Bank Street Park
Blackwattle Bay / Tjerruing

SSD-53386706

Appendix AF

Flood Risk and Impact Assessment (Mott MacDonald)

December 2023

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Infrastructure NSW

Bank Street Park

Flood Risk and Impact Assessment

November 2023

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Bank Street Park

Flood Risk and Impact Assessment

November 2023

Issue and Revision Record

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Executive summary

Mott MacDonald has been engaged in the preparation of a flood risk and impact assessment to support the Bank Street Park State Significant Development Application (SSDA). This report summarises the existing conditions and future development potential of Bank Street Park in terms of flood risk, with a focus on overland flow and emergency response. The study utilised a hydraulic model (TUFLOW) to perform flooding assessment along the watercourses and various overland flow paths on approach to Blackwattle Bay.

Various forms of flooding affect the area as described below. These descriptions focus on the 1% Annual Exceedance Probability (AEP) and the Probable Maximum Flood (PMF) magnitude events, with additional commentary on the minor storm events including the 5% AEP design storm for the local drainage network.

- **Pluvial**: Local intense storms of short duration do contribute to ponding through the local area and overland flows, typically conveyed through the road reserves.
- **Coastal:** Coastal flood events do not typically cause inundation of the park. However, along the foreshore lower areas are subject to elevated water levels from Blackwattle bay in isolated locations. These locations grow in extent and flood depth with the effects of climate change on sea levels.

Flood modelling of the existing conditions and developed scenarios reveal the flooding condition before and after park development, with mapping prepared and attached as Appendices. The constraints of the existing flooding regime have been met in order to limit potential impacts that may require mitigation. Features of the existing floodplain including hydraulic categorisation have been preserved such that impacts are determined to be acceptable.

Mitigation of flood impacts has been integrated into the design solution for park whereby existing flow paths have been largely maintained. Road reserves allow for excess flow in events with larger runoff volumes than the local pit and pipe system captures, with some upgrades to the pit and pipe system included in the design.

An appropriate flood emergency response is proposed to flooding conditions, which are typically worst in short flashy storm events as a result of the catchment scale and topography. The recommended strategy for emergency response in flood events is for evacuation, in accordance with advice from the NSW State Emergency Service (SES).

1 Introduction

1.1 Purpose of Report

The purpose of this report is to provide information on the existing flood risk conditions and design responses to address flood risk and impacts of the proposed design, to support a State Significant Development Application (SSDA) for a new waterfront public park within Blackwattle Bay, to be known as Bank Street Park (SSD-53386706). Bank Street Park is located at 1A-19 Bank Street, Pyrmont on the shoreline of Tjerruing Blackwattle Bay and adjacent areas of Blackwattle Bay.

1.2 Blackwattle Bay Precinct

Bank Street Park forms part of the Blackwattle Bay Precinct, which is an area of predominantly government owned land located on the western edge of the Pyrmont Peninsula and adjoining the waters of Blackwattle Bay as seen in Figure 1-1.

Figure 1-1 Blackwattle Bay Precinct

Source: INSW

The precinct was rezoned in December 2022 to facilitate a new mixed-use community, providing for around 2,000 new residents and 5,600 new jobs and creating a vibrant 24/7 economy. Updated planning and land use controls were incorporated into the Sydney Local Environmental Plan 2012, along with site specific design guidance in the Blackwattle Bay Design Guidelines.

A critical part of the Blackwattle Bay Precinct is the high quality public domain which includes a series of parks and open spaces connected by a foreshore promenade. Bank Street Park will bring new active and passive recreation uses into a unique park environment, catering for both existing and future communities in the vicinity.

1.3 Site Description

Bank Street Park is located at 1A-19 Bank Street, Pyrmont NSW within the City of Sydney local government area (LGA) and includes harbour development in Blackwattle Bay. The site area is

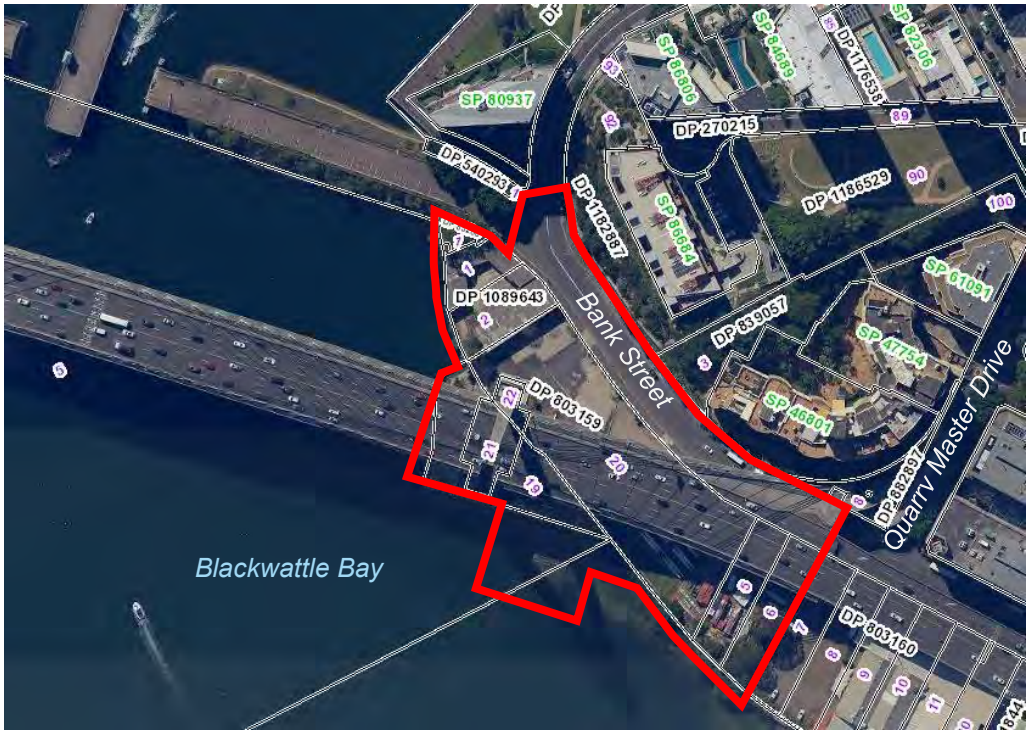
1.9 hectares, including 0.7 hectares of harbour. The relevant lot and deposited plans and the respective ownership for the site are detailed in Table 1-1 and shown in Figure 1-2.

Table 1-1 Summary of land title details of the site

Street address	Lot and Deposited Plan details	Ownership
1A Bank Street, Pyrmont NSW 2009	Lot 1 DP 85206 Lot 1 DP 188671	Transport for NSW
1-3 Bank Street, Pyrmont NSW 2009	Lots 1-2 DP 1089643 Lot 1 DP 439245	Infrastructure NSW
5 Bank Street, Pyrmont NSW 2009	Lot 20 DP 803159	Transport for NSW
7 Bank Street, Pyrmont NSW 2009	Lot 19 DP 803159	Transport for NSW
9 Bank Street, Pyrmont NSW 2009	Lot 21 DP 803159	Transport for NSW
11 Bank Street, Pyrmont NSW 2009	Lot 22 DP 803159	Transport for NSW
17-19 Bank Street, Pyrmont NSW 2009	Lots 5-6 DP 803160	Transport for NSW
Sydney Harbour	Lot 5 DP 1209992	Roads and Maritime Services (Transport for NSW)
Sydney Harbour	Lot 107 in DP 1076596	Transport for NSW
Part Bank Street road reserve	N/A	City of Sydney Council

Bank Street Park is located on Gadigal Land, one of the twenty-nine clans of the great Eora Nation. It adjoins the foreshores of Glebe to the west and Pyrmont Bridge Road and Wentworth Park to the south.

Figure 1-2 Site Context Map



Notes: The indicative site location is outlined in red.

Source: SixMaps with Architectus edits (2023)

Figure 1-3 Bank Street Park site location within Blackwattle Bay State Significant Precinct

Notes: The indicative site location is outlined in red.

Source: Blackwattle Bay Design Guidelines with Architectus edits (2023)

1.4 Proposed Development

Development consent is being sought for a *recreation area* for the primary purpose of a *public park*, comprising:

- Site preparation works, including tree removal, earthworks and remediation to facilitate proposed use;
- Demolition of three existing buildings at 1-3 Bank Street;
- New and adapted facilities for community use, including:
  - New single storey building to accommodate flexible community space, café, and marina office/store facilities, with green roof and photovoltaics;
  - Adaptive reuse of Building D for public amenities, bin and other storage;
  - Boat launching ramp and pontoon for passive watercraft, including dragon boats and kayaks;
  - Boat storage building with change facilities for dragon boat users with publicly accessible rooftop deck.
- Public domain works including:
  - 'Interpretation Garden' in existing building 'ruins' at 1-3 Bank Street;
  - Split level foreshore promenade;
  - Multi-purpose court with edge seating and partial fence;
  - Nature-based inclusive playspace for ages 2-12;
  - Fitness equipment;
  - Public plaza and grassed open space areas;
  - New tree plantings and planter beds;
  - Public art, wayfinding and interpretative signage, lighting, bike parking and seating;
- Harbour works including:
  - Overwater boardwalk;
  - Land/water interface works, including sandstone terracing into water and support structure, to improve marine habitat;
  - Demolition and construction of a new timber launching ramp for dragon boats;
  - Kayak/passive craft pontoon; and
  - Restoration, repair and alterations to the existing seawall for new stormwater outlets;
- Works to Bank Street road reserve, including:
  - Road space reallocation to provide separated cycleway;
  - Cycleway transition to Bank Street to continue south as part of future works;
  - Reinstatement of existing on-street parallel parking;
  - Tree planting;
  - Accessible parking space; and
  - Loading zone adjacent 1-3 Bank Street.

1.5 Planning Secretary's Environmental Assessments Requirements

This report has been prepared in response to the relevant requirements outlined within the Planning Secretary's Environmental Assessments Requirements (SEARs) issued on 11 May 2023 for application SSD-53386706. Table 2 addresses the relevant SEARs requirements and provides a project response.

Table 1.2: Secretary's Environmental Assessments Requirements

Item	SEARs	Relevant report section(s)
4	Consider how the proposed design responds to the context, site constraints (land contamination, hydrology, flooding, wind etc) site opportunities, access and circulation, heritage, character and visual amenity, character and spatial qualities for play and recreation, streetscape and existing and future character of the locality, including the interface with the water and future development of the Blackwattle Bay Precinct.	Refer section 1.7 for flooding and hydrology relevant discussion on the design response to the existing environment. The proposed design includes key grading and stormwater items which serve to achieve a more desirable flooding outcome than under existing conditions.
17	Identify flood risk on-site having regard to adopted flood studies, the potential effects of climate change, and any relevant provisions of the NSW Floodplain Development Manual. The assessment is to:	See sub-items.
	a. be prepared in consultation with council and any other relevant agency including NSW State Emergency Services.	Consultation presented in section 8.
	b. detail potential clashes with services, pipe cover, invert levels, and tidal non-return valves, and services.	This is addressed by the civil design report and associated engineering plans (Enspire, 2023).
	c. map flood prone land, flood planning areas below the flood planning level, hydraulic categorisation (floodways and flood storage areas), and flood hazards.	Refer mapping in the Appendices. Some mapping extracts and commentary is provided in section 6.
	d. flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 5% Annual Exceedance Probability (AEP), 1% AEP, flood levels and the probable maximum flood, or an equivalent extreme event. Sea level rise must also be considered for the 1% AEP flood event. In addition to rainfall-driven flooding, an assessment of estuarine inundation is required under future sea level rise conditions	Refer discussion on methodology in section1.8 and results of the assessment in section 6 (and associated climate change discussion in section 4).
	e. model the effect of the proposed development (including fill) on the flood behaviour including current flood behaviour for a range of design events as identified above. This includes the 0.5% and 0.2% AEP year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.	Refer discussion of results of the assessment in section 6 (and associated climate change discussion in section 4). Climate change scenarios and effects of the proposed development are mapped in the Appendices.
	f. detail the impacts of the development, including any changes to flood behaviour, including:	See sub-items.
	i. whether there will be detrimental increases in the potential flood affectation of other properties, assets, and infrastructure.	Refer section 6.2 for summary and flood impact mapping in the Appendices. There is generally a decrease in flood hazard, with no increases to other properties, assets and infrastructure.

Table 1.2: Secretary's Environmental Assessments Requirements

Item	SEARs		Relevant report section(s)
	ii.	consistency with council floodplain risk management plans.	The technical outputs of floodplain risk management plans and associated studies are summarised in sections 3.2 and 3.3, with the planning context discussed in section 5.1. The discussion of section 6.2 includes measures to achieve the consistency.
	iii.	compatibility with the flood hazard of the land.	Section 6.1 discusses the outcomes of the assessment of the design in terms of the resulting flooding conditions. Design is compatible with the flood hazard, preserving ponded areas, with a reduction in flood hazard generally.
	iv.	compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land.	Section 6.1 discusses the outcomes of the assessment of the design in terms of the resulting flooding conditions. Mapping extract indicates only flood storage and fringe in the 1% AEP. The Appendices include supporting mapping of hydraulic categorisation.
	v.	whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site.	Limited impacts anticipated from the development are discussed in section 6.2. Beneficial inundation of the floodplain doesn't occur in the vicinity of the site due to the heavily urbanised location and position immediately above the tidal receiving waterway of Blackwattle Bay.
	vi.	whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.	Refer section 7.1 and civil design report and associated engineering plans (Enspire, 2023) for discussion on the stormwater system mitigation.
	vii.	any impacts the development may have upon existing community emergency management arrangements for flooding.	Refer section 6.3 for discussion on emergency response. There is an improved evacuation opportunity after development occurs.
	viii.	whether the proposal incorporates specific measures to manage risk to life from flood.	Refer section 6.1 and 6.2 for discussion on flood risk management. Flood risk is largely limited to ponding in already established low points.
	ix.	emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event).	Refer section 6.3 and flood maps for evacuation in Appendices. Routes and flood risk for evacuation movements are detailed for developed conditions.
	x.	any impacts the development may have on the social and economic costs to the community as consequence of flooding.	Refer section 6.2 for the likely impacts to potential social and community consequences.

Input to the SEARs were sought from The Department of Planning and Environment's (DPE) Environment and Heritage Group (EHG) via email request on 12th January 2023. In response EHG assisted with a summary letter dated 25th January 2023, with the provision of standard

EHG SEARs which were integrated into the SEARs (above) and also specific advice on the Blackwattle Bay Precinct with a focus on the need for a technical response to:

- Precinct wide assessment including feasibility of stormwater upgrades including the stormwater configuration, refer Enspire (2023) civil design report and associated drawings.
- Flood modelling and mapping of a wide range of event magnitudes including smaller AEP events, refer appendix mapping.
- Consideration of both coastal flooding and rainfall driven flooding mechanisms and events through future climate scenarios, refer section 4.
- Emergency and evacuation discussions including consultation with NSW State Emergency Service (SES) on appropriate strategies, refer sections 6.3 and 8.

1.6 Previous Studies

- Bays West Stormwater & Flooding Report (Mott MacDonald, 2022)

  This study provides analysis and discussion on flooding conditions in a similar environ to Blackwattle Bay, including recommendations on climate change responses and the protection of infrastructure into future climate change scenarios.
- Blackwattle Bay Seawall Assessment (Mott MacDonald, 2022)

  This assessment informed the civil design aspects of the Bank Street SSDA and helped provide an understanding of the coastal interaction of the development on the foreshore of Blackwattle Bay.
- Blackwattle Bay SSP – Flood Risk and Impact Assessment (Mott MacDonald, 2023)

  This precinct wide assessment was developed in consultation with the State Emergency Service (SES) and EHG and was conducted in response to advice from stakeholders on the importance of a precinct wide detailed assessment of the potential impacts of precinct development. Bank Street Park is included within the scope of the precinct study and is covered under the planning and discussion of important precinct considerations including emergency response and evacuation arrangements.
- City of Sydney Council Blackwattle Bay Catchment Flood Study and Floodplain Risk Management Study (WMAwater, 2015)
- City of Sydney Council Blackwattle Bay Catchment Flood Study Model Update – ARR2019 Hydrology (WMAwater, 2020)
- Flood Protection Elevations for Conceptual Design, The Bays (Mott MacDonald, 2021)
- Flooding and Water Quality Assessment Report, New Sydney Fish Market Concept Design, Stage 1 and Stage 2 (Cardno, 2019)
- Water, Riparian Land, Flooding and Stormwater Study, Blackwattle Bay State Significant Precinct (Cardno, 2021)

1.7 Precinct Objectives

The Blackwattle Bay Design Guidelines includes objectives and provisions relating to flooding to ensure that proposed development is targeted to avoid flood impacts and provide a net improvement in the management of flood risk. The objectives of this study are aligned with the guidelines to address these matters relating to flooding. Specific Bank Street provisions within the guidelines give further direction around the management of existing flood hazard and specifically mitigation of impacts to ensure no increase in off site flooding due to the development in the precinct. Objectives as identified in the design guidelines as they relate to flooding:

- Manage stormwater to minimise flooding and reduce the effects of stormwater pollution on receiving waterways [4f]
- Ensure that development above the flood planning level as defined in the Sydney Local Environmental Plan (LEP) 2012 will minimise the impact of stormwater and flooding on other developments and the public domain both during the event and after the event. [4g]
- Ensure that flood risk management addresses public safety and protection from flooding. [4h]
- Mitigate identified risks of climate change and sea level rise [4k]
- Ensure development and infrastructure design is resilient to the effects of climate change [4m]

Table 1-3 provides the relevant section of this report where the assessment responds to the design guidelines provisions and details the future development approach which addresses each item. It is noted that the design guidelines provisions and SEARs have been developed to align with the flood planning requirements of Section 5.21 of the Sydney LEP (2012) and results in the Blackwattle Bay SSP – Flood Risk and Impact Assessment (Mott MacDonald, 2023) having responded to the objective of the LEP on a precinct scale. Note recent updates to guidance documents are noted where the previous guideline has been specified. Future development applications shall adopt the latest guidelines.

Table 1-3: Implementation of Blackwattle Bay Design Guidelines Provisions

ID	Development Type/Aspect	Relevant Assessment and Discussion
3.5 (7)	Public open space design must consider flood impact and sea level rise considerations informed by flood modelling, including assessment of impacts and any mitigation required.	Refer methodology for assessment of flood impacts and climate affects in sections 1.8 and 4, and project assessment and mitigations in section 6.
4.6 (1)	A precinct-wide Flood Risk and Impact Assessment is to be prepared by Infrastructure NSW prior to the lodgement of the first Development Application in the precinct. The study should: a. be prepared in accordance with the NSW Flood Prone Land Policy, the principles of the Floodplain Development Manual 2005, the Considering flooding in land use planning guidelines 2021 and any adopted flood study and/or floodplain risk management plan prepared by the City of Sydney Council b. to identify precinct-wide flood and risk mitigation for individual sites, public and open space c. consider additional duration frequency flood events d. consider emergency response and consultation with the SES e. be prepared in consultation with Environment and Heritage Group	Refer relevant sections for each sub-item below: a. Standards and guidelines described in section 5.1 including Council flood risk management study and plan considerations. b. The design for mitigation of flood hazard described in section 6.2. c. Section 3.3 provides discussion on flood duration and identification of critical events d. Emergency response considerations are discussed in section 6.3. e. Consultation discussion and outcomes are provided in section 8.
4.6 (2)	Development, including public and open spaces such as roads and parks are to be designed to comply with: a. any site-specific recommendations from the Flood Risk and Impact Assessment required in 1 above b. ensure there is no net loss in flood storage or floodway area because of the development c. all floor levels are to be at or above the Flood Planning Level identified in an adopted flood study and/or floodplain risk management plan prepared in accordance with the principles of the Floodplain Development Manual 2005 as adopted by the relevant Council, or as otherwise	Refer relevant sections for each sub-item below: a. These are identified in this report. b. Discussion on the hydraulic function of the area is included in section 3.4.1. With considerations of hydraulic categorisation in Table 3-3. c. Future floor levels discussed in section 5.2.

ID	Development Type/Aspect	Relevant Assessment and Discussion
	determined through a site-specific flood study prepared in consultation with Environment and Heritage Group d. notwithstanding 2b above, consideration may be provided to some or all of the non-residential floor levels having a freeboard of less than 500 mm above the 1% AEP flood level provided that satisfactory flood proofing is achievable to the Flood Planning Level. All entrances and evacuation routes servicing any residential components must be above the Flood Planning Level. e. Basement car parking must have all access and potential water entry points above the Flood Planning Level and provide a clearly signposted flood free pedestrian evacuation route from the basement area separate to the vehicle access ramps f. Where access to the water is to occur, a suitable edge treatment such as a stepped naturalised embankment between the promenade and water is to be provided to ensure access to water is maintained regardless of sea level.	d. Future floor levels discussed in section 5.2. e. Not applicable for the proposed development. f. Coordinated design of the promenade interface with Blackwattle Bay is noted in discussion of the stormwater strategy in section 7.1.
4.6 (3)	Potential flooding at Bank Street is to be mitigated to ensure no increase in off site flooding due to the development in the precinct. These measures may include, but are not limited to: a. upgrading existing and/or new drainage to carry flows from the impacted area on Bank Street to the discharge outlet across the proposed Miller Street reserve b. providing overland flow path at the rear of proposed development adjoining the impacted area on Bank Street to the discharge outlet across the proposed Miller Street reserve c. revisions to building layout to allow floodwaters to flow around the buildings to mitigate any predicted off-site impacts d. regarding Bank Street to introduce a flow path that connects the proposed flow path on the proposed Miller Street Reserve e. a combination of these measures, or other measures f. Flood mitigation and modification works must ensure they do not have an adverse impact on any surrounding property. The final mitigation design option is to be informed by consultation with Environment and Heritage Group and City of Sydney Council.	Refer relevant sections for each sub-item below: a. The stormwater strategy, for future stormwater system configuration is detailed in section 7.1. b. Mitigation through stormwater system and overland flow optimisation is described in section 6.2. c. Potential options for developers are subject to detailed assessment of off-site impacts. d. Mitigation through stormwater system and overland flow optimisation is described in section 6.2. e. The mitigated flooding outcome is documented in section 6.2
4.6 (4)	Development applications for new buildings are to be subject to a site-specific flood study prepared in accordance with the NSW Floodplain Development Manual 2005, the NSW Coastal Planning Guideline: Adapting to Sea Level Rise, NSW Coastal Risk Management Guide: Incorporating Sea Level Rise Benchmarks in Coastal Risk Assessments* and the NSW Flood Risk management Guide: Incorporating Sea Level Rise Benchmarks in Flood Risk Assessments*. The study is to include, but not limited to: **a.** a detailed topographical survey that defines flow paths, storage areas and hydraulic controls; **b.** flood modelling that uses appropriate hydrological and hydraulic techniques and incorporates boundary conditions **c.** relevant recommendations and/or mitigations from the precinct-wide Flood Risk and Impact Assessment required in 1 above The site-specific flood study is to show pre-development and post-development scenarios, and at a minimum is to include water surface contours, velocity vectors, velocity and depth product	This provision outlines the need for future development applications to consider this Flood Risk and Impact Assessment.

ID	Development Type/Aspect	Relevant Assessment and Discussion
	contours, delineation of flood risk precincts and flood profiles for the full range of events for total development including all structures and works.	
6.4 (4)	The location and siting of community and cultural uses must not result in the location of sensitive land uses in areas that can not effectively evacuate in the event of flooding.	Refer evacuation response discussion in section 6.3.

Source: Blackwattle Bay Design Guidelines, NSW Department of Planning and Environment 2023

Notes: * The NSW Flood Risk Management Manual 2023 supersedes the manual and guidelines listed as being relevant to development applications.

1.8 Assessment Methodology

This flood risk assessment develops an understanding of the flood risk profile across the precinct and guides the development to achieve good outcomes with regard to future development flood immunity, stormwater management and evacuation strategies. The following detailed breakdown describes the approach taken in this assessment:

- Review design guidelines along with statutory and industry guidance on floodplain management.
- Review and update the latest catchment flood study for site specific flood modelling assessment of the baseline conditions, adding scenario capability for assessment of future climate change conditions
- Develop design case scenarios representing the proposed development to assess potential flood impacts and refine the design in accordance with civil design principles for stormwater and flood risk management
- Align the future development design to meet site constraints and interfaces
- Prepare mitigation measures for integration to design for management of stormwater and flood risk
- Provide indicative stormwater infrastructure layouts and sizing to assess future underground stormwater conveyance needs
- Prepare assessment of the flood hazard under existing and developed conditions. Identify the hydraulic categorisation of the flood susceptible areas of the precinct. Provide commentary on the appropriate flood emergency response for the future development, incorporating the latest guidance on flood emergency planning, and potential flood evacuation arrangements.
- Document findings in Flood Risk and Impact Assessment report (this report), with preparation of supporting detailed flood map references.
- Adopt outcomes of the consultation with the DPE EHG and SES on the wider Blackwattle Bay Precinct flood risk management, including design principles and approach to development, and design for emergency response.

The following report sections provide discussions and outcomes of the assessments and consultation listed above.

2 Model Development

The study utilised a hydraulic model (TUFLOW) to perform a flooding assessment along the watercourses and various overland flow paths.

2.1 Existing Flood Study and TUFLOW Model

The City of Sydney has provided the TUFLOW model developed by WMAwater as part of the 2015 Blackwattle Bay Catchment Flood Study, and Floodplain Risk Management Plan. The model was supplemented with additional input and configuration data in 2020 to address updates for new data and rainfall methodologies released with the Australian Rainfall and Runoff Guideline (ARR) of 2019.

A review of the TUFLOW model and its accompanying reports was carried out to assess its validity and assumptions, to identify any limitations of the modelling and form the basis of modelling for the Blackwattle Bay SSP flooding assessment, and subsequently this Bank Street Park SSP site.

2.2 Updates to TUFLOW Model

The TUFLOW model was updated with new information, outlined below, to better predict the flood extents, levels, depths and flood hazards for the Bank Street Park.

Digital Elevation Model Update

The Digital Elevation Model (DEM) input to the TUFLOW model was updated with the latest information available for the new Sydney Fish Market development project. At the time of writing this project is under construction, with the final built form of the new structure and associated public domain applied to the existing scenario or baseline flooding assessment.

Rainfall Application

The rainfall application method to hydraulic modelling adopts pit based wetting of the model which distributes catchment inflow evenly across the pits within each catchment. With this approach the model is not wet at concentrated points in the lowest elevation of catchments. The selected approach is considered to provide a better representation given detailed pit/pipe data.

Hydrology Update for Climate Change

Climate change scenarios have been developed within the Council model taking the approach of proxy climate change events adopting higher rainfall intensities. This methodology aligned with discussions presented within ARR guidelines maintained, with discussion of the following events compared to the 1% AEP for sensitivity analysis on the changes due to rainfall intensity:

- 0.5% AEP, and 0.2% AEP, applied in combination with;
- sea level rise 1.3m, representing the shared socioeconomic pathway (SSP) 8.5 projections with the 2100 horizon.

Refer to **Section 4 Climate Change** for further discussion including rainfall intensity and tailwater conditions from Blackwattle Bay encompassing potential further sea level rise scenarios.

Critical Storm Selection

Additional short duration storms were configured for analysis in the model, given the study area is a smaller scale for this precinct flooding assessment than the wider Blackwattle Bay

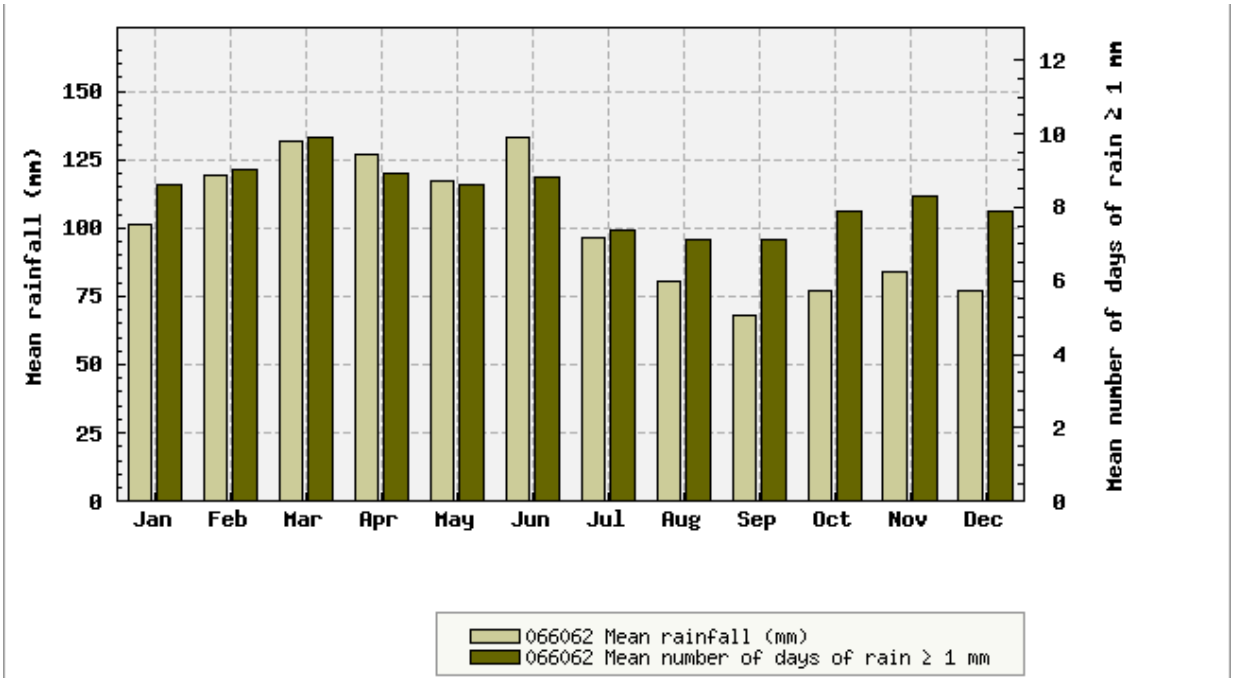
catchment. Typically 15min durations were added across various storm magnitudes to assess the worst case conditions in small catchments.

3 Existing Conditions

3.1 Climate and Topography

Monthly average rainfall statistics and temperature statistics from the nearby Observatory Hill weather station is presented below, indicating the local conditions. This location is selected due to the long history of recorded data, from 1859 to 2020.

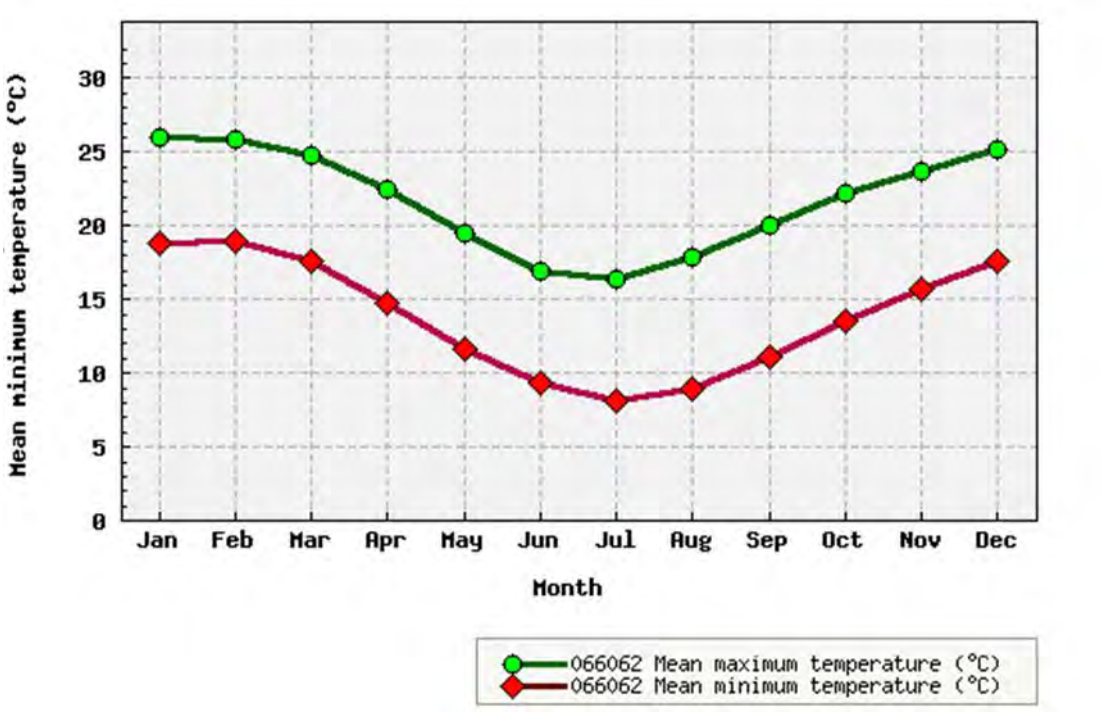
Figure 3-1: Average Monthly Rainfall and days over 1mm rainfall



Source: Australian Government, Bureau of Meteorology

The general trend in monthly rainfall totals is for larger total monthly rainfalls typically experienced during the first 6 months of the year through the Summer-Autumn-Winter period. There is also a trend to higher number of days exceeding 1mm of rainfall across this same 6 month period. The average monthly temperatures indicate Sydney's location as a coastal warm-temperate climate with average temperatures generally between 8 and 26°C.

Figure 3-2: Average Monthly Temperatures



Source: Australian Government, Bureau of Meteorology

3.2 Sources of Flooding

Various forms of flooding affecting the area are as described in the sections below. The resultant flooding varies in magnitude depending on the intensity of the storm event, combination of flooding sources and the base climate conditions that trigger the flooding. General descriptions below focus on the 1% Annual Exceedance Probability (AEP) or the Probable Maximum Flood (PMF) magnitude events to describe the flooded conditions.

3.2.1 Overland Flow

Local rainfall in the catchment is converted to runoff after falling on:

a) Impervious surfaces, and
b) Pervious surfaces in excess of the small rainfall amount that can infiltrate the soil.

Runoff accumulates in depressions in the topography, forming overland flow paths.

3.2.2 Coastal

Coastal flood events do not typically propagate far from the permanent extent of Blackwattle Bay to cause inundation of the precinct. The drainage of local storms via the pit/pipe system and overland flows are impeded at times when the water level in Blackwattle Bay rises during any coincident coastal flood events. The topography of the area results in this influence of Blackwattle Bay water level on the drainage systems being relatively minor, limited to the end of drainage infrastructure on immediate approach to the bay. The position of Blackwattle Bay is relatively protected from sources of wave set-up and the risk of tidal flood levels along the Blackwattle Bay foreshore are not sensitive to wave run-up influences.

Table 3-1: Design Still Water Levels for Fort Denison

% AEP	Design Still Water Level (m AHD)	Notes
1	1.45	
2	1.40	
5	1.38	Interpolated magnitude
10	1.35	
1 exceedance per year	1.25	Coincident with the Peak HHWS(SS)

Source: OEH Floodplain Risk Management Guide

The basis for the tidal conditions used in flood simulations are the adopted conditions within the previous Floodplain Risk Management Study. The design flood event scenarios for the 1% AEP flood adopts a 5% AEP ocean water level (approximately 1.38 mAHD in Sydney Harbour) coincidentally. The 5% AEP rainfall event is paired with an ocean water level of 1% AEP. For scenarios including climate change, the anticipated sea level rise is applied (added) to the relevant AEP harbour levels consistent with the SSP 8.5 2100 (upper bound of the 95% confidence interval) predictions.

Table 3-2: Coincident Tidal and Storm Flood Magnitudes

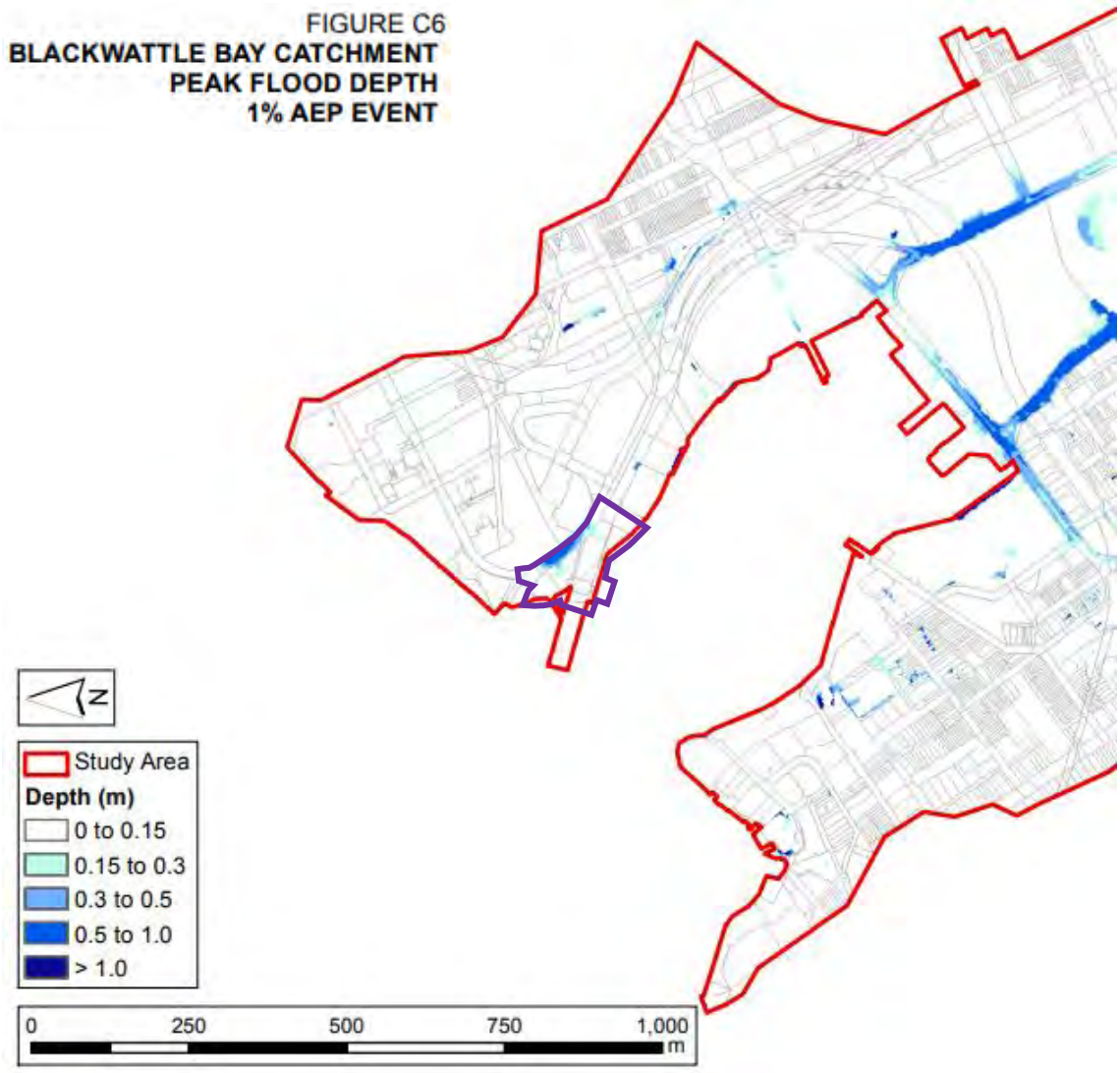
Storm Flood Magnitude	Tidal Boundary Condition
PMF	1% AEP tidal peak
0.2% AEP[1]	5% AEP tidal peak with 2100 elevated sea level
0.5% AEP[2]	5% AEP tidal peak with 2100 elevated sea level
1% AEP	5% AEP tidal peak
5% AEP	5% AEP tidal peak
10% AEP	Peak HHWS (SS)
20% AEP	Peak HHWS (SS)
0.5 EY	Peak HHWS (SS)

1. Climate change sensitivity of the 1% AEP with an approximate equivalent 23% rainfall uplift
2. Climate change sensitivity of the 1% AEP with an approximate equivalent 9% rainfall uplift

3.3 Regional Context

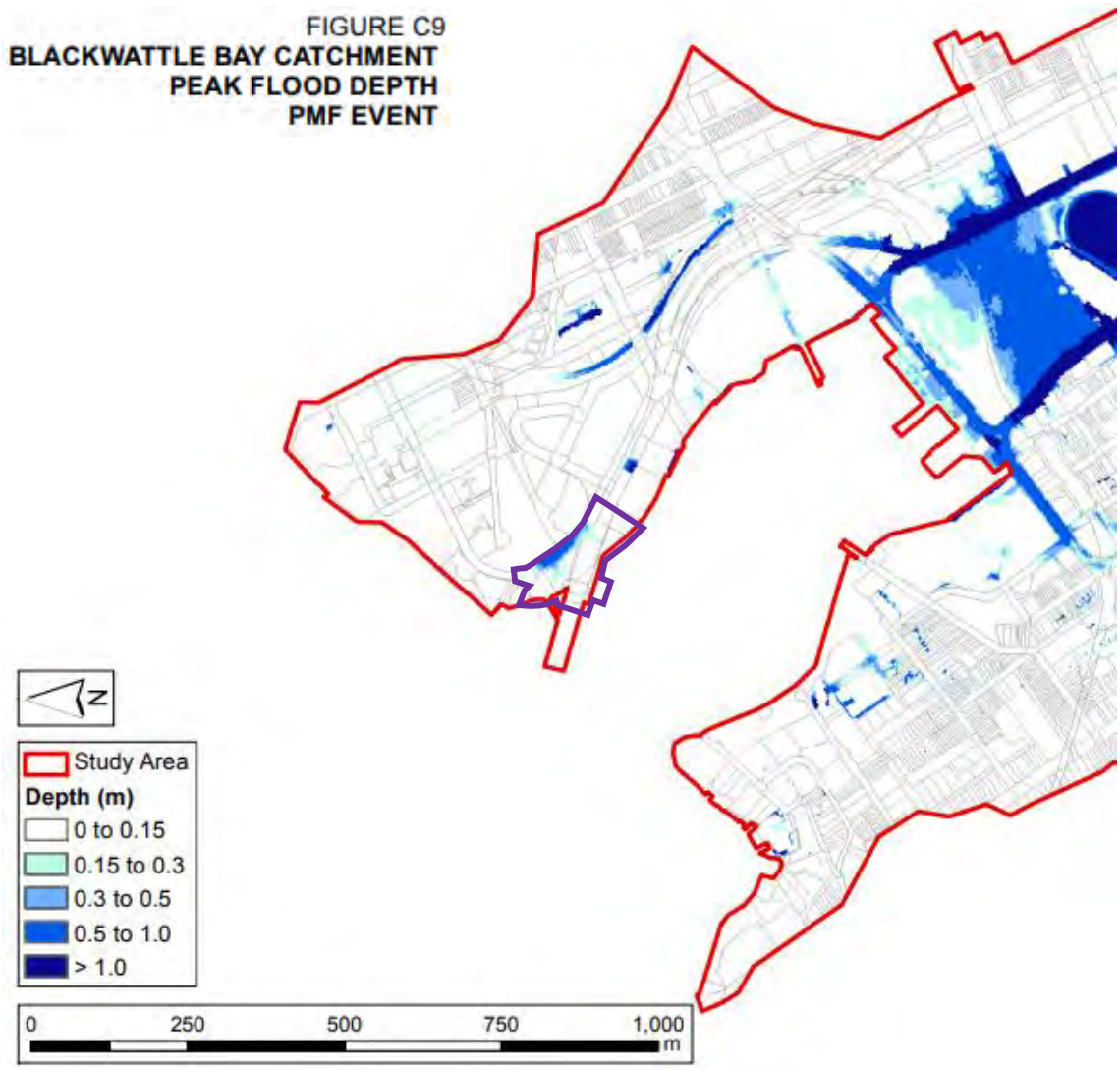
The following flood maps shows the flood impact of the 1% AEP and PMF events on the surrounding areas as per the Blackwattle Bay Catchment Flood Study (WMAwater, 2020). Due to the large scale of the regional catchment relative to the study area, map extracts have been reproduced here with a focus on the bay foreshore area. The approach to representation of flooding at the regional scale has shown depths less than 0.15m as transparent. Critical storm duration analysis in the regional assessment identified an envelope of 30 minute to 60 minute duration storms covered worst case flooding conditions for the majority of the catchment area. Whilst this assessment caters for the catchment wide flooding context, site specific duration assessment of flooding includes the 15 minute short duration storms as noted in section 2.2.

Figure 3-3: Existing Regional Flood Study – 1% AEP (extract)



Source: Blackwattle Bay Catchment Flood Study Model Update – ARR2019 Hydrology: Volume 2 (WMAwater, 2020)

Figure 3-4:Existing Regional Flood Study – PMF (extract)



*Source: Blackwattle Bay Catchment Flood Study Model Update – ARR2019 Hydrology: Volume 2 (WMAwater, 2020)*Flood Depth and Extent

The flooding experienced in the vicinity of Bank Street Park is typically overland flow and a result of short intense storms. Some trapped ponding locations continue to accumulate water in longer storms, however the vast majority of the study area is subject to the worst case flooding from overland flow only.

From review of the existing topographical conditions, the contributing catchment for the Bank Street road reserve is relatively small and worst case flooding conditions are likely from short duration storms with very high rainfall intensity. This is supported from inspection of the critical duration summary from the Blackwattle Bay Catchment Flood Study, with critical duration less than 60 minutes.

The following flood map indicates the worst case flooding in the 1% AEP under existing conditions, with the mapping an envelope result of multiple simulations to capture the range of conditions from short flashy storms to the longer duration events.

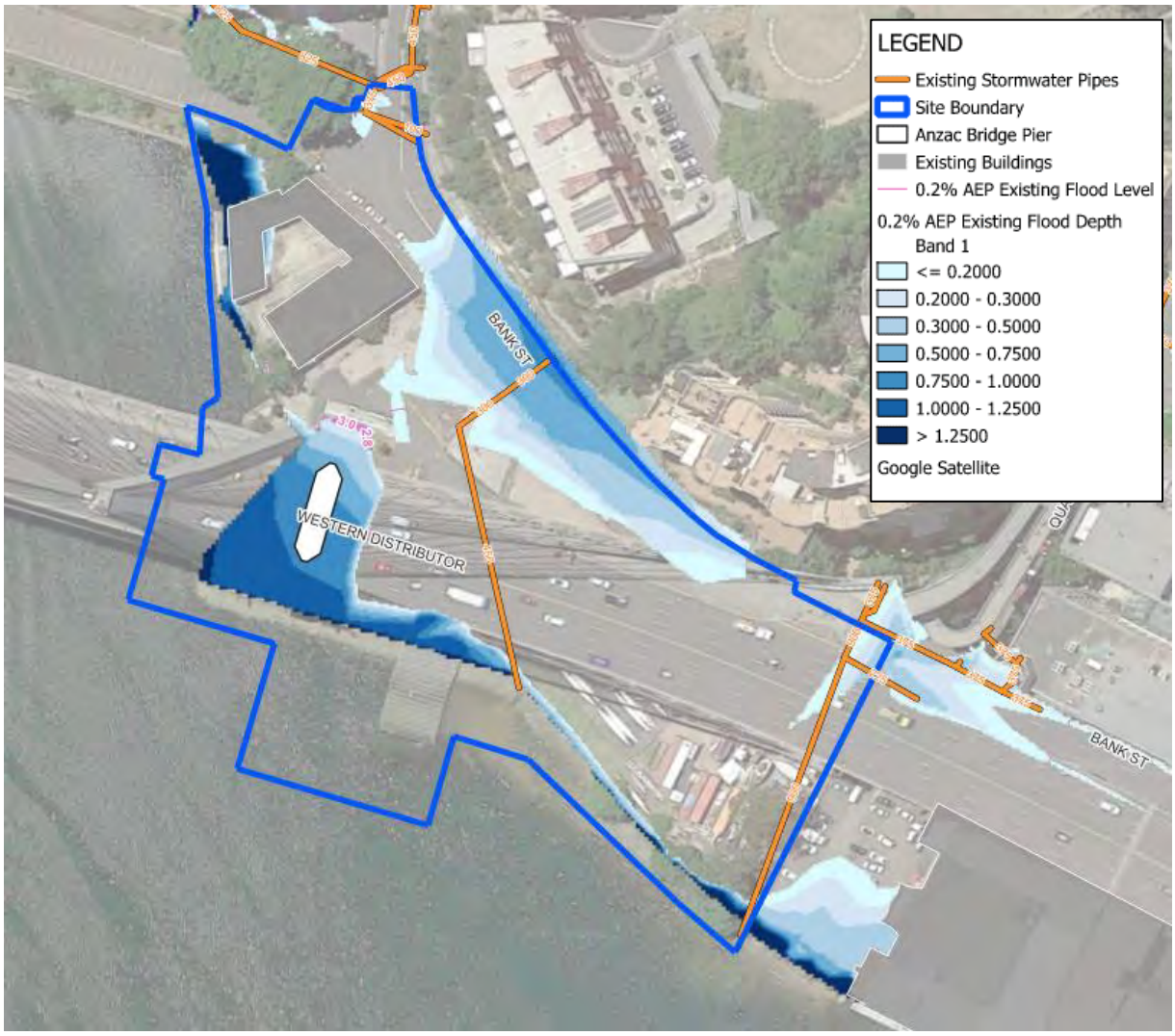
Refer to **Appendix A** for high resolution maps.

Figure 3-5: Existing 1% AEP Flood Depth

Source: Bank Street Park SSP Flood Risk and Impact Assessment

The predicted climate change conditions discussed in section 4 have been applied to the modelling and result in a future 1% AEP flooding condition as indicated below for the 23% uplift in rainfall intensity projected conditions.

Figure 3-6: Existing 1% AEP Flood Depth with climate change



Source: Bank Street Park SSP Flood Risk and Impact Assessment

3.4 Constraints

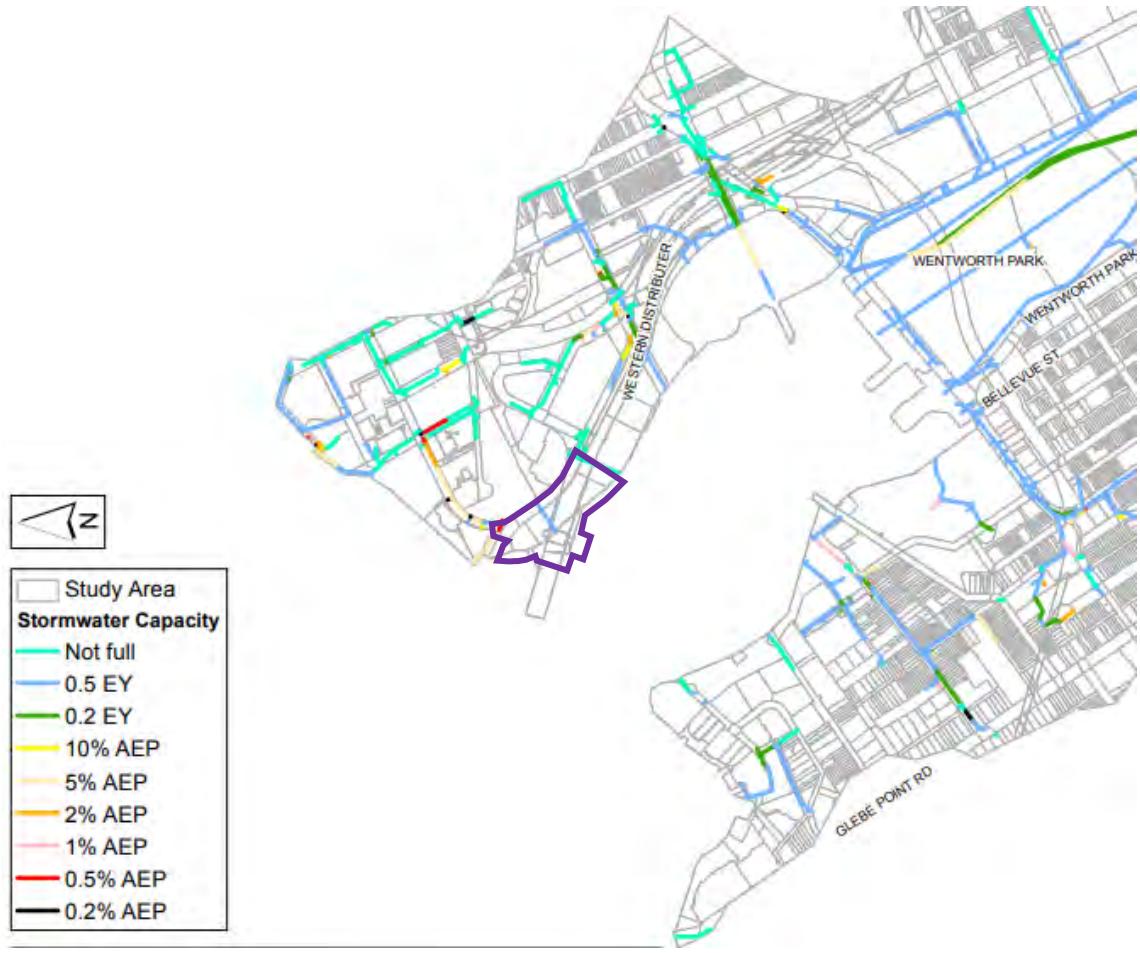
3.4.1 Hydraulic constraints

The urban drainage network in the vicinity of Bank Street Park comprises traditional pit and pipe systems which convey flow of the original watercourses which ran into Blackwattle Bay before development.

The local pipe system owned by Council typically addresses nuisance ponding and collects local overland flow from the street network. Tailwater conditions from Blackwattle Bay provide a variable downstream condition for the urban drainage network including these major culverts.

The tailwater condition of the tidal plane within Blackwattle Bay is a key constraint to the stormwater system provision for future development, particularly with future sea level rise. Any detailed pipe design by future developers should cater for this constraint to discharge flows at times of high tides/storm tides.

Figure 3-7: Constraints in pipe system capacity



Source: Blackwattle Bay Catchment Flood Study Model Update – ARR2019 Hydrology: Volume 2 (WMAwater, 2020)

Bank Street Park sits adjacent a low capacity pipe (0.5 EY) as identified in the Blackwattle Bay Catchment Flood Study, with a relatively large catchment draining to the sag position. Council's flood model indicates a 225mm diameter pipe draining this sag in the road reserve is undersized and results in ponding from the smallest of flood events (0.5 EY). Detailed survey of the area has confirmed the pipe diameter crossing the road is 300mm, connected to a 450mm diameter pipe continuing through to the discharge at Blackwattle Bay. The catchment size draining to this location increases through the range of storm magnitudes; as the capacity of discrete upstream pipe systems are exceeded, larger upstream areas then overflow into the Bank Street sag. In major to extreme storm events the catchment is up to 5 ha once these upstream pipe systems become drowned. As noted in section 2.2, the flood model was updated to distribute water across all pits within each sub-catchment to approximate discrete building hydraulics connections to the stormwater system and allow surcharge of the piped system across the sub-catchment in events in excess of the piped system capacity.

Figure 3-8: Constraints in the Bank Street pipe system

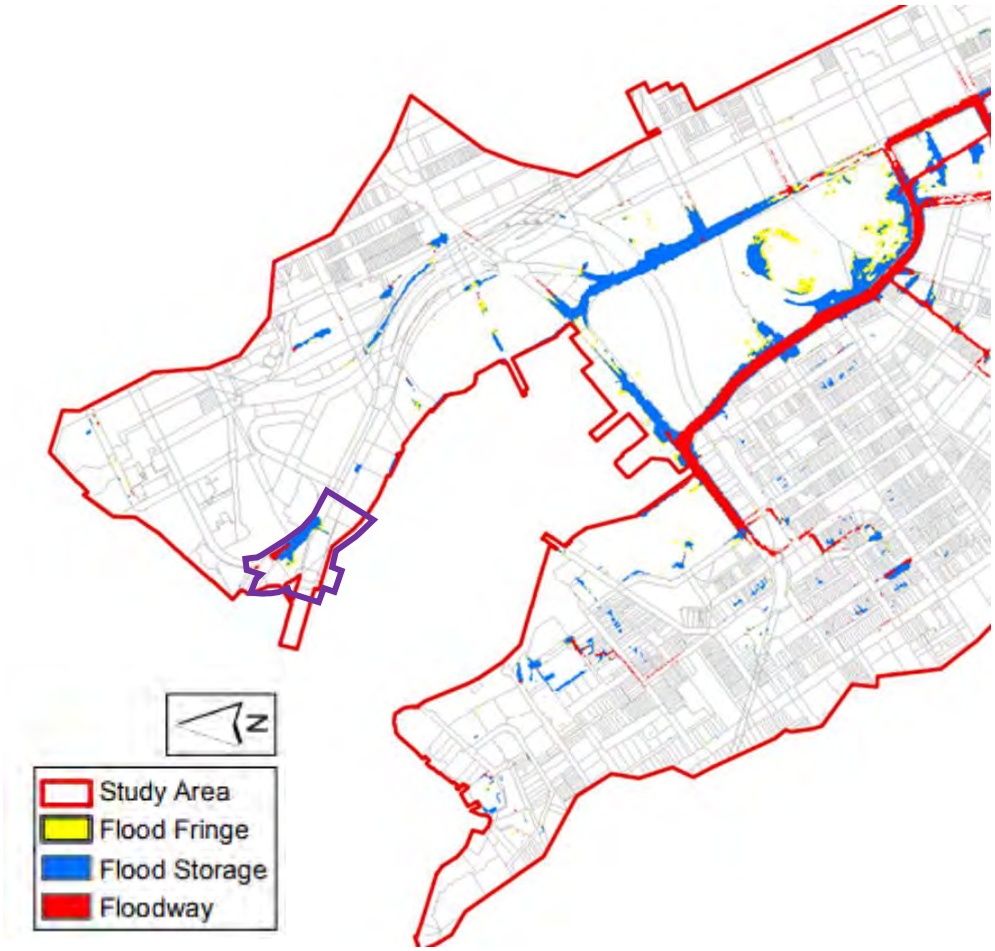
Source: Bank Street Park SSP – Flood Risk and Impact Assessment

3.4.1.1 Hydraulic Function (floodplain categorisation)

The topography of the local catchment area and the proximity to the Blackwattle Bay waterbody results in minimal areas that are classified as Flood Fringe, Flood Storage or Floodway. The regional catchment flood study identifies the Bank Street sag as an area of Flood storage, corresponding with the ponding discussed in section 3.3. Other small areas within the lot areas are not significant.

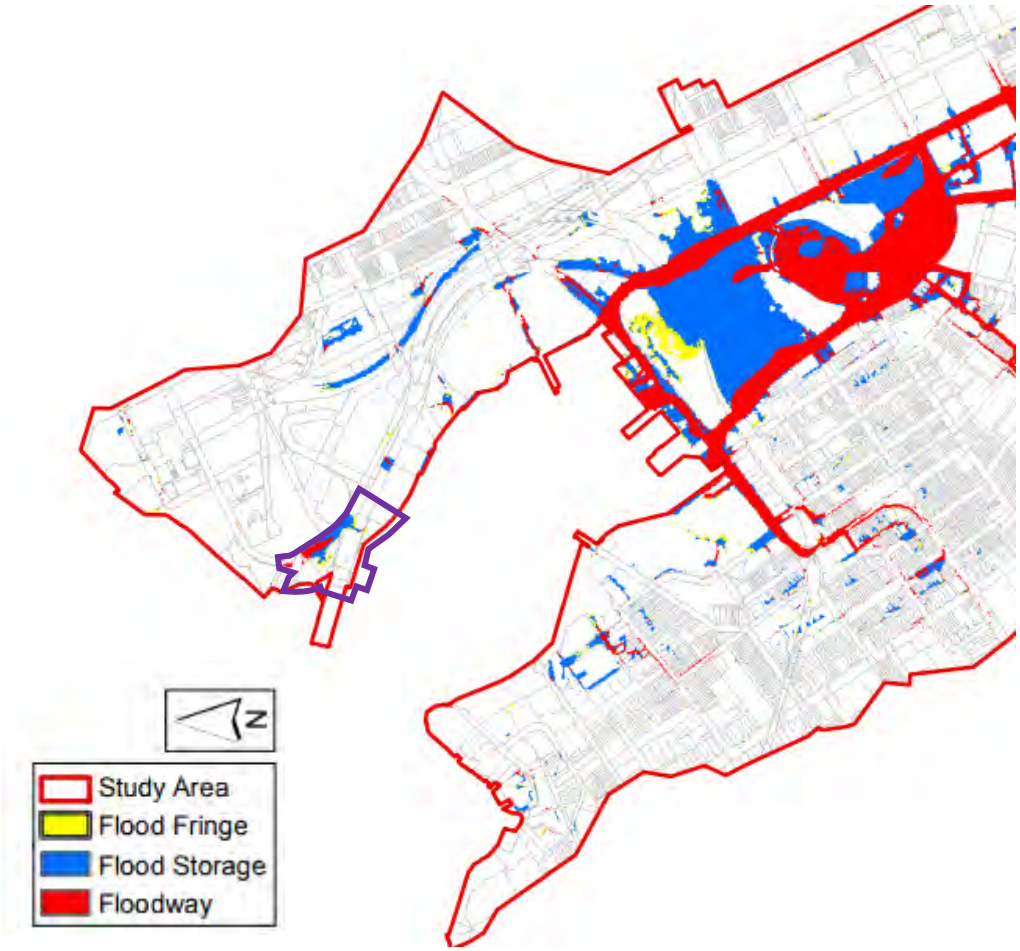
Due to the scale of mapping for the regional catchment study, a high resolution is not found when focussing on the site. Higher resolution floodplain categorisation is provided in Appendix Maps A.56 to A.60.

Figure 3-9: 1% AEP Hydraulic Categorisation



Source: Blackwattle Bay Catchment Flood Study Model Update – ARR2019 Hydrology: Volume 2 (WMAwater, 2020)

Figure 3-10: PMF Hydraulic Categorisation



Source: Blackwattle Bay Catchment Flood Study Model Update – ARR2019 Hydrology: Volume 2 (WMAwater, 2020)

The hydraulic categorisation of the land identifies important features of the floodplain including flow paths and flood storage, and effectively maps constraints to potential development that would be inconsistent with catchment objectives. The wider catchment objectives include;

- Only developing outside high flood hazard areas,
- Only developing in areas where flood impacts to adjacent properties is avoided,
- Only developing in accordance with flood planning directives, and
- Only developing where the appropriate emergency management procedures are feasible for development to achieve.

The general wider catchment principles can be summarised:

- Flood storage is preserved where it is required to minimise the potential peak flood effects on downstream areas, and
- Floodways are preserved such that the conveyance of flooded areas is not limited where reduced conveyance could compromise adjacent and upstream flooded areas.

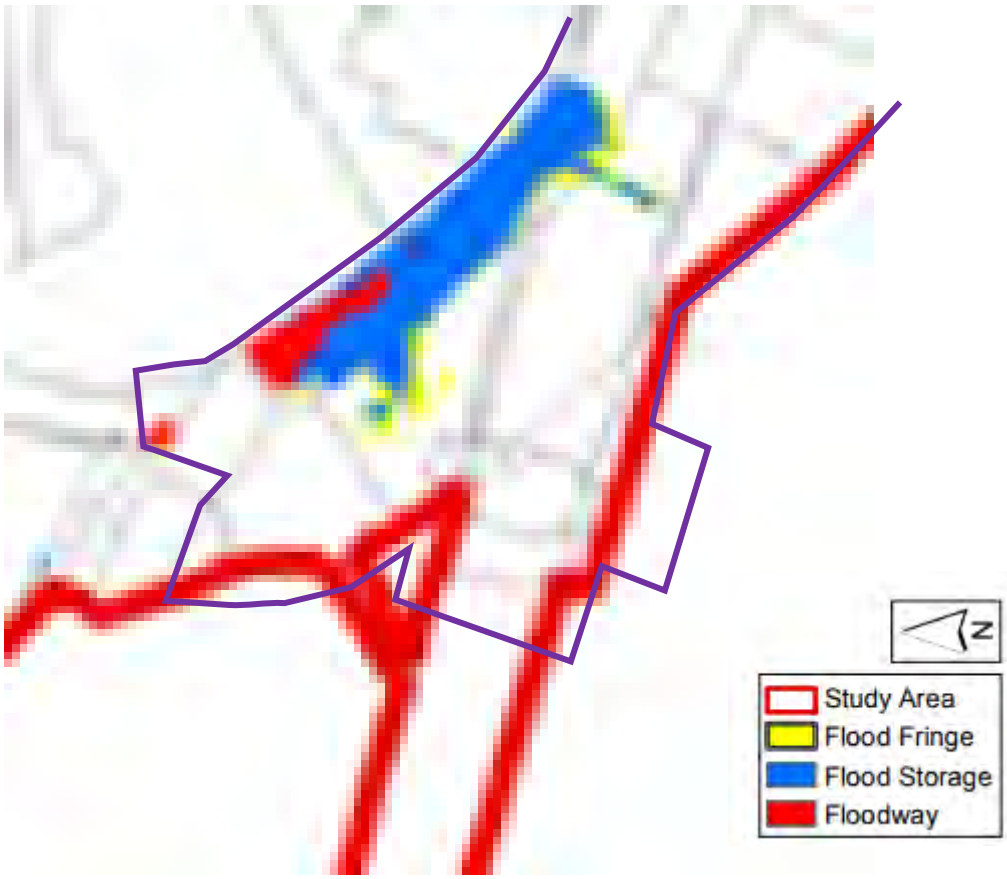
The following table summarises the hydraulic categorisation under existing conditions that has informed design of the park. The consideration was assessed through the design iterations to result in a developed scenario that responds to these hydraulic constraints. The developed scenario hydraulic (floodplain) categorisation is presented in Appendix A.

Table 3-3: Hydraulic Constraints

Location	Hydraulic Constraint	Event	Precinct Consideration
Bank Street sag point	Predominantly flood Storage with some Floodway	1% AEP	To be reduced through design. The Flood Storage and Floodway area is not beneficial to management of local or regional flood hazards.
	Flood Storage and Floodway	PMF	
Bank Street and adjacent lot areas	Minimal areas of flood storage	1% AEP	To be eliminated through design. Flood fringe, storage or floodway areas are not beneficial in managing local or regional flood hazards.
	Predominantly flood Storage with some Floodway	PMF	
	Flood Storage and Floodway	PMF	

Note: Summary here of the defining hydraulic categorisation in individual areas, with small or discrete areas of alternate hydraulic categorisation omitted where not significant for analysis.

Figure 3-11: 1% AEP Hydraulic Categorisation – Site Focus



Source: Blackwattle Bay Catchment Flood Study Model Update – ARR2019 Hydrology: Volume 2 (WMAwater, 2020)

3.4.2 Environmental constraints

There are topographical constraints to the conveyance of stormwater by gravity along the precinct foreshore towards the Bank Street Park as existing surface levels vary considerably. There is a trapped low-point within the road reserve of Bank Street that is a key consideration of hydraulic hazard and the design incorporates mitigation of this known constraint in section 6.2.

4 Climate Change

Climate change guidance from the Australian Rainfall and Runoff (2019) documentation refers to research undertaken in developing an interim recommendation to factor rainfall based on temperature scaling. The recommended methodology outlined in Understanding and Managing Flood Risk (DPE, 2023) is to:

a) adopt temperature projections from the CSIRO future climates tool, and apply 7% change in rainfall intensity for each degree of change in mean temperature, or
b) select larger magnitude floods (ie. 0.5% and 0.2% AEP) for use as proxy climate change events for the 1% AEP flood magnitude.

Sea level projections are recommended based on the International Panel on Climate Change's (IPCC) Sixth assessment report changes in mean sea level guidance. These projections were used to derive factors, applied to specific climate change scenarios in the flood modelling, to reveal flooding responses under future climate change conditions.

4.1 Sea Level Rise

The 95% confidence interval projection for the shared socioeconomic pathway (SSP) 8.5 for sea level rise to the year 2100 was selected for the wider Blackwattle Bay precinct as it is a broad scale rezoning. These projections are documented in the IPCC Assessment Report 6 (AR6) data (DPE, 2023). This latest projection exceeds the previous CoastAdapt guidance which is approximately 0.9m, for the year 2090.

Further rises beyond this outlook, to 2150, are also provided within the IPCC report with a wider range of sea level rise beyond 2m in the upper bound of the 95% confidence interval. The planning response to the uncertainty of projections is discussed in section 4.3.

Tailwater conditions

The elevated sea level has been applied through tidal curves at the downstream boundary conditions of the flood model to simulate the effects of the tidal behaviour under future conditions.

Backwater flooding

Backwater flooding events occur when the dominant source of flooding is downstream of the area of interest and not predominantly a function of the urban overland flows. An extreme tidal surge event is one such scenario whereby extreme sea levels produce flooding of the lower lying areas of land from Blackwattle Bay.

4.2 Rainfall intensity changes

The Australian Rainfall and Runoff guidance on rainfall intensity is to use the conservative RCP 4.5 and 8.5 projections on climate futures and directs practitioners to the Bureau of Meteorology's datahub tool for rainfall intensity increase projections. For this region of NSW coast, the projection for 2090 is an increase in rainfall intensity of 19.7%. As a comparison the 7% uplift approach for each degree of warming detailed by DPE (2023) results in a 26% increase by 2090 for the East Coast South region.

The approach adopted in this study is to assess the 0.5% AEP and 0.2% AEP events relative to the 1% AEP to give a range of conditions to be expected under future scenarios with increased temperatures resulting in the rainfall uplift. General increases in rainfall from the 1% AEP to the

larger 0.5% and 0.2% AEP events are approximately 9% and 23% increases in rainfall intensity respectively.

4.3 Planning response

The design guidelines for the precinct provide recommended Development Application requirements for new buildings. The application is:

- to be subject to a site-specific flood study prepared in accordance with;
  - the NSW Floodplain Development Manual 2005,
  - the NSW Coastal Planning Guideline: Adapting to Sea Level Rise, NSW Coastal Risk Management Guide: Incorporating Sea Level Rise Benchmarks in Coastal Risk Assessments* and
  - the NSW Flood Risk management Guide: Incorporating Sea Level Rise Benchmarks in Flood Risk Assessments*.

* The NSW Flood Risk Management Manual 2023 supersedes the manual and guidelines listed as being relevant to development applications.

- to include a flooding specific response that provides:
  - a detailed topographical survey that defines flow paths, storage areas and hydraulic controls;
  - flood modelling that uses appropriate hydrological and hydraulic techniques and incorporates boundary conditions
  - relevant recommendations and/or mitigations from the Flood Risk and Impact Assessment (this study).

Planning guidance on development is provided in Support for Emergency Management Planning guideline EW01 (DPE, 2023) and notes the key considerations in land use decisions which include the vulnerability of likely occupants, flood free locations for sheltering, the availability of services and structural adequacy of the development. These considerations have been taken into account in deriving the recommendations for Flood Planning Levels (FPL) in this assessment and also the development of the emergency response strategy.

Recommendations in this report adopt floor levels that are derived from the 2090 climate horizon 1% AEP flooding conditions, with critical infrastructure or below ground floor areas subject to a higher protection level (larger magnitude flood) than the FPL for ground floors. Refer section 5.2 for further discussion on planning controls.

Responses to ongoing sea level rise (beyond 2100) include both adaption and avoidance techniques to address the challenge of future sea levels and various risks including inundation or flooding resulting from storm surge and/or local rainfall driven flooding. Avoidance techniques are typically conservative in their approach. These techniques have the benefit of reducing the likelihood of future costly adaption exercises, but potentially front load development costs.

Table 4.1: Climate Change Avoidance and Adaptation

Avoidance Techniques	Adaptation Techniques
Raising development FPLs for development proposals in preparation for future sea level rise beyond the design life of the current proposed development	Staged uplift of development FPLs as development sites are updated/recycled

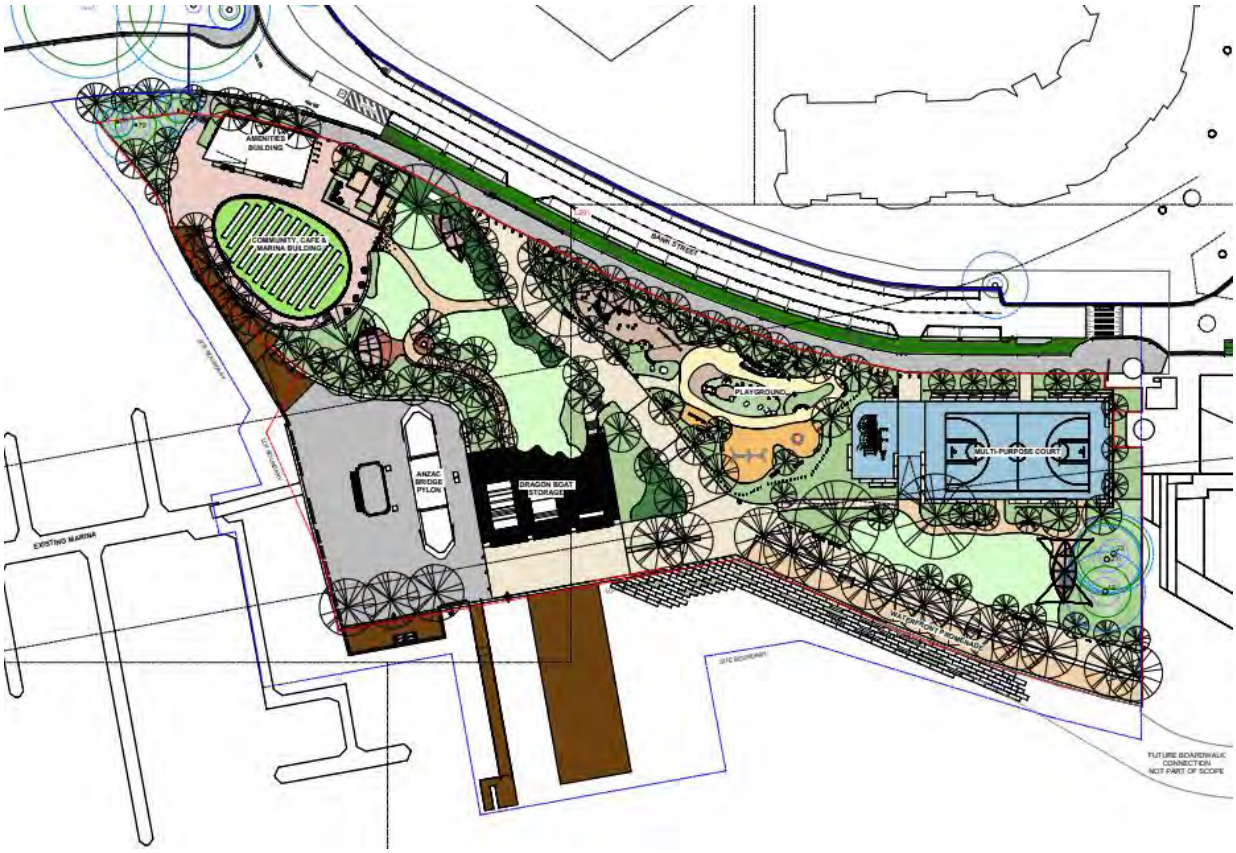
Avoidance Techniques	**Adaptation Techniques**
Retreat from vulnerable coastal areas	Respond to realised increases in sea levels over time with planning changes (rezoning or controls) on land use that reduce risk without requiring raising building levels *

*An example of this approach is the consideration of repurposing habitable floor levels where re-development is proposed after such time that freeboard is potentially compromised by continuing sea level rise

5 Redevelopment Opportunity

The site landscape plan is indicated in Figure 5-1, prepared by Oculus for the final design in coordination with the design team.

Figure 5-1: Bank Street Park landscape plan



Source: Bank Street Park SSDA Site Plan, Oculus

5.1 Current Planning Context

Current planning controls related to flood management are specified across the following documents:

- Blackwattle Bay Design Guidelines (2023)
- City of Sydney's Local Environment Plan (LEP) 2012;
- City of Sydney's Development Control Plan (DCP) 2012, not applicable to this SSD;
- City of Sydney's Interim Floodplain Management Policy (2014); and
- NSW State Government's Flood Prone Land Policy, including;
  - Standard Instrument (Local Environment Plans) Amendment (Flood Planning) Order 2021
  - Environmental Planning and Assessment Amendment (Flood Planning) Regulation 2021
  - State Environmental Planning Policy Amendment (Flood Planning) 2021

Clause 5.21 of Sydney LEP (2012) requires the consent authority to be satisfied that all proposed development adequately protects the safety of property and life, and avoids adverse

impacts on stormwater drainage, flood behaviour and the environment. Table 5-1 notes key items of the Flood planning clause and references to where it is addressed in this document.

Table 5-1: Sydney Local Environmental Plan 2012

Clause	Objective	Reference
5.21 (2)	Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development: a) is compatible with the flood function and behaviour on the land, and	Section 6.1 discusses the outcomes of the assessment of the design in terms of the resulting flooding conditions. The Appendices include supporting mapping of hydraulic categorisation.
	b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and	Section 6.2 addresses the mitigation of flood behaviour.
	c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and	Section 6.3 addresses the emergency response planning including evacuation considerations.
	d) incorporates appropriate measures to manage risk to life in the event of a flood, and	Sections 6.2 and 6.3 provide discussion on the mitigation of hazards and the response to an event.
	e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.	Refer section 7.1 and civil design report and associated engineering plans (Enspire, 2023) for discussion on the stormwater system mitigation.

To confirm that the development complies with these requirements this report identifies the flood planning levels for the development.

Council requires ancillary development issues to be considered in the assessment of proposed development of flood prone land of residential and industrial/commercial properties as summarised in Table 5-2. Whilst Council does not provide development approval for Bank Street Park, the controls are described below for information, and to indicate consistency in the approach to mitigation of flood impacts with the relevant planning conditions.

Table 5-2: Council Ancillary Requirements

Development Type/Aspect	Objective	Requirement
Industrial and Commercial Properties	f) To minimise the damage to industrial and commercial properties from flooding; and g) To minimise risk to human life from the inundation of industrial and commercial properties and to minimise economic cost to the community resulting from flooding	h) The City may consider merits-based approaches presented by the applicant. The proposed industrial or commercial buildings must meet the Flood Planning Level Requirements; and i) The proposed industrial or commercial development should not increase the likelihood of flooding on other developments, properties or infrastructure.
Filling of Flood Prone Land	j) To ensure that any filling of land that is permitted as part of a development consent does not have a negative impact on the floodplain.	k) Unless a floodplain risk management plan for the catchment has been adopted, which allows filling to occur, filling for any purpose, including the raising of a building platform in flood-prone areas is not permitted without Council approval. Application for any must be supported by a flood

Development Type/Aspect	Objective	Requirement
		assessment report from a suitably qualified engineer which certifies that the filling will not increase flood affection elsewhere.

Source: Section 5 of Council's *Interim Floodplain Management Policy (2014)*

In addition to the above requirements, the following building floor level requirements are to be met for Industrial/Commercial developments as per Council's *Interim Floodplain Management Policy (2014)*:

Table 5-3: Council Flood Planning Levels

Development Type/ Aspect	Objective	Type of Flooding	Flood Planning Level
Industrial / Commercial	Business	Mainstream or local drainage flooding	Merits approach presented by the applicant with a minimum of the 1% AEP Flood level.
	Retail Floor Levels	Mainstream or local drainage flooding	Merits approach presented by the applicant with a minimum 1% AEP flood. The proposal must demonstrate a reasonable balance between flood protection and urban design outcomes for street level activation.

Source: Council's *Interim Floodplain Management Policy (2014)*

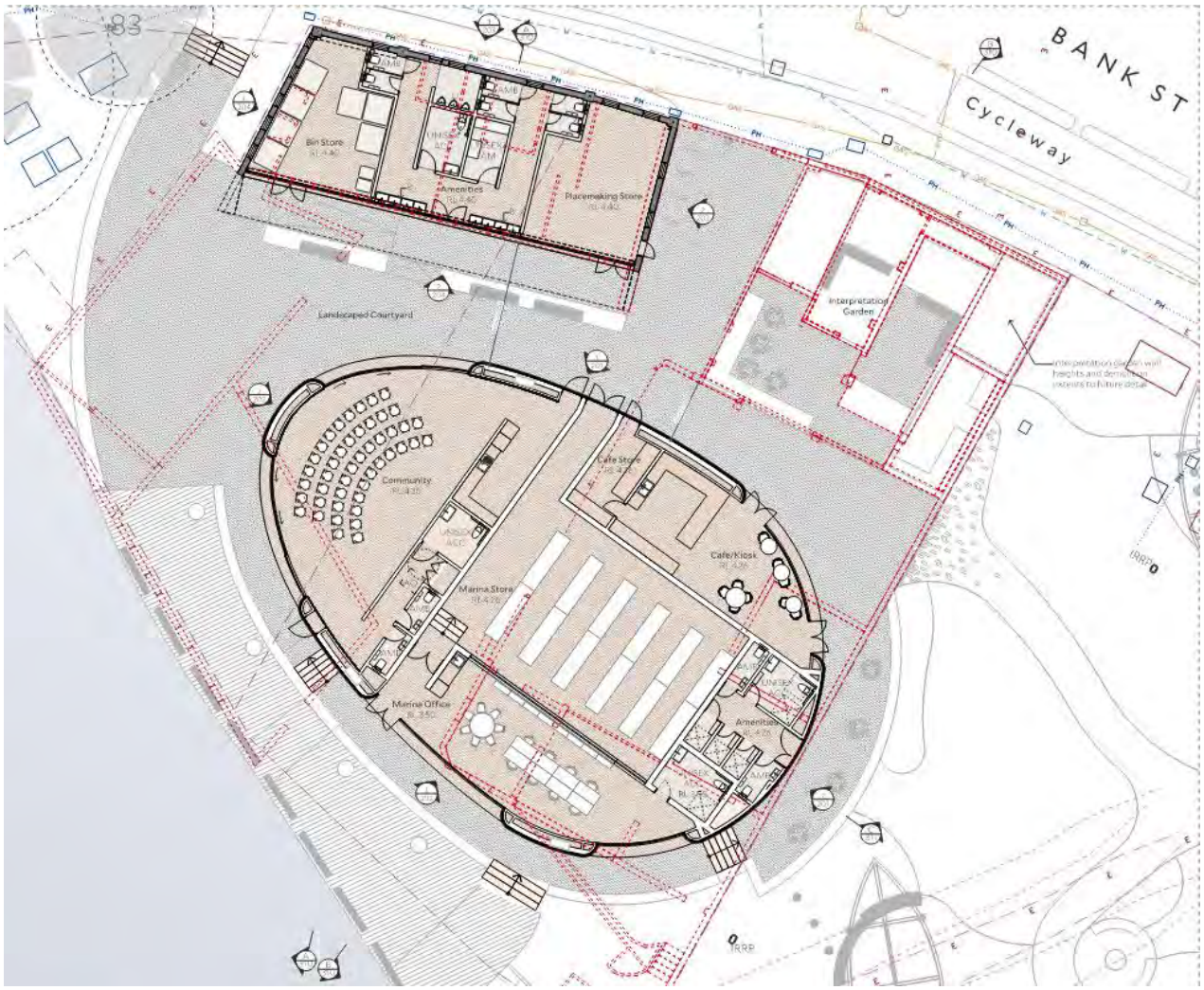
Building floor levels as designed by developers are typically assessed against flood levels from the Blackwattle Bay Catchment *FRMS* basis flood model held by Council. The FPL is the water surface level of the relevant 'planning flood' plus a freeboard. The "planning flood" for all development in all areas of the city is the 1% AEP event.

Recent amendments to the planning guidance including *Planning Circular 21-006* ensures planning proposals consider the flood risks and do not permit residential accommodation in high hazard areas and other land uses on flood prone land where the development cannot effectively evacuate. Approval authorities can develop Special Flood Considerations (SFC) for additional requirements in high hazard areas where additional emergency planning requirements are considered appropriate.

5.2 Future Planning Control

Future planning controls for floor level based around the opportunity to provide an increased amenity within the precinct are under development. A preliminary Flood Planning Level (FPL) assumes a 1% AEP flood level + 0.5m freeboard. This could be varied depending on the land use, but this initial FPL would apply to habitable floors of new structures. The reason for variation by land use is to ensure that the activation of the streetscape is consistent throughout the precinct, noting some areas are lower lying or subject to greater overland flows through the adjacent road reserve. The FPL (m AHD) indicated in Figure 5-2 below applies to the future development, protecting to the 1% AEP flood level in the 2100 climate horizon, accounting for 23% increase in rainfall intensity and sea level rise of 1.3m (upper end of the 95% confidence interval projections). This approach satisfies the relevant flood planning requirements for floor levels.

Figure 5-2: Floor Levels and Proposed Structures



Source: Bank Street Park Architectural Layout – Collins and Turner

5.2.1 Emergency Management

5.2.1.1 DRAFT guidelines for Shelter-in-place (SIP)

The following draft guidance has been prepared by DPE for NSW, and exhibited, but has not been adopted and doesn't reflect the preference of the SES for the emergency response strategy for flooding in new developments or rezoning. If adopted in the future it provides general principles when considering whether to apply SIP controls. Noting that evacuation off-site is always preferrable, SIP may be used where:

- The duration for flood inundation is less than six hours
- The development is not located in an area of high-risk (eg, floodways and H5 or H6 flood hazard areas)
- Access to on-site systems to provide power, water and sewerage services during and beyond the event for the full range of flooding
- The location of storage of food, water and medical emergency for SIP purposes should be above the PMF level and available during and beyond the event for the full range of flooding

- SIP floor level is above PMF
- SIP provides a minimum floor space per person
- SIP must be structurally safe and accessible during floods up to the PMF.

Education is critical to ensuring that the community is aware of actions to be taken before, during and after SIP and the key triggers that require SIP. If SIP is proposed there needs to be ongoing community education campaigns for the areas where SIP will apply.

As the areas surrounding Blackwattle Bay are also subject to the same local flash flooding driven flood hazards, there are similar safety concerns in regional evacuation routes as there are within the precinct itself. Emergency response arrangements of evacuation to local areas is discussed in section 6.3. Future developer designs may consider SIP as an option where the local evacuation route to safe refuge area is subject to flooding in short intense storms.

5.2.1.2 Support for Emergency Management Guideline

These guidelines provide information on the roles of stakeholders in emergency management and planning. The environment that is prone to flood hazard is broken into emergency response classifications of the community which guides the development of appropriate strategies to mitigate hazards.

Recommendations on planning decisions are provided to guide the future development of areas within or adjacent flood prone land to ensure that development is compatible with existing emergency response plans, and further plans are developed appropriately.

Residual risks of flood hazards throughout the precinct are to be treated with the following key considerations throughout the detailed design development:

- Limiting exposure of people to floodwaters, improving the grading of open spaces to manage overland flow
- Provision of adequate open spaces which are publicly accessible for the itinerant population

5.3 Water sensitive design options

The treatment of water quality, including water sensitive urban design is presented in the Bank Street Park SSDA Civil Engineering – Stormwater management Report (Enspire, 2023) and associated civil plans (220067-00-DA-C01.01 to C23.01).

5.4 Local nuisance areas

Within the urban drainage network there are locations of susceptibility to fairly regular nuisance flooding and in larger events, significant hazards to the community. Typically, these locations coincide with elements of the urban drainage network where the capacity of the infrastructure are low:

Bank Street sag point - ponding and overtopping into Blackwattle Bay

To address the ponding constraints within Bank Street the precinct guidelines and flooding provisions give direction as to possible treatment through infrastructure and design coordination:

- Upgrade existing and/or new drainage to carry flows from the impacted area on Bank Street to the discharge outlet across the proposed Miller Street reserve
- Provide overland flow path at the rear of proposed development adjoining the impacted area on Bank Street to the discharge outlet across the proposed Miller Street reserve

- Introduction of a relief flow path that connects ponded road reserve areas to designated low areas in Bank Street Park for overland flow
- The layout of proposed structures allows floodwaters to flow overland through the park to mitigate any potential off-site impacts

An overland flow corridor was established in preliminary designs (as exhibited) for the proposed development of Bank Street Park between Bank Street and Blackwattle Bay, north of the Western Distributor foundations and pier structure. This feature allows overflow from the Bank Street sag location with resulting flood levels within the sag of approximately RL 4.0m AHD.

A piped solution alone is not recommended due to the risk of blockage and residual overland flows, therefore the two measures in combination have been adopted. Providing a new 0.6m diameter pipe to drain the sag point has the capacity to freely drain the sag point.

6 Flood Modelling Results

The following discussion includes reference to flooding conditions that can be observed on the flood maps, provided as outputs of this study. All flood maps are available in **Appendix A**.

6.1 Design scenario results

The maps attached in Appendix A indicate the flooding conditions under the developed scenario. Changed flooding conditions indicate flow paths along the modified road reserve following the major-minor flow system. In this approach the overland flows that are in excess of the piped system follow the road reserve prior to discharge into Blackwattle Bay. The 1% AEP flood depth below is observed with ponding in Bank Street, but predominantly flood free site.

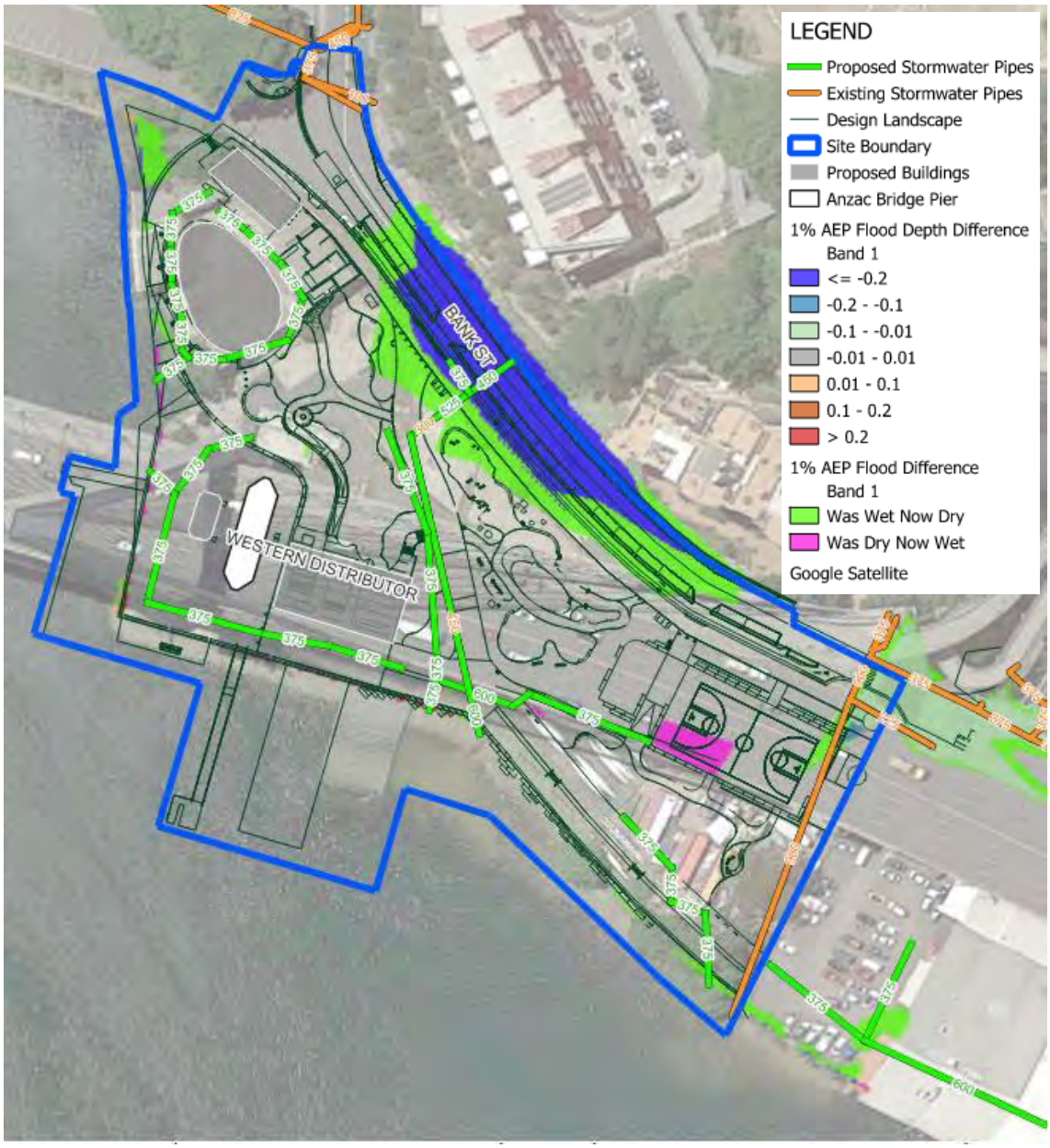
Figure 6.1: 1% AEP Flood Depth

Flood hazard is generally limited to H1 for the minor storm events, with some isolated areas of H2 and H3 at sag locations. In 1% AEP events the H1 hazard is still representative of the conditions generally, with H2, and H3 hazard zones larger than in the minor events at sag points. The PMF event presents high hazard conditions north of Bank Street sag. The high hazard conditions are relatively short in their duration. The spatial distribution of the 1% AEP hazard is indicated below.

Figure 6.2: 1% AEP Flood Hazard

Impact maps at Appendix A indicate the flood impacts as a result of the project, with the majority of impacts observed along the project interface with Bank Street where changes to finished surface levels influence flooding locally. The 1% AEP results comprise areas of 'was wet now dry' indicated by the green shading in the figure following. Blue shading indicates flood levels which are reduced as a result of the development, with an order of magnitude greater than 0.2m relative to existing conditions.

Figure 6.3: 1% AEP Flood Impacts



Hydraulic categorisation maps Appendix A indicate the preservation of the areas of flood storage in ponded areas. The detailed output of the floodplain categorisation indicates much wider extents of flood fringe than the regional catchment assessment by Council due to the inclusion of 15 minute duration storm events. The 1% AEP categories are indicated in the figure following, with the ponded areas within Bank Street seen to comprise both Flood Storage and Flood Fringe. Maintaining the low point in Bank Street ensures compatibility with the hydraulic functions of storage in flood storage areas of the land.

Figure 6.4: 1% AEP Floodplain Categorisation

6.2 Mitigation of flooding

The worst case flooding experienced across the site is due to short events, where localised storms of high intensity contribute larger runoff volumes than the stormwater system has capacity for. Therefore the mitigation of these worst case flood events involves the:

- Provision of overland flow paths to accommodate overland flows which are in excess of the piped system capacity, and;
- Increases to the piped system capacity to capture greater proportions of the runoff volume.

The overland flow optimisation for mitigating flood hazard includes the provision of wider flow paths where flows can continue downstream at a shallower depth and grading generally to reduce the depth of ponded areas where they occur. This results in a general decrease in flood

extent and depth as indicated in Appendix maps A.49 to A.55, with no increases to other properties, assets and infrastructure.

Pit and pipe system upgrades at Bank Street sag point serve to capture more water into the piped system to relieve local nuisance ponding in the road reserve. The stormwater strategy described in section 7.1 covers the pipe system capacity mitigation potential. These upgrades are specific measures to manage risk to life from flooding.

The potential social or community costs of flooding in this area generally comprises property damage including to recreational facilities within the park at Blackwattle Bay foreshore. Through the design mitigation of flood hazard by reducing peak flood depths, the potential flow on of flood caused damage to social and community consequences is generally reduced.

6.3 Emergency Response/Evacuation Strategy

The opportunities for evacuation are limited to the Pyrmont direction as alternatives through the Wentworth Park area are subject to worse flooding conditions and in some cases high hazard areas. Evacuation to Pyrmont is logical however it is noted that most streets in the area will have low hazard flooding in the most intense 15 to 60 minute duration storm events. In longer duration storms evacuation is not required as the flood risk in Bank Street is lower due to the relatively steep terrain of the area and proximity to Blackwattle Bay where overland flows dissipate.

The area of Bank Street Park and surrounds is typically flooded to worst case conditions in short and intense storms. Generally the areas susceptible to flooding experience low hazard conditions, H1 and H2 of the hazard classification of flood hazard mapping in Appendix A. Some areas of lower lying topography adjacent the new Sydney Fish Market, Wentworth Park, and within some existing intersections have higher flood hazards (H3 and above) as a result of deeper ponding.

- Wattle Street, from frequent events through to extreme events
- Bank Street sag point, from frequent events through to extreme events
- Gipps Street at the intersection with Bank Street, from frequent events through to extreme events
- Bridge Road, from major (rare) events through to extreme events
- Miller Street, from major (rare) events through to extreme events

Through consultation with the SES regarding the Blackwattle Bay Precinct, the SES advised that it doesn't consider SIP suitable as the flood emergency response plan and evacuation is the recommended approach to cater for safety of the likely, businesses and visitors that would be present based on the proposed development.

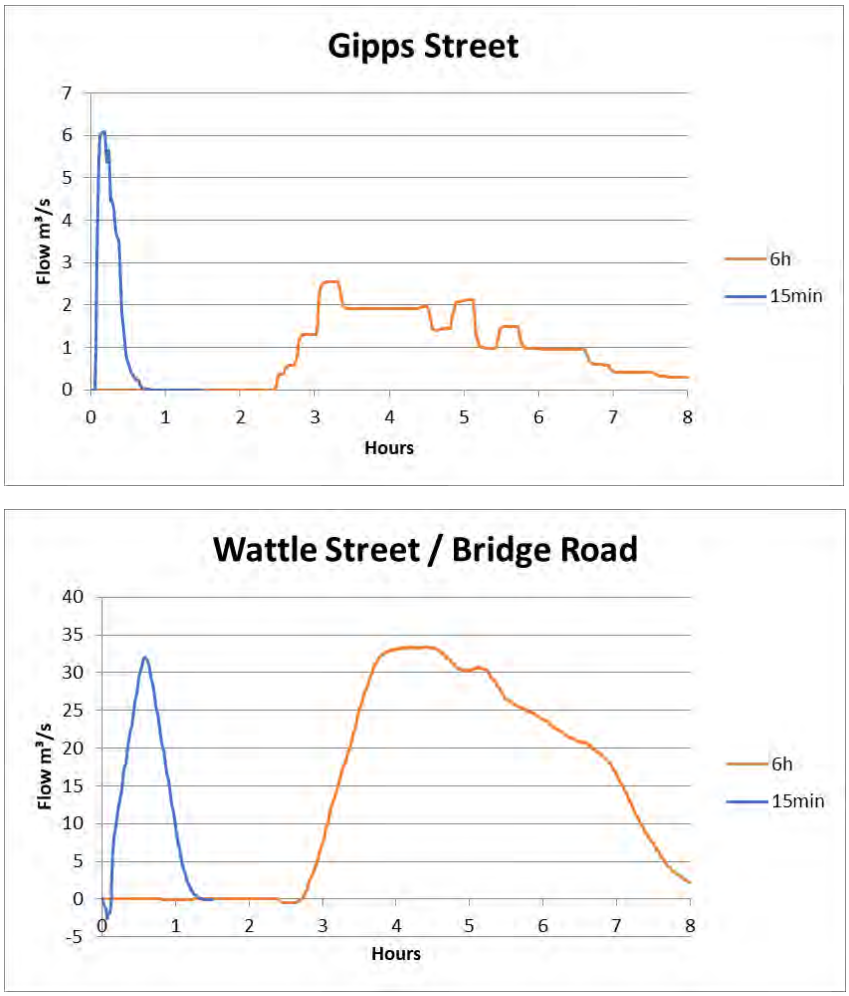
The preferred evacuation routes are indicated in Appendix A, noting the relatively low hazard environment provides for route options being available to individuals in the case of intense storms and flooding. The evacuation routes do not make use of the City of Sydney emergency planning assembly areas, despite the proximity to Wentworth Park nominated assembly area. This is due to the higher hazard experienced at Bridge Road on approach to Wentworth Park and the duration of inundation being longer at Wentworth Park as discussed below. The nominated evacuation routes are directed towards The Star casino given the location via rising road access from Blackwattle Bay, 24hour operation, safety from flood inundation and general amenities available.

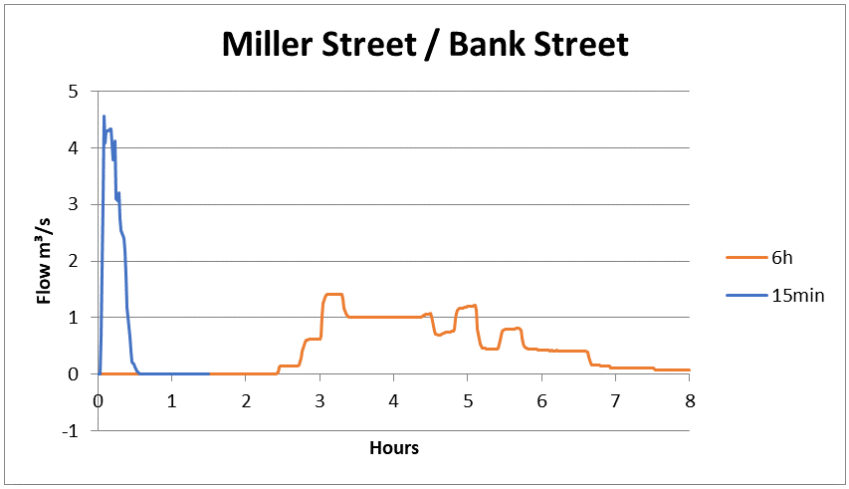
Bridge Road / Wentworth Park Hazard

The relative flow rates of short and long duration flooding is presented at key locations below to identify the type of overland flow response experienced by the catchment in each situation. For

areas in and around the precinct (Miller Street and Gipps Street) there are significantly lower flood hazards experienced in long duration storms due to the flows in short storms being of a higher order of magnitude. Conversely in Bridge Road on approach to the Wattle Street road reserve and into Wentworth Park, the contributing flows from the eastern upstream catchment are significant and in longer duration storms the peak flows are extended, proving unsuitable for evacuation.

Figure 6.5: PMF Flow rates in key locations





Due to hazard areas within the existing roads adjacent the precinct, and the short nature of worst case flooding (typically 15 minute to 60 minute storms) design for SIP as backup for failed evacuation is recommended, subject to individual development meeting the requirements set out in section 5.2.1.

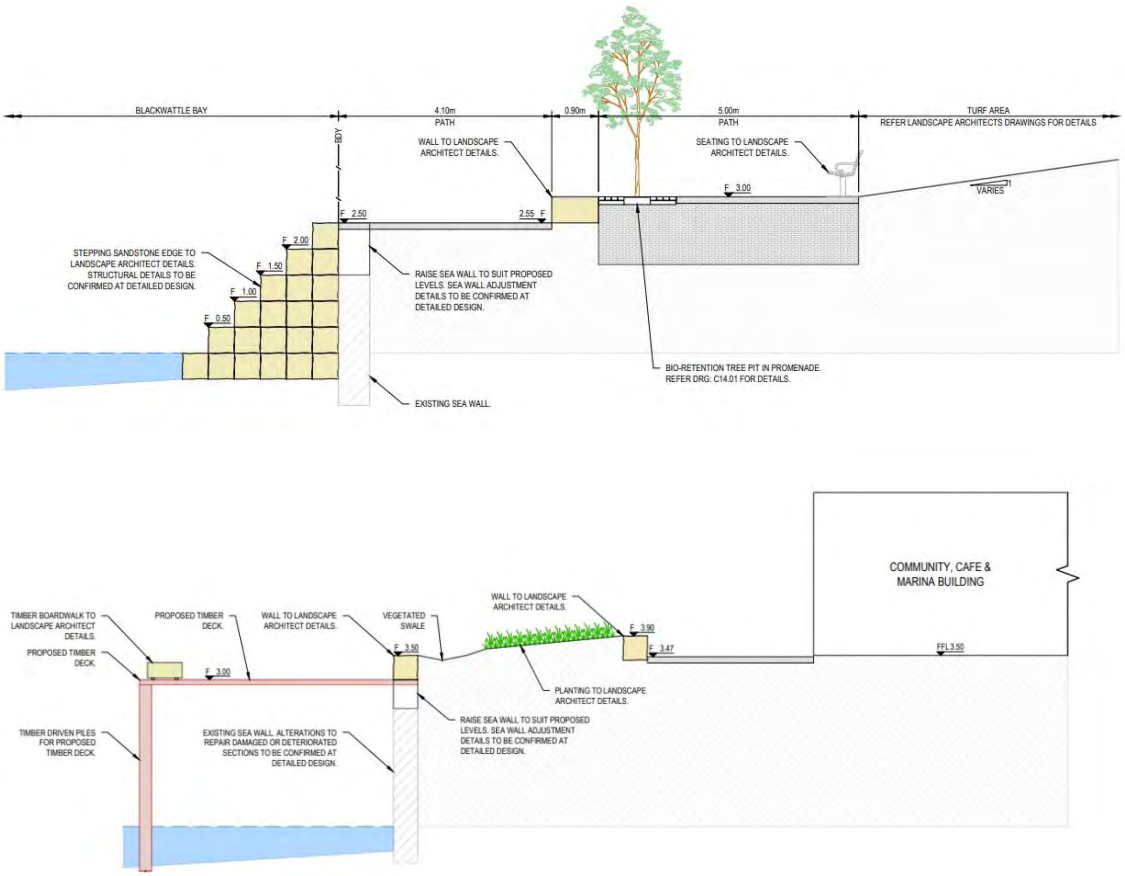
7 Storm Water Management

7.1 Stormwater Strategy

The treatment of existing seawall, including rehabilitation or replacement is presented in the Bank Street Park SSDA Civil Engineering – Stormwater management Report (Enspire, 2023) and associated civil plans (220067-00-DA-C01.01 to C23.01). The report includes discussion of the design strategy to reduce the impacts of existing stormwater system constraints on upstream areas through constructing a new pipe system for Bank Street Park local catchments. The Cut and Fill Plan (C04.01) indicates filling around the existing Anzac Bridge pylon to increase the finished surface level and reduce instances of inundation from coastal flood events.

Options available for the seawall replacement sections including shallow or deepwater structural foundations are key in determining an appropriate culvert design level. For the purpose of the flooding assessment the assumption is made that any new pipe adopts the depth of the existing stormwater system where is discharges through the seawall. This configuration is subject to the detailed design of stormwater system, seawall/revetment and optimisation by developers.

Figure 7-1: Stormwater Design Coordination



Source: Bank Street Park Seawall Treatments, Enspire 2023

7.2 Stormwater Modelling

In assessing the overland flow and resulting flood hazard through the precinct, the small catchment contributing to the majority of the precinct means the causes for worst case flooding conditions are typically surcharging flows or flows in excess of the pit and pipe system capacity. The focus of this report is on larger storm events, and for the treatment of water from more regular storms reference should be made to the Bank Street Park integrated water management strategy outlined in the Bank Street Park Infrastructure Strategy Report (Mott MacDonald 2023).

7.2.1 Model Parameters

A DRAINS analysis of the stormwater network has been adopted for preliminary system sizing for relief of local and trunk system constraints. The ILSAX methodology for assessing pipe capacity for the median temporal pattern from 10 representative temporal patterns was used in accordance with ARR2019. The design storm magnitude selected for analysis of the pipe size is the 5% AEP, with additional flows from larger events to drain overland in the minor/major system approach.

The existing catchments are largely impervious serving to create a relatively large runoff volume from the precinct area. High impervious percentages were retained for sizing of the stormwater system to provide for sufficient pipe size estimates draining the future development lot areas and road reserves.

7.2.2 Existing System

The areas of Pyrmont to the north are captured via pit and pip networks and drained through the precinct via trunk drainage pipes within the land adjacent the waterfront. Limited local drainage connections to the trunk system are assumed for the local precinct catchments. Trunk pipes vary in size.

Council owned drainage assets:

- Quarry Master Drive 900mm diameter pipe through government owned land (TfNSW)
- Bank Street 300mm diameter pipe (to 450mm discharge pipe), through government owned land (TfNSW)

7.2.3 Proposed System

Nominal pipe sizes for the developed conditions have been provided. These are the recommended minimum pipe diameter to cater for the local catchment runoff, assuming a free draining network. During detailed design there are opportunities to consider replacement/upsizing of the existing Council asset to best utilise existing easements however this introduces coordination with the existing asset owner and is subject to the existing system being serviceable for an appropriate connection.

7.2.4 Results

The pipe system documented by Enspire (2023) and reflected on the attached flood maps for the developed scenario provide sufficient capacity to drain the local catchments in a free-draining minor storm event. Due to the upstream catchment areas connected to the existing Council drainage lines, the hydraulic grade of the existing trunk system in the vicinity of the park precludes a free-draining connection of local stormwater pipes.

8 Consultation

In 2022 the initial assessment of flooding for the Blackwattle Bay State Significant Precinct future redevelopment was put on exhibition and feedback was sought from stakeholders including:

- SES
- DPE, Environment and Heritage Group

In response to these submissions, further assessment and documentation was provided regarding the flood emergency procedures for the precinct.

Consultation on the proposed development configuration and arrangements for mitigation of flood risk and impacts is being carried out with the SES and EHG on this Flood Risk and Impact Assessment report and precinct design updates generally.

Table 8-1: Stakeholder submissions and feedback

Agency	Item	Correspondence	Outcomes
SES	The flood emergency management strategy of 'shelter in place'	Response to submissions report and technical response dated 9/11/2022	The requirement for shelter-in-place strategy was removed from the recommendations for emergency response.
EHG	Queries made in relation to the magnitude of flood events in the 1% AEP and PMF events. Impacts queries for events greater than 1% AEP. Mitigation strategies for flood hazard and impacts were queried Future epoch for sea level rise were suggested for further analysis.	Response to submissions report and technical response dated 19/10/2022	Modelling amendments provided in response to submissions addressed the magnitude of flooding queries. Impacts for larger events than the 1% AEP were provided in the response. Mitigation strategies were noted to be addressed by subsequent design stages. Review of future planning horizons was undertaken. The planning recommendations for the State Significant Precinct regarding the response to flooding shall remain as indicated in section 4, with adaptive pathways applied in the future, in accordance with planning guidance.
EHG and SES	SES and EHG discussion/presentation on Flood Risk and Impact Assessment report.	20th July meeting to discuss outstanding flood risk and emergency planning items.	Revision D of the Blackwattle Bay Precinct Flood Risk and Impact Assessment* was provided to SES and EHG to review recent design updates and comment on the inclusion of meeting discussion items/advice. Confirmation on reference IPCC data, mitigation measures and efforts to address hazard, and preferred evacuation approach not to include SIP.

*Note this precinct study was used in discussions with stakeholder on the relevant issues and principles to be adopted regionally, relevant to both the precinct and Bank Street Park.

9 Conclusion

In response to the Blackwattle Bay Design Guidelines, the flood risk across the park has been assessed under existing and developed conditions. Historical development of infrastructure in an isolated manner has led to the present day situation of constrained land use and lower amenity for residents, businesses, visitors and the environment. Through integrated design and flood risk assessment for Bank Street Park, the opportunity to realise the full potential of the site in terms of access and recreational activities along the foreshore and future development is balanced with site grading to achieve improvements in flood risk outcomes.

To facilitate the redevelopment of the Bank Street Park, constraints identified in this report will be managed in both a short term and long term horizon to support the transition to an improved development offering for the community, and adaptation to the changing climate.

The limited flood storage areas of the site are maintained. Due to the small scale of flood storage areas in relatively steep terrain there is no significant benefit in terms of flood risk management to the adjacent area.

Specific mitigations are proposed to:

- the public domain generally, in terms of grading for management of overland flow, and FPLs that respond to the anticipated actions of climate change
- the Bank Street sag location which requires additional capacity of stormwater drainage. This is proposed in the form of additional pit and pipe system capacity and also provision for overland flow, where the pit/pipe system capacity is exceeded.

Evacuation is the method of response for flood events in the Bank Street Park. Mapping of evacuation routes is in included in Appendix A and the routes follow rising access to local flood free areas (or muster points) toward central Pyrmont.

The discussion presented in this report responds to the SEARs and Clause 5.21 of the Sydney LEP 2021 and provides responses to the key items of these requirements. This Flood Risk and Impact Assessment was developed through a coordinated design process to ensure the design satisfied the planning requirements with consideration of relevant stakeholders.

10 References

- Blackwattle Bay Seawall Assessment (Mott MacDonald, 2022)
- Blackwattle Bay SSP – Flood Risk and Impact Assessment (Mott MacDonald, 2023)
- Considering flooding in land use planning guidelines (Planning Circular 21-006), Department of Planning, Industry and Environment 2021
- CSIRO and Bureau of Meteorology, Climate Change in Australia website (http://www.climatechangeinaustralia.gov.au/), cited June 2022
- Draft Shelter-in-place Guideline, Department of Planning and Environment 2022
- Flood risk management manual, The policy and manual for the management of flood liable land (DPE, 2023)
  supersedes the Floodplain Development Manual (2005)
- NSW Flood Prone Land Policy and associated Floodplain Risk Management Guidelines
  - Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways (OEH 2015)
  - Flood Impact and Risk Assessment, Flood risk management guideline LU01 (DPE, 2023)
  - Flood Risk Management Measures, Flood risk management guideline MM01 (DPE, 2023)
  - Support for emergency management planning, Flood risk management guideline EM01 (DPE, 2023)
  - Understanding and Managing Floor Risk, Flood risk management guideline - series FB (DPE, 2023)
- Powells Creek naturalisation project archive, https://www.sydneywatertalk.com.au/powells (accessed June 2022)
- *Understanding sea-level rise and climate change, and associated impacts on the coastal zone*. CoastAdapt Information Manual 2, National Climate Change Adaptation Research Facility, Gold Coast. (Siebentritt, M., 2016)

A. Flood Maps

Map A.1: Existing Conditions - 0.5 EY - Flood Depth

Map A.2: Existing Conditions - 0.5 EY - Flood Hazard

Map A.3: Existing Conditions - 0.5 EY - Flood Velocity

Map A.4: Existing Conditions - 0.2 EY - Flood Depth

Map A.5: Existing Conditions - 0.2 EY - Flood Hazard

Map A.6: Existing Conditions - 0.2 EY - Flood Velocity

Map A.7: Existing Conditions - 10% AEP - Flood Depth

Map A.8: Existing Conditions - 10% AEP - Flood Hazard

Map A.9: Existing Conditions - 10% AEP - Flood Velocity

Map A.10: Existing Conditions - 5% AEP - Flood Depth

Map A.11: Existing Conditions - 5% AEP - Flood Hazard

Map A.12: Existing Conditions - 5% AEP - Flood Velocity

Map A.13: Existing Conditions - 1% AEP - Flood Depth

Map A.14: Existing Conditions - 1% AEP - Flood Hazard

Map A.15: Existing Conditions - 1% AEP - Flood Velocity

Map A.16: Existing Conditions with 9% Climate Change - 1% AEP - Flood Depth

Map A.17: Existing Conditions with 9% Climate Change - 1% AEP - Flood Hazard

Map A.18: Existing Conditions with 9% Climate Change - 1% AEP - Flood Velocity

Map A.19: Existing Conditions with 23% Climate Change - 1% AEP - Flood Depth

Map A.20: Existing Conditions with 23% Climate Change - 1% AEP - Flood Hazard

Map A.21: Existing Conditions with 23% Climate Change - 1% AEP - Flood Velocity

Map A.22: Existing Conditions - PMF - Flood Depth

Map A.23: Existing Conditions - PMF - Flood Hazard

Map A.24: Existing Conditions - PMF - Flood Velocity

Map A.25: Developed Conditions - 0.5 EY - Flood Depth

Map A.26: Developed Conditions - 0.5 EY - Flood Hazard

Map A.56: Developed Conditions - 0.5 EY Floodplain Categorisation

Map A.57: Developed Conditions - 0.2 EY Floodplain Categorisation

Map A.58: Developed Conditions – 10% AEP Floodplain Categorisation

Map A.59: Developed Conditions – 5% AEP Floodplain Categorisation

Map A.60: Developed Conditions – 1% AEP Floodplain Categorisation

Map A.61: Developed Conditions – 1% AEP Flood Planning Levels

Map A.62: Existing Conditions – PMF – Escape Routes

Map A.63: Developed Conditions – PMF – Escape Routes

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.1
Existing Conditions - 0.5 EY - Flood Depth

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

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Flood Risk and Impact Assessment

Map A.1
Existing Conditions - 0.5 EY - Flood Depth

Project Number:	703100678
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Bank Street Park
Flood Risk and Impact Assessment

Map A.2
Existing Conditions - 0.5 EY - Flood Hazard

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Bank Street Park
Flood Risk and Impact Assessment

Map A.3
Existing Conditions - 0.5 EY - Flood Velocity

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Bank Street Park
Flood Risk and Impact Assessment

Map A.4
Existing Conditions - 0.2 EY - Flood Depth

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Flood Risk and Impact Assessment

Map A.5
Existing Conditions - 0.2 EY - Flood Hazard

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Flood Risk and Impact Assessment

Map A.6
Existing Conditions - 0.2 EY - Flood Velocity

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Bank Street Park
Flood Risk and Impact Assessment

Map A.7
Existing Conditions - 10% AEP - Flood Depth

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Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.8
Existing Conditions - 10% AEP - Flood Hazard

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Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.9
Existing Conditions - 10% AEP - Flood Velocity

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Bank Street Park
Flood Risk and Impact Assessment

Map A.10
Existing Conditions - 5% AEP - Flood Depth

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Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.11
Existing Conditions - 5% AEP - Flood Hazard

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Revision No: 2
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Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

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Flood Risk and Impact Assessment

Map A.12
Existing Conditions - 5% AEP - Flood Velocity

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Revision No: 2
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Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.13
Existing Conditions - 1% AEP - Flood Depth

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

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Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.14
Existing Conditions - 1% AEP - Flood Hazard

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.15
Existing Conditions - 1% AEP - Flood Velocity

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

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Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.16
Existing Conditions with 9% Climate Change - 1% AEP - Flood Depth

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

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Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.17
Existing Conditions with 9% Climate Change - 1% AEP - Flood Hazard

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Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.18
Existing Conditions with 9% Climate Change - 1% AEP - Flood Velocity

Project Number: 703100678
Revision No: 2
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Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.19
Existing Conditions with 23% Climate Change - 1% AEP - Flood Depth

Project Number:	703100678
Revision No:	2
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Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.20
Existing Conditions with 23% Climate Change - 1% AEP - Flood Hazard

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.21
Existing Conditions with 23% Climate Change - 1% AEP - Flood Velocity

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.22
Existing Conditions - PMF - Flood Depth

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

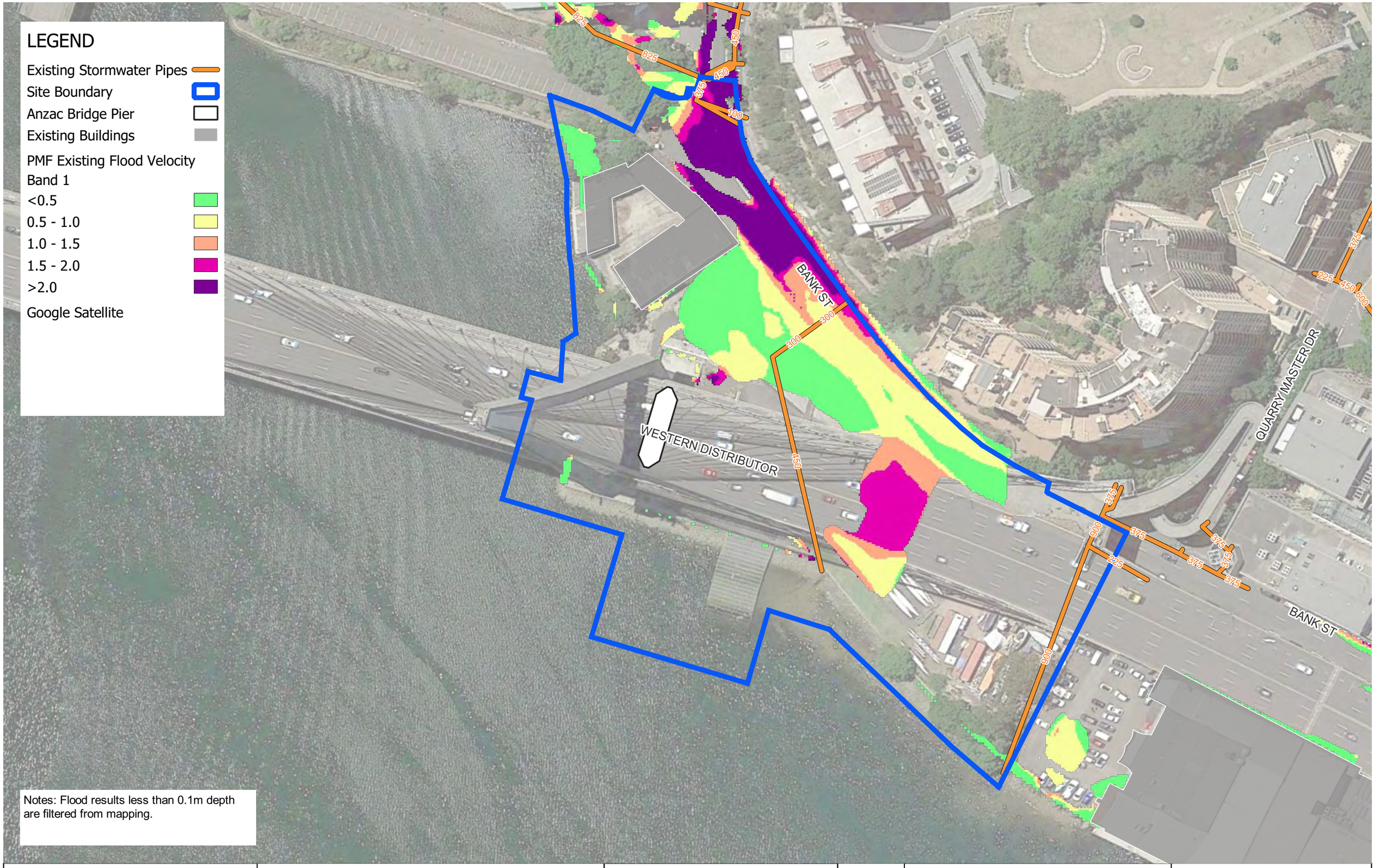
Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.23
Existing Conditions - PMF - Flood Hazard

Project Number:	703100678
Revision No:	2
Date:	27/10/2023



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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

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Flood Risk and Impact Assessment

Map A.24
Existing Conditions - PMF - Flood Velocity

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.25
Developed Conditions - 0.5 EY - Flood Depth

Project Number:	703100678
Revision No:	2
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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.26
Developed Conditions - 0.5 EY - Flood Hazard

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.27
Developed Conditions - 0.5 EY - Flood Velocity

Project Number:	703100678
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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.28
Developed Conditions - 0.2 EY - Flood Depth

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

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Flood Risk and Impact Assessment

Map A.29
Developed Conditions - 0.2 EY - Flood Hazard

Project Number:	703100678
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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.30
Developed Conditions - 0.2 EY - Flood Velocity

Project Number:	703100678
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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.31
Developed Conditions - 10% AEP - Flood Depth

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.32
Developed Conditions - 10% AEP - Flood Hazard

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.33
Developed Conditions - 10% AEP - Flood Velocity

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.34
Developed Conditions - 5% AEP - Flood Depth

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.35
Developed Conditions - 5% AEP - Flood Hazard

Project Number:	703100678
Revision No:	2
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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.36
Developed Conditions - 5% AEP - Flood Velocity

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

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0 25 50 m			
Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.37
Developed Conditions - 1% AEP - Flood Depth

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.39
Developed Conditions - 1% AEP - Flood Velocity

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.40
Developed Conditions with 9% Climate Change - 1% AEP - Flood Depth

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.41
Developed Conditions with 9% Climate Change - 1% AEP - Flood Hazard

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.42
Developed Conditions with 9% Climate Change - 1% AEP - Flood Velocity

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.43
Developed Conditions with 23% Climate Change - 1% AEP - Flood Depth

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.44
Developed Conditions with 23% Climate Change - 1% AEP - Flood Hazard

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.45
Developed Conditions with 23% Climate Change - 1% AEP - Flood Velocity

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.46
Developed Conditions - PMF - Flood Depth

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.47
Developed Conditions - PMF - Flood Hazard

Project Number:	703100678
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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.48
Developed Conditions - PMF - Flood Velocity

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.49
Afflux - Flood Depth Difference - 0.5 EY

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.50
Afflux - Flood Depth Difference - 0.2 EY

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.51
Afflux - Flood Depth Difference - 10% AEP

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.52
Afflux - Flood Depth Difference - 5% AEP

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m			
Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.53
Afflux - Flood Depth Difference - 1% AEP

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.54
Afflux - Flood Depth Difference - 1% AEP with Climate Change

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.55
Afflux - Flood Depth Difference - PMF

Project Number: 703100678
Revision No: 2
Date: 27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.56
Developed Conditions - 0.5 EY Floodplain Categorisation

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

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Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.57
Developed Conditions - 0.2 EY Floodplain Categorisation

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.58
Developed Conditions - 10% AEP Floodplain Categorisation

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.59
Developed Conditions - 5% AEP Floodplain Categorisation

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.60
Developed Conditions - 1% AEP Floodplain Categorisation

Project Number:	703100678
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0 25 50 m			
Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.61
Developed Conditions - 1% AEP - Flood Planning Levels

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m

Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.62
Existing Conditions - PMF - Escape Routes

Project Number:	703100678
Revision No:	2
Date:	27/10/2023

Notes: Flood results less than 0.1m depth are filtered from mapping.

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0 25 50 m			
Coordinate System	GDA94 / MGA zone 56		
Original Size	A3	Drawn	JR
Height Datum	AHD	Check	JM

Scale 1:1,000

Bank Street Park
Flood Risk and Impact Assessment

Map A.63
Developed Conditions - PMF - Escape Routes

Project Number:	703100678
Revision No:	2
Date:	27/10/2023