COCKLE BAY PARK

STORMWATER MANAGEMENT REPORT

Prepared for: DPT Operator Pty Ltd &
DPPT Operator Pty Ltd.

By: **en**struct group pty ltd

August 2017

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ISSUE AUTHORISATION

Document Title:	Stormwater Management Report
Document Number:	4886-CV-RPT-0001
Project Reference:	4886
Prepared For:	DPT Operator Pty Ltd & DPPT Operator Pty Ltd
Date:	August 2017
Author:	Qusai El-Jurf
Reviewer:	Liam Delaney

Rev	Date	Purpose of Issue / Nature of Revision	Prepared by	Reviewed by	Issue Authorise by
01	02/08/17	Draft Report	QEJ	LD	LD
02	07/08/17	Add Comments	QEJ	LD	LD
03	24/08/17	Final Report	QEJ	LD	LD

Executive Summary

enstruct Group has been commissioned by DPT Operator Pty Ltd & DPPT Operator Pty Ltd to assist with the preparation of the Environmental Impact Statement (EIS) in response to the Secretary's Environmental Assessment Requirements (SEARs) for the proposed Cockle Bay Park Development. This report addresses stormwater management issues to be considered in the EIS.

The report discusses the existing site and identifies the proposed site drainage design for the concept proposal.

Existing Site Conditions

Existing stormwater drainage is generally located to the east of the site and includes assets owned and maintained by the City of Sydney Council and Sydney Water Corporation. Two main underground drainage lines convey flows through the property including a 1500 mm diameter line in the central part of the site and an 1800 mm diameter line in the southern part of the site.

Three silt arrestors were installed to capture pollutants from local drainage catchments prior to discharge into Cockle Bay. The outlets from these silt arrestors project through the sea wall and discharge via three 375 mm diameter pipes fitted with non-return valves.

Existing major street drainage lines will remain undisturbed in their current locations, aside from some proposed inlet modifications at the eastern edge of the property to improve drainage during extreme floods in Harbour Street.

Concept Proposal

The concept proposal involves demolition of existing buildings and construction of a commercial tower and podium. The site is bounded to the west by Darling Harbour, to the north by the Pyrmont Bridge, and to the east and south by the Western Distributor. The bridge over the Western Distributor provides a pedestrian connection with Darling Park and the city to the east.

The concept proposal at Cockle Bay affords the opportunity to collect roof runoff for irrigation of podium level garden planters. It is proposed that appropriate rainwater storage will be provided for this purpose. New drainage systems will meet authority requirements in terms of capacity and water quality management.

Flooding

A review was made of the Flood Assessment previously undertaken for the City of Sydney Council, predicted flood levels derived from this flood study are directly relevant to the Cockle Bay Development. An existing Jersey kerb barrier (RMS Type F unit) exists along Harbour Street and will be reconstructed to provide a flood protection barrier for the slip lane to the site. Additional provisions will be made to improve drainage from Harbour Street during extreme flood events as well as draining the concept proposal.

The development will not have building openings facing Harbour Street. Public realm spaces at the ground level will drain directly to the bay. There will be no adverse effects on flooding as a result of the concept proposal.

Finished floor levels will be above the predicted maximum sea level in Cockle Bay, taking into account the effects of sea level rise. Maximum water levels and minmum planning levels as presents in the tables below:

Sydney Harbour Maximum Water Levels

Existing (5% AEP Tide)	2050 (+0.4m)	2100 (+0.9m)
1.38 m AHD	1.78 m AHD	2.28 m AHD

Flood Planning Levels

Event	Flood Level mAHD	Planning Level mAHD
Overland Flood (1:100 ARI)	2.87	3.37
Probable Maximum Flood	3.34	3.34
Ocean Water (Year 2100)	2.28	2.78

On-Site Detention

On-site stormwater detention (OSD) for developments located in the lower reaches of a catchment are not considered beneficial for preventing downstream flooding. An OSD concession is provided by the drainage manual and Sydney Water for such areas.

It is not proposed to provide on-site detention as part of this development. A review of the as-built drainage plans prepared in 1998 for the existing Cockle Bay development confirms that no on-site detention was provided.

Water Quality

The stormwater system proposed for the site will discharge into Cockle Bay. The quality of the stormwater shall meet the requirements imposed by City of Sydney Council. The development will achieve the pollution reduction targets by utilising water sensitive urban design (WSUD) treatment initiatives.

External Works and Drainage

This report is based on illustrative design. Alternate solutions are to be developed depending on final extent and location of Wheat Road based on design principals.

The proposed roads will be drained with grated inlets connected to a new site stormwater pipe network. The new pipes will drain directly to the bay. Prior to discharge, stormwater flows will pass through a Gross Pollutant Trap (GTP).

Erosion and Sediment Control

The design will consider measures to control soil erosion and sediment transportation to mitigate the risk of sediment impact affecting the site and surrounding areas including the harbour during construction. Such measures will include sediment fences, settlement ponds and shaker grates.

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1 Introduction

enstruct has been engaged by DPT Operator Pty Ltd & DPPT Operator Pty Ltd to provide civil engineering consultancy and design services in support of the concept proposal at the Cockle Bay Park, adjacent to Wheat Road and the Western Distributor in Sydney. The location of the concept proposal is in the local government area of the City of Sydney Council, but is administered by the Sydney Harbour Foreshore Authority. In September 2015 it was announced that the Sydney Harbour Foreshore Authority's functions would be consolidated with Property NSW.

As part of the Development Approval process, **en**struct has been commissioned to develop conceptual performance requirements for a stormwater management plan. Consideration will be given to the respective components of the stormwater drainage system, rainwater harvesting, on-site stormwater detention (OSD) storage, flood level assessment and water quality targets to suit anticipated and applicable local authority requirements. This report addresses these conceptual design requirements.

2 Project Overview

This report supports the Response to Submissions and amended Concept Proposal associated with a State Significant Development Application (SSDA 7684) submitted to the Minister for Planning and Infrastructure pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

DPT Operator Pty Ltd and DPPT Operator Pty Ltd (the Proponent) are seeking approval for a Concept Proposal for the redevelopment of the Cockle Bay Wharf Building and the surrounding area to create new open space and a commercial, retail and tourist precinct in the heart of the CBD (now referred to as Cockle Bay Park). The amended Concept Proposal includes:

- a large area of publicly accessible open space;
- new retail outlets, including new food and beverage destinations;
- new cultural and entertainment destinations; and
- a new commercial office tower.

The project will add new open space to the Sydney CBD and help to reconnect the city to the Darling Harbour waterfront. Cockle Bay Park will take its place in a revitalised Sydney CBD and speaks directly to local government objectives to create a 'Green, Global and Connected City' (City of Sydney) as well as the strategic vision outlined in 'Towards Greater Sydney 2056' to grow the "developing central city". The vision for this project was developed with consideration for the NSW Government objectives to support and "grow the knowledge industry", double tourism expenditure and "strengthen our local environment and communities" as outlined in 'NSW 2021: A Plan to Make NSW Number One'.

Please note that all plans, diagrams, images and graphics within this report and the supporting documentation (excluding the amended Concept Proposal Envelope Plans prepared by Francis-Jones Morehen Thorp Pty Ltd) are indicative only and have been included to communicate the intent of the amended Concept Proposal, including representative building shapes, forms, locations, layouts and relationships. It is proposed that these representations, together with acceptance of the building envelopes and massing, and associated design principles, will then be used to inform the Design Excellence process to follow the Stage 1 SSD Determination. Design Excellence outcomes will form the basis of the Stage 2 SSDA.

2.1 Background

The Proponent controls the lease of the Site, and also of the adjacent Darling Park precinct. The Darling Park site is a successful premium grade office precinct located on the west of the Sydney CBD, the associated Crescent Garden, located to the west of the three existing Darling Park towers, is a key area of open space in this part of the city.

The Proponent has recognised a number key issues with the existing layout of the Darling Park and Cockle Bay precinct, these being:

- The existing Cockle Bay Wharf building is not well integrated with the city, the Western Distributor freeway currently acts as a barrier to separate this area from the CBD;
- Publicly accessible open space is limited to the existing Crescent Garden in Darling Park; and
- The existing Cockle Bay Wharf building is outdated and is not in keeping with the future of Darling Harbour area as a vibrant entertainment and tourist destination.

The Cockle Bay precinct is at risk of being left behind and undermining the significant investment being made in Darling Harbour that will see it return to the world stage as a destination for events and entertainment. Accordingly, the Proponent is taking a carefully considered and staged approach to the complete revitalisation of the site and its surrounds. The envisaged development, which will be facilitated by the proposed building envelopes will:

- Reconnect the city with the Darling Harbour waterfront;
- Create new publicly accessible open space in the heart of the Sydney CBD;
- Create new public land above the Western Distributor;
- Provide new access routes between the city and the ICC Sydney / Darling Harbour Live precinct;
- Support the Sydney economy by providing a new premium commercial building; and
- Refresh and renew an existing entertainment and tourist destination.

2.2 Site Description

The Site is located within Darling Harbour. Darling Harbour is a 60 hectare waterfront precinct on the south-western edge of the Sydney Central Business District that provides a mix of functions including recreational, tourist, entertainment and business.
The Site is located to the immediate south of Pyrmont Bridge, within the Sydney CBD on the eastern side of the Darling Harbour precinct. The Site is also located within the City of Sydney local government area (LGA). A locational context area plan and location plan are provided at Figure 1 below.

The project Site area has been slightly amended by this Response to Submissions, a comparison of the exhibited and now-proposed Site area is provided as Figure 2, and the now proposed Site area is shown below as Figure 3.

The Darling Harbour precinct is undergoing significant redevelopment as part of the SICEEP, Darling Square, and IMAX renewal projects. The urban, built form and public transport / pedestrian context for the proposed Harbourside development will fundamentally change as these developments are progressively completed.

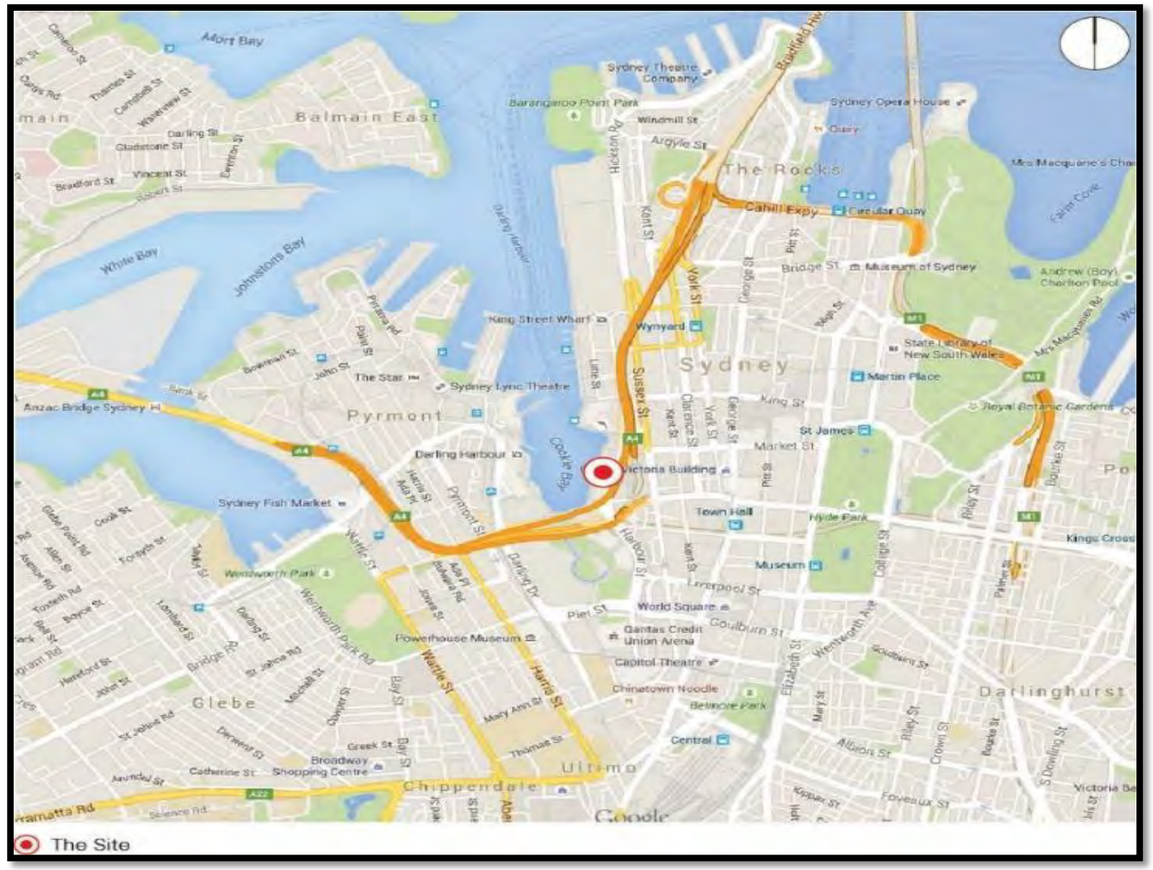


Figure 1 – Location Context Area Plan

Figure 2 – Location Plan (revisited site area in yellow)

Figure 3 – Amended Location Plan

2.3 Overview of Amended Concept Proposal

The proposal relates to a staged SSDA and seeks to establish amended concept proposal details for the renewal and re-imagining of the Cockle Bay precinct. The amended Concept Proposal establishes the vision, planning and development framework which will be the basis for the consent authority to assess future detailed development proposals. The Cockle Bay Park Site is to be developed for a mix of Retail, Cultural and Commercial (Office) uses including retail and restaurants, offices, and publicly accessible open space.

The amended Concept Proposal seeks approval for the following key components and development parameters:

- Demolition of existing site improvements, including the existing Cockle Bay Wharf building complex, pedestrian bridge links across the Western Distributor, and obsolete monorail infrastructure;
- Building envelopes;
- Land uses across the Site;
- A maximum total Gross Floor Area (GFA) across the Cockle Bay Park of 75,000m^2 for commercial development and 14,000m^2 for retail (including food and beverage) development;
- Urban Design and Public Realm design principles to provide a Design Excellence framework; and
- Strategies for utilities and services provision, drainage and flooding, and ecological sustainable development.

2.4 Planning Approvals Strategy

The Site is located within the Darling Harbour precinct, which is identified as a State Significant Site in Schedule 2 of State Environmental Planning Policy (State and Regional Development) 2011. As the concept proposal will have a capital investment exceeding $10 million, it is declared to be State Significant Development (SSD) for the purposes of the Environmental Planning and Assessment Act 1979 (EP&A Act), with the Minister for Planning the consent authority for the project.

This State Significant Development Application (DA) is a staged development application made under Section 83B of the EP&A Act. It seeks approval for the concept proposal for the entire site and its surrounds.

More specifically this staged DA includes establishing land uses, gross floor area, building envelopes, public domain concept, pedestrian and vehicle access and circulation arrangements and associated car parking provision.

Detailed development application/s (Stage 2 DAs) will accordingly follow seeking approval for the detailed design and construction of all or specific aspects of the proposal in accordance with the approved staged development application.

The Department of Planning and Environment provided the Secretary's Environmental Assessment Requirements (SEARs) to the applicant for the preparation of an Environmental Impact Statement for the concept proposal on 23 June 2016. This report has been prepared having regard to the SEARs as relevant.

3 Existing Drainage

Existing stormwater drainage is generally located to the east of the site and includes assets owned and maintained by the City of Sydney Council (CoS) and Sydney Water Corporation (SWC). Two main underground drainage lines convey flows through the property including a 1500 mm diameter line in the central part of the site and an 1800 mm diameter line in the southern part of the site (refer to Figure 4). The proposed design aims to protect existing active drainage piping and silt traps with minor relocation, if any. This relocation will be handled during detailed design.

The works-as-executed (as-built) plans prepared in 1998 indicate that three silt arrestors were installed to capture pollutants from local drainage catchments prior to discharge into Cockle Bay. The outlets from these silt arrestors project through the sea wall and discharge via three 375mm diameter pipes fitted with non-return valves (refer to Appendix A for existing stormwater plan).

An additional 600 mm pipe is shown on the as-built plan which is not indicated on CoS or SWC records. Investigations will be undertaken to confirm if this line drains the sag areas in Wheat Road and Habour Street.

Existing major street drainage lines will remain undisturbed in their current locations, aside from some proposed inlet modifications at the eastern edge of the property to improve drainage during extreme floods in Harbour Street. This arrangement is described further in the Flood Assessment section of this report.

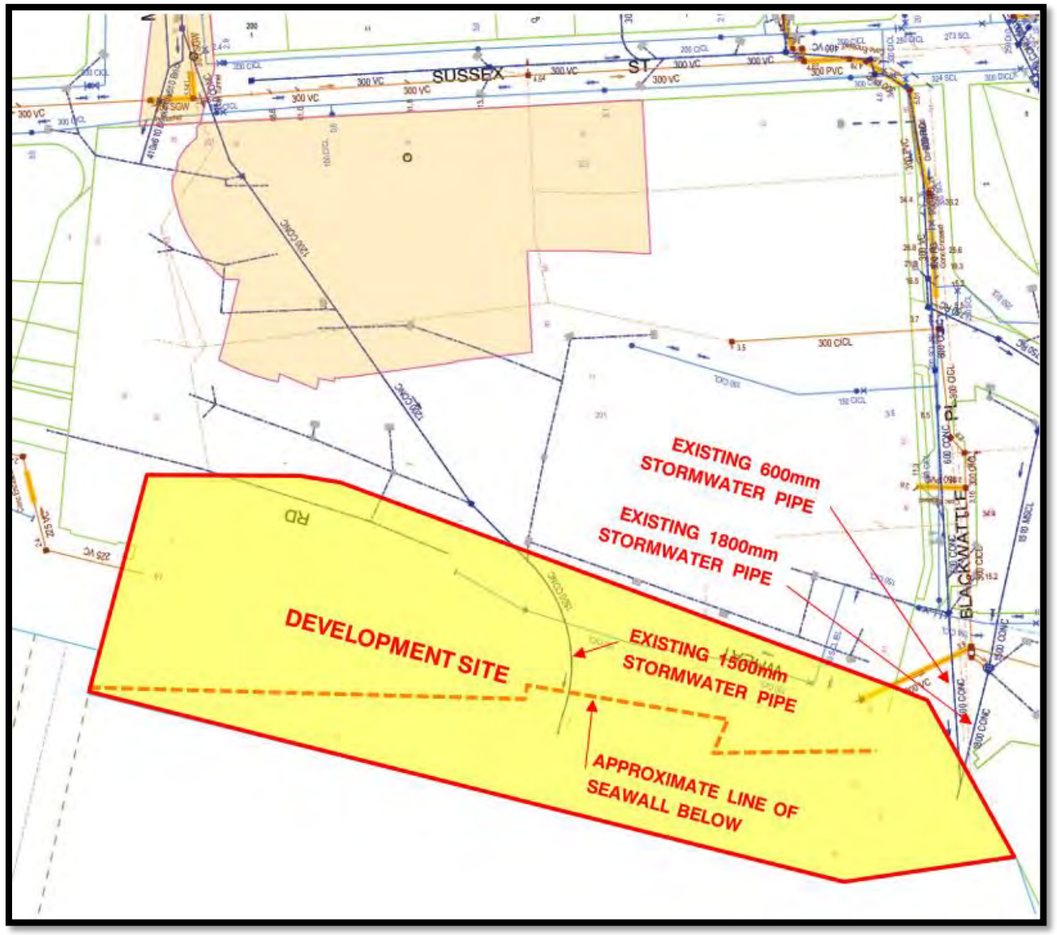


Figure 4 – Sydney Water Hydraplot Record of Existing Stormwater Mains

4 Flood Assessment

4.1 Overland Flow

A Flood Assessment was undertaken for the City of Sydney Council and is presented in the "Darling Harbour Catchment Flood Study" dated October 2014, prepared by BMT WBM. Information from this flood study has been extracted for the vicinity of the Cockle Bay Development (refer to Appendix D). The flood modelling indicates anticipated flood levels in Harbour Street immediately adjacent to the development site will be RL 2.87 for the 100 year average recurrence interval (ARI) storm event and RL 3.34 for the probable maximum flood (PMF) storm event.

An existing Type F Jersey kerb barrier exists between Wheat Road and Harbour Street which currently provides some level of protection from floods in Harbour Street. As part of the development works it is intended that the Type F kerb will be reconstructed to provide a formal flood barrier while retaining its primary function as a traffic barrier in the vicinity of the slip lane to the site.

Additional provisions will be made to improve drainage from Harbour Street during extreme flood events as well as draining the site. A series of new low level drainage slot inlets will be provided to improve conveyance of floodwaters to Cockle Bay via a proposed concrete box culvert located below the ground floor level of the concept proposal. Although this provision is not a specified proposal or requirement of the Flood Study, it will provide some reduction in flood levels in Harbour Street during extreme flood events and improve the current flood risk levels.

The slip lane will also be elevated between the F-kerb and building wall to above PMF level to prevent flooding of driveway inside the development. Additional drainage pits inside driveway and drop off areas are provided.

The development will not have building openings facing Harbour Street. Public realm spaces and accesses at the ground level will drain directly to the bay. There will be no adverse effects on flooding as a result of the concept proposal.

4.2 Ocean Water Level

Sea level rise has previously been derived for the vicinity of Cockle Bay in the Darling Harbour Catchment Flood Study as described below.

The sea level rise planning benchmarks provided in the NSW Sea Level Rise Policy Statement (DECCW. 2009) have been adopted for this Flood Study. The benchmarks are a projected rise in sea level relative to the 1990 mean sea level of 0.4 metres by 2050 and 0.9 metres by 2100 (DECCW. 2009). Based on these guidelines, design ocean boundary conditions were raised by 0.4 m and 0.9 m to assess the potential impact of sea level rise on flood behaviour in the Darling Harbour catchment for the year 2050 and 2100, respectively.

The sea level rise allowances provide for direct increases in these ocean water levels. Table 1 presents a summary of the adopted peak ocean water levels for 1% AEP design modelling for existing water level conditions and the 2050 and 2100 sea level rise benchmarks.

Table 1 – Sydney Harbour water levels incorporating level rise

Existing (5% AEP Tide)	2050 (+0.4m)	2100 (+0.9m)
1.38 m AHD	1.78 m AHD	2.28 m AHD

The peak water level expected in Sydney Harbour will be RL 2.28. The proposed flood level for the development will be at least RL 3.05 (the intended base structural slab level). Therefore, no adverse flood impacts are anticipated to affect the concept proposal from flooding in Harbour Street or from sea levels in Cockle Bay.

4.3 *Planning and Proposed Floor Levels*

The flood design criteria is set by the council and incorporates the following requirements:

- The habitable floor level of all new buildings should be flood protected above the 1 in 100 year ARI flood level with a freeboard of 500 mm. This level is referred to as the Flood Planning Level (FPL).
- All the entrances to the basement car-park should be protected passively through the provision of crests or bunds to the FPL with fully automated flood barriers to as high as practicable up to the PMF (Probable Maximum Flood).

The site is subjected by two types of flooding (1 in 100 year ARI):

- from overland flow; and
- from ocean water levels.

The dominant form of flooding will be used to set the final flood planning level, as detailed in Table 2.

Table 2 – Planning floor levels

Event	Flood Level mAHD	Planning Level mAHD
Overland Flood (1:100 ARI)	2.87	3.37
Probable Maximum Flood	3.34	3.34
Ocean Water (Year 2100)	2.28	2.78

Figure 5 depicts existing floor levels, including wharf dock of 2.45 mAHD. There are no plans to change the existing dock. The new development will include a slab on top of the existing dock to raise the ground floor level to 3.25 mAHD, as described on Table 3.

Table 3 – Architectural floor levels

Level	Existing mAHD	New Podium mAHD	New Mezzanine mAHD
Deck Structure	2.45	2.45	
Ground Floor	3.25	3.25	
L1	7.75	7.75	10.95
L2	12.25	12	14
L3		19	
L4		24	

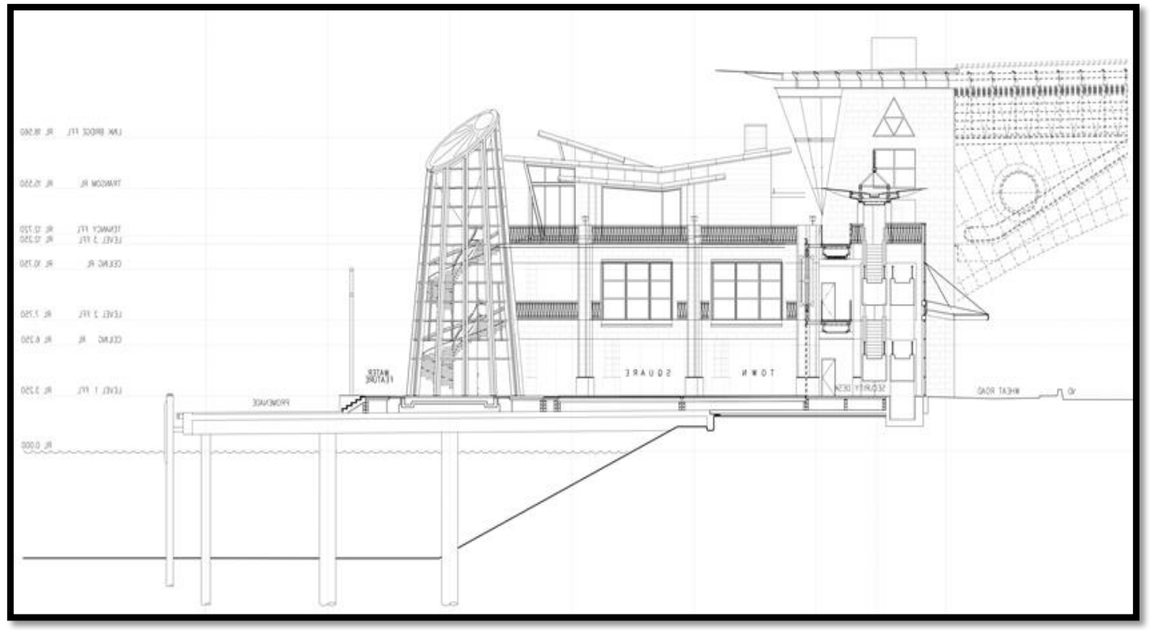


Figure 5 – Existing floor levels

The existing levels for public realm will remain unchanged to maintain cross fall for drainage; sloping towards the bay. No ponding or flooding is anticipated in these areas.

The ground floor elevation is also proposed to be kept unchanged to maintain functional connections to and minimise impacts on adjoining footpaths, roads, essential services (water, electricity, sewer, etc.), neighbouring blocks, and other local features.

4.4 Proposed Flood Protection

The following flood protection measures are planned for the site:

- All floor levels to be equal or greater than the 20 year ARI of 2.77 mAHD.
- Habitable floor levels to be set at a minimum of 3.37 mAHD
- Flood planning level of 3.37 mAHD will be provided passively for all entrances to basements.
- Flood barriers will be provided to isolate the north and south sides of the building to separate the tower lobby and core area from retail and plant areas.
- Flood barriers must be provided to the PMF level for lifts and staircases within the building that lead down to the ground levels.
- Any fire escape stairway that exits within the building below the PMF level must be protected from flood inundation by automated flood barriers/gates up to the PMF level or as high as practicable.

Ground floor retail areas will be subject to individual DAs and floor levels will be assessed at that time.

5 On-Site Detention

City of Sydney DCP (2012) requires stormwater detention devices to be designed to ensure that the overflow and flowpaths have sufficient capacity during all design rainfall events to discharge to the public stormwater system without affecting adjoining properties and should be free of obstructions.

The Stormwater Drainage Manual (February 2017) of City of Sydney Council indicates that requirements for On-Site Detention (OSD) are determined by Sydney Water. Consideration of the provision of OSD is generally required for all types of development in accordance with Section 5 of the manual. However, for developments located in the lower reaches of a catchment, OSD is not considered to be of benefit for prevention of downstream flooding. An OSD concession is provided by the drainage manual and Sydney Water for such areas.

It is not proposed to provide on-site stormwater detention as part of this development. A review of the as-built drainage plans prepared in 1998 for the existing Cockle Bay development confirms that no on-site detention was provided.

6 Rainwater Storage

Section 3.6.2 of the DCP states that rainwater tanks are to be installed for all non-residential developments that have access to a roof form from which rainwater can be feasibly collected and plumbed to appropriate end uses. The harvested rainwater shall be used for:

- Non-potable uses such as toilet flushing, car washing, firefighting and certain industrial purposes like cooling towers.
- Irrigation of public and private open space.

The concept proposal at Cockle Bay affords the opportunity to collect relatively clean roof runoff for irrigation of podium level garden planters and it is proposed that appropriate provision for rainwater storage be provided to suit the available roof catchments.

Water collected from non-trafficable roof areas is considered to be relatively clean and can be readily used for irrigation and non-potable purposes. Surface runoff from pedestrian or vehicular traffic areas is considered to be potentially contaminated and harvesting of this surface runoff is not recommended. The distribution of collected rainwater is normally achieved by a pump system to direct flows at a suitable pressure to the required locations (e.g. garden hose taps or automatic sprinklers).

The rainwater tanks will be sized by the hydraulic engineer and requirements of the sustainability designer.

7 Proposed Drainage

The site drainage from the new development is to be discharged into Cockle Bay through the existing sea wall in a similar manner to the current outlet discharge arrangement. The new drainage system will include pollution control devices.

Characteristics of the proposed stormwater system are shown on the stormwater concept drawings contained in Appendix E of this report. Where stormwater structures such as pits or tanks are to be installed, safe access is to be provided in accessible locations for regular inspection and maintenance.

Wheat Road is to be diverted through the new ground level space and will include grated drainage pits located at sag points along the road. An alternative option is to provide linear grated trench drains along “flat” longitudinal grades with appropriate cross falls associated with the road design layout. The road strategy is to be confirmed in advanced design stages.

This report is based on illustrative design. Alternate solutions are to be developed depending on final extent and location of Wheat Road based on design principals.

7.1 Drainage Design Criteria and Parameters

The key design criteria and Council requirements for stormwater drainage design are as follows:

- Stormwater Network:
  - Site stormwater network is to be designed for the 20-year ARI event.
  - Stormwater is to drain by gravity to the bay through sea wall.
  - Gross pollutant traps are required to treat water from car parks and hardstand areas.
- Tower:
  - Rainwater tanks may be provided to store roof runoff for reuse.
  - Excess water will drain by gravity to the site’s stormwater system.
  - Floor levels are to be above the greater of the 100-year ARI flood level plus 0.5 m freeboard or PMF level;
- Retail Podiums:
  - Surface areas to be collected via floor drains to the site’s stormwater system.

- WSUD treatment is proposed utilising rain gardens. The design will be developed in conjunction with the landscape architect for the podiums.

- Roads:

  - Harbour Street and the adjacent M4 Western Distibutor Freeway drainage system will remain. Upon finalising the architectural and structural design, we anticipate minor relocation of piping or silt traps.

  - New site access from Harbour Street will require connection to the site stormwater system for collections and drainage. Overland flow of this acess area is to be unobstructed to drain to the bay.

Drainage for this site has been designed in accordance with the methods outlined in "Australian Rainfall and Runoff", Institution of Engineers. The software package DRAINS was used to design the new stormwater network.

7.2 Stormwater Management

The overall site stormwater management objectives applicable to the site were identified as follows:

Table 4 – Stormwater Management Objectives

Management Objective	Measure
Environmental	Provision of appropriately designed detention facilities, limitation of downstream discharge peaks and velocities. WSUD principles adhered to
Urban Amenity	Provision of a stormwater management strategy that ensures the effective drainage of the site and provision of aesthetic design forms that enhance amenity
Engineering Considerations	Effective management and control of peak discharges, discharge velocities and site detention; industry best practice technical analysis of catchment hydrology and system hydraulic performance
Economics	Provision of a cost effective, functional site drainage system that optimises performance, provides maximum value for expenditure and keeps on-going maintenance requirements to a minimum

The Stormwater Management Strategy proposed for site development has been prepared with consideration of the above objectives and Council's requirements and guidelines. The strategy focuses on minimising the impacts of the development on the adjoining properties and maximising the environmental, social and economic benefits achievable by utilising responsible and sustainable stormwater management practices.

7.2.1 Rainwater Collection

Gutters, floor drains, and downpipes will be designed by the Hydraulic Engineer. The roof drainage system of gutters, downpipes and associated pipework is to be designed in accordance with AS/NZS 3500.3 Plumbing and Drainage Part 3: Stormwater Drainage.

7.2.2 Roof Levels

Flow of rainwater from the roof will be collected and conveyed via a downpipe system to the rainwater harvesting tank (RWT). The downpipe system shall be provided with a first flush device prior the rainwater entering the RWT.

The harvested rainwater will be filtered and treated to supply an irrigation tank which will be used to water soft landscaped areas. The tank will be topped up by a mains potable water supply.

Overflow from the rainwater harvesting tank, located within the tower, will be directed to the stormwater drainage system.

7.2.3 Surface Water

Courtyards, terraces at ground level, and surface water will be collected and conveyed via a downpipe system and floor pits to the stormwater drainage system. The stormwater drainage system will collect surface water flows and discharge to the harbour via outlet pipes installed through the seawall. The stormwater drainage network will be a gravity system which utilises the natural level change from the proposed site to the point of discharge.

8 External Works and Drainage

8.1 Site Stormwater Piping

The concept proposal will require the following:

- Verification of existing stormwater trunk network condition and capacities as they enter site.
- Verification of Harbour Street drainage piping in relation to new driveway and proposed building locations.
- Modifications maybe required to the existing trunk stormwater due to concept proposal piers.

8.2 Minor Design Storm Drainage

The minor drainage design storm will be the 20-year design storm. Setting this as the minor design storm means that rainfall runoff from all storm events up to and including the 20-year design storm will be conveyed through formalised in ground drainage structures to controlled points of discharge.

Appendix E presents the drainage design associated with the new tower design. Drawings also include drainage locations for the proposed driveway from Harbour Street into site.

Levels 2 and 3 will contain surface drain pits and below slab stormwater piping. This surface water will be designed by the hydraulic engineer to be directed to the site drainage system prior to discharge into the Cockle Bay.

8.3 Design Requirements

All stormwater drainage will be in accordance with the relevant requirements in:

- National Construction Code (NCC);
- Australian Rainfall and Runoff;
- Australian/New Zealand Standard AS/NZS 3500.3:20185;
- City of Sydney Council Streets Technical Specifications, Part A4 Drainage Design and Part B10: Stormwater Drainage Construction, and Standard Drawings;
- Managing Urban Stormwater (MUS): Soils and Construction – (Blue Book); and
- FAWB (2009). Adoption Guidelines for Stormwater Biofiltration Systems, Facility for Advancing Water Biofiltration, Monash University.

Table 5 – Stormwater Design Requirements

Element	Criteria
Pipe Class	Minimum Class 3
Design Loading	• SM1600 – Traffic Loading • T44, CAT16H – Construction Loading
Minimum Pipe Size	• Private Property – 150 mm diameter min. • Local Roads – 375mm diameter min.
Minimum Pit Sizes	• 450 x 450 mm (Up to 600 mm depth, pipe diameter: 150 to 300 mm) • 600 x 600 mm (Depth: 600 mm to 1.0 m, pipe diameter up to 300 mm) • 750 x 900 mm (Depth over 1.0 m, pipe diameter over 300 mm)
Maximum Spacing of Pits	• Desirable – 70m • Absolute – 120m
Pit Blockage Allowance	• On-grade – 0.2 • Sag – 0.5
Minimum Pipe Cover	Greater of 900 mm or SMZ plus 300mm
Design Storm	• Minor – 20 Year ARI • Major – 100 Year ARI
Minor Storm Pit Freeboard	• Desirable – 150 mm • Absolute – 100 mm
Design Freeboard	0.5m above trunk open drainage channel
Minor Storm Flow Widths	1.0 m width of flow into travel lane in 1 in 10-year event
Allowable Flow Velocities	• Max. 6.0m/s for 10 Year ARI • Min. 0.6m/s in 6-month ARI

9 Water Quality Requirements

9.1 Existing Site

At present, the extent of the site consists of approximately 90% impervious surfaces. The new development will not increase the percentage of impervious area. The new development will require pollution reduction measures incorporated within the design to remove potential contaminants from the system.

9.2 WSUD Pollution Reduction Initiatives

The quality of stormwater discharge into Cockle Bay is intended to meet the requirements normally imposed by the Council of the City of Sydney as specified in the Sydney Development Control Plan 2012 - Section 3 - Clause 3.7.3. The pollutant reduction guidelines outlined in the following table have therefore been adopted as the target values for water quality treatment.

Table 6 – Pollutant reduction targets

Pollutant	Guideline Reduction
Gross Pollutants (GP)	90%
Total Suspended Solids (TSS)	85%
Total Phosphorous (TP)	65%
Total Nitrogen (TN)	45%

9.3 WSUD Strategy

The WSUD Strategy proposed for the development will utilise a treatment train approach, consisting of the following: vegetated buffer, bioretention swales, vegetated swales, bioretention tree pits, rainwater tank, pit inserts and filtration devices.

To meet stormwater quality and quantity objectives for this development, a stormwater management system has been proposed that utilises the available landscape area for the installation of raingardens to treat the surface runoff.

The following design system has been proposed for the treatment of site runoff:

1. Pavements and all landscape areas will be graded toward various drainage infrastructure, e.g. drains, grated trenches and grated pits to mitigate the site runoff.

2. The surface area of the proposed rain-gardens shall be combined with a proprietary treatment device to achieve minimum Council pollution reduction targets. The raingardens shall have extended detention depths and shall provide treatment as part of a greater treatment train encompassing; rainwater harvesting tanks, onsite detention tanks and proprietary treatment devices.

3. The car park and hard surfaces areas shall be graded to achieve falls towards the raingardens where feasible and where direct runoff into the raingardens cannot be achieved, daylighting pipes onto the raingarden surface with appropriate velocity calming rock beaching or similar shall be undertaken to provide suitable catchment coverage.

4. The stormwater runoff shall be directed to raingardens and overflow grates shall convey runoff greater than a 1 in 20-year ARI to discharge via the proposed stormwater outfall from the site to Council's drainage network.

5. Where raingardens are situated on elevated area in the development, an overflow grate/s with a 1 in 100-ARI capacity shall be provided to ensure the local catchment does not breech the raingarden zone and flood the surrounding area.

9.3.1 Bioretention Swale

WSUD strategy starts with providing bioretention of stormwater. This strategy will be refined with detailed landscape design of the site to maximize bioretention and minimize mechanical filtration.

A stormwater bioretention system is an industry standard WSUD approach that improves the quality of stormwater by filtering water through a biologically influenced media. A typical bioretention system, such as a bioretention swale, consists of a vegetated surface overlaying a porous filter medium with a drainage pipe at the bottom. Stormwater is directed into the bioretention system, flows through dense vegetation and temporarily ponds on the surface before slowly filtering down through the filter media. Treated flows are then collected by the lower drainage system for conveyance to stormwater system.

Overflow pits will be provided within these swales to take in excess flows and discharge them into the surface drainage system. Subdrain pipes running at the base of the swales collect the treated flows and discharge them into the overflow pits.

9.3.2 Rain Gardens

Raingardens are specially designed garden beds which filter stormwater runoff from surrounding areas or stormwater pipes. They are also called bioretention systems as they provide biological treatment of stormwater using soil, plants, roots and microbes.

Raingardens are designed to stop excess stormwater, nutrients, and sediment from polluting recieving drainage system. They are positioned to capture overflow from a rainwater tank or surface water.

A raingarden lets water collect and settle on the garden surface then soak through the plants and filter media. Sediment is trapped on the surface. Nutrients dissolved in the stormwater are used by the plants and toxins stick to the soil. The soil and plant roots work together to naturally filter the water and remove pollutants.

9.3.3 Pit Inserts

Pit inserts, also known as litter baskets, are considered as an at-source primary treatment solution. It is an efficient and cost-effective pre-screening primary treatment system that captures and retains gross pollutants at drainage entry points. Pit inserts, consisting of a capture basket and a filter mesh liner, are usually fitted below the road invert or surface of the pit and hence are visually unobtrusive.

Pit inserts can be customised to fit almost any stormwater inlet pit and the mesh liner opening could vary depending on the targeted capture of solids, sediment and attached pollutants. Cleaning of the pit inserts is undertaken either manually or using a small vacuum truck. The cleaning frequency depends on the catchment type, size and expected pollutant loading.

Pit inserts have been proposed for the pits along the roads to treat runoff from the landscaped and impervious areas fronting the development.

9.3.4 Mechanical Filtration

Mechanical filtration devices can be used as a substitute where bioretention systems (e.g. bioretention swales and raingardens) are not possible or need augmentation. As a best management practice treatment option, such engineered devices are designed to remove a range of target pollutants including fine solids, soluble heavy metals, oils and nutrients. Apart from meeting stringent regulatory requirements, these filtration systems (e.g. Stormwater 360's StormFilter) are usually installed below ground allowing savings in land space and hence increase development yield and more efficient maintenance and management.

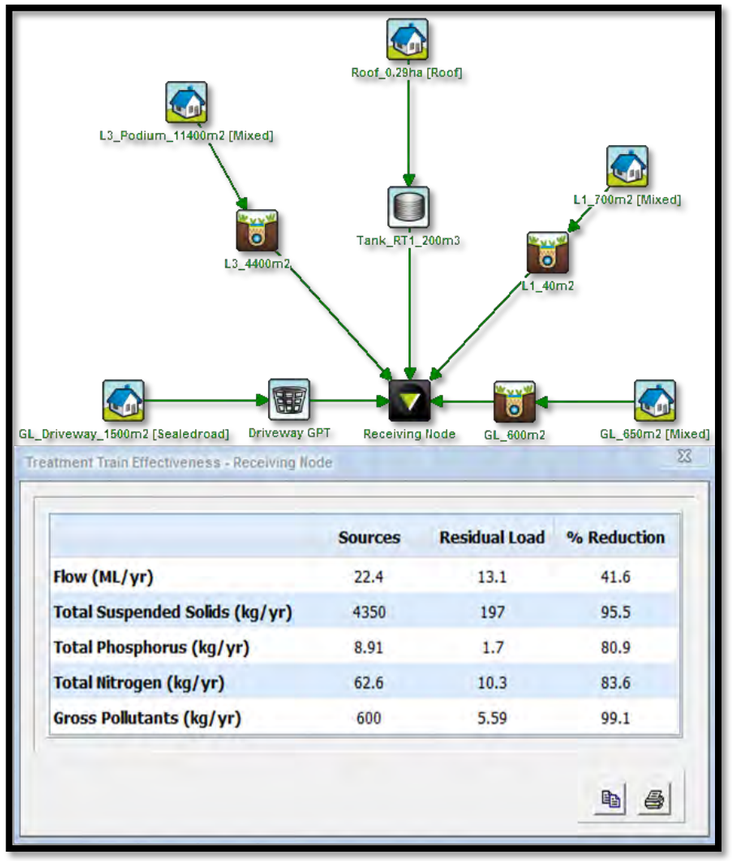
9.4 Music Modelling Setup

A water quality analysis has been undertaken by **en**struct to develop the WSUD strategy for the concept proposal to meet Council's water quality targets. The water quality modelling for this study was undertaken using the industry standard software model MUSIC (Model for Urban Stormwater Improvement Conceptualisation) Version 6.2. The MUSIC model layout representing the proposed WSUD strategy for the concept proposal is shown in Figure 6. A larger version of this MUSIC model layout is included in Appendix B.

The catchments considered in the water quality analysis was considered for areas containing:

- Tower
- Podium retail
- Public domain
- Access road to site.

Roads in immediate vicinity of the site (Harbour Street and Western Distributor Freeway) are not included in the stormwater quality assessment. The road drainage and quality treatment system is proposed to remain unchanged.



	Sources	Residual Load	% Reduction
Flow (ML/yr)	22.4	13.1	41.6
Total Suspended Solids (kg/yr)	4350	197	95.5
Total Phosphorus (kg/yr)	8.91	1.7	80.9
Total Nitrogen (kg/yr)	62.6	10.3	83.6
Gross Pollutants (kg/yr)	600	5.59	99.1

Figure 6 – MUSIC model layout for the concept proposal

9.4.1 Modelling Data & Parameters

The nearest rainfall station with a reasonable period of 6-minute rainfall data is Sydney (Station 066037) which is approximately 7 km from the site. In MUSIC, rainfall data is available for this station from 1/01/1990 to 21/12/1999. However, for water quality modelling purposes, only rainfall data for the 6-minute period was used. Apart from addressing the required data length of 10 years, this period was selected for the quality and continuity of the available rainfall data. The mean annual rainfall (MAR) during this 10-year period is 1,035 mm which is slightly lower than the long-term MAR of 1,261 mm which was calculated from the rainfall data sourced from the Bureau of Meteorology (BOM) website.

The soil / groundwater parameters and the pollutant loading rates adopted for the site for Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN) used in the MUSIC model are consistent with the values recommended by both Sydney Metropolitan Catchment Management Authority (SMCMA) and Sydney Catchment Authority (SCA) guidelines. A summary of the soil / groundwater parameters and pollutant loading rates are provided in Appendix B.

9.4.2 Results

The MUSIC model developed for the development was run to estimate the annual pollutant loads attributed to the concept proposal as well as the resultant pollutant loads leaving the site after flows go through the treatment train proposed for the development.

Table 7 presents the estimated average annual pollutant export loads from the concept proposal and the performance of the adopted treatment train of stormwater management measures based on the MUSIC modelling.

It shows that the estimated average annual pollutant export loads from the concept proposal have been reduced using the adopted treatment train stormwater management measures and that the treatment targets set in Council's guidelines have been met.

Table 7 – Estimated mean annual pollutant loads and reductions for the concept proposal

Criteria	Pollutant			
	Gross Pollutants	TSS	TP	TN
Total Development Source Loads (kg/yr)	600	4350	8.91	62.6
Minimum Reduction Required	90%	85%	65%	45%
Total Residual Load leaving the site (kg/yr)	5.59	197	1.7	10.3
Total Reduction Achieved	99.1%	95.5%	80.9%	83.6%
Compliance Rating	Pass	Pass	Pass	Pass

The combination of vegetated buffer, bioretention swales, rainwater tank, pit inserts and filtration devices as elements of the Stormwater Quality Management Strategy for the concept proposal will achieve all the pollution reduction targets (Gross Pollutants, Total Suspended Solids, Total Phosphorus and Total Nitrogen) recommended by City of Sydney Council.

10 Sediment and Erosion Control

The erosion and sediment control measures adopted for the development during the construction phase have been designed in accordance with Council guidelines and Soils and Construction – Managing Urban Stormwater – Landcom.

The measures to be adopted are summarised in the table below:

Table 8 – Sedimentation Control

Measure	Location	Purpose
Sediment Fence	Near site boundary along the downstream side of the site.	To prevent sediment leaving the site with stormwater runoff. Stormwater will pass through the fence but the fence will trap the sediment.
Shaker Grid and Wash Down	At construction exit from the site.	To remove ground materials from the construction vehicle wheels prior to the vehicle leaving the site and discharging material onto the public roadway.
Sand Bag Sediment Traps	Directly upstream of all stormwater kerb inlet structures located in close proximity of the site.	To prevent sediment discharged from the site from entering the stormwater inlet structure and contaminating the water course.
Inlet Sediment Trap	Around any stormwater surface inlet structures	To prevent sediment discharged from the site from entering the stormwater inlet structure and contaminating the water course.
Sediment Basin	At the downstream end of the site near the boundary.	To store sediment on site during the construction phase. Basins to be cleaned out prior to the completion of the landscaping in the basins.

Erosion and sediment controls are to be provided during the construction phase in accordance with applicable guidelines and as shown in Appendix C.

The general approach is intended to confine all ground level soil disturbance between Harbour Street and the foreshore of Cockle Bay, so that no sediment will be transferred to the adjacent streets or introduced into the existing stormwater drainage lines discharging through the sea wall. During

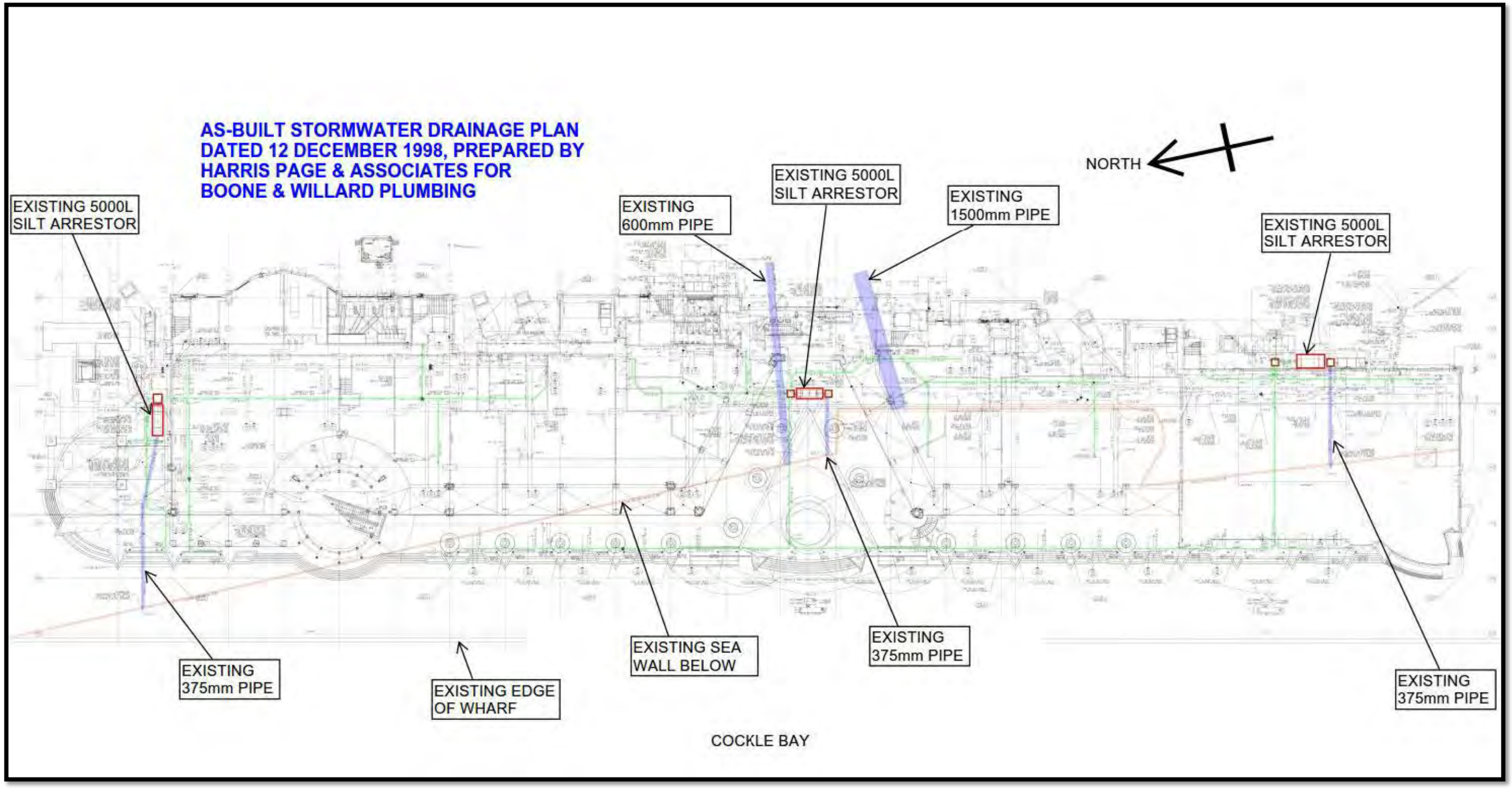
earthworks behind the existing Park structure, suitable temporary sediment basins within the demolished site areas will be provided to capture all runoff from disturbed areas.

Additional measures such as sediment fences surrounding disturbed areas, sand bags around existing pit inlets and a truck shaker grid at the point of access to the work area are to be included where appropriate in the Contractor's detailed soil and water management plan, to be submitted for approval prior to commencement of any work on the site.

Final details of Erosion and Sediment Control measures for the early works and main works to be implemented on site by the successful contractor. The Contractor will be required to take into account the site works staging including the preferred site access points, site shed locations and temporary stockpile locations in developing and implementing these requirements but will be ultimately responsible for managing temporary stormwater and sediment and erosion control during construction.

APPENDIX A

EXISTING STORMWATER PLAN


AS-BUILT STORMWATER DRAINAGE PLAN
DATED 12 DECEMBER 1998, PREPARED BY
HARRIS PAGE & ASSOCIATES FOR
BOONE & WILLARD PLUMBING
NORTH
EXISTING 5000L SILT ARRESTOR
EXISTING 600mm PIPE
EXISTING 5000L SILT ARRESTOR
EXISTING 1500mm PIPE
EXISTING 5000L SILT ARRESTOR
EXISTING 375mm PIPE
EXISTING EDGE OF WHARF
EXISTING SEA WALL BELOW
EXISTING 375mm PIPE
EXISTING 375mm PIPE
COCKLE BAY

APPENDIX B

WSUD MUSIC MODEL

Stormwater Treatment

WATER QUALITY (MUSIC) MODEL FOR COCKLE BAY PARK

Filename: 4886_Cockle_Bay_rev1.sqz

As part of preparing a WSUD Strategy, stormwater quality modelling is required to quantify stormwater pollutant loads and test management measures to reduce pollutant loads in line with the stormwater quality targets. The sizing of stormwater treatment measures can be refined using a stormwater quality model like MUSIC.

MUSIC is a planning and conceptual design tool. It can be used to estimate stormwater pollutant loads that will be generated in a catchment, predict the performance of stormwater treatment measures, develop a stormwater management strategy for a catchment and estimate life cycle costs for stormwater treatment systems.

WSUD Pollution Reduction

The quality of stormwater discharge into Cockle Bay is intended to meet the requirements normally imposed by the Council of the City of Sydney as specified in the Sydney Development Control Plan 2012 - Section 3 - Clause 3.7.3. The pollutant reduction guidelines outlined in the following table have therefore been adopted as the target values for water quality treatment.

Table B1 – Pollution reduction targets

Pollutant	Target
Gross Pollutants	90%
Total Suspended Solids	85%
Total Phosphorous	60%
Total Nitrogen	45%

Existing Site

At present the extent of the current site of the concept proposal is fully covered with an impervious surface.

It is **en**struct's opinion that the concept proposal adds no additional impact to the surrounding environment nor does it increase any burden on the existing stormwater infrastructure or surrounding bay. It is **en**struct's opinion the site's post development conditions will be better than the pre-development conditions as the new development will have pollution reduction measures incorporated within the design which will remove potential contaminants from the system.

Water Efficiency Conservation

The nearest rainfall station with a reasonable period of 6-minute rainfall data is Sydney (Station 066037) which is about 14 km from the site. In MUSIC, rainfall data is available for this station from 1/01/1990 to 21/12/1999. However, for water quality modelling purposes, only rainfall data for the 6-minute period was used. Apart from addressing the required data length of 10 years, this period was selected for the quality and continuity of the available rainfall data. The mean annual rainfall (MAR) during this 10-year period is 1,035 mm which is slightly lower than the long-term MAR of 1,261 mm which was calculated from the rainfall data sourced from the Bureau of Meteorology (BOM) website.

The rainwater will be harvested from the tower roof structure will be split and gravitated to a 200,000 litre rainwater harvesting tanks via first flush devices located on Ground Level of the building. The rainwater will be filtered and treated, prior to being reticulated through the building via pressure booster pumps.

Treated rainwater will be reticulated through the building as a non-potable water service for the purposes of toilet, urinal flushing and landscape water supply.

In the event of overflow from rainwater harvesting tank, the water will overflow to the site stormwater system to the bay.

Model Case Setup

The proposed stormwater quality management strategy for Cockle Bay Park will consist of the following treatment devices:

1. Rainwater tank (vol. = 200 m^3) is used for rainwater harvesting from roof areas.
2. Raised landscaped areas to have bioretention function. This water will be drained to bay, and there is no OSD for this site.
3. Driveways will be provided with Gross Pollutant Treatment (GPT) devices. There are no planter areas in ground level near driveways for WSUD treatment. This water will exit directly after GPT treatment to bay.

Table B2 – East Core Tower Contributing Areas

Level	Elevation	LS Area	Tree Pits	Surface Area	Paved Area
Ground Level	3.2	600	120	7650	1500
Level 1	7.75		40	700	
Level 2	14				
Level 3	19	3100	55	11400	
Level 4	24			2900	
… Roof	189.8			4650	

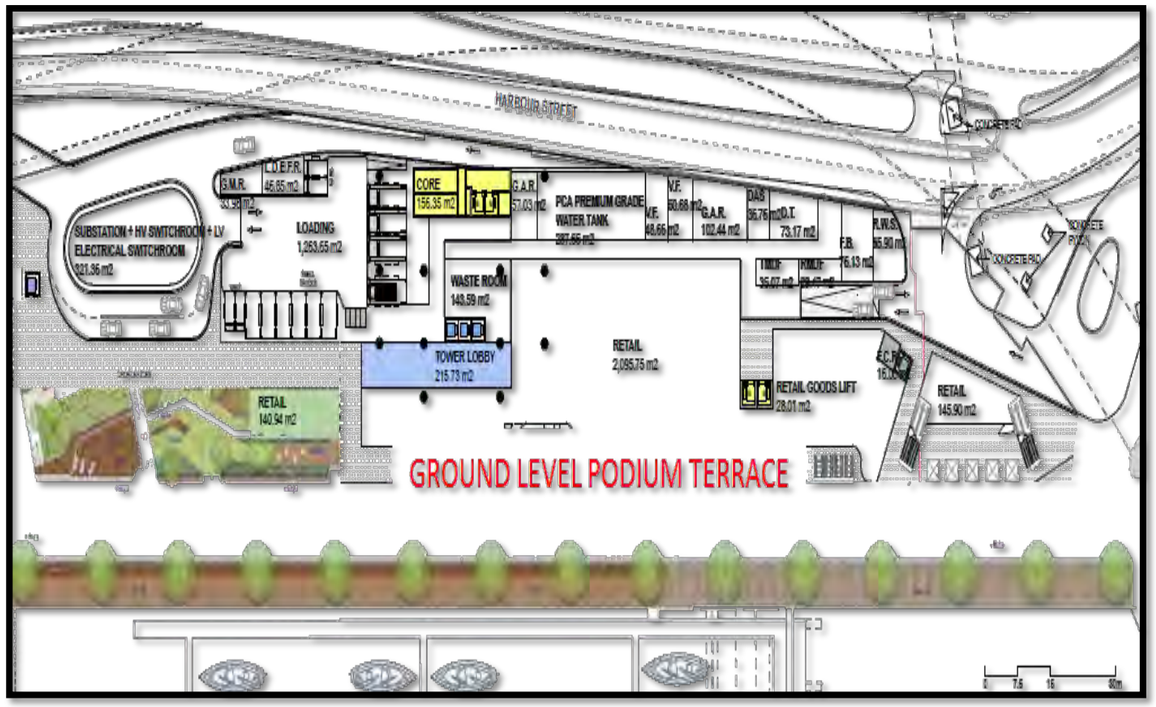


Figure B1 – Ground level podium terrace LS area

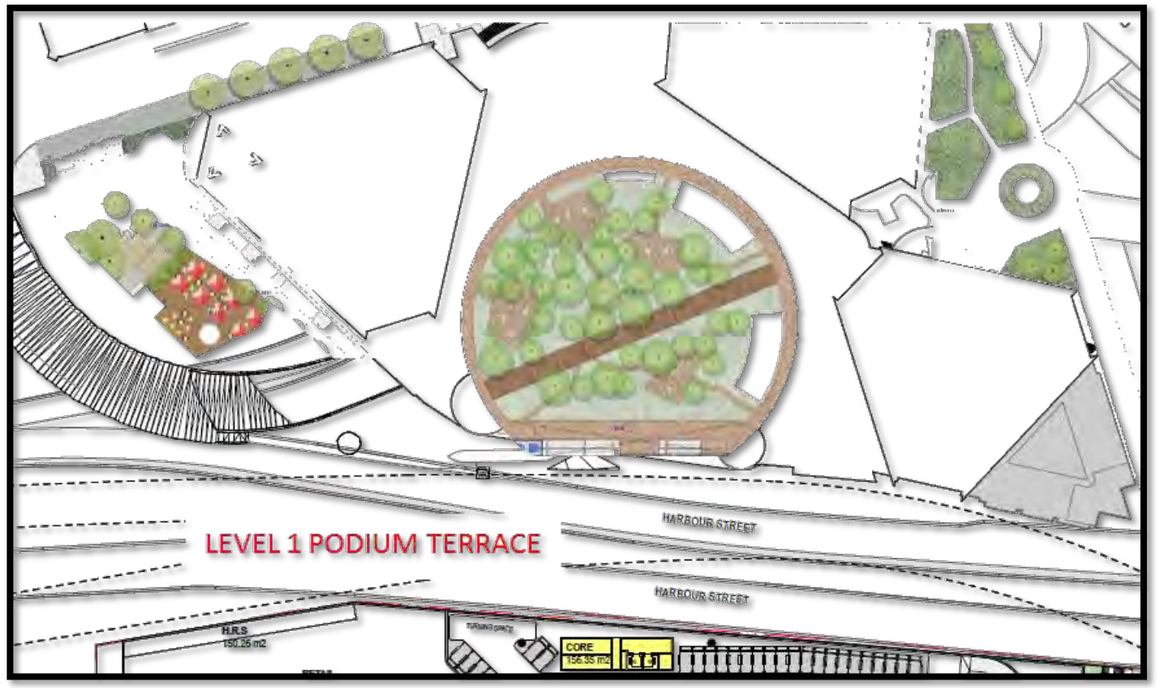


Figure B2 – Level 1 podium terrace LS area

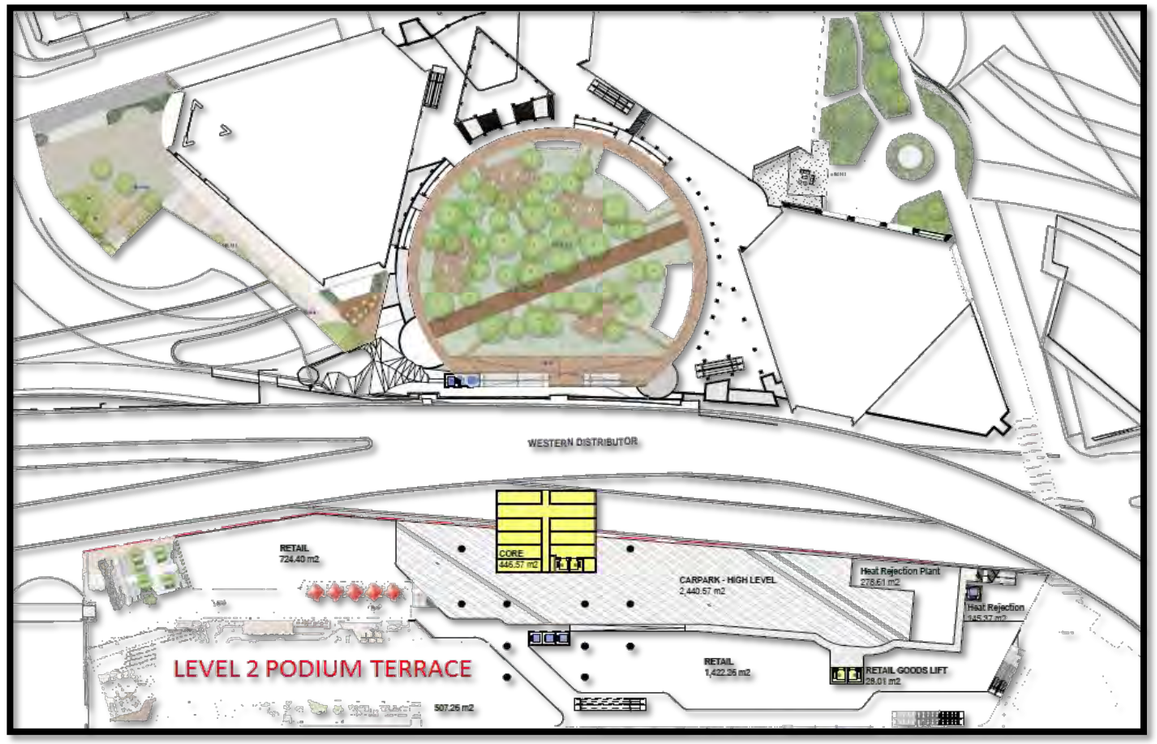


Figure B3 – Level 2 podium terrace LS area

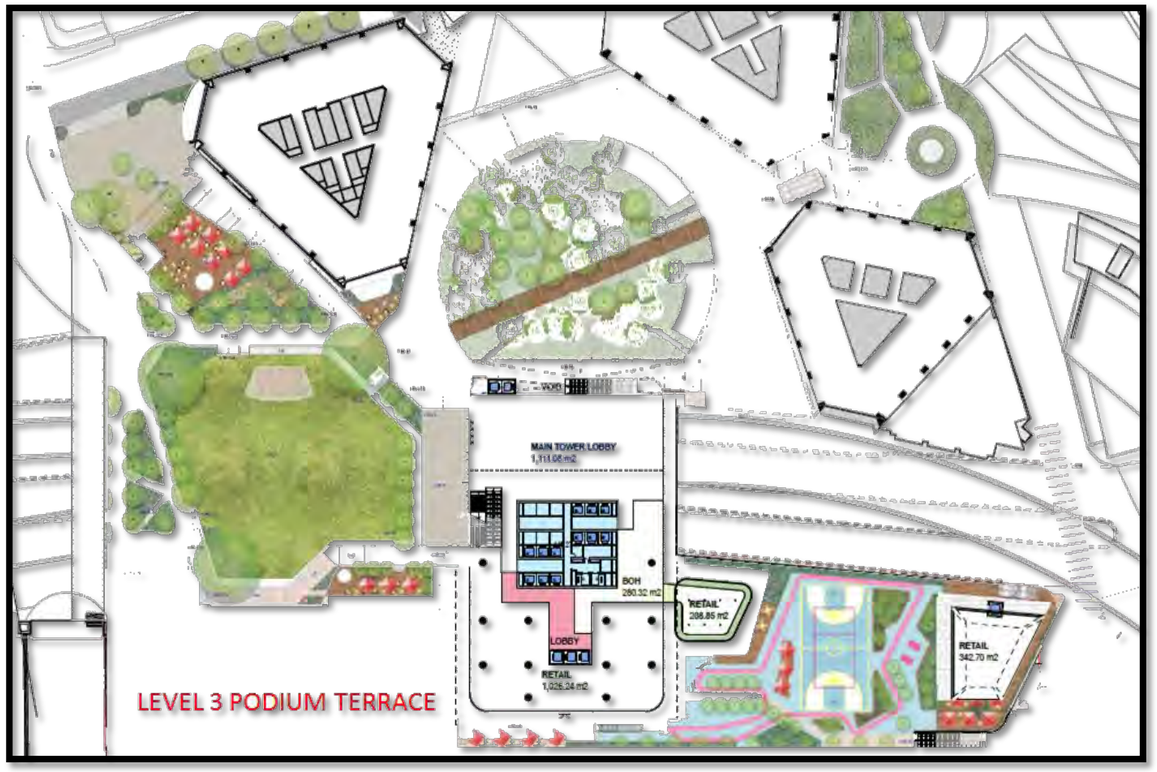


Figure B4 – Level 3 podium terrace LS area

Areas with grass require minimum of 600mm soil depth, whereas tree pits require 1200mm to grow. These areas are condusive to be retrofitted for bioretention and utilised for WSUD. Additional collaboration with landscape architect is required at advanced stages of design to align WSUD with landscaping strategy.

Stormwater Pollution

Pollution to waterways can come from direct sources such as sewage and industry and diffuse sources, including stormwater. Stormwater flows overland and into the stormwater system through the local drainage pipe network that feeds into larger trunk drains and channels that ultimately discharge to receiving waterways. The four key pollutants associated with stormwater include total nitrogen (TN), total phosphorous (TP), total suspended solids (TSS) and gross pollutants (GP). Each of these has been considered when analysing the pollution reduction potential of WSUD opportunities.

For the purposes of reporting, TN has been adopted as a proxy for other nutrients, particularly TP. A brief explanation of each of these follows:

GP: represents floatable litter including rubbish, leaf litter, grass clippings and twigs that cause visual as well as environmental pollution of waterways.

TSS: represents the silt and organic or inorganic suspended particles transported by stormwater runoff from the roofs, hardstands, roads and construction activities in the City.

TN: has been adopted as a proxy for nutrients contained within leaf litter, dog droppings and fertilisers from gardens and parks. Although not as visible as GP and TSS, high concentrations of nutrients can harm waterways resulting in algal blooms that damage the ecological health of waterways.

Other pollutants such as oil, grease, heavy metals and hydrocarbons that originate from vehicular traffic are also harmful to the visual amenity and ecological function of waterways, however they have not been specifically modelled and quantified.

Surface Area and Pollutant Concentrations

MUSIC modelling software was used to estimate stormwater pollution loads for each sub-catchment based on the surface area analysis completed as part of the catchment characterisation stage. The pollutant concentrations assumptions made are summarised in Table B3.

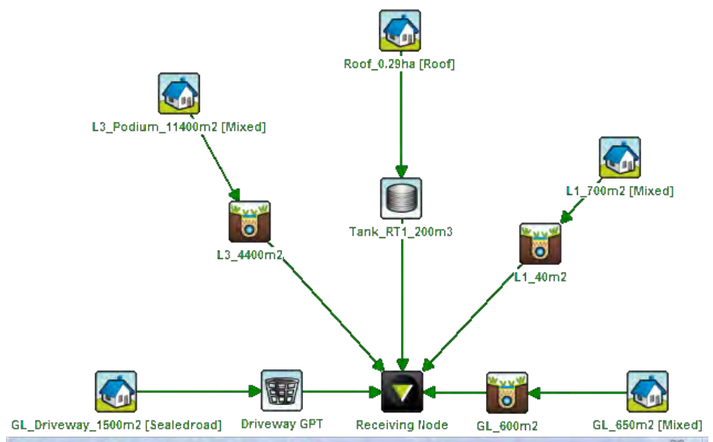
Table B3 – Pollutant Concentration Assumptions

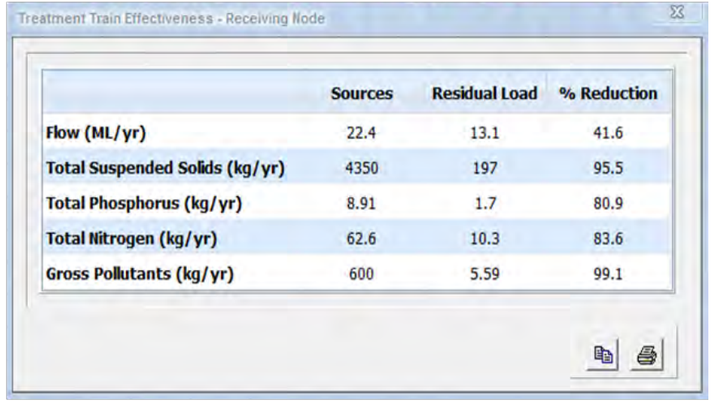
Surface Type	TSS (mg/l)	TP (mg/l)	TN (mg/l)
Road	270	0.5	2.2
Roof	20	0.13	2
Hardstand areas (e.g. pavements and car parks)	140	0.25	2
Pervious areas (e.g. parks and gardens)	90	0.16	1.4

The soil / groundwater parameters and the pollutant loading rates adopted for the site for Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN) used in the MUSIC model are consistent with the values recommended by both Sydney Metropolitan Catchment Management Authority (SMCMA) and Sydney Catchment Authority (SCA) guidelines.

WSUD Pollution Reduction Model

To refine the site model further based on proposed site development master plan, building was modelled with RWT and effluent treatment train. In addition, surface areas were further broken down into their section components as depicted on the following Music Model:




Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	22.4	13.1	41.6
Total Suspended Solids (kg/yr)	4350	197	95.5
Total Phosphorus (kg/yr)	8.91	1.7	80.9
Total Nitrogen (kg/yr)	62.6	10.3	83.6
Gross Pollutants (kg/yr)	600	5.59	99.1

The below table outlines DCP for WSUD performance target to proposed treatment devices performance achieved.

Table B4 – WSUD Stormwater Quality Performance

Pollutant	Target	Achieved
Gross Pollutants	90%	99.1%
Total Suspended Solids	85%	95.5%
Total Phosphorous	60%	80.9%
Total Nitrogen	45%	83.6%

Therefore, the proposed stormwater quality management strategy exceeds Council's pollutant reduction targets.

WSUD Maintenance Strategy

As part of the site's WSUD strategy regular maintenance will be undertaken on the pollution reduction devices/initiatives described above in this report. The maintenance of the devices will be as indicated in the maintenance schedule below.

OSD Systems

Maintenance Action	Frequency	Responsibility	Procedure
Outlets			
Inspect & remove any blockage of orifice plates	Six Monthly	Owners Contractor	Remove grate & screen to inspect orifice. See plan for location of outlets
Check attachment of orifice plates to wall of chamber and/or pit (gaps less than 5 mm)	Annually	Maintenance Contractor	Remove grate and screen. Ensure plates are mounted securely, tighten fixings if required. Seal gaps as required.
Check orifice diameters are correct and retain sharp edges	Five yearly	Maintenance Contractor	Compare diameter to design (see Work-as-Executed) and ensure edge is not pitted or damaged.
Inspect screen and clean	Six monthly	Owner	Remove grate(s) and screens if required to clean them.
Check attachment of screens to wall of chamber or pit	Annually	Maintenance Contractor	Remove grate(s) and screen(s). Ensure screen fixings are secure. Repair as required.
Check trash screen(s) for corrosion	Annually	Maintenance Contractor	Remove grate(s) and examine screen(s) for rust or corrosion, especially at corners or welds.
Inspect walls (internal and external, if appropriate) for cracks or spalling	Annually	Maintenance Contractor	Remove grate(s) to inspect internal walls. Repair as required. Clear vegetation from external walls if necessary and repair as required.
Inspect outlet sumps & remove any sediment/sludge	Six monthly	Owner	Remove grate(s) and screen(s). Remove sediment/sludge build-up and check orifices are clear.
Inspect grate(s) for damage or blockage	Six monthly	Owner	Check both sides of a grate for corrosion, (especially corners and welds) damage or blockage.
Inspect outlet pipe & remove any blockage	Six monthly	Maintenance Contractor	Remove grate(s) and screen(s). Ventilate underground storage if present. Check orifices and remove any blockages in outlet pipe. Flush outlet pipe to confirm it drains freely. Check for sludge/debris on upstream side of return line.
Check step irons for corrosion	Annually	Maintenance Contractor	Remove grate. Examine step irons and repair any corrosion or damage.
Check fixing of step irons is secure	Six monthly	Maintenance Contractor	Remove grate(s) and ensure fixings are secure prior to placing weight on step iron.
Storage			
Inspect storage & remove any sediment/sludge in pit	Six monthly	Owner	Remove grate(s) and screen(s). Remove sediment/sludge build-up.
Inspect internal walls of storage (and external, if appropriate) for cracks or spalling	Annually	Maintenance Contractor	Remove grate(s) to inspect internal walls. Repair as required. Clear vegetation from external walls if necessary and repair as required.
Inspect & remove any debris/litter/mulch etc. blocking grates	Six monthly	Owner	Remove blockages from grate(s) and check if storage is blocked.
Inspect areas draining to the storage(s) & remove debris/mulch/litter etc likely to block screens/grates	Six monthly	Owner	Remove debris and floatable material likely to be carried to grates.
Compare storage volume to volume approved. (Rectify if loss >5%)	Annually	Maintenance Contractor	Compare actual storage available with Work-as Executed plans. If volume loss is greater than 5%, arrange for reconstruction to replace the lost volume. Council to be notified of the proposal.
Inspect storages for subsidence near pits	Annually	Maintenance Contractor	Check along drainage lines and at pits for subsidence likely to indicate leakages.
Inspect OSD Overflow Weir	Six Monthly	Owner	Check that the overflow weir slot is free of obstructions to allow emergency overflow of the OSD storage system.

First Flush Devices

Maintenance Action	Frequency	Responsibility	Procedure
Inspect & remove any blockage or silt build up in the first flush diverter systems.	Monthly	Owner	Remove diverter filtration screens and clean first flush diverter of all silt or debris build up in diverter tailpipe

Gross Pollutant Trap

Maintenance Action	Frequency	Responsibility	Procedure
Pump out all debris from pollutant trap	Three monthly	Owner	Remove grate(s) and screens as required. Pump out contents of collection trap into collection truck.
Inspect trash screen and clean	Six monthly	Owner	Remove grate(s) and screens if required to clean them.
Check attachment of screens to wall of chamber or pit	Annually	Owner	Remove grate(s) and screen(s). Ensure screen fixings are secure. Repair as required.
Check trash screen(s) for corrosion	Annually	Owner	Remove grate(s) and examine screen(s) for rust or corrosion, especially at corners or welds.
Inspect outlet sumps & remove any sediment/sludge	Six monthly	Owner	Remove grate(s) and screen(s). Remove sediment/sludge build-up and check orifices are clear.
Inspect grate(s) for damage or blockage	Six monthly	Owner	Check both sides of a grate for corrosion, (especially corners and welds) damage or blockage.
Inspect outlet pipe & remove any blockage	Six monthly	Owner	Remove grate(s) and screen(s). Ventilate underground storage if present. Check outlet and remove any blockages in outlet pipe. Flush outlet pipe to confirm it drains freely. Check for sludge/debris on upstream side of return line.

Silt Arrestor Devices

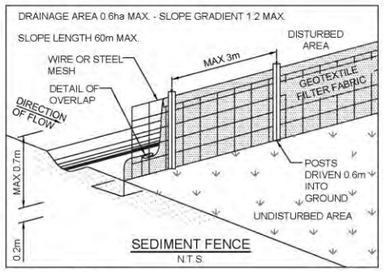
Maintenance Action	Frequency	Responsibility	Procedure
Inspect & remove any blockage or silt build up in the Silt Arrestor systems.	Six Monthly	Owner	Remove debris and floatable material likely to be carried to the silt arrestor.

APPENDIX C

EROSION AND SEDIMENT CONTROL PLAN

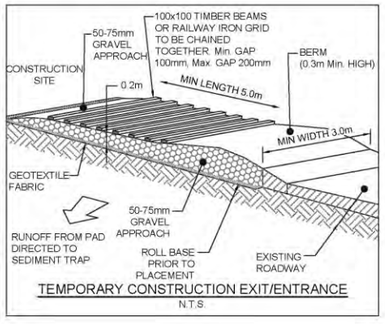
EROSION AND SEDIMENT CONTROL

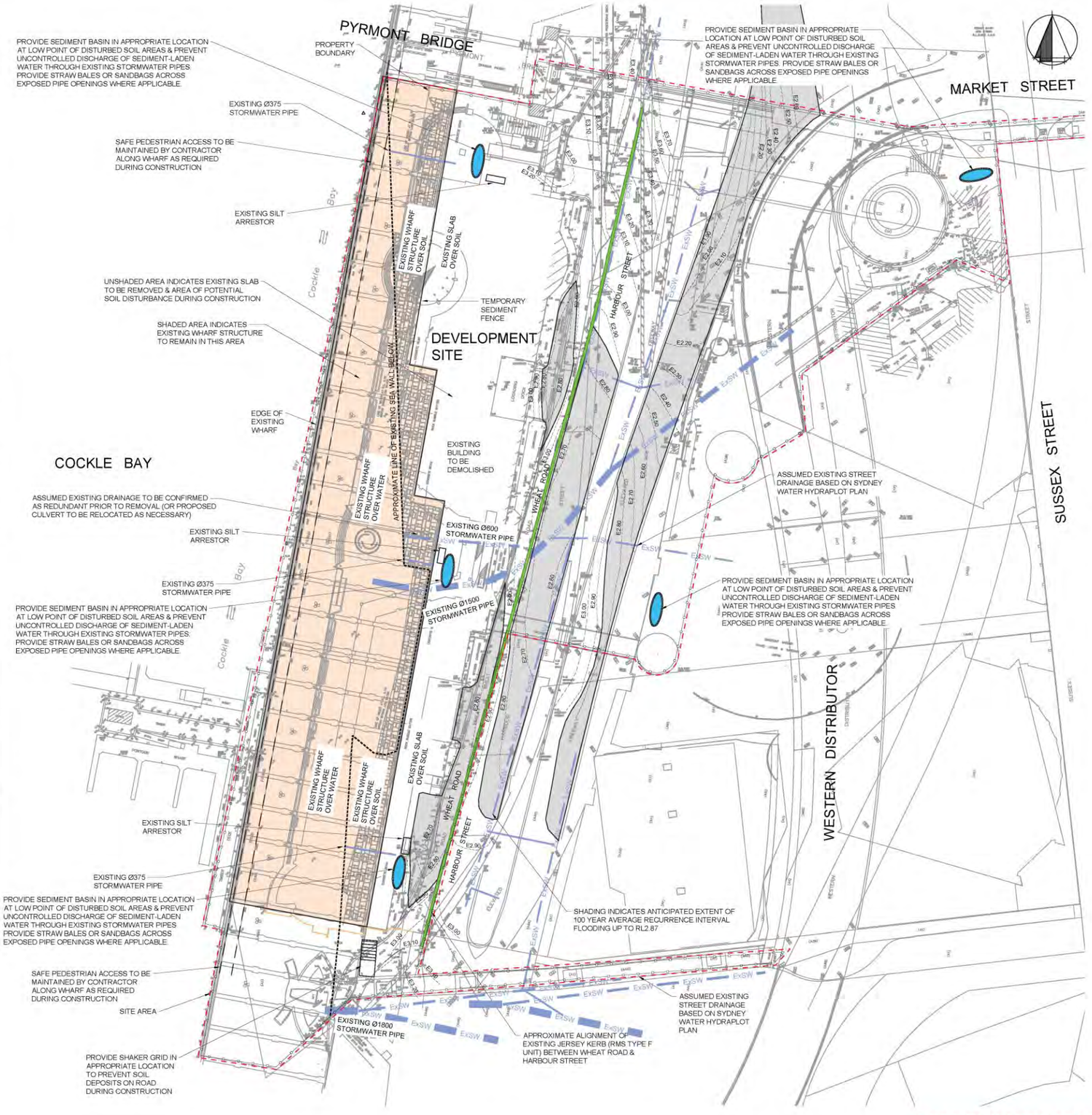
1. THE CONTRACTOR SHALL PROVIDE ADEQUATE TRUCK WASH FACILITIES AT THE SITE EXIT AND SHALL CLEAN ALL VEHICLES EXITING THE SITE TO ENSURE MATERIALS AND MUD IS NOT TRANSPORTED AND DEPOSITED OFF SITE. WATER FROM ANY WASHBAY IS TO BE DIVERTED TO THE SEDIMENT FENCE OR TO THE SEDIMENT BASIN PRIOR TO DISCHARGE.
2. NOTWITHSTANDING THE EROSION AND SEDIMENT CONTROL NOTES THE CONTRACTOR SHALL NOTE THEIR OVERARCHING OBLIGATION WITH CITY OF SYDNEY COUNCIL IN RESPECT OF ENVIRONMENTAL CONTROLS. PARTICULARLY ONGOING TESTING OF DISCHARGE, MAINTENANCE, DREDGING OF SEDIMENTATION PONDS AND FINAL FILTRATION AT OUTLETS.
3. THE CONTRACTOR SHALL TAKE ALL STEPS NECESSARY TO PROTECT THE ENVIRONMENT AND IN PARTICULAR SHALL CONTROL EROSION, SEDIMENTATION AND POLLUTION DURING CONSTRUCTION IN ACCORDANCE WITH THE REQUIREMENTS OF THE EPA, THE RELEVANT HARBOUR FORESHORE AUTHORITY, LOCAL COUNCIL, AND THE EROSION AND SEDIMENT CONTROL PLAN.
4. EROSION AND SEDIMENT CONTROL DEVICES ARE TO BE CONSTRUCTED IN ACCORDANCE WITH "MANAGING URBAN STORMWATER - SOILS AND CONSTRUCTION' (2004 - BLUE BOOK), AND THE CITY OF SYDNEY COUNCIL'S DCP.
5. EROSION AND SEDIMENT CONTROL DEVICES SHALL BE CONFIRMED IN THE QUALITY PLAN PRODUCED BY THE CONTRACTOR AND SHALL BE IMPLEMENTED AND ADJUSTED TO SUIT CONSTRUCTION ACCESS AND STAGING.
6. FOLLOWING EVERY RAINFALL EVENT EXCEEDING 10mm OR WHEN BASINS ARE GREATER THAN 50% FULL, WATER SHALL BE TESTED FOR COMPLIANCE WITH EPA'S STANDARDS AND, IF FOUND NOT TO COMPLY, WATER SHALL BE TREATED BY APPROPRIATE FLOCCULATION, FILTRATION OR OTHER APPROVED METHODS.
7. WATER SHALL NOT BE REMOVED FROM SEDIMENT BASIN UNTIL TESTED WATER MEETS EPA WATER QUALITY REQUIREMENTS e.g <50 MG/L SUSPENDED SOLIDS.
8. CONTRACTOR TO PROVIDE ALL PERIMETER SITE FENCING FOR SECURITY & SAFETY PURPOSES AS REQUIRED.



INSTALLATION

1. EXCAVATE A TRENCH 200mm DEEP.
2. DRIVE POSTS 500-700mm INTO GROUND AT A MAXIMUM SPACING OF 3.0m CENTRES.
3. PLACE AND FIX SUPPORT MESH (F52) TO POST.
4. LAY BIDIM GEOFABRIC (SF 2000) AGAINST THE SUPPORT MESH AND FIX BY TIE WIRE, STAPLES OR HOG RINGS.
5. PLACE BIDIM IN TRENCH AND BACKFILL WITH SOIL.





NOT FOR CONSTRUCTION

LEGEND

- PROPOSED TEMPORARY SEDIMENT FENCE
- PROPOSED TEMPORARY SEDIMENT BASIN
- FLOW DIRECTION
- PROPOSED TEMPORARY SHAKER GRID AND WASH DOWN FACILITY
- PROVIDE TEMPORARY SANDBAGS AROUND PITS OR EXPOSED PIPES:
  1. AFTER PAVEMENT WORKS ARE COMPLETE IF WORKS ARE ONGOING UPSTREAM
  2. TO EXISTING GRATED PITS OR OPEN PIPE ENDS DOWNSTREAM OF CONSTRUCTION WORKS
- ExSW — EXISTING DRAINAGE
- SW — PROPOSED DRAINAGE

SCALE 1:500

0 10 20 30 m

rev	date	description	drn	ch'k
2	07.08.17	PRELIMANRY DA ISSUE	IM	ER
1	23/09/16	PRELIMANRY DA ISSUE	IY	GH

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project: COCKLE BAY WHARF REDEVELOPMENT

drawing title: EROSION & SEDIMENT CONTROL PLAN

status: FOR INFORMATION ONLY

scale at A1	drawn by	checked	date
1:500	IY	GH	SEP-16

project no.	drawing no.	rev.
4886	CV-0400	2

APPENDIX D

FLOODING PLAN

7 DESIGN FLOOD RESULTS

A range of design flood events were modelled, the results of which are presented and discussed below. The simulated design events included the 2 year ARI, 5 year ARI, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.2% AEP and PMF events for catchment derived flooding and the 1 year ARI Harbour level for the tidal inundation mapping.

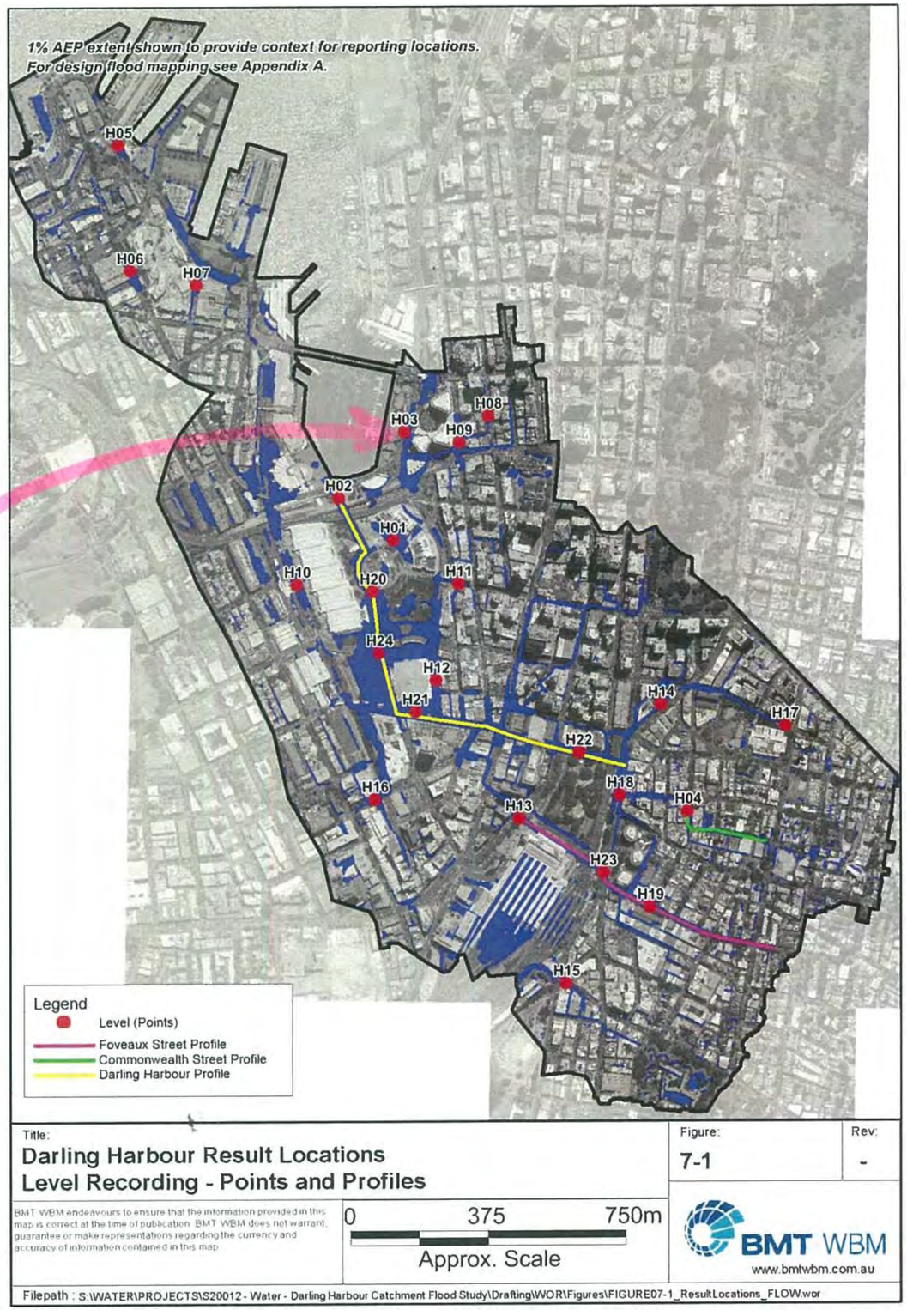
A range of design event storm durations have been simulated for each event. The design results presented in the remainder of the report represent the maximum values across all durations (peak envelope) for each design event simulated.

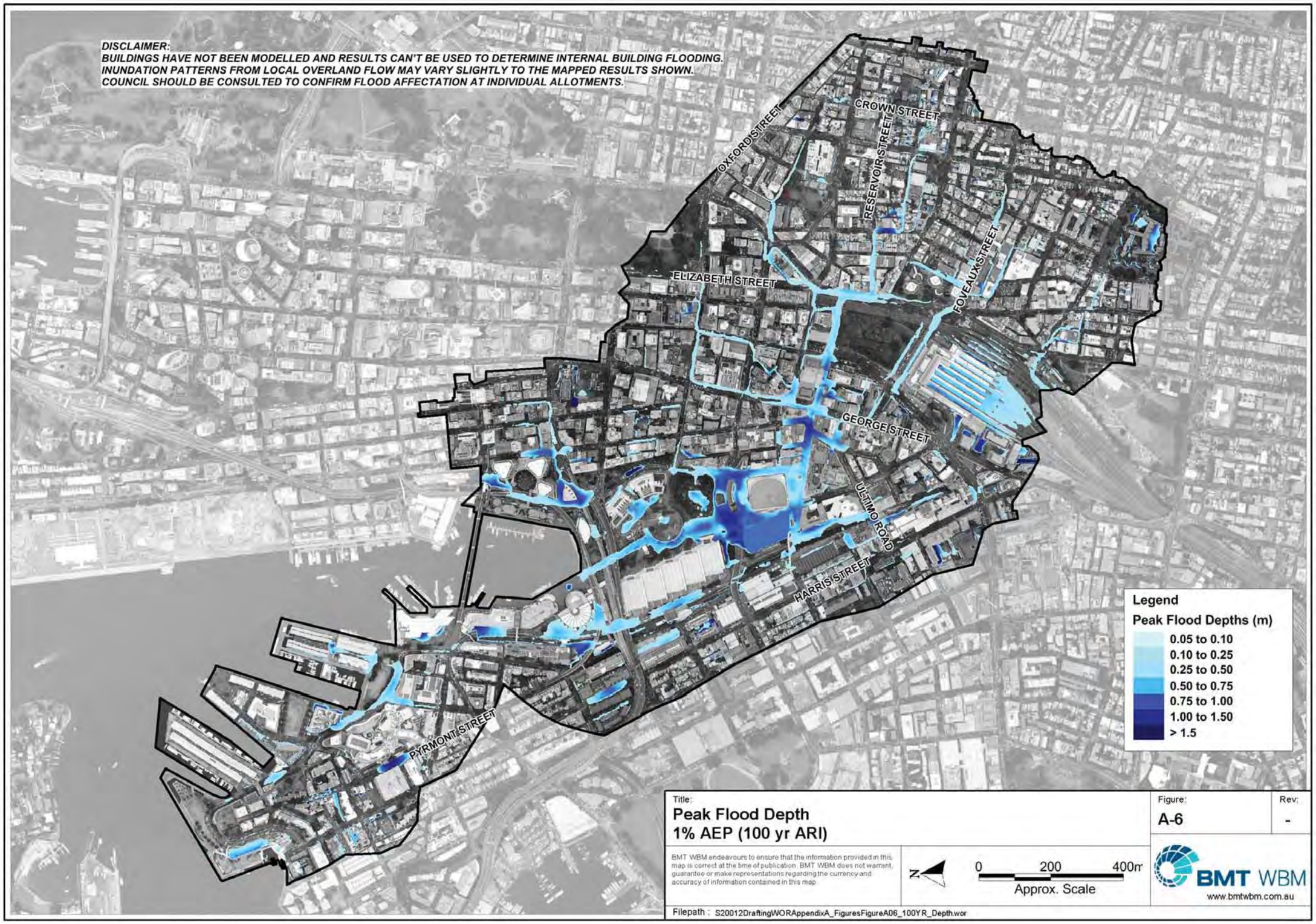
A series of design flood maps are provided in Appendix A. Supplementary to mapped results output, tabular results of peak flood behaviour have been provided for all design events in Table 7-1 and Table 7-2. The locations of flooding behaviour reported in Table 7-1 and Table 7-2 are shown in Figure 7-1 and Figure 7-2, respectively.

Table 7-1 Peak design flood levels

Location#	2yr ARI	5yr ARI	10% AEP	5% AEP	2% AEP	1% AEP	0.2% AEP	PMF
H01	3.38	3.40	3.42	3.42	3.43	3.44	3.45	4.29
H02	2.43	2.44	2.45	2.46	2.60	2.69	2.83	3.50
H03	2.76	2.76	2.76	2.77	2.82	2.87	2.95	3.34
H04	16.54	16.60	17.23	17.32	17.39	17.45	17.57	18.09
H05	2.60	2.63	2.68	2.73	2.76	2.79	2.85	3.00
H06	6.47	6.55	7.23	7.32	7.42	7.53	7.77	10.81
H07	2.54	2.60	2.75	2.79	2.82	2.85	2.90	3.16
H08	11.34	11.36	11.37	11.38	11.39	11.40	11.42	11.57
H09	5.40	5.51	5.62	5.69	5.73	5.77	5.87	6.24
H10	2.77	2.85	2.89	2.95	3.02	3.09	3.18	4.47
H11	6.82	6.83	6.85	6.88	6.89	6.90	6.92	6.99
H12	2.88	3.01	3.08	3.14	3.18	3.23	3.43	4.62
H13	11.49	11.52	11.53	11.54	11.55	11.56	11.58	11.72
H14	17.06	17.09	17.10	17.11	17.12	17.13	17.14	17.31
H15	24.37	24.39	24.40	24.42	24.42	24.43	24.46	24.66
H16	4.45	4.52	4.57	4.60	4.63	4.67	4.74	5.22
H17	35.06	35.07	35.07	35.09	35.09	35.10	35.11	35.25
H18	11.24	11.28	11.35	11.41	11.45	11.49	11.59	12.33
H19	19.50	19.53	19.55	19.57	19.58	19.61	19.65	19.90
H20	2.67	2.67	2.68	2.85	3.03	3.16	3.40	4.54
H21	3.15	3.21	3.28	3.34	3.38	3.43	3.53	4.68
H22	7.61	7.64	7.66	7.69	7.72	7.75	7.83	8.28
H23	16.25	16.27	16.29	16.30	16.30	16.31	16.33	16.54
H24	2.48	2.48	2.74	2.91	3.06	3.19	3.43	4.63

Refer to Figure 7-1 for the reporting locations

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BUILDINGS HAVE NOT BEEN MODELLED AND RESULTS CAN'T BE USED TO DETERMINE INTERNAL BUILDING FLOODING.
INUNDATION PATTERNS FROM LOCAL OVERLAND FLOW MAY VARY SLIGHTLY TO THE MAPPED RESULTS SHOWN.
COUNCIL SHOULD BE CONSULTED TO CONFIRM FLOOD AFFECTATION AT INDIVIDUAL ALLOTMENTS.
OXFORD STREET
CROWN STREET
RESERVOIR STREET
FOVEAUX STREET
ELIZABETH STREET
GEORGE STREET
ULTIMO ROAD
HARRIS STREET
PYRMONT STREET
Legend
Peak Flood Depths (m)
0.05 to 0.10
0.10 to 0.25
0.25 to 0.50
0.50 to 0.75
0.75 to 1.00
1.00 to 1.50
> 1.5
Title:
Peak Flood Depth
1% AEP (100 yr ARI)
Figure:
A-6
Rev:
-
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400m
Approx. Scale
BMT WBM
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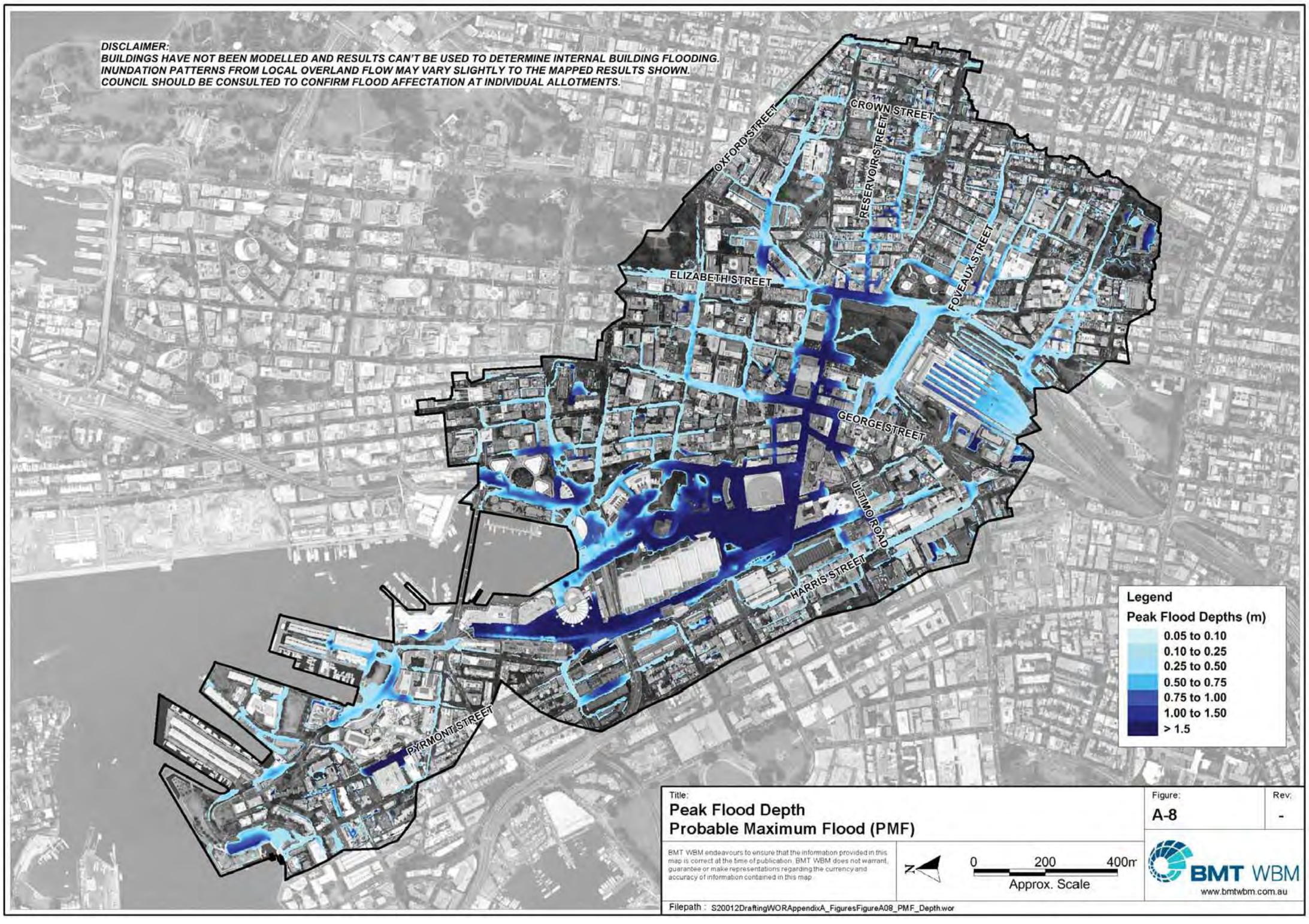
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BUILDINGS HAVE NOT BEEN MODELLED AND RESULTS CAN'T BE USED TO DETERMINE INTERNAL BUILDING FLOODING.
INUNDATION PATTERNS FROM LOCAL OVERLAND FLOW MAY VARY SLIGHTLY TO THE MAPPED RESULTS SHOWN.
COUNCIL SHOULD BE CONSULTED TO CONFIRM FLOOD AFFECTATION AT INDIVIDUAL ALLOTMENTS.
OXFORD STREET
CROWN STREET
RESERVOIR STREET
FOVEAUX STREET
ELIZABETH STREET
GEORGE STREET
ULTIMO ROAD
HARRIS STREET
PYRMONT STREET
Legend
Peak Flood Depths (m)
0.05 to 0.10
0.10 to 0.25
0.25 to 0.50
0.50 to 0.75
0.75 to 1.00
1.00 to 1.50
> 1.5
Title:
Peak Flood Depth
Probable Maximum Flood (PMF)
Figure:
A-8
Rev:
-
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400m
Approx. Scale
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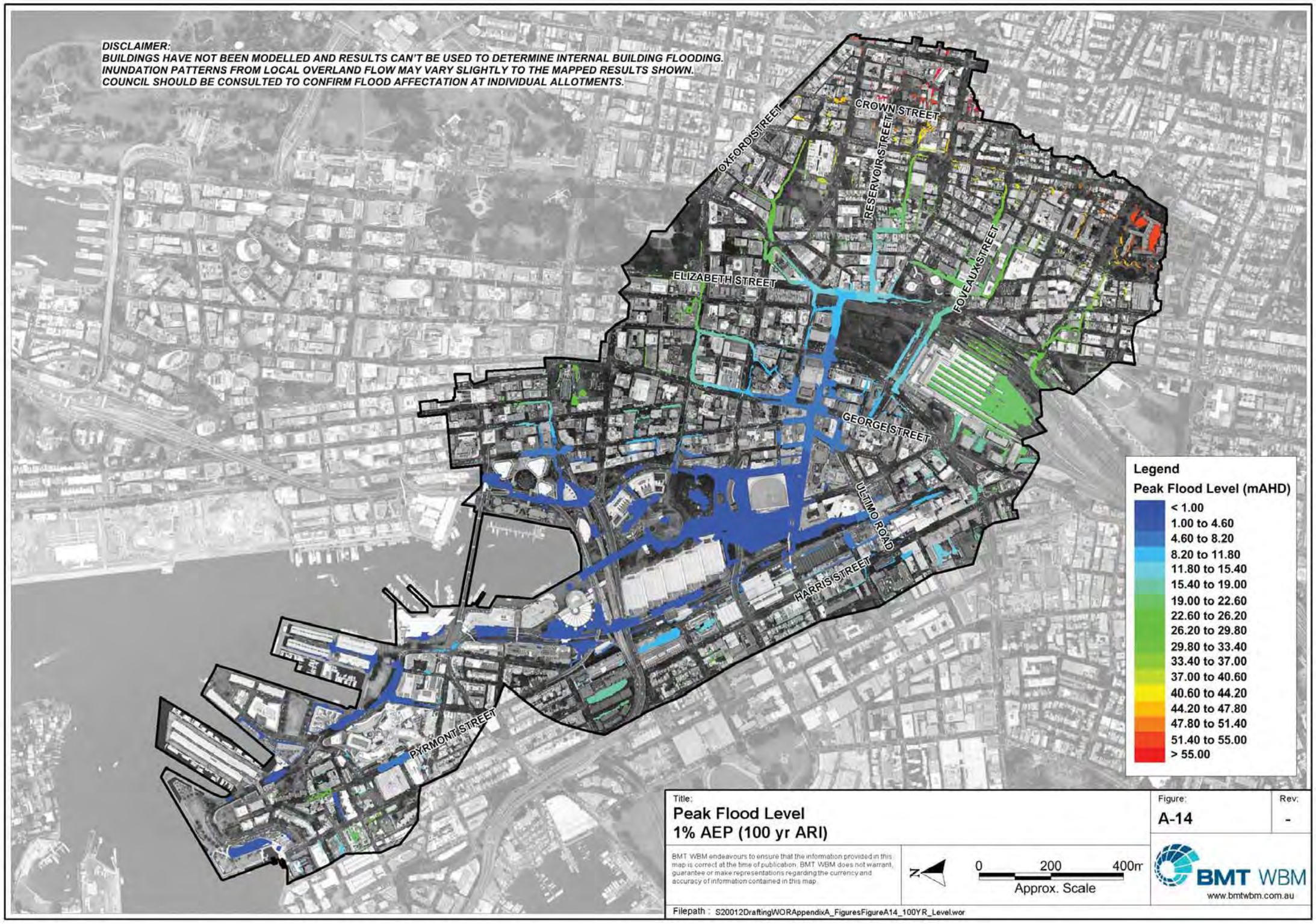
DISCLAIMER:
BUILDINGS HAVE NOT BEEN MODELLED AND RESULTS CAN'T BE USED TO DETERMINE INTERNAL BUILDING FLOODING.
INUNDATION PATTERNS FROM LOCAL OVERLAND FLOW MAY VARY SLIGHTLY TO THE MAPPED RESULTS SHOWN.
COUNCIL SHOULD BE CONSULTED TO CONFIRM FLOOD AFFECTATION AT INDIVIDUAL ALLOTMENTS.
OXFORD STREET
CROWN STREET
RESERVOIR STREET
FOVEAUX STREET
ELIZABETH STREET
GEORGE STREET
ULTIMO ROAD
HARRIS STREET
PYRMONT STREET
Legend
Peak Flood Level (mAHD)
< 1.00
1.00 to 4.60
4.60 to 8.20
8.20 to 11.80
11.80 to 15.40
15.40 to 19.00
19.00 to 22.60
22.60 to 26.20
26.20 to 29.80
29.80 to 33.40
33.40 to 37.00
37.00 to 40.60
40.60 to 44.20
44.20 to 47.80
47.80 to 51.40
51.40 to 55.00
> 55.00
Title:
Peak Flood Level
1% AEP (100 yr ARI)
Figure:
A-14
Rev:
-
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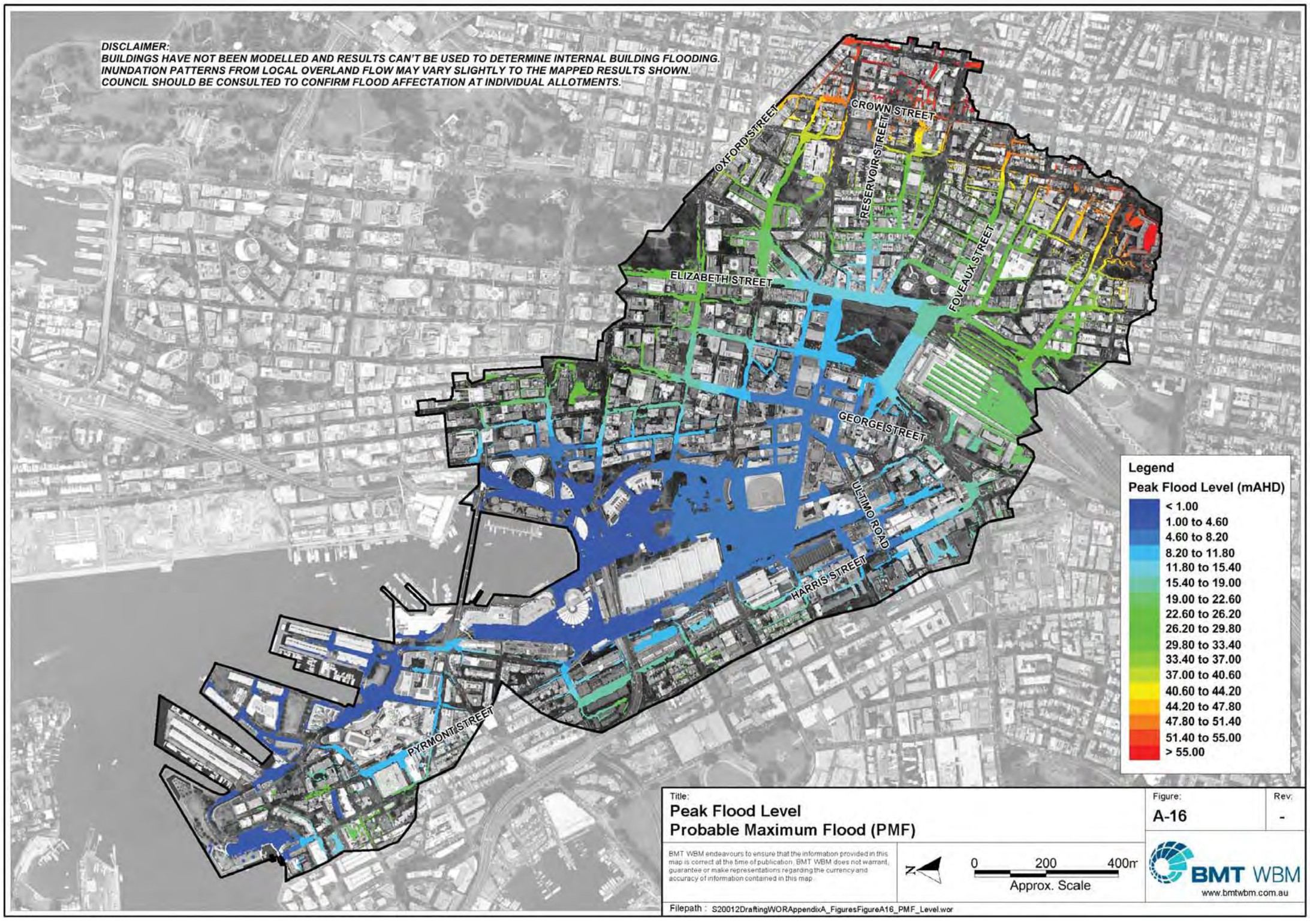
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INUNDATION PATTERNS FROM LOCAL OVERLAND FLOW MAY VARY SLIGHTLY TO THE MAPPED RESULTS SHOWN.
COUNCIL SHOULD BE CONSULTED TO CONFIRM FLOOD AFFECTATION AT INDIVIDUAL ALLOTMENTS.
OXFORD STREET
CROWN STREET
RESERVOIR STREET
FOVEAUX STREET
ELIZABETH STREET
GEORGE STREET
ULTIMO ROAD
HARRIS STREET
PYRMONT STREET
Legend
Peak Flood Level (mAHD)
< 1.00
1.00 to 4.60
4.60 to 8.20
8.20 to 11.80
11.80 to 15.40
15.40 to 19.00
19.00 to 22.60
22.60 to 26.20
26.20 to 29.80
29.80 to 33.40
33.40 to 37.00
37.00 to 40.60
40.60 to 44.20
44.20 to 47.80
47.80 to 51.40
51.40 to 55.00
> 55.00
Title:
Peak Flood Level
Probable Maximum Flood (PMF)
Figure:
A-16
Rev:
-
BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map
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400m
Approx. Scale
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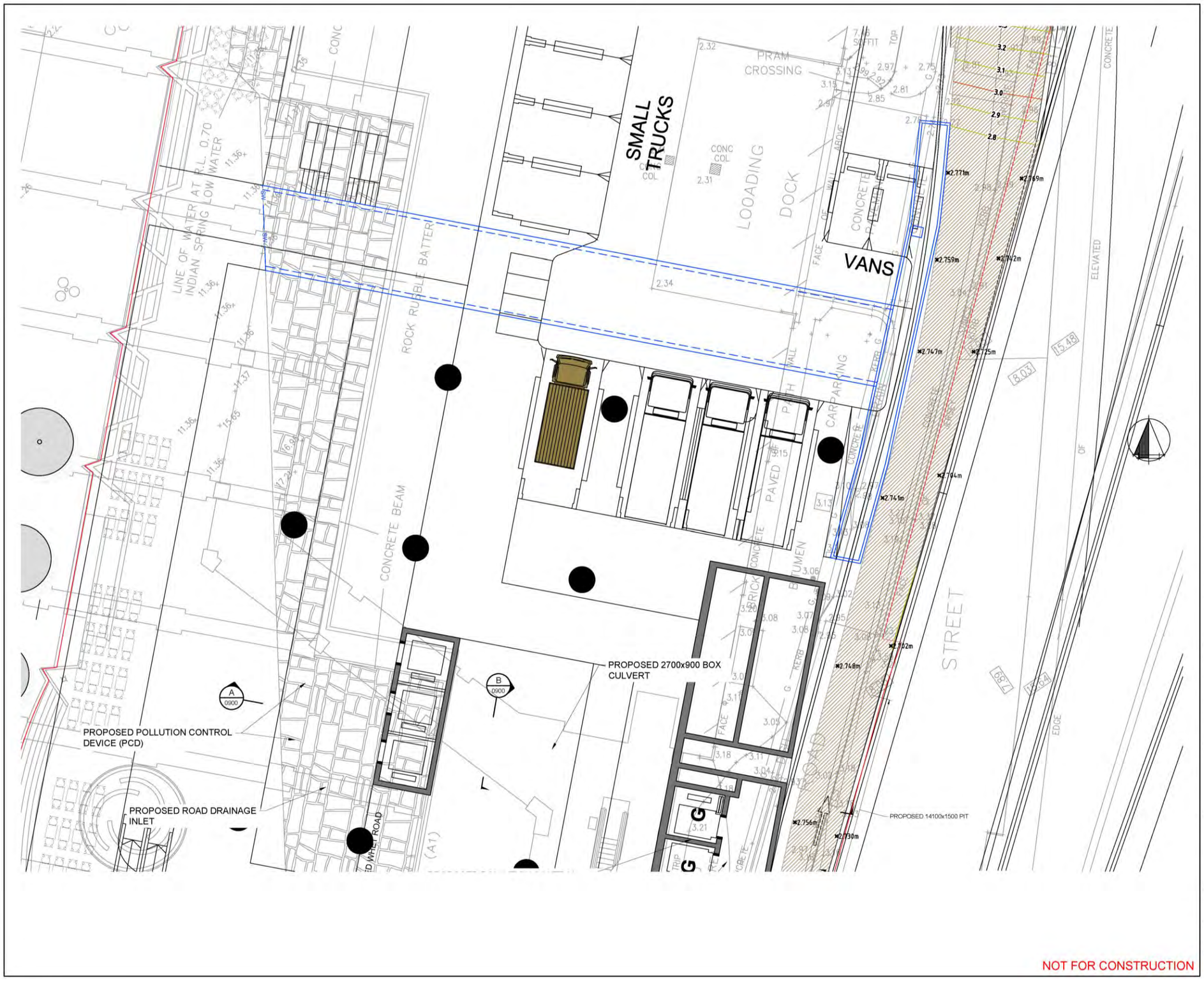
APPENDIX E

STORMWATER CONCEPT DESIGN



KEY PLAN

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STRATEGIC CONCEPT STORMWATER DRAINAGE ARRANGEMENT SHEET 1

status
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1:100	CF	GH	SEP-16

project no.	drawing no.	rev.
4886	CV-0100	2

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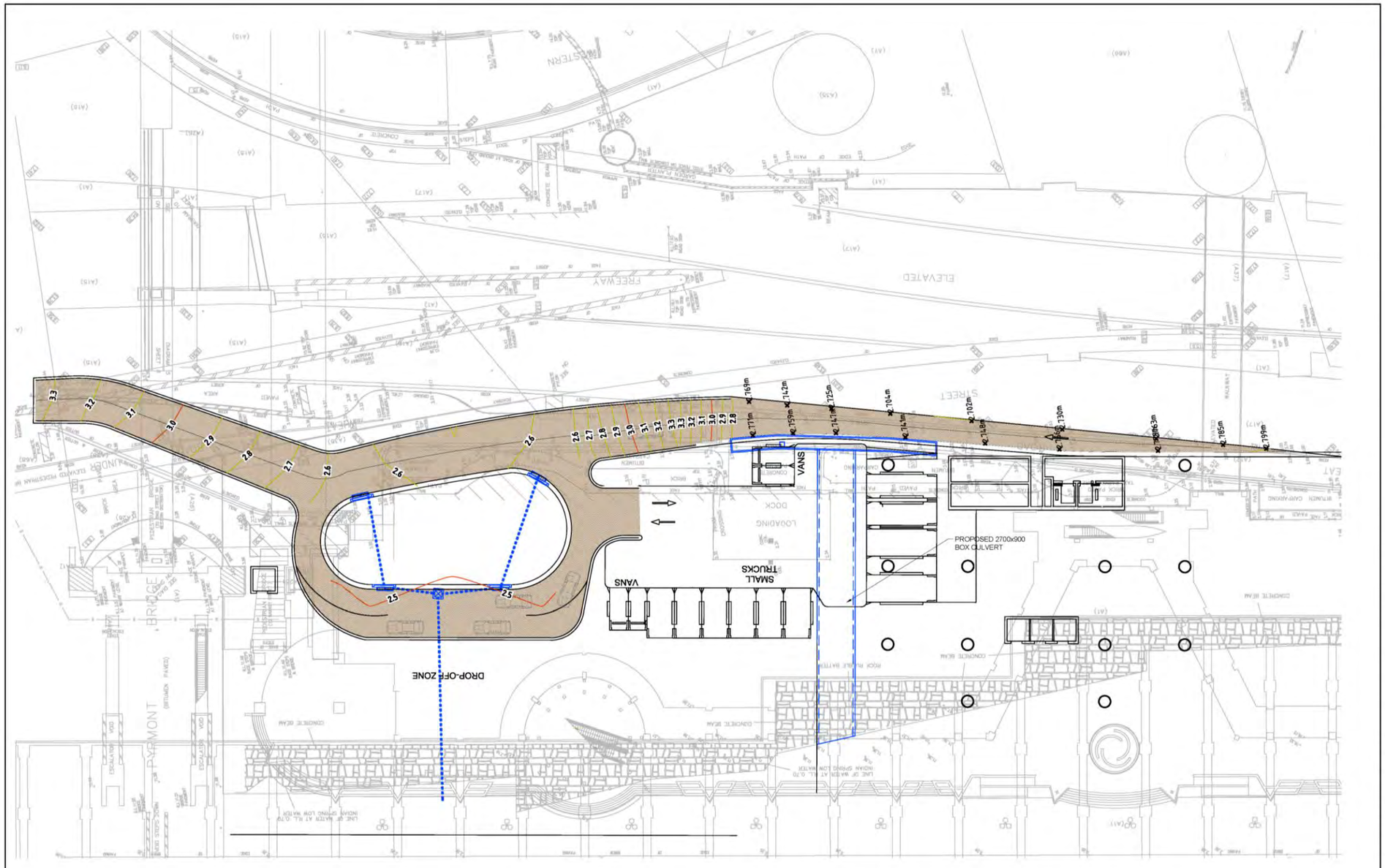

NOT FOR CONSTRUCTION

LEGEND

PROPOSED KERB INLET WITH GRATED COVER

PROPOSED OSD TANK

NOTE
PROPOSED ROAD DRAINAGE SYSTEM TO DISCHARGE INTO BOX CULVERT

SCALE 1:500

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rev	date	description	drn	ch'k
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2	28/09/16	PRELIMINARY DA ISSUE	CF	GH
1	23/09/16	PRELIMINARY DA ISSUE	CF	GH

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STRATEGIC CONCEPT STORMWATER DRAINAGE ARRANGEMENT SHEET 2

status
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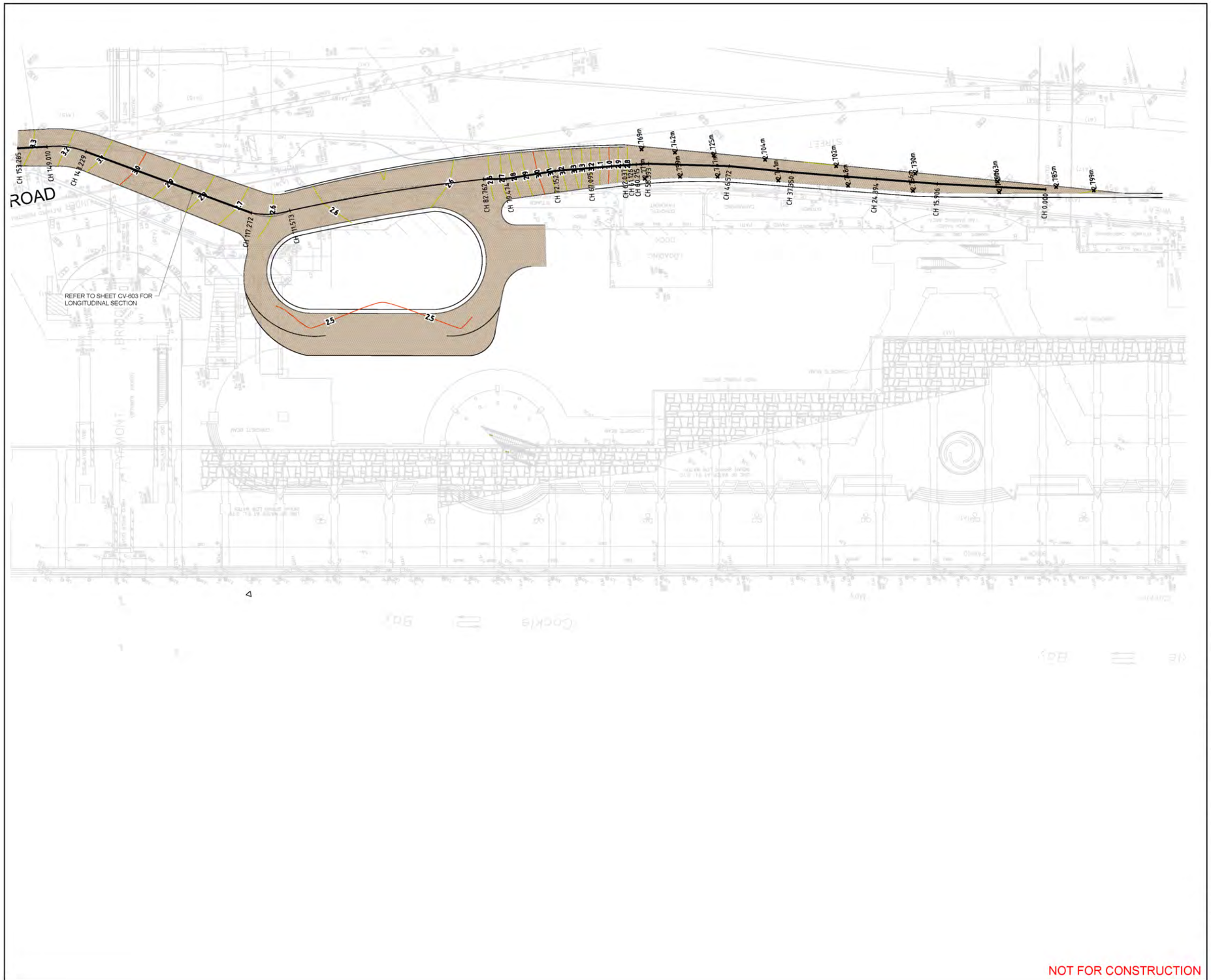
project no.	drawing no.	rev.
4886	CV-0101	3



NOT FOR CONSTRUCTION

LEGEND

PROPOSED MAJOR CONTOUR

PROPOSED MINOR CONTOUR

NOTE
1. DESIGN DISPLAYED IS FOR INFORMATION PURPOSES ONLY AND IS SUBJECT TO CHANGE AS DESIGN PROGRESSES.
2. ASSUMED INTERPOLATED SURFACES AT INTERSECTION WITH HARBOUR STREET. AREA SUBJECT TO CHANGE ONCE SURVEY BECOME AVAILABLE.
3. PROPOSED ROAD DRAINAGE SYSTEM TO DISCHARGE INTO BOX CULVERT

SCALE 1:500

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1	14/10/16	FOR INFORMATION	CF	GP

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drawing title
STRATEGIC CONCEPT PROPOSED DRAINAGE ARRANGEMENT

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1:250	CF	GP	OCT-16

project no.	drawing no.	rev.
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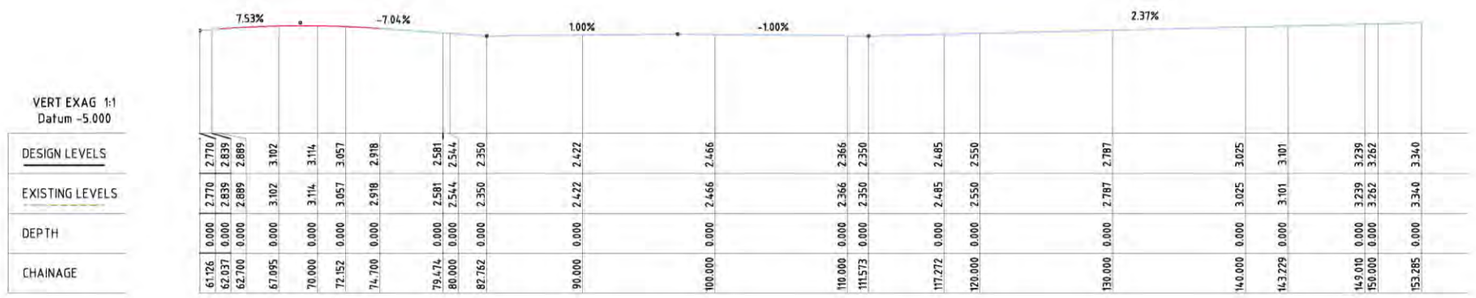

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1	14/10/16	FOR INFORMATION	CF	GP

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drawing title
STRATEGIC CONCEPT WHEAT ROAD PROPOSED ARRANGEMENT SHEET 4

status
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1:500	CF	GP	OCT-16

project no.	drawing no.	rev
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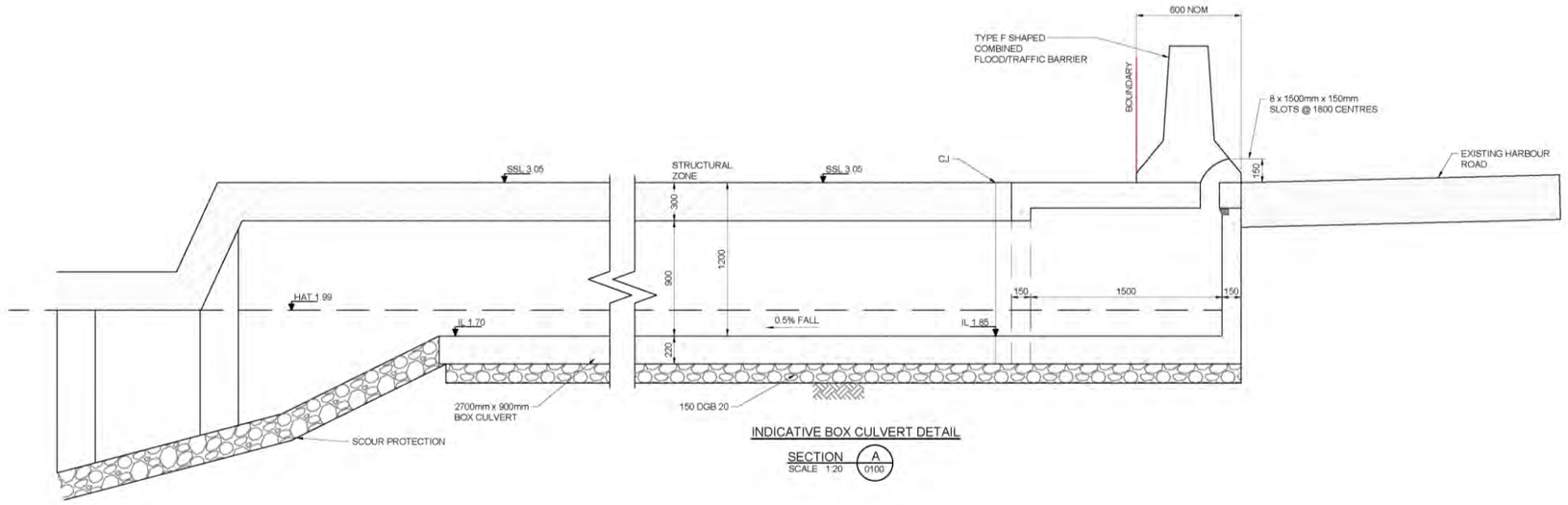

INDICATIVE BOX CULVERT DETAIL

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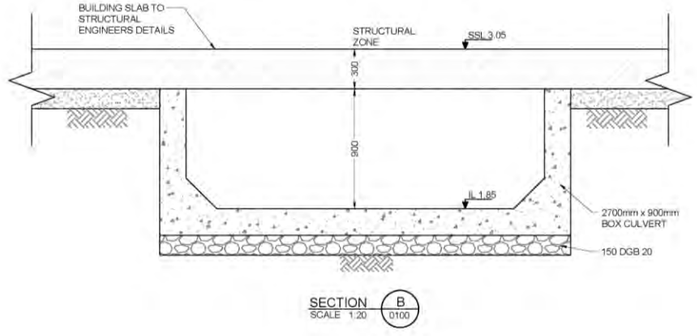

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SCALE 1:20

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rev	date	description	drn	ch'k
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project
COCKLE BAY WHARF
REDEVELOPMENT

drawing title
STATEGIC CONCEPT
CIVIL DRAINAGE DETAILS

status
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scale at A1	drawn by	checked	date
1:100	CF	GH	SEP-16

project no	drawing no	rev.
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