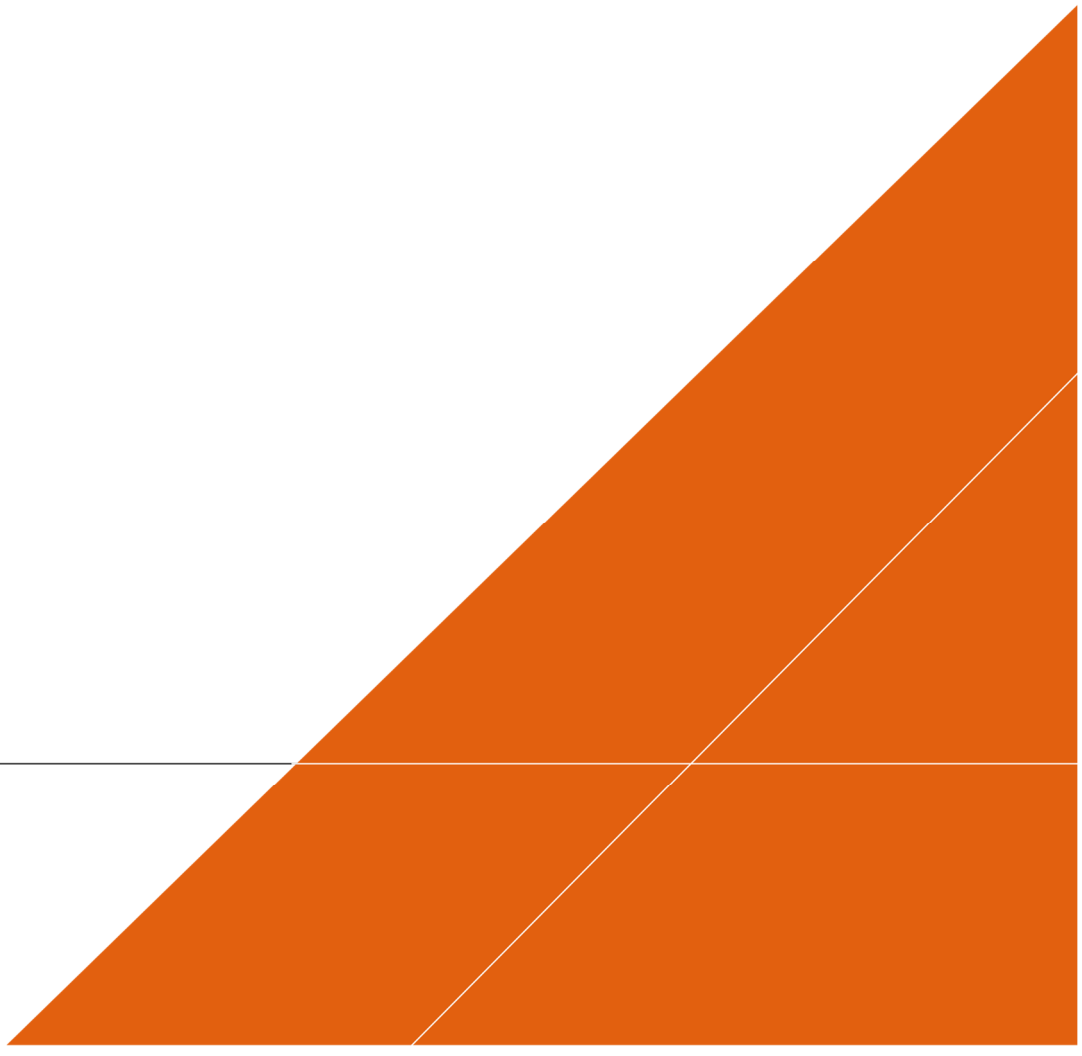
ARCADIS Design & Consultancy for natural and built assets

HARBOURSIDE SHOPPING CENTRE

FLOODING, STORMWATER & WSUD FOR STAGE 1 DA

12 SEPTEMBER 2016



Incorporating Hyder

MIRVAC
HARBOURSIDE SHOPPING CENTRE

Flooding, Stormwater & WSUD for Stage 1 DA

Author	Bruce Caldwell (flooding) George Dunstan (water quality)
Checker	Joe Heydon
Approver	Joe Heydon
Report No	AA008883SW_stg1
Date	12/09/2016
Revision Text	A

REVISIONS

Revision	Date	Description	Prepared by	Approved by
A	12/09/2016	Final issue for DA	Bruce Caldwell	Joe Heydon

\\HC-AUS-NS-FS-01\jobs\AA008883\Reports\Flooding and Stormwater\SSDA1\Updated for Residential Tower 300816\Harbourside Shopping Centre - SSDA1 - Flooding, Stormwater & WSUD Report.docx

CONTENTS

FIGURES

TABLES

APPENDICES

DRAWINGS

1 INTRODUCTION

This report supports a State Significant Development Application (SSDA) submitted to the Minister for Planning and Infrastructure pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

Mirvac Projects Pty Ltd (Mirvac) is seeking to secure approval to establish concept proposal details for the redevelopment of the Harbourside Shopping Centre (Harbourside), including a new retail shopping centre, residential tower and substantial public domain improvements.

The project supports the realisation of the NSW State Government's vision for an expanded 'cultural ribbon' spanning from Barangaroo, around to Darling Harbour and Pyrmont. The project importantly will add further renewed diversity in tourism and entertainment facilities to reinforce Sydney's CBD being Australia's pre-eminent tourist destination.

1.1 BACKGROUND

Mirvac acquired Harbourside, a key location within the Darling Harbour precinct, in November 2013. Harbourside, which was opened in 1988 as part of the Bicentennial Program, has played a key role to the success of Darling Harbour as Australia's premier gathering and entertainment precinct.

Despite its success, with an annual pedestrian visitation of around 13 million people, Harbourside is now outdated and in decline. The building lacks a quality interface to the Darling Harbour public domain and Cockle Bay and does not integrate well with the major transformation projects underway and planned for across Darling Harbour.

Harbourside 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, Mirvac are taking a carefully considered and staged approach to the complete revitalisation of the site and its surrounds.

1.2 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.

More generally the site is bound by Pyrmont Bridge to the north, the Sydney International Convention, Exhibition and Entertainment Centre Precinct (SICEEP) to the south, Darling Drive and the alignment of the Light Rail to the west and Cockle Bay to the east.

A locational context area plan and site location plan are is provided in **Figures 1 and 2** below.

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 Harbourside will fundamentally change as these developments are progressively completed.

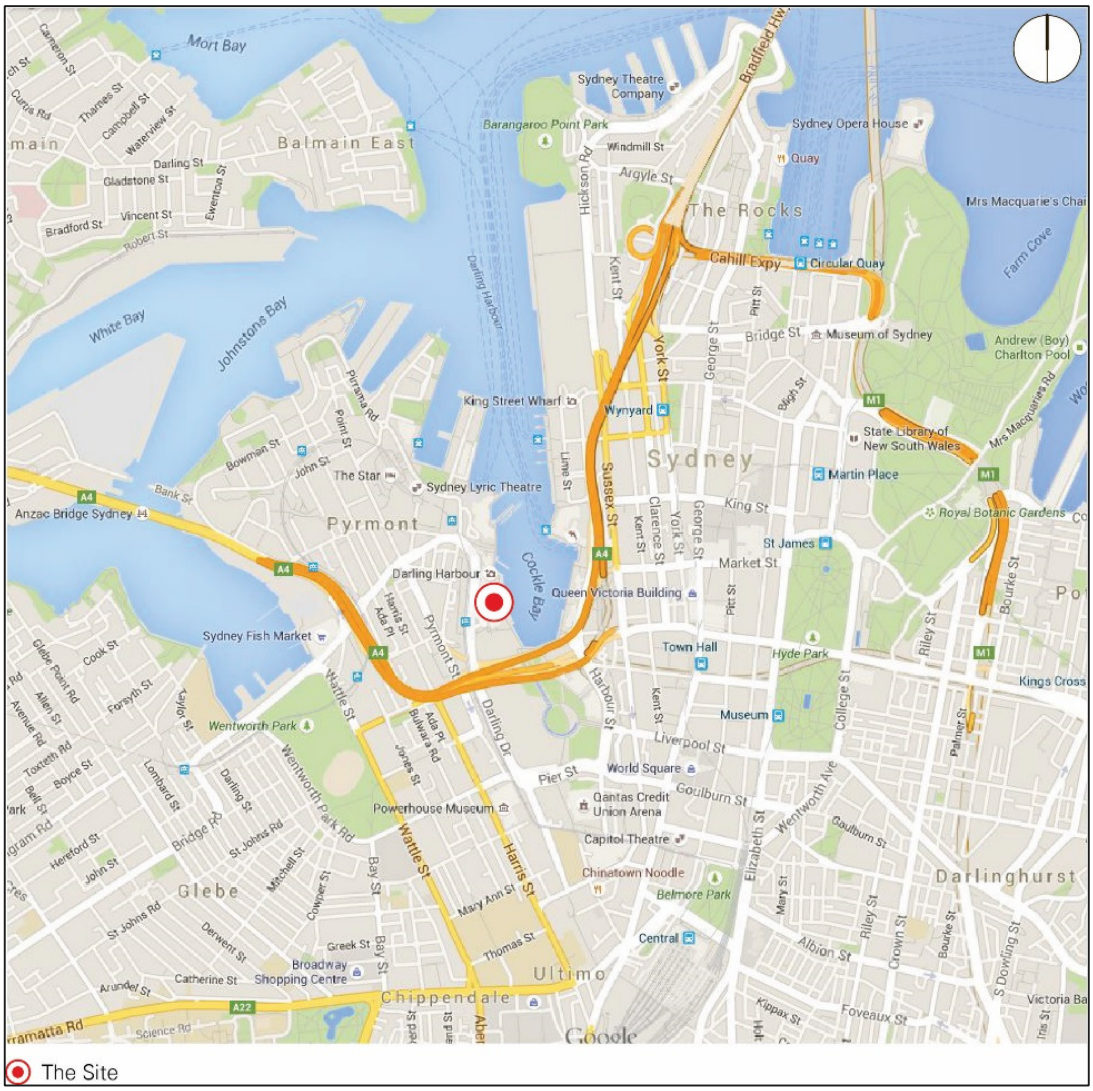


***Figure 1**: Location Context Area Plan (Source: Google Maps)*

1.3 OVERVIEW OF PROPOSED DEVELOPMENT

The proposal relates to a staged development application and seeks to establish concept proposal details for the renewal and re-imagining of Harbourside.

The concept proposal establishes the vision and planning and development framework which will be the basis for the consent authority to assess future detailed development proposals.

The Harbourside site is to be developed for a mix of uses, including residential, retail and restaurants, residential and open space.

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

- Demolition of existing site improvements, including the Harbourside Shopping Centre, pedestrian bridge links across Darling Drive, obsolete monorail infrastructure, and associated tree removal.
- A network of open space areas and links generally as shown within the Public Domain Concept Proposal, to facilitate re-integration of the site into the wider urban context;
- Building envelopes;
- Land uses across the site, limited to only non-residential uses;
- A maximum total Gross Floor Area (GFA) across the Harbourside site of 87,000m2 for mixed use development (non-residential and residential development);

- Basement car parking,
- Car parking rates to be utilised in subsequent detailed (Stage 2) Development Applications);
- Urban Design and Public Realm Guidelines to guide future development and the public domain; and
- Strategies for utilities and services provision, drainage and flooding, and ecological sustainable development.

A more detailed and comprehensive description of the proposal is contained in the Environmental Impact Statement (EIS) prepared by JBA

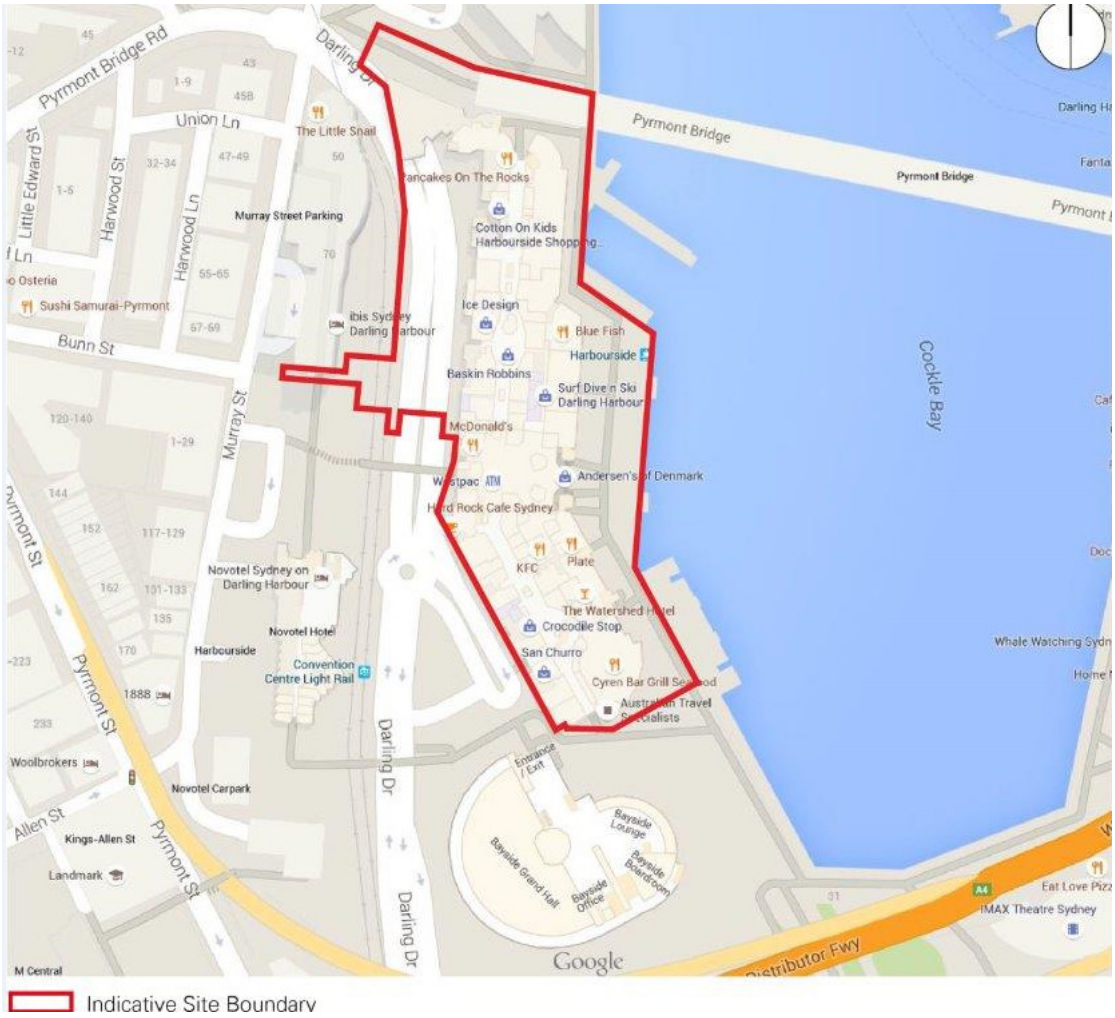


Figure 2: Site Location Plan (Source: Google Maps)

1.4 PLANNING APPROVAL 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 proposed development 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 proposed development on 30 August 2016. This report has been prepared having regard to the SEARs as relevant.

2.0 PURPOSE OF THE REPORT

This report has been prepared to accompany the Stage 1 DA for Harbourside. It addresses the relevant requirements of the Draft SEARs for the project, issued on the 9 December 2015. A summary of the relevant SEARs is listed below.

2.1 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

SEARs Reference	Key Assessment	Relevant Section in This Report	Comments
7. Drainage, Flooding, Climate Change and Sea Level Rise	Identify potential flood risk from groundwater, wastewater, stormwater, and sea level rise on site.	Section 3	This report relates to Harbourside as shown in **Figure 2** and provides a drainage concept for the site which addresses the flooding and sea-level rise risks on the site. However, this report does not address potential groundwater risks or impacts (as these are of a geotechnical nature), nor wastewater risks or impacts (as these relate to waste disposal).
7. Drainage, Flooding, Climate Change and Sea Level Rise	Include proposals to mitigate any potential impacts such as water sensitive urban design within the public domain and landscaping.	Section 4	This report provides initial WSUD analysis and discussion of initiatives proposed to be adopted to achieve pollutant reduction targets.
Plans and Documents	The EIS must include the following: • flood assessment • stormwater concept plan • sediment and erosion control plan	Section 3 Drawings	

Table 1: *Secretary's Environmental Assessment Requirements*

3.0 FLOODING & STORMWATER DRAINAGE

3.1 SITE FLOODING

The Harbourside Shopping Centre site is located downstream of significant urban catchment areas as identified in **Figure 3**, making the site vulnerable to overland flows during major rainfall storm events. Furthermore, the underground stormwater conduits conveying catchment runoff and discharging into Cockle Bay are influenced by tidal sea levels, which can reduce the discharge capacity of the stormwater conduits, resulting in increased flows and flooding above ground.

These influences have been taken into account in the City of Sydney (CoS) Darling Harbour Catchment Flood Study (BMT WBM, 2014) with the resulting Harbourside site flood levels presented as follows in Section 3.2 of this Report.

***Figure 3**:* Darling Harbour Catchment Study Area

3.2 SITE FLOOD LEVELS

Figure 4 presents a part plan of the CoS 2014 100 year ARI flood figure (i.e. 1%AEP, refer to **Appendix F** for information on terminology).

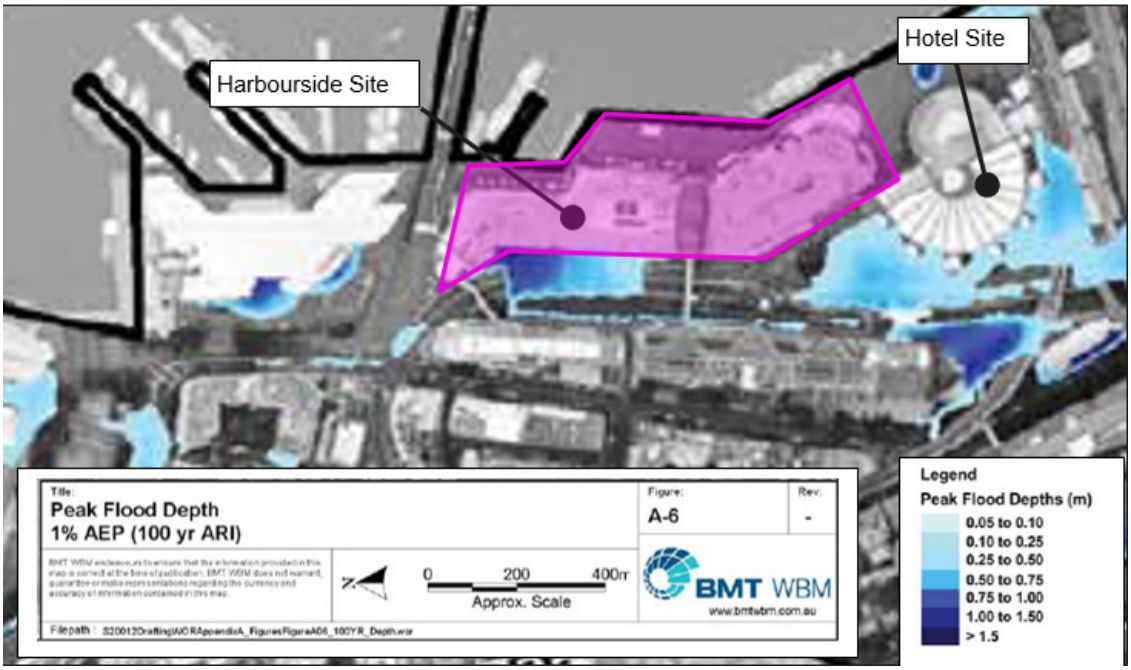


Figure 4: 1% AEP Peak Flood Depths Part Plan ('Darling Harbour Catchment Flood Study – Final Report' by BMT WBM, 23 October 2014)

In addition, CoS (through WMAWater Consultants) have provided a flood certificate for the Harbourside site (which is included in **Appendix A**). **Table 2** summaries the flood certificate site flood depths and levels under existing development conditions (at the time of the flood study), and **Figure 5** presents 100 year flood extent information.

Table 2: *Harbourside Site Flood Levels (Northern end of Harbourside, Location 'A')*

Average Recurrence Interval (year)	Water Depth* (m)	Water Level* (mAHD)
2	0.51	2.98
100	0.79	3.26
PMF	1.3	4.30

* see **Appendix A** for full flood certificate figure. See **Appendix F** for flood frequency terminology.

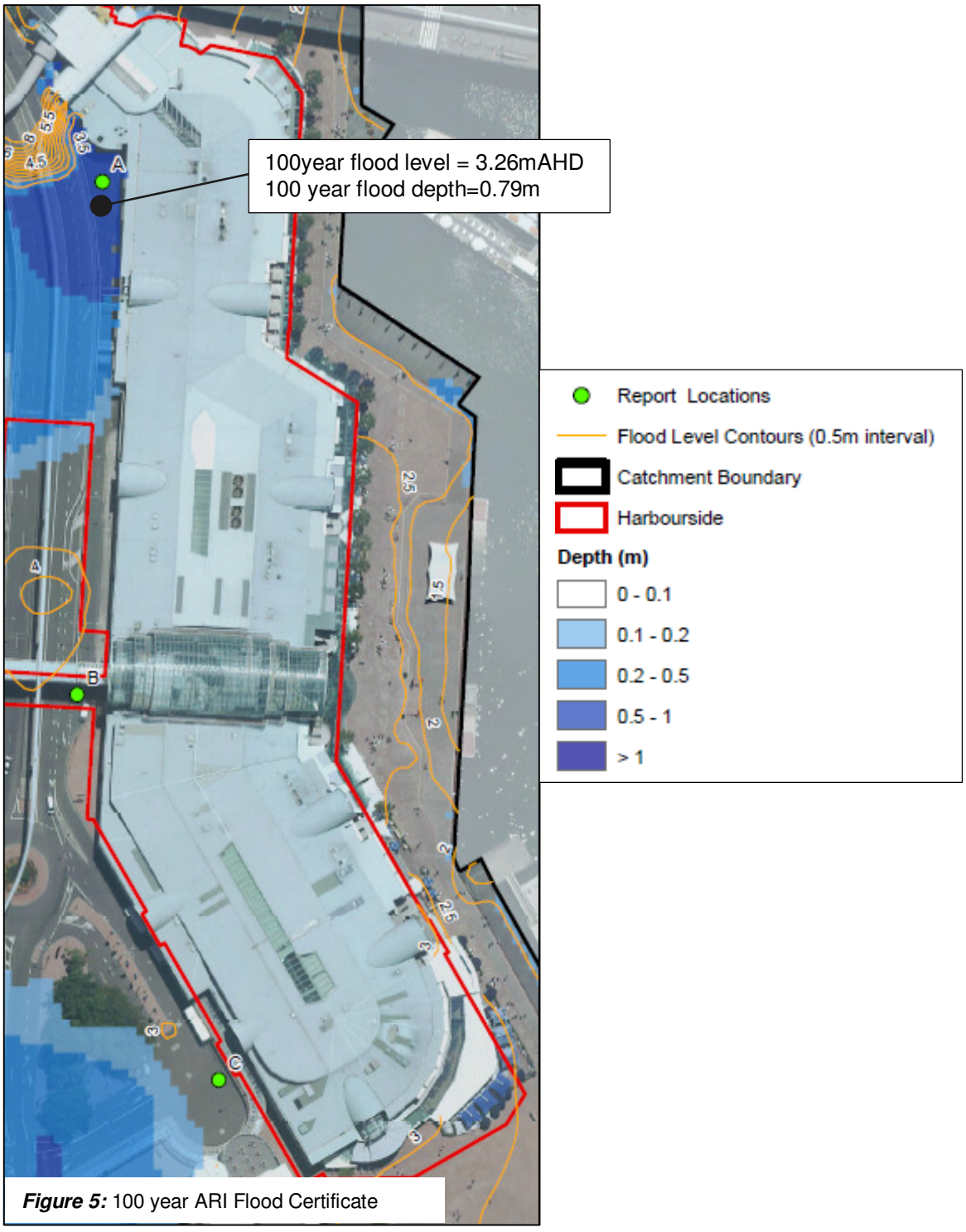


Figure 5: 100 year ARI Flood Certificate

While the CoS 2014 flood study and the associated flood levels at the Harbourside site may be considered adequate for determining flood planning levels for site re-development, it should be noted that:

- as a 'regional' flood study, the assessed flood regimes at the local Harbourside site may not have adequately considered/incorporated local catchment details that may influence the site flooding; and
- the CoS 2014 flood study has been based on the existing site development, and the associated site flood regimes could be altered by re-development.

3.3 PROPOSED FLOODING & STORMWATER MANAGEMENT

3.3.1 Modifications to Existing Stormwater System

The accompanying concept design plans outline the proposed stormwater management for the Harbourside complex. The proposed flooding and stormwater management for this development is expected to include:

- Modifications to the existing trunk drainage and local stormwater systems;
- Building over the existing Sydney Water culvert that conveys flows through the Harbourside site and discharges into Cockle Bay (this culvert passes below the existing Harbourside development, prior to discharging to Cockle Bay);
- Demolition of existing stormwater infrastructure and inclusion of new drainage systems to accommodate the proposed Harbourside development, particularly in the southern area of the development where new external laneways are proposed;
- Retention of existing neighbouring property stormwater connections, during construction and completion of the Harbourside complex;
- Re-use of existing drainage systems and connections where possible; and
- Sediment and Erosion Control measures during construction.

It should be noted that the accompanying drainage concept plan indicates the potential re-use of an existing pit and conduit stormwater system running along the western side of Harbourside (of which the existence, configuration, capacity and integrity, is yet to be confirmed on-site). Furthermore, the re-use of this system will most likely require no adverse impact on its hydraulic capacity.

3.3.2 Works that Impact on Sydney Water Conduits

Although not directly related to the assessment of stormwater drainage and flooding, we provide the following commentary to describe potential impacts of the proposed development on the existing Sydney Water stormwater system(s).

The Harbourside development includes the demolition and the existing building, pavements, kerbs, and landscaping currently located over the Sydney Water culvert. Where the proposed Harbourside building crosses over the existing stormwater culvert (see **Figure 6**), the building structure is to be designed to ensure that building loads are not supported by the culvert and the culvert is not affected in terms of structural integrity and function. In addition, the construction methodology is to be developed to ensure excessive temporary construction loadings are not imposed on the existing culvert. Consultation with relevant authorities to secure approval for these works has commenced and is on-going.

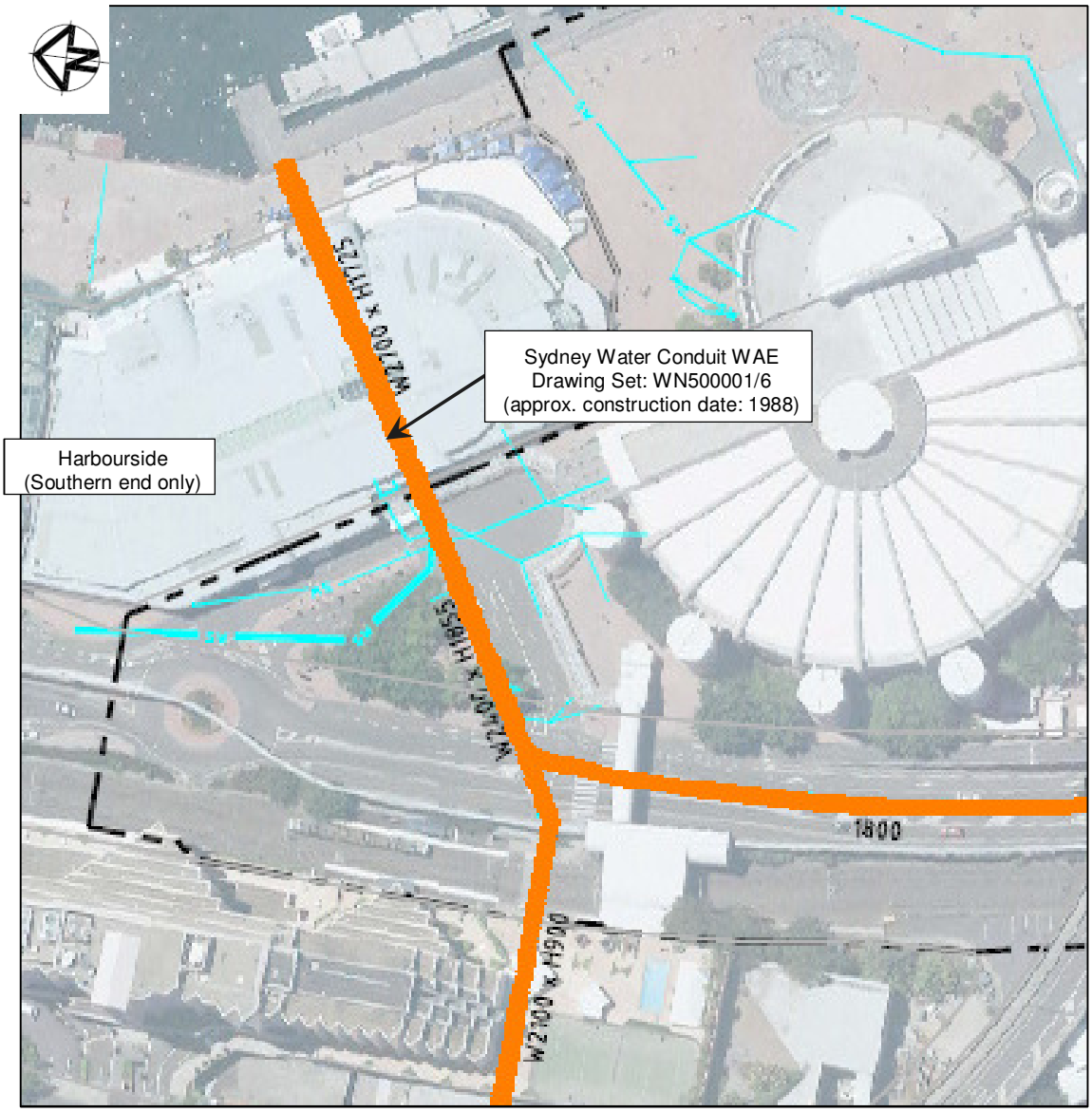


Figure 6 – Sydney Water Closed Conduit Information

3.3.3 Modelling and Analysis

Arcadis has obtained and reviewed the 'Darling Harbour Catchment Flood Study – Final Report' (23 October 2014) prepared by BMT WBM Pty Ltd for City of Sydney (CoS) and associated direct rainfall TUFLOW model developed by BMT WBM Pty Ltd for the CoS 2014 flood study.

It is noted that the model represents the catchment stormwater pits and conduits as 1D elements which are dynamically linked to the 2D domain at specified pit locations for inflow and surcharging. The 2D domain is a 2m x 2m gridded Digital Terrain Model derived from Aerial Laser Survey provided by Council.

The modelled pit and conduit set is outlined in **Figure 7**, with **Figure 8** showing the systems and catchment features more locally around the Harbourside site.

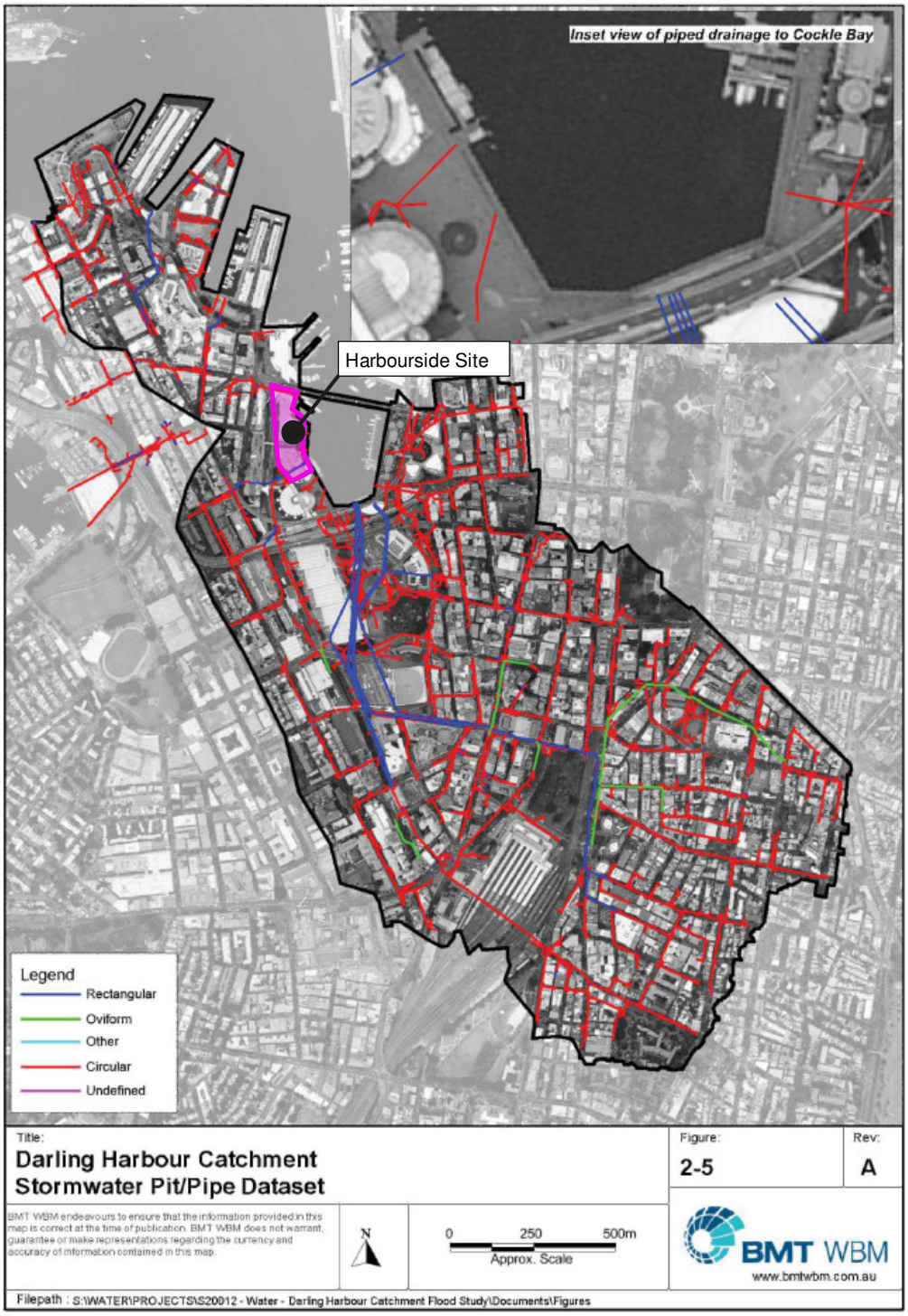


Figure 7: *Darling Harbour Stormwater Pit/Pipe Data Set (CoS 2014 Flood Study)*

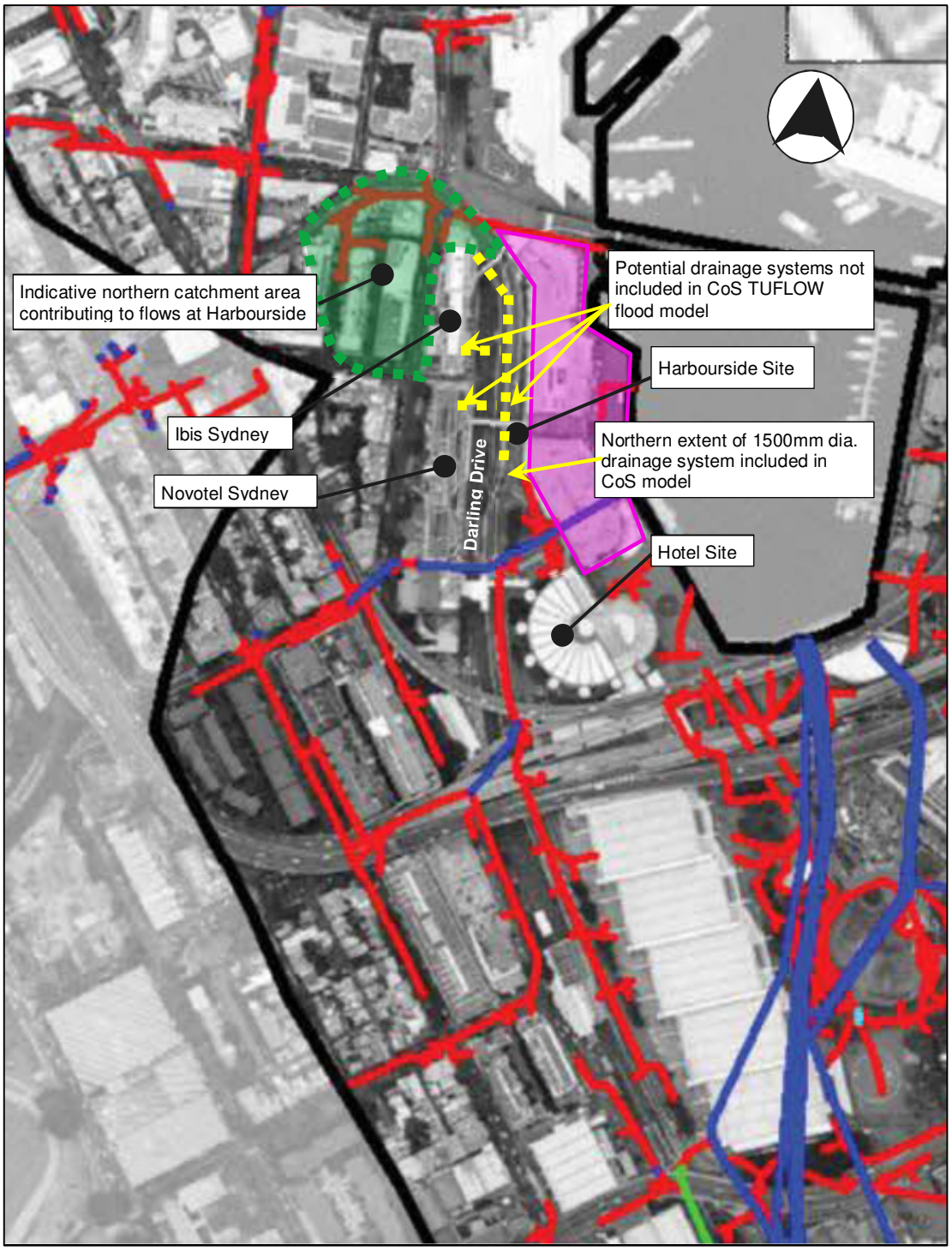


Figure 8: *Stormwater Pit/Pipe Data Set at Harbourside Area (CoS 2014 Flood Study)*

DRAINAGE SYSTEMS

'As Built' stormwater system drawings (included in **Appendix C**) indicate that there is a 290m long 825mm / 1050mm / 1200mm / 1350mm diameter system under the Harbourside access road which would capture and convey flows from the Location 'A' street sag (and associated neighbouring areas) to Cockle Bay via a 1500mm diameter conduit and Sydney Water box culvert system. It is noted on the 'As Built' drawings that this access road drainage system was not part of the construction contract at that time.

Site inspections by Arcadis indicated that associated grated stormwater inlet pits are located along the access road (see **Appendix B** Photos 6 to 10). However, as indicated in **Figure 8**, no such conduit system has been included in the CoS flood model.

Similarly, catchment inspection also indicates connecting drainage systems extending westward under Darling Drive to the Novotel building (see **Appendix B** Photos 4, 5, 16 and 17) and Ibis building that have not been included in the CoS flood model.

BUILDING HYDRAULICS

Direct connection of building stormwater hydraulics systems is not accounted for in the CoS TUFLOW flood model. Instead building rainfall-runoff is discharged adjacent to building at ground surface levels, then relying on street inlet systems to capture flows (see 'Pit Blockages' comments below).

The 'As Built' stormwater system drawings (**Appendix C**) indicate that external catchment area inflows are accommodated for from the Harbourside site, Ibis Sydney and Novotel Sydney areas. Site inspection indicated extensive building downpipe systems for the Ibis and Novotel buildings (see **Appendix B** photos).

It is likely that stormwater drainage systems from these buildings would be directly connected to adjacent underground stormwater systems.

PIT BLOCKAGES

The CoS flood study modelling is based on CoS stormwater pit blockage assumptions which includes 100% blockage of sag pits for events rarer than the 5 year ARI, a decision which is referred to as 'extreme' and which may increase 100 year flood levels by up to '0.7m' (CoS 2014 flood study page 89).

Due to such blocking of street inlet pits identified in the CoS flood study model, and the ignoring of building hydraulic systems that directly connect to underground street drainage systems, while increasing flood levels at the local street sags (as indicated in **Figure 9**), also has the potential to reduce downstream flows and under-estimate downstream flood levels/depths.

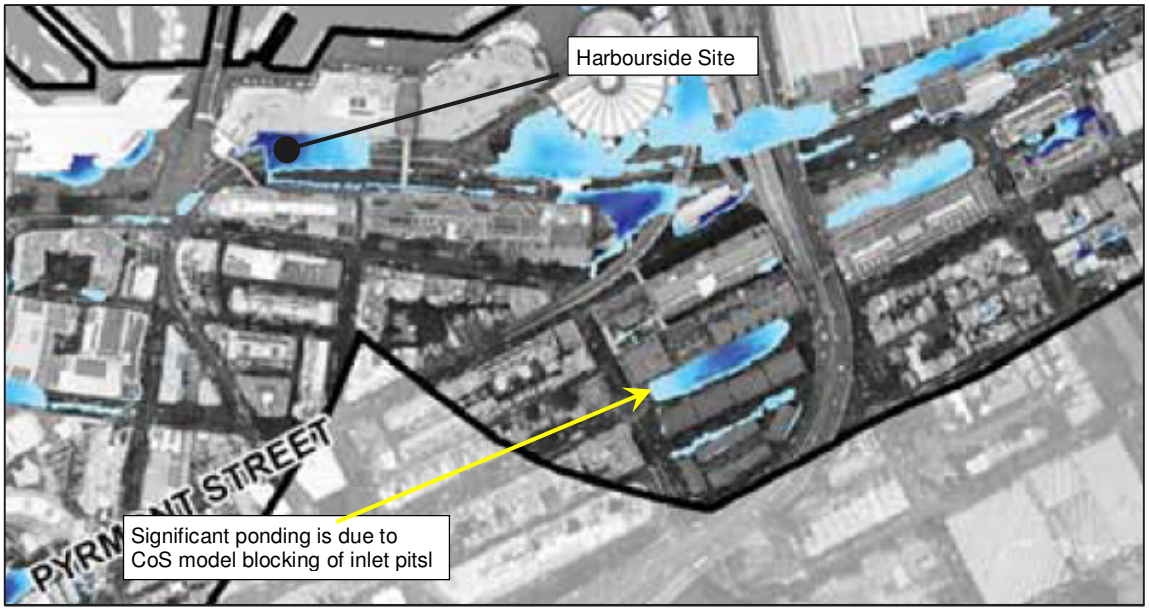


Figure 9: *Darling Harbour Part Figure A-6, 100 year Peak Flood Depth (CoS 2014 Flood Study)*

CLIMATE CHANGE

The CoS flood study assesses rainfall increases (of 10%, 20% and 30%) and sea level rise of 0.4m (for 2050 horizon) and 0.9m (for 2100 horizon) in accordance with the NSW Sea Level Rise Policy Statement (DECCW, 2009). While not stated in the CoS flood study, a 10% rainfall

increase would seem appropriate to Arcadis for the Harbourside site (being consistent with NSW Department of Environment and Climate Change (DECC) 'Flood Risk Management Guideline – Practical Consideration of Climate Change' (October 2007) Table 1 for Sydney Metropolitan Catchments).

COMMENTS

Existing condition flood levels surrounding the Harbourside site have been assessed by City of Sydney (CoS), 'Darling Harbour Catchment Flood Study – Final Report' (BMT WBM Pty Ltd, 23 October 2014). While the flood study states that:

'The principal outcome of the flood study is an understanding of flood behaviour in the catchment and in particular the design flood level information that will be used to set appropriate flood planning levels.'

It is apparent from our review of the 2014 flood study report and associated TUFLOW model that there are a number of refinements that could, and should (in the opinion of Arcadis), be made to the CoS model so as to adequately represent flood levels and flow regimes in and around the Harbourside site. In particular:

- the Harbourside access road drainage system and associated direct building drainage systems (to be confirmed by survey) should be included,
- local ground level survey be incorporated into the TUFLOW modelling (replacing the CoS model's aerial survey),
- upstream stormwater pit blockages reduced/removed, and
- design ocean boundary and climate change assumptions further investigated.

Such TUFLOW model adjustments to represent existing development conditions would likely result in reduced Harbourside site flood levels, however such adjustments are also considered necessary to:

- inform on flood risk with respect to the re-development itself;
- facilitate the assessment of potential flood impacts and flood mitigation measures;
- adequately demonstrate that existing neighbouring catchment areas would not be adversely impacted by the proposed development.

3.3.4 Construction Sediment & Erosion Controls

An erosion and sediment control plan (refer to accompanying Drawings) has been prepared to assist the implementation of erosion and sedimentation control measures in accordance with 'Managing Urban Stormwater: Soils and Construction' Landcom 2004 publication. These measures include:

- Hay Bales;
- Silt Fences;
- Inlet filters;
- Diversion channels;
- Sediment basin; and
- Stabilised site access and truck wash-down area.

3.3.5 Local Stormwater Management

WATER QUANTITY

In addition to the modifications outlined in **Section 3.3.1**, the accompanying drainage concept plan proposes stormwater management that:

- includes building hydraulic and ground surface connections which discharge into the Sydney Water conduits. While these local drainage systems will be sized to convey up to 20 year ARI flows, their performance may be limited by the Sydney Water system capacities.
- excludes on-site detention for the Harbourside Complex.

The above-noted stormwater management is subject to hydrological and hydraulic analysis of existing and proposed stormwater systems to determine capacities, overland flow regimes and works that may be necessary to mitigate potential adverse flood impacts, as a result of the Harbourside re-development. Such stormwater options may include the introduction of relief overland flow path(s) and system amplification(s).

Also, should a new stormwater system be necessary on the eastern side of Harbourside, the discharge into Cockle will require approval.

WATER QUALITY

Water sensitive design elements are discussed in Section 4 of this Report, but water quality measures that are likely to be considered for the re-development include:

- roof level raingardens;
- rainwater reuse; and
- stormwater quality improvement devices.

3.4 FLOOD PLANNING LEVELS

The City of Sydney (CoS) flood mapping and associated site flood levels (provided in the **Appendix A**) has been provided to allow Architects and the developer to determine initial floor levels. Floor levels are prescribed through the flood planning level requirements of the local authority through their flood risk management plan, which is developed with the input of stakeholders in order to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods.

The CoS 'Interim Floodplain Management Policy' (adopted 12 May 2014) included in **Appendix D** is the current floodplain management policy applicable to the Harbourside site. Key re-development requirements include:

Performance Criteria (section 3.1, p8)

That adequate consideration be given to the impact of climate change, including for a minimum 10% rainfall increase, and 0.9m sea level rise (by 2100 from the 2009 mean sea level) in accordance with the NSW Government Coastal Planning Guideline: Adopting Sea Level Rise 2010'. (p12)

General Requirements (section 4, p10-12)

Filling of flood prone land must be supported by a flood assessment report from a suitably qualified engineer which certifies that the filling will not increase flood affectation elsewhere.

Flood Planning Levels (section 5, p13-16)

The minimum level at each access point for:

- Business and Retail is to be based on a merits approach presented by the applicant with a minimum of the 1% AEP flood level;
- Residential floors within tourist establishments are to be 1% AEP flood level + 0.5 m
- All below-ground car parks are to be 1% AEP flood level + 0.5 m or the PMF (whichever is the higher). The below ground garage/car park level applies to all possible ingress points to the car

park such as vehicle entrances and exits, ventilation ducts, windows, light wells, lift shaft openings, risers and stairwells.

In addition, adequate flooding and stormwater analysis will be required to demonstrate that:

- New development will not experience undue flood risk; and
- Existing development will not be adversely flood affected through increased damage or hazard as a result of any new development (p1).

3.5 RE-DEVELOPMENT IMPLICATIONS

Based on CoS flood study levels for the Harbourside site, and the re-development concept plan 'Harbourside Shopping Centre Sydney, Australia' 2016 March 21, prepared by FJMT (included in **Appendix E**) it is noted that:

- In general, since the re-development includes retail at ground level, the CoS minimum floor level of no lower than the 100 year (1% AEP) flood level applies.
- The concept plan indicates minimum floor levels are proposed to be 3.5mAHD. While the maximum 1%AEP flood level adjacent to the buildings is 3.37mAHD (at location B, see Figure 5 and Appendix A). As such, minimum floor levels would be compliant with CoS requirements.
- The Harbourside access road/'Shared Exit Route'/'Car Park Entry', Back of House and loading dock area would appear to have excessive inundation. Typically, expected minor system capacity would be 20 year, with inundation limited to 0.2m in a 100 year event. CoS flood levels (Location A) indicates that for current conditions, inundation would be up to approximately 0.8m in a 100 year event.
- The above noted inundation is for existing conditions and further investigations are recommended in the Stage 2 DA, to assess if flood conditions can be improved.
- The proposed Back of House and cold storage room areas will require flood mitigation measures up to the 100 year flood event, for any area located within the 100 year floodplain and below the 100 year (1% AEP) flood level, following determination of the 100 year floodplain in future detailed flood modelling.
- The proposed basement car park requires protection from probable maximum flood (PMF) inundation. CoS flood levels (Location A) indicates that for current conditions, inundation would be up to approximately 1.3m in a PMF event (based on PMF flood level of 4.3mAHD and current ground level of 3.0mAHD near the proposed access, noting Figure 10 flood extents). The current Architectural concept design has considered protection measures for the basement car park up to PMF flood level, to prevent the car park from overland flow flooding up to this flood event. This will be reviewed in the future following more detailed flood modelling and investigations.
- Any proposed electrical infrastructure such as proposed substations will be set no lower than the 100 year (1% AEP) flood level.
- Any entrances/lobbies that lead directly to the residential development above the retail area should be set no lower than the 100 year (1%AEP) flood level allowing for a freeboard of 0.5m.

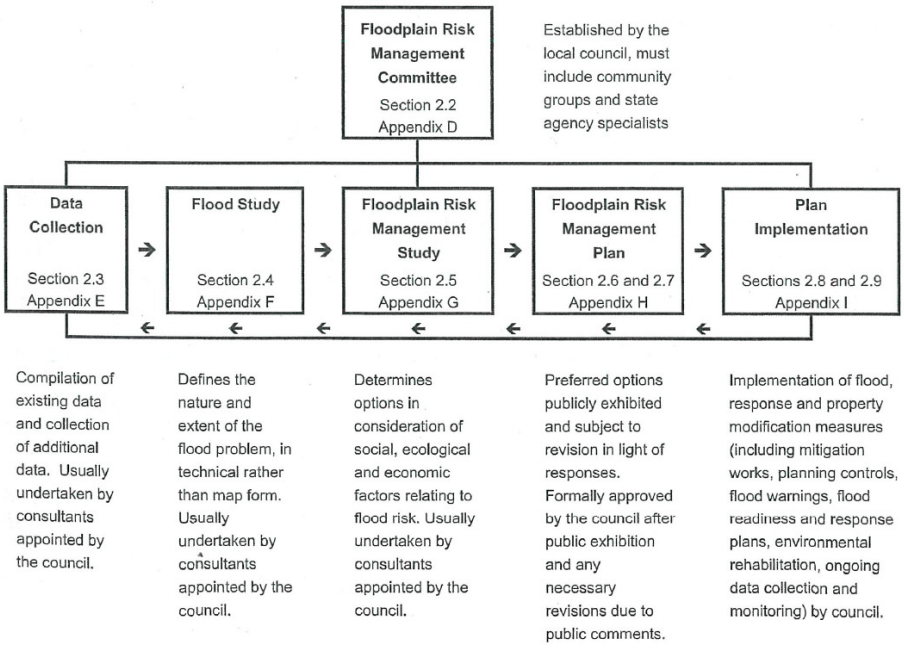
Figure 10: *Darling Harbour Part Figure A-8, Probable Maximum Flood (PMF) Peak Flood Depth (CoS 2014 Flood Study)*

If final flood levels and flow regimes change as a result of future flood model refinements and site reconfiguration, then the proposed building floor level, access road/'Shared Exit Route'/'Car Park Entry' are to be reassessed against the revised flood modelling.

3.6 FLOODPLAIN RISK MANAGEMENT PLAN

It is noted that WMA Water has recently issued additional flood risk management study and floodplain risk management plan reports in May 2016 on behalf of the City of Sydney.

The 2014 City of Sydney flood study along with the floodplain risk management study is an input into the process of determining the floodplain risk management plan. See flowchart figure below which outlines this process.



The results of the 2014 City of Sydney flood study have not changed. As such, these additional 2016 floodplain risk management reports do not change the findings of this SSDA1 stormwater and flood report.

4 WATER QUALITY AND WATER SENSITIVE URBAN DESIGN (WSUD)

4.1 WATER SENSITIVE URBAN DESIGN

Water Sensitive Urban Design aims to minimise the hydrological impacts of urban development and maximise the multiple use benefits of a stormwater system.

Australian Runoff Quality (Engineer's Australia, 2006) identifies the objectives of WSUD to include:

- Reducing potable water demand through water efficient appliances, rainwater and grey water reuse.
- Minimising wastewater generation and treatment of wastewater to a standard suitable for effluent reuse opportunities and/or release to receiving waters.
- Treating urban stormwater to meet water quality objectives for reuse and/or discharge to surface waters.
- Preserving the natural hydrological regime of catchments.

Australian Runoff Quality also identifies WSUD as the adoption of the following planning and design approaches that integrate the following opportunities into the built form of cities and towns:

- Detention, rather than rapid conveyance of stormwater.
- Capture and use of stormwater as an alternative source of water to conserve potable water.
- Use of vegetation for filtering purposes.
- Protection of water-related environmental, recreational and cultural values.
- Localised water harvesting for various use.

The stormwater management strategy proposed for the site focuses on minimising the impacts of the development on the total water cycle, and maximising the environmental, social and economic benefits achievable by utilising responsible and sustainable stormwater management practices. The proposed water strategy will be designed during the detailed design stage. However, key features of the proposed water quality strategy are likely to include the following measures:

- Rainwater tank(s).
- Green roofs.
- Proprietary devices such as Gross Pollutant Traps (GPTs)

4.2 RAINWATER TANKS

Rain falling on roof areas of the building (other than green roofs) will be collected and stored in a rainwater tank(s). The proposed hydraulics of the building and the ground levels within the site will be configured to allow this rainwater to be available for non-potable uses including toilet flushing and irrigation of landscaped areas. These numbers will be confirmed with the building hydraulic engineers at a future stage of the project.

In addition to water savings, rainwater tanks help reduce runoff volumes from the Harbourside development during small storms and associated stormwater pollutants that would discharge into Darling Harbour.

The tributary roof area and properties of the rainwater tank are summarised in **Table 3**.

Table 3: Tank Properties and Tributary Roof Area

Tank	Tributary Roof Area (ha)	Tank Properties			
		Cross-Sectional Area (m2)	Tank Height (m)	Tank Volume* (m3)	Roof area per m3 of Storage
Retail	0.9	75	2,25	150	60
Residential	0.1	25	2.25	50	20

* - effective volume

For the purpose of the above assessment, it is assumed that all roof areas (excluding green roofs) drain to the rainwater tank(s). This will be reviewed during future detailed design stages.

4.3 RAINWATER TANK MODELLING

The rainwater tank analysis for this study was undertaken using the industry standard software model MUSIC (Model for Urban Stormwater Improvement Conceptualisation) Version 6.1 (Build 16). This water quality modelling software was first released in July 2002, and was developed by the Cooperative Research Centre (CRC) for Catchment Hydrology (CRC for Catchment Hydrology, 2005), which is based at Monash University in Melbourne, Australia.

4.3.1 Rainfall Data

The nearest rainfall station to the site with a reasonable period of 6 minute rainfall data is Sydney Observatory Hill (Station 066062) which is about 1.8 km north of the site. In MUSIC, rainfall data is available for this station from 1913 to 2010. However, for the rainwater tank MUSIC modelling purposes, only rainfall data for the 1957-1966 period was used. The mean annual rainfall during this 10 year period is 1288 mm which is similar to the long term mean annual rainfall of 1215 mm which was calculated from the 1859 to 2012 rainfall data sourced from the Bureau of Meteorology (BOM) website. During this decade, there occurred 1 La Niña (wet) year, 3 El Niño (dry) years and 6 Neutral years. Based on these observations, this decade can be considered as average in terms of rainfall.

4.3.2 Evapotranspiration Data

Monthly average potential evapotranspiration (PET) data was used in the rainwater tank model. These PET values for Sydney are shown in **Table 4.**

Table 4: Monthly potential evapotranspiration (PET) values for Sydney

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PET (mm)	180	135	128	85	58	43	43	58	88	127	152	163

4.3.3 Non-Potable Water Demands

Except for the first flush flows, rainwater harvested from the roofs of the Harbourside development will be directed to tank(s) located within or adjoining the building. From these

tank(s), water is conveyed either by gravity or pressure to service the following uses within the development:

- Toilet flushing and urinals.
- Irrigation.

Sinks will be connected to mains water only.

The use of rainwater for flushing is assumed to take precedence over irrigation. Watering of landscaped areas using rainwater will only occur when there is adequate volume available in the tanks, and for the purpose of sizing the rainwater tank(s), only toilet flushing demands are assessed.

4.3.4 Daily Water Demand Volume

Water re-use demand volumes will be determined during detailed design of the project in conjunction with the Architect, Building Hydraulics Engineer, Landscape Architect and ESD Consultant, which will help inform the number and size of rainwater tanks required.

Should the Harbourside development be provided with water efficient toilets and urinals as recommended in the ESD Statement prepared by Cundall Consulting, the following water usage rates are applied in estimating the volume of water for flushing purposes:

- Toilet flushing : 4/3.5 L per flush
- Urinal flushing: 0.8 L per flush

4.3.5 Population

To calculate the retail toilet flushing and urinal demand, it has been assumed there is one person per 5m^2 of retail. For a retail area of 22,000 m^2 with 2 flushes per day this gives a toilet flushing and urinal demand of 6.6 L/day/ep, after adjusting for daily fluctuations in population. In total the retail demand for toilet flushing and urinals is 29 kL/day.

The residential toilet flushing demand has been calculated as per the draft NSW MUSIC Modelling Guidelines (August 2010). The total toilet flushing demand was calculated to be 48 kL/day, as summarised in **Table 5**.

Table 5: Residential Toilet Flushing Demand

Apartment Type (No. of Bedrooms)	Number of Apartments	Toilet Flushing Demand (kL/yr/dwelling)	Toilet Flushing Demand (kL/day)
1	143	0.085	17.9
2	184	0.120	23.0
3	32	0.155	5.8
4	5	0.195	1.2
Total	**364**	**-**	**47.8**

The above assumptions will be confirmed with the building hydraulic engineers in the detailed design stage.

4.3.6 Tank Configuration

The Harbourside rainwater tanks will be supplemented by mains water during dry periods or days of no rainfall. The tanks will be provided with a floating switch mechanism that activates mains water to top up when the critical level in the tank is reached. Activation of the mains water occurs when the volume of stored water in the tank reduces to 10% of the total tank volume.

A first-flush diverter will be installed for all tanks. The diverter ensures that the initial (often dirty) quantity of rain water collected from the roofs is diverted away from the tank. In this study, we have assumed the first 1 mm of rain to bypass the tank.

A screen will be provided at the inlet to prevent the ingress of debris and vermin into the tank. An overflow pipe will allow excess flows to discharge, and take with them accumulated sediments at the pump out take area.

A typical configuration of the building tanks is shown in **Figure 11.**

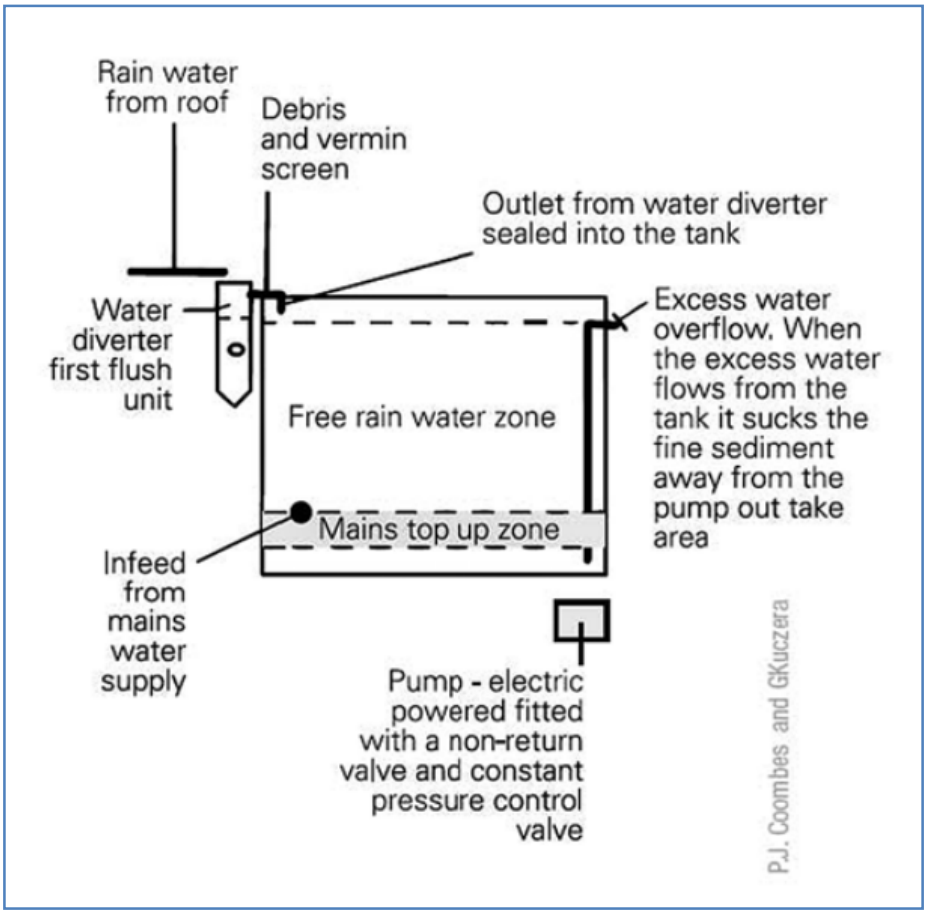


Figure 11: A typical configuration of a rainwater tank (Source: Coomes and Kuzcera, 2001)

4.3.7 Tank Reliability

The reliability of a reuse tank is typically reported as the percentage of the total demand that is supplied from the tank. The results of the tank reliability analysis are summarised in **Table 6** and **Figure 12**.

Table 6: Reliability of the rainwater tanks

Scenario	Reliability (% total demand supplied from rainwater tanks)
Residential and Retail	27
Retail Only	50

The above rainwater tank reliability calculations are indicative only at this concept stage of the design process, and will be subject to further review during more detailed design stages, when

a better understanding of the building hydraulics is available with regard to roof drainage catchments, demands and tank sizes and locations. The reliability of the rainwater reuse system is subject to the total roof area available for reuse. Given the high density of the development a larger tank volume will not greatly increase the tanks reliability as there is not enough runoff generated from the roof area to meet the demand. This is compounded when the toilet flushes of the residential tower are added in. At this stage it seems most appropriate to use rainwater re-use in the retail area only.

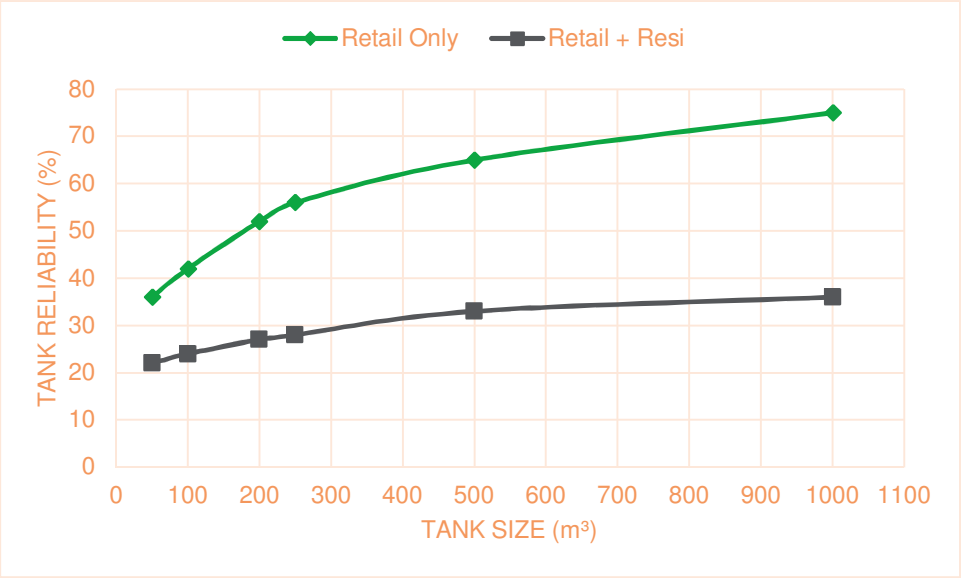


Figure 12: Rainwater tank reliability

4.4 GREEN ROOFS

The proposed water quality strategy for the development may include green roof areas, which would likely be located within the retail element of the proposed development masterplan.

A green roof is typically a modular, pre-vegetated engineered bio-retention system that is easily installed onto the roofing membrane in a similar manner to readymade lawn products. These systems are prepared at local nurseries using localised plant stock for a few months prior to installation. This means that only strong, mature plants are installed onto the roof top.

4.5 PROPRIETARY DEVICES

4.5.1 Gross Pollution Traps (GPTs)

GPTs will be incorporated into the proposed stormwater design network and will be located on all systems directly upstream of all outlets into the Harbour, in accordance with best practice design principles.

CDS gross pollutant traps (GPT) are designed to capture and retain gross pollutants, litter, grit, sediments and associated oils. GPTs utilise continuous deflection separation (CDS) technology to isolate the pollutants from the incoming flows. The CDS units are sized and designed by taking into account the catchment's characteristics, pollution load, hydraulic site constraints and opportunities, system capacities, velocity, backwater, as well as the location of the services and access for cleaning. Cleaning of the CDS unit will be undertaken using a small vacuum truck. The cleaning frequency depends on the catchment type, size and expected pollutant loading.

4.5.2 Pit Inserts

Pit inserts, also known as litter baskets, are also a potential Stormwater Quality Improvement Devices (SQID) that may be proposed for this development and could be provided in stormwater pits within the development site, where they can be appropriately provided. A pit insert, which is considered as an at-source primary treatment solution, is an efficient and cost-effective pre-screening primary treatment system that captures and retains solid pollutants at drainage entry points. These 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 are visually unobtrusive.

4.5.3 Filter Cartridge Systems

A filter cartridge system is a best management practice designed to remove a range of target pollutants including fine solids, soluble heavy metals, oils and total nutrients. Apart from meeting stringent regulatory requirements, these systems are usually installed below ground allowing savings in land space and increase development yield. These devices may also be considered as part of the proposed water quality treatment design for the proposed development.

APPENDIX A

Harbourside Site Flood Levels (Flood Certificate provided by WMA on behalf of City of Sydney)

Arcadis
Level 5/141 Walker Street
North Sydney
NSW 2060

L11409599_Harbourside.docx

22 December 2015

Attention: Bruce Caldwell

Dear Bruce,

Re: Flood Certificate for Harbourside, Darling Harbour

Thank you for contacting WMAwater in regard to a flood certificate for possible development at the above referenced address. WMAwater are currently undertaking the Darling Harbour Floodplain Risk Management Study (WMAwater, 2015), covering the area within which the property is located. The description of results we supply herein is based on detailed modelling carried out for the floodplain risk management study.

Harbourside shopping centre is located in the very downstream of the catchment and has flood affectation at some points on its perimeter. Figure 1 shows the site and the 1% AEP flood behaviour. In a flood event, runoff pools on the western side of the site, originating from Union Street/Darling Drive and from local catchment inflows (i.e. rainfall immediately west of the building). The east side of the property is adjacent to Darling Harbour, and flooding is limited to very shallow (<0.1 m) depth of flow discharging into the harbour. Elevated sea levels do not directly flood the site, although there is very minor exacerbation of the runoff depth under an elevated sea level.

Table 1 lists the peak flood depth and level for the 1% AEP event, the PMF and the climate change sea level rise scenarios modelled in the Darling Harbour Flood Study (2014). The peak flood level and depth is given for three locations on the west side of the property, as shown on Figure 1. As described, flooding is limited to shallow flow on the eastern side, including under sea level rise scenarios. Flood levels given for location 'A' are representative of the peak flood level of the ponding in that area, which is of constant height.

WMAwater Pty Ltd (Formerly Webb McKeown and Associates)

ABN 14 600 315 053

DIRECTORS
M K Babister BE(Hons), MEngSc GradDipMgt, FIEAust
R W Dewar BSc(Hons), MEngSc, MAIG, MIEAust
E J Askew BE(Hons), MIEAust
S D Gray BE, MEng

ASSOCIATES
R Hardwick Jones BE(Hons), MEngSc, MIEAust
M E Retallick BE(Hons), BSc, MIEAust

Level 2, 160 Clarence St, SYDNEY NSW 2000
Phone: 02 9299 2855 Fax: 02 9262 6208
Email: enquiry@wmawater.com.au
Website: wmawater.com.au

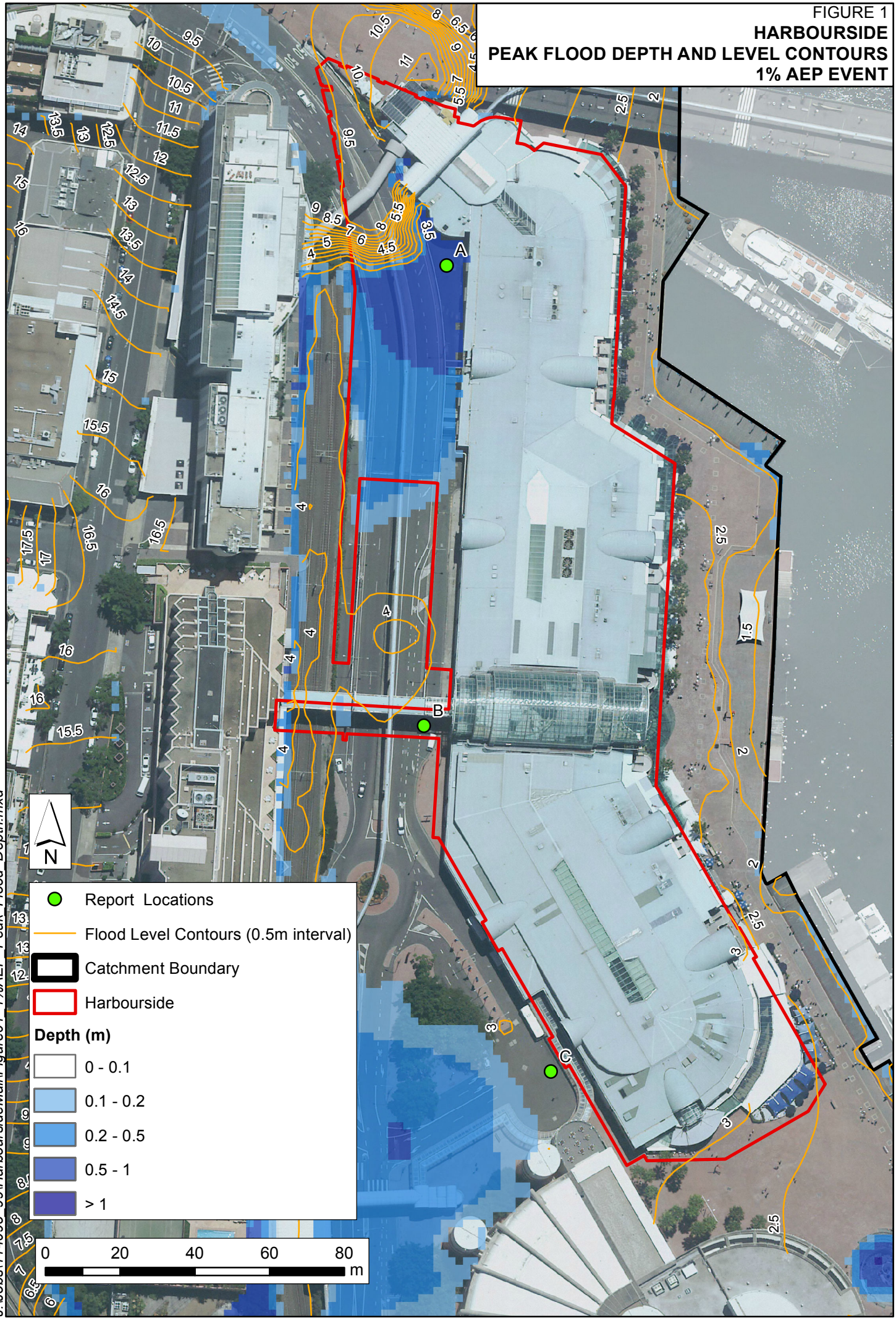
Table 1 Flood Behaviour – Locations shown on Figure 1

Location	A		B		C	
Design Event	Depth (m)	Level (mAHD)	Depth (m)	Level (mAHD)	Depth (m)	Level (mAHD)
50% AEP	0.51	2.98	0.00	3.36	0.01	3.07
20% AEP	0.61	3.08	0.00	3.36	0.01	3.07
10% AEP	0.65	3.12	0.00	3.36	0.01	3.07
5% AEP	0.71	3.18	0.00	3.36	0.01	3.07
2% AEP	0.77	3.24	0.01	3.37	0.01	3.07
1% AEP	0.79	3.26	0.01	3.37	0.01	3.07
0.2% AEP	0.82	3.29	0.01	3.37	0.09	3.15
PMF	1.83	4.30	0.94	4.30	1.25	4.31
1% AEP – 2050 Tailwater	0.85	3.32	0.01	3.37	0.02	3.08
1% AEP – 2100 Tailwater	0.85	3.32	0.01	3.37	0.04	3.1
1% AEP - 10% Rainfall Increase	0.89	3.36	0.01	3.37	0.02	3.08
1% AEP - 20% Rainfall Increase	0.93	3.40	0.01	3.37	0.06	3.12
1% AEP - 30% Rainfall Increase	0.96	3.43	0.01	3.37	0.11	3.17

Yours Sincerely,
WMAwater

Felix Taaffe
Project Engineer

FIGURE 1
HARBOURSIDE
PEAK FLOOD DEPTH AND LEVEL CONTOURS
1% AEP EVENT



J:\Jobs\114095_99\HarboursideMall\Figure01_1%AEP_Peak_Flood_Depth.mxd

APPENDIX B

Catchment and Site Photos

Figure B1: Photo locations (Google Earth)

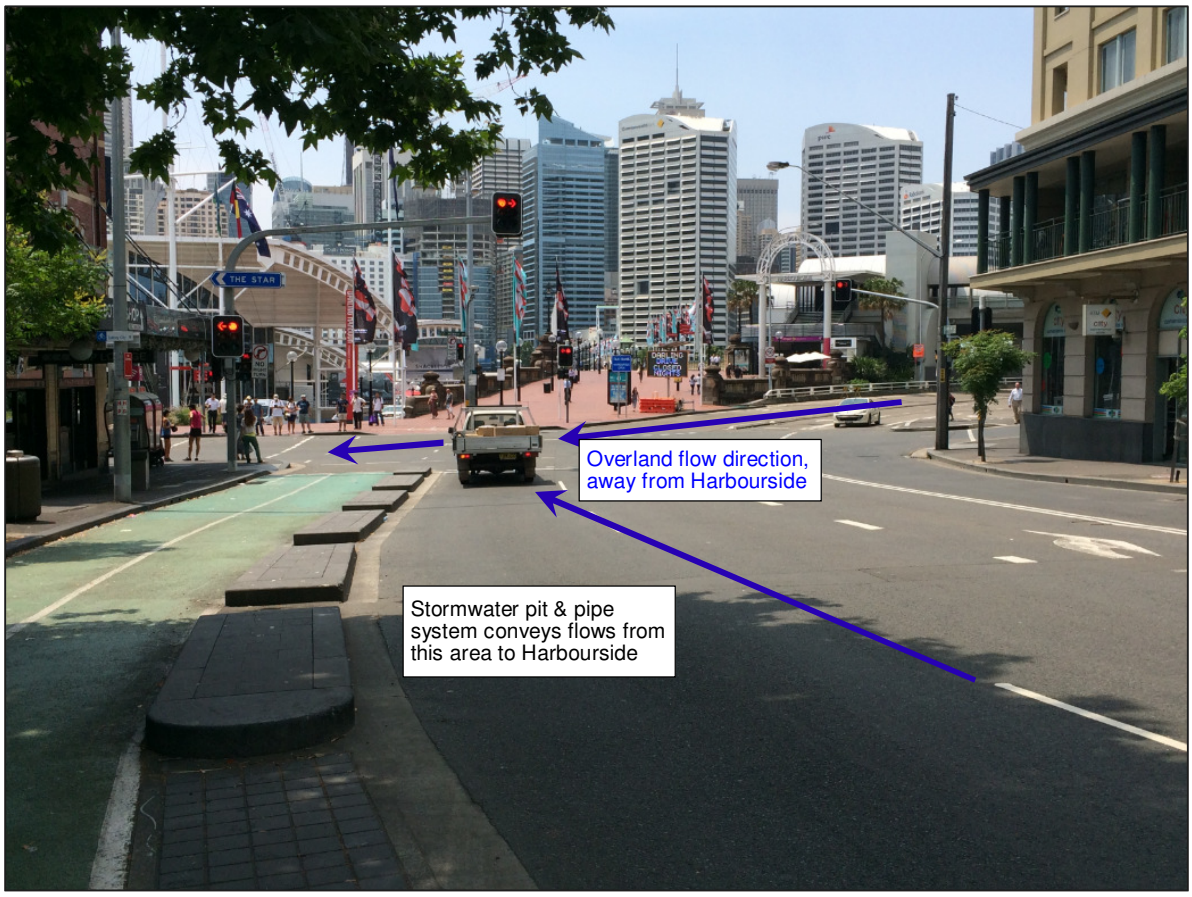


Photo 1: Pyrmont Bridge/Darling Drive, viewing eastward to IBIS Sydney

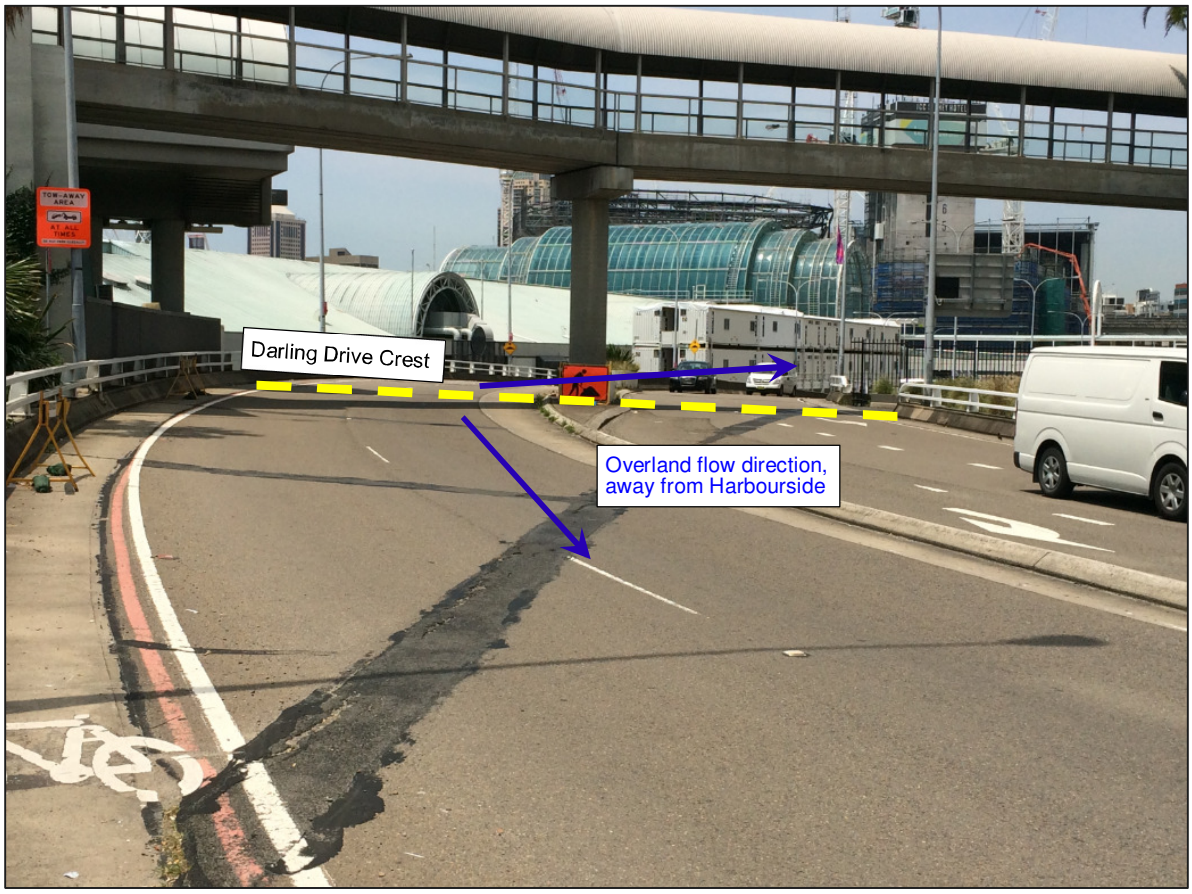


Photo 2: Darling Drive Road Crest, viewing south-eastward to Harbourside

Photo 3: Darling Drive Road Crest, viewing Northward from Harbourside

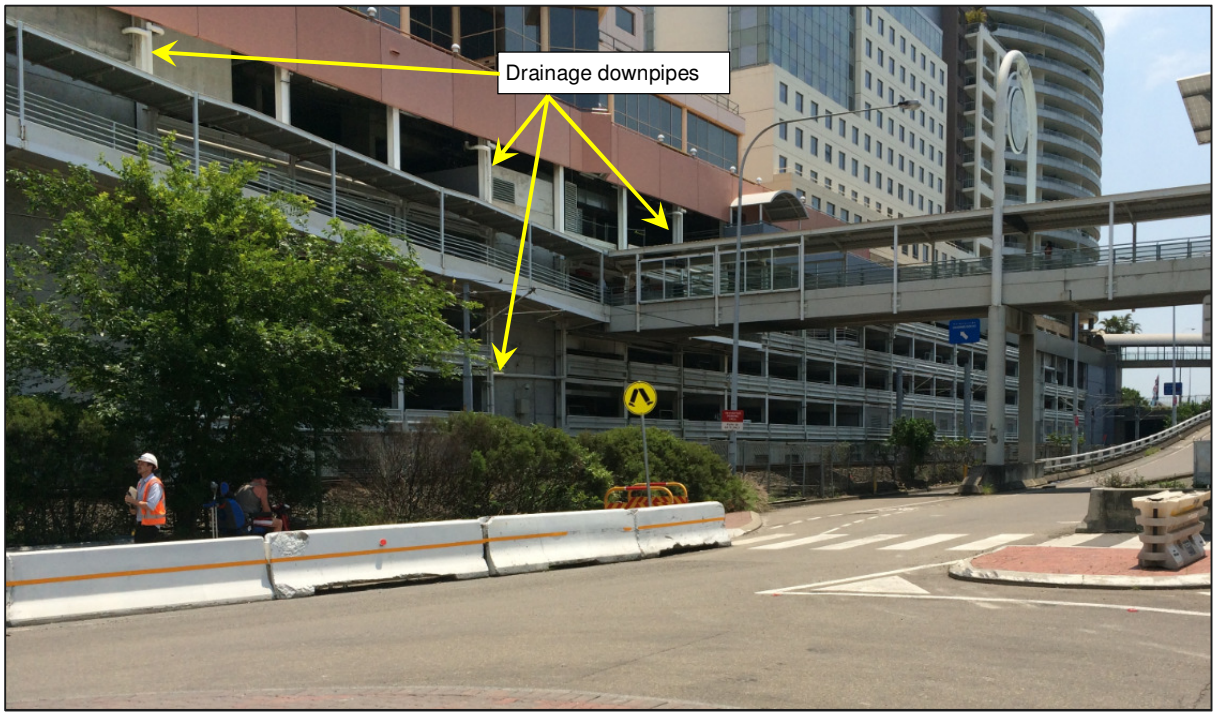


Photo 4: Darling Drive, viewing north-westward to Novotel Sydney and IBIS Sydney

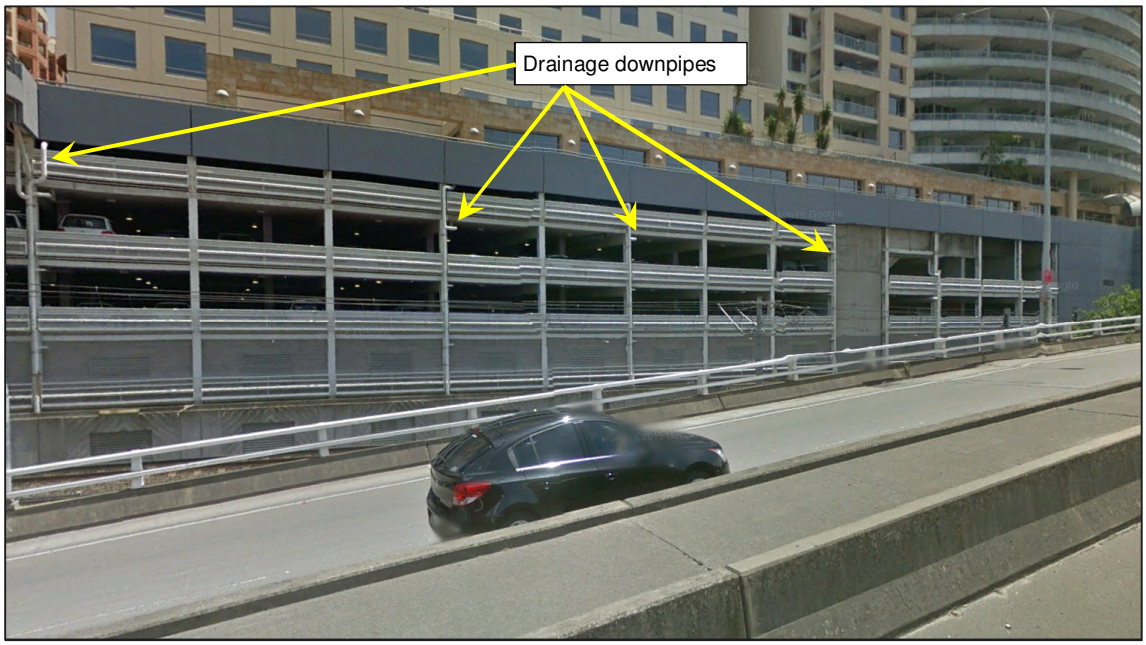


Photo 5: Darling Drive, viewing north-westward to IBIS Sydney (Google street view)

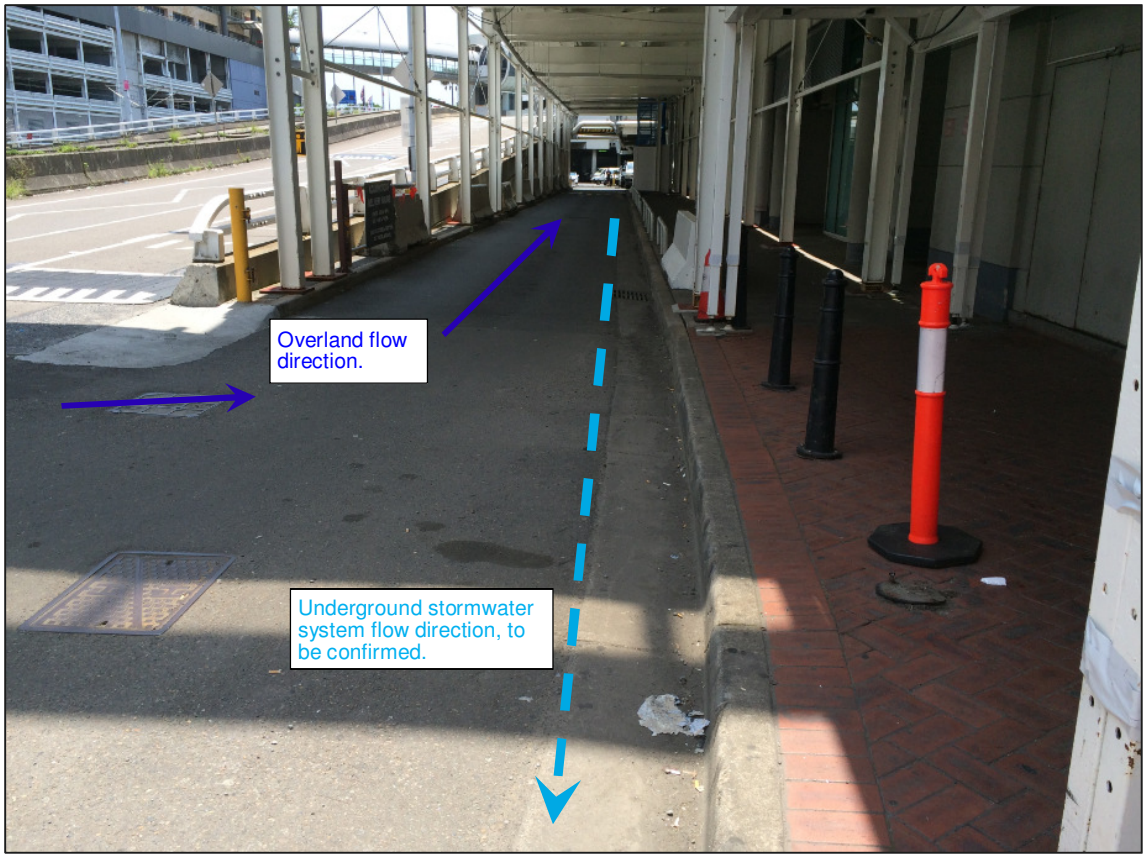


Photo 6: Harbourside, access road viewing Northward

Photos 6 to 10 show stormwater inlet pits likely to discharge into conduit system(s) (not included in CoS flood model)

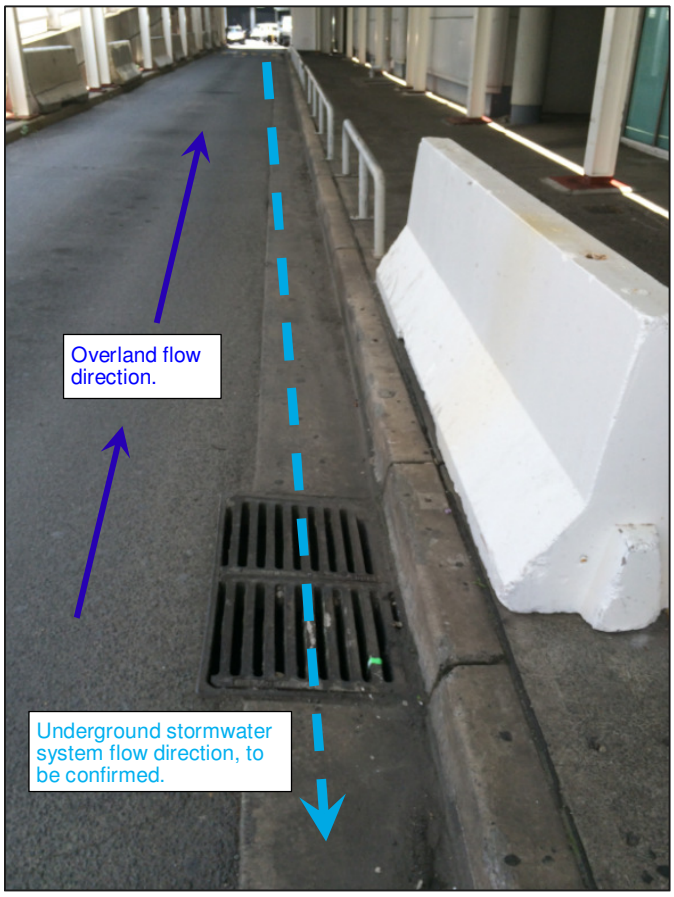


Photo 7: Harbourside, access road viewing Northward

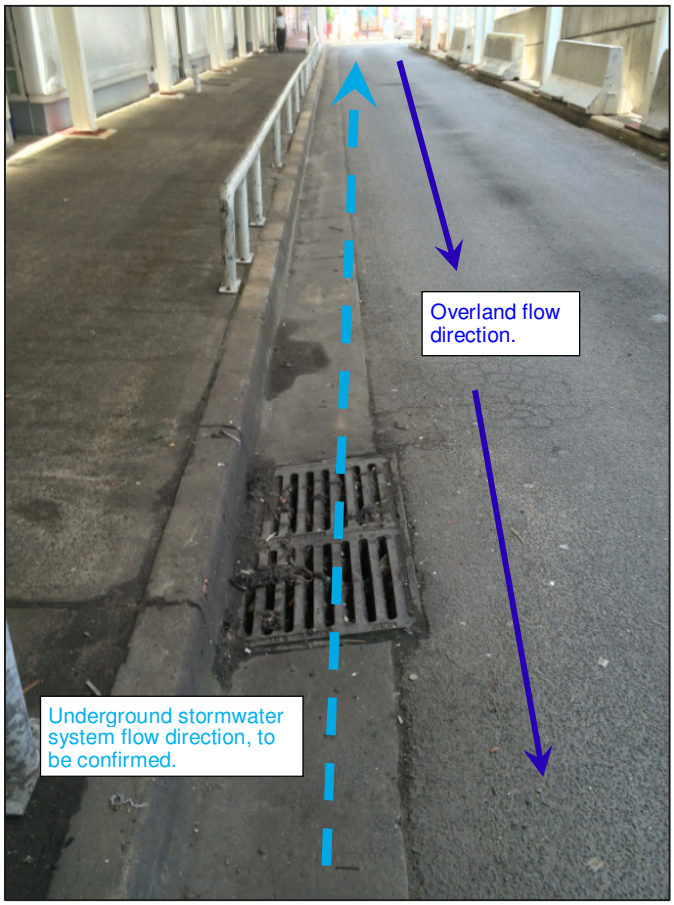


Photo 8: Harbourside, access road viewing Southward

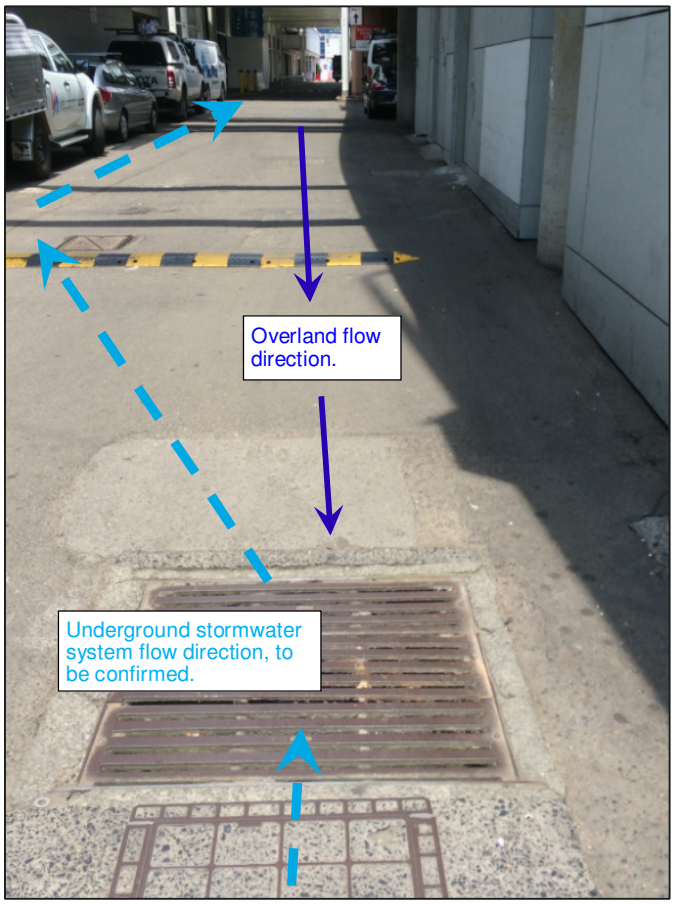


Photo 9: Harbourside, access road viewing Southward

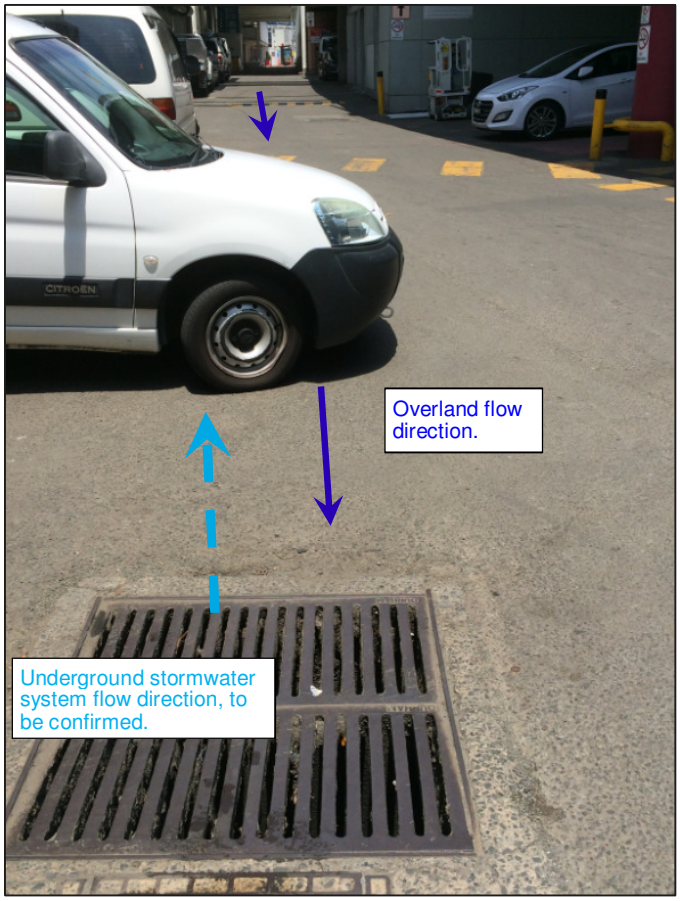


Photo 10: Harbourside, access road viewing Southward from street sag.

Photo 11: Harbourside, Loading Dock.

Photo 12: Harbourside, northern end adjacent to Pyrmont Bridge.

Potential overland flow path (not included in the CoS flood study). However, the relief 'flow path' is high level (~3.5mAHD?), narrow, and potential to block.

Photo 13: Harbourside, northern end (viewing out towards Pyrmont Bridge, not seen).

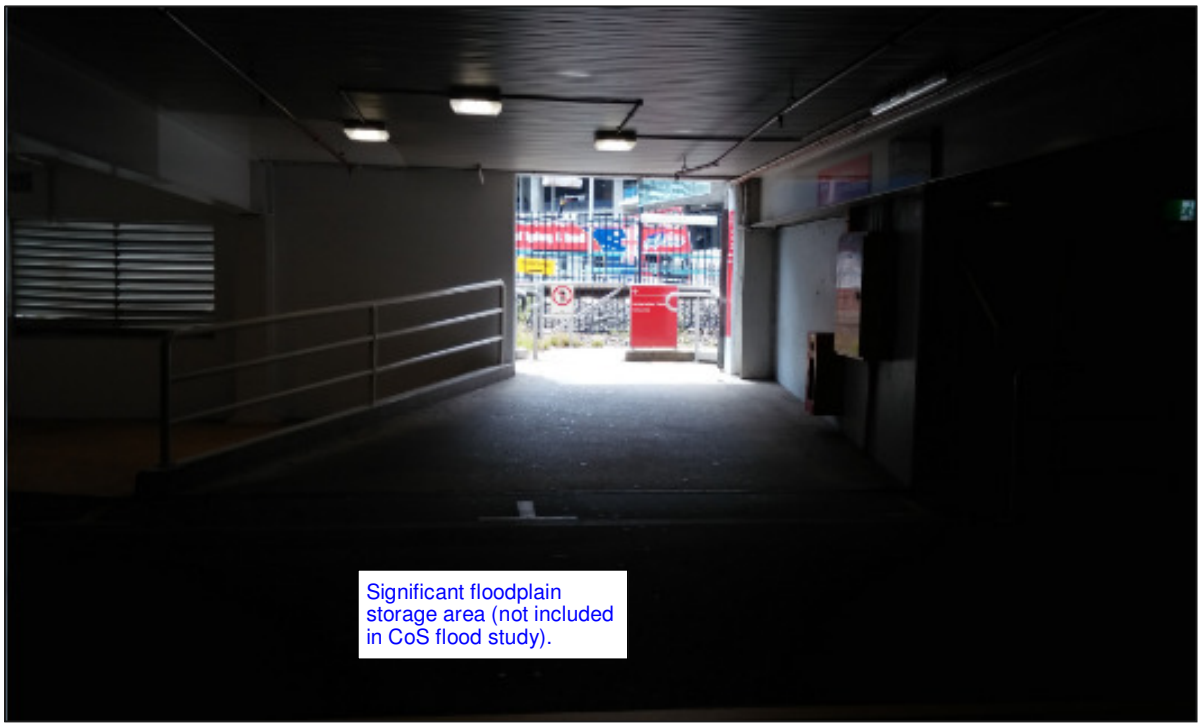


Photo 14: Novotel, Wilson lower level carpark eastern entrance viewing east towards light rail platform.

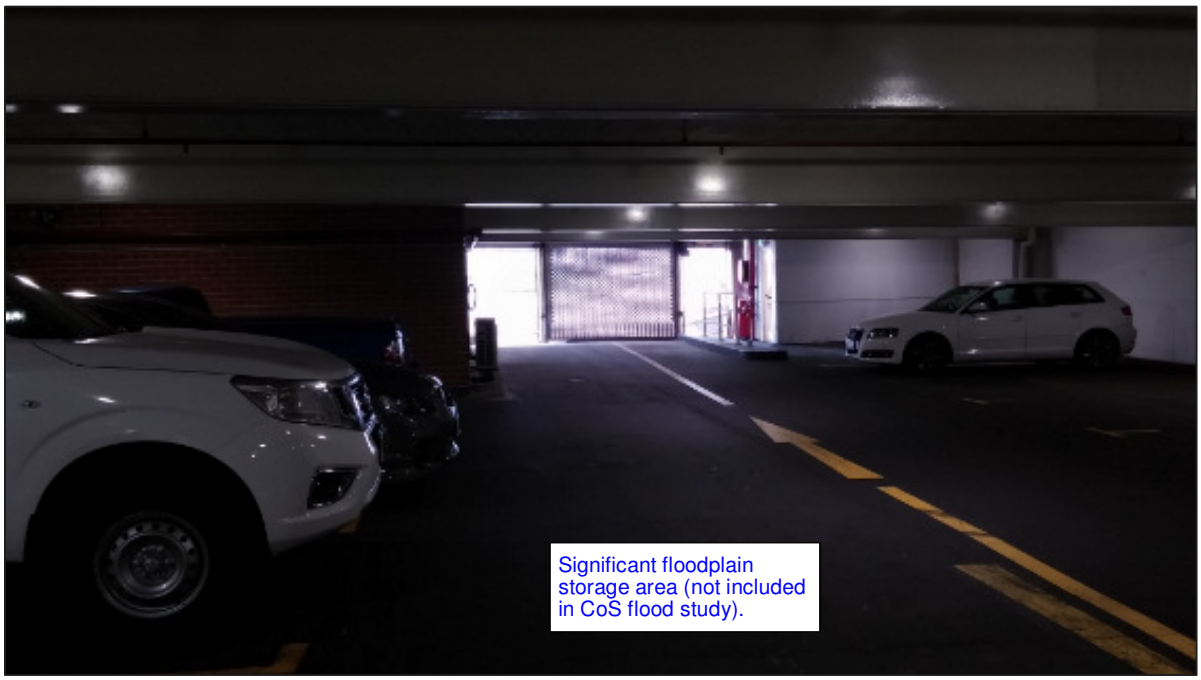


Photo 15: Novotel, Wilson lower level carpark southern entrance viewing south.

Photo 16: Novotel, Wilson lower level carpark viewing west.

This pit and associated stormwater conduits (to be confirmed) do not appears to be included in the CoS flood study).

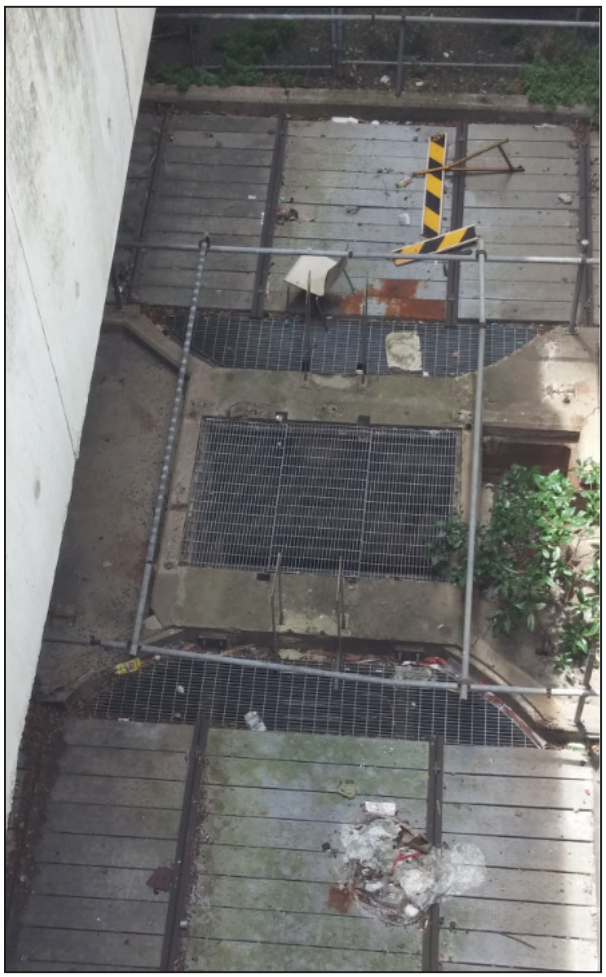


Photo 17: Novotel, Wilson lower level carpark viewing down from Murray Street.

Figure B2: Light Rail tunnel Alignment & Photo locations (Google Earth)

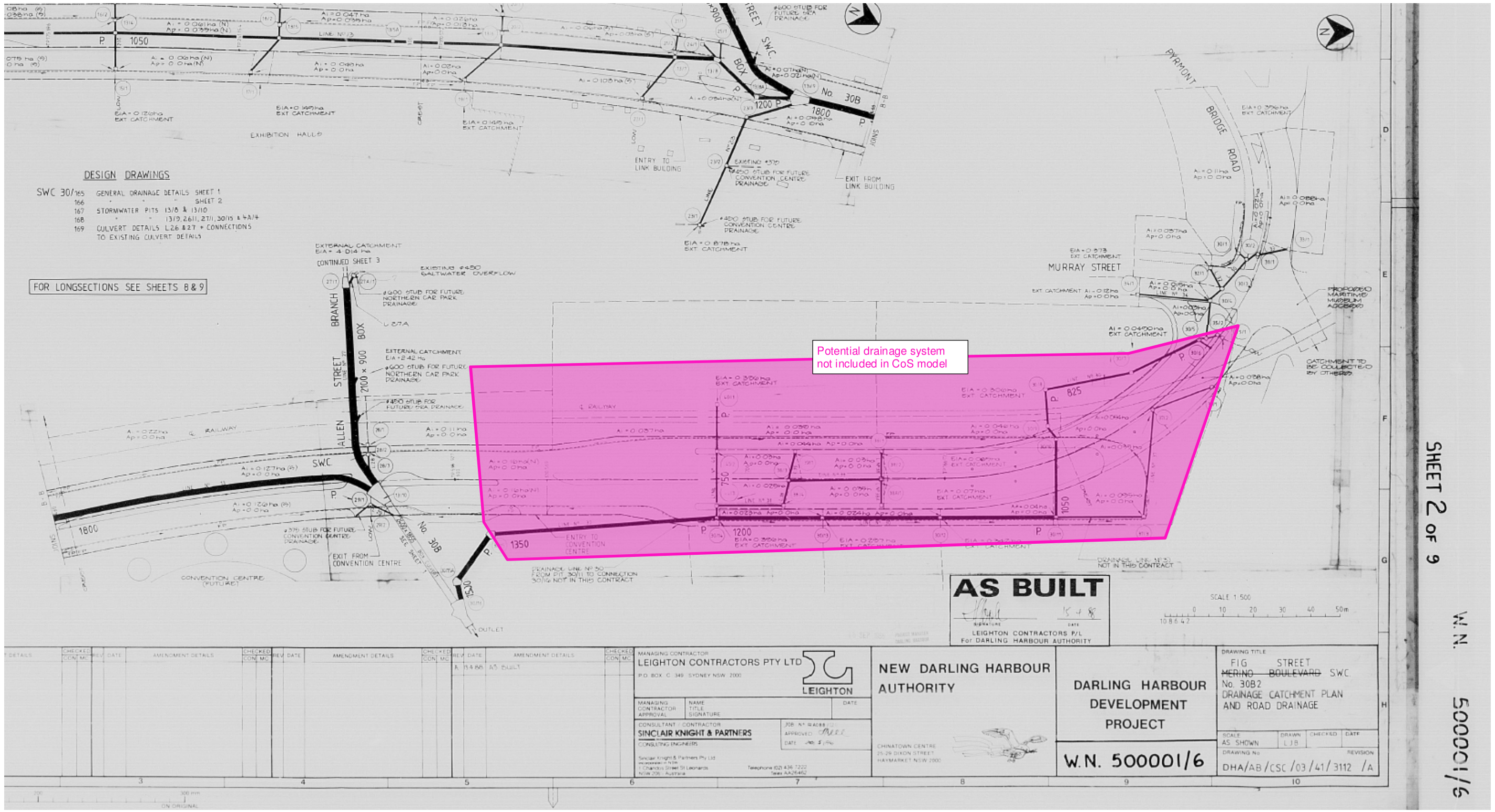
Photo 18: Light rail viewing north to tunnel entrance.

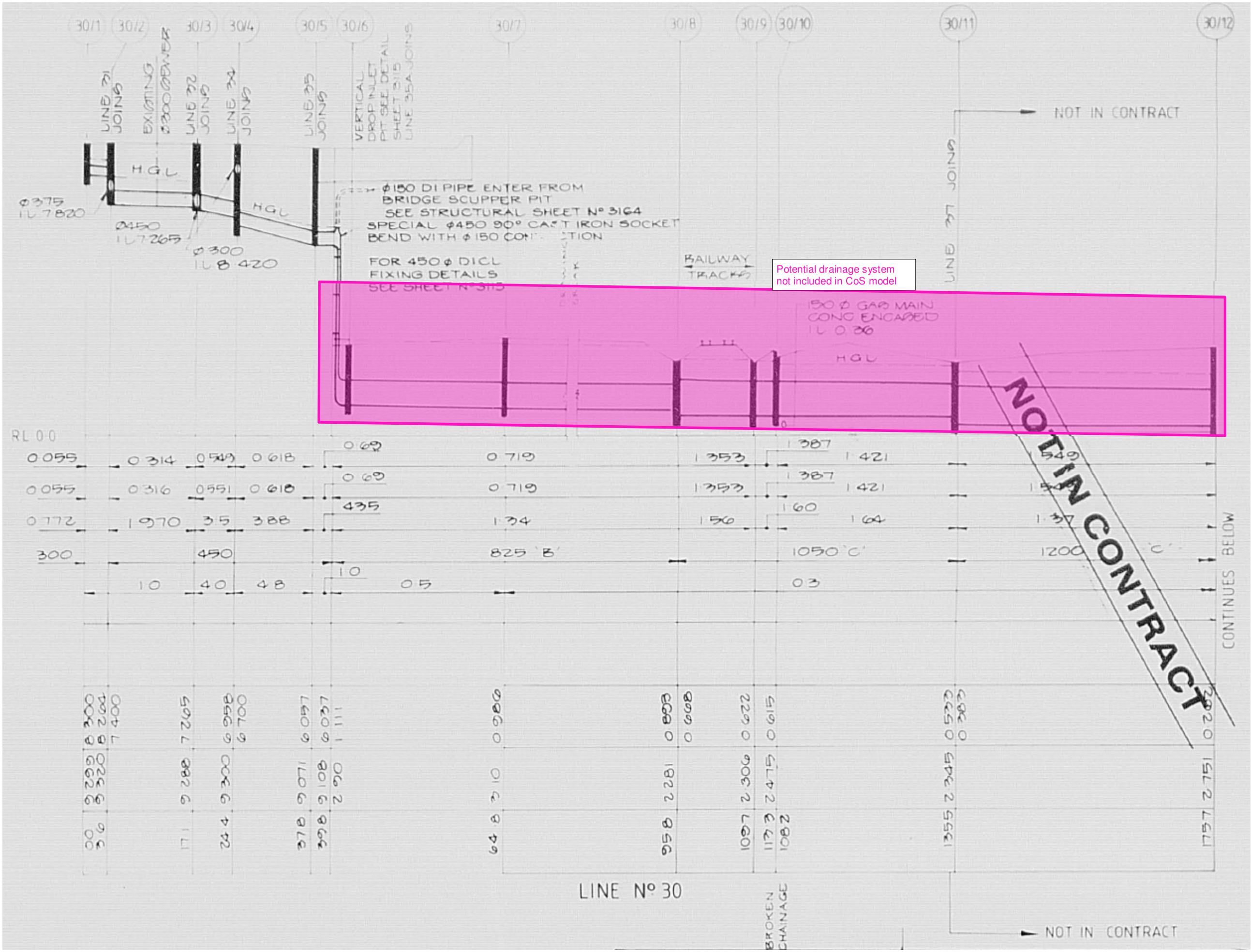
Photo 19: Viewing west from Harbourside access road to light rail (south of tunnel entrance).

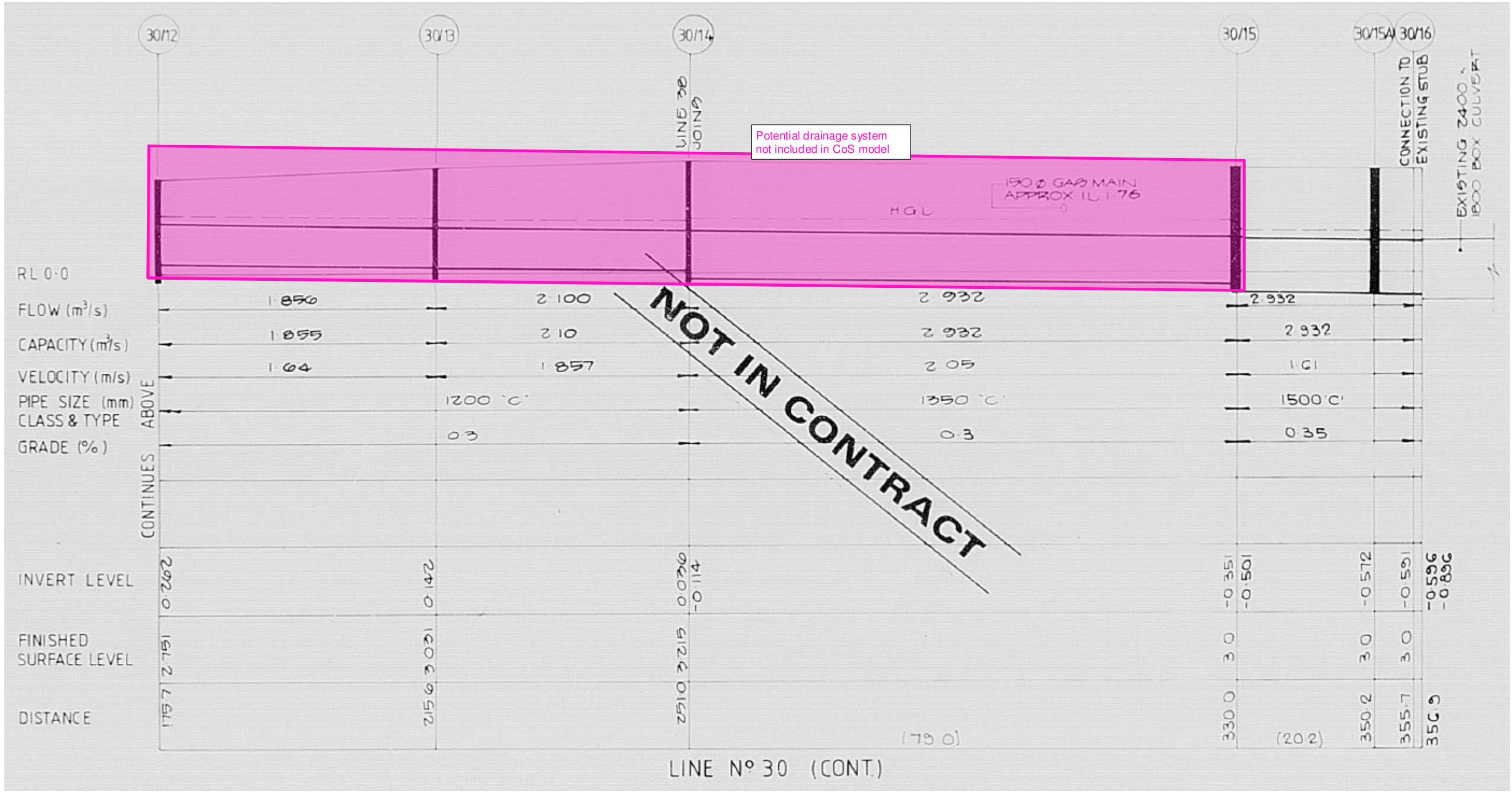
Photo 20: Light rail tunnel, viewing northward from Edward Street (Google street view)

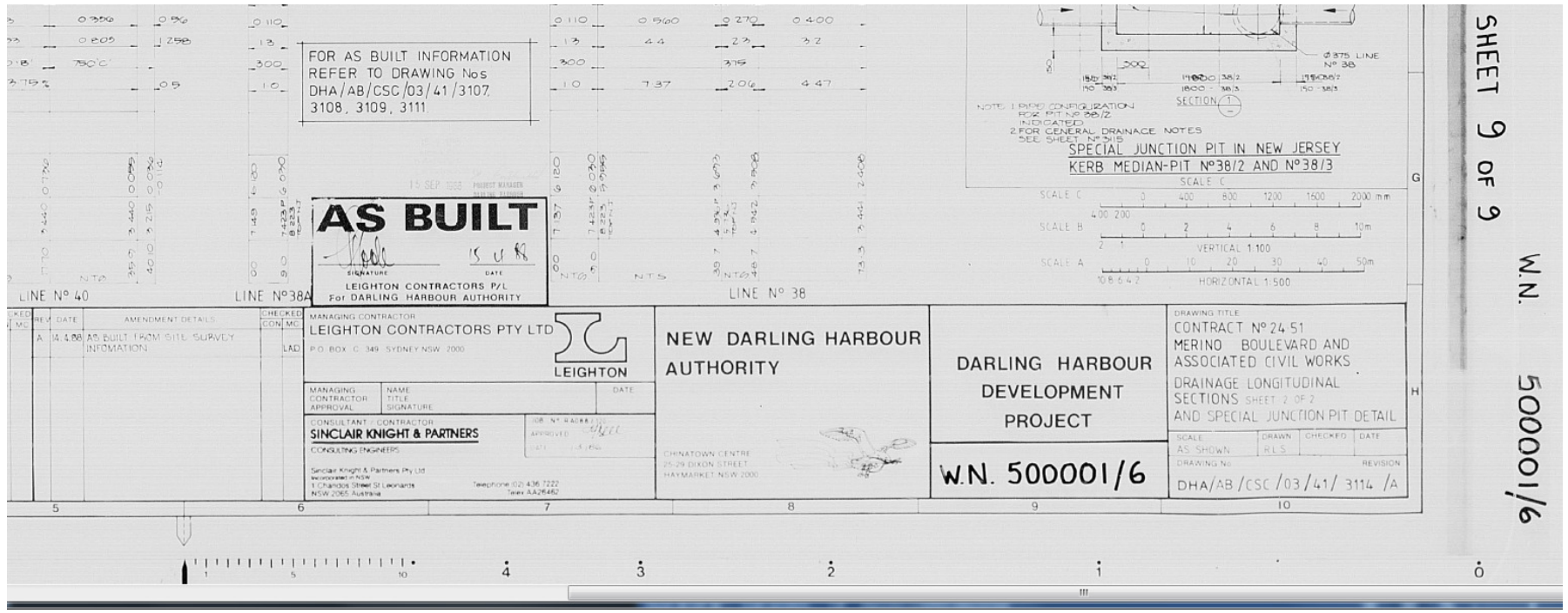
APPENDIX C

Drainage ‘As Built’ Part Plans


DESIGN DRAWINGS
SWC 30/165 GENERAL DRAINAGE DETAILS SHEET 1
166 " " SHEET 2
167 STORMWATER PITS 13/8 & 13/10
168 " 13/9, 26/1, 27/1, 30/15 & 4A/4
169 CULVERT DETAILS L26 &27 + CONNECTIONS TO EXISTING CULVERT DETAILS
FOR LONGSECTIONS SEE SHEETS 8 & 9
EXHIBITION HALLS
ENTRY TO LINK BUILDING
EXIT FROM LINK BUILDING
EXISTING #450
#450 STUB FOR FUTURE CONVENTION CENTRE DRAINAGE
#600 STUB FOR FUTURE SEA DRAINAGE
EXTERNAL CATCHMENT EIA = 4.014 ha
CONTINUED SHEET 3
EXISTING #450 SALTWATER OVERFLOW
#600 STUB FOR FUTURE NORTHERN CAR PARK DRAINAGE
EXTERNAL CATCHMENT EIA = 2.42 Ha
#450 STUB FOR FUTURE SEA DRAINAGE
BRANCH
STREET
ALLEN
2100 x 900 BOX
S.W.C.
RAILWAY
No. 30B
1800
1200
1350
1050
825
750
EXIT FROM CONVENTION CENTRE
CONVENTION CENTRE (FUTURE)
DRAINAGE LINE N° 30 FROM PIT 30/11 TO CONNECTION 30/16 NOT IN THIS CONTRACT
OUTLET
PYRMONT BRIDGE ROAD
MURRAY STREET
PROPOSED MARITIME MUSEUM ADDED
CATCHMENT TO BE COLLECTED BY OTHERS
DRAINAGE LINE N° 30 NOT IN THIS CONTRACT
Potential drainage system not included in CoS model
AS BUILT
LEIGHTON CONTRACTORS P/L
For DARLING HARBOUR AUTHORITY
SCALE 1:500
0 10 20 30 40 50m
MANAGING CONTRACTOR
LEIGHTON CONTRACTORS PTY LTD
P.O. BOX C 349 SYDNEY NSW 2000
LEIGHTON
CONSULTANT / CONTRACTOR
SINCLAIR KNIGHT & PARTNERS
CONSULTING ENGINEERS
NEW DARLING HARBOUR AUTHORITY
CHINATOWN CENTRE
25-29 DIXON STREET
HAYMARKET NSW 2000
DARLING HARBOUR DEVELOPMENT PROJECT
W.N. 500001/6
DRAWING TITLE
FIG STREET
~~MERINO BOULEVARD~~ S.W.C.
No. 30B2
DRAINAGE CATCHMENT PLAN AND ROAD DRAINAGE
SCALE AS SHOWN
DRAWN LJB
CHECKED
DATE
DRAWING No DHA/AB/CSC/03/41/3112 /A
REVISION
SHEET 2 OF 9
W.N. 500001/6


30/1
30/2
30/3
30/4
30/5
30/6
30/7
30/8
30/9
30/10
30/11
30/12
LINE 31 JOINS
EXISTING Ø300 CONCRETE PIPE
LINE 32 JOINS
LINE 34 JOINS
LINE 35 JOINS
VERTICAL DROP INLET PIT SEE DETAIL SHEET 315 LINE 35A JOINS
H.G.L
Ø375 I.L 7.820
Ø450 I.L 7.265
Ø300 I.L 8.420
Ø150 DI PIPE ENTER FROM BRIDGE SCUPPER PIT SEE STRUCTURAL SHEET Nº 3164
SPECIAL Ø450 90° CAST IRON SOCKET BEND WITH Ø150 CONNECTION
FOR 450Ø DICL FIXING DETAILS SEE SHEET Nº 315
RAILWAY TRACKS
Potential drainage system not included in CoS model
150 Ø GAS MAIN CONC ENCASED I.L 0.36
NOT IN CONTRACT
LINE 37 JOINS
RL 0.0
0.055 0.314 0.549 0.618 0.69 0.719 1.353 1.387 1.421 1.549
0.055 0.316 0.551 0.618 0.69 0.719 1.353 1.387 1.421 1.549
0.772 1.970 35 388 435 1.34 1.56 1.60 1.64 1.37
300 450 825 'B' 1050 'C' 1200 'C'
10 40 48 10 05 03
LINE Nº 30
BROKEN CHAINAGE
NOT IN CONTRACT
CONTINUES BELOW


30/12
30/13
30/14
30/15
30/15A
30/16
LINE 30 JOINS
Potential drainage system not included in CoS model
150Ø GAS MAIN APPROX IL 1·76
H.G.L
CONNECTION TO EXISTING STUB
EXISTING 2400 x 1800 BOX CULVERT
NOT IN CONTRACT
RL 0·0
FLOW (m³/s)
CAPACITY (m³/s)
VELOCITY (m/s)
PIPE SIZE (mm)
CLASS & TYPE
GRADE (%)
CONTINUES ABOVE
1·850
2·100
2·932
2·932
1·855
2·10
2·932
2·932
1·64
1·857
2·05
1·61
1200 'C'
1350 'C'
1500 'C'
0·3
0·3
0·35
INVERT LEVEL
292·0
241·0
-0·114
-0·351
-0·501
-0·572
-0·591
-0·596
-0·896
FINISHED SURFACE LEVEL
294·2
294·2
294·2
3·0
3·0
3·0
3·0
DISTANCE
119·7
121·9
251·0
(79·0)
330·0
(20·2)
350·2
355·7
356·5
LINE Nº 30 (CONT.)


FOR AS BUILT INFORMATION REFER TO DRAWING Nos DHA/AB/CSC/03/41/3107, 3108, 3109, 3111
AS BUILT
LEIGHTON CONTRACTORS P/L
For DARLING HARBOUR AUTHORITY
LINE Nº 40
LINE Nº 38A
LINE Nº 38
SPECIAL JUNCTION PIT IN NEW JERSEY KERB MEDIAN-PIT Nº38/2 AND Nº38/3
SECTION 1
SCALE C
SCALE B
SCALE A
VERTICAL 1:100
HORIZONTAL 1:500
MANAGING CONTRACTOR
LEIGHTON CONTRACTORS PTY LTD
P.O. BOX C 349 SYDNEY NSW 2000
LEIGHTON
CONSULTANT / CONTRACTOR
SINCLAIR KNIGHT & PARTNERS
CONSULTING ENGINEERS
NEW DARLING HARBOUR AUTHORITY
CHINATOWN CENTRE
25-29 DIXON STREET
HAYMARKET NSW 2000
DARLING HARBOUR DEVELOPMENT PROJECT
W.N. 500001/6
DRAWING TITLE
CONTRACT Nº 24.51
MERINO BOULEVARD AND ASSOCIATED CIVIL WORKS
DRAINAGE LONGITUDINAL SECTIONS SHEET 2 OF 2
AND SPECIAL JUNCTION PIT DETAIL
AS SHOWN
DRAWN R.L.S.
DRAWING No. DHA/AB/CSC/03/41/3114/A
SHEET 9 OF 9
W.N. 500001/6

APPENDIX D

City of Sydney's 'Interim Floodplain Management Policy'

Interim Floodplain Management Policy

Purpose

The Floodplain Management Policy provides direction with respect to how floodplains are managed within the Local Government Area (LGA) of the City of Sydney Council (the City).

The City has a responsibility to manage floodplains to ensure that any:

- new development will not experience undue flood risk; and
- existing development will not be adversely flood affected through increased damage or hazard as a result of any new development.

The Policy provides controls to facilitate a consistent, technically sound and best practice approach for the management of flood risk within the City's LGA. In forthcoming years the City will complete Floodplain Risk Management Plans and then integrate outcomes from these plans into planning controls. Once this process is completed this interim policy will be withdrawn.

Scope

This Policy applies to all new developments within the City of Sydney.

Definitions

Term	Meaning
Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. 1% AEP flood is approximately equal to 1 in 100 year Average Recurrent Interval (ARI) flood event (or simply 100 year flood). It has 1% chance to occur in a given year.
Australian Height Datum (AHD)	A common national plan of level corresponding approximately to mean sea level.
Average Recurrence Interval (ARI)	The long-term average number of years between the occurrence of a flood as big as or larger than, the selected event. For example, floods with a discharge as great as, or greater than, the 20 year ARI flood event may occur on average once every 20 years.

Term	Meaning
Basement Car Parking or Below-Ground Car Parking	The car parking area generally below ground level where inundation of the surrounding areas may raise water levels above the entry level to the basement, resulting in inundation. Basement car parks are areas where the means of drainage of accumulated water in the car park has an outflow discharge capacity significantly less than the potential inflow capacity.
Below-Ground Garage/Car park	Applies where the floor of the parking and/or access surface is more than 1 m below the surrounding natural ground.)
Carport	A structure used to house motor vehicles, which has a minimum of two sides "open" and not less than one third of its perimeter "open".
Critical Facilities	Includes hospitals and ancillary services, communication centres, police, fire SES, major transport facilities, sewerage and electricity plants; any installations containing critical infrastructure control equipment and any operational centres for use in a flood.
Effective Warning Time	The time available after receiving advice of an impending flood and before the floodwaters prevent appropriate flood response actions being undertaken. The effective warning time is typically used to raise furniture, evacuate people and transport their possessions.
Evacuation	The transfer of people and or stock from areas where flooding is likely, either close to, or during a flood event. It is affected not only by warning time available, but also the suitability of the road network, available infrastructure, and the number of people that have to evacuate during floods.
Extreme Flood	An estimate of the probable maximum flood (PMF), which is the largest flood that could conceivably occur at a particular location, generally estimated from the probable maximum precipitation (PMP). Generally it is not physically or economically possible to provide complete protection against this event.
Flood	A relatively high stream flow that overtops the natural or artificial banks in any part of a stream, channel, river, estuary, lake or dam, and/or local overland flooding associated with major drainage as defined by the NSW Floodplain Development Manual (FDM) before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
Flood Compatible Materials	Those materials used in building which are resistant to damage when inundated. A list of flood compatible materials is attached.
Flood Evacuation Strategy	The proposed strategy for the evacuation of areas with effective warning time during periods of flood as specified within any policy of Council, the floodplain risk management plan (FRMP), the relevant state government disaster plan, by advices received from the State Emergency Services (SES) or as determined in the assessment of individual proposals.
Floodplain	The area of land which is subject to inundation by floods up to and including the probable maximum flood (PMF) event.

Term	Meaning
Floodplain Development Manual (FDM)	The document dated April 2005, published by the New South Wales Government and entitled 'Floodplain Development Manual: the management of flood liable land'.
Flood Planning Area	The area of land below the FPL and thus subject to flood related development controls.
Flood Planning Level (FPL)	The combinations of flood levels and freeboards selected for floodplain risk management purposes, as determined in flood studies and floodplain risk management studies and plans.
Floodplain Risk Management Plan (FRMP)	A plan prepared for one or more floodplains in accordance with the requirements of the FDM or its predecessor.
Floodplain Risk Management Study (FRMS)	A study prepared for one or more floodplains in accordance with the requirements of the FDM or its predecessor.
Flood Storage	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood.
Floodway	Those areas, often aligned with obvious naturally defined channels, where a significant discharge of water occurs during floods. They are also areas where, if only partially blocked, will cause a significant redistribution of flood flow or significant increase in flood levels, which many impact on other properties.
Freeboard	A factor of safety expressed as the height above the design flood level. Freeboard provides a factor of safety to compensate for uncertainties in the estimation of flood levels across the floodplain, such as wave action; localised hydraulic behaviour and impacts that are specific event related, such as levee and embankment settlement; cumulative impacts of fill in floodplains and other effects such as changes in rainfall patterns as a result of climate change.
Garage	A private building or part of a building used to park or keep a motor vehicle and that is not defined as a carport.
Habitable Floor Area	• in a residential situation: a living or working area, such as a lounge room, dining room, rumpus room, kitchen, bedroom or workroom; • in an industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.
Hazardous Materials	Solids, liquids, or gases that can harm people, other living organisms, property, or the environment. These may include materials that are radioactive, flammable, explosive, corrosive, oxidizing, asphyxiating, bio-hazardous, toxic, pathogenic, or allergenic. Also included are physical conditions such as compressed gases and liquids or hot materials, including all goods containing such materials or chemicals, or may have other characteristics that render them hazardous in specific circumstances.
Large Scale Development	For the purposes of this document refers to a proposal that involves site disturbance 1000m2 of land or greater.

Term	Meaning
Local Overland ~~Flooding~~ Flow Path	Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.
Probable Maximum Flood (PMF)	The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation.
Probable Maximum Precipitation (PMP)	The greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to the estimation of the probable maximum flood.
Reliable Access During A Flood	The ability for people to safely evacuate an area subject to imminent flooding within effective warning time, having regard to the depth and velocity of flood waters, the suitability of the evacuation route, and without a need to travel through areas where flood hazard increases
Section 149 Planning Certificate	Information, including the statutory planning controls that apply to a parcel of land on the date the certificate is issued.
Shed	Includes machinery sheds, garden and storage sheds but does not include a garage or car park.
Suitably Qualified Engineer	An engineer who is included in the National Professional Engineers Register, administered by the Institution of Engineers Australia.
Survey plan	A plan prepared by a Registered Surveyor which shows the information required for the assessment of an application in accordance with the provisions of this Policy.

Policy statement

1 Introduction

The Policy has been prepared in accordance with the guidelines provided in the NSW Government Floodplain Development Manual (2005) (FDM). This manual guides Council in the development and implementation of local Floodplain Risk Management Plans to produce robust and effective floodplain risk management outcomes.

In accordance with the FDM, the Flood Risk Management Process entails four sequential stages:

- Stage 1:Flood Study
- Stage 2:Floodplain Risk Management Study
- Stage 3:Floodplain Risk Management Plan
- Stage 4:Implementation of the Plan

The City is progressively producing Floodplain Risk Management Plans for each of the individual drainage catchments within the City's LGA. Floodplain Risk Management Plans consider the existing flood environment and recommend specific measures to manage the impact of flooding. In assessing the flood environment, elements such as known flood behaviour, evacuation issues, site access and the potential impact of sea level rise are taken into consideration. This information is used to create floodplain risk mapping for each catchment.

Floodplain Risk Management Plans provide a range of measures that can be used to mitigate the impact of flooding. Invariably one of the most successful measures is the implementation of effective land use planning. This document provides the means for implementing the Floodplain Risk Management Plans and associated mapping for the control of development on the floodplain within the City.

1.1 Aims and Objectives of the Policy

- To inform the community of the City's Policy with regard to the use of flood prone land;
- To establish guidelines for the development of flood prone land that are consistent with the NSW Flood Policy and NSW Floodplain Development Manual (2005) as updated by the Floodplain Management Guides;
- To control development and activity within each of the individual floodplains within the City having regard to the characteristics and level of information available for each of the floodplains;
- To minimise the risk to human life and damage to property by controlling development on flood prone land;
- To apply a merit based approach to all development decisions taking into account ecological, social and environmental considerations;
- To ensure that the development or use of floodplains does not adversely impact upon the aesthetic, recreational and ecological values of the waterway corridors;
- To ensure that all land uses and essential services are appropriately sited and designed in recognition of all potential floods;
- To ensure that all development on the floodplain complies with Ecologically Sustainable Development (ESD) principles and guidelines; and
- To promote building design that considers requirements for the development of flood prone land and to ensure that the development of flood prone land does not have significant impacts upon the amenity of an area.

1.2 Background

This Policy has been prepared having regard to the provisions of the NSW Flood Policy and NSW Floodplain Development Manual (2005).

Sydney Local Environmental Plan 2012 (Sydney LEP 2012) requires the consent authority to be satisfied that all new development adequately protects the safety of property and life, and avoid significant adverse impacts on flood behaviour and the environment. Specified flood planning controls apply to all land which is at or below the flood planning level. The requirements set out in Sydney LEP 2012 must be met before development consent is granted.

This Policy is to be read in conjunction with the provisions of Sydney LEP 2012 and Sydney DCP 2012.

1.3 Relationship to other Policies

This Policy is to be read in conjunction with Sydney LEP 2012 and Sydney DCP 2012. It includes but is not limited to the development types listed below:

- Single dwellings, terraces, and dual occupancy buildings;
- Residential flat, commercial and mixed use developments;
- Industrial developments; and
- Other development types and uses, as detailed in the Sydney DCP 2012.

In conjunction with the development type requirements, the Sydney LEP 2012 and Sydney DCP 2012 also require:

- Sustainable water use practices;
- The reduction of stormwater pollution on receiving waterways; and
- That development does not exacerbate the potential for flood damage or hazard for existing development or public domain.

1.4 Application of Policy

The policy is written in an objectives/requirements format. Where an applicant seeks variation from the requirements, appropriate written justification indicating how the proposal meets the relevant objectives, must be provided for the consideration of Council.

2 Application Requirements

2.1 Required Information

Applications must include information that addresses all relevant controls listed within this document and the following matters as applicable:

a Development applications affected by this Policy shall be accompanied by a survey plan showing:

- i the position of the existing building/s or proposed building/s;
- ii the existing ground levels and features to Australian Height Datum around the perimeter of the site and contours of the site; and
- iii the existing or proposed floor levels to Australian Height Datum.

b Applications for earthworks, filling of land, infrastructure and subdivision shall be accompanied by a survey plan (with a minimum contour interval of 0.25m) showing relative levels to Australian Height Datum.

c For large scale developments, or developments that in the opinion of the City are in critical situations, where an existing catchment based flood study is not available, a flood assessment report prepared by a suitably qualified engineer using a hydrologic and hydraulic dynamic one or two dimensional computer model.

d Where the controls for a particular development proposal require an assessment of structural soundness during potential floods, the following impacts must be addressed:

- iv hydrostatic pressure;
- v hydrodynamic pressure;
- vi impact of debris; and
- vii buoyancy forces.

Foundations need to be included in the structural analysis. Scour protection may be required at foundations.

3 Development Provisions

The Department of Planning and Infrastructure has produced a group of Model Local Provisions for inclusion in Local Environmental Plans. The Model Local Provisions have been produced to address common topics raised by Councils in Local Environmental Plan preparation and provide them with guidance in what is to be considered in the assessment of development proposals. The Model Clause for Flood Planning has been adopted as clause 7.15 in Sydney LEP 2012. The Performance Criteria listed under Section 3.2 below reflects the considerations specified in Sydney LEP 2012.

Sydney DCP 2012 provides prescriptive planning controls in Section 3.7. The objectives of these planning controls are to:

- Ensure an integrated approach to water management across the City through the use of water sensitive urban design principles.
- Encourage sustainable water use practices.
- Assist in the management of stormwater to minimise flooding and reduce the effects of stormwater pollution on receiving waterways.
- Ensure that development manages and mitigates flood risk, and does not exacerbate the potential for flood damage or hazard to existing development and to the public domain.
- Ensure that development above the flood planning level as defined in the Sydney 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.

Note: A number of flood studies and associated flood risk management plans are currently under development. New development will be required to conform to the requirements of these flood studies and associated flood risk management plans once endorsed by Council.

3.1 Performance Criteria

If a proposal does not meet the requirements of the relevant Prescriptive Provisions, consent must not be granted to development unless the consent authority is satisfied with the following the provision and assessment of information relating to the development. The development:

a is compatible with the established flood hazard of the land. In areas where flood hazard has not been established through previous studies or reports, the flood hazard must be established in accordance with the Floodplain Development Manual considering the following:

- i Impact of flooding and flood liability is to be managed ensuring the development does not divert floodwaters or interfere with flood storage or the natural function of the waterway;
- ii Flood behaviour (for example, flood depths reached, flood flow velocities, flood hazard, rate of rise of floodwater);
- iii Duration of flooding for a full range of events;
- iv Appropriate flood mitigation works;
- v Freeboard;
- vi Council's duty of care – Proposals to address or limit; and
- vii Depth and velocity of flood waters for relevant flood events.

b will not significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties;

c incorporates appropriate measures to manage risk to life from flood considering the followings:

- i The proposed development should not result in any increased risk to human life
- ii Controls for risk to life for floods up to the Flood Planning Level
- iii Controls for risk to life for floods greater than the Flood Planning Level

iv Existing floor levels of development in relation to the Flood Planning Level and floods greater than the Flood Planning level

v Council's duty of care – Proposals to address and limit

vi What level of flooding should apply to the development e.g. 1 in 100 year, etc

vii Effective flood access and evacuation issues

viii Flood readiness – Methods to ensure relative flood information is available to current and future occupants and visitors;

d will not significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of creek or channel banks or watercourses;

e is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding;

f is consistent with the principles of Ecologically Sustainable Development; and

g adequately considers the impact of climate change.

It is to be noted that with regard to climate change, appropriate benchmarks based on the best available current information have been used in producing the flood risk management plans that inform this document.

Some prescriptive requirements such as flood planning level requirements may be relaxed if Council can be satisfied that the projected life of the proposed development is for a relatively short-term and therefore does not warrant the imposition of controls that consider impacts beyond the cessation of the proposed development. This will only be considered for uses where the residual risk to the occupation of the development is considered to be low. This may include certain temporary or demountable structures but would not include residential developments.

3.2 Concessional Development – Minor Additions

a. The City acknowledges that in some instances, relatively minor building additions will have minimal impact on the floodplain and will not present an unmanageable risk to life. Council will give consideration for the following forms of development on suitable sites:

i attached dwelling additions of up to 40m^2 of habitable floor area at or above the same level as the existing adjoining approved floor level for habitable floor area. The allowance for additions shall be made no more than once for any given development;

ii additions to Commercial and Industrial Uses of up to an additional 100 m^2 or 20% (whichever the less) of the Gross Floor Area of the existing building at no less than the same level as the existing adjoining approved floor level. The allowance for additions shall be made no more than once for any given development.

b. As part of any consent issued pursuant to this section Council will require:

i a restriction on the property title requiring compliance with the flood studies and associated flood risk management plans.

ii the existing development is to be suitably upgraded to address the potential impacts of flooding.

3.3 Heritage Considerations

The City acknowledges that certain buildings or structures require preservation due to their heritage significance. Developments with heritage significance can be assessed on a merit based approach provided the following requirements are satisfied:

i. Expert assessment has identified the structure or development as having heritage conservation value;

ii. Planning instruments have specifically identified the existing developmentas having heritage conservation value and provide the appropriate level of statutory protection;
iii. The highest practical level of flood protection is provided while maintaining an appropriate balance with heritage conservation;
iv. The proposed development will not be subject to frequent flooding risk that may jeopardise the long term viability or heritage conservation of the development. Comprehensive assessment would be required where the development is subject to flooding in storms more frequent than the 5% AEP flood;
v. A restriction shall be placed on the property title, identifying the flooding risk and requiring conservation of heritage values.

4 General Requirements

The following ancillary development issues are to be considered in the assessment of proposed development of flood prone land.

Development Type/ Aspect	Objective	Requirement
Fencing	• To ensure that fencing does not result in any significant obstruction to the free flow of floodwaters; and • To ensure that fencing will remain safe during floods and not become moving debris that potentially threatens the security of structures or the safety of people.	Fencing is to be designed and constructed in such a manner that it will not modify the flow of floodwaters and cause damage to surrounding land.
Residential Properties	• To minimise the damage to residential properties from flooding; and • To minimise risk to human life from the inundation of residential properties and to minimise economic cost to the community resulting from flooding.	• The proposed residential building or dwelling must be free from flooding up to and including the 1% AEP flood and must meet the Flood Planning Level Requirements detailed in Section 5; and • The proposed residential building or dwelling should not increase the likelihood of flooding on other developments, properties or infrastructure.
Industrial and Commercial Properties	• To minimise the damage to industrial and commercial properties from flooding; and • 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.	• The City may consider merits-based approaches presented by the applicant. The proposed industrial or commercial buildings must meet the Flood Planning Level Requirements detailed in Section 5; and • The proposed industrial or commercial development should not increase the likelihood of flooding on other developments, properties or infrastructure.

Development Type/ Aspect	Objective	Requirement
Car Parking	• To minimise the damage to motor vehicles from flooding; • To ensure that motor vehicles do not become moving debris during floods, which threaten the integrity or blockage of structures or the safety of people, or damage other property; and • To minimise risk to human life from the inundation of basement and other car park or driveway areas.	• The proposed car park should not increase the risk of vehicle damage by flooding inundation; • The proposed garage or car park should not increase the likelihood of flooding on other developments, properties or infrastructure; • The proposed garage or car park must meet the Flood Planning Level Requirements detailed in *Section 5*; and • Open car parking - The minimum surface level of open space car parking subject to inundation should be designed giving regard to vehicle stability in terms of depths and velocity during inundation by flood waters. Where this is not possible, it shall be demonstrated how the objectives will be met.
Filling of Flood Prone Land	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.	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 filling must be supported by a flood assessment report from a suitably qualified engineer which certifies that the filling will not increase flood affectation elsewhere.
On-Site Sewer Management (Sewer mining)	• To prevent the spread of pollution from on-site sewer management systems during periods of flood; and • To assist in the ongoing operation of on-site sewer management systems during periods of flood.	The treatment facility must be located above the 1% AEP flood level and must comply with Flood Planning Level requirements, or are otherwise protected and may function if below this level.
Storage of Hazardous Substances	To prevent the potential spread of pollution from hazardous substances.	The storage of products which, in the opinion of the City, may be hazardous or pollute floodwaters, must be placed above the 1% AEP flood level or placed within an area protected by bunds or levels such that no flood waters can enter the bunded area and must comply with the Flood Planning Level requirement for such a facility.

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

5 Flood Planning Levels

A Flood Planning Level refers to the permissible minimum building floor levels. For below-ground parking or other forms of below-ground development, the Flood Planning Level refers to the minimum level at each access point. Where more than one flood planning level is applicable the higher of the applicable Flood Planning Levels shall prevail.

Development		Type of flooding	Flood Planning Level
Residential	Habitable rooms	Mainstream flooding	1% AEP flood level + 0.5 m
		Local drainage flooding (Refer to Note 2)	1% AEP flood level + 0.5 m or Two times the depth of flow with a minimum of 0.3 m above the surrounding surface if the depth of flow in the 1% AEP flood is less than 0.25 m
		Outside floodplain	0.3 m above surrounding ground
	Non-habitable rooms such as a laundry or garage (excluding below-ground car parks)	Mainstream or local drainage flooding	1% AEP flood level
Industrial or Commercial	Business	Mainstream or local drainage flooding	Merits approach presented by the applicant with a minimum of the 1% AEP flood level
	Schools and child care facilities	Mainstream or local drainage flooding	Merits approach presented by the applicant with a minimum of the 1% AEP flood level + 0.5m
	Residential floors within tourist establishments	Mainstream or local drainage flooding	1% AEP flood level + 0.5 m
	Housing for older people or people with disabilities	Mainstream or local drainage flooding	1% AEP flood level + 0.5 m or a the PMF, whichever is the higher
	On-site sewer management (sewer mining)	Mainstream or local drainage flooding	1% AEP flood level
	Retail Floor Levels	Mainstream or local drainage flooding	Merits approach presented by the applicant with a minimum of the 1% AEP flood. The proposal must demonstrate a reasonable balance between flood protection and urban design outcomes for street level activation.
Below-ground garage/ car park	Single property owner with not more than 2 car spaces.	Mainstream or local drainage flooding	1% AEP flood level + 0.5 m

Development		Type of flooding	Flood Planning Level
	All other below-ground car parks	Mainstream or local drainage flooding	1% AEP flood level + 0.5 m or the PMF (whichever is the higher) See Note 1
	Below-ground car park outside floodplain	Outside floodplain	0.3 m above the surrounding surface
Above ground car park	Enclosed car parks	Mainstream or local drainage flooding	1% AEP flood level
	Open car parks	Mainstream or local drainage	5% AEP flood level
Critical Facilities	Floor level	Mainstream or local drainage flooding	1% AEP flood level + 0.5m or the PMF (whichever is higher)
	Access to and from critical facility within development site	Mainstream or local drainage flooding	1% AEP flood level

Note***s***

1) The below ground garage/car park level applies to all possible ingress points to the car park such as vehicle entrances and exits, ventilation ducts, windows, light wells, lift shaft openings, risers and stairwells.

2) Local drainage flooding occurs where:

- The maximum cross sectional depth of flooding in the local overland flow path through and upstream of the site is less than 0.25m for the 1% AEP flood; and
- The development is at least 0.5m above the 1% AEP flood level at the nearest downstream trapped low point; and
- The development does not adjoin the nearest upstream trapped low point; and
- Blockage of an upstream trapped low point is unlikely to increase the depth of flow past the property to greater than 0.25m in the 1% AEP flood.

3) Mainstream flooding occurs where the local drainage flooding criteria cannot be satisfied.

4) A property is considered to be outside the floodplain where it is above the mainstream and local drainage flood planning levels including freeboard.

6 Flood Compatible Materials

Where required for development, the following materials are to be applied. Materials not listed may be accepted by Council subject to certification of the suitability of the material of the manufacturer.

Component	Flood Compatible Material
Flooring and Sub-floor	▪ Concrete slab-on-ground monolith construction ▪ Suspended reinforced concrete slab
Wall Structure	▪ Solid brickwork, blockwork, reinforced concrete or mass concrete
Wall and Ceiling Linings	▪ Fibro-cement board ▪ Brick, face or glazed ▪ Clay tile glazed in waterproof mortar ▪ Concrete ▪ Concrete block ▪ Steel with waterproof applications ▪ Stone, natural solid or veneer, waterproof grout ▪ Glass blocks ▪ Glass ▪ Plastic sheeting or wall with waterproof adhesive
Roof Structure	▪ Reinforced concrete construction ▪ Galvanised metal construction
Doors	▪ Solid panel with water proof adhesives ▪ Flush door with marine ply filled with closed cell foam ▪ Painted metal construction ▪ Aluminium or galvanised steel frame
Insulation	▪ Closed cell solid insulation ▪ Plastic/polystyrene boards
Windows	▪ Aluminium frame with stainless steel rollers or similar corrosion and water resistant material.
Nails, Bolts, Hinges and Fittings	▪ Brass, nylon or stainless steel ▪ Removable pin hinges ▪ Hot dipped galvanised steel wire nails or similar
Main Power Supply	▪ Subject to the approval of the relevant authority the incoming main commercial power service equipment, including all metering equipment, shall be located above the designated flood planning level. Means shall be available to easily disconnect the dwelling from the main power supply.
Wiring	▪ All wiring, power outlets, switches, etc., should be located above the designated flood planning level. All electrical wiring installed below this level should be suitable for continuous underwater immersion and should contain no fibrous components. This will not be applicable for below-ground car parks where the car park complies with flood planning level requirements. ▪ Earth leakage circuit-breakers (core balance relays) or Residual Current Devices (RCD) must be installed. ▪ Only submersible type splices should be used below maximum flood level. ▪ All conduits located below the relevant designated flood level should be so installed that they will be self-draining if subjected to flooding.
Electrical Equipment	▪ All equipment installed below or partially below the designated flood planning level should be capable of disconnection by a single plug and socket assembly.

Component	Flood Compatible Material
Heating and Air Conditioning Systems	▪ Heating and air conditioning systems should be installed in areas and spaces of the house above the designated flood planning level.
Fuel storage for heating purposes	▪ Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off. ▪ The heating equipment and related fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line. The tanks should be vented above the flood planning level.
Ducting for heating/cooling purposes	▪ All ductwork located below the relevant flood level should be provided with openings for drainage and cleaning. Self-draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a water-tight wall or floor below the relevant flood level, a closure assembly operated from above relevant flood level should protect the ductwork.

Responsibilities

The Technical Services Manager is responsible for the development and revision of the policy. The City's Planning team together with the Public Domain team are responsible for communicating the policy and ensuring systems are in place to validate its compliance.

Consultation

The initial draft edition of the Interim Floodplain Management Policy was first reviewed by internal stakeholders of the City including City Operations and City Planning divisions. The Policy was then revised to take account of this input.

The City's Floodplain Risk Management Committee was initially informed regarding the need for the interim policy in December 2012. During the March 2013 Floodplain Risk Management Committee meeting a presentation was made by City staff regarding the draft policy. Copies of the policy were then provided to all Committee members for comment. Some minor changes were then made to the draft policy following feedback from committee members.

References

Laws and standards	• Local Government Act 1993, Section 733 • Environment Planning and Assessment Act 1979
Policies and procedures	• *Floodplain Development Manual: the management of flood liable land*, New South Wales Government, Published April 2005 • Sydney LEP 2012 • Sydney DCP 2012 • South Sydney DCP 1997, Green Square precinct amended 2006

Approval

Council approved this policy on 12 May 2014.

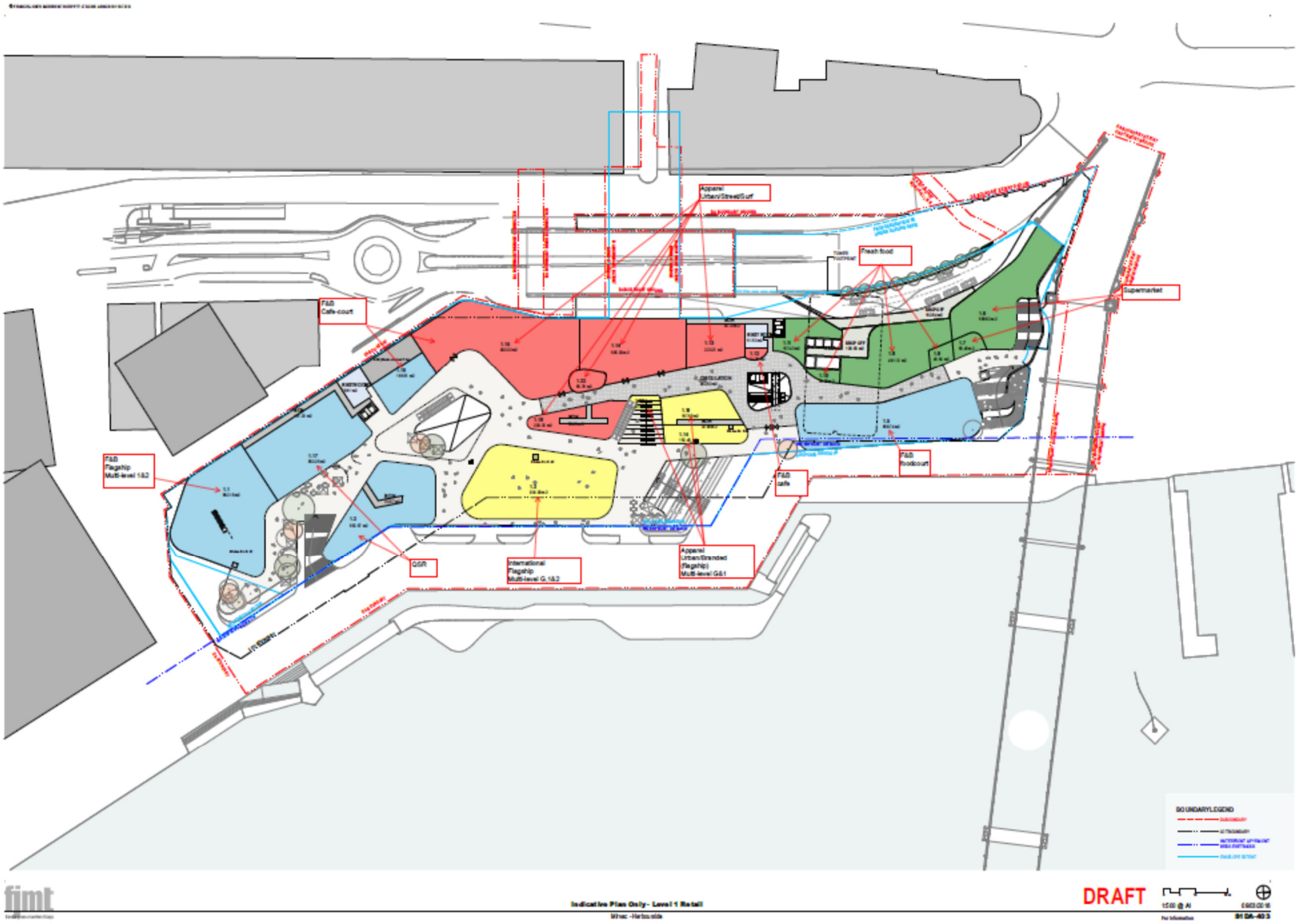
Review

Review period	Next review date	TRIM reference
City Operations will review this policy every 2 years	May 2016	2014/216277

APPENDIX E

Harbourside Re-development Concept Plan

(concept plan 'Harbourside Shopping Centre Sydney, Australia' 2015 July 23, prepared by Jerde) Proposed development plans shown in this report are indicative only and are subject to change in future design stages.


Apparel
Urban/Street/Surf
Fresh food
Supermarket
F&B
Cafe court
F&B
Flagship
Multi-level 1&2
F&B
Foodcourt
F&B
cafe
QSR
International
Flagship
Multi-level G,1&2
Apparel
Urban/Branded
Flagship
Multi-level G&1
BOUNDARY LEGEND
DRAFT
Indicative Plan Only - Level 1 Retail
Mixec -Horizontale

APPENDIX F

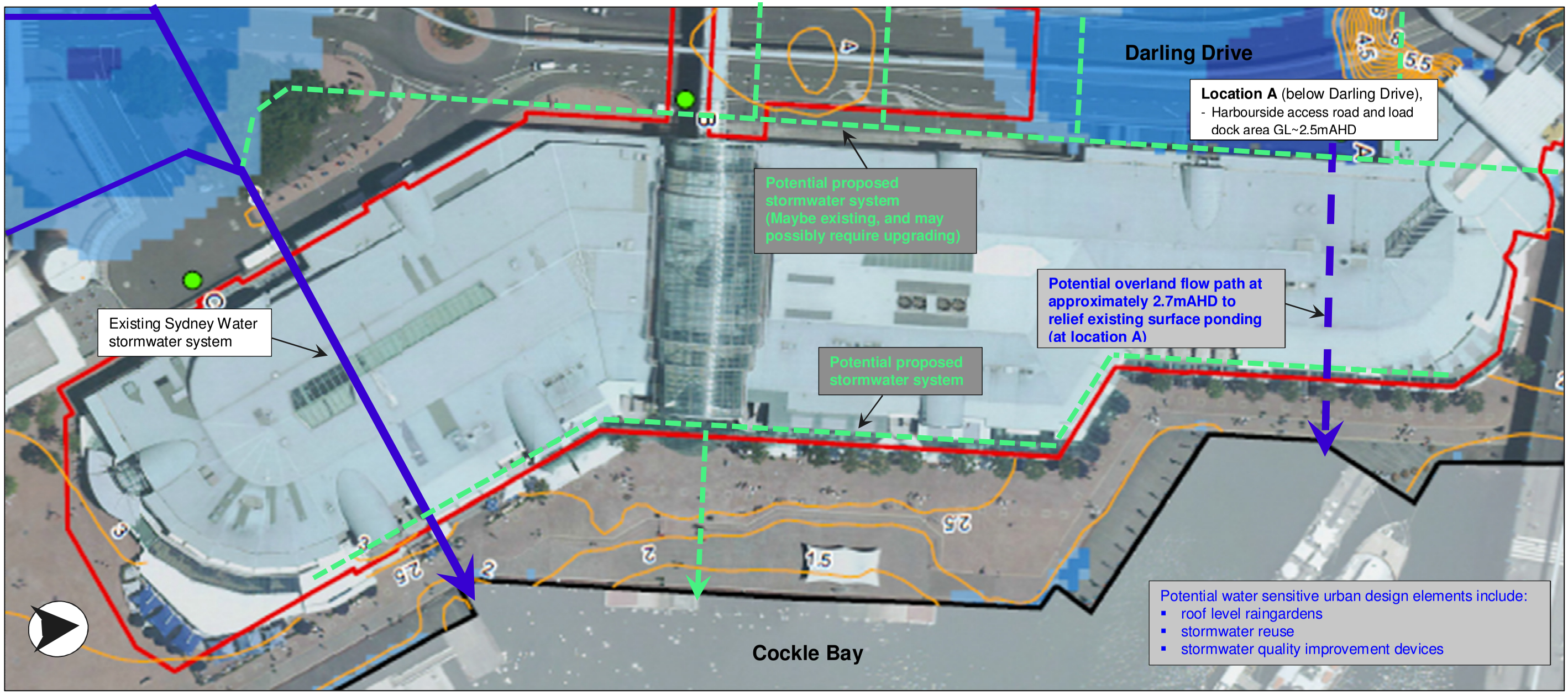
Flood Estimation Terminology

(Extract from Australian Rainfall and Runoff 'Terminology Draft Discussion Paper' ARR Website 18/06/2015)

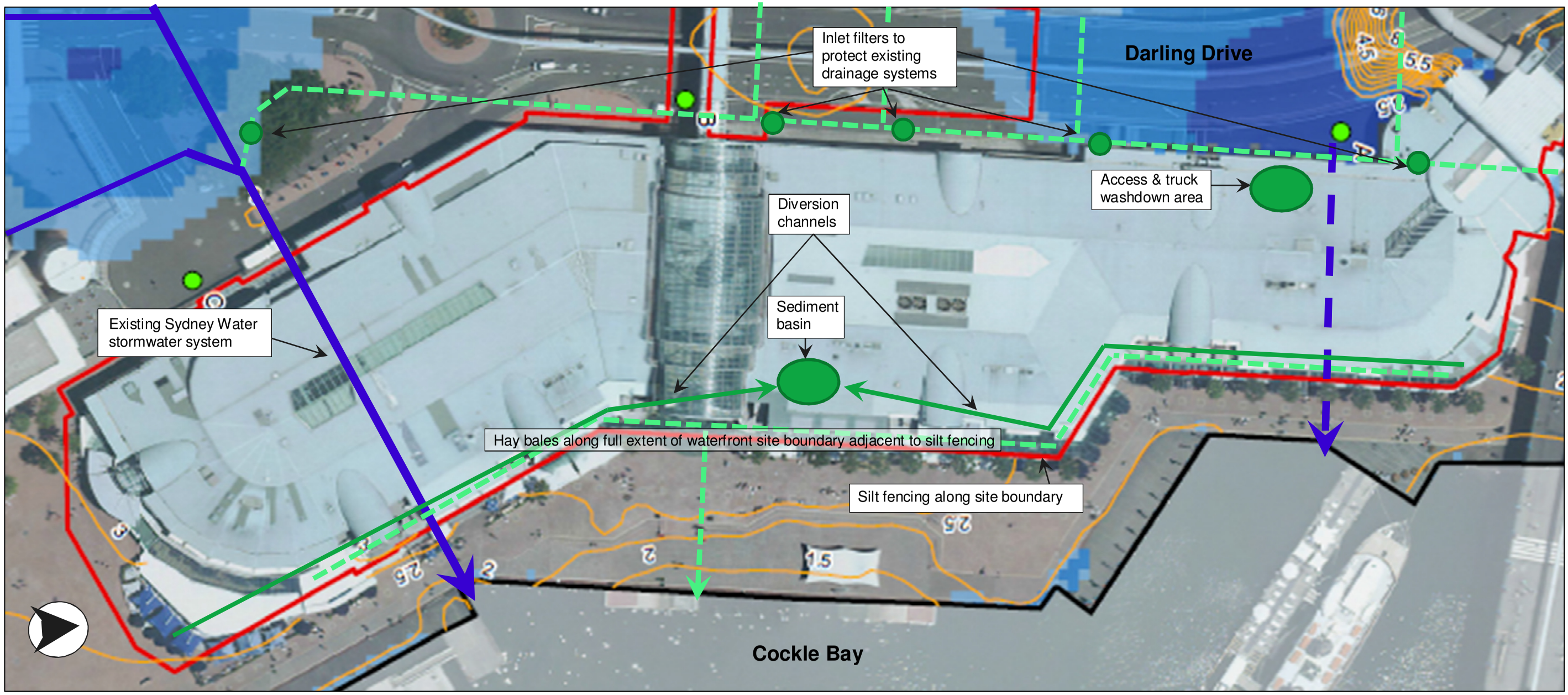
Table 1.1 Australian Rainfall and Runoff Preferred Terminology

EY	AEP (%)	AEP (1 in x)	ARI	Use
6	99.75	1.002	0.17	WSUD
4	98.17	1.02	0.25	
3	95.02	1.05	0.33	
2	86.47	1.16	0.50	
1	63.21	1.58	1.00	
0.69	50.00	2	1.44	Stormwater/pit and pipe design
0.5	39.35	2.54	2.00	
0.22	20.00	5	4.48	
0.2	18.13	5.52	5.00	
0.11	10.00	10	9.49	
0.05	5.00	20	20	Flooding
0.02	2.00	50	50	
0.01	1.00	100	100	
0.005	0.50	200	200	
0.002	0.20	500	500	
0.001	0.10	1000	1000	
0.0005	0.05	2000	2000	Limit CRC FORGE
0.0002	0.02	5000	5000	Extreme risk /Dams

DRAWINGS



Drainage Concept Plan (Proposed Harbourside building not shown)



Sediment and Erosion Control Plan (Proposed Harbourside building not shown)

ARCADIS Design & Consultancy for natural and built assets