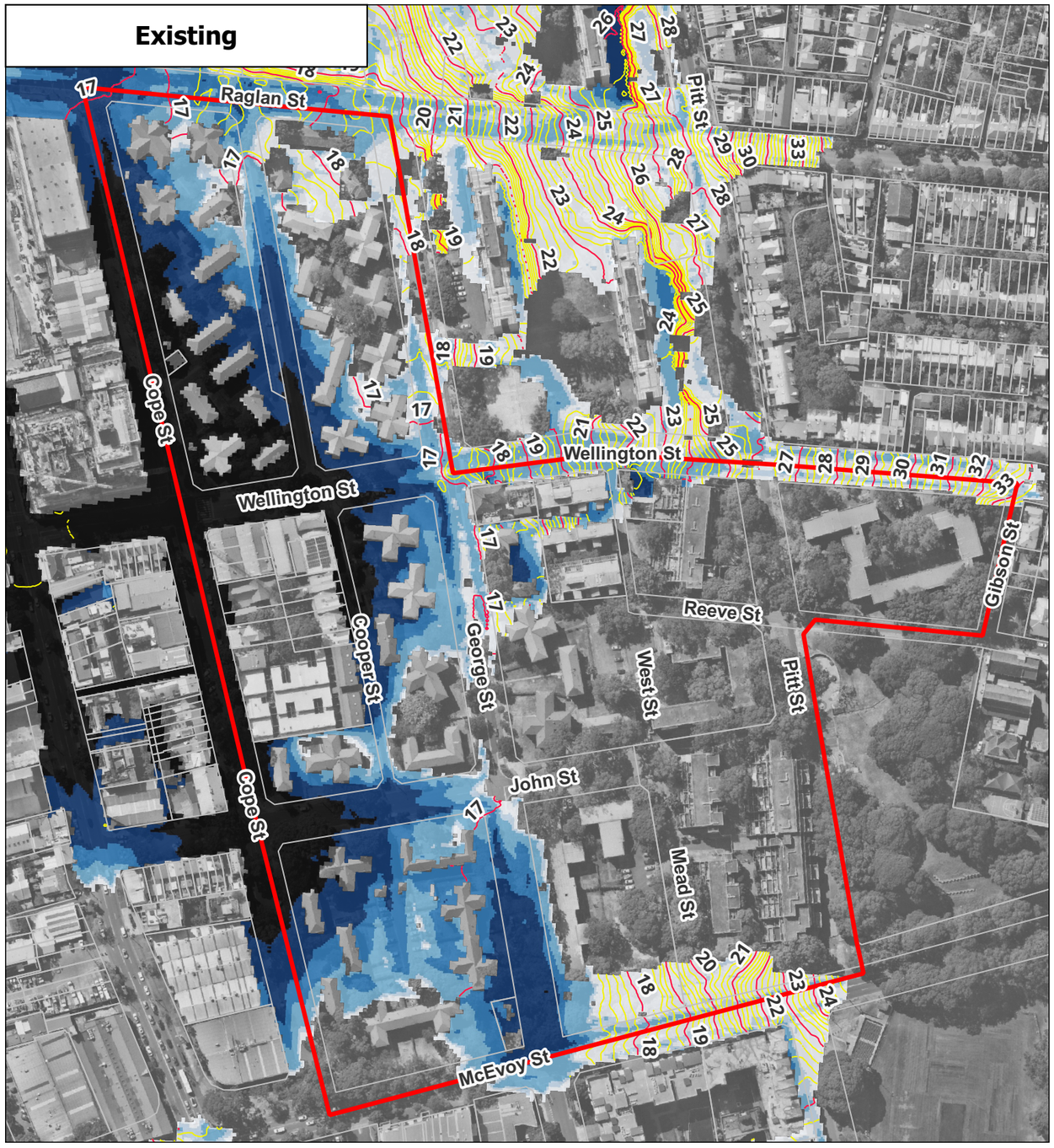
N W E S

0 100 200

grc HYDRO

TITLE: **1% AEP Peak Flood Depths and Levels - Climate Change 2050**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A31**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

- Major Flood Level Contours (Spacing = 1 m)
- Minor Flood Level Contours (Spacing = 0.2 m)

- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **PMF Peak Flood Depths and Levels - Climate Change 2050**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A32**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

- Major Flood Level Contours (Spacing = 1 m)
- Minor Flood Level Contours (Spacing = 0.2 m)
- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

N W E S

0 100 200

grc HYDRO

TITLE: **1% AEP Peak Flood Depths and Levels - Climate Change 2100**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A33**

Existing

Proposed

Raglan St
Pitt St
Cope St
Wellington St
Cooper St
George St
West St
Reeve St
Gibson St
John St
Mead St
McEvoy St

Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

- Major Flood Level Contours (Spacing = 1 m)
- Minor Flood Level Contours (Spacing = 0.2 m)
- Existing Stormwater Pits
- Existing Stormwater Pipes
- Proposed Stormwater Pits
- Proposed Stormwater Pipes

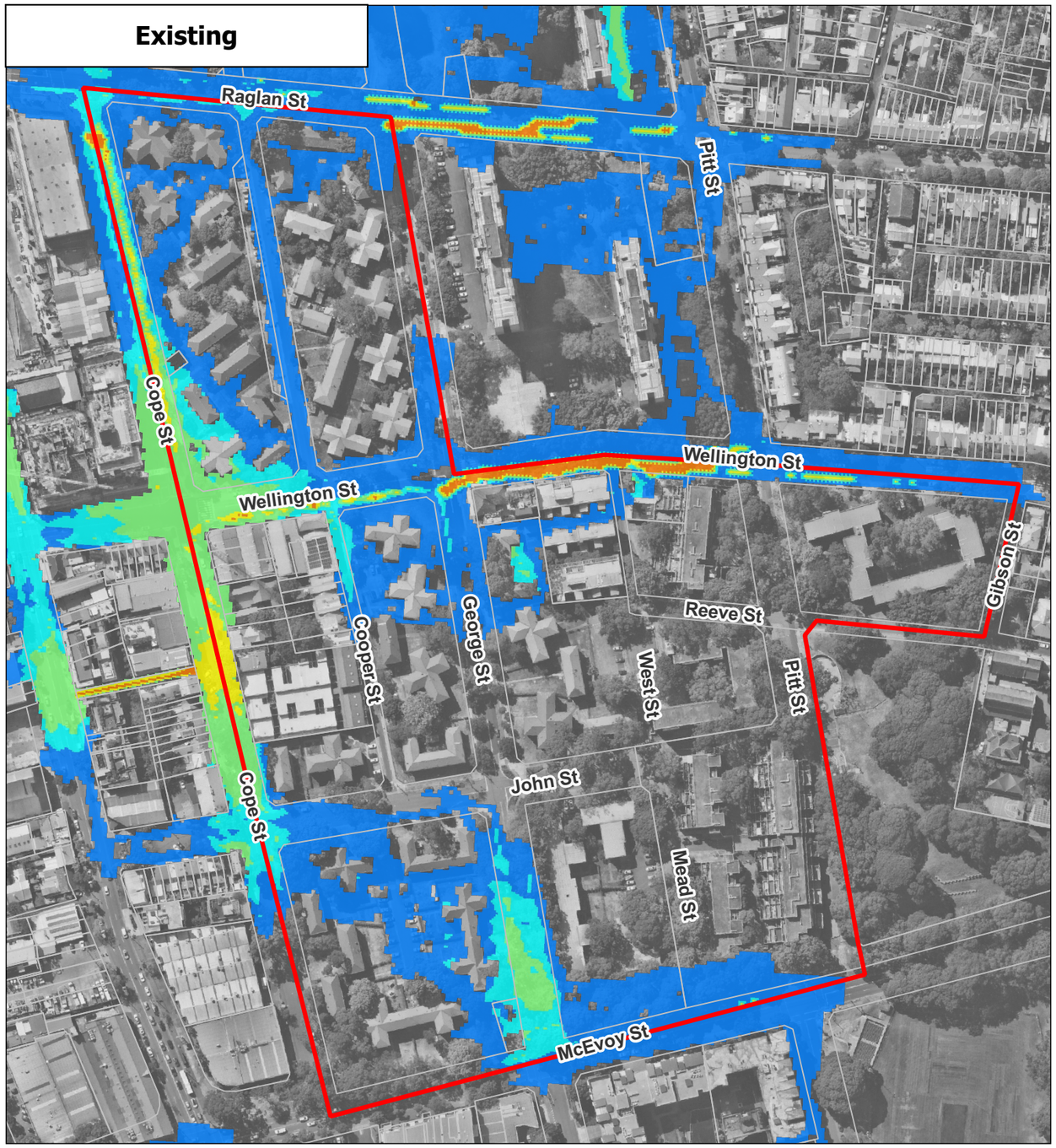
N W E S

0 100 200

grc HYDRO

TITLE: **PMF Peak Flood Depths and Levels - Climate Change 2100**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A34**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

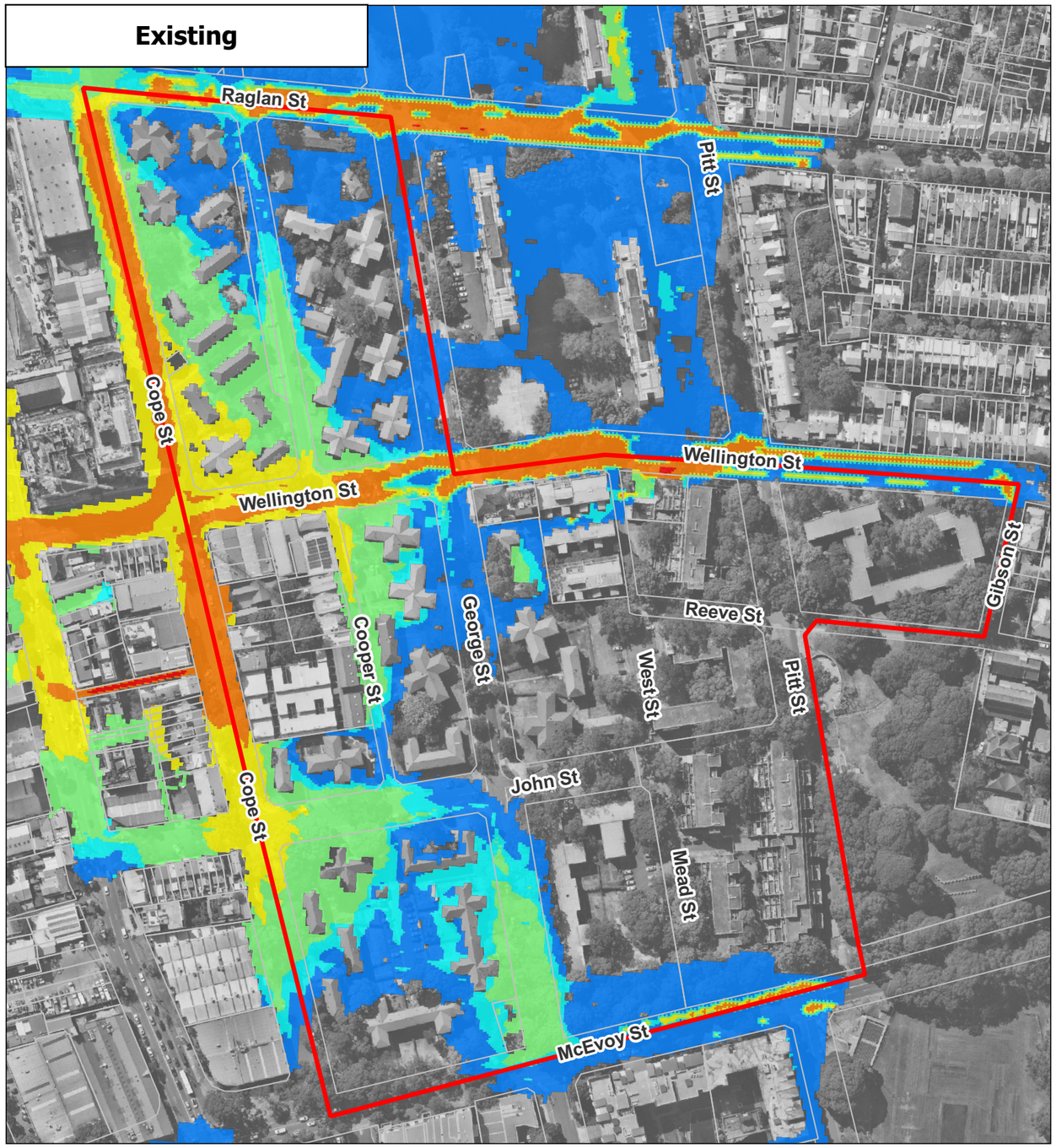
N
W E
S

0 100 200

grc HYDRO

TITLE: **1% AEP Peak Flood Hazard - Present Day Scaling**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A35**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

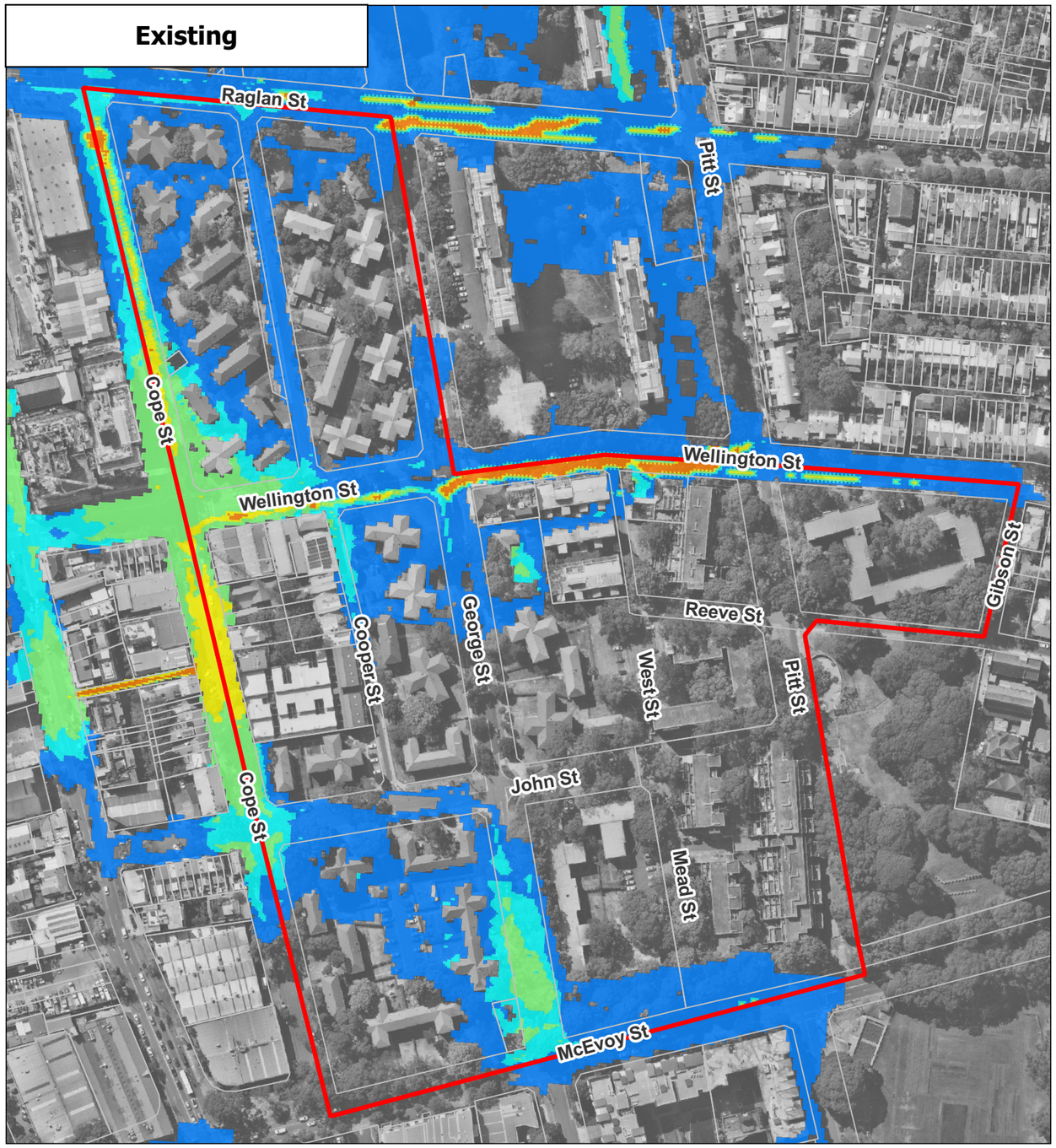
N
W E
S

0 100 200

grc HYDRO

TITLE: **PMF Peak Flood Hazard - Present Day Scaling**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A36**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

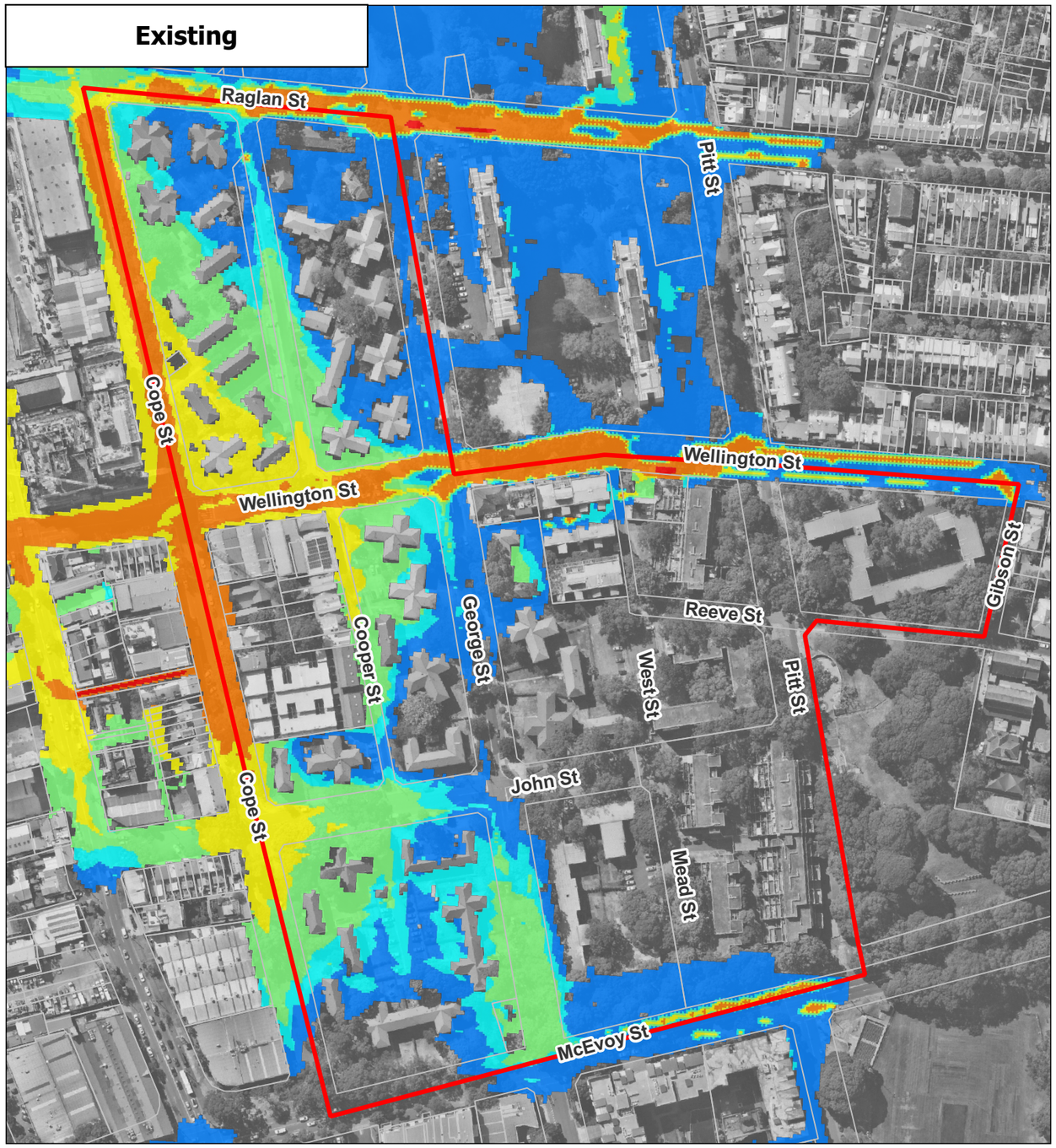
N
W E
S

0 100 200

grc HYDRO

TITLE: **1% AEP Peak Flood Hazard - Climate Change 2050**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A37**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

N
W E
S

0 100 200

grc HYDRO

TITLE: **PMF Peak Flood Hazard - Climate Change 2050**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A38**

Existing

Proposed

Raglan St
Pitt St
Cope St
Wellington St
Gibson St
Reeve St
Cooper St
George St
West St
John St
Mead St
McEvoy St

Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

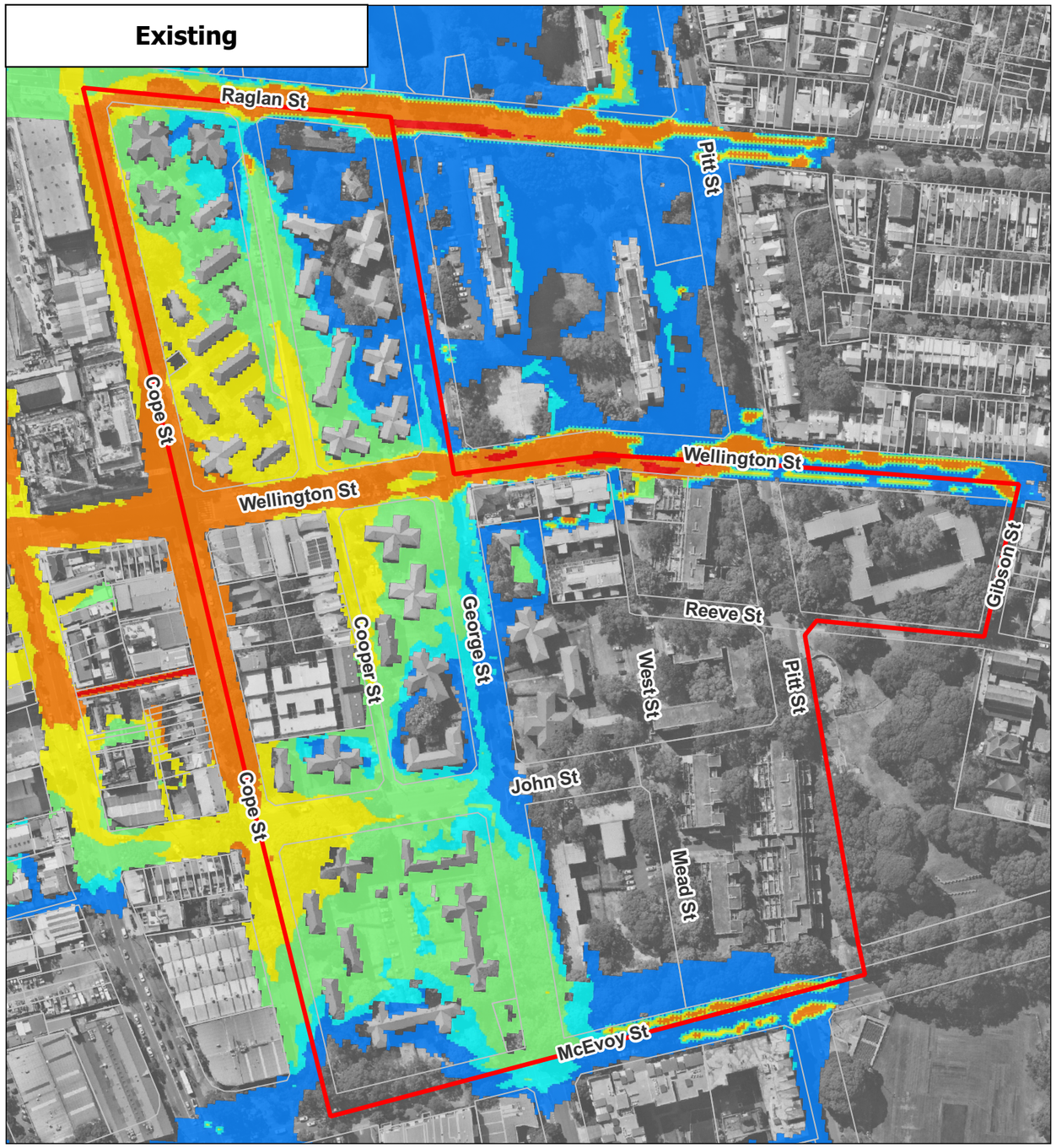
N
W E
S

0 100 200

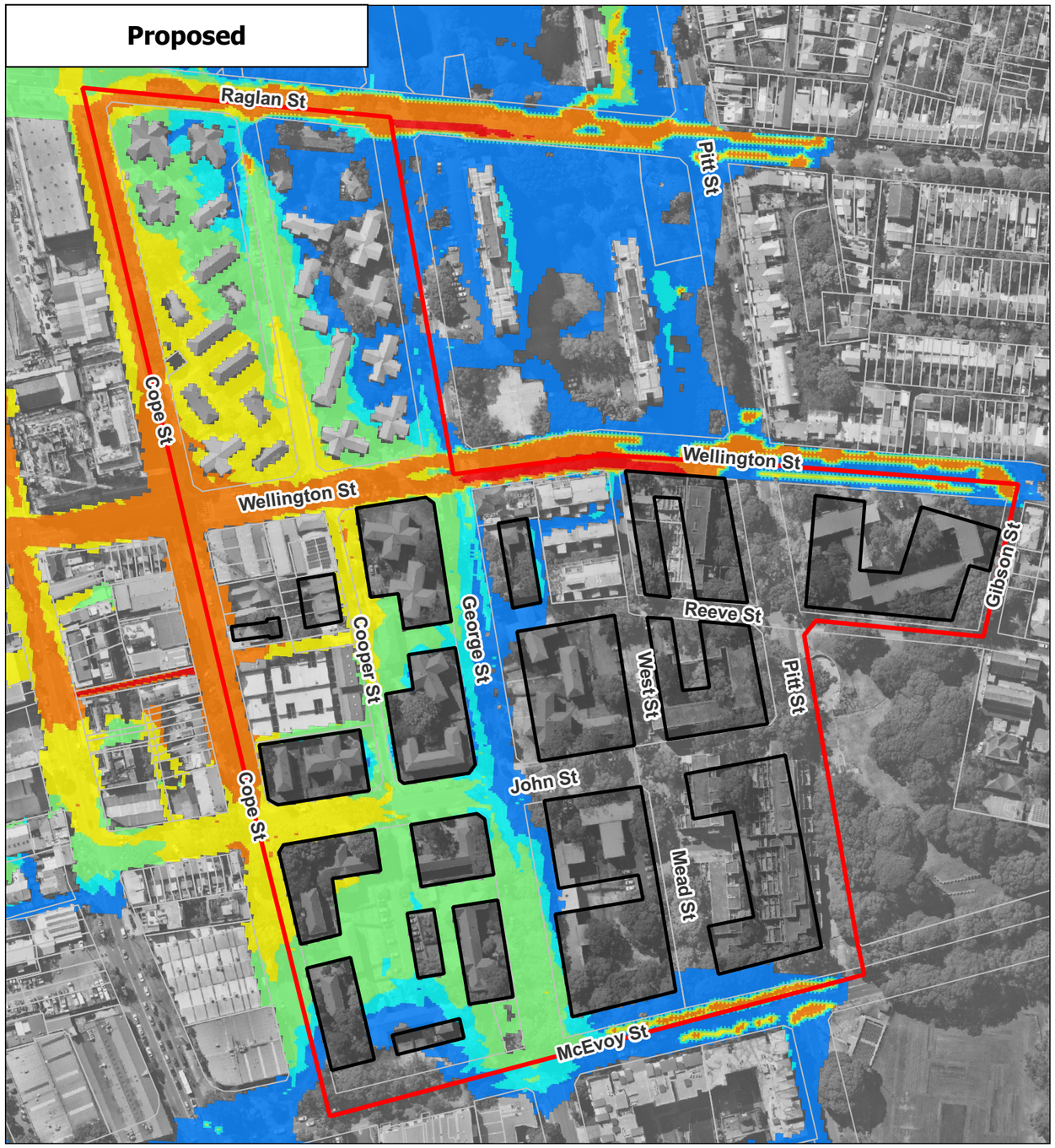
grc HYDRO

TITLE: **1% AEP Peak Flood Hazard - Climate Change 2100**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A39**

Existing



Proposed



Legend

- Subject Site
- Cadastral Boundaries
- Proposed Building Footprint

Flood Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

N
W E
S

0 100 200

grc HYDRO

TITLE: **PMF Peak Flood Hazard - Climate Change 2100**	PROJECT: **Waterloo Estate (South)**	PROJECT No. **220126**	DATE: **01-2026**	SCALE: **1:2600**	FIGURE No. **A40**