Attachment D

Flood impact and risk assessment

DEPARTMENT OF PLANNING, HOUSING AND INFRASTRUCTURE

PYRMONT AND ULTIMO PLANNING PROPOSAL – FLOOD IMPACT AND RISK ASSESSMENT – STAGE 2 ADDENDUM

FINAL REPORT



JUNE 2026

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Project Pyrmont and Ultimo Planning Proposal – Flood Impact and Risk Assessment – Stage 2 Addendum	Project Number 124030
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Cover Image: Pyrmont Peninsula looking south, Source: Google Maps 2024

PYRMONT AND ULTIMO PLANNING PROPOSAL – FLOOD IMPACT AND RISK ASSESSMENT – STAGE 2 ADDENDUM

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LIST OF ACRONYMS

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
BW	Blackwattle Bay
CoS	City of Sydney
DCP	Development Control Plan
DHCA	Darling Harbour and City Area
DPHI	NSW Department of Planning, Housing and Infrastructure
FFL	Finished Floor Level
FIRA	Flood Impact and Risk Assessment
FPL	Flood Planning Level
FRMS&P	Floodplain Risk Management Studies and Plan
FSR	Floor Space Ratio
IFD	Intensity Frequency Duration
LEP	Local Environmental Plan
LiDAR	Light Detection and Ranging or known as ALS (Airbourne Laser Scanning)
LGA	Local Government Area
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
SSP	Shared Socioeconomic Pathway

EXECUTIVE SUMMARY

The City of Sydney prepared a Planning Proposal to set new planning controls for sites identified within the suburbs of Pyrmont and Ultimo, in response to the NSW Government's Pyrmont Peninsula Place Strategy. The Pyrmont and Ultimo Planning proposal – Flood Impact and Risk Assessment was finalised in August 2024 by WMAwater for these sites, known as the 'Stage 1' sites.

There were 8 additional sites subsequently identified as part of 'Stage 2' of the Planning Proposal that is currently being drafted. The Stage 2 sites are assessed in this report, which serves as an addendum to the main report. This report only focusses on the 8 additional sites, with a FIRA undertaken that is consistent with the Stage 1 sites. Further background information can be found in the Stage 1 report, this addendum should be read in conjunction with the Stage 1 report.

The detailed breakdown of the sites in Section 4 show that Pyrmont and Ultimo has varying degrees of flood affectation. It should be noted that the sites that are shown to be flood affected are currently developed and occupied. The most significant constraints for flood affected sites are achieving minimum floor level requirements and site access and evacuation requirements. The Planning Proposal may improve the feasibility of redevelopment in those lots as it may enable less sensitive uses of the ground floor in mixed use developments and increased height restrictions may allow for building floor levels to be raised to meet flood planning level requirements. Redevelopment of some buildings may also enable emergency access to be incorporated, with internal connections enabling flood free frontages to be accessed from any point within the building. In most cases, the requirement for deep soil areas has the potential to improve local flood conditions by increasing infiltration capacity. The redevelopment of the lots identified is likely to allow for a design that caters for the flood conditions of the site.

WMAwater considers that the Planning Proposal is consistent with the objectives of the Ministerial Directions for flood prone land (see Section 6 for detailed discussion). The Planning Proposal is consistent with other relevant legislation and Council's strategic planning framework for flood planning, in that the flood-related development controls enforced through that framework are not significantly altered by the Planning Proposal. It is recommended that consultation is undertaken with relevant public agencies (such as the NSW State Emergency Service, the Department of Climate Change, Energy, the Environment and Water, and the Department of Planning, Housing and Infrastructure) following Gateway determination. Comments from these public agencies regarding specific constraints or development controls can be addressed as part of the site-specific development control plans.

This review does not include detailed flood modelling of potential development or building layouts and does not constitute a flood impact assessment for specific development sites. Future development proposals for flood prone sites will need to be accompanied by site specific flood assessments demonstrating compliance with Council's flood-related development controls.

1. INTRODUCTION

1.1. Overview

On 29 July 2022, the NSW Government issued a Ministerial Direction to guide the preparation of planning controls for Ultimo and Pyrmont. This was in response to the NSW Government's Pyrmont Peninsula Place Strategy. This strategy aims to provide floor space capacity for 8,500 new residents and up to 23,000 new jobs within Ultimo and Pyrmont. City of Sydney (CoS or Council) subsequently prepared a Planning Proposal (Reference 1) in response to the strategy. The Planning Proposal sets new planning controls for sites that are under the control of the CoS.

WMAwater was engaged to undertake a flood impact and risk assessment (FIRA) for the proposed two rezonings, 57 sites with proposed Local Environmental Plan (LEP) changes and 120 small lots with development potential. The Pyrmont and Ultimo Planning Proposal – Flood Impact and Risk Assessment was finalised in August 2024 (Reference 2) and is herein referred to as the 'Stage 1 report'.

There were 8 additional sites subsequently identified as part of 'Stage 2' of the Planning Proposal that is currently being drafted. The NSW Department of Planning, Housing and Infrastructure (DPHI) engaged WMAwater to prepare a FIRA for the Stage 2 sites. The Stage 2 sites are assessed in this report, which serves as an addendum to the Stage 1 report. This report only focusses on the 8 additional sites, with a FIRA undertaken that is consistent with the FIRA undertaken for the Stage 1 sites. Further background information can be found in the Stage 1 report, and this addendum should be read in conjunction with the Stage 1 report.

The FIRA was undertaken in accordance with the 2023 NSW Flood Risk Management Manual (Reference 3). Utilising existing flood information, the flood affectation of each of the sites was reviewed and the proposed changes under the Planning Proposal were assessed. WMAwater has reviewed and summarised the flood constraints with a view to providing sufficient information for the Planning Proposal to proceed to Gateway Determination.

This review does not include detailed flood modelling of potential development or building layouts and does not constitute a FIRA for specific development sites. Future development proposals for flood prone sites will need to be accompanied by site specific flood assessments demonstrating compliance with Council's flood-related development controls. Site-specific FIRAs should utilise Council's endorsed flood models (Section 3.2) and consider guidelines and policies including Australian Rainfall and Runoff (ARR) 2019 version 4.2 (Section 2.3.1), the Shelter-in-place Guideline (Section 2.3.3) and the Climate Change and Natural Hazards State Environmental Planning Policy (SEPP) (Section 2.3.4).

1.2. Stage 2 Sites

The Stage 2 sites subject to this FIRA are located within the Ultimo and Pyrmont study area, located in the CoS Local Government Area (LGA). The Stage 2 Planning Proposal relates to 8 large lots, as shown in Figure 2.1. For the purpose of showing flood model results in detail, several areas have been identified for which detailed flood results are provided, covering multiple sites. These areas are indicated in Figure 2.2.

2. BACKGROUND

2.1. Planning Proposal Description

The Stage 2 Planning Proposal (yet to be drafted) seeks to amend controls at the sites with the changes generally including:

- Increase zoning, floor space ratio, height of building and height in storeys.
- Increase in required Deep soils to approximately 10%-25%

At some sites this would require the possible change in zoning, commercial to Mixed Use, or commercial to E2.

In addition to the above, changes are proposed to protect sun access to Wentworth Park, ensure affordable housing contributions and other minor amendments. The implementation of these changes would be through proposed amendments to the Sydney LEP 2012 (Reference 4), in addition to amendments to the Sydney Development Control Plan (DCP) 2012 (Reference 5) for the specific sites within the Planning Proposal.

2.2. Flood-related Development Controls

Flood-related development controls are based on the following high-level principles:

1. **Protection of Development**
    - New development is to be adequately protected from flooding through appropriate minimum floor levels (Flood Planning Levels), flood-compatible materials, and structural design capable of withstanding flood forces.
2. **No Worsening of Flood Impacts**
    - Development must not exacerbate flood behaviour on surrounding land, including through obstruction of flow paths, loss of flood storage, or adverse changes to depths, velocities, or flood duration.
3. **Risk to Life Management**
    - Residual flood risk is to be appropriately managed by considering occupant safety, access and egress conditions, and whether shelter-in-place or evacuation is appropriate during flood events.

These principles underpin the flood controls applied to the Planning Proposal and are implemented through the CoS Interim Floodplain Management Policy (Reference 6). Detailed statutory interpretation and policy alignment are provided in the Stage 1 report.

2.3. New Information Available

Since the finalisation of the Stage 1 report, there has been a significant update to ARR and the Darling Harbour and City Area (DHCA) Flood Study. These are outlined in the following sections.

2.3.1. Australian Rainfall and Runoff Version 4.2

ARR guidelines were recently updated in August 2024 (ARR 2019 version 4.2, Reference 7). In

late 2022 the Australian Government Department of Climate Change, Energy, the Environment and Water in partnership with Engineers Australia commenced an 18 month project to update the climate change considerations chapter of the ARR guidelines (Book 1, Chapter 6) to incorporate the most recent and relevant climate science and projections. The project involved the undertaking of a rigorous literature review of hydroclimatology under climate change relevant to design flood estimation, which was peer reviewed and published in a leading international journal. The findings were used to draft practical flood guidance which was finalised after an extensive process of review and feedback by industry. The project report was adapted to replace Book 1 Chapter 6. The chapter commences with the following:

> *There is unequivocal evidence that greenhouse gas emissions have caused global warming. The Intergovernmental Panel on Climate Change's sixth assessment report concluded that global surface temperatures have significantly increased above pre-industrial levels, with significant further warming expected (IPCC, 2023). This warming is causing an increase in many drivers of flood risk, including an intensification of extreme rainfall events and the elevation of average and extreme sea levels (IPCC, 2023).*
>
> *Traditionally, design flood estimation has assumed that historical observations are representative of current and future conditions. This is no longer the case. Records on historical flooding or flood drivers (such as extreme rainfall or sea level) can no longer be assumed to provide a direct analogue of current or future flood risk. To account for significant observed and projected changes to the drivers of flooding, it is necessary to account for the non-stationarity of flooding in the assessment of current and future flood risks.*

The chapter then provides updated advice which can be summarised as follows:

- It is necessary to account for the non-stationarity of flooding in the assessment of current and future flood risks.
- Recommendation to adjust 2016 Intensity Frequency Duration (IFD) curves to present (i.e. current climate) conditions and future climate conditions.
- Provision of guidance for climate change factors across the full range of design storm events considered in ARR up to and including the Probable Maximum Precipitation (PMP). These factors are dependent on the adopted planning horizon (point in time for which flood risk is to be estimated) and Shared Socio-Economic Pathway (SSP, possible future development scenarios that account for various social, political, technological and economic factors which drive fossil fuel use and greenhouse gas emissions) and Representative Concentration Pathway (RCP, future emissions scenarios presented as the level of radiative forcing that is expected to result from greenhouse gas concentrations by the year 2100). This provides an indicative temperature increase, for which an increase in rainfall intensity can be estimated for a range of storm durations.
- Consideration of additional factors that influence design flood estimates; that is, changes in rainfall losses, temporal patterns and sea level rise.

2.3.2. Darling Harbour and City Area Flood Study Update

The Stage 2 sites located within the Darling Harbour catchment have been reviewed with reference to the DHCA Flood Study Update (Reference 8). This flood study was submitted to CoS in draft form in March 2026 for review and, while not yet formally adopted, represents the most recent and comprehensive flood assessment for the catchment. The study reviewed existing flood mapping and updated the hydraulic models using 2020 Light Detection and Ranging (LiDAR) data, incorporated recent development, and revised hydrological inputs to align with ARR version 4.2 guidelines.

The updated modelling framework adopts a conceptual rainfall–runoff approach using the DRAINS hydrologic model (calculates rainfall runoff) in combination with the TUFLOW hydraulic computer model (calculated flood parameters such as flood depths and extents), replacing the previous direct rainfall methodology used in earlier studies. The base TUFLOW model was developed from the existing model, with relevant features updated to reflect known real-world changes. Recent large-scale developments within the Planning Proposal study area are focussed around Darling Harbour, including the International Convention Centre and Darling Square. Most of the underground pit and pipe network remains unchanged from the 2016 Floodplain Risk Management Study and Plan (FRMS&P) model (Reference 9); however, updates were made to blockage parameters in the 2026 model. There is a small overlap with the existing Blackwattle Bay (BW) model (Reference 10), east of the light rail line that runs through the Bank Street station south to Pyrmont Bridge Road. No site from Stage 2 is directly within this area, however it is noted that the DHCA model would represent the most accurate flood behaviour in this area.

Adoption of ARR 4.2 also included explicit consideration of climate change through the application of SSP scenarios. Design flood modelling was updated to reflect current conditions, with the 2030 SSP3–7.0 climate scenario adopted for the study. It is noted that there is no material difference in projected temperature increases between the 2030 SSP3–7.0, SSP2–4.5 and SSP1-2.6 scenarios. The study includes a detailed sensitivity analysis of future climate conditions, comparing SSP3-7.0 2030 to SSP3-7.0 2050 and 2100, unlike earlier studies which commonly used the 0.5% Annual Exceedance Probability (AEP) and 0.2% AEP flood events as proxies for climate change impacts for the 1% AEP event. Drainage blockage assumptions were also updated as part of the revised modelling. Previous modelling adopted blockage parameters of 50% on-grade inlet blockage and 100% sag inlet blockage, applied to events greater than the 5-year Average Recurrence Interval (ARI). The updated design assumptions adopt 20% on-grade blockage and 50% sag blockage, reflecting current best-practice guidance.

The Stage 2 assessment adopts the existing flood tagging established under the Stage 1 FIRA as this was not yet produced in the March 2026 draft DHCA report. The finalised DHCA Flood Study Update will likely result in updates to flood tagging and notations on Section 10.7 planning certificates. When finalised and adopted, the updated flood tagging should inform development applications (DA’s).

2.3.3. Shelter-in-place Guideline for Flash Flooding

The Shelter-in-Place guideline for flash flooding (Reference 11) was released in January 2025 and aims to assist consent authorities to undertake site-specific, risk-based assessment to assess if shelter-in-place is a suitable emergency management strategy for development proposed in flash flood environments. The guideline suggests that shelter-in-place may be suitable where flooding occurs "*within 6 hours from the commencement of causative rain and the duration of shelter-in-place due to isolation by floodwaters is less than 12 hours*." (Reference 11, p. 5). Given the nature of flooding in the Pyrmont and Ultimo area, this suggests that all sites in this area are suitable for shelter-in-place based on the timing of flooding in the catchment. It is recognised that there are numerous other requirements that need to also be met for shelter-in-place to be viable, however, given the potential for flooding to occur rapidly, the relatively short duration of inundation and the availability of flood-free areas (including upper levels), shelter-in-place is likely to be the most suitable response to flooding in the catchments. This reduces the risk of people entering floodwater (on foot or in a vehicle) and potentially coming to harm.

However, it is recognised that even if a flood refuge is provided in an area of flash flooding, there may be situations in which access is still required during a flood event for additional emergencies (requiring medical assistance or the fire brigade for example). As such, this FIRA assesses access to and from the site in events up to and including the Probable Maximum Flood (PMF).

2.3.4. Climate Change & Natural Hazards SEPP

The DPHI has released a draft Climate Change and Natural Hazards SEPP for public exhibition in February 2026. The proposed policy introduces a clear, consistent framework for tackling current and future risks, including climate change and natural hazards (coastal hazards, flooding, bushfires and urban heat), and rebuilding after natural disasters. The policy would replace the existing Resilience and Hazards SEPP, with the aim of providing a more consistent and streamlined approach to managing climate and natural hazard risks under the *Environmental Planning and Assessment Act 1979*.

The draft SEPP introduced Draft Climate Change Scenario Guidelines (February 2026, Reference 12). The guidance emphasises that consideration of climate change in planning decisions should be proportionate to the scale, context and lifetime of the decision. Rezoning and strategic planning decisions operate at a broader scale than site specific development assessments and can influence land use outcomes for many decades. As such, these decisions warrant consideration against higher emissions scenarios and longer modelling timeframes than individual developments. The intent is to ensure that future climate risks are appropriately understood and managed at a strategic level, without applying disproportionate requirements intended for critical infrastructure or sensitive land uses.

Context further influences how climate risk should be assessed, particularly the consequences of failure or exposure. Higher intensity development, increased population exposure, or uses involving vulnerable occupants or critical services justify more conservative climate assumptions.

The guidance assigns rezoning and major development decisions a 50–100-year decision lifetime,

and strategic planning a 100+ year reflecting the extended period over which zoning controls typically apply. However, it is recognised that timeframes extending beyond 100 years exceed the reliability of current climate guidance and socio-economic and emissions pathways, particularly in relation to temperature rise and derived rainfall intensity assumptions. Beyond this horizon, uncertainty increases substantially and projections move outside policy aligned climate targets. Accordingly, climate risk assessment for rezoning should focus on robust mid to long term scenarios (up to 100 years), with longer term risks considered qualitatively in terms of residual risk awareness and future adaptability rather than fixed design outcomes.

The guideline identifies a minimum requirement of considering the SSP2-4.5 scenario for local development over a timeframe of 50 years, with SSP3-7.0 scenario for major development over a timeframe of 50 and 100 years. It is noted that the SSP3-7.0 scenario was adopted in the draft DHCA study (Reference 8).

3. FLOOD CONSTRAINTS REVIEW

Detailed flood constraints review can be found in Section 3 of the Stage 1 assessment. The following provides a summary of points and notes any changes resulting from the use of the DHCA model.

3.1. Overview of Flood Behaviour and Risks

Flooding within the Planning Proposal area is dominated by urban overland flow generated when rainfall exceeds the capacity of the existing pit and pipe drainage networks. Drainage systems typically surcharge in relatively frequent events, resulting in shallow, fast moving, short duration "flash flooding" along historical drainage lines, roads, and low points. Due to the established urban form, flood risk is primarily managed through development controls rather than large scale infrastructure upgrades. Further detail on flood processes is provided in the Stage 1 report.

3.2. Adopted Flood Modelling

This Stage 2 assessment adopts the most recent CoS endorsed flood models for the BW catchment, consistent with Stage 1 and the updated DHCA model as noted in Section 2.3.2.

No amendments were made to the models, and no redevelopment scenarios were tested in relation to the Stage 1 or Stage 2 sites. Flood depth, level and hazard outputs for relevant design events (including 10% AEP, 1% AEP and PMF) are used to inform site-based planning considerations only. Refer to Stage 1 for detailed modelling assumptions and limitations. Flood behaviour is presented in Figure 2.3 to Figure 2.17 for the various areas shown in Figure 2.2.

3.3. Hydraulic Hazard Classification

Hydraulic hazard classifications are based on flood depth and velocity relationships consistent with contemporary national guidance and as outlined in the Stage 1 report. For the DHCA and BW catchment, hazard outputs were adopted directly from the respective latest flood studies. The results are used at a strategic level to inform land use compatibility rather than detailed building design.

3.4. Flood Function

Flood function mapping from the adopted catchment studies is used to identify areas sensitive to obstruction or filling. As documented in Stage 1, no sites are affected by 1% AEP floodways, and mapped flood storage areas are generally located adjacent to, rather than within, nominated sites (see Figure 2.18). Given the highly urbanised context and existing site disturbance, redevelopment is not expected to result in adverse off-site flood impacts, subject to future site-specific FIRA's where required. The recent DHCA Flood Study used the same flood function criteria as noted in the Stage 1 report.

3.5. Emergency Management and Risk to Life

Flooding in the study area is characterised by rapid onset flash flooding with limited warning time. As outlined in the Stage 1 report, emergency response in such catchments largely relies on building resilience and passive safety, rather than evacuation during events. Accordingly, risk to life is best managed through appropriate floor levels, avoidance of hazardous uses at lower levels, and discouraging pedestrian and vehicle exposure to floodwaters.

3.6. Extreme Flood Events and the Probable Maximum Flood

Consistent with Stage 1 and Council policy, consideration has been given to residual risk associated with events larger than the 1% AEP, including the PMF. While the PMF is extremely unlikely, it is used to inform planning decisions for vulnerable or critical land uses where tolerance to risk is low. PMF depth and hazard mapping is included to support this strategic assessment.

3.7. Flood Planning Level

Flood Planning Levels (FPLs) applied in this assessment are based on the CoS Interim Floodplain Management Policy (Reference 6), consistent with the Stage 1 report. Indicative flood levels have been identified for each site to assess redevelopment feasibility only and must not be relied upon for detailed design. The levels are indicative only and may vary across the lot or across different road frontages. Final FPLs will require confirmation through site specific FIRA's at the DA stage.

3.7.1. Flood Tagging

Flood tagging information adopted in this assessment reflects the CoS lot-based flood tagging review process (Reference 13), as outlined in the Stage 1 report. Tagging is used here solely to assist in understanding whether sites are subject to flood related planning controls under Clause 7A (now Clause 9) of Schedule 4 of Environmental Planning and Assessment Regulation 2000 (the Regulation), contained in the Environmental Planning and Assessment Amendment (Flood Planning) Regulation 2021 (the Amendment). The presence or absence of a flood tag does not replace the need for detailed FIRA for future development.

The Stage 2 assessment does not use updated tagging based on DHCA results, instead using the existing tagging available for sites in this catchment.

4. PLANNING PROPOSAL SITE ASSESSMENT

For each site, an assessment of the flood risk was undertaken. The following information is provided for each site:

- Planning Proposal changes
- Flood Behaviour
- Flood Planning Levels
- Impact Considerations
- Hazard Considerations

The last three points address those floodplain management principles identified in Section 2.2.

4.1. 26-52 Mount Street

The site sits on a local rise, plateauing above a sharp 14 m drop to the south. The lot has two frontages, with the primary frontage being Mount Street (Photo 1). There is a small frontage 73-83 Harris Street to the east (Photo 2). There is an approximate 10 m elevation drop from Mount Street to Harris Street. The site is within the DHCA model. Flood depths, level contours and hazard categorisation are shown in Area A on Figure 2.3 to Figure 2.7.



Photo 1: Southeast facing photo of no. 26-52 Mount Street. *Google Streetview*



Photo 2: Northwest facing photo of no. 79-83 Harris Street frontage (the site). *Google Streetview*

4.1.1. Site Characteristics and Flood Behaviour

26-52 Mount Street is indicated to be free of any flood risk, as water flows away from the site on all sides. Flood modelling in Harris Street indicates that floodwaters remain in the gutter on the opposite (western) side of the street in both the 1% AEP and PMF events. At the southern end of Mount Street the water builds in the gutter, when it tops it flows south and off the high cliff face. The site is considered to be 'Local Drainage'. The flood tagging status of the lot is shown in Table 1. Indicative site flood characteristics are shown in Table 2 and Table 3.

Table 1: Flood tagging for 26-52 Mount Street

Clause 9(1)	Clause 9(2)
No	Yes

Table 2: Indicative site flood characteristics for 26-52 Mount Street, Mount Street frontage

Model	Type of Flooding	Peak Flood Level (mAHD)		Hazard[1]	
		1% AEP	PMF	1% AEP	PMF
DHCA	Local drainage	28.4	28.76	H5	H6

1. High hazard assumed due to shallow, high velocity flow falling off small cliff face.

Table 3: Indicative site flood characteristics for 26-52 Mount Street, Harris Street frontage

Model	Type of Flooding	Peak Flood Level (mAHD)		Hazard	
		1% AEP	PMF	1% AEP	PMF
DHCA	Local drainage	20.05	20.08	H1	H1

4.1.2. Flood Planning Levels

Minimum FFL requirements for Local Drainage are:

- Non-sensitive use – 1% AEP flood level;
- Sensitive use – 1% AEP flood level + 0.5 m or the PMF (whichever is the higher);
- Basement parking – 1% AEP flood level + 0.5 m or the PMF (whichever is the higher);
- Enclosed parking – 1% AEP flood level;
- Open parking – 5% AEP flood level.

Meeting minimum FFL requirements is considered reasonable and practicable for construction based on the indicative flood levels and existing site topography.

4.1.3. Impact Considerations

Local stormwater conveyance may have nominal impact if stormwater outlet locations are modified, however this would be managed through adequate stormwater design. No flood impacts are expected from development of the site.

4.1.4. Hazard Consideration

Access is available to the lot for vehicles and pedestrians in both the 1% AEP and PMF events. The H1 hazard rating is only in the road carriageway on Harris Street. Due to the low flow depth in the street, there are no access constraints.

4.2. 1-7 Henry Avenue and 336-374 Jones Street

The site is bounded by Jones Street (Photo 3), Henry Avenue (Photo 4), Fig Lane and Quarry Lane. Jones Street slopes towards the north and south, with the overall natural landform falling west, towards Wattle Street. The site is within the BW catchment. Flood depths, level contours and hazard categorisation are shown in Area B on Figure 2.8 to Figure 2.12.



Photo 3: Southeast facing photo over Jones Street and Fig Lane. *Google Streetview*



Photo 4: Southwest facing photo over Henry Avenue and Fig Lane. *Google Streetview*

4.2.1. Site Characteristics and Flood Behaviour

The natural landform falls west from Henry Avenue towards Jones Street and onto Wattle Street. Local stormwater would flow to the north and south away from the site along Henry Street and Jones Street, and west along Fig Lane and Quarry Lane past the site (to Jones Street). There is

minimal overland flood risk at the site. Some of the most significant flooding in the catchment occurs one block to the west on Wattle Street, however Jones Street is approximately 18 m above the flooding on Wattle Street. Based on the BW model results; accumulation of floodwater commences in the gutter at the intersection of Jones Street and Quarry Steet approximately 50 m to the south from the site. The site itself is not modelled to be affected by any overland flood risk and is considered to be 'outside the floodplain'. 1-7 Henry Avenue and 336-374 Jones Street are considered a single parcel and the flood tagging status of the lot is shown in Table 4.

Table 4: Flood tagging for 1-7 Henry Avenue and 336-374 Jones Street

Clause 9(1)	Clause 9(2)
No	No

4.2.2. Flood Planning Levels

Minimum FFL requirements for 'outside the floodplain':

- Habitable floors – 0.3 m above surrounding ground
- Basement parking – 0.3 m above surrounding ground

The site is 'outside the floodplain' and as such flood related FFLs are not applicable for commercial sites (except basement level parking or any habitable floors). It is advisable in such conditions that a minimum of 0.3 m freeboard be constructed above the adjacent landform, usually taken from the gutter invert. Meeting minimum FFL requirements is considered reasonable and practicable for construction based on the indicative flood levels and existing site topography.

4.2.3. Impact Considerations

The existing building utilises much of the lots and the proposed changes would require a minimum of 15% deep soil landscaping (including a new proposed park), adding flood storage and infiltration capacity. As such, redevelopment of the site could provide a net positive impact for the local flood conditions.

4.2.4. Hazard Consideration

The site is above all modelled flood hazard with access available to the immediate area available up to and including the PMF.

4.3. 463-467 Harris Street

The site is bounded by Harris Street, Quarry Street and Kirk Street, with a frontage to each of these streets (Photo 5). The site is within the DHCA model. Flood depths, level contours and hazard categorisation are shown in Area B on Figure 2.8 to Figure 2.12.



Photo 5: South facing photo over 463-467 Harris Street. *Google Streetview*

4.3.1. Site Characteristics and Flood Behaviour

There is minimal modelled inundation surrounding the building in the 1% AEP and PMF events. There are minor flows in the Quarry Street gutter, although the flows do not exceed 0.15 m in the gutter on the southern side of Quarry Street (adjacent to the site), in events up to and including the PMF. The site is considered to be 'outside the floodplain'. The flood tagging status of the lot is shown in Table 5.

Table 5: Flood tagging for 463-467 Harris Street

Clause 9(1)	Clause 9(2)
No	No

4.3.2. Flood Planning Levels

Minimum FFL requirements for 'outside the floodplain':

- Habitable floors – 0.3 m above surrounding ground
- Basement parking – 0.3 m above surrounding ground

The site is 'outside the floodplain' and as such flood related FFLs are not applicable for commercial sites (except basement level parking or any habitable floors). It is advisable in such conditions that a minimum of 0.3 m freeboard be constructed above the adjacent landform, usually taken from the gutter invert. Meeting minimum FFL requirements is considered reasonable and practicable for construction based on the indicative flood levels and existing site topography.

4.3.3. Impact Considerations

The existing structures utilises 100% of the respective lots and the Planning Proposal requires a minimum of 15% deep soil landscaping, adding flood storage and infiltration capacity. As such, redevelopment of the site could provide a net positive impact for the local flood conditions.

4.3.4. Hazard Consideration

Access is available to the building in both the 1% AEP and PMF events on multiple frontages. There is very low flow depth in the street and there are no access constraints for people or vehicles.

4.4. 344 Bulwara Road

The site is bounded by Bulwara Road (Photo 6), Hacket Street (Photo 7) and Macarthur Street at the northern end of the lot. The site is within the DHCA model. Flood depths, level contours and hazard categorisation are shown in Area C on Figure 2.13 to Figure 2.17.



Photo 6: North facing photo over Bulwara Avenue. *Google Streetview*



Photo 7: North facing photo over Hackett Street. *Google Streetview*

4.4.1. Site Characteristics and Flood Behaviour

There is minimal modelled flooding surrounding the Bulwara Road site. Runoff on Bulwara Road flows south and accumulates within the eastern gutter (adjacent to the site). The model indicates that there are two minor local sag points on Bulwara Road where flooding occurs adjacent to the site. The first at a loading zone on Bulwara Road (Photo 8), the second approximately 20 m downstream (south) of that location. At these locations water will build up until it continues to spill down the street or over the gutter. The modelling indicates that the over gutter flow is minor. The largest flood depths at these sag points are approximately 0.2 m in the 1% AEP and 0.3 m in the PMF. The imagery and LiDAR topography suggest that once the water builds up at the sag, it should follow the gutter down the street, however if the rise is rapid, there is a chance the gutter will overtop. Currently, there are ventilation openings to the basement car park in the vicinity of the sag points if water was to overtop the footpath (Photo 8).



Photo 8: Loading zone sag point on Bulwara Road. *Google Streetview*

On Hackett Street the modelling indicates that water accumulates into a significant flow approximately at the rear of 625-629 Harris Street, with depths of 0.15 m in the 1%AEP and above 0.2 m in the PMF event, although this is primarily in the eastern gutter on the opposite side of the road to the site. The existing garage entrance location is located outside of the modelled flood risk (modelled to commence at approximately 625 Harris Street), with additional protection from a crest level above the street level into the site (Photo 9).



Photo 9: Bulwara Road garage entrance, with flow modelled to occur on the left side of the image. *Google Streetview*

There is only shallow water over Macarthur Street in the 1% AEP and PMF event. The flood tagging status for 344 Bulwara Road is shown in Table 6. Indicative site flood characteristics are shown in Table 7 and Table 8.

Table 6: Flood tagging for 344 Bulwara Road

Clause 9(1)	Clause 9(2)
No	No

Table 7: Indicative site flood characteristics for 344 Bulwara Road, Bulwara Road frontage

Model	Type of Flooding	Peak Flood Level (mAHD)		Hazard	
		1% AEP	PMF	1% AEP	PMF
DHCA	Local drainage	15.03	15.11	H1	H1

Note: at the location of the Loading zone sag point

Table 8: Indicative site flood characteristics for 344 Bulwara Road, Hackett Street frontage

Model	Type of Flooding	Peak Flood Level (mAHD)		Hazard	
		1% AEP	PMF	1% AEP	PMF
DHCA	Local drainage	12.19	12.41	H1	H2

4.4.2. Flood Planning Levels

Minimum FFL requirements for Local Drainage are:

- Non-sensitive use – 1% AEP flood level;
- Sensitive use – 1% AEP flood level + 0.5 m or the PMF (whichever is the higher);
- Basement parking – 1% AEP flood level + 0.5 m or the PMF (whichever is the higher);

- Enclosed parking – 1% AEP flood level;
- Open parking – 5% AEP flood level.

Meeting minimum FFL requirements is considered reasonable and practicable for construction based on the indicative flood levels and existing site topography. The northern (upper) sections of Bulwara Road and Hacket Street are above the flood risk, therefore access to a below ground car park is achievable above the 1% AEP +0.5 m or the PMF if placed in the upper portions of the lot, noting that the existing car park entrance is assumed close to, if not already compliant.

4.4.3. Impact Considerations

The existing structure covers the majority of the lot, with an estimated 3% of the lot being pervious. The Planning Proposal would require a minimum of 25% deep soil landscaping, adding flood storage and infiltration capacity. As such, redevelopment of the site could provide a net positive impact for the local flood conditions.

4.4.4. Hazard Consideration

Access is available to the building in both the 1% AEP and PMF events, for pedestrians and vehicles, with the flood hazard not exceeding H1 on any frontage adjacent to the building.

4.5. 100-130 Harris Street

The site is bound by Harris Street to the west (Photo 10) and Pyrmont Street (Photo 11) to the east. There is approximately a 12 m difference in elevation between the streets, with Pyrmont Street being the lower of the two. The building under consideration is located at the southern end of the lot. The base of the building has been constructed and occupied; the proposal is for an increase to the height level and number of storeys. The site is within the DHCA model. The lot as a whole was assessed in Stage 1, although new commentary had been provided based on the updated DHCA Flood Study (Reference 8) and changes to planning controls. Flood depths, level contours and hazard categorisation are shown in Area A on Figure 2.3 to Figure 2.7.



Photo 10: East facing over 100 Harris Street frontage. *Google Streetview*



Photo 11: North facing over Pyrmont Street access to no. 100 Harris Street garage in relation to Pyrmont Street sag point. *Google Streetview*

4.5.1. Site Characteristics and Flood Behaviour

Flooding occurs on both Harris Street and Pyrmont Street. Flooding on Harris Street occurs when water accumulates in the gutter and flows south towards Union Street. In front of the site the water in the 1% AEP event is modelled to most likely still be in the gutter at approximately 0.15 m depth.

In the PMF event, however, the water spills out of the gutter and flows past the site with a depth of approximately 0.25 m.

There is a trapped sag point on Pyrmont Street, adjacent to the site where runoff ponds in events greater than the 5% AEP, when the capacity of the stormwater system (with design blockage of pits considered) is exceeded. The sag point is drained by a 2.25 m (W) x 1.9 m (H) box culvert that conveys flows to the north, discharging to Pyrmont Bay. The flood depths at the Pyrmont Street sag reach 0.3 m and 2.6 m in the 1% AEP and PMF events, respectively. There is no overland relief point for inundation and as such, ponding increases (subject to the performance of the drainage network) until overflows commence down Jones Bay Road (to the north), followed closely by overflows down Union Street (to the south). Flood depths need to exceed approximately 4 m at the sag point for these overflow points to be activated.

The flood tagging status of the lot is shown in Table 9 and flood characteristics for the site are shown in Table 10 and Table 11. The site is sensitive to changes in rainfall intensity (climate change) and drainage conditions (blockage). The site is not sensitive to sea level rise due to climate change. When considering blockage to the pits on Pyrmont Street there is an expected increase to the flood depth by approximately 0.7 m and 1.7 m in the 1% AEP event for increased blockage and full blockage, respectively. See Sections 5.1 and 5.2 for discussion on blockage and climate change sensitivity, respectively.

Table 9: Flood tagging for 100-130 Harris Street

Clause 9(1)	Clause 9(2)
Yes	Yes

Table 10: Indicative site flood characteristics for 100-130 Harris Street (Harris Street frontage)

Model	Type of Flooding	Peak Flood Level (mAHD)		Hazard	
		1% AEP	PMF	1% AEP	PMF
DHCA	Mainstream Flooding	19.6-17.8	19.8-17.9	H1	H5

Table 11: Indicative site flood characteristics for 100-130 Harris Street (Pyrmont Street frontage)

Model	Type of Flooding	Peak Flood Level (mAHD)		Hazard	
		1% AEP	PMF	1% AEP	PMF
DHCA	Mainstream Flooding	6.5	8.9	H1	H5

4.5.2. Flood Planning Levels

Minimum FFL requirements for Mainstream Flooding are:

- Non-sensitive use – 1% AEP flood level;
- Sensitive use – 1% AEP flood level + 0.5 m or the PMF (whichever is the higher);
- Basement parking – 1% AEP flood level + 0.5 m or the PMF (whichever is the higher);
- Enclosed parking (above ground) – 1% AEP flood level;
- Open parking – 5% AEP flood level.

The Planning Proposal would result in no changes to the ground floor or car park entrance, since there would only be additional storeys added above the existing development. It is assumed that

the relatively new construction is complaint with the contemporary FPL requirements.

4.5.3. Impact Considerations

Proposed zoning changes to have nil impact on surrounding flood levels, as proposed changes do not alter the existing building footprint.

4.5.4. Hazard Consideration

A hotel development would significantly increase the occupancy rates of the site at any given time. Evacuation up until and including the 1% AEP event is reasonably feasible by foot on both Pyrmont Street and Harris Street. At a point above the 1% AEP event and in circumstances where the inlet pits on Pyrmont Street are blocked, Pyrmont Street becomes unsafe to evacuate to, with the area categorised as H5 in the PMF due to the depth of water expected. Harris Street is mainly categorised as H1 in the PMF event, although the gutter line is categorised as H5. Access to the site via Harris Street is possible even in the PMF event, particularly for pedestrians, although if a large number of people were to evacuate to Harris Street in a greater than 1% AEP event, it may be difficult to ensure all people refrain from entering the street where the rapid flows in the gutter may be unsafe.

4.6. 56 Harris Street

The site is primarily bounded by John Street to the south and Harris Street to the west. The rear (north) of the site overlooks the light rail line, which is in a deep cutting. The site is within the DHCA model. Flood depths, level contours and hazard categorisation are shown in Area A on Figure 2.3 to Figure 2.7.



Photo 12: Northeast facing photo over the 56 Harris Street. Harris Street (Left) and John Street (right). *Google Streetview*

4.6.1. Site Characteristics and Flood Behaviour

The highest elevation for the area is at the junction of John Street and Cadigal Avenue, approximately 150 m to the west of the site. From this point the surface water flows in the local gutter network to the east and west along John Street, and north along Cadigal Avenue. Being so high in the catchment, the flows along John Street to the east do not exceed 0.1 m in the gutter, even in the PMF event. These flows are directed onto Harris Street at the location of the site (Photo 12) and continue to the north. The light rail line is inundated in the PMF, although it is a significant elevation drop, from the site to the line (over 16 m). The area is considered to be 'local drainage'. The flood tagging status of the lot is shown in Table 12. Indicative site flood characteristics are shown in Table 13.

Table 12: Flood tagging for 56 Harris Street

Clause 9(1)	Clause 9(2)
No	Yes

Table 13: Indicative site flood characteristics for 56 Harris Street

Model	Type of Flooding	Peak Flood Level (mAHD)		Hazard	
		1% AEP	PMF	1% AEP	PMF
DHCA	Local drainage	-	21.2	-	H5

4.6.2. Flood Planning Levels

Minimum FFL requirements for Local Drainage are:

- Non-sensitive use – 1% AEP flood level;
- Sensitive use – 1% AEP flood level + 0.5 m or the PMF (whichever is the higher);
- Basement parking – 1% AEP flood level + 0.5 m or the PMF (whichever is the higher);
- Enclosed parking – 1% AEP flood level;
- Open parking – 5% AEP flood level.

Meeting minimum FFL requirements is considered reasonable and practicable for construction based on the indicative flood levels and existing site topography.

4.6.3. Impact Considerations

The existing structures utilises a large percentage of the lot and the Planning Proposal requires a minimum of 15% deep soil landscaping, adding flood storage and infiltration capacity. As such, redevelopment of the site could provide a net positive impact for the local flood conditions.

4.6.4. Hazard Consideration

The immediate footpath around the site is located outside of H1 hazard categorisation for the 1% AEP and PMF events. In the PMF event, there are locations of H5 categorisation in gutters leading away from the site. Although the immediate area is safe for evacuation access to and from the site, wider access from the wider suburb may be temporarily restricted. In the PMF event, there is

H5 flow in the gutter coming from John Street, on the east of the road on Harris Street and across the road carriageway on Pyrmont Street to the southeast of the site.

4.7. 1-19 Allen Street and 313-369 Harris Street

The two separate parcels (together considered to be the site) are bounded by Bulwara Road to the west, Harris Street to the east (see Photo 13), Allen Street to the north and Fig Street to the south. There is a public walkway (Ada Place walkway) between the lots and the elevated Western Distributor runs along the southern corner of the site (see Photo 14). The site is within the DHCA model. Flood depths, level contours and hazard categorisation are shown in Area B on Figure 2.8 to Figure 2.12.



Photo 13: Northwest facing photo over Harris Street. *Google Streetview*

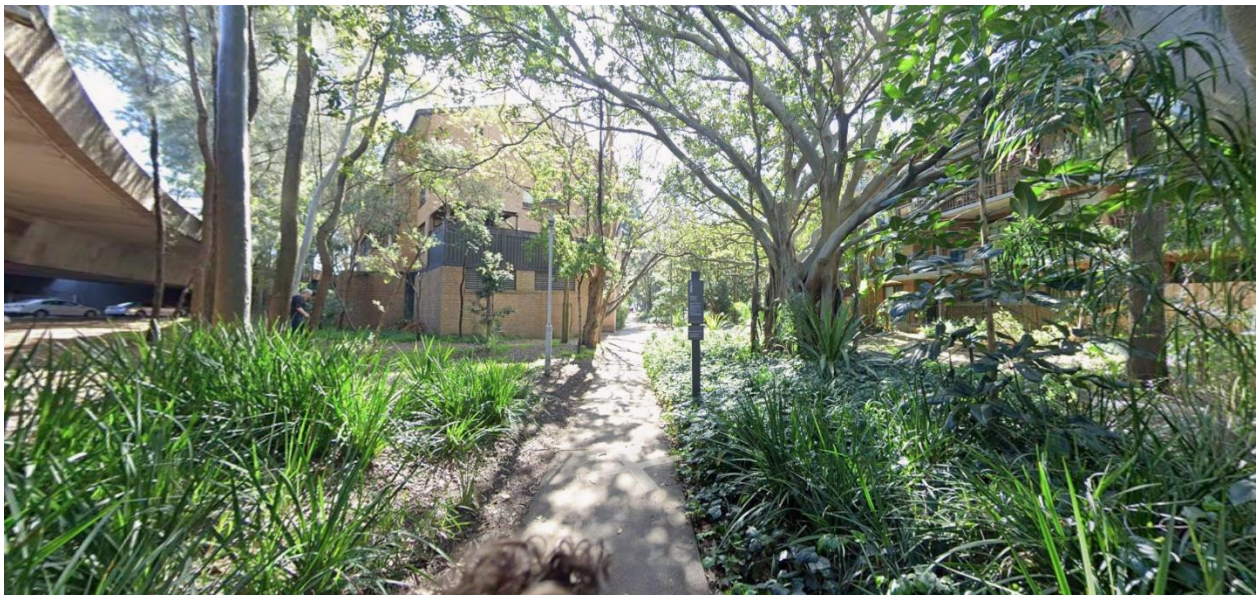


Photo 14: Ada Place walkway between 1-19 Allen Street (left) and 313-369 Harris Street (right), looking north from Fig Street, with the Western Distributor overhead. *Google Streetview*

4.7.1. Site Characteristics and Flood Behaviour

Bulwara Road and the Ada Place walkway slope north. There is no flooding on Bulwara Road and only minor flows within the walkway. Flood depths at the northern end of the walkway are less than 0.3 m in the 1% AEP event and 0.4 m in the PMF event. The modelling indicates that this ponding is adjacent to structures on the northeast of 1-19 Allen Street (Photo 15). The water builds up due to assumed subtle undulations in the LiDAR and then spills onto Allen Street. There is no suggestion that this is a significant sag or trapped point and water is free to flow through the area in all events. Due to the relatively low depths and the absence of a trapped low point, 1-19 Allen Street is considered to be a ‘local drainage’ classification.



Photo 15: Northern end of walkway where ponding occurs at the rear of no. 1-19 Allen Street. North facing. *Google Streetview.*

Flows from the Ada Place walkway discharge onto Allen Street and continue to the east to the intersection with Harris Street. From this location, the majority of flow enters Harris Street and ponds at a trapped sag point mid-way between Harris Street and Fig Street, adjacent to 313-369 Harris Street. Ponding occurs in events greater than the 20% AEP, when the capacity of the stormwater (with design blockage of pits considered) is exceeded. The sag point is drained by a 375 mm diameter pipe that conveys flows from the western side of the street to the north, and a 525 mm diameter pipe that conveys flows from the eastern side of the street to the south.

The flood depths at the Harris Street sag reach 0.5 m and over 1 m in the 1% AEP and PMF events, respectively. The modelling indicates that the 1% AEP event does not reach the footpath in front of the building on Harris Street (as it is more than 0.5 m above the sag point, see Photo 16). The footpath slopes up to the existing building such that floor levels are approximately 1 m above the sag point, however, the PMF is large enough to reach the building and may cause above floor inundation of approximately 0.2 m depth. There is no overland relief point for inundation and as such, ponding increases (subject to the performance of the drainage network) until overflows commence down Allen Street (to the north). Flood depths need to exceed approximately 0.7 m at the sag point for these overflow points to be activated. The proximity to this trapped low point results in 313-369 Harris Street being classified as mainstream flooding.



Photo 16: No. 313-369 Harris Street in relation to the Harris Street sag point. South facing. *Google Streetview*

The site is sensitive to changes in rainfall intensity (climate change) and drainage conditions (blockage). Noting that the site is not sensitive to sea level rise due to climate change. When considering blockage to the pits on Harris Street there is an expected increase to the flood depth by approximately 0.08 m and 0.47 m in the 1% AEP event for increased blockage and full blockage, respectively. Refer Sections 5.1 and 5.2 for discussion on blockage and climate change sensitivity, respectively.

The flood tagging status for 1-19 Allen Street and 313-369 Harris Street is shown in Table 14 and Table 15 with indicative site characteristics shown in Table 16 and Table 17.

Table 14: Flood tagging for 1-19 Allen Street

Clause 9(1)	Clause 9(2)
No	No

Table 15: Flood tagging for 313-369 Harris Street

Clause 9(1)	Clause 9(2)
Yes	Yes

Table 16: Indicative site flood characteristics for 1-19 Allen Street

Model	Type of Flooding	Peak Flood Level (mAHD)		Hazard	
		1% AEP	PMF	1% AEP	PMF
DHCA	Local Drainage	17.24	17.41	H1	H2

Note: taken at the northeast lot corner

Table 17: Indicative site flood characteristics for 313-369 Harris Street

Model	Type of Flooding	Peak Flood Level (mAHD)		Hazard	
		1% AEP	PMF	1% AEP	PMF
DHCA	Mainstream Flooding	14.71	15.45	H2 - H3	H3 - H4

Note: taken at the sag point location on Harris Street. Indicative site characteristics for 1-19 Allen Street (Table 16) relevant to 313-369 Harris Street when considering Ada Place walkway frontage.

4.7.2. Flood Planning Levels

Minimum FFL requirements for Mainstream Flooding and Local Drainage:

- Non-sensitive use – 1% AEP flood level;
- Sensitive use – 1% AEP flood level + 0.5 m or the PMF (whichever is the higher);
- Basement parking – 1% AEP flood level + 0.5 m or the PMF (whichever is the higher);
- Enclosed parking (above ground) – 1% AEP flood level;
- Open parking – 5% AEP flood level,

The roads/pathways are tiered between the buildings, meaning that the primary flood risk to 313-369 Harris Street is from the Harris Street sag, however, the building floor levels are currently approximately 0.5 m above the 1% AEP flood level. If considering the flood risk from Bulwara Road on the upstream side, a reasonable design should ensure a minimum of 0.3 m above the surrounding ground for the Bulwara Road frontage. The FPLs for the site are considered readily achievable.

4.7.3. Impact Considerations

The existing structures utilises a large percentage of the lot and the Planning Proposal requires a minimum of 15% deep soil landscaping, adding flood storage and infiltration capacity. As such, redevelopment of the site could provide a net positive impact for the local flood conditions. In the PMF event, there is a minor flow path from Bulwara Road under the Western Distributor to the site that flows around the existing building and onto the Ada Place walkway. This flow path would need to be confirmed with site-specific survey and modelling (as LiDAR data does not necessarily accurately represent the topography under the Western Distributor), however, if this is correct a larger building footprint for 1-19 Allen Street is likely to redirect this flow along an alternate path to the Ada Place walkway and impacts are expected to be negligible. Development of 313-369 Harris Street should maintain the existing raised pathway within the site boundary on the Harris Street frontage as this provides flood storage in the PMF event.

4.7.4. Hazard Consideration

The footpath at the front of 313-369 Harris Street remains free of inundation until above the 1% AEP. In the PMF event the footpath is categorised as H1. In the PMF the road would be unsafe for children and vehicles to enter, however the footpath would still be manageable for persons to navigate away from the buildings if required. Maintaining connectivity through the building and providing access to Fig Street, or providing access from the building to the Ada Place walkway would improve evacuation potential in an event greater than the 1% AEP. From 1-19 Allen Street, access is available to the building in both the 1% AEP and PMF events, for pedestrians and

vehicles.

4.8. 1-33 Saunders Street

The site was assessed in Stage 1. The Stage 2 proposed controls would not be expected to have any material difference on the risk to the site compared to Stage 1 proposed controls in relation to planning levels and impact considerations. Refer the Stage 1 report Section 4.7 for full site evaluation.

The site consists of two adjacent lots, bounded by Bank Street, Quarry Master Drive and Saunders Street. The Western Distributor is elevated adjacent to Bank Street. Flood depths, level contours and hazard categorisation are shown in Area A on Figure 2.3 to Figure 2.7.

While the previous assessment of flood risk in the Stage 1 report is considered valid, there is a proposed increase in building height from 15 to 33 storeys, which would substantially increase the number of occupants on site. There is only minor inundation on Bank Street to the south of the site that does not overtop the gutter in the 1% AEP event, with depths of up to 0.2 m in the PMF event in isolated locations. The hazard remains H1 in the PMF event. No flood constraints were identified for this property in the Stage 1 report (in terms of FPLs, impact and hazard considerations) and hence the site is appropriate for the further increase in occupancy.

4.9. Site Constraint Summary

A summary is tabulated of the key constraints considered for each site, as given in Table 18 and described below.

Flood Planning constraint rating

- Nil Constraints
  - Site is free from inundation affecting FPLs.
- Minor Constraints
  - Site is affected by 1% AEP or PMF inundation.
  - FPLs easily achievable.
- Moderate Constraints
  - Site is affected by 1% AEP inundation.
  - FPLs partially or fully achievable with an appropriate design.
- Major Constraints
  - Site is heavily flood affected, with FPLs elevated high above the ground.
  - FPLs difficult to achieve.

Impacts constraint rating

- Nil Constraints
  - No adverse flood level changes anticipated from redevelopment of the site.
- Minor Constraints
  - Potential for minor adverse flood level changes post-development.
  - Impact of redevelopment fully resolvable with an appropriate design.
- Moderate Constraints
  - Potential for moderate adverse flood level changes post-development.
  - Impact of redevelopment partially or fully resolvable and may require a unique design incorporating flood mitigation measures.
- Major Constraints
  - Potential for significant adverse flood level changes post-development.
  - Impacts of redevelopment difficult to resolve.

Hazard constraint rating

- Nil Constraints
  - Site is free from inundation constraining immediate access or affecting occupant safety.
- Minor Constraints
  - Access to and from site affected during PMF event (road inundation).
- Moderate Constraints
  - Access to and from site affected during 1% AEP event (road inundation).
  - Direct access (footpath) to the site is partially affected (inundation above gutter) in the PMF.
- Major Constraints
  - Site isolated during 1% AEP event.

Table 18: Summary Table of Site Constraints

Site Ref.	Site	Summary	Constraint Rating		
			FPL	Impact	Hazard
4.1	26-52 Mount Street	Not affected by PMF mainstream flooding.	Nil	Nil	Nil
4.2	1-7 Henry Avenue	Not affected by PMF mainstream flooding.	Nil	Nil	Nil
	336-374 Jones Street	Not affected by PMF mainstream flooding.	Nil	Nil	Nil
4.3	463-467 Harris Street	Not affected by PMF mainstream flooding.	Nil	Nil	Nil
4.4	344 Bulwara Road	Minor flooding in the 1% AEP and up to the PMF event. Affects lower (southern) areas of the lot.	Minor	Nil	Nil
4.5	100-130 Harris Street	Affected by mainstream flooding during a 1% AEP event.	Minor	Nil	Moderate
4.6	56 Harris Street	Site above 1% AEP and minor affectation in the PMF.	Nil	Nil	Minor
4.7	1-19 Allen Street	Minor flooding in the 1% AEP and up to the PMF event.	Minor	Minor	Nil
	313-369 Harris Street	Affected by mainstream flooding during a 1% AEP event.	Minor	Minor	Moderate
4.8	1-33 Saunders Street	Not affected by 1% AEP event, Minor affectation in the PMF.	Nil	Minor	Nil

In general, the lots are not heavily constrained by flooding. If there were any constraints to FPLs, flood impacts or flood hazard that were classified as ‘major’, it would provide reason to not pursue intensification of a lot. Those lots that do have ‘moderate’ constraints include sites that front areas with deep floodwaters on:

- Pyrmont Street
- Harris Street

The lots on these road frontages (100-130 and 313-369 Harris Street) were identified as having ‘moderate’ constraints, however, in each case, the site has more than one frontage to a road and is located on terrain steep enough that a large portion of the site rises from the frontage that experiences inundation. In this way, FPLs can be met as a raised floor is typically required for the remainder of the site to cater for rising ground levels away from the inundated road. Less sensitive uses (such as commercial) of the ground floor fronting flood affected roads would be a way to reduce the required minimum floor level in addition to avoiding basement carpark entrances on flooded roads (which would also benefit site access in flood events). Access to multiple frontages and the topography of the sites also assist with hazard constraints, where access from the site can be maintained with an appropriate building design. The Planning Proposal allows for multiple storeys such that flood refuge is also possible even if the ground floor is inundated in a flood event. There are no sites with ‘moderate’ flood impact constraints.

The issues associated with flooding at these locations (in terms of redevelopment and intensification potential) would require a design that considers flood affectation of the site at an early stage in the design process to develop solutions to the requirements for minimum floor levels and/or access requirements. In each case, however, the constraint is not considered to preclude development of the lot. Rather, a building design is possible at each site that minimises the flood risk to the building itself (minimum floor levels) and its occupants (ensuring adequate on-site refuge and access to and from the site is maintained). Redevelopment of sites that are flood affected can provide the opportunity to reduce the flood risk to occupants through a building design that is compatible with the flood behaviour, while accommodating increased occupants (where appropriate), particularly on high economic value land such as that found in Pyrmont and Ultimo.

5. FACTORS AFFECTING FLOOD BEHAVIOUR

5.1. Blockage Sensitivity

Blockage sensitivity was analysed across the DHCA and BW catchments. BW was discussed in the Stage 1 report (Reference 2). No changes have been made to the BW sensitivity assumptions and conclusions, refer the Stage 1 report, Section 5.1 for blockage sensitivity details.

The DHCA study (Reference 8) adopted lower design blockage parameters compared to the 2014 Flood Study (Reference 14). As part of the study sensitivity testing was completed with a high blockage and a full blockage scenario. The high blockage scenario is consistent with that modelled for the BW catchment.

Blockage Scenario	On-grade Pit	Sag Pit
Design Blockage	20%	50%
No Blockage[1]	0%	0%
High Blockage	50%	100%
Full Blockage	100%	100%

1. Discussion on the 'No Blockage' scenario is not relevant for the FIRA

Blockage sensitivity was analysed across the DHCA and BW catchments. The 1% AEP change in flood level with increased blockage is shown in Figure 2.19. The mapping shows a high blockage scenario (50% blockage of on-grade pits and 100% blockage of sag pits) compared to the adopted base model flood levels (20% blockage of on-grade pits and 50% blockage of sag pits) for both catchments.

Most of the sites nominated in the Planning Proposal are unaffected by pit blockage assumptions (< 0.02 m change), with no new sites identified as constrained. However, the sites previously found to be constrained by flooding at trapped sag points are adversely affected by blockage. In particular 100-130 Harris Street (Pyrmont Street frontage) (Section 4.5), and 313-369 Harris Street (Section 4.7) are both sensitive to blockage of the stormwater network.

The assessment of 100-130 Harris Street (Section 4.5) indicated that it would likely be feasible to evacuate to both Harris Street and Pyrmont Street in a 1% AEP event with only H1 hazard present. In the high blockage scenario, however, the 1% AEP flood level increases by approximately 0.7 m, making it H3 hazard and unlikely to be safe for vehicles and some pedestrians. This would need to be a consideration for the proposal to increase the building height to accommodate a hotel at the site, noting that the possible need to evacuate may be restricted to Harris Street during a flooding event if severe blockage of the drainage pits occurs. It is recognised, however, that this blockage scenario requires all the 6+ pits located on Pyrmont Street to be 100% blocked such that there are no flows in the large 2.55 m x 1.9 m box culvert that drains the sag point.

313-369 Harris Street (Section 4.7) is also sensitive to blockage, albeit to a much lesser extent, with the 1% AEP flood levels increasing by less than 0.1 m. The 2020 LiDAR indicates that the overland relief point at the end of the street (onto Allen Street) is lower than the footpath and floor level of the current building. Blockage may affect access through the street by slightly increasing

the extent of H2 and H3 hazard on the road, but evacuation by foot is still assumed safe via the footpath. The assessment noted however, that the PMF overtops the footpath and access to Harris Street may be limited in events larger than the 1% AEP.

The blockage sensitivity modelling indicates that a requirement to include a high blockage factor would not preclude any site from pursuing redevelopment under the Planning Proposal. However, it would be prudent to consider the additional risk that blockage poses to a development.

5.2. Climate Change

The Stage 1 report (Reference 2) details the climate change sensitivity analysis undertaken in the BW Flood Study (Reference 10) and used 0.5% AEP and 0.2% AEP events as proxies to show the 1% AEP event sensitivity of the catchment to changes in rainfall intensity. The Stage 1 report detailed the resulting differences in flood levels across the BW catchment for the 0.2% AEP event, representing a 23% increase in rainfall intensity, concluding that the given Stage 1 sites could accommodate the changes in flood levels in the FPLs and that the developments would not change the flood behaviour in a future climate scenario.

Since the Stage 1 report was finalised, ARR has updated guidance related to climate change scenarios and impacts, as outlined in Section 2.3.1. This updated guidance was utilised in the DHCA Flood Study (Reference 8) by simulating SSP3-7.0 rainfall intensity for 2050 and 2100. The 2100 scenario was selected to indicate the potential impacts due to rainfall intensity increases. This represents approximately a 40% increase in rainfall intensity, which is much larger than previous estimates (such as those assumed in the BW Flood Study). The SSP3-7.0 2100 1% AEP impact (compared to the SSP3-7.0 2030 base case) is shown in Figure 2.20 for the DHCA catchment, together with the difference between the 0.2% AEP and 1% AEP events for the BW catchment.

The increase in rainfall intensity indicates that the sag points through the catchments are sensitive to the increase in rainfall intensity. In the DHCA catchment, the peak flood levels in the 1% AEP event rise on Pyrmont Street by 0.35 m (100-130 Harris Street, Section 4.5) and Harris Street by 0.26 m (313-369 Harris Street, Section 4.7) at the sag points. The other sites within DHCA (Sections 4.1, 4.3, 4.4, 4.5, 4.6, and 4.7) are not sensitive to changes in rainfall intensity. The increase in rainfall intensity does not generate a new flood risk by forming new flow paths through or adjacent to the sites, nor is it likely to generate additional over floor flood risk for the remaining DHCA sites.

The two sites within the BW study area, 1-33 Saunders Street (Section 4.8) and 1-7 Henry Avenue and 336-374 Jones Street (Section 4.2) have low flood risk in the existing climate conditions. 1% AEP flood levels on Bank Street at 1-33 Saunders Street only increase by up to 0.02 m. At 1-7 Henry Avenue and 336-374 Jones Street, there is no modelled overland flood risk as water sheds away from the site and it sits relatively high in the catchment with no sag points nearby.

Sea level rise significantly impacts floods at the lower elevations of the catchments, particularly around Tumbalong Park in DHCA and Wentworth Park in BW. However, the Stage 2 sites are relatively elevated such that the majority of the sites would not be affected by sea level rise. The

only site that could potentially be affected is 1-33 Saunders Street (Section 4.8). The DHCA Flood Study (Reference 8) assessed recent sea level rise projections for the SSP3-7.0 for 2050, 2100 and 2150. For the 2150 scenario, the adopted sea level was 2.58 mAHD. The 2020 LiDAR data indicates that the low point of Banks Street is approximately 4 mAHD. Since the site is more than 1 m above the SSP3-7.0 2150 sea level, it is concluded that the Stage 2 sites are not significantly affected by future sea level rise.

The climate change sensitivity modelling indicates that a requirement to include climate change would not preclude any site from pursuing redevelopment under the Planning Proposal. However, it would be prudent to consider climate change impacts at 100-130 Harris Street and 313-369 Harris Street.

The existing controls are guided by the CoS LEP 2012 5.21 (3)(a), in which any development must demonstrate satisfactory compliance to the flood planning provisions considering future climate change conditions (Reference 4). The Interim Floodplain Management Policy is more prescriptive in its requirements for developments (Reference 6). Three requirements are given to prevent the potential impact of climate change:

- For those developments which have a lifespan of more than fifty years the impact due to sea level rise and impacts due to increased rainfall intensities shall be considered.
- Meet the allowances for sea level rise as recommended in the NSW Government Coastal Planning Guideline: Adopting Sea Level Rise 2010 (now withdrawn from publication). Specifically, this shall include and allowance of 40cm by 2050 and a 90cm by 2100 from the 2009 Mean Sea Level.
- Where in the opinion of the City the proposed development is of reasonable impact to regional or catchment trunk drainage, the drainage system design shall allow for a minimum of 10% increased rainfall.

In the context of the draft Climate Change and Natural Hazards SEPP guidelines (Reference 12), the DHCA modelling adopts a 2100 SSP3-7.0 scenario for sensitivity analysis for potential future rainfall intensity increase and sea level rise. A further 2150 SSP3-7.0 sea level rise projection was also simulated. This corresponds to an approximately 74-year horizon for rainfall intensity and a 124-year horizon for sea level rise. These horizons are considered reasonable, as it aligns with the practical limits of confidence in rainfall projections (to around 2100), while acknowledging the more predictable nature of sea level rise beyond this period. As such, the DHCA sensitivity testing provides an appropriate basis for understanding site vulnerability over the expected lifetime of development.

By contrast, the use of proxy approaches within the BW model does not provide an equivalent level of understanding of climate change impacts over the lifetime of development, particularly in relation to rainfall intensity and sea level rise. It is noted, however, that the Stage 2 sites within the BW are relatively insensitive to changes in rainfall intensity.

While the report does not specify finished floor levels or directly quantify development specific climate change impacts, the sensitivity testing indicates that the sites are likely capable of complying with applicable planning controls, even under increased hazard levels associated with

climate change. Detailed design responses, including floor level setting and site-specific risk mitigation, would be addressed at the DA stage, where proponents would undertake detailed assessments consistent with the Draft Guidelines and relevant Council DCP and LEP requirements.

5.3. Increase in Impervious Surfaces

When considering flood behaviour, unmitigated intensification of the land correlates with potential adverse flood level impacts. That is, the increase in (or establishment of) more impervious surfaces, results in more stormwater run-off concentrating in the surrounding flow paths and potentially raising neighbouring flood levels. In the case of the Planning Proposal there is little to negligible intensification projected in terms of new impervious surfaces. Most of the catchment is already highly urbanised. In most cases 100% of the site is utilised by the existing structure and/or hardstand (i.e. car park). In general, the existing urbanised conditions suggest that there is limited potential for increasing stormwater run-off post-development. Included in the Planning Proposal is a requirement of 10-15% deep soils for most sites. Where most sites currently exist with 100% imperviousness, the increase in deep soils allows for infiltration of water locally, reducing run-off entering downstream. Therefore, if implemented as proposed the changes could have a net reduction in flood levels, an inverse on the historical outcome of unmitigated intensification.

5.4. Flood Risk Management Measures

The Stage 1 report (Reference 2) identified relevant flood risk management measures that may affect the Stage 1 sites, with details contained in Section 5.4 of that report. The Stage 2 sites are not directly affected by any of the flood modification measures proposed in the previous FRMS&Ps, with the exception of 100-130 Harris Street (Section 4.5). The proposed flood mitigation option ‘FM-DH06’ in the Darling Harbour FRMS&P (Reference 9) examined upgrading the trunk drainage and pit inlet capacity at the sag point on Pyrmont Street. Details of this option were discussed in the Stage 1 report, Section 5.4.1. The Harris Street sag point affecting 313-369 Harris Street (Section 4.7) was identified as a flood ‘hot spot’ in Reference 9, however, no flood modification measures were proposed for this area.

6. CONSISTENCY WITH MINISTERIAL DIRECTIONS

The Stage 2 Planning Proposal is required to comply with Directions issued by the Minister for Planning under section 9.1(2) of the Environmental Planning and Assessment Act 1979 (previously section 117(2)). The applicable directions for flooding are found in Direction 4.1 (Reference 15), which commenced 20 February 2023. Consistency with these directions are assessed in Table 19.

Table 19: Consistency with Ministerial Direction 4.1

Direction	Assessment
(1) A planning proposal must include provisions that give effect to and are consistent with: (a) the NSW Flood Prone Land Policy, (b) the principles of the Floodplain Development Manual 2005, (c) the Considering flooding in land use planning guideline 2021, and (d) any adopted flood study and/or floodplain risk management plan prepared in accordance with the principles of the Floodplain Development Manual 2005 and adopted by the relevant council.	The Planning Proposal and referenced flood studies (& FRMS&Ps) are consistent with the NSW Flood Prone Land Policy, the principles of the Floodplain Development Manual 2005 (Reference 16, now superseded by the 2023 Flood Risk Management Manual), and the Considering flooding in land use planning guideline 2021.
(2) A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Conservation Zones to a Residential, Employment, Mixed Use, W4 Working Waterfront or Special Purpose Zones.	No site in the Planning Proposal is currently zoned Recreation, Rural, Special Purpose or Conservation Zones.
(3) A planning proposal must not contain provisions that apply to the flood planning area which: (a) permit development in floodway areas,	The Planning Proposal does not include sites within floodway areas (see Figure 2.18).
(b) permit development that will result in significant flood impacts to other properties,	The existing requirements of the LEP/DCP/Interim Floodplain Management Policy ensure that there are no adverse impacts of potential developments. It will be necessary for future DA's to demonstrate the proposed works will not result in significant flood impacts to other developments, through modelling as part of a FIRA where appropriate. Satisfaction of this requirement depends on the details of the proposed development as is enforced through Council's strategic planning framework at the DA stage. These controls already apply to the land under consideration, and the nature of the controls and the development constraints presented by the controls would not be altered by the Planning Proposal. This FIRA has not identified any significant constraints to this requirement being met for the proposed sites. The approval of the

	Planning Proposal does not provide a guarantee or an implication that these requirements can be waived at subsequent development approval stages.
(c) permit development for the purposes of residential accommodation in high hazard areas,	The Planning Proposal does not include sites within high hazard areas (see Figure 2.7, Figure 2.12 and Figure 2.17).
(d) permit a significant increase in the development and/or dwelling density of that land,	It is unclear in this context what "significant increase in the development and/or dwelling density of that land" means. From the perspective of flood risk, the land is generally fully urbanised, and primarily covered by hardstand and buildings. The Planning Proposal will not significantly increase the development with regards to how much runoff will occur from the area. The Planning Proposal will increase the development of the land in terms of intensity of floor space and the population density in the area – that is the entire purpose of the Planning Proposal. With regards to flood risk, this increase in population density is largely offset by the following considerations: i. The increase in floor space will be primarily related to additional building storeys that are not at risk of damage from flooding, or new buildings that are located outside the floodplain. ii. With appropriate building design, some level of access to and from each site can be maintained in the PMF event. iii. In some areas the increase in population density will be associated with higher density land use zoning. It is more likely that consolidated high-density redevelopment of some lots would be able to resolve these flood issues (such as evacuation), compared to existing uses. The change in zoning (for example to mixed use) may allow less sensitive development on the ground floor (such as commercial facilities) and more sensitive development on upper floors (such as residential apartments). Rezoning of the flood affected lots and consolidation of buildings would generally be an effective long-term strategy for reducing flood risks in the areas under consideration, as a higher density development proposal with a larger

	building is more likely to be able to provide a design solution that complies with the LEP/DCP requirements. iv. New buildings would need to comply with minimum floor level controls and protection of basement areas, which in many cases are not satisfied by the existing buildings. Redevelopment of the land will therefore reduce the likely flood damages for the ground floor and basement levels, as well as reducing the risk to life to people within the buildings, despite the concurrent increase in total population. Redevelopment of urbanised areas is an inevitable result of increases to population in the Sydney metropolitan area. The NSW Flood Prone Land Policy recognises that: *"Flood prone land is a valuable resource and that development applications and proposals for rezoning of flood prone land should be the subject of careful assessment which incorporates consideration of local circumstances."* The Flood Risk Management Manual (Reference 3) indicates that development within the floodplain should be undertaken on a merit-based approach, ensuring that the development is compatible with the flood hazard of the land. Based on the review of available flood information as part of this assessment, the Planning Proposal improves the likelihood that redevelopment of the subject land can meet the required development controls and be compatible with the flood hazard, relative to existing zoning and height/FSR controls.
(e) permit development for the purpose of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate,	In areas where evacuation was considered a 'moderate' constraint, it is recommended that sensitive development, including centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing (where applicable based on zoning), not be permitted, unless safe and effective evacuation can be demonstrated in the PMF event. This direction applies to the sites at 100-130 Harris Street (Section 4.5), and 313-369 Harris Street (Section 4.7). For these sites the proximity to

	inundation in the 1% AEP event may make evacuation difficult in the 1% AEP event, depending on the specific design of the building.
(f) permit development to be carried out without development consent except for the purposes of exempt development or agriculture. Dams, drainage canals, levees, still require development consent,	WMAwater understands that the development indicated in the Planning Proposal will require development consent.
(g) are likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities, or	The development resulting from the Planning Proposal is unlikely to result in substantially increased requirement for government spending on emergency management or flood mitigation measures. The primary flood risk mitigation measure to reduce existing flood risks in this region would be to redevelop land to be consistent with the planning controls, including increasing the building floor levels up to the relevant standard, which is achieved through redevelopment of the land in accordance with the Planning Proposal. No site would require a significant increase in government spending to allow redevelopment to comply with the existing LEP/DCP/Interim floodplain management controls and the existing flood risk management measures identified for the catchments (Stage 1 report, Section 5.4) would remain.
(h) permit hazardous industries or hazardous storage establishments where hazardous materials cannot be effectively contained during the occurrence of a flood event.	Based on the proposed changes, there should be no hazardous industries or hazardous storage establishments.
(4) A planning proposal must not contain provisions that apply to areas between the flood planning area and probable maximum flood to which Special Flood Considerations apply which: (a) permit development in floodway areas,	As discussed for Direction 4.1 (3) (a).
(b) permit development that will result in significant flood impacts to other properties,	As discussed for Direction 4.1 (3) (b).
(c) permit a significant increase in the dwelling density of that land,	As discussed for Direction 4.1 (3) (d).
(d) permit the development of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate,	As discussed for Direction 4.1 (3) (e).
(e) are likely to affect the safe occupation of	As discussed for Direction 4.1 (3) (e). While there

and efficient evacuation of the lot, or	are some sites that may be inundated in the PMF event (subject to specific building design and FFLs), CoS's Interim Floodplain Management Policy will dictate the required FFL's and hence the associated acceptable level of risk of inundation depending on the proposed use of the floor. These minimum floor levels are considered to be reasonable and commensurate with the flood risk in the Pyrmont and Ultimo area. The FPLs are consistent with the principals of the Flood Risk Management Manual (Reference 3). Evacuation of some lots is a concern (primarily 100-130 Harris Street (Section 4.5), and 313-369 Harris Street (Section 4.7)), given the hazardous flooding that may be present in the streets adjacent to the building. However, each lot has at least one frontage with access in the PMF event, such that an appropriate building design can ensure access is maintained to the building even in the most extreme flood event.
(f) are likely to result in a significantly increased requirement for government spending on emergency management services, and flood mitigation and emergency response measures, which can include but not limited to road infrastructure, flood mitigation infrastructure and utilities.	As discussed for Direction 4.1 (3) (g).
(5) For the purposes of preparing a planning proposal, the flood planning area must be consistent with the principles of the Floodplain Development Manual 2005 or as otherwise determined by a Floodplain Risk Management Study or Plan adopted by the relevant council.	The flood planning area was taken from a study (Reference 13) that was based on the relevant flood studies and undertaken in accordance with the principles of the Floodplain Development Manual 2005.

The Planning Proposal is therefore consistent with the Section 9.1 Ministerial Directions, with the exception of Directions 4.1 (3) (d) and 4.1 (4) (c) – that is, permitting a significant increase in the development and/or dwelling density of that land. It has been demonstrated that although the Planning Proposal seeks to increase the development of some land within Pyrmont and Ultimo that is flood affected, the increase in floor space will typically not be flood affected (additional stories above flood levels or buildings outside the floodplain), access to and from the sites can be maintained during flood events with appropriate building design and redevelopment of the sites will typically result in a building that is more commensurate with the flood risk, having regard for the relevant flood-related development controls. As such, the Planning Proposal is considered to be consistent with the objectives of the Section 9.1 Ministerial Directions.

7. CONCLUSIONS

Some of the Stage 2 sites are affected by flood constraints. The details and constraints of each site have been discussed in Section 4, with a summary presented in Section 4.9. Where flood constraints are identified, there are no instances where redevelopment of the sites is wholly prohibitive, either under the existing LEP/DCP/Interim Floodplain Management Policy or under the amendments resulting from the Planning Proposal. However, future developments at these sites would still be required to demonstrate compliance with the existing LEP/DCP/Interim Floodplain Management Policy.

The current LEP/DCP provisions and controls are not prohibitive to redevelopment of the sites within the Planning Proposal. Where sites are affected by flood constraints, the controls in the DCP and Interim Floodplain Management Policy ensure the development is compatible with the flood risk for the site and an acceptable level of detail is required as to how the flood risks are managed with any proposed development. The nature of these constraints and the solutions to satisfy the development controls are not significantly altered by the Planning Proposal. However, as with the current LEP zoning, height allowances and maximum FSR, the flood constraints may preclude full development of some sites to the maximum allowable density. This is because compliance with various flood controls (such as basement carpark entrances or minimum ground floor levels) may reduce the achievable FSR or number of building storeys within a given site.

The detailed breakdown of the sites in Section 4 show that Pyrmont and Ultimo has varying degrees of flood affectation. It should be noted that the sites that are shown to be flood affected are currently developed and occupied. The most significant constraints for flood affected sites are achieving minimum floor level requirements and site access and evacuation requirements. The Planning Proposal may improve the feasibility of redevelopment in those lots as it may enable less sensitive uses of the ground floor in mixed use developments and increased height restrictions may allow for building floor levels to be raised to meet FPL requirements. Redevelopment of some buildings may also enable emergency access to be incorporated, with internal connections enabling flood free frontages to be accessed from any point within the building. In most cases, the requirement for deep soil areas has the potential to improve local flood conditions by increasing infiltration. The redevelopment of the lots identified is likely to allow for a design that caters for the flood conditions of the site.

WMAwater considers that the Planning Proposal is consistent with the Ministerial Directions for flood prone land (see Section 6 for detailed discussion), with the exception of permitting a significant increase in the development and/or dwelling density of that land. It was demonstrated that the increase in floor space will typically not be flood affected (additional storeys above flood levels or buildings outside the floodplain), access to and from the sites can be maintained during flood events with appropriate building design and redevelopment of the sites will typically result in a building that is more commensurate with the flood risk, having regard for the relevant flood-related development controls. As such, the Planning Proposal is considered to be consistent with the objectives of the Section 9.1 Ministerial Directions.

The Planning Proposal is consistent with other relevant legislation and Council's strategic planning framework for flood planning, in that the flood-related development controls enforced through that

framework are not significantly altered by the Planning Proposal. It is recommended that consultation is undertaken with relevant public agencies (such as the NSW State Emergency Service, the Department of Climate Change, Energy, the Environment and Water, and the Department of Planning, Housing and Infrastructure) following Gateway determination. Comments from these public agencies regarding specific constraints or development controls can be addressed as part of the site-specific DCPs.

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FIGURES

Figure 2.1: Study area and sites
Figure 2.2: Map extents

Figure 2.3: Area A Peak Flood Depth and Level Contours – 10% AEP Event
Figure 2.4: Area A Peak Flood Depth and Level Contours – 1% AEP Event
Figure 2.5: Area A Peak Flood Depth and Level Contours – PMF Event
Figure 2.6: Area A Peak Hydraulic Hazard – 1% AEP Event
Figure 2.7: Area A Peak Hydraulic Hazard – PMF Event

Figure 2.8: Area B Peak Flood Depth and Level Contours – 10% AEP Event
Figure 2.9: Area B Peak Flood Depth and Level Contours – 1% AEP Event
Figure 2.10: Area B Peak Flood Depth and Level Contours – PMF Event
Figure 2.11: Area B Peak Hydraulic Hazard – 1% AEP Event
Figure 2.12: Area B Peak Hydraulic Hazard – PMF Event

Figure 2.13: Area C Peak Flood Depth and Level Contours – 10% AEP Event
Figure 2.14: Area C Peak Flood Depth and Level Contours – 1% AEP Event
Figure 2.15: Area C Peak Flood Depth and Level Contours – PMF Event
Figure 2.16: Area C Peak Hydraulic Hazard – 1% AEP Event
Figure 2.17: Area C Peak Hydraulic Hazard – PMF Event

Figure 2.18: Flood Function – 1% AEP Event
Figure 2.19: Pit Blockage Sensitivity – 1% AEP Event with High Blockage
Figure 2.20: Climate Change Sensitivity – SSP3-7.0 2100 1% AEP Event

FIGURE 2.1
STUDY AREA AND SITES

N

4.6
4.5
4.1
4.8
4.7
4.2
4.3
4.4

Stage 2 Sites
Cadastral
BW Catchment Area
DH Catchment Area

0 300 600 m

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FIGURE 2.2
MAP EXTENTS

N

4.6
4.1
4.5
4.8
Area A

4.7
4.2
4.3
Area B

4.4
Area C

PIRRAMA ROAD
WULUGUL WALK
BOWMAN STREET
HARRIS STREET
PYRMONT STREET
BANK STREET
WESTERN DISTRIBUTOR
DARLING DRIVE
ADA PLACE
WATTLE STREET
COOK STREET
FORSYTH LANE
FERRY ROAD
FERRY LANE
BRIDGE ROAD
DARLING STREET
QUEEN STREET
CROWN STREET
GLEBE STREET
DERWENT LANE
DERWENT STREET
GLEBE LANE
JONES STREET
HACKETT STREET
SYDNEY STREET
MCKEE STREET

Stage 2 Sites
Cadastral

0 300 600 m

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FIGURE 2.3
AREA A
PEAK FLOOD DEPTH
10% AEP EVENT

REFINERY DRIVE
BOWMAN STREET
TAMBUA STREET
JONES STREET
DISTILLERY DRIVE
QUARRY MASTER DRIVE
HARVEY STREET
JOHN STREET
CADIGAL AVENUE
SCOTT STREET
POINT STREET
JONES BAY ROAD
MOUNT STREET
PYRMONT STREET
HARRIS STREET
MILLER STREET
PATERNOSTER RO
LITTLE MOUNT STREET
SAUNDERS STREET
BANK STREET
WESTERN DISTRIBUTOR
MILLER LANE
BULWARA ROAD
JONES STREET

4.1
4.5
4.6
4.8

N

Stage 2 Sites
Cadastral
Flood Level Contour (1m Interval)

Depth (m)
<= 0.15
0.15 - 0.30
0.30 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00

0 150 300 m

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FIGURE 2.4
AREA A
PEAK FLOOD DEPTH
1% AEP EVENT

REFINERY DRIVE
BOWMAN STREET
TAMBUA STREET
JONES STREET
DISTILLERY DRIVE
QUARRY MASTER DRIVE
JOHN STREET
HARVEY STREET
POINT STREET
JONES BAY ROAD
MOUNT STREET
PYRMONT STREET
HARRIS STREET
MILLER STREET
PATERNOSTER ROW
SAUNDERS STREET
BANK STREET
WESTERN DISTRIBUTOR
MILLER LANE
BULWARA ROAD

4.1
4.5
4.6
4.8

N

Stage 2 Sites
Cadastral
Flood Level Contour (1m Interval)

Depth (m)
<= 0.15
0.15 - 0.30
0.30 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00

0 150 300 m

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FIGURE 2.5
AREA A
PEAK FLOOD DEPTH
PMF EVENT

REFINERY DRIVE
BOWMAN STREET
TAMBUA STREET
DISTILLERY DRIVE
QUARRY MASTER DRIVE
SAUNDERS STREET
BANK STREET
WESTERN DISTRIBUTOR
HARVEY STREET
POINT STREET
JONES BAY ROAD
MOUNT STREET
JONES STREET
MILLER LANE
HARRIS STREET
PYRMONT STREET
LITTLE MOUNT STREET
PATERNOSTER RO
BULWARA ROAD

4.1
4.5
4.6
4.8

N

Stage 2 Sites
Cadastral
Flood Level Contour (1m Interval)

Depth (m)
<= 0.15
0.15 - 0.30
0.30 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00

0 150 300 m

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FIGURE 2.6
AREA A
PEAK HYDRAULIC HAZARD
1% AEP EVENT

REFINERY DRIVE
BOWMAN STREET
TAMBUA STREET
JONES STREET
DISTILLERY DRIVE
QUARRY MASTER DRIVE
MOUNT STREET WALK
CADIGAL AVENUE
HARVEY STREET
SCOTT STREET
POINT STREET
JOHN STREET
JONES BAY ROAD
MOUNT STREET
HARRIS STREET
PYRMONT STREET
UNION STREET
SAUNDERS STREET
BANK STREET
WESTERN DISTRIBUTOR
MILLER STREET
MILLER LANE
BOULARA
PATERNOSTE

4.1
4.5
4.6
4.8

N

Stage 2 Sites
Cadastral

Hydraulic Hazard

H1 - Generally safe for people, vehicles and buildings
H2 - Unsafe for vehicles
H3 - Unsafe for vehicles, children and the elderly
H4 - Unsafe for people and vehicles
H5 - Unsafe for vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure
H6 - Unsafe for vehicles and people.
All building types consider vulnerable to failure

0 150 300 m

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FIGURE 2.7
AREA A
PEAK HYDRAULIC HAZARD
PMF EVENT

REFINERY DRIVE
BOWMAN STREET
TAMBUA STREET
JONES STREET
DISTILLERY DRIVE
QUARRY MASTER DRIVE
SAUNDERS STREET
BANK STREET
WESTERN DISTRIBUTOR
MOUNT STREET WALK
CADIGAL AVENUE
HARVEY STREET
JOHN STREET
SCOTT STREET
POINT STREET
JONES BAY ROAD
MOUNT STREET
HARRIS STREET
PYRMONT STREET
UNION STREET
MILLER STREET
MILLER LANE
BULWARA RD
PATERNOSTE

4.1
4.5
4.6
4.8

N

Stage 2 Sites
Cadstral

Hydraulic Hazard

H1 - Generally safe for people, vehicles and buildings
H2 - Unsafe for vehicles
H3 - Unsafe for vehicles, children and the elderly
H4 - Unsafe for people and vehicles
H5 - Unsafe for vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure
H6 - Unsafe for vehicles and people.
All building types consider vulnerable to failure

0 150 300 m

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FIGURE 2.8
AREA B
PEAK FLOOD DEPTH
10% AEP EVENT

N

4.7
4.7
4.2
4.3

PYRMONT BRIDGE ROAD
BRIDGE ROAD
WATTLE CRESCENT
BULWARA ROAD
ADA PLACE
WESTERN DISTRIBUTOR
JONES LANE
FIG STREET
FIG LANE
WATTLE STREET
HENRY AVENUE
JONES STREET
QUARRY LANE
QUARRY STREET
HARRIS STREET
PYRMONT STREET
IRON WHARF PLACE
KIRK STREET
DARLING DRIVE
MORIARTY WALK

Stage 2 Sites
Cadastral
Flood Level Contour (1m Interval)

Depth (m)
<= 0.15
0.15 - 0.30
0.30 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00

0 150 300 m

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FIGURE 2.9
AREA B
PEAK FLOOD DEPTH
1% AEP EVENT

N

PYRMONT BRIDGE ROAD
BRIDGE ROAD
WATTLE CRESCENT
BULWARA ROAD
ADA PLACE
IRON WHARF PLACE
WESTERN DISTRICTOR
JONES LANE
FIG STREET
FIG LANE
HENRY AVENUE
QUARRY LANE
QUARRY STREET
WATTLE STREET
HARRIS STREET
PYRMONT STREET
KIRK STREET
DARLING DRIVE
MORIARTY WALK

4.7
4.7
4.2
4.3

Stage 2 Sites
Cadastral
Flood Level Contour (1m Interval)

Depth (m)
<= 0.15
0.15 - 0.30
0.30 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00

0 150 300 m

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FIGURE 2.10
AREA B
PEAK FLOOD DEPTH
PMF EVENT

N

4.7
4.7
4.2
4.3

PYRMONT BRIDGE ROAD
WATTLE CRESCENT
BULWARA ROAD
ADA PLACE
WESTERN DISTRIBUTOR
JONES LANE
FIG STREET
FIG LANE
HENRY AVENUE
QUARRY LANE
QUARRY STREET
WATTLE STREET
HARRIS STREET
PYRMONT STREET
IRON WHARF PLACE
DARLING DRIVE
MORIARTY WALK
KIRK STREET

Stage 2 Sites
Cadastral
Flood Level Contour (1m Interval)

Depth (m)
- <= 0.15
- 0.15 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

0 150 300 m

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FIGURE 2.11
AREA B
PEAK HYDRAULIC HAZARD
1% AEP EVENT

N

4.7
4.7
4.2
4.3

BULWARA ROAD
ADA PLACE
ALLEN STREET
IRON WHARF PLACE
PYRMONT BRIDGE ROAD
WATTLE CRESCENT
BRIDGE ROAD
WESTERN DISTRIBUTOR
JONES LANE
HARRIS STREET
PYRMONT STREET
DARLING DRIVE
FIG STREET
FIG LANE
WATTLE STREET
HENRY AVENUE
JONES STREET
QUARRY LANE
QUARRY STREET
KIRK STREET
MORIARTY WALK

Stage 2 Sites
Cadastral

Hydraulic Hazard

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6 - Unsafe for vehicles and people. All building types consider vulnerable to failure

0 150 300 m

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FIGURE 2.12
AREA B
PEAK HYDRAULIC HAZARD
PMF EVENT

N

PYRMONT BRIDGE ROAD
WATTLE CRESCENT
BRIDGE ROAD
BULWARA ROAD
ADA PLACE
ALLEN STREET
WESTERN DISTRIBUTOR
JONES LANE
IRON WHARF PLACE
PYRMONT STREET
HARRIS STREET
DARLING DRIVE
MORIARTY WALK
WATTLE STREET
FIG STREET
FIG LANE
HENRY AVENUE
JONES STREET
QUARRY LANE
QUARRY STREET
KIRK STREET

4.7
4.7
4.2
4.3

Stage 2 Sites
Cadastral

Hydraulic Hazard

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for vehicles
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6 - Unsafe for vehicles and people. All building types consider vulnerable to failure

0 150 300 m

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FIGURE 2.13
AREA C
PEAK FLOOD DEPTH
10% EVENT

WILLIAM HENRY STREET
PARBURY LANE
HENSON LANE
BULWARA ROAD
HACKETT STREET
4.4
OMNIBUS LANE
SYDSTRUM STREET
HARRIS STREET
STEAM MILL LANE
LITTLE HAY STREET
TUMBALONG BOULEVARD
HAY STREET
QUAY STREET
DARLING DRIVE
DARLING DRIVE
WATTLE STREET
MACARTHUR STREET
JONES STREET
MCKEE STREET
WATTLE LANE
MARY ANN STREET
ULTIMO ROAD
THOMAS STREET
BAY LANE
BAY STREET
KELLY STREET
MOUNTAIN STREET
BLACKWATTLE LANE
WEST END LANE
MOUNTAIN LANE
KETTLE LANE

N

Stage 2 Sites
Cadastral
Flood Level Contour (1m Intervals)

Depths (m)
- <= 0.15
- 0.15 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

0 150 300 m

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FIGURE 2.14
AREA C
PEAK FLOOD DEPTH
1% EVENT

WILLIAM HENRY STREET
PARBURY LANE
HENSON LANE
BULWARA ROAD
HACKETT STREET
4.4
OMNIBUS LANE
HARRIS STREET
SYSTRUM STREET
STEAM MILL LANE
TUMBALONG BOULEVARD
HAY STREET
QUAY STREET
DARLING DRIVE
ULTIMO ROAD
THOMAS STREET
MARY ANN STREET
JONES STREET
MCKEE STREET
WATTLE LANE
WATTLE STREET
MACARTHUR STREET
BAY LANE
BAY STREET
BLACKWATTLE LANE
KELLY STREET
MOUNTAIN STREET
MOUNTAIN LANE
WEST END LANE
KETTLE LANE

N

Stage 2 Sites
Cadastral
Flood Level Contour (1m Interval)

Depths (m)
<= 0.15
0.15 - 0.30
0.30 - 0.50
0.50 - 1.00
1.00 - 2.00
> 2.00

0 150 300 m

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FIGURE 2.15
AREA C
PEAK FLOOD DEPTH
PMF EVENT

N

WILLIAM HENRY STREET
PARBURY LANE
HENSON LANE
BULWARA ROAD
HACKETT STREET
OMNIBUS LANE
STEAM MILL LANE
LITTLE HAY STREET
TUMBALONG BOULEVARD
HAY STREET
QUAY STREET
DARLING DRIVE
SYDNEY STREET
HARRIS STREET
WATTLE STREET
MACARTHUR STREET
JONES STREET
MCKEE STREET
WATTLE LANE
BAY LANE
BAY STREET
KELLY STREET
MOUNTAIN STREET
BLACKWATTLE LANE
WEST END LANE
MOUNTAIN LANE
KETTLE LANE
MARY ANN STREET
ULTIMO ROAD
THOMAS STREET
4.4

Stage 2 Sites
Cadastral
Flood Level Contour (1m Interval)

Depths (m)
- <= 0.15
- 0.15 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

0 150 300 m

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FIGURE 16
AREA C
PEAK HYDRAULIC HAZARD
1% AEP EVENT

WILLIAM HENRY STREET
PARBURY LANE
HENSON LANE
BULWARA ROAD
MACARTHUR STREET
HACKETT STREET
4.4
OMNIBUS LANE
SYDNEY STREET
HARRIS STREET
STEAM MILL LANE
LITTLE HAY STREET
TUMBALONG BOULEVARD
HAY STREET
QUAY STREET
DARLING DRIVE
OMNIBUS LANE
ULTIMO ROAD
THOMAS STREET
MARY ANN STREET
WATTLE STREET
MACARTHUR STREET
BAY LANE
BAY STREET
KELLY STREET
MOUNTAIN STREET
BLACKWATTLE LANE
WEST END LANE
MOUNTAIN LANE
KETTLE LANE
JONES STREET
MCKEE STREET
WATTLE LANE

N

Stage 2 Sites
Cadastral

Hydraulic Hazard

H1 - Generally safe for people, vehicles and buildings
H2 - Unsafe for vehicles
H3 - Unsafe for vehicles, children and the elderly
H4 - Unsafe for people and vehicles
H5 - Unsafe for vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure
H6 - Unsafe for vehicles and people.
All building types consider vulnerable to failure

0 150 300 m

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FIGURE 2.17
AREA C
PEAK HYDRAULIC HAZARD
PMF EVENT

WILLIAM HENRY STREET
PARBURY LANE
HENSON LANE
BULWARA ROAD
MACARTHUR STREET
HACKETT STREET
OMNIBUS LANE
SYDNEY STREET
HARRIS STREET
STEAM MILL LANE
LITTLE HAY STREET
TUMBALONG BOULEVARD
HAY STREET
QUAY STREET
DARLING DRIVE
ULTIMO ROAD
THOMAS STREET
MARY ANN STREET
MCKEE STREET
WATTLE LANE
JONES STREET
WATTLE STREET
BAY LANE
BAY STREET
KELLY STREET
MOUNTAIN STREET
BLACKWATTLE LANE
WEST END LANE
MOUNTAIN LANE
KETTLE LANE
4.4

N

Stage 2 Sites
Cadastral

Hydraulic Hazard

H1 - Generally safe for people, vehicles and buildings
H2 - Unsafe for vehicles
H3 - Unsafe for vehicles, children and the elderly
H4 - Unsafe for people and vehicles
H5 - Unsafe for vehicles and people.
All buildings vulnerable to structural damage.
Some less robust building types vulnerable to failure
H6 - Unsafe for vehicles and people.
All building types consider vulnerable to failure

0 150 300 m

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FIGURE 2.18
FLOOD FUNCTION
1% AEP EVENT

PIRRAMA ROAD
REFINERY DRIVE
BOWMAN STREET
JONES BAY ROAD
PIRRAMA ROAD
HARRIS STREET
PYRMONT STREET
BANK STREET
WESTERN DISTRIBUTOR
LITTLE MOUNT STREET
HARRIS STREET
EXPERIMENT STREET
BULWARA ROAD
ADA PLACE
MURRAY STREET
DARLING DRIVE
COOK STREET
FORSYTH LANE
FERRY ROAD
FERRY LANE
BRIDGE ROAD
DARLING STREET
WATTLE STREET
ADA PLACE
PYRMONT STREET
MORIARTY WALK
HACKETT STREET
JONES STREET
WATTLE STREET
SYDNEY STREET
HARRIS STREET
DARLING DRIVE
MCKEE STREET
WATTLE LANE
QUEEN STREET
CROWN STREET
GLEBE STREET
GLEBE LANE
DERWENT LANE
DERWENT STREET

4.1
4.2
4.3
4.4
4.5
4.6
4.7
4.8

N

Stages 2 Sites
Cadastral
Hydraulic Category
Floodway
Flood Storage
Flood Fringe

0 300 600 m

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FIGURE 2.19

PIT BLOCKAGE SENSITIVITY
1% AEP EVENT
WITH HIGH BLOCKAGE



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FIGURE 2.20

CLIMATE CHANGE SENSITIVITY
SSP3-7.0 2100 1% AEP EVENT



DHCA IMPACT GRID:
2030 SSP3-7.0 1% AEP vs 2100 SSP3-7.0 1% AEP
BW IMPACT GRID:
1% AEP vs 0.2% AEP

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