INNER WEST

Council's Alternate Approach for New Housing in the Inner West

APPENDIX 5

Flood Impact and Risk Assessment (FIRA) Our Fairer Future Plan 2

September 2026

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Inner West Council

Our Fairer Future Plan 2

Flood Impact and Risk Assessment

September 2026

rp311015-00885lt260901 Inner West OFFP2 FIRA

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Project No. 311015-00885: Our Fairer Future Plan 2 Flood Impact and Risk Assessment

Rev	Description	Author	Reviewer	Approver	Revision Date
A	Draft for Internal Review	**LT** L To	**CRT** C Thomas		25/08/2026
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Executive Summary

Background

Inner West Council (**Council**) is working together with the NSW Government to create more well-located homes close to transport, jobs and services. Parts of the Inner West Local Government Area (**LGA**) are affected by a number of key NSW Government Housing Reforms including the Transport Oriented Development (**TOD**) Program, the Low and Mid-Rise Housing (**LMRH**) policy and ongoing State-Led Rezoning projects for Parramatta Road and Bays West. The NSW Government has also assigned Council an LGA-wide target for delivery of 7,800 new constructed dwellings by 2029.

In response to the housing reforms and the housing target, Council resolved to prepare an alternative plan for the Inner West titled, *Our Fairer Future Plan*. This plan is being prepared in two stages and seeks to replace the State's reforms while meeting or exceeding the new housing capacity that the implementation of the reforms would deliver.

Our Fairer Future Plan 1 was adopted by Council in September 2025 and has been submitted to the NSW Government for finalisation. It proposes new housing capacity in the suburbs of:

- Ashfield, Dulwich Hill and Marrickville; as informed by the *Inner West Housing Investigation Area Master Plans Flood Impact and Risk Assessment* (Worley Consulting, 2025); and,
- Leichhardt, Stanmore, Petersham, Lewisham and St Peters; on sites located outside of the adopted Probable Maximum Flood extent and therefore not identified as being flood affected.

Our Fairer Future Plan 2 was initiated following Council's adoption of Our Fairer Future Plan 1. It proposes new housing capacity in the suburbs of Leichhardt, Lilyfield, Annandale, Stanmore, Petersham, Lewisham and St Peters, at locations not already investigated under Our Fairer Future Plan 1. Our Fairer Future Plan 2 also includes certain sites which are owned by Homes NSW which are located in the Inner West LGA.

The studies completed by Council indicate that several locations within the Our Fairer Future Plan 2 study area could be affected by flooding. Therefore, any proposed redevelopment to increase the density of built form would need to allow for appropriate management of flooding. In recognition of this, Council engaged Worley Consulting to undertake a Flood Impact and Risk Assessment (**FIRA**) for a number of potential uplift scenarios which are representative of the proposed planning controls for the study area.

Flood Modelling of Uplift Scenarios

The FIRA investigated the potential for several uplift scenarios to affect existing flooding patterns and flood risk in the study area (refer **Figure 7-1** to **Figure 7-3**). These investigations determined that redevelopment of many of the development areas is not predicted to lead to unacceptable off-site impacts on existing flood characteristics. However, the uplift scenarios for six (6) of the development areas will lead to some adverse impacts on neighbouring properties. This includes proposed developments in the vicinity of:

a. Francis Street, Leichhardt (refer Section 7.3.1 and Figure 7-4);

b. View Street, Annandale (refer Section 7.3.2 and Figure 7-5);

c. Ainsworth Street and White Street, Lilyfield (refer Section 7.3.3 and Figure 7-6);

d. Livingstone Road and Maria Street, Petersham (refer Section 7.3.4 and Figure 7-7);

e. Fotheringham Street, Enmore (refer Section 7.3.5 and Figure 7-8); and,

f. Edgeware Road and Camden Street, Marrickville (refer Section 7.3.6 and Figure 7-9).

For some sites at Francis Street, View Street, Ainsworth Street and White Street, further flood model testing is required post-exhibition of this report in order to reduce the magnitude of the off-site flood impact. The relevant sites identified by the solid red polygons in **Figure 7-4** to **Figure 7-6**.

For all other sites nominated in the list above, it is envisaged that the flood impacts could be managed at the development application stage given that the flood impacts are localised or otherwise expected to be confined to road reserves where there are no material impacts to the existing trafficability of the road.

Accordingly, the proposed planning controls for most proposed uplift locations, as represented by the indicative building footprints, can proceed subject to compliance with the development controls and flood planning recommendations outlined below. The locations denoted by the solid red polygons in **Figure 7-4** to **Figure 7-6** require further flood testing to be undertaken post-exhibition to reduce the predicted flood impacts before they can proceed.

The other potential uplift scenarios are not expected to lead to any material adverse off-site flood impacts, or otherwise are predicted to lead to some minor flood impacts which could be managed through design refinements and/or the implementation of on-site mitigation measures.

Flood Modification Measures and Proposed Drainage Works

Several flood modification measures were recommended in Council's adopted floodplain risk management plans for the catchments that drain through the Our Fairer Future Plan 2 study area. A number of relevant drainage works items in the Inner West Local Infrastructure Contributions Plan 2023 are also proposed for the study area. However, these flood modification measures / drainage works items either provide limited benefit in reducing the existing flood risk in the study areas and/or would involve significant cost and disruption to implement.

Flash Flooding and Shelter in Place

Flooding in the study area can be characterised as flash flooding. Flooding typically occurs within 10 to 15 minutes from the onset of rainfall, with flood levels peaking within an hour from the onset of rainfall. Flash flooding has several implications for emergency response management:

a. Given the minimal response time, an evacuation strategy based on advanced warning and with assistance by the NSW State Emergency Services (**SES**) is not feasible. Therefore, self-evacuation is the only potential means of evacuation.

b. There are safe evacuation routes available for most development sites which can be used by occupants to reach land outside of the Probable Maximum Flood (**PMF**) extent, which would allow occupants to self-evacuate if required at these respective sites.

c. However, there are some sites where a safe evacuation route is not available. These sites would be required to adopt a shelter-in-place (**SIP**) flood emergency response. The location of development sites which require SIP is shown in **Figure 8-1** and **Figure 8-2**.

   It is understood that self-evacuation at these sites <u>may</u> become feasible should alternative lot amalgamations arise which provide additional access points, thereby enabling occupants to safely leave the site without entering hazardous floodwaters. Self-evacuation may also become feasible with the adoption of right-of-way easements which would provide alternative access points and evacuation routes.

d. The adoption of SIP for <u>all</u> potential uplift locations within the PMF extent would align with the objectives and criteria outlined in the NSW Government's '*Shelter-in-place guideline for flash flooding*' (NSW Department of Planning, Housing and Infrastructure, 2025).

e. The availability of a safe evacuation route for most development sites is beneficial at reducing flood risk at these sites, given that the safe evacuation route can be used by emergency response personnel to reach the site to attend to secondary emergencies such as medical or fire related incidents.

Flood Planning Advice and Recommendations

A number of recommendations to manage the flood risk for new developments in the area were also provided.

a. All proposed development within the study area must adhere to the flood planning controls specified in **Section 8.1**.

b. The proposed housing uplift in the study area generally leads to larger distances between proposed buildings when compared to existing conditions where existing housing is closely spaced. This leads to the capacity for a greater quantity of runoff flowing onto the surrounding streets.

   Therefore, it is recommended that all housing uplift in the study area should be supported by further modelling analysis at the development application stage to ensure that the proposed development will not lead to an increase in the amount of runoff discharging into adjacent streets. This could comprise the implementation of on-site detention in accordance with Council's planning controls and engineering guidelines.

c. Sensitive land uses such as hospitals, aged care, childcare, schools and emergency services should be located outside the PMF extent.

d. While safe evacuation routes exist for many of the development sites to land outside of the PMF extent, it is recommended for all developments within the PMF extent to incorporate features to enable a Shelter-in-Place (**SIP**) response. Given that the duration of inundation is typically 2 hours or less, it would be safer and more practical for residents to remain at home. Therefore, development must ensure that it aligns with the objectives and criteria outlined in the NSW Government's guideline titled, '*Shelter-in-place guideline for flash flooding'* (NSW Department of Planning, Housing and Infrastructure, 2025).

e. For developments where off-site evacuation is not possible (refer **Section 8.2.2**, **Figure 8-1** and **Figure** 8-2), a site-specific Flood Emergency Response Plan (**FERP**) must be developed which specifies how SIP will be implemented and must include specific details on how secondary emergencies such as medical or fire incidents will be managed. This is important as it may be difficult for emergency services to access specific development areas due to flooding of roads that would provide access. These developments should also explore the possibility of alternative lot amalgamations and/or right-of-way easements to provide safe evacuation routes.

f. The Bureau of Meteorology's FLARE resource should be used to investigate the feasibility of developing a tailored flash flood warning system for the study area.

g. Several proposed uplift locations would be affected by H5 to H6 flood hazard during the PMF. These areas are listed in **Section 8.2.3**. Specialist structural engineering design of buildings that are proposed in these areas is required to ensure that the buildings are able to withstand the force of floodwaters in events up to and including the PMF.

h. Due to the low likelihood of achieving reliable off-site evacuation, all new developments should provide a floor area that is above the peak PMF level and large enough to enable a Shelter-in-Place (**SIP**) emergency response option. This is particularly important at housing uplift locations that are affected by high PMF depths (e.g. higher than 1.5 metres), such as locations adjacent to the Darley Road ponding area, Whites Creek, Johnstons Creek and Hawthorne Canal. For these locations, all habitable spaces may be required to be located on the first floor of the building; i.e., the ground floor would be reserved for non-habitable uses. Further detail is provided in **Section 8.2.4**. The time required for residents to vertically evacuate to higher floors should be assessed with reference to the predicted rate of rise of floodwaters in a PMF.

i. As noted in Point 9b in **Section 10.1**, the assessed climate change scenario is predicted to lead to significant increases in peak 1% AEP flood levels at six locations. The higher flood levels will take up a significant portion of the adopted 0.5 metre freeboard used to determine the Flood Planning Level. There are proposed developments which are located in the vicinity of these six locations. Therefore, Council should consider revising the freeboard applicable to new developments in these areas.

j. Ground level activation (i.e., entries to buildings or basements) should be provided in areas of shallowest flood depth to minimise filling or steps / ramps, according to the floor level and basement entry requirements specified in the LDCP 2013, the MDCP 2011 and the draft IWDCP 2026. Further discussion is provided in **Section 8.3**.

k. Proposed uplift in the vicinity of Francis Street, Leichhardt and View Street, Annandale, should consider the upgrade of the existing underground stormwater network at the respective locations to reduce the severity and frequency of flooding that currently affects these areas (refer **Section 7.3.1** and **Section 7.3.2**).

l. A detailed Flood Impact and Risk Assessment (**FIRA**) should be completed in support of any Development Applications (**DA**) for new developments or areas of redevelopment in flood affected parts of the housing uplift locations. The detailed FIRA should:

- assess the flood impacts of the final building design to meet the criteria specified in the LDCP 2013, the MDCP 2011 and the draft IWDCP 2026;
- address flood risk issues and emergency response, accounting for the proposed uses of the site and the number and demographic of future occupants once these details are available;
- address how SIP will be used as part of the site's emergency management response, including actions before, during and after the SIP period;
- address how SIP will be communicated to occupants and visitors of the building and how this communication will be maintained for the life of the development; and,
- provide an understanding of secondary risks and how the proponent proposes to manage these risks (e.g., building fire, medical emergencies, health and wellbeing) during a flood emergency.

The Impact of Climate Change

This FIRA has assessed a climate change sensitivity scenario which applies a 30% increase in existing ARR 1987 1% AEP rainfall intensities, as well as a sea level rise of 0.68 metres. This climate change scenario is expected to lead to increases in present day estimates of the 1% AEP flood level that are typically less than 0.2 metres along most overland flow paths.

However, there are some proposed development locations which are located in areas that are predicted to be more significantly influenced by climate change. The increase in peak 1% AEP flood level in these areas would "take up" a significant portion of the adopted 0.5 metre freeboard which is used to determine the Flood Planning Level. Council should consider revising the freeboard applicable to new developments in the areas listed below.

a. Flood levels are predicted to increase by 0.37 metres in the Darley Road ponding area to the south of the Hawthorne light rail station.

b. Flood levels are predicted to increase by 0.30 metres in the trapped area on the southern side of the proposed development which is located south of the William St / Hubert St intersection. The upgrade of the existing underground stormwater drainage network (refer **Section 7.3.1**) may reduce the magnitude of this flood level increase.

c. Flood levels along Whites Creek to the north of Piper Street are predicted to increase by up to 0.41 metres.

d. Flood levels along Johnstons Creek to the north of Booth Street are predicted to increase by up to 0.52 metres.

e. Flood levels along Hawthorne Canal to the north of Old Canterbury Road are predicted to increase by up to 0.41 metres.

f. Flood levels in the Trafalgar Street low point to the south-west of Petersham Station are predicted to increase by up to 0.43 metres.

Also, several additional sites would no longer be able to enact self-evacuation under the climate change scenario. As noted in **Section 8.2.2**, only two (2) sites do not have access to a safe evacuation route during the occurrence of a 1% AEP event based on present day estimates of rainfall and ocean tailwater levels. This would increase to a total of seven (7) sites under the adopted climate change scenario (refer **Section 8.2.2**, **Figure 8-1** and **Figure 8-2**).

1. Introduction

Inner West Council (Council) is working together with the NSW Government to create more well-located homes close to transport, jobs and services. Parts of the Inner West Local Government Area (**LGA**) are affected by key NSW Government Housing Reforms including the Transport Oriented Development (**TOD**) program, the Low and Mid-Rise Housing (**LMRH**) policy and ongoing State-Led Rezoning projects for Parramatta Road and Bays West. The NSW Government has also assigned Council an LGA-wide target for delivery of 7,800 new constructed dwellings by 2029.

In response to the housing reforms and target, Council resolved to prepare an alternative plan for the Inner West titled, *Our Fairer Future Plan*. This plan is being prepared in two stages and seeks to replace the State's reforms while meeting or exceeding the new housing capacity that they would provide.

Our Fairer Future Plan 1 was adopted by Council in September 2025 and has been submitted to the NSW Government for finalisation. It proposes new housing capacity in the suburbs of:

- Ashfield, Dulwich Hill and Marrickville; as informed by the *Inner West Housing Investigation Area Master Plans Flood Impact and Risk Assessment* (Worley Consulting, 2025); and
- Leichhardt, Stanmore, Petersham, Lewisham and St Peters; on sites located outside of the adopted Probable Maximum Flood (**PMF**) extent and therefore not identified as being flood affected.

Our Fairer Future Plan 2 was initiated following Council's adoption of Our Fairer Future Plan 1. It proposes new housing capacity in the suburbs of Leichhardt, Lilyfield, Annandale, Stanmore, Petersham, Lewisham and St Peters, at locations not already investigated under Our Fairer Future Plan 1. Our Fairer Future Plan 2 also includes certain sites which are owned by Homes NSW which are located in the Inner West LGA. The study area for Our Fairer Future Plan 2 is shown in **Figure 1-1**.

Council has previously completed flood studies and floodplain risk management studies and plans (**FRMSPs**) in the vicinity of the study area. The study area can be affected by flooding in the Hawthorne Canal, Marrickville Valley, Whites Creek, Johnstons Creek, Alexandra Canal and Eastern Channel East catchments. The extents of the catchments relative to the study area are shown in **Figure 1-2**.

The studies completed by Council indicate that several locations within the study area could be affected by flooding. Therefore, any proposed densification of built form or redevelopment would need to allow for appropriate management of flooding.

In recognition of this, Council engaged Worley Consulting to undertake a Flood Impact and Risk Assessment (**FIRA**) for Our Fairer Future Plan 2, for a number of potential uplift scenarios which are representative of the proposed planning controls for the study areas. The FIRA is to investigate the potential for the uplift scenarios to affect existing flooding patterns and flood risk in the suburbs covered by Our Fairer Future Plan 2.

This report documents the findings of the FIRA and also provides a number of recommendations to manage the flood risk for new developments in the area.

FIGURE 1-1

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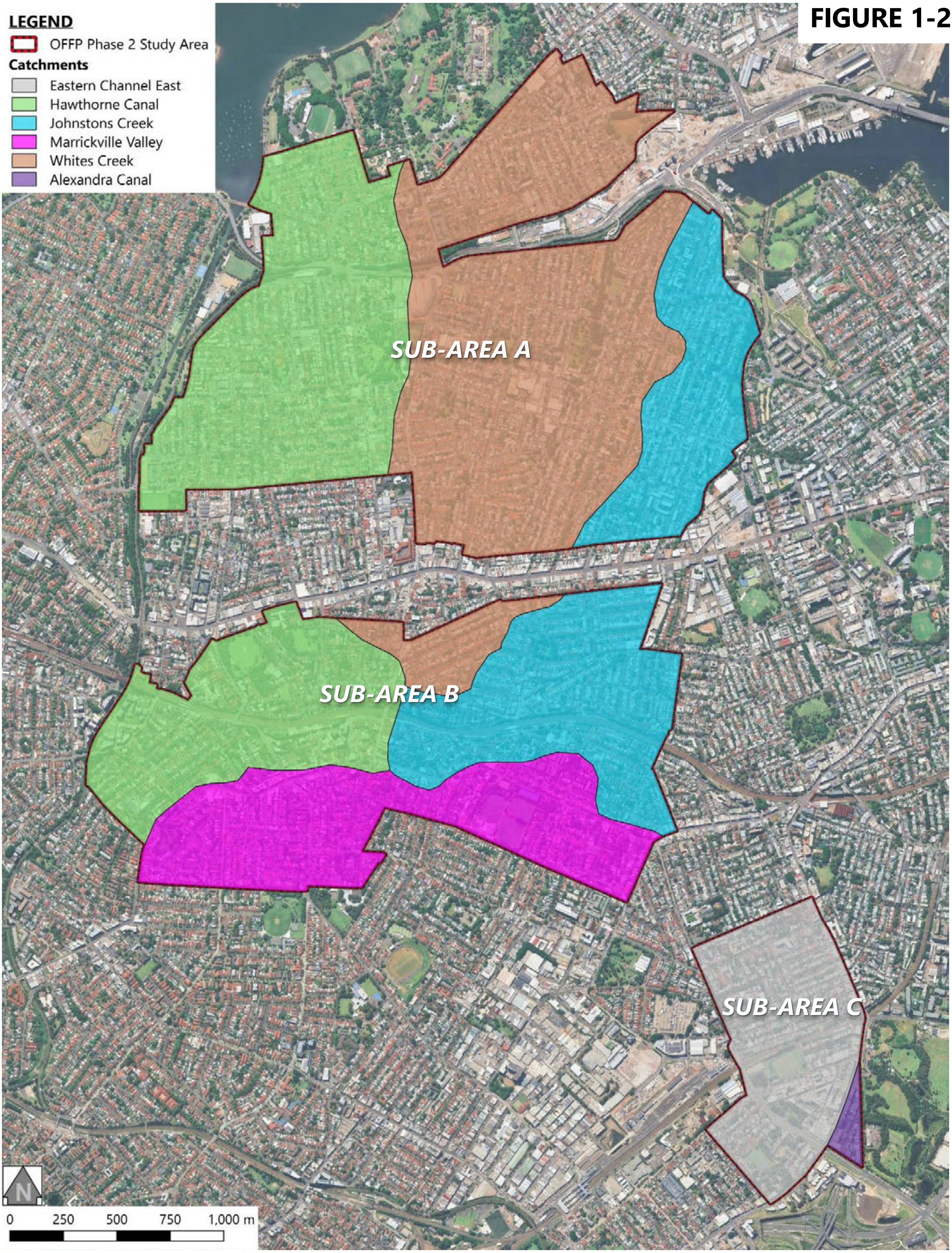
OVERVIEW OF STUDY AREA

FIGURE 1-2



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worley consulting

CATCHMENTS IN THE STUDY AREA

2. Background

2.1 Site Description

The study area is located in the inner west of the Sydney Metropolitan Area to the south-west of the Sydney Central Business District (CBD). The study area is divided into three sub-areas (refer **Figure 1-1**):

- Sub-Area A: Comprising areas to the north of the Parramatta Road State-Led Rezoning boundary including parts of Leichhardt, Annandale, Lilyfield and Rozelle. The area is serviced primarily by the light rail line which runs along the western boundary and through the northern portion of this sub-area.
- Sub-Area B: Comprising areas to the south of the Parramatta Road State-Led Rezoning boundary including parts of Lewisham, Petersham and Stanmore. The area is serviced primarily by the T2 / T4 railway line which runs in an east-west alignment through the centre of the sub-area.
- Sub-Area C: Comprising parts of St Peters and Newtown in the vicinity of St Peters railway station. The area is serviced primarily by the T3 railway line which runs in an east-west alignment through the centre of the sub-area.

The sub-areas comprise primarily residential properties, with some pockets of commercial land use located near rail stations and main roads. The study areas are highly urbanised with minimal areas of open space outside dedicated road reserves.

Sub-Area A is drained by the three major watercourses of Hawthorne Canal, Whites Creek and Johnstons Creek. Hawthorne Canal is an open concrete-lined channel which flows from south to north, discharging into Iron Cove at the north-western extent of Sub-Area A. The western section of Sub-Area A falls within the Hawthorne Canal catchment.

Whites Creek runs from south to north through the middle of Sub-Area A. It originates near the southern boundary of Sub-Area A and comprises an underground culvert system which follows the general alignment of Whites Creek Lane. The underground culvert transitions into an open concrete channel near Wisdom Street and Whites Creek Valley Park, and continues in a northerly direction before discharging into Rozelle Bay.

The eastern portion of Sub-Area A falls within the Johnstons Creek catchment. The creek channel starts near Salisbury Road and comprises an open concrete channel between Salisbury Road and Parramatta Road. The creek passes beneath Parramatta Road as an underground channel (culvert) before transitioning back into an open concrete-lined channel to the north of Water Street near the south-eastern extent of Sub-Area A. Johnstons Creek then continues in a northward direction through Annandale and Glebe before discharging into Rozelle Bay.

New Canterbury Road / Stanmore Road runs in an east-west alignment through Sub-Area B and acts as a catchment divide. Areas to the north of this road drain northwards into Hawthorne Canal, Whites Creek and Johnstons Creek, while areas to the south fall within the Marrickville Valley catchment. The Marrickville Valley catchment comprises several overland flow paths that typically drain southward towards low-lying land in the vicinity of the Marrickville industrial area.

Sub-Area C falls mostly within the Eastern Channel East catchment. The Princes Highway acts as a catchment divide, with areas west of the highway draining to the Eastern Channel East catchment. The small area to the east of the highway drains into Alexandra Canal.

2.2 Data Collection and Review

2.2.1 Previous Flood Studies

Flood behaviour in the Hawthorne Canal, Whites Creek, Johnstons Creek, Marrickville Valley, Alexandra Canal and Eastern Channel East catchments has previously been investigated in FRMSPs undertaken by Inner West Council as part of the NSW Government's floodplain management program.

A summary of previous completed flood studies relevant to the two study areas is provided in the following.

Dobroyd Canal and Hawthorne Canal Floodplain Risk Management Study and Plan (WMAwater 2020)

- The FRMSP builds on the understanding of flood behaviour that was established in the Dobroyd Canal Flood Study (WMAwater, 2014) and the Hawthorne Canal Flood Study (WMAwater, 2015).
- The flood models developed for the 2014 and 2015 flood studies were revised and updated as part of the FRMSP. The updated flood models were used to simulate a range of design events.
- The critical storm duration for both the Dobroyd and Hawthorne Canal catchments was determined to be 1 hour for the range of design events.
- The FRMSP identified that the Dobroyd Canal catchment has a more severe flood affectation than the Hawthorne Canal catchment, with approximately double the number of properties expected to be inundated for any given design flood event.
- A number of areas of notable flood risk were identified, including Heighway Avenue in Croydon as well as the Brown Street / Bland Street underpass beneath the T2 railway line at Ashfield.

Whites Creek and Johnstons Creek Floodplain Risk Management Study and Plan (Stantec, 2024)

- The FRMSP builds on the understanding of flood behaviour that was established in the Johnstons Creek and Whites Creek Flood Study (WMAwater, 2017).
- The DRAINS hydrologic model was adopted without change from the 2017 flood study. The TUFLOW hydraulic model developed for the 2017 flood study was revised and updated as part of the FRMSP. The updated TUFLOW model was used to simulate a range of design events using rainfall data and methods from ARR 1987.
- The critical storm durations for the Whites Creek and Johnstons Creek catchments were determined to be 20 minutes and 1 hour, respectively, for the range of design events.
- The FRMSP also completed a sensitivity analysis and simulated the 5% and 1% AEP events using rainfall data and methods from ARR 2019. It was found that the adoption of ARR 2019 led to significant reductions in peak flood levels for both design events.
- The Floodplain Risk Management Plan (**FRMP**) recommended a number of structural mitigation measures aimed at reducing the severity of flooding throughout the Whites Creek and Johnstons Creek catchments. This includes detention basins at Camperdown Oval and at Bridge Road in Stanmore as well as various channel and stormwater upgrades.

Marrickville Valley Floodplain Risk Management Study and Plan (Cardno, 2017)

- The FRMSP builds on the understanding of flood behaviour that was established in the Marrickville Valley Flood Study (WMAwater, 2013).
- The flood models developed for the 2013 flood study were revised and updated as part of the FRMSP. The updated flood models were used to simulate a range of design events.
- The 1 hour storm duration was found to be critical for the PMF, while the 2 hour storm duration was found to be critical for smaller events such as the 10% and 1% Annual Exceedance Probability (AEP) events.
- The updated flood model results were used to identify areas of notable flood risk which includes the T3 railway line near Marrickville Station as well as some surrounding streets such as Byrnes Street, Crawford Place and Hollands Avenue.

Leichhardt Floodplain Risk Management Study and Plan (Cardno, 2017)

- The FRMSP builds on the understanding of flood behaviour that was established in the Leichhardt Flood Study (Cardno, 2015).
- An XP-RAFTS hydrologic model and a SOBEK hydraulic model was developed as part of the 2015 Flood Study.
- The study area overlaps partially with the study area of the Dobroyd Canal, Hawthorne Canal, Whites Creek and Johnstons Creek studies. The study area comprises all areas within the formal Leichhardt Council LGA, which is located to the north of Parramatta Road.
- A significant number of structural mitigation measures were investigated as part of the FRMSP, comprising various drainage upgrades to existing stormwater networks located to the north of Parramatta Road.

Alexandra Canal Floodplain Risk Management Study and Plan (Stantec, 2024)

- The FRMSP builds on the understanding of flood behaviour that was established in the Alexandra Canal Flood Study (WMAwater, 2017).
- The DRAINS hydrologic model was adopted without change from the 2017 flood study. The TUFLOW hydraulic model developed for the 2017 flood study was revised and updated as part of the FRMSP. The updated TUFLOW model was used to simulate a range of design events using rainfall data and methods from ARR 1987.
- The critical storm duration for the Alexandra Canal was determined to be 1 hour for the range of design events.
- The FRMSP also completed a sensitivity analysis and simulated the 5% and 1% AEP events using rainfall data and methods from ARR 2019. It was found that the adoption of ARR 2019 led to moderate reductions in peak flood levels for both design events.
- The FRMP recommended a number of structural mitigation measures aimed at reducing the severity of flooding throughout the Alexandra Canal catchment. This includes various stormwater upgrades throughout the catchment.

Eastern Channel East Flood Study (Golder Associates, 2009)

- A DRAINS hydrologic model and a TUFLOW hydraulic model were developed for the Eastern Channel East catchment.
- The critical duration throughout the catchment typically varied from 30 minutes to 2 hours.
- The model results were used to identify areas which were particularly flood-affected and also used to complete a flood damages analysis.

It is noted that the flood modelling completed in the four flood studies / FRMSPs listed above adopted rainfall data and techniques from *Australian Rainfall and Runoff 1987* (ARR 1987). This is understandable because the updated version of *Australian Rainfall and Runoff 2019* (ARR 2019) had not been released at the time the flood studies were initiated.

Given that the critical storm duration was determined to be typically less than 2 hours for the Hawthorne Canal, Whites Creek, Johnstons Creek, Marrickville Valley, Alexandra Canal and Eastern Channel East catchments, each of the studies identified flash flooding to be a notable factor when accounting for flood emergency response issues.

Each of the FRMSPs summarised above also completed a detailed assessment of potential mitigation measures to reduce the existing flood risk. These assessments included the investigation of flood modification, property modification and response modification measures. A number of measures were then recommended for implementation via a benefit-cost and multi-criteria analysis. The recommended and other flood modification measures were assessed for their relevance to the study areas (refer **Section 6**).

2.2.2 Flood Model Files

Flood model data and output files relevant to the two study areas were provided by Council, including:

- DRAINS hydrologic models for the Hawthorne Canal, Whites Creek, Johnstons Creek, Marrickville Valley, Alexandra Canal and Eastern Channel East catchments.
- 1D/2D TUFLOW hydraulic models for the aforementioned catchments, including topographic data, building footprints, representation of major drainage channels and the stormwater pit and pipe network and hydraulic roughness delineation.
- The XP-RAFTS hydrologic model and the SOBEK hydraulic model for the areas to the north of Parramatta Road which are located within the previous Leichhardt Council LGA, which were developed for the *Leichhardt Floodplain Risk Management Study and Plan* (Cardno, 2017).
- GIS grids for processed TUFLOW and SOBEK model results.

2.2.3 GIS Data

Council provided the following GIS data:

- The boundaries of the Our Fairer Future Plan 2 study area.
- Drainage catchment boundaries.
- Lots tagged as flood affected.

3. Existing Flood Planning Controls

3.1 Inner West Local Environmental Plan 2022

The Inner West Local Environmental Plan 2022 (IWLEP 2022) is the statutory planning instrument that establishes the permissible and/or prohibited forms of development and land use within the Inner West LGA.

Flood planning for properties within the Flood Planning Area (**FPA**) is addressed in Clause 5.21 of the IWLEP 2022. Council has also opted to include Clause 5.22 from the Standard Instrument into IWLEP 2022. Clause 5.22 applies to land between the FPA and the Probable Maximum Flood (**PMF**).

The objectives of Clause 5.21 are:

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; and,

d. to enable the safe occupation and efficient evacuation of people in the event of a flood.

Clause 5.22 expands on these objectives to add the need:

e. to protect the operational capacity of emergency response facilities and critical infrastructure during flood events; and,

f. to avoid adverse effects of hazardous development on the environment during flood events.

The remainder of Clause 5.21 is reproduced 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 riverbanks or watercourses.

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,*
   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.*
4) *A word or expression used in this clause has the same meaning as it has in the Considering Flooding in Land Use Planning Guideline unless it is otherwise defined in this clause.*
5) *In this clause –*

   Considering Flooding in Land Use Planning Guideline *means the Considering Flooding in Land Use Planning Guideline published on the Department's website on 14 July 2021.*

   Flood Planning Area *has the same meaning as it has in the Flood Risk Management Manual.*

   Floodplain Development Manual *means the Flood Risk Management Manual (ISBN 978-1-923076-17-4) published by the NSW Government in June 2023.*

The remainder of the special flood considerations from Clause 5.22 are reproduced below.

2) *This clause applies to —*
   a. *for sensitive and hazardous development – land between the flood planning area and the probable maximum flood, and*
   b. *for development that is not sensitive and hazardous development – land the consent authority considers to be land that, in the event of a flood, may –*
      i. *cause a particular risk to life, and*
      ii. *require the evacuation of people or other safety considerations.*
3) *Development consent must not be granted to development on land to which this clause applies unless the consent authority has considered whether the development —*
   a. *will affect the safe occupation and efficient evacuation of people in the event of a flood, and*
   b. *incorporates appropriate measures to manage risk to life in the event of a flood, and*
   c. *will adversely affect the environment in the event of a flood.*
4) *A word or expression used in this clause has the same meaning as it has in the Considering Flooding in Land Use Planning Guideline unless it is otherwise defined in this clause.*
5) *In this clause—*

   Considering Flooding in Land Use Planning Guideline *– see clause 5.21(5).*

   Flood Planning Area *– see clause 5.21(5).*

   Flood Risk Management Manual *– see clause 5.21(5).*

   Probable maximum flood *has the same meaning as in the Flood Risk Management Manual.*

   Sensitive and hazardous development *means development for the following purposes –*

   (a) boarding houses, (b) caravan parks, (c) correctional centres, (d) early education and care facilities, (e) eco-tourist facilities, (f) educational establishments, (g) emergency services facilities, (h) group homes, (i) hazardous industries, (j) hazardous storage establishments, (k) hospitals, (l) hostels, (m) information and education facilities, (n) respite day care centres, (o) seniors housing, (p) sewerage systems, (q) tourist and visitor accommodation, (r) water supply systems.

3.2 Legacy Development Control Plans

Inner West Council was formed in May 2016 from the merger of the former Ashfield, Leichhardt and Marrickville Councils. Development Control Plans (DCPs) from the previous Councils are still applicable to the two study areas. In particular, the Leichhardt DCP (2013) and the Marrickville DCP (2011) provide flood-related planning controls to parts of the study area located to the north and south of Parramatta Road, respectively.

Flood-related planning controls for new developments are found in Part E and Appendix E of the Leichhardt DCP (LDCP 2013) as well as Section 2.22 of the Marrickville DCP (MDCP 2011). A summary of the key controls found in these two policies is provided in **Table 3-1**.

Table 3-1 Relevant flood-related planning controls

Requirement / Development Control	Relevant Section of LDCP 2013	Relevant Section of MDCP 2011
A Flood Risk Management Report is required for applications that are identified as flood control lots or as flood liable land.	Section E1.3.1 Clause C1	Section 2.22.5 Clause C1
Floor levels for residential developments are to be at or above the Flood Planning Level, with some select exceptions regarding minor alterations, affectation by minor overland flow and Heritage/Conservation constraints.	Section E1.3.1 Clauses C2-C3	Section 2.22.5 Clause C5
Floor levels for non-residential developments to be at or above the Flood Planning Level, or to be constructed from flood compatible materials to the Flood Planning Level where raising the floor level may be impractical. Applicable to MDCP 2011 only: floor levels for additions to existing buildings may be approved below the Flood Planning Level if the applicant can demonstrate that all practical measures will be taken to prevent or minimise the impact of flooding.	Section E1.3.1 Clause C4	Section 2.22.5 Clauses C13, C15
Floor levels for special land uses (emergency services or care for vulnerable population) are to be at or above the PMF level or the Flood Planning Level, whichever is the highest.	Section E1.3.1 Clause C6	N/A
Parts of the development located below the Flood Planning Level must be constructed from flood compatible materials.	Section E.1.3.1 Clauses C2, C4	Section 2.22.5 Clauses C6, C10, C12, C16
Filling of floodways or high flood hazard areas within the Flood Planning Area may only be considered where the filling does not lead to adverse impacts in surrounding properties (a range of controls apply including limiting flood level increases to 10 mm or less).	N/A	Section 2.22.5 Clause C21

Requirement / Development Control	Relevant Section of LDCP 2013	Relevant Section of MDCP 2011
Development affected by 'High' hazard flooding must demonstrate that it does not result in a net loss of flood storage or floodway area and that the development will not increase the velocity, volume or direction of floodwaters. Floor levels, principal entries and basement entries to these developments are to be located above the PMF level or the Flood Planning Level, whichever is the higher. An evacuation route is to be provided which is not within the floodway.	Section E1.3.1 Clause C8	N/A
Flood liable land identified on the MDCP 2011 Flood Liable Land Map must have a site emergency response flood plan, adequate flood warning systems, signage for evacuation and reliable access to an area of refuge above the PMF.	N/A	Section 2.22.5 Clauses C22-24
Floor levels of new enclosed garages, open car park areas and carports must be at or above the 1% AEP flood level plus 200 mm. In extenuating circumstances, consideration may be given to a lower floor level, being the highest practical level but no lower than 180 mm below the 1% AEP flood level	Section E1.3.1 Clause C9	Section 2.22.5 Clauses C25-26
Basement carparking for properties affected by Low flood hazard must have all access and potential water entry points above the Flood Planning Level. For properties affected by High flood hazard, access and potential water entry points should be located above the Flood Planning Level or the peak PMF level, whichever is higher.	Section E1.3.1 Clause C9	Section 2.22.5 Clause C27
Works which modify the stormwater drainage system or flood behaviour within the development site must not have an adverse impact on surrounding properties.	Section E1.3.1 Clause C10	N/A

3.3 Inner West Development Control Plan 2026 (in draft)

The draft Inner West Development Control Plan 2026 (draft IWDCP 2026) is currently on exhibition, with feedback currently being sought via Council's Your Say webpage. Once adopted, the IWDCP 2026 will supersede the aforementioned three DCPs associated with the former Ashfield, Leichhardt and Marrickville Councils.

Flood related planning controls are found in Chapter 2.9 of the draft IWDCP 2026. Many of the flood related planning controls in the draft IWDCP 2026 are similar to those listed in **Table 3-1** above.

The more notable updates are summarised in the following.

- The Flood Planning Level (FPL) was previously defined as the peak 1% AEP flood level plus a freeboard of 500 mm, for all flood affected areas. Clause C6 of the draft IWDCP 2026 updates the FPL as follows:
  - For sensitive and hazardous development types, the FPL is adopted as the peak PMF level.
  - For residential developments affected by peak 1% AEP flood depths ≤300 mm AND peak 1% AEP flow velocities ≤2 m/s, the FPL is adopted as the peak 1% AEP flood level + 300 mm.

  - For residential developments which do not meet the hydraulic criteria described above, the FPL is adopted as the peak 1% AEP flood level + 500 mm.
  - For all other development, the FPL is adopted as the peak 1% AEP flood level + 500 mm.
- The draft IWDCP 2026 specifies more stringent criteria regarding flood evacuation routes, which include the following:
  - Clause C10: Single dwelling houses, dual occupancies, secondary dwellings and semi-detached housing are to provide for reliable access for evacuation to flood-free land, or to a flood-free area of the site above the peak PMF level where off-site evacuation cannot be achieved.
  - Clause C11: All other development is to provide a flood-free evacuation route for all occupants from the site to flood-free land.
  - Clause C12: Any sensitive or hazardous development, or development for vulnerable people is also to provide flood-free access for emergency vehicles to the site.
  - Clause C27: Residential development of new attached dwellings, boarding houses, co-living housing, group homes, hostels, multi-dwelling housing, residential flat buildings, seniors housing and shop top housing are to provide a flood evacuation route for safe evacuation from the site to flood-free land.
  - Clause C31: Commercial, industrial and mixed-use development is to ensure that all entrances and evacuation routes servicing residential components are to be above the FPL.

4. Flood Modelling Approach

4.1 Design Rainfall Data

4.1.1 Adoption of ARR 1987 Hydrology

As noted previously, Council's adopted flood studies and floodplain risk management studies and plans have adopted rainfall data and techniques from ARR 1987. The flood models for each of these catchments were finalised prior to the release of the updated ARR 2019 rainfall data and guidance.

Following discussions with staff from Council, the NSW Department of Climate Change, Energy, the Environment and Water (**DCCEEW**) and the NSW Department of Planning, Housing and Infrastructure (**DPHI**), it was agreed that the flood modelling undertaken for this project, as well as similar projects in the Inner West LGA, should continue to adopt ARR 1987 rainfall data and techniques. This approach was considered suitable for this project for the following reasons.

(i) The adoption of ARR 1987 rainfall data and techniques ensures continuity with the current flood studies for the relevant catchments in the study area. The flood modelling results from these studies have been adopted by Council to define flood characteristics in the vicinity of the study area and for flood planning purposes; e.g., for setting the Flood Planning Level.

(ii) ARR 2019 design rainfall for the study area is significantly lower than the corresponding ARR 1987 rainfall data (refer **Table 4-1**). Therefore, adoption of ARR 2019 rainfall for this study would lead to flood levels, velocities and hazards which are lower than those adopted in Council's current flood studies. Accordingly, the adoption of ARR 1987 rainfall data for this study is considered to be suitable as it ensures a conservative outcome in terms of defining design flood characteristics.

Table 4-1 Comparison of ARR 1987 and ARR 2019 Rainfall IFD Data at Leichhardt

Design Event	ARR 1987 Design Rainfall Depth (mm)	ARR 2019 Design Rainfall Depth (mm)
1% AEP 20 minute storm	52.0	44.1
1% AEP 30 minute storm	65.0	52.1
1% AEP 60 minute storm	90.0	66.7
1% AEP 120 minute storm	118.2	85.6

4.1.2 Consideration of Climate Change

An update of the Climate Change Considerations chapter of ARR 2019 (Book 1 Chapter 6) was published by NSW DCCEEW and Engineers Australia on 27 August 2024 (refer version 4.2). This chapter provides up to date guidance aligned with the latest relevant science from publications such as IPCC 2023 and Wasko et al (2023). It includes new estimates of increased rainfall intensity to be applied to ARR 2019 rainfall data under a range of future climate scenarios which are typically higher than those presented in the original chapter.

The update presents climate change projections for five potential Shared Socio-economic Pathways (SSPs) up to 2100 consistent with IPCC 2023. The SSPs are used to derive greenhouse gas emission scenarios with different climate policies and are often referred to as very low (SSP1-1.9), low (SSP1-2.6), medium (SSP2-4.5), high (SSP3-7.0) and very high (SSP5-8.5) emissions pathways.

NSW DPHI recently exhibited the *Climate Change Scenario Guidelines* (in draft, 2026), which provides guidance on climate change scenarios to test based on the type and scale of development. For rezoning and strategic planning projects such as this, the draft guidelines recommend testing of the SSP3-7.0 climate scenario over a long term horizon from 50 to 100 years.

For short duration events equal to or less than 1 hour, the updated climate change guidance predicts that ARR 2019 rainfall intensities will increase by 59% under the SSP3-7.0 climate scenario for a long-term time horizon to 2100.

The flood studies which have been adopted by Council in the Inner West LGA have all undertaken a climate change analysis by applying a 30% increase to ARR 1987 1% AEP rainfall intensities.

A comparison of the two climate change approaches is summarised in **Table 4-2**.

Table 4-2 Comparison of climate change approximation approaches

Design Event	ARR 1987 Design Rainfall Depth + 30% (mm)	ARR 2019 Design Rainfall Depth + 59% (mm)	% Difference
1% AEP 30 minute storm	84.5	82.8	~2%
1% AEP 60 minute storm	117	106	~9%
1% AEP 120 minute storm	153.7	136.1	~11%

Table 4-2 indicates that adoption of the climate change analyses in Council's existing flood studies (i.e., increasing ARR 1987 1% AEP rainfall intensities by 30%) would be comparable to the application of the latest climate change guidance associated with SSP3-7.0 climate conditions for a long-term horizon.

As noted previously, the critical duration storm for catchments within the study area was determined to be typically 1-2 hours. Therefore, **Table** 4-2 indicates that the adoption of the climate change analysis in Council's existing flood studies would lead to a conservative estimation of rainfall in the study area.

Accordingly, the adoption of the ARR 1987 climate change approach would lead to peak flood levels which are generally similar to, or higher than, the corresponding peak flood levels under the ARR 2019 climate change approach.

Therefore, it was considered suitable to adopt the existing climate change analysis from Council's adopted flood studies (i.e., increasing ARR 1987 1% AEP rainfall intensities by 30%) for the purposes of a climate change sensitivity assessment for this FIRA. This allows the findings of this FIRA to align with both Council's current adopted flood modelling as well as industry best practice.

The adopted climate change scenario also accounted for a sea level rise of 0.68 metres. Further detail is provided in **Section 9**.

4.2 Adopted Flood Models

The TUFLOW hydraulic models developed for the *Dobroyd Canal and Hawthorne Canal Floodplain Risk Management Study and Plan* (WMAwater 2020), the *Whites Creek and Johnstons Creek Floodplain Risk Management Study and Plan* (Stantec, 2024), the *Marrickville Valley Floodplain Risk Management Study and Plan* (Cardno, 2017) and the *Alexandra Canal Floodplain Risk Management Study and Plan* (Stantec, 2024) were adopted by Worley Consulting as the primary basis for flood modelling for this FIRA.

A new TUFLOW hydraulic model was developed for the area which is captured in the existing SOBEK model from the *Leichhardt Floodplain Risk Management Study and Plan* (Cardno, 2017) due to compatibility issues with the SOBEK software as well as to align computational methods with the TUFLOW models used for all other locations within the Our Fairer Future Plan 2 study areas.

Some adjustments were also made to the TUFLOW model developed for the *Eastern Channel East Flood Study* (Golder Associates, 2009) to enable testing of development footprints as well as to align with the modelling approach of the other TUFLOW models.

The extents of the various TUFLOW hydraulic models in relation to the Our Fairer Future Plan 2 study areas are shown in **Figure 4-1**.

Further details on the new Leichhardt TUFLOW model and the adjusted Eastern Channel East TUFLOW model are provided in the following.

4.2.1 New Leichhardt TUFLOW model

Key details on the development of the new Leichhardt TUFLOW model are provided in the following.

- The model domain was delineated into areas of different hydraulic roughness, including material types for open space, water bodies, roads / hardstands, railway corridors, residential blocks and commercial / industrial blocks.
- The 1-hour storm was assumed to be the critical duration storm for all design events in accordance with the Cardno study.
- Design rainfall depths for the 1-hour storm duration were obtained from ARR 1987 IFD data from the Bureau of Meteorology, to achieve consistency with existing studies in the Inner West LGA.
- The TUFLOW model adopted the direct rainfall (rainfall on grid) approach to allow for the natural resolution of overland flow paths.
- Model parameters and methodologies were adopted from the SOBEK model where reasonable, including Manning's 'n' roughness coefficients, design rainfall data and rainfall loss rates. Building footprints were modelled using GIS terrain modification techniques which raised the footprint by a height of 3 metres above the ground, which is the same approach adopted in the SOBEK model.
- Some updates were made to better represent existing conditions in the new Leichhardt TUFLOW model. This included the adoption of 1-metre LiDAR data captured in 2020 which was sourced from the online ELVIS portal, as well as minor updates to building footprints in some areas to better represent the existing building.
- Tailwater levels in Iron Cove and Rozelle Bay were adopted to be 1.4 mAHD during the 1% AEP and 1% AEP climate change events, and 1.45 mAHD during the PMF event, in accordance with Council's Hawthorne Canal and Johnstons Creek studies.
- Upstream inflows along Johnstons Creek were obtained from the TUFLOW model adopted for the Johnstons Creek studies.
- The raw TUFLOW model results were filtered to remove areas of benign flooding or localised minor ponding. The filtering criteria applied is described in the following:
  - ➢ Depth ≥ 0.15 m

    This criterion removes flood depths shallower than 0.15 m which are generally considered quite benign.
  - ➢ Velocity x Depth ≥ 0.025 m^2/s

    This criterion was used to include depths shallower than 0.15 m where some flow conveyance is evident which may:

- Occur near-bank along creeks and waterways;
- Form part of overland flood flow paths;
- Form important linkages between deeper areas of flooding and their source.

➢ Mapping of these shallower flows can be important as:

- It provides a better understanding of flood behaviour;
- Obstruction of such flows may have adverse flood impacts;
- It provides confidence that discrete 'ponds' of inundation removed by the following mapping criterion are not associated with broader flood flowpaths.

➢ Area of inundation ≥ 100 m^2

This criterion removes discrete areas of inundation with an area of less than 100 m^2. Such areas are generally expected to be related to local ponding in ground depressions rather than significant flood flowpaths.

A comparison of the peak 1% AEP flood levels between the SOBEK model and the new Leichhardt TUFLOW model is shown in **Figure 4-2**. Areas where the new Leichhardt TUFLOW model predicted a higher peak flood level are represented in shades of yellow and red. Areas where the new model predicted a lower peak flood level are represented as shades of blue. The white shading indicates differences in peak flood levels that are between +/- 0.05 metres.

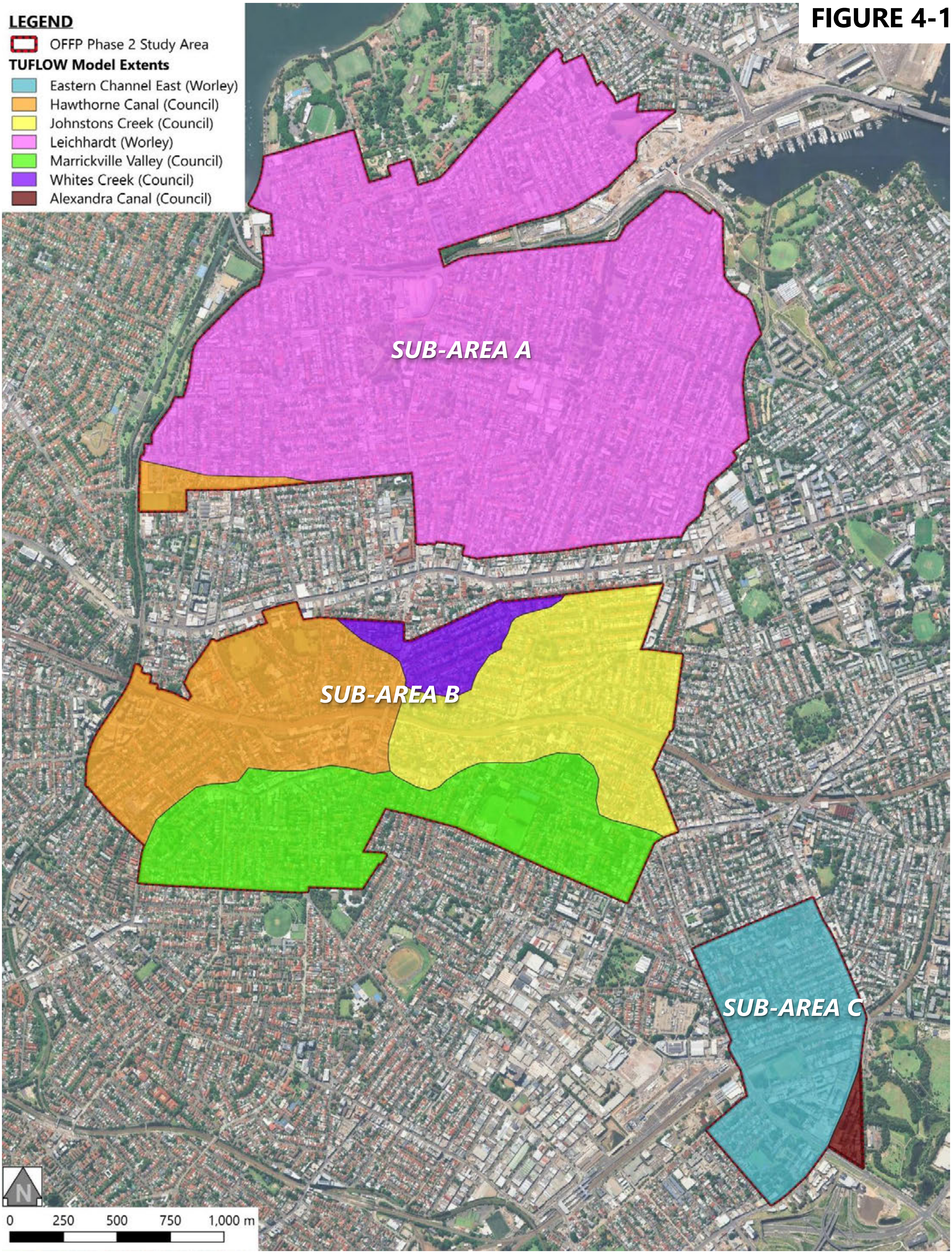
The models achieved a good agreement in the location and extent of the major flow paths in the study area. Peak flood levels are generally comparable, with localised differences attributed to the adoption of updated LiDAR data or otherwise variances in modelling algorithms in tight confined areas between building footprints.

Some areas of more widespread and significant flood level differences are indicated in **Figure 4-2** and also explained in the following.

- The new Leichhardt TUFLOW model predicts 1% AEP peak flood levels in the Darley Road ponding area which are about 0.2 metres higher than the SOBEK model. This is attributed to significant earthworks which have occurred in the parkland to the east of the Hawthorne light rail station, assumed to be associated with the construction of a footpath to the station. It is understood that this filling was completed after the development of the SOBEK model, and accordingly was not captured in the SOBEK model. The filling in this area has created a significant hydraulic control which influences the flood levels in the Darley Road ponding area.
- The new Leichhardt TUFLOW model predicts 1% AEP peak flood levels along Whites Creek which are typically 0.2 to 0.3 metres lower than the SOBEK model. This is attributed to the representation of the Brenan Street bridge at the downstream (northern) end of Whites Creek in the SOBEK model. The waterway area below the bridge was not included in the SOBEK model, leading to floodwaters backing up to the south of the bridge and increasing flood levels along Whites Creek.
- The new Leichhardt TUFLOW model predicts 1% AEP peak flood levels along Johnstons Creek which are typically 0.1 to 0.2 metres lower than the SOBEK model. The SOBEK model has adopted Johnstons Creek as the downstream model boundary, with areas east of the creek excluded from the model as it falls outside of the LGA boundary.

  The new Leichhardt TUFLOW model has included the full Johnstons Creek floodplain within the model domain to eliminate boundary condition effects which may affect the study area. It is noted that flood mapping from the new Leichhardt TUFLOW model has been clipped to exclude areas outside of the Our Fairer Future Plan 2 study area, so as not to mislead residents in these areas for which a formal flood study has not been completed.

FIGURE 4-1



Prepared by:

worley consulting

TUFLOW MODEL EXTENTS

FIGURE 4-2

Prepared by:

worley consulting

COMPARISON OF PEAK FLOOD LEVELS
NEW LEICHHARDT TUFLOW MODEL & EXISTING SOBEK MODEL

4.2.2 Adjustments to the Eastern Channel East TUFLOW model

The existing Eastern Channel East TUFLOW model adopted a methodology which raised entire residential / commercial blocks by a height of 5 metres above the adjacent street level. Consequently, the existing TUFLOW model results only predicts flooding within road reserves.

Worley Consulting has adopted an alternate approach which 'blocks out' building footprints from the model domain only, while keeping other areas within the residential / commercial blocks (e.g. yards and open spaces) at land elevations which are defined by the raw topographic data. The adoption of this approach allows overland flow paths to resolve naturally without being confined to road reserves only and facilitates the testing of building footprints.

5. Existing Conditions Flood Modelling

5.1 Adopted Approach

The TUFLOW flood models described in **Section 4.2** were used to establish flood behaviour in the Our Fairer Future Plan 2 study areas under existing conditions.

As noted previously, the rainfall data and techniques from ARR 1987 have been adopted for the purposes of this FIRA. In accordance with Council's adopted flood studies and floodplain risk management studies and plans, the models adopted critical storm durations ranging from 30 minutes to 2 hours.

5.2 Flood Mapping

The TUFLOW models were used to simulate the 1% AEP design event, the 1% AEP climate change scenario and the Probable Maximum Flood (PMF). Flood mapping for existing development conditions is included in **Appendix A**.

The flood mapping outlined above also includes flood hazard mapping. Flood hazard provides a measure of the potential risk to life, well-being and property posed by a flood event. ARR 2019 presents a set of hazard curves which assess the vulnerability of people, vehicles and buildings to flooding based on the velocity and depth of flood flows. These curves have been adopted to define flood hazard in this study and are reproduced in **Figure 5-1**, however noting that the rainfall data and methods of ARR 2019 have not been adopted for the flood modelling (refer **Section 5.1**).

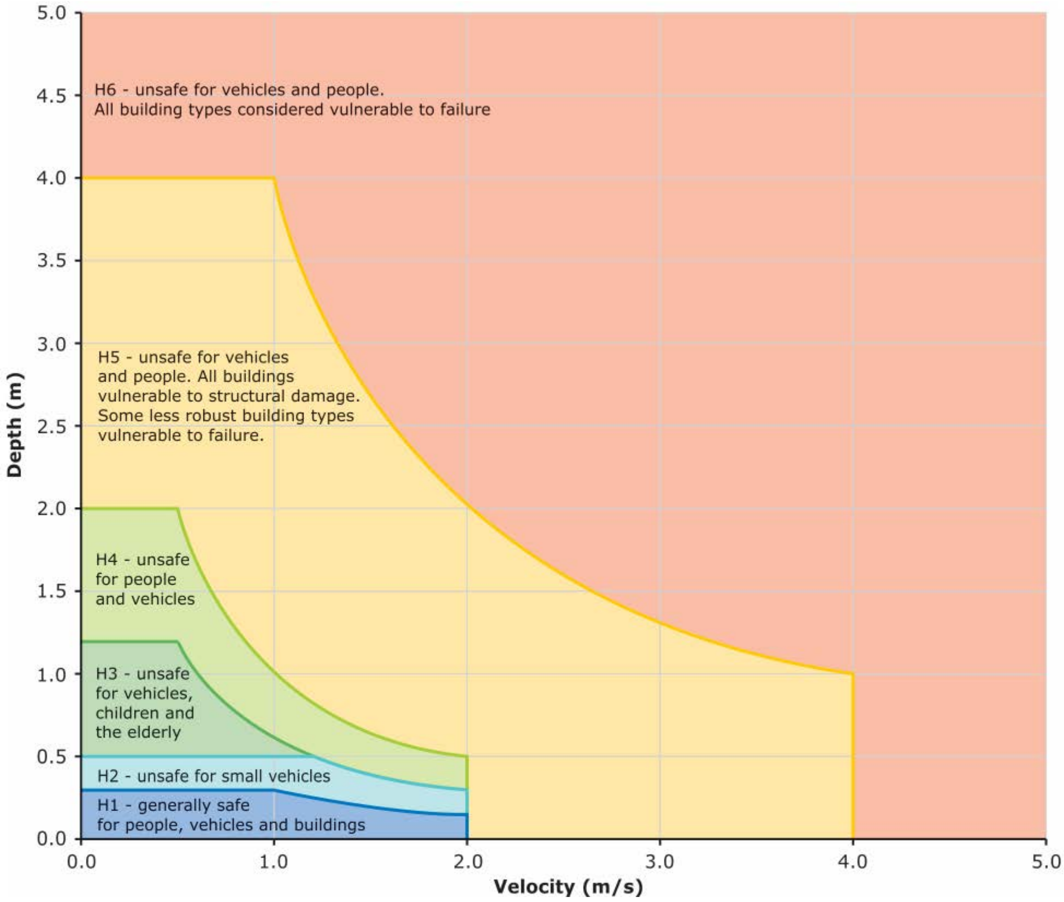


Figure 5-1 ARR 2019 Flood Hazard Curves

5.3 Flooding "Hotspots"

The flood model results for existing conditions indicate a number of areas which are particularly flood prone within the study areas.

5.3.1 Sub-Area A Hotspots

Flooding hotspots in Sub-Area A are shown in **Figure 5-2** and discussed below.

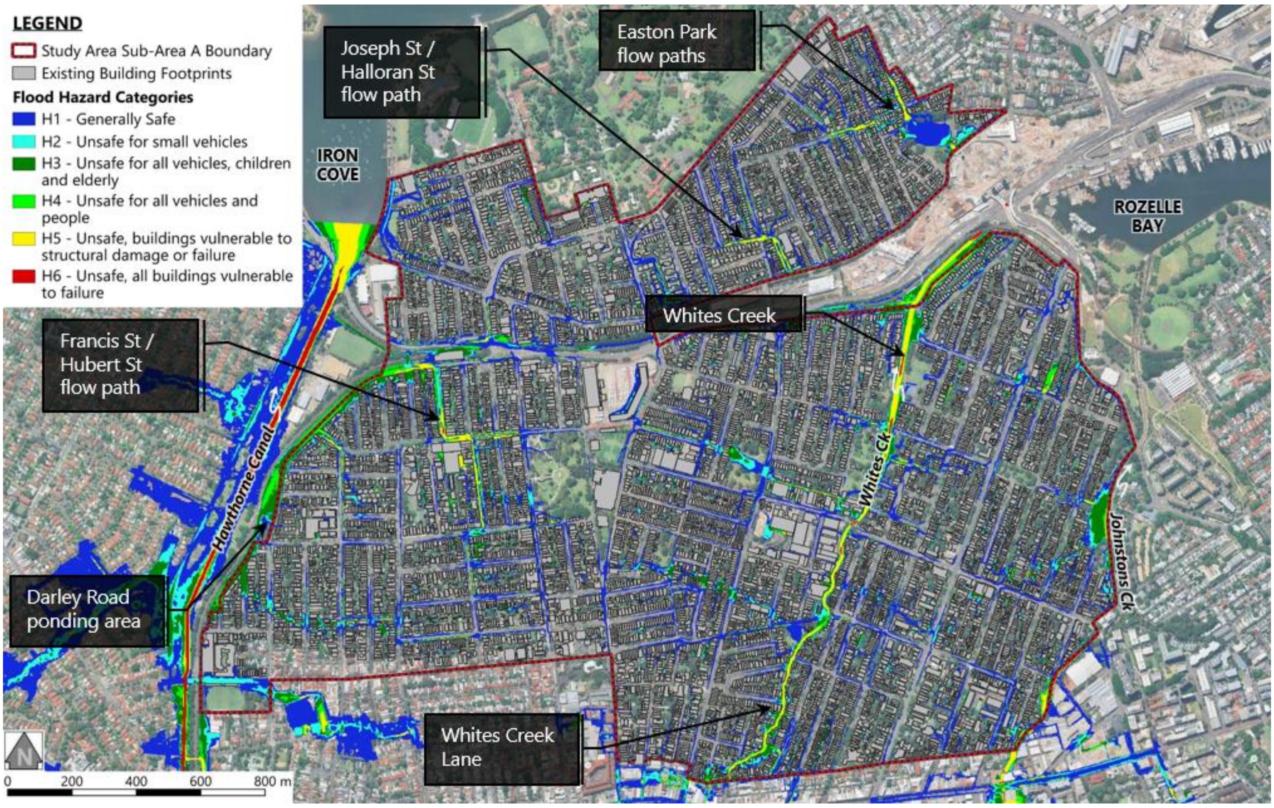


Figure 5-2 Overview of flooding hotspots in Sub-Area A

- Whites Creek Lane and Whites Creek

  These locations are affected by H5 flood hazard during the 1% AEP event as well as the adopted 1% AEP climate change scenario. Areas of high flood hazard are typically confined to the Whites Creek Lane road reserve as well as the Whites Creek channel and immediate overbank areas during these design events. During the PMF, the hazard increases to H6, with some adjacent lots also affected by high hazard floodwaters typically between H3-H5.

- Darley Road Ponding Area

  Overland flow paths in the western portion of Sub-Area A drain westward towards the light rail line and Hawthorne Canal. Waters are expected to temporarily pond on the upstream (eastern) side of the light rail embankment before draining into Hawthorne Canal through several culverts in the embankment. This leads to widespread inundation along an approximate 1.1-kilometre length of Darley Road from Walter Street to the south to Hubert Street to the north. Peak 1% AEP flood depths typically range from 0.5 metres to 1.5 metres along Darley Road. The depth of flooding along Darley Road ranges from 0.8 metres to 1.9 metres at the peak of the adopted climate change scenario, and from 1.5 metres to 2.5 metres at the peak of the PMF.

The ponding extends east and south from Darley Road onto several various streets connected to Darley Road, leading to the inundation of the properties along these streets which are closest to Darley Road. Flood hazard increases from typically H3-H4 during the 1% AEP event and the adopted 1% AEP climate change event to H4-H5 during the PMF.

- Francis Street / Hubert Street flow path

  A significant overland flow path discharges runoff north along Francis Street before continuing down Hubert Street and into the Darley Road ponding area. The streets are affected by H5 flood hazard during the 1% AEP event, the adopted 1% AEP climate change event and the PMF due to significant flow velocities which can reach up to 4 m/s.

  It is noted that areas of high hazard are typically confined to the road reserve in events up to and including the PMF.

- Joseph Street / Halloran Street flow path

  There is a significant flow path which conveys runoff east along Joseph Street before continuing south down Halloran Street and towards the Rozelle Parklands and Whites Creek. The streets are affected by H5 flood hazard during the 1% AEP event, the adopted 1% AEP climate change event and the PMF due to significant flow velocities which can reach up to 3 m/s.

  It is noted that areas of high hazard are typically confined to the road reserve in events up to and including the PMF.

- Easton Park flow paths

  Significant flow paths along O'Neill Street and Denison Street conveys runoff eastward and southward to Easton Park, respectively. The streets are affected by H5 flood hazard during the 1% AEP event, the adopted 1% AEP climate change event and the PMF due to significant flow velocities which can reach up to 3 m/s.

  It is noted that areas of high hazard are typically confined to the road reserve in events up to and including the PMF.

5.3.2 Sub-Area B Hotspots

Flooding hotspots in Sub-Area B are shown in **Figure 5-3** and also discussed below.

- Johnstons Creek Catchment

  There are two significant overland flow paths at the north-eastern portion of Sub-Area B which convey runoff along Salisbury Road and Cardigan Street towards Johnstons Creek. Areas of high flood hazard are typically confined to these road reserves in both the 1% AEP event as well as the adopted 1% AEP climate change scenario. During the PMF, the extent of areas affected by high flood hazard increases to some neighbouring lots and lanes.

- Hawthorne Canal

  Hawthorne Canal runs along the western boundary of Sub-Area B. High hazard floodwaters typically remain within the open concrete channel during the 1% AEP event except where it spills into several residential properties between Fred Street and Old Canterbury Road. During the 1% AEP climate change event, the number of properties along Fred Street which are affected by high flood hazard increases, although floodwaters are still predicted to remain within the open channel in the industrial areas to the north of Old Canterbury Road.

  During the PMF, the extent of high hazard areas increases significantly, with significant portions of the industrial area now affected by H5 flood hazard.

- Browns Avenue flow path

  There is a significant flow path which conveys runoff south along Browns Avenue toward the Marrickville Industrial Area to the south of Sub-Area B. Areas of high flood hazard (typically H5) is confined to the Browns Avenue road reserve in events up to and including the PMF.

- Marrickville Oval flow path

  Significant flow paths along Wardell Road, Bishop Street and Napier Street convey runoff southward toward Marrickville Oval. Areas of H4+ flood hazard are typically confined to these roads and other laneways in the vicinity of these roads for events up to and including the adopted 1% AEP climate change scenario. During the PMF, high hazard flows spill into several residential properties between Wardell Road and Bishop Street.

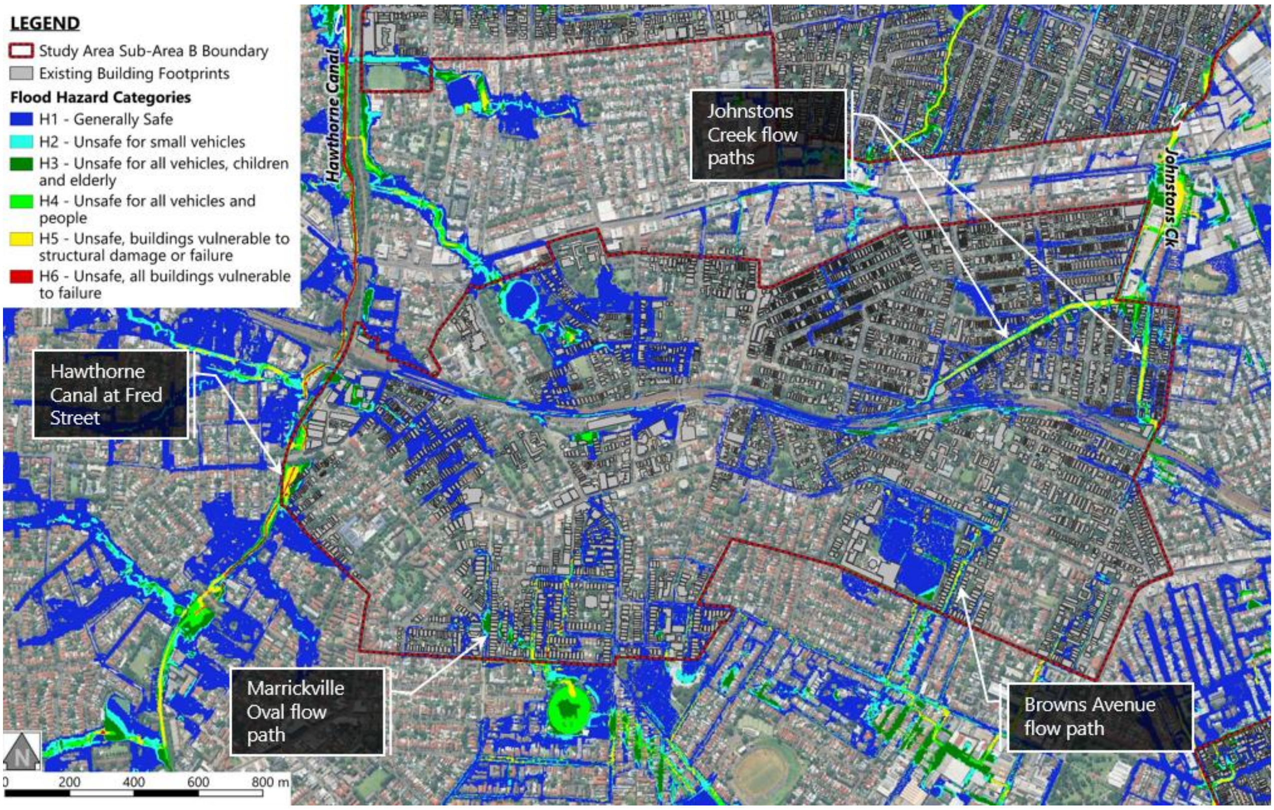


Figure 5-3 Overview of flooding hotspots in Sub-Area B

5.3.3 Sub-Area C Hotspots

Flooding hotspots in Sub-Area C are shown in **Figure 5-4** and also discussed below.

- Edgeware Road flow path

  Edgeware Road and nearby streets including Prince Street and Alice Avenue convey runoff southward into Murray Street and subsequently into the Marrickville Industrial Area. High hazard flooding up to H5 is expected to remain within the road reserve in events up to and including the adopted 1% AEP climate change scenario. High hazard is attributed to significant flow velocities which exceed 2 m/s, noting that the depth of flooding is not expected to exceed 0.5 metres during the climate change event.

  During the PMF, some residential lots to the east of Edgeware Road and south of Camden Street are affected by high flood hazard. Similarly, the high flood hazard is attributed to high flow velocities, while the depth of flooding remains low and typically does not exceed 0.6 metres.

- <u>Camdenville Park Wetlands</u>

  Floodwaters are expected to pond in the wetlands at the south-western corner of Camdenville Park, which overflow and spill into the intersection of Unwins Bridge Road and Bedwin Road. The intersection is affected by H3 flood hazard in the 1% AEP event as well as the adopted 1% AEP climate change scenario.

  During the PMF, the flood hazard at this intersection increases to H4-H5.

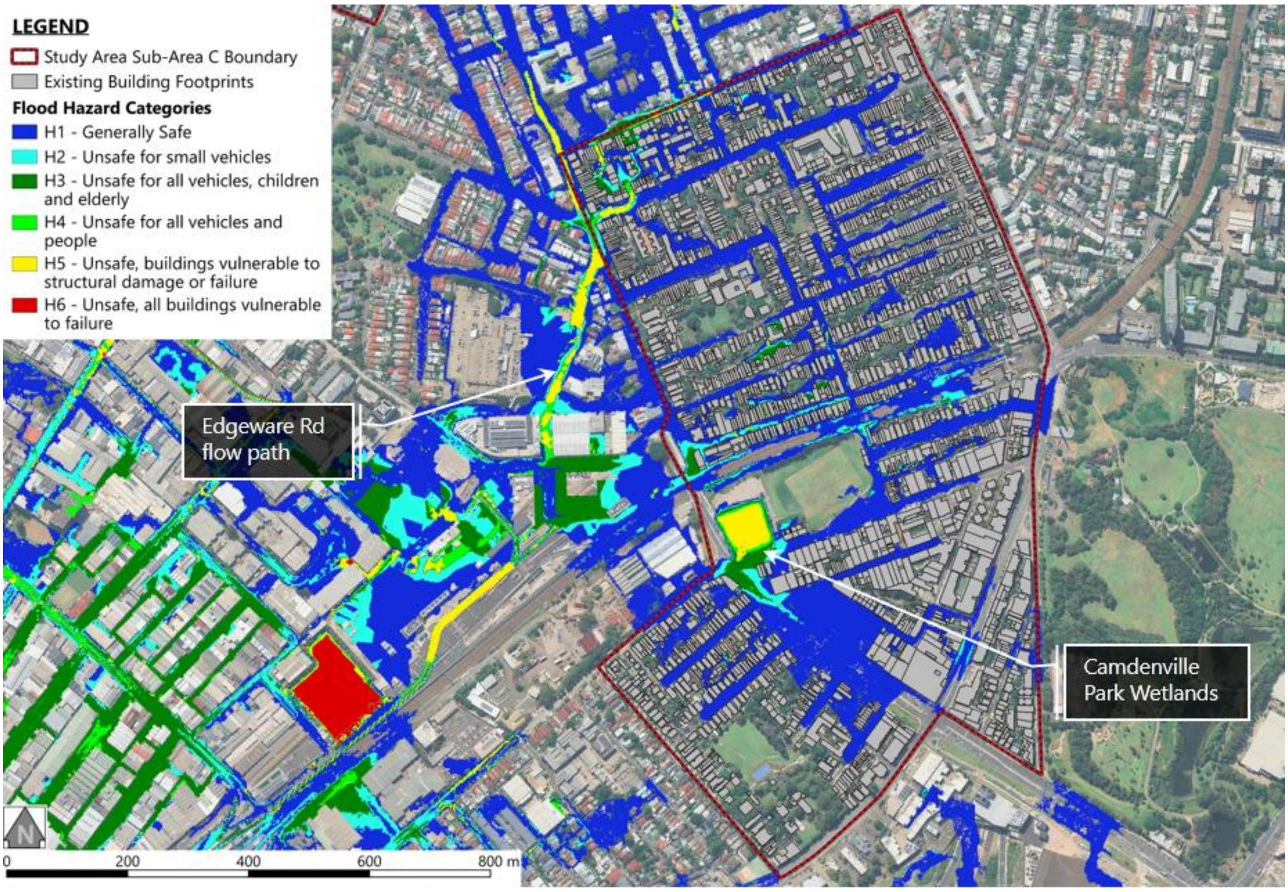


Figure 5-4 Overview of flooding hotspots in Sub-Area C

6. Review of Mitigation Measures and Proposed Drainage Works

The Floodplain Risk Management Studies (FRMS) completed for the Hawthorne Canal, Whites Creek, Johnstons Creek, Marrickville Valley and Eastern Channel East catchments investigated an extensive list of possible flood modification measures to reduce the flood risk across the study areas. This included consideration of flood protection levees, detention basins, drainage upgrades and diversion channels.

Several measures were not recommended for implementation due to either limited benefits in reducing the impact of flooding, a low benefit-cost ratio or other factors which were identified during a multi-criteria assessment. The recommended measures for implementation are documented in the respective Floodplain Risk Management Plans (FRMP). Some of the flood modification measures were also included in the *Inner West Local Infrastructure Contributions Plan 2023* (GLN Planning, 2023). These measures comprise drainage works which are expected to be delivered by 2036.

Worley Consulting has undertaken a review of the flood modification measures recommended in the various adopted FRMPs, as well as the relevant drainage works items in the *Inner West Local Infrastructure Contributions Plan 2023*.

The measures relevant to the study areas have been reviewed and are presented in the following sections. Several of the recommended modification measures or drainage works fall outside of the study areas, are not expected to impact flooding in the vicinity of proposed uplift locations or else have insignificant benefits in very localised areas which were not considered worthwhile for further investigation for the purposes of this report.

6.1 Elswick St Flow Path Stormwater Upgrades [Leichhardt]

6.1.1 Overview

This option comprises upgrades to the existing underground stormwater drainage network which runs beneath the Elswick Street flow path, which conveys runoff from Elswick Street in a westerly direction toward the light rail embankment and Hawthorne Canal. The upgrade comprises increasing the capacity of the existing underground stormwater network in order to capture more overland flow.

This option also comprises additional pipes through the light rail embankment to reduce the depth of flooding along Darley Road to the east of the light rail embankment.

This measure was identified as Option HC FM3 in the *Leichhardt Floodplain Risk Management Study and Plan* (Cardno, 2017) but was not included in the Inner West Local Infrastructure Contributions Plan 2023. The layout of the option and the predicted flood impacts during the 1% AEP event has been extracted from the 2017 FRMSP report and shown in **Figure 6-1** below.

6.1.2 Expected Flood Impacts

As shown in **Figure 6-1**, the implementation of this option would lead to widespread flood level decreases along the overland flow path as well as parts of the Darley Road ponding area.

However, it should be noted that flood model results indicate that the flood risk is not significant along this flow path. For flooding in events up to and including the adopted 1% AEP climate change scenario, the flood hazard is not expected to exceed H3 except in localised areas which are confined to existing road reserves.

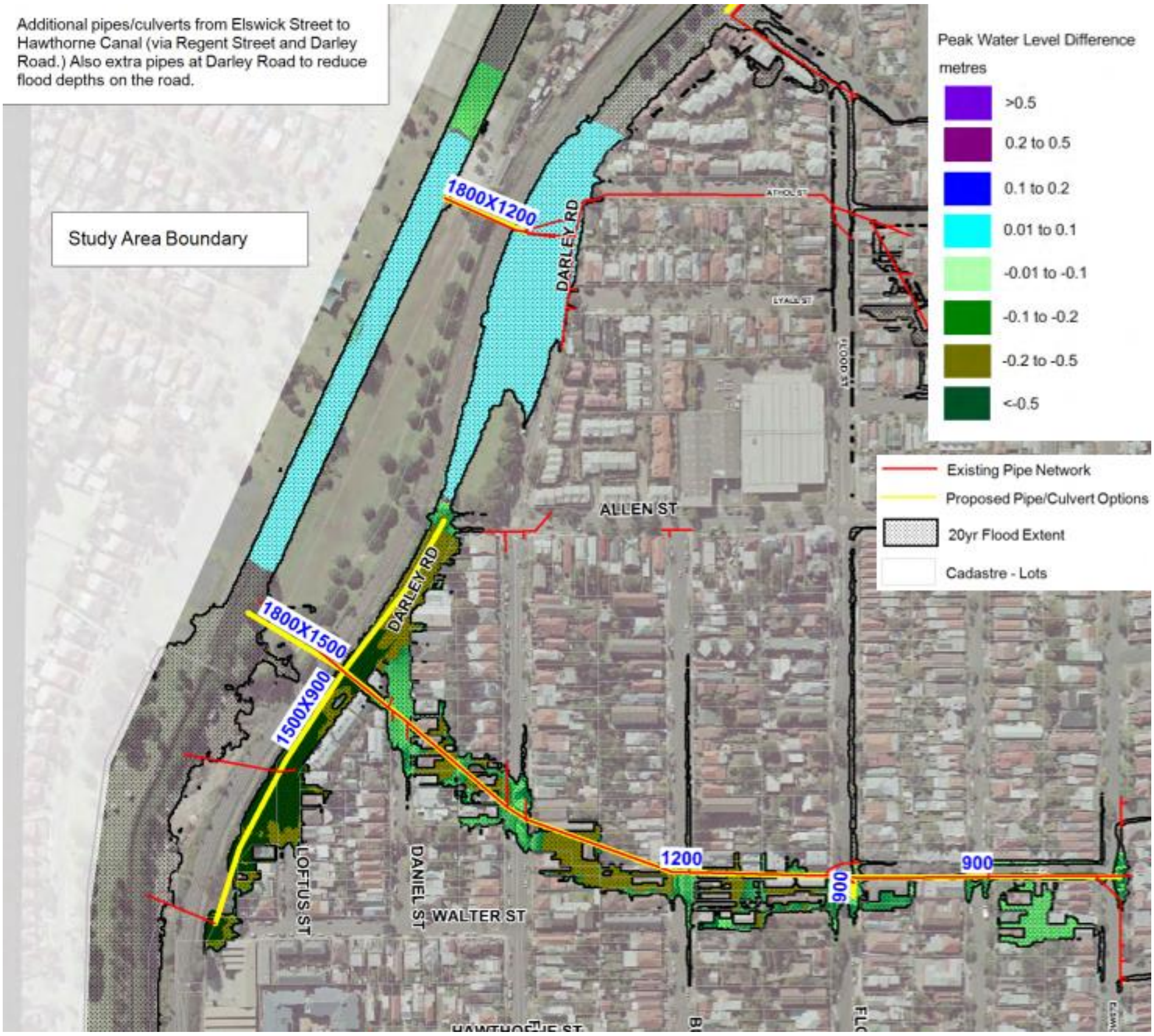


Figure 6-1 Layout of Elswick St Stormwater Upgrade [source: Cardno, 2017]

6.1.3 Additional Considerations

The implementation of this mitigation measure is expected to be highly disruptive, comprising underground works within both roads and private properties. Additionally, the upgrade of the existing culverts through the light rail embankment is also highly disruptive and would not be considered feasible.

The 2017 FRMSP report estimates that this option would cost $17M with a benefit-cost ratio of 0.13. Given the low benefit-cost ratio, the significant disruptions and the minor flood risk along this flow path, this option is not considered worthwhile for further consideration as part of this project.

6.2 Hubert St Flow Path Stormwater Upgrades [Leichhardt]

6.2.1 Overview

This option comprises upgrades to the existing underground stormwater drainage network which runs beneath the Hubert Street flow path, which conveys runoff from Hubert Street in a northerly direction toward the light rail embankment and Hawthorne Canal. The upgrade comprises increasing the capacity of the existing underground stormwater network in order to capture more overland flow.

This option also comprises additional pipes through the light rail embankment to reduce the depth of flooding along Darley Road to the south of the light rail embankment.

This measure was identified as Option HC FM4 in the *Leichhardt Floodplain Risk Management Study and Plan* (Cardno, 2017) but was not included in the Inner West Local Infrastructure Contributions Plan 2023.

The layout of the option and the predicted flood impacts during the 1% AEP event has been extracted from the 2017 FRMSP report and shown in **Figure 6-2**.

6.2.2 Expected Flood Impacts

As shown in **Figure 6-2**, this mitigation measure results in flood level decreases of up to 0.5 metres in the Darley Road ponding area. However, there are no notable benefits to the flooding along Hubert Street.

6.2.3 Additional Considerations

The implementation of this mitigation measure is expected to be highly disruptive, comprising underground works within the Darley Road and Hubert Street road reserves. Additionally, the upgrade of the existing culverts through the light rail embankment is also highly disruptive and would not be considered feasible.

The 2017 FRMSP report estimates that this option would cost $8.3M with a benefit-cost ratio of 0.17. Given the low benefit-cost ratio and the significant disruptions, this option is not considered worthwhile for further consideration as part of this project.

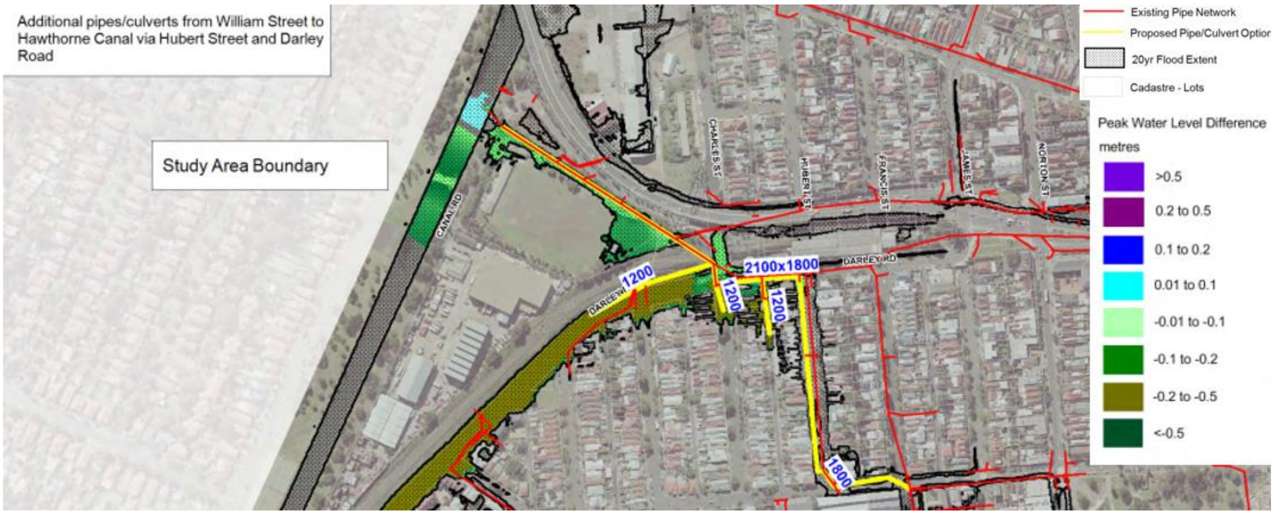


Figure 6-2 Layout of Hubert St Stormwater Upgrade [source: Cardno, 2017]

6.3 Whites Creek Culvert Upgrade and Channel Widening [Leichhardt]

6.3.1 Overview

This measure comprises increasing the capacity of the existing Whites Creek culvert from Parramatta Rd to the open channel at Wisdom St, as well as widening of the open channel downstream of Wisdom Street and upgrading the bridge crossings at Piper St and Brenan St.

This measure was identified as Option WC FM13 in the *Leichhardt Floodplain Risk Management Study and Plan* (Cardno, 2017) but was not included in the Inner West Local Infrastructure Contributions Plan 2023.

The layout of the option and the predicted flood impacts during the 1% AEP event has been extracted from the 2017 FRMSP report and shown in **Figure 6-3** below.

6.3.2 Expected Flood Impacts

As shown in **Figure 6-3**, increasing the capacity of Whites Creek results in significant flood level decreases of between 0.2 to 0.5 metres along the length of Whites Creek.

However, it should be noted that flood model results indicate that flooding along Whites Creek is typically confined to the creek channel and immediate overbank areas in events up to and including the adopted 1% AEP climate change scenario.

6.3.3 Additional Considerations

The implementation of this mitigation measure is expected to be highly disruptive, comprising underground works along the narrow corridor of Whites Creek Lane where there are many properties in close proximity to the lane.

Additionally, uplift is not expected in areas within the Whites Creek channel or immediate overbank areas. Therefore, the implementation of this option would not have any material benefits in alleviating flood risk for future developments.

The 2017 FRMSP report estimates that this option would cost $28.5M with a benefit-cost ratio of 0.23. Given the low benefit-cost ratio, the significant disruptions and the lack of material benefit for future development, this option is not considered worthwhile for further consideration as part of this project.

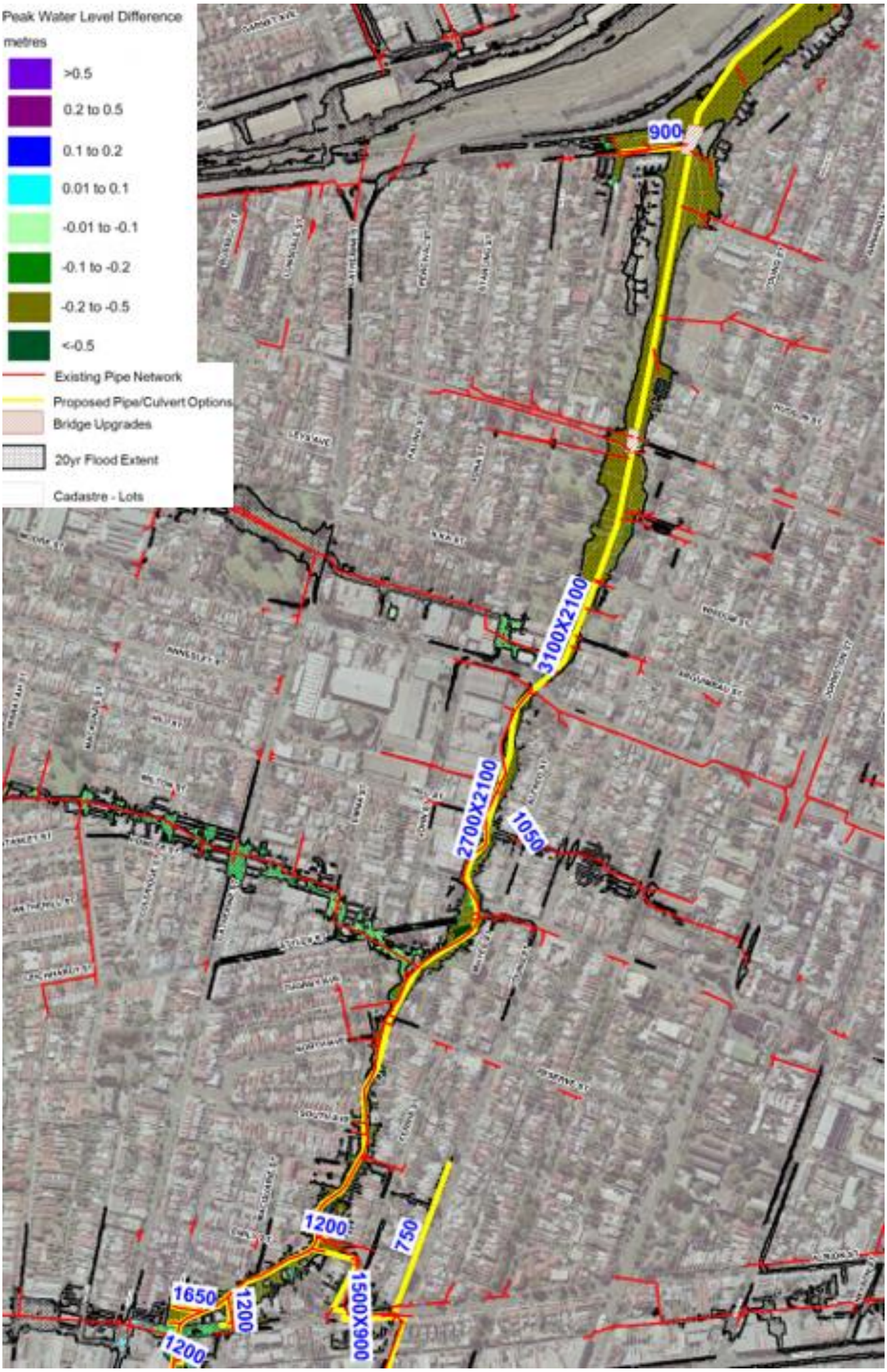


Figure 6-3 **Layout of Whites Creek culvert upgrade and channel widening [source: Cardno, 2017]**

6.4 Moore Lane Flow Path Stormwater Upgrades [Leichhardt]

6.4.1 Overview

This option comprises the upgrade of the existing stormwater network from Alfred Street to the War Memorial Park and then from War Memorial Park through to Whites Creek via Moore Lane.

This measure was identified as Option WC FM11 in the *Leichhardt Floodplain Risk Management Study and Plan* (Cardno, 2017) as well as item 193 in the *Inner West Local Infrastructure Contributions Plan 2023*. The layout of the option and the predicted flood impacts during the 1% AEP event has been extracted from the 2017 FRMP and shown in **Figure 6-4** below.

6.4.2 Expected Flood Impacts

As shown in **Figure 6-4**, increasing the stormwater network capacity in this area results in some moderate flood level decreases along the flow path. However, most of the benefits are predicted to occur in the park or along road reserves, with only localised benefits to a few properties.

Additionally, it should be noted that areas of significant flood risk are limited to the Alfred Street and Moore Lane road reserves for design events up to and including the PMF. There is negligible flood risk to residential lots within the catchment of this flow path, with flood hazard in the lots remaining at H1 during the PMF.

6.4.3 Additional Considerations

The implementation of this mitigation measure is expected to cost $5.1M according to the *Inner West Local Infrastructure Contributions Plan 2023*. The 2017 FRMSP notes that the benefit-cost ratio for this options is low at 0.13. Given the limited benefit to residential lots and the low benefit-cost ratio, this option was not considered further as part of this project.

Figure 6-4 Layout of Moore Lane flow path stormwater upgrades [source: Cardno, 2017]

6.5 View Street Flow Path Stormwater Upgrades [Annandale]

6.5.1 Overview

This option comprises upgrades to the existing underground stormwater drainage network which runs beneath the View Street flow path, which conveys runoff from View Street, Trafalgar Street, Nelson Street and Taylor Street in an easterly direction toward Johnstons Creek. The upgrade comprises increasing the capacity of the existing underground stormwater network in order to capture more overland flow.

This measure was identified as Option JC FM3 in the *Leichhardt Floodplain Risk Management Study and Plan* (Cardno, 2017) but was not included in the Inner West Local Infrastructure Contributions Plan 2023.

The layout of the option and the predicted flood impacts during the 1% AEP event has been extracted from the 2017 FRMSP report and shown in **Figure 6-5** below.

6.5.2 Expected Flood Impacts

As shown in **Figure 6-5**, increasing the capacity of the stormwater network in the vicinity of this flow path is expected to lead to moderate decreases in flood level of up to 0.1 metres.

Additionally, it should be noted that the flood risk along this flow path is generally minor. Flooding along the flow path typically does not exceed a hazard category of H3 in events up to and including the adopted 1% AEP climate change scenario except for in small, localised areas.

6.5.3 Additional Considerations

The implementation of this mitigation measure is expected to cost $3.0M according to the *Leichhardt Floodplain Risk Management Plan* (Cardno, 2017). Along with a low benefit-cost ratio of 0.32 and the minor flood risk, this option was not considered further as part of this project.

Figure 6-5 Layout of Arthur Street drainage upgrades [source: Cardno, 2017]

7. Flood Impact Assessment

7.1 Overview of Uplift Locations

In order to assess whether Council's master planning would result in an acceptable/unacceptable level of flood impacts and flood risk, a number of uplift scenarios were provided to Worley for testing in the TUFLOW flood models.

The uplift scenarios were provided to Worley in the form of indicative building footprints which represent proposed planning controls. It is noted that these footprints are indicative only, as alternative development schemes may come forward which could meet the proposed planning controls and also adequately address potential flood impact and risk issues.

Indicative building footprints were provided for all sites identified for uplift as part of Our Fairer Future Plan 2. Additionally, indicative building footprints were also provided for the sites nominated for uplift as part of Our Fairer Future Plan 1. These sites were not included in the *Inner West Housing Investigation Area Master Plans Flood Impact and Risk Assessment* (Worley Consulting, 2025) as they were located in areas which were not expected to be constrained by flooding.

The location of the proposed uplift scenarios for the study areas are shown in **Figure 7-1** to **Figure 7-3**.

Worley completed a flood impact and risk assessment for all of these uplift scenarios to assess the predicted impacts on the existing flood risk and flood behaviour in the study areas. This assessment was completed using the TUFLOW flood models described in **Section 4.2**. These models were modified to incorporate the indicative building footprints associated with the uplift scenarios.

The predicted impacts of the proposed uplift on existing flood risk and flood behaviour is provided in the following.

7.2 Flood Mapping

Flood mapping which shows the predicted post-development flood behaviour is provided in **Appendix B**.

The impact of the uplift scenarios is demonstrated in the flood level difference mapping included in **Appendix C**. The difference maps were created by comparing peak flood level estimates from the results of simulations undertaken for existing and post-development scenarios.

This effectively creates a contour map of predicted changes in peak flood levels (*i.e., increases and decreases*) and allows visual assessment of the impact of each uplift scenario on existing peak flood levels. Increases in peak flood levels are represented in different shades of yellow and red, while decreases are represented as shades of blue. The white shading indicates changes in peak flood levels that are between +/- 0.02 metres, which represents the threshold of flood impacts that are considered material for the purposes of this broadscale assessment, particularly given the indicative nature of the proposed building footprints.

The impact of each uplift scenario on the existing flood risk can also be assessed through the comparison of flood hazard mapping for both existing conditions and post-development conditions.

It is noted that difference mapping was not undertaken for the PMF event. The PMF event is not typically used for the assessment of flood impacts given the extreme rarity of this event. The PMF is generally used for the purposes of emergency response planning and for planning authorities to decide on potential restrictions for sensitive developments such as schools and hospitals.

FIGURE 7-1

Prepared by:

worley consulting

PROPOSED UPLIFT LOCATIONS AT SUB-AREA A

Prepared by:

worley consulting

PROPOSED UPLIFT LOCATIONS AT SUB-AREA B

FIGURE 7-3

Prepared by:

worley consulting

PROPOSED UPLIFT LOCATIONS AT SUB-AREA C

7.3 Impact of Proposed Developments on Flood Behaviour

The difference mapping included in **Appendix C** indicates that the majority of the proposed developments are expected to have negligible impacts on flooding across the study area for all events tested.

In some instances, redevelopment under proposed planning controls is expected to lead to minor adverse flood impacts in off-site areas.

At this stage, it is expected that most adverse flood impacts can be reduced at a later stage of the development design as the majority of the impacts are considered minor. Potential strategies to minimise these minor adverse off-site impacts include implementing on-site management measures or refining the proposed building footprints.

The majority of the adverse impacts are considered minor for the following reasons.

- The impacts are predicted to occur in small localised areas typically in adjacent road reserves and outside of other private properties; or
- The magnitude of the impacts is not considered to be significant; or
- A comparison of the flood hazard mapping for existing conditions and post-development conditions indicates that the predicted changes in flood behaviour do not manifest as any material change in the flood hazard category; or
- Any changes in flood behaviour are not expected to meaningfully prolong the duration of inundation and therefore do not have any material consequences on emergency response actions during a flash flood event.

Some sites are expected to lead some more notable off-site flood impacts. A detailed summary of, and recommendations for, these sites are provided in the following.

Flood level difference mapping at the sites discussed in the following sections are provided in **Figure 7-4** to **Figure 7-9**. This flood level difference mapping includes the identification of some proposed developments which would require design refinements in order to reduce the predicted adverse off-site flood impacts.

Proposed developments that are expected to lead to off-site flood impacts which are considered minor have been identified using red dashed polygons in **Figure 7-4** to **Figure 7-9**. For these developments, given the minor nature of the adverse impact, it is envisaged that these impacts could be managed at a later stage (i.e., at development application stage).

Proposed developments that are expected to lead to off-site flood impacts which are not considered minor have been identified using solid red polygons in **Figure 7-4** to **Figure 7-9**. For these developments, it is recommended that further flood model testing be done following exhibition of Our Fairer Future Plan 2 to reduce these impacts to an acceptable level.

7.3.1 Francis Street, Leichhardt

The impact of the proposed developments in the vicinity of Francis Street, Leichhardt on peak flood levels during the 1% AEP climate change event are shown in **Figure 7-4**.

The uplift in this area will lead to larger distances between buildings when compared to existing conditions, where existing housing is closely spaced. This leads to a greater quantity of runoff flowing onto the surrounding streets including Francis Street, Allen Street, William Street and Hubert Street.

Generally, this only leads to increases in flood levels which are confined to road reserves. This increase in flood level is not expected to lead to any impacts on flood hazard which would materially affect the trafficability of these streets. Some of these streets are already affected by high flood hazard under existing conditions (refer **Section 5.3.1**).

Some flood level increases are predicted to occur at the existing building at the corner of William Street and Hubert Street, however, it is noted that the impact at the building is localised against the southern wall.

Given that the flood impact is localised or otherwise expected to occur within road reserves, it is envisaged that the impacts could be managed at the development application stage. Further flood model testing should be undertaken to ensure that development at the sites bound by the red dashed polygons in **Figure** 7-4 do not lead to an increased quantity of runoff discharging onto Francis Street, Allen Street, William Street or Hubert Street.

One of the proposed buildings on the western side of Francis Street (denoted by the solid red polygon in **Figure 7-4**) is expected to lead to a build up of floodwaters on the southern side of the building, leading to flood level increases in the adjacent existing development to the north. Further flood model testing is recommended to be undertaken post-exhibition to reduce this off-site adverse impact. It is envisaged that this could comprise the incorporation of a gap in the proposed building to allow runoff to drain to the north.

Flood model results for existing conditions indicate that there is a significant quantity of runoff ponding at the rear (south) of the buildings on the southern side of William Street between North Street and Francis Street. This area is proposed for uplift, and accordingly, any uplift could consider the upgrade of the underground stormwater network at this location to improve the existing ponding problem.

7.3.2 View Street, Annandale

The impact of the proposed developments in the vicinity of View Street, Annandale on peak flood levels during the 1% AEP climate change event are shown in **Figure 7-5**.

The modelled indicative building footprints are expected to alter the existing flow behaviour at this location, leading to a greater quantity of runoff entering existing developments at Trafalgar Street and Trafalgar Lane. This leads to flood level increases of up to 0.09 metres and 0.07 metres at the respective developments.

It is recommended for the two buildings denoted by the solid red polygon in **Figure 7-5** to modify the building footprints so that the impact on existing flow behaviour is minimised. This should then be retested to confirm that the modified footprints do not lead to unacceptable adverse off-site flood impacts.

Uplift in this area could also consider the upgrade of the existing underground stormwater network in order to reduce flood levels along this flow path.

7.3.3 Ainsworth Street and White Street, Lilyfield

The impact of the proposed developments in the vicinity of Ainsworth Street and White Street, Lilyfield on peak flood levels during the 1% AEP climate change event are shown in **Figure 7-6**.

The proposed uplift at the Ainsworth Street site denoted by the red polygon in **Figure 7-6** is expected to lead to a larger gap to the building to the south. This increases the amount of runoff travelling east along the flow path, leading to significant flood level increases along Moore Lane and its adjacent properties. It is recommended that retesting be undertaken following exhibition of Our Fairer Future Plan 2 to confirm that this impact can be reduced by either increasing the size of the proposed building at Ainsworth Street, or otherwise by constructing a wall at this location to narrow the gap.

The proposed uplift at the White Street site denoted by the red polygon in **Figure 7-6** is expected to redirect flows to the south, leading to flood level increases in several existing properties to the south. It is recommended that retesting be undertaken following exhibition of Our Fairer Future Plan 2 to confirm that this impact can be reduced by modifying the proposed footprint at this location to avoid the redirection of floodwaters.

7.3.4 Livingstone Road & Maria Street, Petersham

The impact of the proposed developments in the vicinity of Ainsworth Street and White Street, Lilyfield on peak flood levels during the 1% AEP climate change event are shown in **Figure 7-7**.

The proposed uplift at this site is expected to lead to a minor redirection of flow, which is expected to lead to minor and localised flood level increases at adjacent properties to the south. Given that the impacts are localised, it is envisaged that this can be managed at the development application stage through refining the building footprints denoted by the red dashed polygon in **Figure 7-7**.

7.3.5 Fotheringham Street, Enmore

The impact of the proposed developments in the vicinity of Fotheringham Street, Enmore on peak flood levels during the 1% AEP climate change event are shown in **Figure 7-8**.

The proposed uplift at this site is expected to lead to a minor redirection of flow, which is expected to lead to minor and localised flood level increases at adjacent properties to the south. Given that the impacts are localised, it is envisaged that this can be managed at the development application stage through refining the building footprint denoted by the red dashed polygon in **Figure 7-8**.

7.3.6 Edgeware Road & Camden Street, Marrickville

The impact of the proposed developments in the vicinity of Edgeware Road and Camden Street, Marrickville on peak flood levels during the 1% AEP climate change event are shown in **Figure 7-9**.

The uplift in this area will lead to larger distances between buildings when compared to existing conditions, where existing housing is closely spaced. This leads to a greater quantity of runoff flowing onto the surrounding streets including Edgeware Road, Llewellyn Street, Murray Street and Smidmore Street. This is similar to the discussion for the proposed developments near Francis Street in Leichhardt (refer **Section 7.3.1**)

Generally, this only leads to increases in flood levels which are confined to road reserves. This increase in flood level is not expected to lead to any impacts on flood hazard which would materially affect the trafficability of these streets. Some of these streets are already affected by high flood hazard under existing conditions (refer **Section 5.3.3**).

Given that the flood impact is localised or otherwise expected to occur within road reserves, it is envisaged that the impacts could be managed at the development application stage. Further flood model testing should be undertaken to ensure that development at the sites bound by the red dashed polygons in **Figure** 7-9 do not lead to an increased quantity of runoff discharging onto Edgeware Road, Llewellyn Street, Murray Street and Smidmore Street.

7.4 Additional Commentary on Flood Impacts

The proposed uplift in the study area generally leads to larger distances between proposed buildings when compared to existing conditions, where existing housing is closely spaced. This leads to a greater quantity of runoff flowing onto the surrounding streets. Flood model results indicate that this would lead to increases in peak flood levels in some downstream areas.

Therefore, it is recommended that all uplift in the study area should be supported by further modelling analysis at the development application stage to ensure that the proposed development will not lead to an increase in the amount of runoff discharging into adjacent streets. This could comprise the implementation of on-site detention in accordance with Council's planning controls and engineering guidelines.

Further commentary on some areas where this is predicted to occur are provided in the following.

7.4.1 Impact on Darley Road Ponding Area

The provided building footprints indicate that a significant area of Leichhardt bound by Marion Street to the south, Norton Street to the east and Darley Road to the west and north have been identified for uplift as part of Our Fairer Future Plan 2 (refer **Figure 7-1**). The proposed uplift in this area will lead to larger distances between buildings when compared to existing conditions. This leads to a greater quantity of runoff flowing onto the surrounding streets and draining to the low point of the catchment along Darley Road.

As a result, uplift in this area is expected to lead to flood level increases in the Darley Road ponding area of up to 0.07 metres in the 1% AEP event and up to 0.03 metres in the 1% AEP climate change event.

This impact is not considered to be a material off-site impact as the road is already inundated to significant depths under existing conditions (refer **Section 5.3.1**), and the flood level increase attributed to the proposed uplift would not materially affect the trafficability of the road nor the duration of inundation. Additionally, it is understood that all lots fronting Darley Road are propose for uplift as part of Our Fairer Future Plan 2, and accordingly the potential flood level increases in these lots have not been considered as an off-site impact.

7.4.2 Impact on Whites Creek

The provided building footprints indicate that several blocks to the north and south of Piper Street, between Balmain Road to the west and Whites Creek to the east, have been identified for uplift as part of Our Fairer Future Plan 2 (refer **Figure 7-1**). The proposed uplift in this area will lead to larger distances between buildings when compared to existing conditions. This leads to a greater quantity of runoff flowing onto the surrounding streets and draining to Whites Creek.

As a result, uplift in this area is expected to lead to flood level increases along Whites Creek of up to 0.04 metres in the 1% AEP event and up to 0.05 metres in the 1% AEP climate change event. However, it is noted that these increases in peak flood level are not expected to lead to any increases to the lateral flood extent, where flooding is generally confined to the creek channel and adjacent parklands and road reserves.

7.4.3 Uplift near Styles St / Catherine St intersection

Some lots on the northern side of Styles Street near the Catherine Street intersection at Leichhardt have been identified for uplift as part of Our Fairer Future Plan 1 (refer **Figure 7-1**). These lots are located outside of the PMF extent according to the *Leichhardt Flood Study* (Cardno, 2015) and the *Leichhardt Floodplain Risk Management Study and Plan* (Cardno, 2017) and accordingly have not been identified as flood constrained lots in Council's planning instruments.

Per Section 8.1 of the 2015 Cardno study, it is noted that the SOBEK model adopted as part of the existing Leichhardt studies have adopted a 'direct rainfall' approach, which effectively results in every 2D cell in the flood model to be inundated with some flood depth. Accordingly, the existing Leichhardt studies filtered the raw flood model results to remove areas of benign runoff and ponding.

A similar approach was adopted by Worley Consulting as part of the development of the new Leichhardt TUFLOW model (refer **Section 4.2.1**).

The raw model results indicate that uplift at these lots is expected to lead to a minor increase in the quantity of runoff which discharges onto Catherine Street. This is attributed to the larger distances between the proposed buildings when compared to existing conditions.

Given that this runoff remains minor and benign, it has also been filtered out of the flood model results. However, the model results also indicate that this minor runoff collects in the low points along Catherine Street and Coleridge Street, leading to flood level increases in some existing residential lots to the north of up to 0.05 metres during the 1% AEP event and up to 0.06 metres during the 1% AEP climate change event. The existing buildings in this area are tightly spaced, and therefore even minor increases to the amount of runoff reaching this area would impact on peak flood levels due to the significant number of constrictions and obstructions to flow.

Therefore, per the recommendations above, it is recommended that uplift in this area should be supported by further flood modelling analysis at the development application stage to ensure that the proposed development will not lead to an increase in the amount of runoff discharging into adjacent streets.

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INCREASES IN PEAK 1% AEP CLIMATE CHANGE FLOOD LEVELS NEAR PROPOSED DEVELOPMENTS AT FRANCIS STREET LEICHHARDT

FIGURE 7-5

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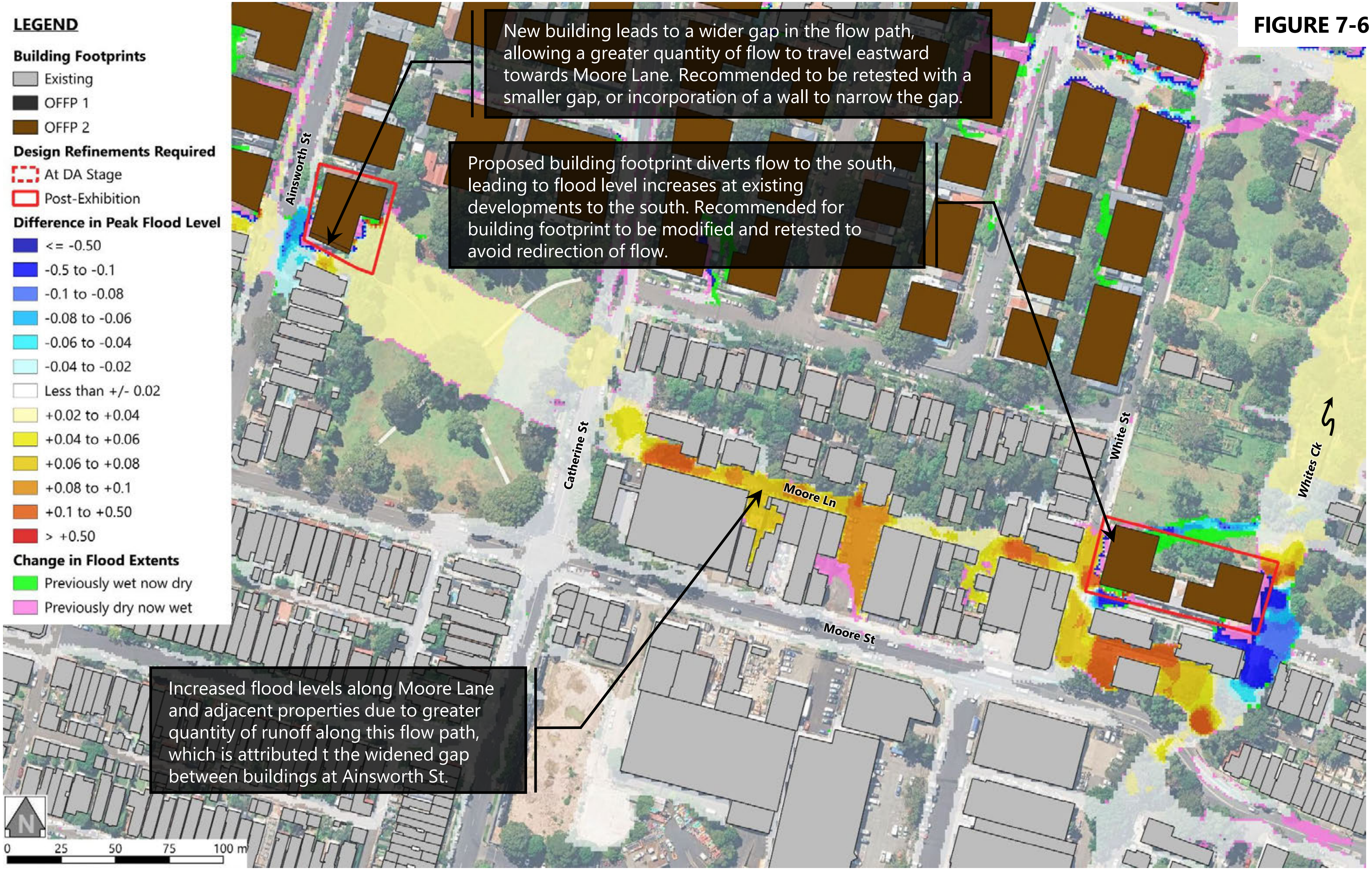
worley consulting

INCREASES IN PEAK 1% AEP CLIMATE CHANGE FLOOD LEVELS NEAR PROPOSED DEVELOPMENTS AT VIEW STREET ANNANDALE



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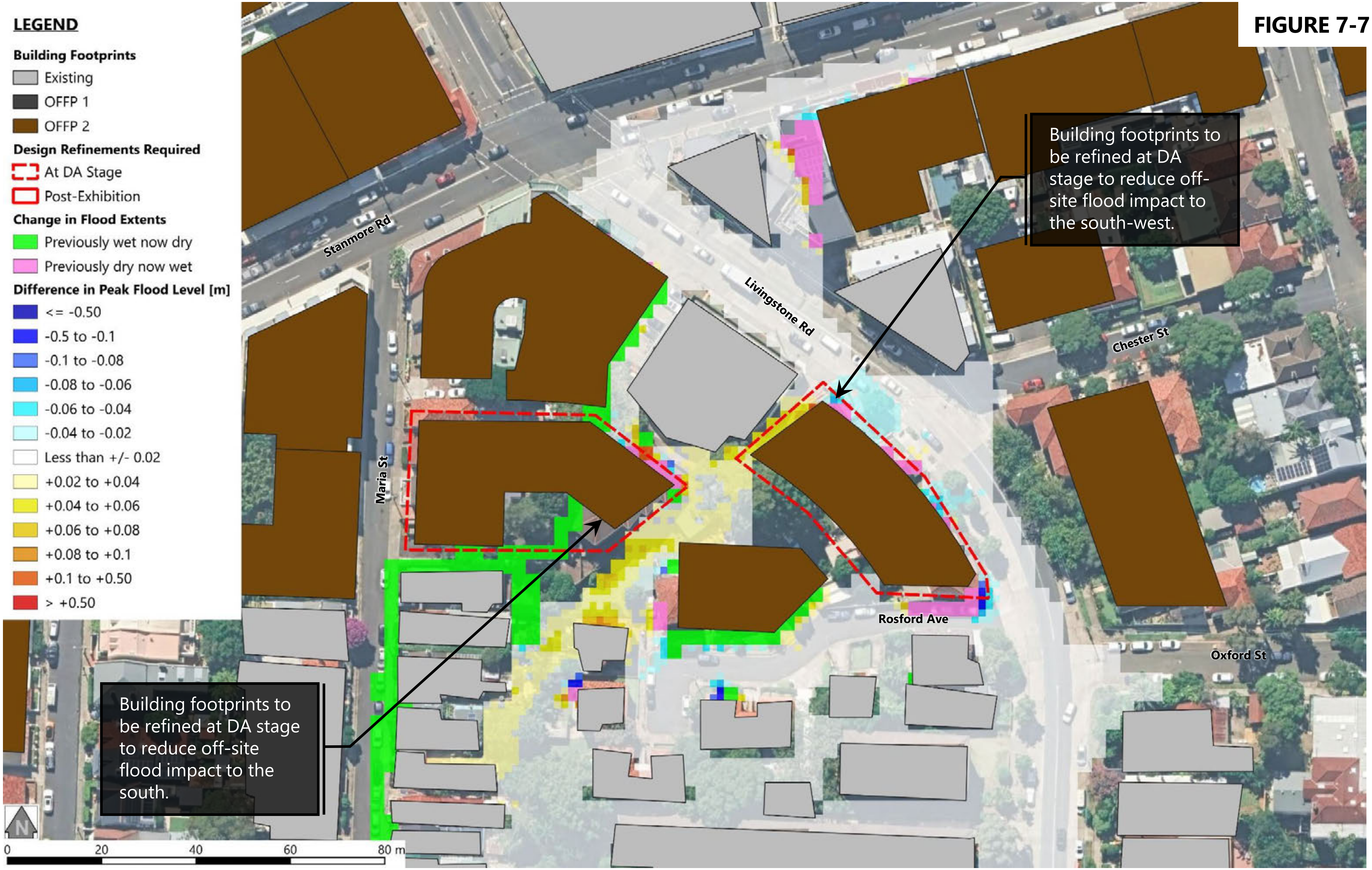
worley consulting

INCREASES IN PEAK 1% AEP CLIMATE CHANGE FLOOD LEVELS AT PROPOSED DEVELOPMENTS NEAR AINSWORTH ST & WHITE ST, LILYFIELD

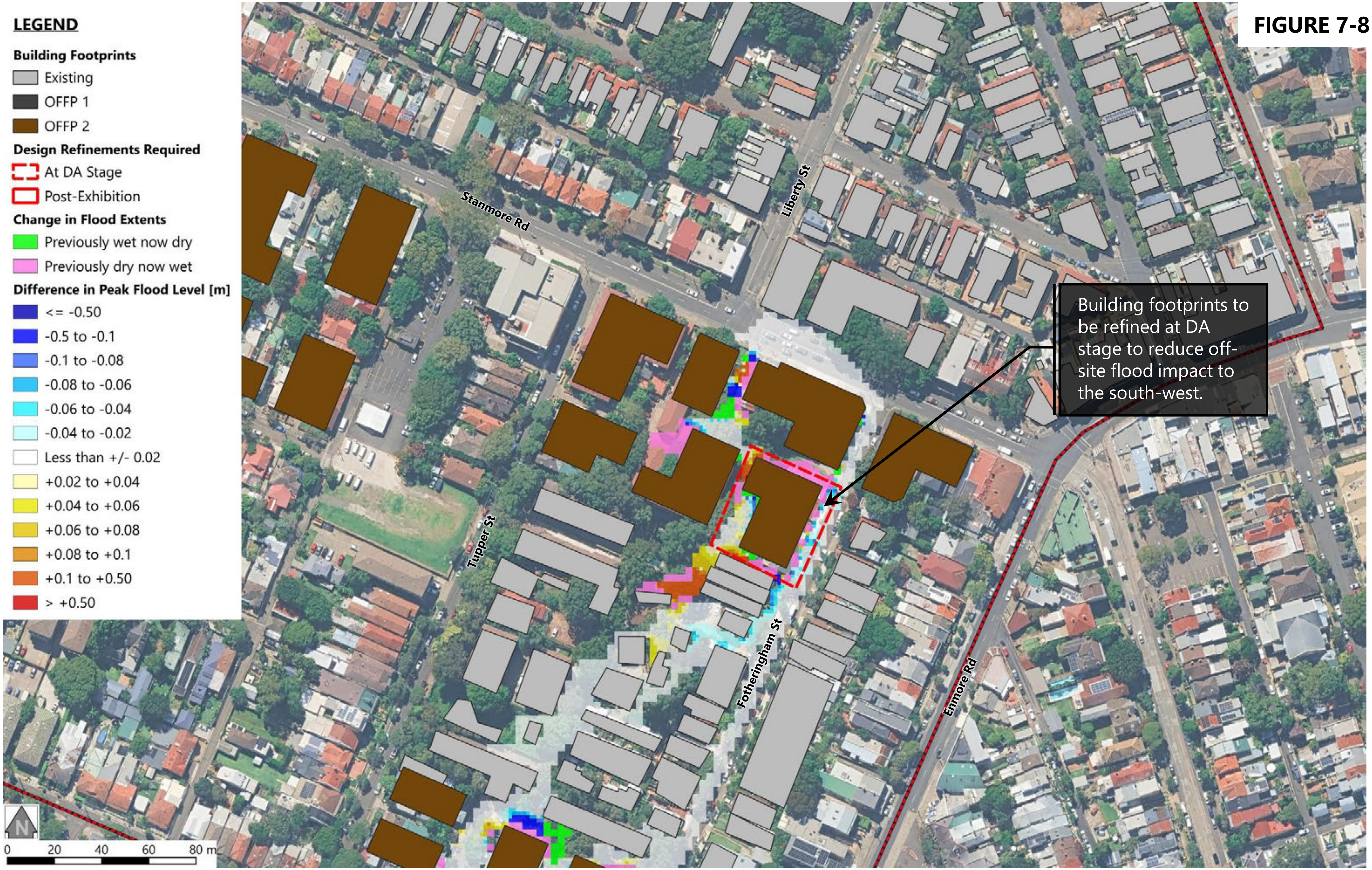
FIGURE 7-7



Prepared by:

worley consulting

INCREASES IN PEAK 1% AEP CLIMATE CHANGE FLOOD LEVELS AT PROPOSED DEVELOPMENTS NEAR LIVINGSTONE RD & MARIA ST, PETERSHAM



Prepared by:

worley consulting

INCREASES IN PEAK 1% AEP CLIMATE CHANGE FLOOD LEVELS AT PROPOSED DEVELOPMENTS NEAR FOTHERINGHAM STREET, ENMORE

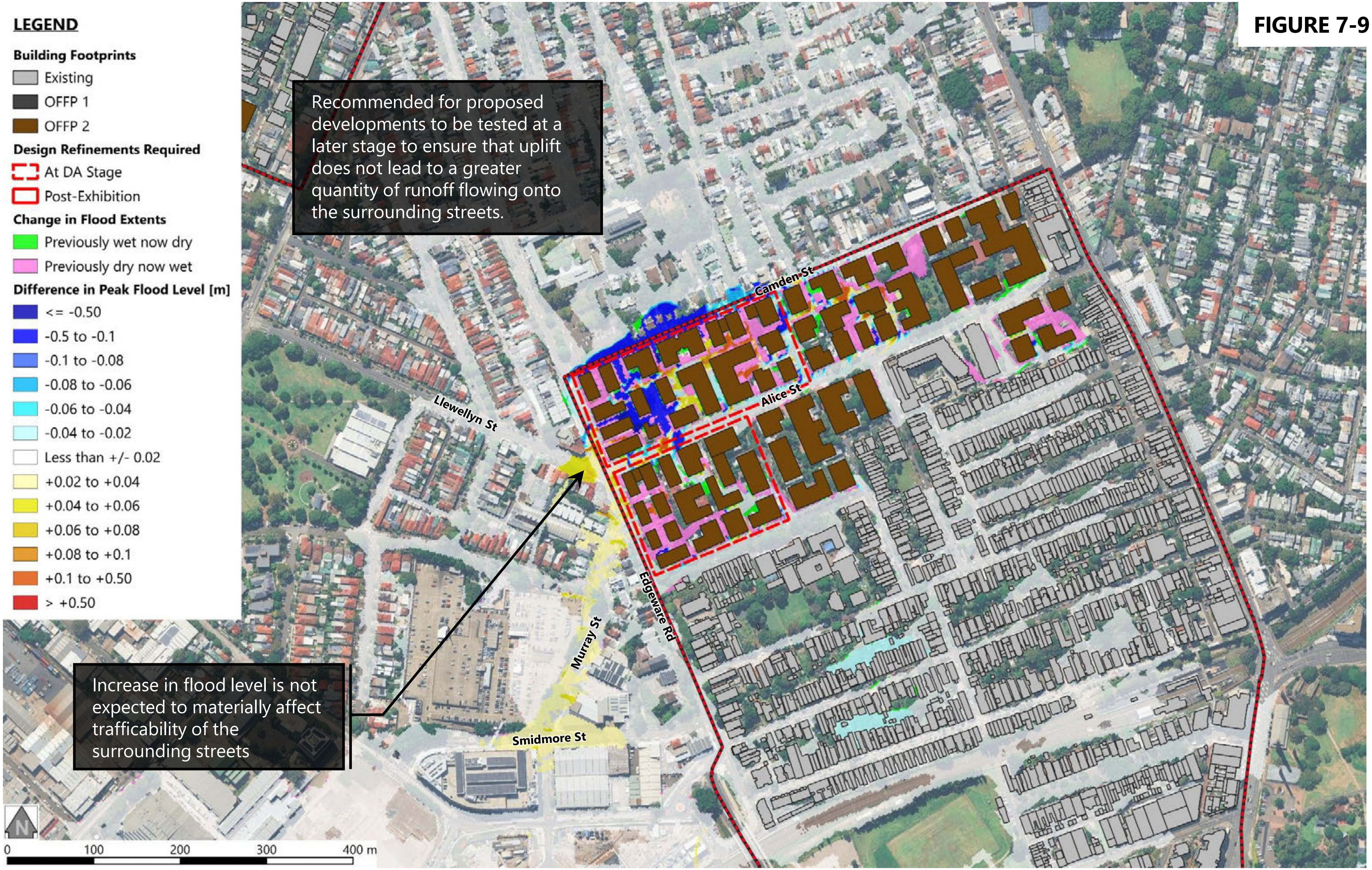


FIGURE 7-9

INCREASES IN PEAK 1% AEP CLIMATE CHANGE FLOOD LEVELS AT PROPOSED DEVELOPMENTS NEAR EDGEWARE ROAD & CAMDEN STREET, MARRICKVILLE

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8. Flood Planning Advice

8.1 Recommended Flood-Related Development Controls

For uplift scenarios under both Our Fairer Future Plan 1 and Our Fairer Future Plan 2, the following development controls should be taken into consideration as part of any proposal for redevelopment or the construction of new buildings, in accordance with the Leichhardt Development Control Plan (**LDCP 2013**), the Marrickville Development Control Plan (**MDCP 2011**) and the draft Inner West Development Control Plan (**draft IWDCP 2026**).

a. All development proposals on land which is affected by flooding in events up to and including the Probable Maximum Flood (PMF) are to be supported by a Flood Impact and Risk Assessment (FIRA) prepared by a suitably qualified civil or environmental engineer with experience in flood investigation and flood impact assessment. The FIRA is to be prepared in accordance with the draft Inner West Development Control Plan 2026 (draft IWDCP 2026) as well as Flood Risk Management Guideline LU01 (DPE, 2023).

b. The proposed development, or any associated works which will modify the stormwater drainage system or flood behaviour within a property, must not lead to any material increase to peak flood levels or hazards in off-site areas. The proposed works must also not lead to any material increase to the flood risk in off-site areas.

c. The Flood Planning Level (FPL) at each development is to be determined in accordance with **Table 8-1**, which is adopted from the draft IWDCP 2026.

Table 8-1 Inner West Council draft Flood Planning Level definitions

Development Type	Flood Planning Level
Sensitive and Hazardous Development (e.g. educational establishments, childcare, seniors housing. Refer Clause 5 of IWLEP 5.22)	PMF level
Residential development in areas where flood depth ≤ 300 mm AND velocity ≤ 2 m/s	1% AEP flood level + 300mm or the PMF level, whichever is lower.
Residential development in areas where flood depth > 300 mm	1% AEP flood level + 500mm or the PMF level, whichever is lower.
All other development	1% AEP flood level + 500mm or the PMF level, whichever is lower.

d. Floor levels are to be adopted as follows:

- Habitable (residential) floor levels at development sites affected by Low (H1-H3) Hazard flooding in the PMF are to be set at or above the FPL.
- Habitable (residential) floor levels at development sites affected by High (H4-H6) Hazard flooding in the PMF are to be set at or above the FPL or the peak PMF level, whichever is higher.
- Commercial / industrial floor levels are to be set at or above the FPL.
- Floor levels for sensitive and hazardous land uses are to be set at or above the peak PMF level.

e. Basements for new developments are to be designed as follows:
   - All potential water entry points are to be located above the peak PMF level.
   - Pedestrian evacuation routes are to be separate from vehicular access ramps, with clear signage and to provide a continuous upward path of travel from the lowest basement level to a refuge space above the peak PMF level.
   - Structural elements are to be designed to withstand hydrostatic and hydrodynamic pressures in events up to and including the PMF.

f. Above-ground parking spaces to be located at or above the 1% AEP flood level plus 200mm freeboard and outside of areas affected by High Hazard (H4-H6) flooding during the 1% AEP event.

g. All parts of the development located below the FPL shall be constructed from flood compatible materials.

h. Developments which are affected by H5 or H6 flood hazard in events up to and including the PMF are required to demonstrate that the building can withstand the force of floodwaters. This will require a report from a specialist structural engineer.

i. All developments must incorporate features to facilitate a Shelter in Place (SIP) flood emergency response and must demonstrate compliance with the *Shelter in place guideline for flash flooding* (NSW DPHI, 2025).

j. Ground floor commercial uses in areas affected by High (H4-H6) Hazard in the PMF are to provide ready access to a refuge space above the peak PMF level. This would require the construction of additional floors above the ground floor.

k. Developments affected by H3 to H6 flood hazard in the PMF are to be accompanied by a site-specific Flood Emergency Response Plan (FERP) to be prepared by a suitably qualified consultant.

8.2 Flood Emergency Response Considerations

Flooding in the study area can be characterised as flash flooding. Flash flooding typically arises from short duration high intensity storms which lead to rapid changes in the velocity and depth of floodwaters. The Australasian Fire and Emergency Service Authorities Council defines flash flooding as “flooding that occurs within 6 hours of the precipitating weather event, and often involves rapid water level changes and flood water velocity” (AFAC, 2018).

The available response time is limited in the study area, with inundation typically occurring within 10 minutes from the start of the rainfall event. Flood levels are expected to peak typically within one hour from the commencement of rainfall. The duration of inundation is also typically short, with floodwaters rising and then receding over a short period of time - typically no more than 2 hours.

It is understood that a tailored flash flooding warning system is currently not available in the Inner West LGA. Therefore, given the rapid catchment response time, it would not be feasible to adopt a flood emergency response strategy which relies on NSW State Emergency Services (**SES**) assisted evacuation.

Accordingly, the only viable emergency response strategies are self-evacuation to an off-site location, or Shelter in Place (**SIP**). These two strategies are discussed in the following.

8.2.1 Off-Site Self-Evacuation

To enable off-site self-evacuation prior to the onset of rainfall and the inundation of surrounding roads, an evacuation strategy would need to be developed based on a suitable flood warning system which uses flood forecasting methods. However, frequent evacuation that is triggered by a flood warning system but where only minor flooding occurs, can lead to a situation where warnings are eventually ignored. Additionally, evacuation which occurs too late could be more dangerous than staying put, as residents may be endangered by walking or driving through hazardous floodwaters.

Given that there is no tailored flash flood warning system available, this is not considered to be feasible or practical. It is noted that the Bureau of Meteorology has developed a Flash Flood Advisory Resource (**FLARE**) which assists relevant agencies such as local councils to design, implement and manage "fit-for-purpose" flood warning systems. FLARE includes a website and advisory service for registered users. Council could explore obtaining access to FLARE and could investigate the feasibility of developing a tailored flash flood warning system for the flash flooding in the study area.

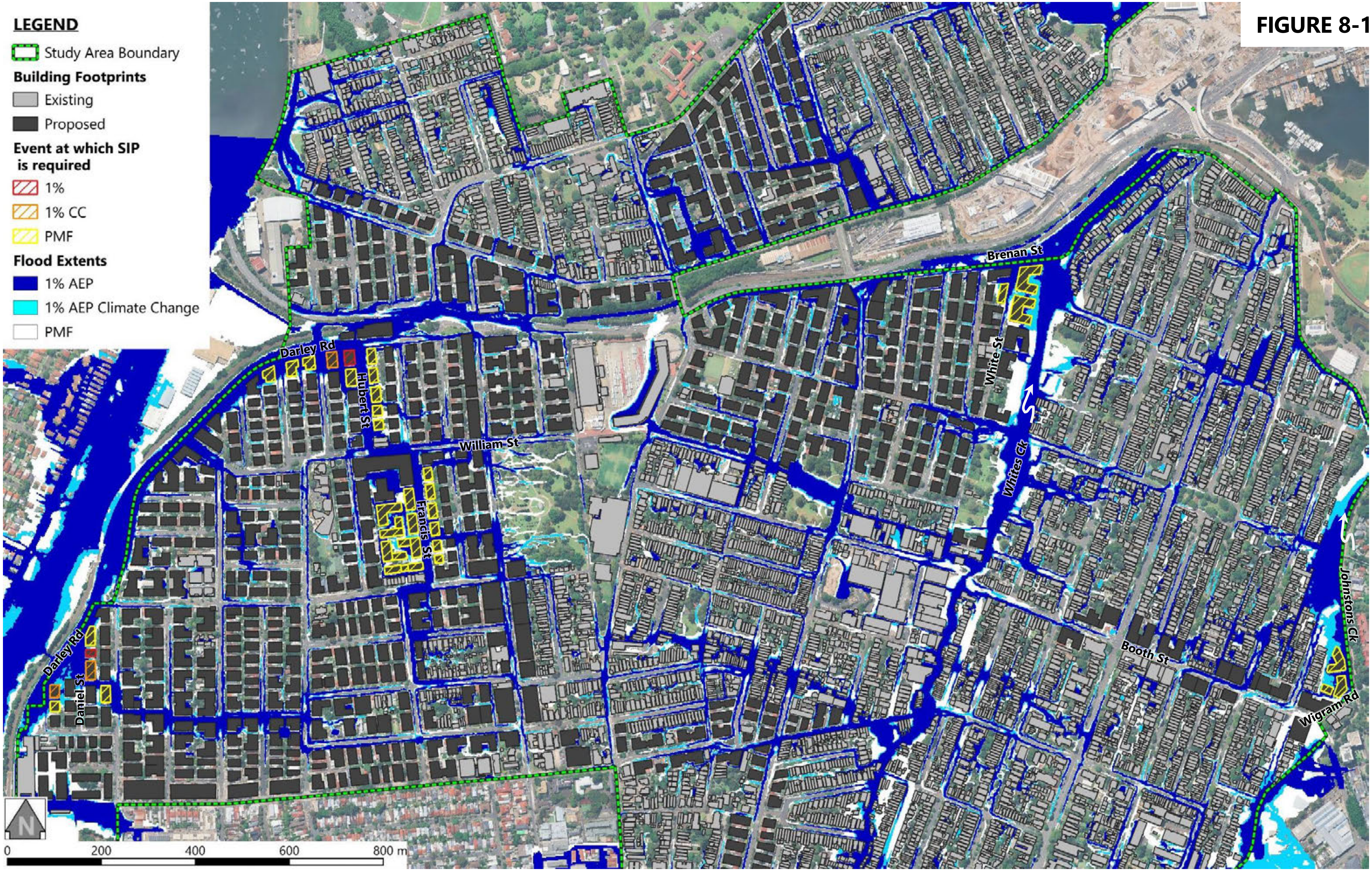
If required, self-evacuation which occurs close to or after the onset of rainfall may be feasible at some locations, given that these locations are only affected by benign flooding which do not pose a material risk to life in events up to and including the PMF. In these areas, it is expected that residents would be able to leave the site without entering hazardous floodwaters by walking or driving.

Off-site evacuation via self-evacuation to land outside of the PMF extent is possible at all development sites except for the sites shown in **Figure 8-1** and **Figure 8-2**. These sites are located in the vicinity of the flooding hotspots described in **Section 5.3** and including the Darley Road ponding area, the Francis Street / Hubert Street flowpath, the Edgeware Road and areas adjacent to Hawthorne Canal, Whites Creek and Johnstons Creek. These sites would be required to adopt a Shelter in Place (**SIP**) flood emergency response. The requirements to facilitate SIP as a flood emergency response strategy are discussed in **Section 8.2.2**.

It is understood that self-evacuation at the sites shown in **Figure 8-1** and **Figure 8-2** may become feasible should alternative lot amalgamations arise which provide additional access points, thereby enabling occupants to leave the site without entering hazardous floodwaters. Self-evacuation may also become feasible with the adoption of right-of-way easements which would provide alternative access points and evacuation routes.

Even with the availability of a safe evacuation route, it is recommended for all developments within the PMF extent to incorporate features to enable a SIP response as it would be safer and more practical for residents to remain at home given that the duration of inundation is typically 2 hours or less. Self-evacuation during a weather event is not without risk, given that residents would be travelling outside during a storm. These residents would potentially be exposed to heavy rain and wind, even if evacuating the site would not require travel through floodwaters.

Notwithstanding, it is noted that the availability of a safe evacuation route reduces the risk of isolation given that residents can leave if required (e.g., due to a medical emergency) and emergency services would be able to safely access the development.



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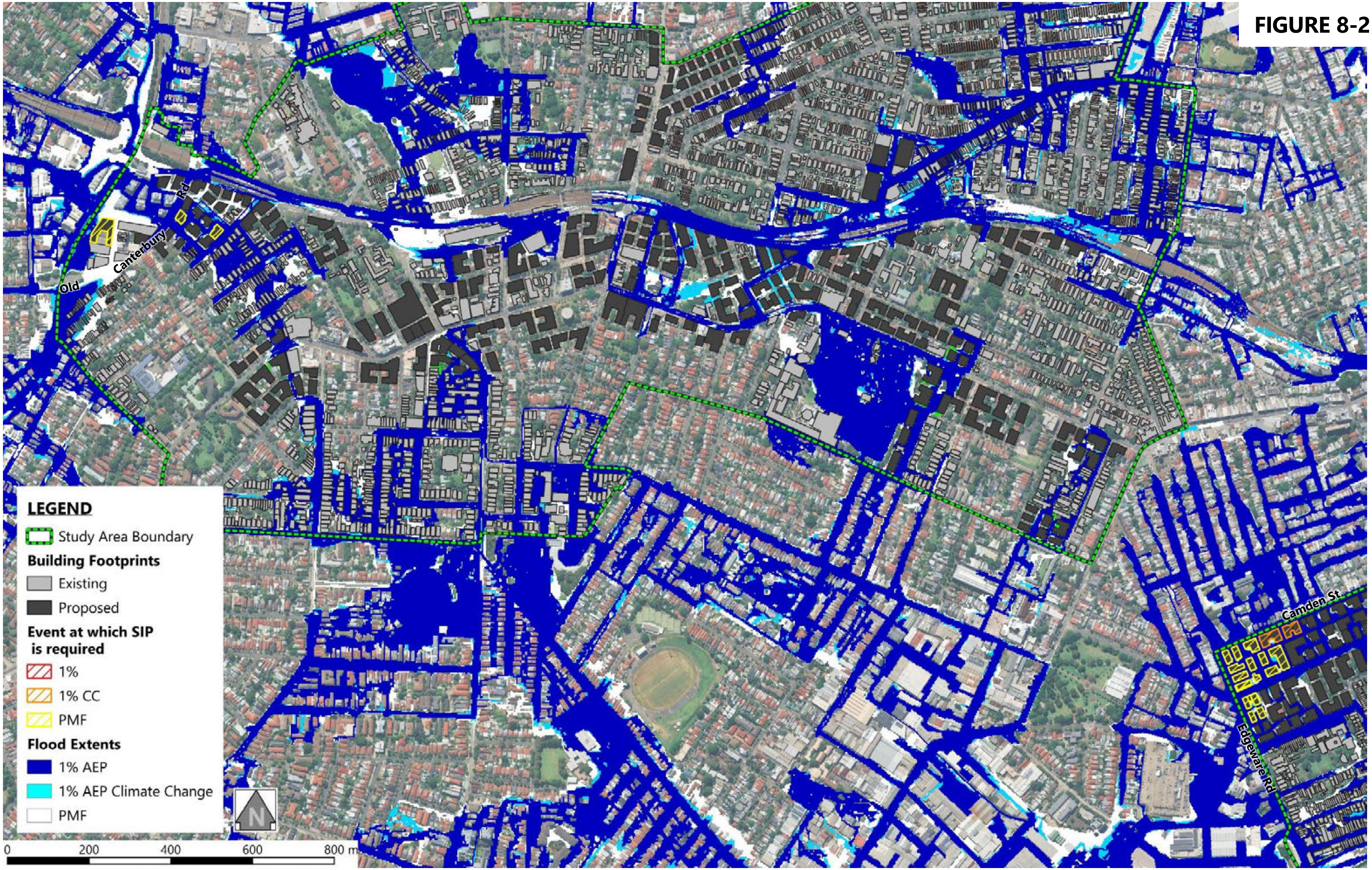
OVERVIEW OF PROPOSED DEVELOPMENTS REQUIRING A SHELTER IN PLACE EMERGENCY RESPONSE AT SUB-AREA A



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OVERVIEW OF PROPOSED DEVELOPMENTS REQUIRING A SHELTER IN PLACE EMERGENCY RESPONSE AT SUB-AREAS B & C

8.2.2 Shelter in Place

The flood modelling and analysis completed for this investigation indicates that the duration of inundation throughout the study area would not exceed 12 hours. In particular, peak flood levels and hazards within the study area are predicted to occur during short duration storms which do not exceed 1 hour. The duration of inundation under these critical duration storms typically does not exceed 2-3 hours, including areas of inundation at the Darley Road ponding area.

Therefore, given that flooding in the study area is not expected to isolate developments for significant periods of time, Shelter in Place (**SIP**) is the recommended emergency response strategy for new developments that are proposed under the Our Fairer Future Plan 1 and Our Fairer Future Plan 2 master planning process.

For the following sites, self-evacuation is not currently feasible and SIP is the only viable flood emergency response strategy (refer **Figure 8-1** and **Figure 8-2**):

- During the 1% AEP event: two sites in the northern and southern end of the Darley Road ponding area, respectively. One site is located near the Darley Road / Daniel Street intersection and the other site is located near the Darley Road / Hubert Street intersection.
- During the 1% AEP climate change event: two additional sites near the Darley Road / Daniel Street intersection; one additional site near the Darley Road / Hubert Street intersection and two sites along Camden Street near the Edgeware Road flow path.
- During the PMF: Several additional sites near the northern and southern end of the Darley Road ponding area, several sites along the Francis Street / Hubert Street flow path, three sites adjacent to Whites Creek near the White Street / Brenan Street intersection, three sites adjacent to Johnstons Creek near Wigram Road and several sites in the vicinity of the Edgeware Road flow path.

Given that SIP is the only viable flood emergency response, it is critical for developments at these locations to demonstrate full compliance with the Shelter-in-place Guideline released by NSW DPHI in 2025, which provides guidance for the assessment of whether SIP is an appropriate emergency response strategy for particular development types and sites. In particular, these developments should outline how secondary emergencies (such as medical or fire) which occur at the same time as a flood, will be addressed, given that occupants will not be able to leave and that it would be difficult for emergency services to access the site.

Any implementation of a SIP emergency response would require consideration of the issues raised in the commentary below.

- The NSW Department of Planning, Housing and Infrastructure (**DPHI**) recently released a guideline document titled, '*Shelter-in-place guideline for flash flooding*' (2025). **Table 8-2** provides a summary of how developments for the identified uplift locations would align with the objectives of, and criteria set out, in the SIP Guideline.
- Locations nominated for SIP would need to consider the structural stability of the building with reference to the flood hazard as well as the capacity to provide a refuge above the PMF level for residents to shelter while waiting for floodwaters to recede. This would likely require a mezzanine level or a first floor to be constructed where the existing floor level of a building is below the level of the PMF.
- SIP locations, and obtaining access to these locations, should not rely on access to electricity and should also have clearly marked internal access for all people on site. Items for self-sufficiency (such as drinking water, food, medical kits, fire extinguishers, radios etc.) should be stored and regularly maintained in these locations.
- Notwithstanding the points made above, the Australian Fire and Emergency Service Authorities Council (AFAC) notes that SIP is not low risk. Risks to consider include the ability of elderly, disabled and young residents to reach higher parts of the residence, difficulties in servicing medical emergencies and the

unpredictability of behaviour under stress; e.g., residents changing their minds and deciding to evacuate when floodwaters enter their dwelling.

- It should also be noted that it is Worley Consulting's recent experience that the SES is not supportive of new developments that rely on SIP as justification for development approval.
- Flood awareness programs are an effective way of educating residents of the flood risk in their area. The development and implementation of a flood awareness program is likely to improve the capacity of residents to respond in a flood emergency, thereby reducing the risk to life and flood damages.
- Site-specific emergency response plans should be considered for new multi-unit developments. It is Worley Consulting's experience that any site-specific emergency response plans would need to consider the practicality of implementation, which can depend on the scale of development; e.g., it is more likely for a plan to be effective for a large commercial building which has a building manager trained as a Flood Warden, compared to smaller strata schemes relying on individual residents to enact their own property-specific plan. Site specific emergency response plans are not recommended as an emergency response strategy for individual houses.

Table 8-2 Assessment of the SIP strategy for proposed uplift locations

#	SIP Consideration*	Assessment of Stage 1 Inner West Housing uplift locations
1	Does SIP align with existing emergency management strategies for the area, as determined through the flood risk management process and by the NSW SES?	Previously completed flood risk management studies for Dobroyd Canal, Hawthorne Canal, Johnstons Creek, Whites Creek, Marrickville Valley, Alexandra Canal and Eastern Channel East catchments have identified that off-site evacuation is challenging given the rapid catchment response times (typically 1-2 hours) and the lack of a catchment-specific flash flood warning system. These studies note that SIP is a safer emergency response strategy.
2	Has evacuation off-site (the primary emergency management strategy) been investigated and determined to be unachievable?	The discussion in **Section 8.2.1** demonstrates that off-site evacuation which is assisted by the NSW SES is not practical in the study area, given the rapid catchment response and the lack of a catchment-specific flash flood warning system. While off-site evacuation via self-evacuation is possible at some sites, it is considered safer and more practical for residents to remain at home given that the duration of inundation is typically 2 hours or less. Self-evacuation during a weather event is not without risk, given that residents would be travelling outside during a storm. These residents would potentially be exposed to heavy rain and wind, even if evacuating the site would not require travel through floodwaters.
3	Does the development include medical centres, emergency service and community facilities, and sensitive and hazardous land uses, some of which may not be suitable for SIP?	Sensitive land-uses are recommended to be located outside of the PMF extent (**refer Section 8.1)**

#	SIP Consideration*	Assessment of Stage 1 Inner West Housing uplift locations
4	SIP for greenfield development is not supported.	The developments are not greenfield developments.
5	Are there existing government developed flood warning systems that give advanced detailed forecasts of flash flooding to allow sufficient time to evacuate to the proposed refuge locations?	There are no existing government developed flood warning systems that give advanced detailed forecasts of flash flooding to allow sufficient time to evacuate to the proposed refuge locations.
6	Can the community effectively be informed of the risks associated with the emergency management strategy?	Yes, this can be implemented through community flood awareness programs and through printed material to be distributed to residents who will be living in these new buildings.
7	The FIRA should include detailed assessment of evacuation off-site (the primary emergency management strategy) to determine that evacuation off-site is not achievable.	The discussion in **Section 8.2.1** demonstrates that off-site evacuation which is assisted by the NSW SES is not practical in the study area, given the rapid catchment response and the lack of a catchment-specific flash flood warning system. While off-site evacuation via self-evacuation is possible at some sites, it is considered safer and more practical for residents to remain at home given that the duration of inundation is typically 2 hours or less. Self-evacuation during a weather event is not without risk, given that residents would be travelling outside during a storm. These residents would potentially be exposed to heavy rain and wind, even if evacuating the site would not require travel through floodwaters..
8	The FIRA should include the flood behaviour at the site, with consideration of climate change and assessment of the potential maximum duration of isolation up to and including the PMF to identify that: a. Flash flooding is the only flood risk present at the site, whether it be from overland flooding, local creek or riverine flooding; and b. The flooding occurs within less than 6 hours from the commencement of the causative rain and the duration of SIP due to isolation by floodwaters is less than 12 hours from the commencement of rainfall; and The development is not subject to high hazard flooding (e.g. floodways, high hazard H5 of H6 areas) or surrounding roadways are not subject to high hazard flooding.	The flood modelling adopted for this study is based on existing floodplain risk management studies which have been completed under the NSW Floodplain Management Program. These flood models indicate that the study areas are affected by flash flooding where flooding occurs within less than 6 hours from the commencement of the causative rain and are not affected by flooding which lasts for longer than 12 hours. Item 8c can be considered inconsistent with the rationale behind the need for a SIP strategy given that off-site evacuation would be more plausible under low hazard conditions at the site and in surrounding roads. SIP would be expected to lead to a safer outcome for buildings in high hazard conditions, as residents would be protected from high hazard floodwaters as well as wind and rain in their homes, provided that the buildings are designed to withstand the force of PMF waters. Recommendations for uplift locations which require specialist structural engineering design input for this purpose are provided in **Section 8.2.3**.

#	SIP Consideration*	Assessment of Stage 1 Inner West Housing uplift locations
9	a. How will SIP be used as part of the site's emergency management response, including actions before, during and after the SIP period? b. How will SIP be communicated to occupants and visitors of the building and how will this communication be maintained for the life of the development?	As per the SIP guidelines, these items are to be addressed as part of a site-specific FIRA once the consent authority considers that SIP is an appropriate emergency response strategy. These items are included as recommendations for future site-specific FIRAs (refer **Section 10.2**).
10	Provide an understanding of the secondary risks and how the proponent proposes they will be managed. This should include medical emergencies, building fire, health and wellbeing.	

**Source: Shelter-in-place Guideline for flash flooding (NSW DPHI, 2025) pages 4-6*

8.2.3 Structural Stability

As noted in **Section 8.2.2**, Shelter in Place is the recommended emergency response strategy for new developments that are proposed under the Our Fairer Future Plan 1 and Our Fairer Future Plan 2 master planning process.

The adoption of Shelter-in-Place requires that the building be structurally sound in events up to and including the PMF. Buildings which are proposed on sites which are classified as being exposed to H5 or H6 flood hazard during the PMF would be vulnerable to structural damage or failure (AIDR, 2017). Therefore, any proposals to site buildings in areas categorised as having H5 or H6 flood hazard will require specialist structural engineering design input to ensure that the building is able to withstand the force of floodwaters.

Figure 8-3 and **Figure 8-4** shows the uplift locations which are predicted to be affected by H5 to H6 flood hazard during the PMF and would require specialist structural engineering input during the design of development proposed for these sites.

8.2.4 Habitable Floor Levels

As noted in Council's planning instruments, floor levels should be set at or above the Flood Planning Level (FPL). However, given that developments will likely rely on a Shelter-in-Place flood emergency response strategy as opposed to evacuation to off-site locations, it is recommended that minimum habitable floor levels be set at or above the peak PMF level in areas affected by high flood hazard during the PMF; i.e., where the PMF flood hazard is H3 and above.

In this regard, it is recognised that some development areas are affected by high PMF depths (e.g., greater than 1.5 metres), such as locations adjacent to the Darley Road ponding area, Whites Creek, Johnstons Creek and Hawthorne Canal. For these locations, all habitable spaces may be required to be located on the first floor of the building; i.e., the ground floor would be reserved for non-habitable uses.

Mapping of peak depths, levels and hazards for the PMF event are included in **Appendix B**. Proposed uplift should review the expected peak PMF depths, levels and hazards at each respective location to determine minimum habitable floor levels to facilitate SIP during a PMF.

Further design of developments must assess the time required for vertical evacuation against the rate of rise of PMF floodwaters, to ensure occupants can evacuate safely to floors above the PMF level and avoid getting trapped in ground floor premises.

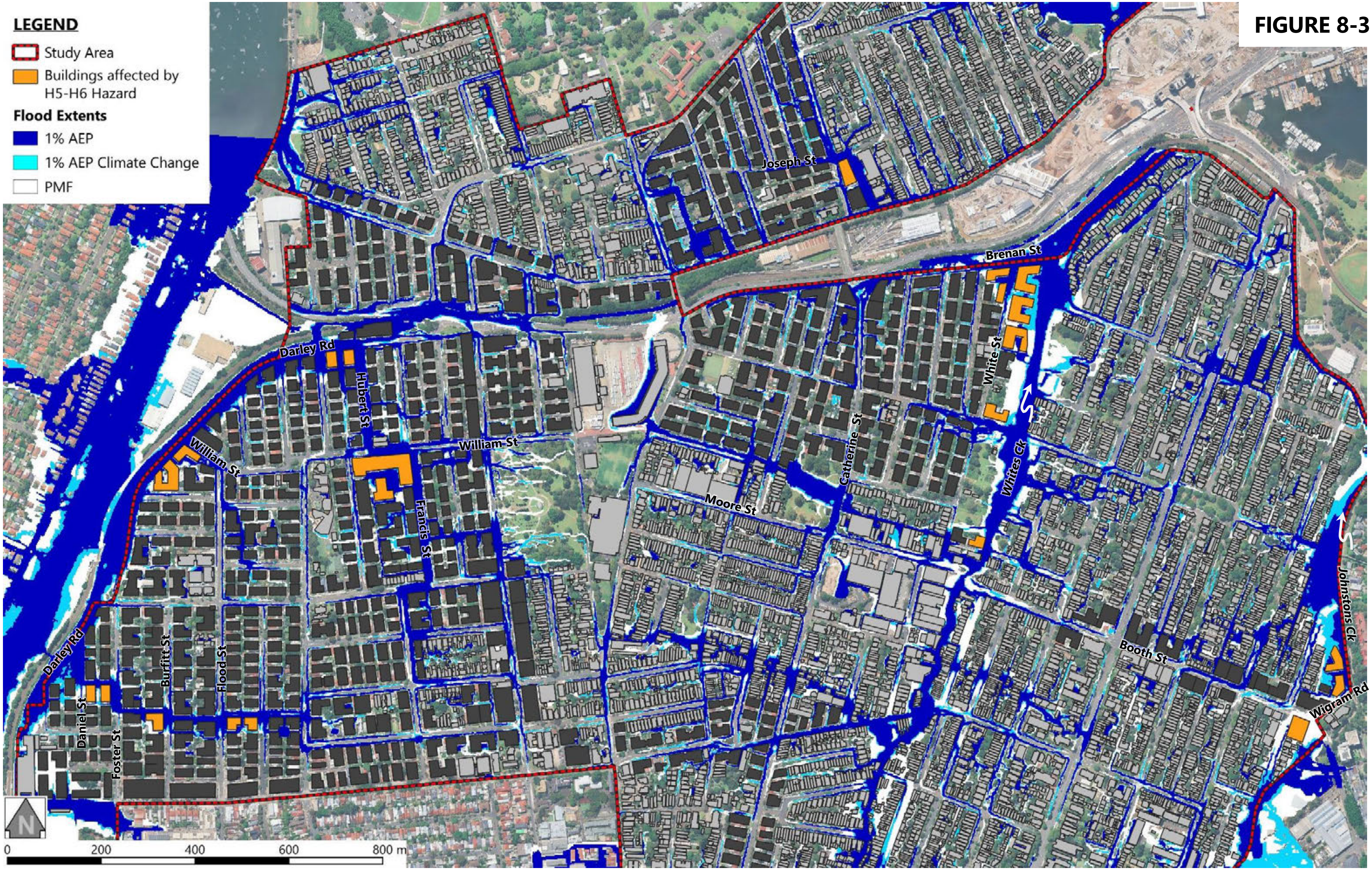
8.3 Ground Level Activation

Pedestrian entries should be located in areas where the flooding is shallowest to facilitate efficient ground level activation without requiring excessive filling or steps / ramps, while also reducing the potential for significant inflows during flooding.

Similarly, basement entries should be located in areas where flooding is shallowest. As noted in **Section 8.1**, all potential water entry points into basements (e.g. driveways for basement carparks) are to be located above the peak PMF level. Therefore, it would be impractical to locate basement entries in areas which are affected by significant PMF depths, for example, along Darley Road and areas facing towards the Whites Creek, Johnstons Creek and Hawthorne Canal channels.

Mapping of peak flood depths is included in **Appendix B**.

FIGURE 8-3



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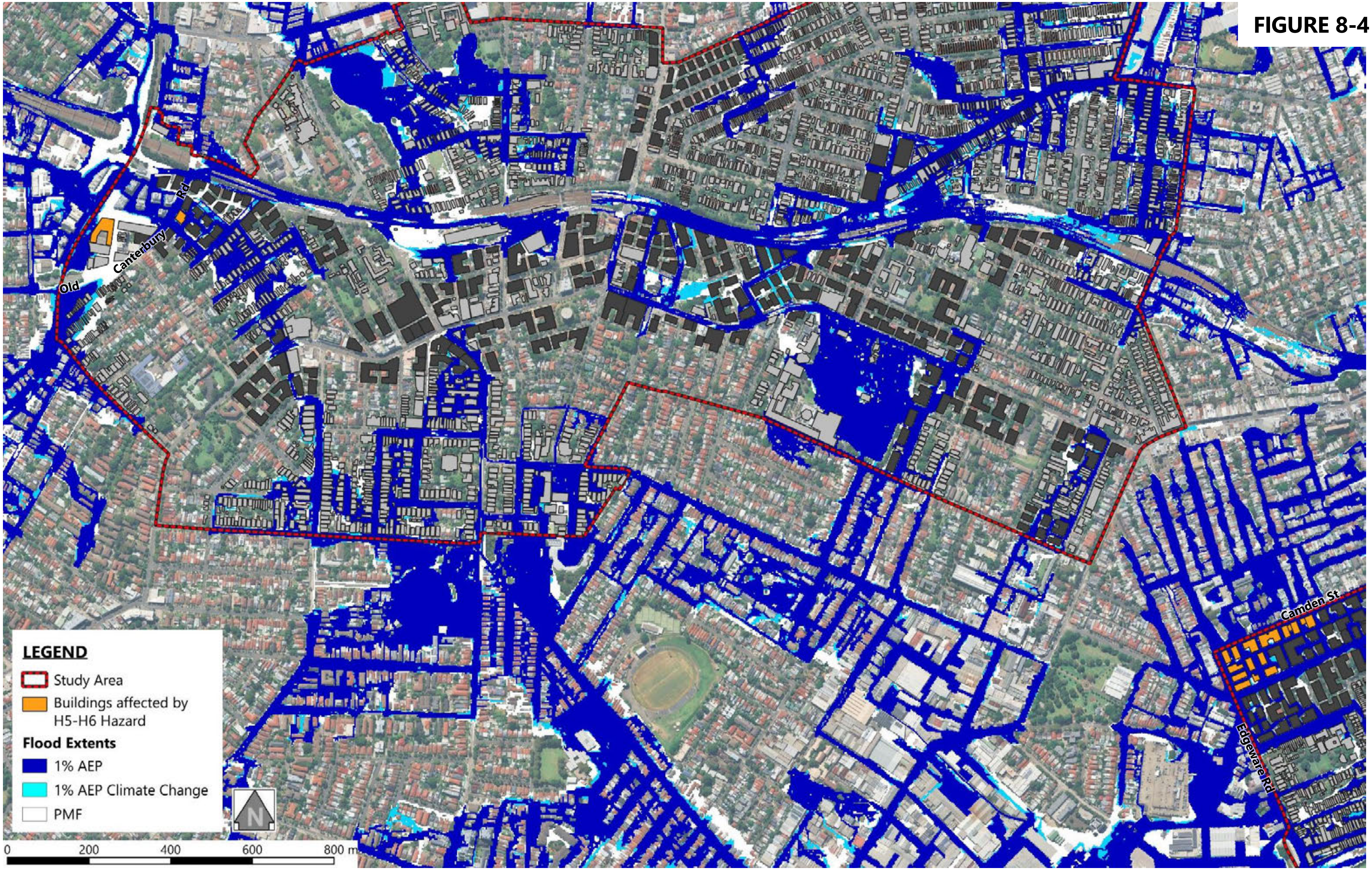
OVERVIEW OF PROPOSED DEVELOPMENTS AFFECTED BY H5-H6 HAZARD DURING THE PMF AT SUB-AREA A



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OVERVIEW OF PROPOSED DEVELOPMENTS AFFECTED BY H5-H6 HAZARD DURING THE PMF AT SUB-AREA B & C

9. Climate Change Analysis

9.1 Climate Change and Flooding

The Intergovernmental Panel on Climate Change's *Fifth Assessment Report* (IPCC 2013) found that human influence on climate is clear and increasing, with impacts observed across all continents and oceans. Climate change is expected to increase flood impacts through more intense rainfall events and sea level rise. Updated climate projections indicate that this may lead to higher peak flood levels and extended flood durations. These considerations are critical for informing long-term flood risk management and planning decisions in the precinct.

Quantifying the potential impacts of climate change on flooding allows current decisions on proposed development and flood risk mitigation measures within the study area to be assessed in an informed manner that considers potential changes in flood risk in the future.

While climate models show uncertainty in quantifying the effect of climate change on rainfall intensity, the latest *Climate Change in Australia Technical Report* from CSIRO and BoM (2015) projects increased intensity of extreme rainfall events for the east coast with a high confidence. Therefore, the potential impacts of climate change on flooding within the study area were assessed by focusing on projected increases in rainfall intensity as the key driver of future changes to flood risk.

On 27th August 2024 an update of the Climate Change Considerations chapter of ARR 2019 (Book 1 Chapter 6) was published by DCCEEW and Engineers Australia. The chapter provides up to date guidance aligned with the latest relevant science such as IPCC 2023 and Wasko et al. (2023). This includes new estimates of increased rainfall intensity under a range of climate change scenarios which are typically higher than those presented in the original chapter.

Additionally, sea levels in Sydney are expected to rise by 0.68 metres by 2100 under the SSP3-7.0 emissions pathway. This sea level rise projection was obtained from NASA's sea level rise projection tool for Fort Denison in Sydney and is based on data from IPCC 2023.

9.2 Adopted Climate Change Scenario

As noted and justified in **Section 4.1.2**, this study has adopted the existing climate change analysis from Council's adopted flood studies (i.e., increasing ARR 1987 1% AEP rainfall intensities by 30%) for the climate change sensitivity assessment for the study area. A sea level rise of 0.68 metres was also included in the climate change scenario.

For reference, it is noted that a 30% increase in 1% AEP rainfall is similar to the 1 in 500 AEP rainfall for the three subject catchments in the study area. A comparison of rainfall depths is shown in **Table** 9-1 for a range of durations.

Table 9-1 Comparison of design and climate change rainfall depths

Design Event	Design Rainfall Depths (mm)		
	Hawthorne Canal (1 hr crit. duration)	Whites Creek (20 min crit. Duration)	Johnstons Creek (1 hr crit. duration)
1% AEP	90.0	53.3	93.0
1% AEP + 30%	117.0	69.3	120.9
0.2% AEP	118.3	70.3	122.0

9.3 Climate Change Impact Assessment

Mapping of design flood depths, levels, velocities and hazards for the climate change scenario is presented in **Appendix A** for existing conditions and **Appendix B** for post-development conditions.

The impacts of climate change on flood behaviour in the vicinity of the Our Fairer Future Plan 2 study area are summarised in the following.

a. The impacts of climate change on peak flood levels are shown in the difference mapping in **Figure 9-1** to **Figure 9-3**. The difference mapping indicates that peak flood levels typically increase by 0.2 metres or less along most overland flow paths in the study area.

b. However, there are some developments which are located in areas that are predicted to be more significantly influenced by climate change. The increase in peak 1% AEP flood level in these areas would take up a significant portion of the adopted 0.5 metre freeboard which is used to determine the Flood Planning Level. Council should consider revising the freeboard applicable to new developments in the areas listed below.

    i. Flood levels are predicted to increase by 0.37 metres in the Darley Road ponding area to the south of the Hawthorne light rail station.

    ii. Flood levels are predicted to increase by 0.30 metres in the trapped area on the southern side of the proposed development which is located south of the William St / Hubert St intersection. The upgrade of the existing underground stormwater drainage network (refer **Section 7.3.1**) may reduce the magnitude of this flood level increase.

    iii. Flood levels along Whites Creek to the north of Piper Street are predicted to increase by up to 0.41 metres.

    iv. Flood levels along Johnstons Creek to the north of Booth Street are predicted to increase by up to 0.52 metres.

    v. Flood levels along Hawthorne Canal to the north of Old Canterbury Road are predicted to increase by up to 0.41 metres.

    vi. Flood levels in the Trafalgar Street low point to the south-west of Petersham Station are predicted to increase by up to 0.43 metres.

c. The entire precinct would still be affected by flash flooding. There are no major changes to the implications for emergency management which were discussed in **Section 8.2**.

d. However, several additional sites would no longer be able to enact self-evacuation under the climate change scenario. As noted in **Section 8.2.2**, only two (2) sites do not have access to a safe evacuation route during the 1% AEP event. This would increase to a total of seven (7) sites under the adopted climate change scenario (refer **Section 8.2.2**, **Figure 8-1** and **Figure 8-2**).

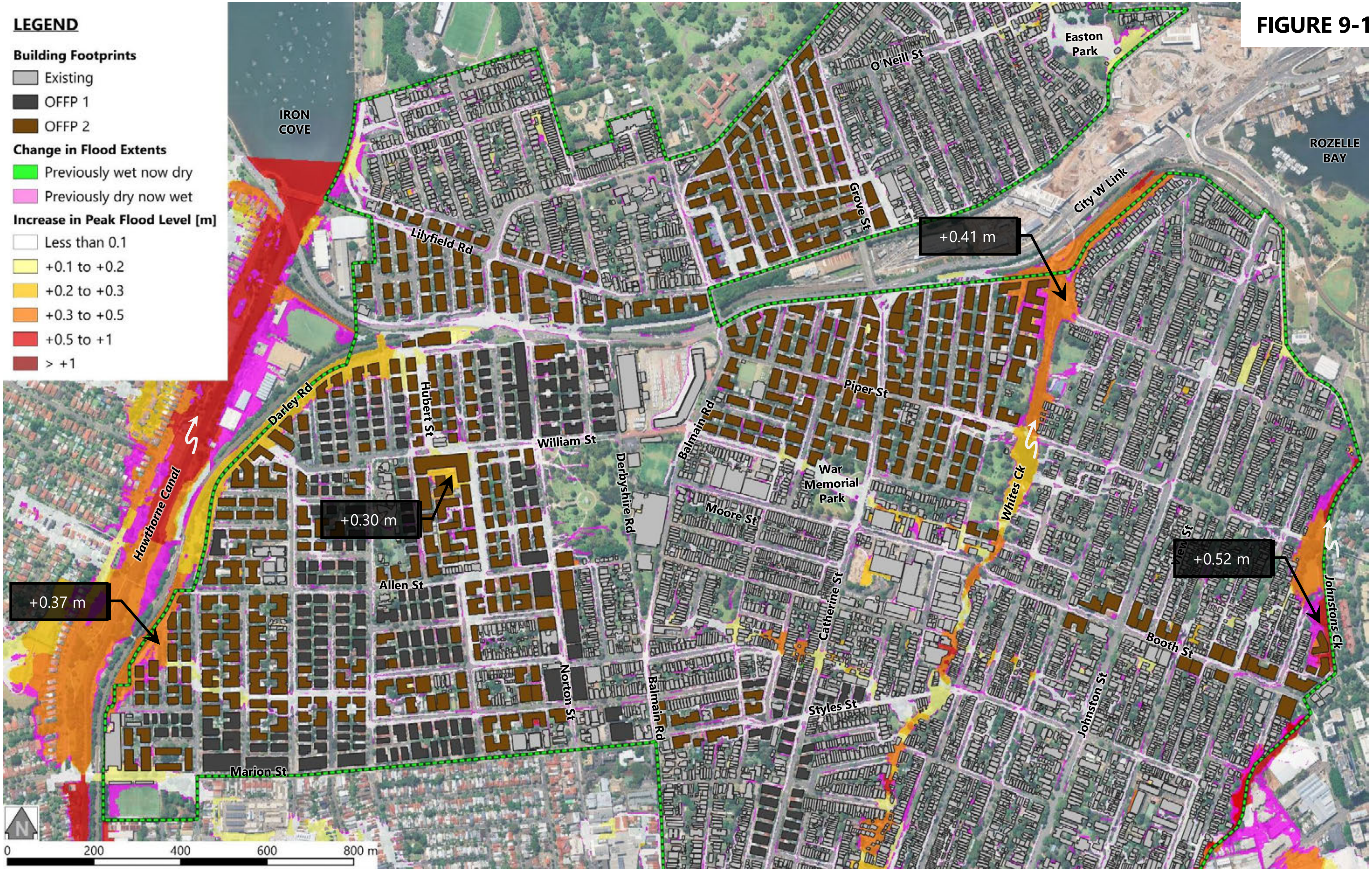

FIGURE 9-1

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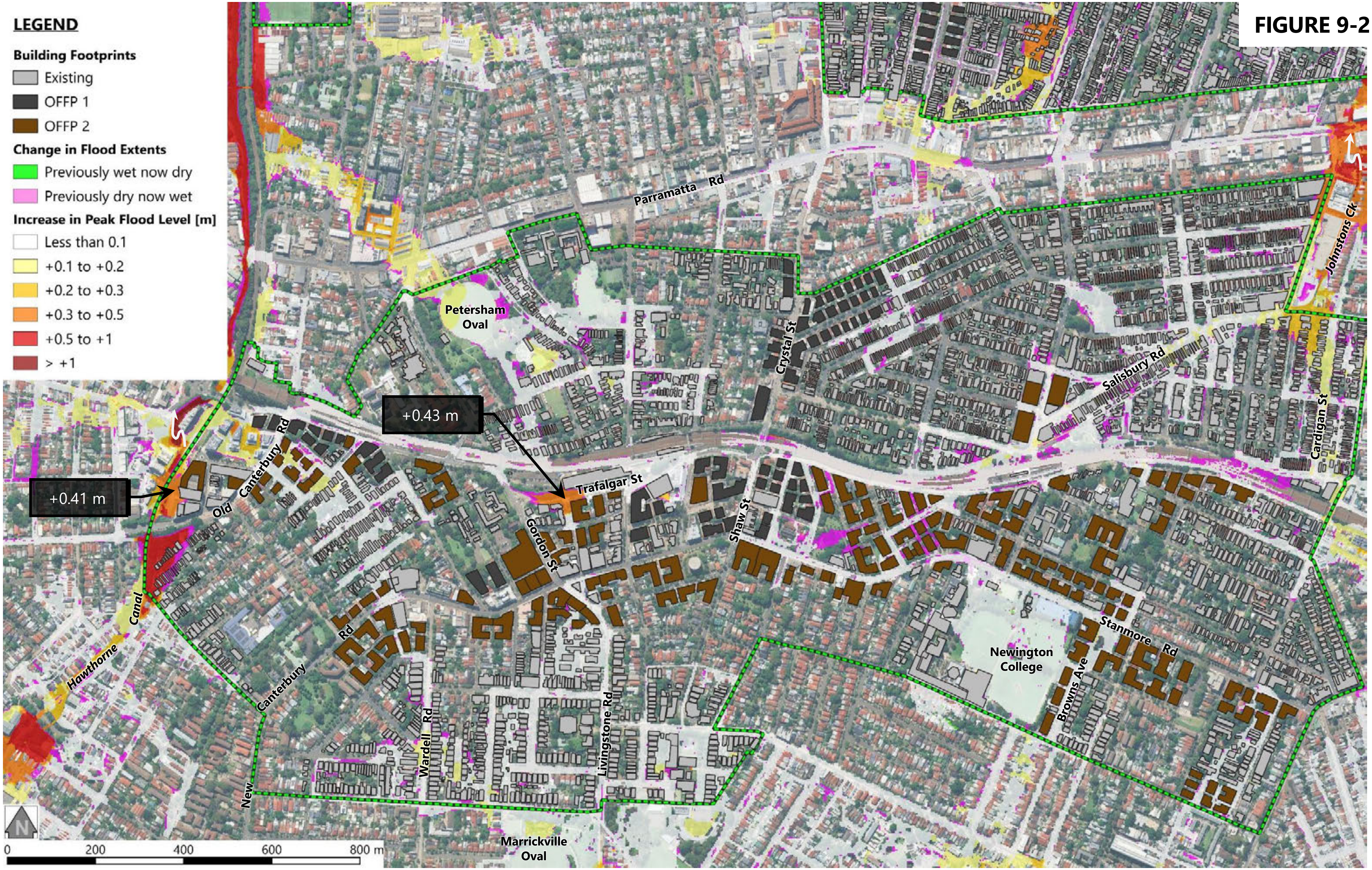
IMPACT OF CLIMATE CHANGE ON PEAK 1% AEP FLOOD LEVELS AT SUB-AREA A

FIGURE 9-2



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IMPACT OF CLIMATE CHANGE ON PEAK 1% AEP FLOOD LEVELS AT SUB-AREA B

FIGURE 9-3

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IMPACT OF CLIMATE CHANGE ON PEAK 1% AEP FLOOD LEVELS AT SUB-AREA C

10. Conclusions and Recommendations

Inner West Council (Council) is working together with the NSW Government to provide more well-located homes close to transport, jobs and services. Parts of the Inner West Local Government Area (LGA) are affected by key NSW Government Housing Reforms including the Transport Oriented Development (TOD) program, the Low and Mid-Rise Housing (LMRH) policy and ongoing State-Led Rezoning projects for Parramatta Road and Bays West. The NSW Government has also assigned Council an LGA-wide target for delivery of 7,800 new constructed dwellings by 2029.

In response to the housing reforms and the housing target, Council resolved to prepare an alternative plan for the Inner West titled, *Our Fairer Future Plan*. This plan is being prepared in two stages and seeks to replace the State's reforms while meeting or exceeding the new housing capacity that those reforms aim to provide.

Our Fairer Future Plan 1 was adopted by Council in September 2025 and has been submitted to the NSW Government for finalisation. It proposes new housing capacity in the suburbs of:

- Ashfield, Dulwich Hill and Marrickville; as informed by the *Inner West Housing Investigation Area Master Plans Flood Impact and Risk Assessment* (Worley Consulting, 2025); and,
- Leichhardt, Stanmore, Petersham, Lewisham and St Peters; on sites located outside of the adopted Probable Maximum Flood extent and therefore not identified as being flood affected.

Our Fairer Future Plan 2 was initiated following Council's adoption of Our Fairer Future Plan 1. It proposes new housing capacity in the suburbs of Leichhardt, Lilyfield, Annandale, Stanmore, Petersham, Lewisham and St Peters, at locations that have not previously been investigated as part of Our Fairer Future Plan 1. Our Fairer Future Plan 2 also includes certain sites which are owned by Homes NSW which are located in the Inner West LGA.

Flash flooding in the catchments that drain through the suburbs covered by Our Fairer Future Plan 2 was identified as a key concern in previous flood studies undertaken by Council and the NSW Government. Accordingly, the master planning program needs to allow for appropriate management of flooding in areas where increased housing densification is proposed.

Worley Consulting, acting in concert with Inner West Council, has considered the flood impact and flood risk issues that could arise at a range of locations where increased housing density is proposed. This has involved adoption and application of the TUFLOW flood models developed for several of Council's existing Floodplain Risk Management Studies and Plans for the Hawthorne Canal, Whites Creek, Johnstons Creek, Marrickville Valley, Alexandra Canal and Eastern Channel East catchments.

Additionally, Worley Consulting has developed a new TUFLOW model of the area covered by the *Leichhardt Floodplain Risk Management Study and Plan* (Cardno, 2017) due to compatibility issues with the SOBEK software as well as to align computational methods with the TUFLOW models used for all other locations within the Our Fairer Future Plan 2 study area.

10.1 Conclusions

The flood models were used to investigate the potential for uplift scenarios to impact on the existing flood behaviour and flood risk within the study area. The key outcomes from the flood impact assessment are provided in the following.

2. Existing flood behaviour in the catchments which drain through the Our Fairer Future Plan 2 study area is documented in Section 5. A description of key flooding 'hotspots' within the study area has also been provided in this section.

3. Several locations were nominated for re-development or densification across the Our Fairer Future Plan 2 study area. The locations of the proposed uplift sites are shown in **Figure 7-1** to **Figure 7-3**.

4. Redevelopment of many of the development areas is not predicted to lead to unacceptable off-site impacts on existing flood characteristics. However, the uplift scenarios for six (6) of the development areas will lead to some adverse flood impacts on neighbouring properties. This includes proposed developments in the vicinity of:

    a. Francis Street, Leichhardt (refer Section 7.3.1 and Figure 7-4);

    b. View Street, Annandale (refer Section 7.3.2 and Figure 7-5);

    c. Ainsworth Street and White Street, Lilyfield (refer Section 7.3.3 and Figure 7-6);

    d. Livingstone Road and Maria Street, Petersham (refer Section 7.3.4 and Figure 7-7);

    e. Fotheringham Street, Enmore (refer Section 7.3.5 and Figure 7-8);

    f. Edgeware Road and Camden Street, Marrickville (refer Section 7.3.6 and Figure 7-9).

5. For some sites at Francis Street, View Street, Ainsworth Street and White Street, further flood model testing is required post-exhibition of this report to reduce the magnitude of the off-site flood impact. The relevant sites have been identified by the solid red polygons in **Figure 7-4** to **Figure 7-6**.

6. For all other sites nominated in Point 3 above, it is envisaged that the flood impacts could be managed at the development application stage given that the flood impacts are localised or otherwise expected to be confined to road reserves where there are no material impacts to the existing trafficability of the road.

7. Several flood modification measures were recommended in the floodplain risk management plans for the catchments which affect the study area. A number of relevant drainage works items detailed in the *Inner West Local Infrastructure Contributions Plan 2023* are also proposed for the study area. A detailed commentary on the expected benefits and the viability of these options is presented in **Section 6**.

8. The flood modification measures / drainage works items discussed in **Section 6** either provide limited benefit in reducing the existing flood risk in the study areas and/or would involve significant cost and disruption to implement.

9. Flooding in the study area can be characterised as flash flooding. Flooding typically occurs within 10 to 15 minutes from the onset of rainfall, with flood levels peaking within an hour from the onset of rainfall. Flash flooding has several implications for emergency response management:

    a. Given the minimal response time, an evacuation strategy based on advanced warning and with assistance by the NSW State Emergency Services (**SES**) is not feasible. Therefore, self-evacuation is the only potential means of evacuation.

    b. There are safe evacuation routes available for most development sites which can be used by occupants to reach land outside of the PMF extent, which would allow occupants to self-evacuate if required at these respective sites.

    c. However, there are some sites where a safe evacuation route is not available. These sites would be required to adopt a shelter-in-place (**SIP**) flood emergency response. The location of development sites which require SIP is shown in **Figure 8-1** and **Figure 8-2**.

       It is understood that self-evacuation at these sites <u>may</u> become feasible should alternative lot amalgamations arise which provide additional access points, thereby enabling occupants to safely leave the site without entering hazardous floodwaters. Self-evacuation may also become feasible with the adoption of right-of-way easements which would provide alternative access points and evacuation routes.

    d. The adoption of SIP for <u>all</u> potential uplift locations within the PMF extent would align with the objectives and criteria outlined in the NSW Government's '*Shelter-in-place guideline for flash* *flooding'* (DPHI, 2025).

e. The availability of a safe evacuation route for <u>most</u> development sites is beneficial at reducing flood risk at these sites, given that the safe evacuation route can be used by emergency response personnel to reach the site to attend to secondary emergencies such as medical or fire related incidents.

10. The adopted climate change scenario aligns with both Council's adopted climate change modelling as well as the 2024 update to the Climate Change Considerations chapter found in Book 1 Chapter 6 of ARR 2019 (refer **Section 4.1.2**). Key findings from the climate change sensitivity analysis include the following.
    a. The impact of climate change on flood behaviour is expected to be relatively minor across most of the study area. Peak flood levels typically increase by 0.2 metres or less along most overland flow paths in the study area.
    b. However, there are some developments which are located in areas that are predicted to be more significantly influenced by climate change (refer **Section 9.3**). The flood level increases in these areas would take up a significant portion of the adopted 0.5 metre freeboard above the 1% AEP peak flood level. These areas are listed in the following.
        i. The Darley Road ponding area to the south of the Hawthorne light rail station.
        ii. The trapped area on the southern side of the proposed development which is located south of the William St / Hubert St intersection. Upgrading the existing underground stormwater drainage network (refer **Section 7.3.1**) may reduce the magnitude of this flood level increase.
        iii. Along Whites Creek north of Piper Street.
        iv. Along Johnstons Creek north of Booth Street.
        v. Along Hawthorne Canal to the north of Old Canterbury Road.
        vi. In the Trafalgar Street low point to the south-west of Petersham Station.
    c. The entire precinct would still be affected by flash flooding. There are no major changes to the implications for emergency management which were discussed in **Section 8.2**.
    d. However, several additional sites would no longer be able to enact self-evacuation under the climate change scenario. As noted in **Section 8.2.2**, only two (2) sites do not have access to a safe evacuation route during the 1% AEP event. This would increase to a total of seven (7) sites under the adopted climate change scenario (refer **Section 8.2.2**, **Figure 8-1** and **Figure 8-2**).

In light of the findings documented above, the nominated proposed planning controls for most proposed uplift locations, as represented by the indicative building footprints, can proceed subject to compliance with the development controls and flood planning recommendations outlined below. The locations described in Point 4 above require further flood testing to be undertaken post-exhibition to reduce the predicted adverse flood impacts before they can proceed.

The other potential uplift scenarios are not expected to lead to any material adverse off-site flood impacts, or otherwise are predicted to lead to some minor flood impacts which could be managed through design refinements and/or the implementation of on-site mitigation measures.

10.2 Recommendations

Based on the findings of the flood modelling investigations and the flood-related controls outlined in the *Inner West Local Environment Plan 2022* (IWLEP 2022), the *Leichhardt Development Control Plan 2013* (LDCP 2013), *Marrickville Development Control Plan 2011* (MDCP 2011) and the draft *Inner West Development*

Control Plan 2026 (draft IWDCP 2026), the following recommendations are provided for consideration in the Our Fairer Future Plan 2 master planning process:

a. All proposed development within the study area must adhere to the flood planning controls specified in **Section 8.1**.

b. The proposed housing uplift in the study area generally leads to larger distances between proposed buildings when compared to existing conditions, where existing housing is closely spaced. This leads to the capacity for a greater quantity of runoff flowing onto the surrounding streets.

   Therefore, it is recommended that <u>all</u> housing uplift in the study area should be supported by further modelling analysis at the development application stage to ensure that the proposed development will not lead to an increase in the amount of runoff discharging into adjacent streets. This could comprise the implementation of on-site detention in accordance with Council's planning controls and engineering guidelines.

c. Sensitive land uses such as hospitals, aged care, childcare, schools and emergency services should be located outside the PMF extent.

d. While safe evacuation routes exist for many of the development sites to land outside of the PMF extent, it is recommended for <u>all developments</u> within the PMF extent to incorporate features to enable a Shelter In Place (**SIP**) response. Given that the duration of inundation is typically 2 hours or less, it would be safer and more practical for residents to remain at home. Therefore, development must ensure that it aligns with the objectives and criteria outlined in the NSW Government's '*Shelter-in-place guideline for flash flooding*' (DPHI, 2025).

e. For developments where off-site evacuation is not possible (refer **Section 8.2.2**, **Figure 8-1** and **Figure** 8-2), a site-specific Flood Emergency Response Plan (**FERP**) must be developed which specifies how SIP will be implemented and must include specific details on how secondary emergencies such as medical or fire incidents will be managed. This is important as it may be difficult for emergency services to access specific development areas due to flooding of roads that would provide access. These developments should also explore the possibility of alternative lot amalgamations and/or right-of-way easements to provide safe evacuation routes.

f. The Bureau of Meteorology's FLARE resource should be used to investigate the feasibility of developing a tailored flash flood warning system for the study area.

g. Several proposed uplift locations would be affected by H5 to H6 flood hazard during the PMF. These areas are listed in **Section 8.2.3**. Specialist structural engineering design of building that are proposed in these areas is required to ensure that the buildings are able to withstand the force of floodwaters in events up to and including the PMF.

h. Due to the low likelihood of achieving reliable off-site evacuation, all new developments should provide a floor area that is above the peak PMF level and large enough to enable a Shelter-in-Place (**SIP**) emergency response option. This is particularly important at housing uplift locations that are affected by high PMF flood depths (e.g. higher than 1.5 metres), such as locations adjacent to the Darley Road ponding area, Whites Creek, Johnstons Creek and Hawthorne Canal. For these locations, all habitable spaces may be required to be located on the first floor of the building; i.e., the ground floor would be reserved for non-habitable uses. Further detail is provided in **Section 8.2.4**. The time required for residents to vertically evacuate to higher floors should be assessed with reference to the predicted rate of rise of floodwaters in a PMF.

i. As noted in Point 9b in **Section 10.1**, the assessed climate change scenario is expected to lead to significant increases in peak 1% AEP flood levels at six locations which would take up a significant portion of the adopted 0.5 metre freeboard used to determine the Flood Planning Level. There are proposed developments which are located in the vicinity of these six locations. Therefore, Council should consider revising the freeboard applicable to new developments in these areas.

j. Ground level activation (i.e., entries to buildings or basements) should be provided in areas of shallowest flood depth to minimise filling or steps / ramps, according to the floor level and basement entry requirements specified in the LDCP 2013, the MDCP 2011 and the draft IWDCP 2026. Further discussion is provided in **Section 8.3**.

k. Proposed uplift in the vicinity of Francis Street, Leichhardt and View Street, Annandale, should consider the upgrade of the existing underground stormwater network at the respective locations to reduce the severity and frequency of flooding that currently affects these areas (refer **Section 7.3.1** and **Section 7.3.2**).

l. A detailed Flood Impact and Risk Assessment (FIRA) should be completed in support of any Development Applications (DA) for new developments or areas of redevelopment in flood affected parts of the housing uplift locations. The detailed FIRA should:

  - assess the flood impacts of the final building design to meet the criteria specified in the LDCP 2013, the MDCP 2011 and the draft IWDCP 2026;
  - address flood risk issues and emergency response, accounting for the proposed uses of the site and the number and demographic of future occupants once these details are available;
  - address how SIP will be used as part of the site's emergency management response, including actions before, during and after the SIP period;
  - address how SIP will be communicated to occupants and visitors of the building and how this communication will be maintained for the life of the development; and,
  - provide an understanding of secondary risks and how the proponent proposes to manage these risks (e.g., building fire, medical emergencies, health and wellbeing) during a flood emergency.

11. References

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