Appendix U

Integrated Water Management and Water Quality Plan

Sydney Metro West

Hunter Street East Over Station Development Integrated Water Management and Water Quality Plan

Appendix U

November 2022

NSW GOVERNMENT

sydney METRO

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Contents

List of Figures

List of Tables

Glossary

Term	Definition
AEP	Annual Exceedance Probability The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. In this study AEP has been used consistently to define the probability of occurrence of flooding. The following relationships between AEP and ARI applies to this study (Ball et al, 2019).
ARI	Average Recurrence Interval The long-term average number of years between the occurrences of a flood as big as or larger than the selected flood event. For example, floods with a discharge as great as or greater than the 20-year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event. Also refer to Average Exceedance Probability (AEP), which is the industry standard terminology for definition of design flood events.
AR&R	Australian Rainfall and Runoff (AR&R) is a national guideline document used for the estimation of design flood characteristics in Australia. Reference is made to either ARR1987 (3rd edition) or AR&R2019 (4th edition) as specified.
Catchment	The land area draining through the mainstream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
Concept and Stage 1 CSSI Application	Application SSI-10038, including all major civil construction works between Westmead and The Bays, including station excavation and tunnelling, associated with the Sydney Metro West line
Concept SSDA	Concept development application defined in section 4.22 of the EP&A Act, as a development application that sets out concept proposals for the development of a site, and for which detailed proposals for the site or for separate parts of the site are to be the subject of a subsequent development application or applications.
Council	City of Sydney
CSSI	Critical State Significant Infrastructure
DCP	Development Control Plan
DPE	Department of Planning and Environment
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	NSW Environment Protection Authority
ESD	Ecologically Sustainable Design
EIS	Environmental Impact Statement
GFA	Gross floor area
Hydrologic modelling	Hydrologic modelling refers to the conversion of the design rainfall and runoff into flow hydrographs that are applied to the hydraulic model to define flood depths, flood extents, velocities and hazards for a range of design storms.
Hydrology	The study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.

Term	Definition
Hydraulic modelling	Hydraulic modelling uses the rainfall, catchment and watercourse topography to predict flood behaviour including flood levels, flood extents, flood velocities and the duration of inundation in the catchment and watercourse.
OSD	Over Station Development
IWMP	Integrated Water Management Plan
LEP	Local Environmental Plan
PMF	Probable Maximum Flood
PSD	Permissible Site Discharge
POEO Act	Protection of the Environment Operations Act 1997
SEARs	Secretary's Environmental Assessment Requirements
SSDA	State Significant Development Application
SSI	State Significant Infrastructure
Stage 2 CSSI Application	Application SSI-19238057, including major civil construction works between The Bays and Hunter Street station
Stage 3 CSSI Application	Application SSI-22765520, including rail infrastructure, stations, precincts and operation of the Sydney Metro West line
SEPP	State Environmental Planning Policy
SSDA	State Significant Development Application
Sydney Metro West	Construction and operation of a metro rail line and associated stations between Westmead and the Sydney CBD as described in section 1.1
TfNSW	Transport for New South Wales
The site	The site which is the subject of the Concept SSDA
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
WQ	Water Quality Treatment
WSUD	Water Sensitive Urban Design

Executive summary

This Integrated Water Management Plan supports a Concept State Significant Development Application (Concept SSDA) submitted to the Department of Planning and Environment (DPE) pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Concept SSDA is made under section 4.22 of the EP&A Act.

Sydney Metro is seeking concept approval for a commercial tower above the Hunter Street metro station eastern site (the site), otherwise known as the over station development (OSD).

The Concept SSDA seeks consent for a building envelope and its use for a commercial and retail premises, a maximum building height of 58 storeys (257.7m, reduced level 269.10), a maximum gross floor area (GFA) of 84,223m^2, pedestrian and vehicular access, circulation arrangements and associated car parking and the strategies and design parameters for the future detailed design of development.

This Integrated Water Management Plan responds specifically to the Secretary's Environmental Assessment Requirements (SEARs) and involves the analysis of the existing stormwater quantity and water quality conditions for Hunter Street East OSD (referred to hereafter as 'the proposed development'). The report aims to provide a hydraulic and water quality analysis and preliminary design of on-site detention systems and water quality treatment measures according to relevant stormwater and water quality standards.

The baseline investigations involved analysing the existing drainage network, catchment and topography, and the existing stormwater performance. Sydney Water was consulted on the on-site detention and Permissible Site Discharge (PSD) for the site. Sydney Water advised that there was no requirement for site storage or PSD for the site. A DRAINS model was set up to analyse the 5% and 1% AEP storm events including climate change and bypass.

The initial design of the on-site detention involved modelling the storage requirements set by Sydney Water and assessing PSD compliance. The modelling results indicated that a larger on-site detention tank would be required to account for the increase in rainfall from climate change and an on-site detention would be recommended on the site to ensure post-development flows do not exceed the pre-development state. The on-site detention also presents opportunities to incorporate stormwater treatment devices. The design of on-site detention for the site was optimised to 50m^3.

MUSIC software was used to model the existing catchment for the site and design the treatment train to meet City of Sydney water quality targets. The proposed treatment process involves treating stormwater runoff through filter cartridges within the on-site detention tank. Bypass area will be treated by treatment channels before discharging to council's system. The model results indicate that the design is compliant with Green Star and City of Sydney Water Quality reduction targets.

Future work that is required to finalise the stormwater and water quality design, will be part of the Detailed SSDA design process. This will include the following:

- design of connection to existing council drainage system
- final on-site detention requirements based on the finalised architectural scheme
- further authority coordination as required.

1 Introduction

1.1 Sydney Metro West

Sydney Metro West will double rail capacity between Greater Parramatta and the Sydney Central Business District (CBD), transforming Sydney for generations to come. The once in a century infrastructure investment will have a target travel time of about 20 minutes between Parramatta and the Sydney CBD, link new communities to rail services and support employment growth and housing supply.

Stations have been confirmed at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock, The Bays, Pyrmont and Hunter Street.

Sydney Metro West station locations are shown in Figure 1-1 below.

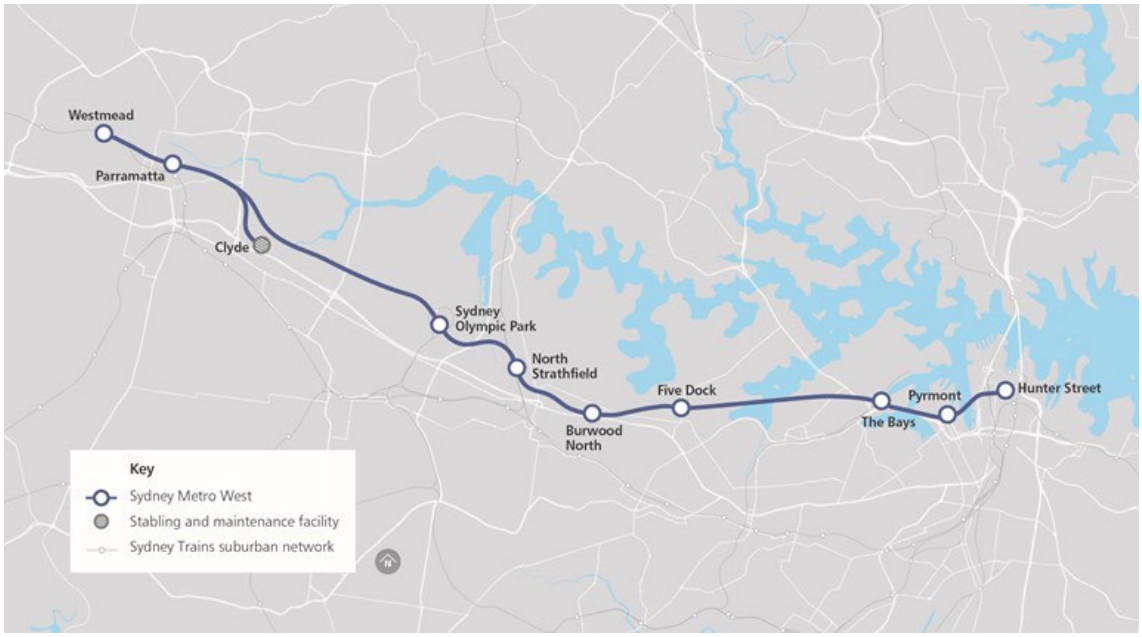

Figure 1-1 Sydney Metro West

1.2 Background and planning context

Sydney Metro is seeking to deliver Hunter Street Station under a two part planning approval process. The station fit out infrastructure is to be delivered under a Critical State Significant Infrastructure (CSSI) application subject to provisions under Division 5.2 of the EP&A Act, while the over station developments are to be delivered under a State Significant Development (SSD) subject to the provisions of Part 4 of the EP&A Act. It is noted a Planning Proposal request has been submitted to the City of Sydney Council to amend the planning controls on the site (refer to section 1.2.3)

1.2.1 Critical state significant infrastructure

The state significant infrastructure (SSI) planning approval process for the Sydney Metro West metro line, including delivery of station infrastructure, has been broken down into a number of planning application stages, comprising the following:

- Concept and Stage 1 CSSI Approval (SSI-10038) – All major civil construction works between Westmead and The Bays including station excavation, tunnelling and demolition of existing buildings (approved 11 March 2021).

- Stage 2 CSSI Application (SSI-19238057) – All major civil construction works between The Bays and Hunter Street Station (approved 24 August 2022).
- Stage 3 CSSI Application (SSI-22765520) – Tunnel fit-out, construction of stations, ancillary facilities, and station precincts between Westmead and Hunter Street Station, and operation and maintenance of the Sydney Metro West line (under assessment).

1.2.2 State Significant Development application

The SSD will be undertaken as a staged development with the subject concept state significant development application (Concept SSDA) being consistent with the meaning under section 4.22 of the EP&A Act and seeking conceptual approval for a building envelope, land uses, maximum building heights, a maximum gross floor area, pedestrian and vehicle access, vertical circulation arrangements and associated car parking. A subsequent Detailed SSDA/s is to be prepared by a future development partner which will seek consent for detailed design and construction of the development.

1.2.3 Planning Proposal

A Planning Proposal request has been submitted to the City of Sydney Council to amend the planning controls that apply to the Hunter Street Station under the Sydney Local Environmental Plan 2012 (LEP). Hunter Street Station includes both an eastern site (this application) and western site.

The Planning Proposal request seeks to enable the development of a commercial office building on the site that would:

- comprise a maximum building height of between reduced level (RL) 257.7m and RL 269.10m (as it varies to comply with the relevant sun access plane controls)
- deliver a maximum gross floor area (GFA) of 84,287m^2 (resulting in a maximum floor space ratio (FSR) of 22.82:1), measured above ground level.
- facilitate the adaptive reuse of the existing Former Skinners Family Hotel within the overall development.
- include site specific controls which ensure the provision of employment and other non-residential land uses.
- require the mandatory consideration of a site-specific Design Guideline.
- allow for the provision of up to 70 car parking spaces.
- establish an alternative approach to design excellence.

The Planning Proposal request was submitted to the City of Sydney in May 2022 and is currently under assessment.

1.3 Purpose of the report

This Integrated Water Management Plan supports a Concept SSDA submitted to the Department of Planning and Environment (DPE) pursuant to Part 4 of the EP&A Act. The Concept SSDA is made under section 4.22 of the EP&A Act.

This report has been prepared to specifically respond to the Secretary's Environmental Assessment Requirements (SEARs) issued for the Concept SSDA on 8 August 2022 which states that the environmental impact statement is to address the following requirements:

SEARs requirements	Where addressed in report
Provide an Integrated Water Management Plan for the development that: • is prepared in consultation with the local council and any other relevant drainage or water authority • details the proposed drainage design for the site including any on-site treatment, reuse and detention facilities, water quality management measures, and the nominated discharge points • demonstrates compliance with the local council or other drainage or water authority requirements and avoids adverse impacts on any downstream properties.	Section 3 and 4 – The proposal

This Integrated Water Management Plan summarises the design approach, key assumptions, relevant references and standards applied to the development of the concept stormwater design documentation for the proposed development.

These concept stormwater works are for the permanent works for the proposed development. Enabling and temporary works have not been included within this concept design report and package.

This report has been developed to:

- describe how input data has been obtained, collected and interpreted
- discuss the key design standards used for the design
- present the stormwater strategies that have been developed within the proposed development
- Show key interfaces with other disciplines and stakeholders, including details on any external coordination meetings. Detail required next steps and further civil engineering work required to develop the design in subsequent stages.

2 The site and proposal

2.1 Site location and description

Hunter Street Station is in the northern part of the Sydney CBD, within the commercial core precinct of Central Sydney and within the Sydney Local Government Area (LGA). The Hunter Street Station includes two sites – the eastern site and the western site. This report relates to the eastern site only.

The Hunter Street Station eastern site (the site) is on the corner of O'Connell Street, Hunter Street and Bligh Street adjacent to the existing CBD and South East Light Rail that extends from Circular Quay to Moore Park, Kensington and Kingsford. The east site is adjacent to the new Martin Place Station which forms part of the Sydney Metro City and Southwest, Australia's biggest public transport project connecting Chatswood to Sydenham and extending to Bankstown. The remainder of the site is currently occupied by commercial office buildings and a range of ground floor business premises including retail, restaurants and cafes.

The site area is 3,694 m^2 and will be cleared of all buildings and prior to commencement of station construction activities. The site location is shown in Figure 2-1.

Figure 2-1 Location of the site

Table 2-1 sets out the address and legal description of the parcels of land that comprise the site.

Table 2-1 Site legal description

Address	Lot and DP
28 O'Connell Street, Sydney	Lot 1, DP217112
28 O'Connell Street, Sydney	Lot 1, DP536538
28 O'Connell Street, Sydney	Lot 1, DP1107981
48 Hunter Street, Sydney	Lot 1, DP59871
48 Hunter Street, Sydney	Lot 2, DP217112
33 Bligh Street, Sydney	Lot 1, DP626651
37 Bligh Street, Sydney	CP and Lots 1-14, 21-31, 33-36, and 40, SP58859
37 Bligh Street, Sydney	CP and Lots 41-49, SP61852
37 Bligh Street, Sydney	CP and Lots 50-57, SP61922
37 Bligh Street, Sydney	CP and Lots 58-65, SP61923
37 Bligh Street, Sydney	CP and Lots 66 and 67, SP63146
37 Bligh Street, Sydney	CP and Lots 67-70, SP63147
37 Bligh Street, Sydney	CP and Lot 72, SP74004
37 Bligh Street, Sydney	CP and Lots 75-82, SP87437
37 Bligh Street, Sydney	CP and Lots 73-74, SP87628
	Total Area: 3,694 **m^2**

2.2 Overview of the proposal

The Concept SSDA will seek consent for a building envelope above the site (the proposed development). As detailed in Table 2-2 and Figure 2-2.

Table 2-2 Proposed development overview

Built form component	Proposed development outcome
Site area	3,694m^2
Height	Building height up to 257.7m (RL 269.10)
Gross floor area	Up to 84,223m^2
Land use(s)	Commercial office and retail
Carparking	Up to 70 car parking spaces

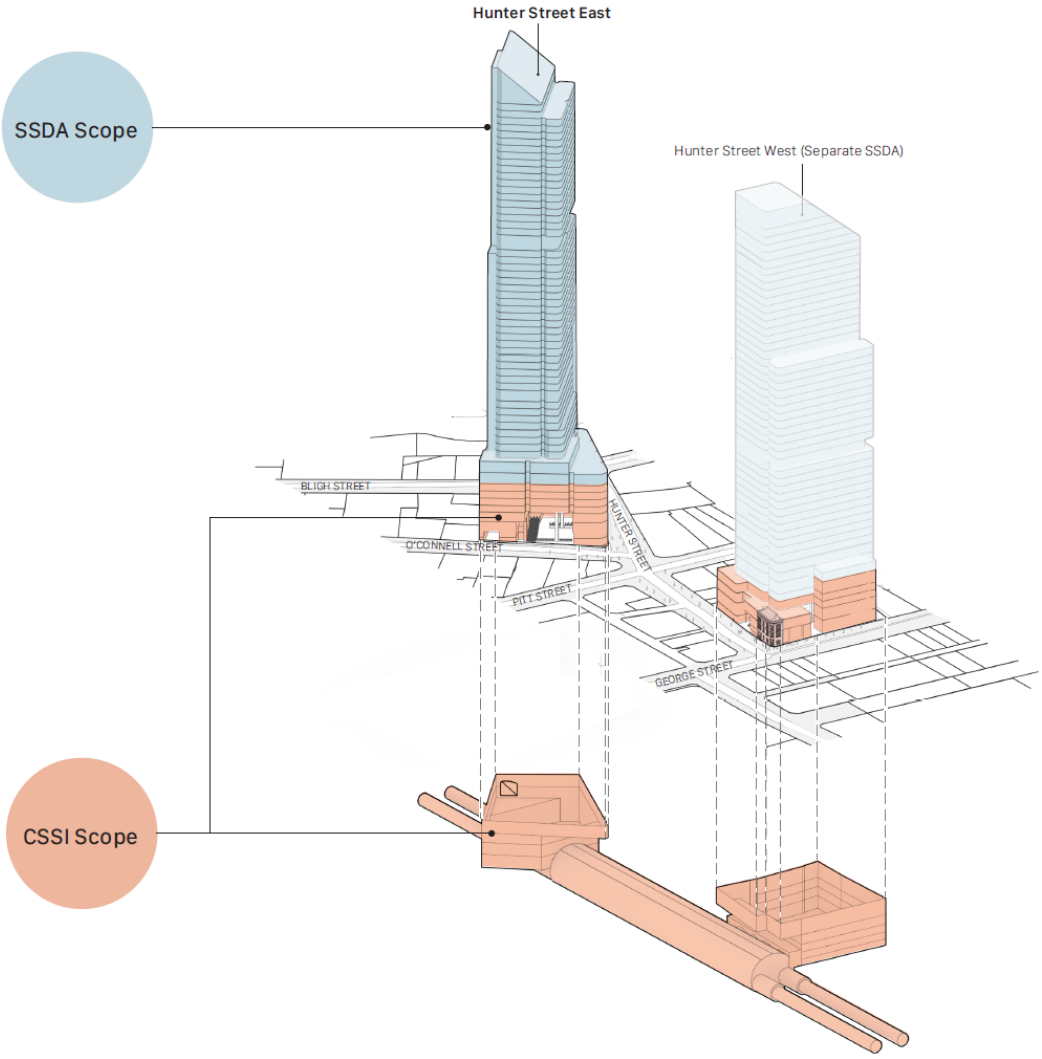

Figure 2-2 Proposed Concept SSDA development and CSSI scope

3 Methodology

This report summarises existing stormwater and water quality conditions and detail required upgrades, infrastructure and protection measures required to satisfy the relevant stormwater and water quality standards.

The stormwater and water quality requirements are summarised below along with the location where they have been addressed within this report:

- stormwater discharge from development site shall have no adverse impacts on upstream and downstream drainage system as per City of Sydney DCP 2012. Further details outlined in section 3.6
- provision of on-site detention system as required by Sydney Water
- development site stormwater quality to meet City of Sydney targets as outlined in section 3.6.

It is noted that this assessment relates to the proposed building envelopes and associated reference design of the on-site detention for the planning proposal. Additionally, this report identifies preliminary development staging and stormwater consultation, the final staging and delivery of stormwater and water quality infrastructure will form part of subsequent design stages.

The stormwater and water quality assessment involved:

- undertaking a desktop review of publicly available data to characterise existing surface water (baseline) conditions at the proposal site including climate, catchment history, topography, hydrology, the soil landscape and environmental values
- reviewing relevant legislation, plans, policies and guidelines for water management within NSW and local council
- identifying the types of surface water impacts which may occur due to the proposal
- identifying mitigation measures to address potential surface water impacts.

A separate Hunter Street Station Planning Proposal Preliminary Flooding Report (Appendix V) has been developed for this site.

A separate Hunter Street Station Planning Proposal Ecologically Sustainable Development (ESD) Report (Appendix P) has been developed for this site. Key indicatives that might be applicable for this site include:

- target a 5+ star Green Star Buildings rating
- commit to a 6 Star NABERS Energy for Offices and 4.5-star NABERS Water for Offices performance, respectively
- deliver a 40% reduction in annual water consumption when compared to a reference building.

3.1 Design standards

The design has been undertaken in compliance with relevant Australian standards and local government guidelines. City of Sydney standards have generally been adopted for the development. Key documents used as guidance for the design are summarised below in Table 3-1.

Table 3-1 Stormwater design standards

Document No.	Document name	Version or date
City of Sydney	Sydney Streets Technical Specifications: A4 Stormwater Drainage Design	2016
RMS R11	RMS Specification R11	2021
AR&R	Australian Rainfall and Runoff: A Guide to Flood Estimation	2019
AS 3500.3	Australian Standard AS3500.3: Plumbing and Drainage Code – Stormwater Drainage (2003)	2021

3.2 Basis of design

In developing the civil concept design, information from a variety of sources has been used. A summary of this information is contained below in Table 3-2.

Table 3-2 Stormwater basis of design

Document No.	Document name	Version or date
NA	City of Sydney Development Control Plan	2012
NA	Local Planning for Healthy Waterways using NSW Water Quality Objectives	June 2006
NA	City of Sydney Water Sensitive Urban Design (WSUD) Technical Guidelines	2014

3.3 Consultation

The Integrated Water Management Plan (IWMP) integrates correspondence and comments from Sydney Water. Comments include the detention storage and permissible discharge requirement from the proposed development.

3.4 Design criteria

The design criteria applied to the stormwater works are summarised in Table 3-3 below.

Table 3-3 Stormwater design criteria

Item	Standard	Adopted
Hydrology & hydraulics		
Hydrological model	Sydney Street technical specifications: A4 stormwater drainage	DRAINS model time and area method - ILSAX
Minor design storm	Sydney Street technical specifications: A4 stormwater drainage	20yr Average recurrence interval (5% AEP)
Major design storm	Sydney Street technical specifications: A4 stormwater drainage	100yr Average recurrence interval (1% AEP)
Design rainfall	Sydney Street technical specifications: A4 stormwater drainage	AR&R 2016 values

Item	Standard	Adopted
Urban rainfall losses	AR&R datahub	Pervious IL = 28mm pervious CL = 0.64mm/h Imperv. IL = 1mm Imperv. CL = 0.0mm/h
Pipe size	Sydney Street technical specifications: A4 stormwater drainage	Min 150mm diameter (pipes located in private property) Min 375mm diameter (pipes owned by City of Sydney)
Pit spacing	Sydney Street technical specifications: A4 stormwater drainage	Max. 40m (pipes 375mm to 750mm dia.) max. 60m (pipes 750mm to 1500 mm dia.)
Pit losses	Sydney Street technical specifications: A4 stormwater drainage	Missouri charts
Pit blockage factors	Sydney Street technical specifications: A4 stormwater drainage	Grated inlet pits: 90% kerb inlet pits <=1.0 m • On-grade: 50% • Sag: 70% kerb inlet pits > 1.0 m • On-grade: 20% • Sag: 50%
Overland flow safety criteria	AR&R	Max depth x velocity = 0.4m²/s
Climate change rainfall Factor	AR&R 2019	1.213 multiplier to rainfall intensities
Water quality		
Pollution reduction targets	TfNSW City of Sydney DCP 2012	Gross pollutants 90% TSS 85% TP 65% TN 45%

3.5 Stormwater quantity control requirements

Sydney Water (the authority responsible stormwater quantity control requirement for City of Sydney) has advised of the required stormwater quantity controls for the sites, summarised below in Table 3-4.

Table 3-4 Sydney Water quantity control requirements

On-site detention	Permissible site discharge (PSD)
Not required	Not required

Sydney Water has further clarified that the above requirement in an email dated 29 September 2021. It states that:

'Approval for the On-Site Detention would only be given as part of the Section 73 application for this development. The On-Site Detention is to be designed according to the above values and submitted to Sydney Water for approval with the Section 73 application.'

The CSSI approval includes space provisioning within the station for the future OSD including facilities such as onsite stormwater detention systems.

3.6 City of Sydney Development Control Plan 2012

The provisions of DCP 2012 have been used as a in the preparation of this report to demonstrate that a suitable stormwater condition can be achieved on the site and surrounding properties resulting from an increase in development density on the site.

The SDCP 2012 details planning and design guidelines to support the planning controls throughout the City of Sydney local government area (LGA) which include the management of stormwater. The DCP requirements are outlined in section 3.7 of the DCP 2012.

Specific key requirements in the DCP which relate to stormwater include:

- a site-specific flood study should be prepared to support the development of the site
- the connection to the existing stormwater network is not to reduce the capacity of that infrastructure by more than 10%
- post development run-off from impermeable surfaces is to be managed by stormwater source measures that: contain frequent low-magnitude flows; maintain the natural balance between run-off and infiltration; remove some pollutants prior to discharge into receiving waters; prevent nuisance flows from affecting adjacent properties; and enable appropriate use of rainwater and stormwater
- the stormwater quality management approach will involve integrating Water Sensitive Urban Design (WSUD) techniques in the proposed stormwater drainage system. The water quality requirements are summarised below, and are in line with Green Star 5+ rating:
    - reduce the baseline and annual pollutant load for litter and vegetation larger than 5mm by 90%
    - reduce the baseline annual pollutant load for total suspended solids by 85%
    - reduce the baseline annual pollutant load for phosphorous by 65%
    - reduce the baseline annual pollutant load for total nitrogen by 45%.

4 Assessment

4.1 Baseline investigations

4.1.1 Existing drainage network

The drainage network around the site consists of road kerb and gutter system, local piped drainage and a trunk drainage system (the Tank Stream and Bennelong sewer) which discharge to Sydney Harbour to the north. The trunk drainage system is owned by the Sydney Water Corporation.

The existing drainage network within the existing site is unknown. It is assumed that the stormwater runoff is collected and discharged to the nearby kerb inlet pits and kerb and gutter channel, as shown in Figure 4-1.

The existing stormwater networks are presented in drawings in Appendix A.

4.1.2 Catchment and topography

The site is located in the City Area catchment within the City of Sydney LGA. The existing site is fully developed. The surrounding sites are comprised of paved public spaces and high-rise buildings which provides minimal water infiltration due to the high level of impervious areas.

The catchments for the site consist of the roof and bypass areas. The roofs are all draining towards the detention tank as shown in Table 4-1.

Table 4-1 The site catchment areas

Catchment area (ha)	Catchment area – % Impervious	Detention tank catchment area (ha)	Detention tank bypass area (ha)
0.3667	100	0.2390	0.1277

Figure 4-1 The site catchment areas

4.1.3 Existing stormwater performance

A hydrological model of the catchment was formulated using the DRAINS software package and was analysed to assess the performance of the site stormwater network. The DRAINS program typically performs design and analysis calculations for urban stormwater systems behaviour on both rural and urban catchments. The DRAINS model prepared for this site and results are summarised below. The DRAINS Model shown in Figure 4-2 includes the Pre-development and Post-development catchment for the site. The on-site detention tanks are also modelled to be connected to the council pits.

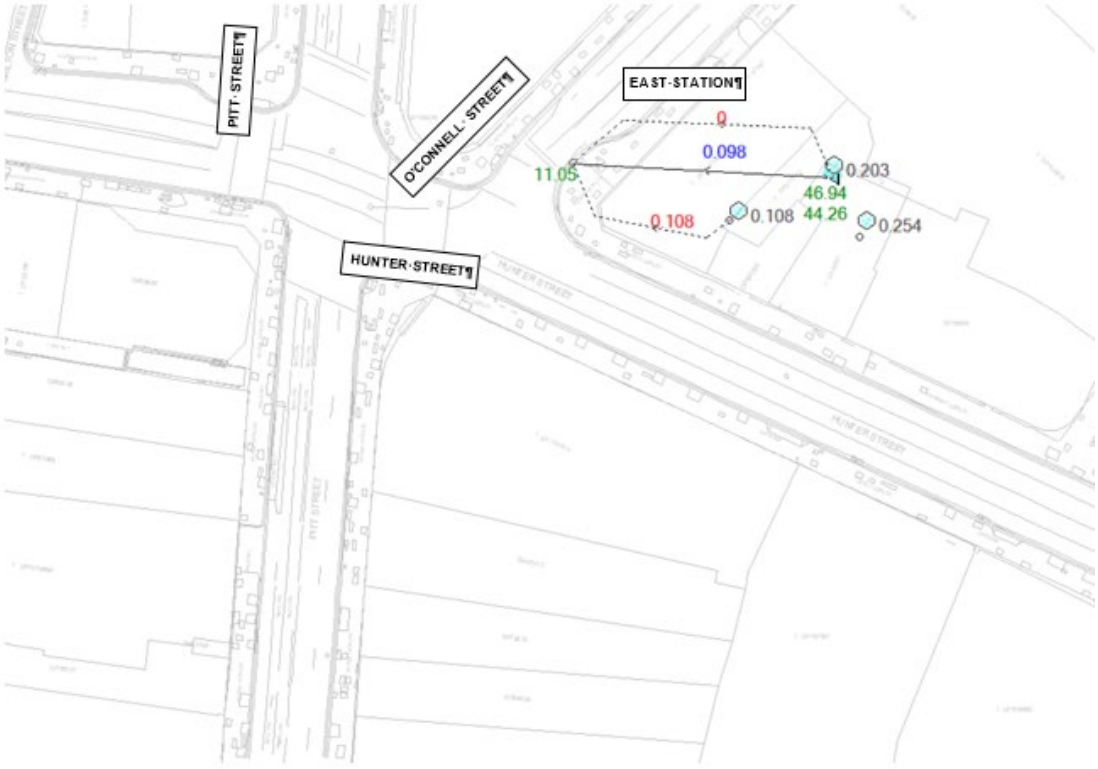

Figure 4-2 Hunter Street DRAINS model

The existing stormwater network surrounding the site is also modelled in TUFLOW to produce flood maps to assess the flood depths and existing conditions. Flood depths around the site are outlined below:

- Flood depths up to 0.06 metres occur in the 5% AEP Climate Change flood event and 0.25 metres occur in the 1% AEP Climate Change flood event between the southern boundary and Bligh Street. Elsewhere Hunter Street is inundated up to 0.07 metres in the 1% AEP Climate Change flood event and O'Connell Street experiences less than 0.1 metres. Flooding with the 5% AEP Climate Change flood event in these roads are very minor (0.02m). In the PMF flood event both Hunter Street and the southern portion of the site have flood depths up to 0.3 metres whilst O'Connell Street has depths up to 0.15 metres.

Preliminary flood depth mapping and flood hazard mapping are presented in the Preliminary Flood Report (at Appendix Y of the EIS). The flood hazards for the sites are outlined below:

- In the 5% AEP Climate Change flood event all roads surrounding the site are within a low H1 hazard category. In both the 1% AEP Climate Change and PMF flood events, Hunter Street falls within a H5 hazard category whereas O'Connell and Bligh Street are both within the H1 hazard category.

In order to model the tail water influence at the discharge or existing connection pit in the DRAINS model, the tail water level is estimated using the flood depths at the connection point from the flood maps. The tailwater can impact the stormwater modelling and design as it creates downstream condition that impacts the size and location of any stormwater storage and discharge system.

Table 4-2 summarises the tail water levels for the east drainage connection points (part of the station structure) to the nearest council stormwater pits.

Table 4-2 Tail water levels of the site

Location of connection point	5% AEP Flood depth (m)	5% AEP Tail water level (mAHD)	1% AEP Flood depth (m)	1% AEP Tail water level (mAHD)
O'Connell Street kerb inlet pit	0.05	11.05	0.05	11.05

4.2 Stormwater quantity

4.2.1 Stormwater strategy

The proposed stormwater drainage and runoff system for the site will comply with the design requirements as identified in section 3.4 with the main design considerations summarised below:

- post development stormwater runoff connections into existing drainage infrastructure will match predevelopment case where feasible. (i.e. building connection to O'Connell St.)
- on-site detention is to be situated above the 100 year annual reoccurrence interval (ARI) flood levels to facilitate discharge into potentially fully charged stormwater pipes
- management of water quantity to ensure no increase in stormwater discharge rate from the sites for the 20 and 100 year ARI storms.

A DRAINS model was developed to assess the existing hydrological and hydraulic conditions for the site and revised to estimate the stormwater discharge from the site under the proposed future conditions.

4.2.2 Proposed stormwater design

On-site detention is required as a part of the proposed development.

The impervious areas of the site in the post-development scenario is the same as the pre-development because the existing site conditions is the same as a built-up commercial building with 100% impervious area. The detention tank will be located on plant room, as such not all of the hardstand areas can be captured and directed towards the tank. The storage volume therefore have been increased to accommodate for the bypass while still meeting the PSD requirements of the site.

The proposed drainage system is to be sized to convey the 5% AEP storm event, with climate change in accordance with Australian Rainfall & Runoff and council requirements as outlined in section 4.2.1. The catchment flow results for the 5% AEP and 1% AEP storm events are summarised in Table 4-4 below. A HED chamber is also utilised within the detention tank to optimise the dimension and reduce tank size. As such outflow from the tank will be similar during both storm events.

The proposed development post development flows are expected to be greater than the pre-development due to the application of a climate change factor in the hydrological model. Although Sydney Water does not have a storage requirement for the site, the post development flows accounting for climate change will result in adverse impacts on the local stormwater drainage system due to the 21.3% volume increase of rainfall required as part of that assessment. The City of Sydney A4 drainage manual requires stormwater connections to have no adverse impacts on the private property due to the development. As such, an on-site detention system has been designed using DRAINS to control the flows. The design of the proposed on-site detention system basin will be undertaken to ensure the post developed flow with

climate change does not exceed the pre-developed flow for 5% and 1% AEP storm events. This approach, including the climate change factor in the post development assessment, is conservative at this stage and may not be required based on future consultation with Council.

A summary of the concept on-site detention design is provided in Table 4-3.

Table 4-3 On-site detention summary

Volume (m^3)	Orifice diameter (mm)	Outlet pipe diameter (mm)	Weir width (m)
50	375	375	2

Table 4-4 On-site detention catchment flow rates

5% AEP pre flow (m^3/s)	5% AEP tank flow (m^3/s)	5% AEP bypass flow (m^3/s)	1% AEP pre flow (m^3/s)	1% AEP tank flow (m^3/s)	1% AEP bypass flow (m^3/s)
0.192	0.097	0.082	0.254	0.098	0.108

The proposed development flows also show no adverse impacts on the stormwater system. The post flows are less than the pre flows for both the 5% and 1% AEP storm events including climate change when allowance is made from on-site detention system. The inclusion of an on-site detention system, which is not required by council or Sydney Water standards, is dependent on the need to accommodate extra catchment runoff due to climate change and bypass.

The provision of an on-site detention system also provides opportunity to implement stormwater quality control devices as discussed further in section 4.3.

Due to the elevated tailwater levels in the council stormwater network, it is unlikely that a detention system can be buried at ground level as it will become inundated in high storm events.

4.2.3 Proposed stormwater works

A summary of the proposed stormwater works on site are summarised below.

For the proposed development contract:

- construction of stormwater pipe network and associated storage and rainwater tanks within the proposed development.

4.3 Stormwater quality

4.3.1 Existing stormwater quality measures

There are no known stormwater quality treatment measures on the existing development sites.

The site is located to the east of Darling Harbour catchment, a sub-catchment of Sydney harbour catchment. The Darling Harbour catchment, comprising of Haymarket, Surry Hills, Pyrmont and Sydney CBD, is a receiving environment of both Pyrmont Station and Hunter Street Station. The harbour and its surrounding environment are fully developed with urban and commercial usage giving water very little opportunity to infiltrate due to large amounts of impervious areas. As a result, the harbour is characterised by elevated nutrient, heavy metal concentrations and high

turbidity. The total catchment covers approximately 307 hectares which drains to Sydney Harbour at various locations (RPS Australia East, 2014).

Prior works include the installation of a temporary construction water treatment plant at the site which will discharge treated water to Circular Quay via the local stormwater network. The water treatment plant would be configured so that treated water is compliant with the ANZECC/ANZG (2018) guideline values.

A review of available data indicates the watercourses relevant to this proposal are generally in poor condition and are representative of a heavily urbanised system (Jacobs, 2020). The watercourses which discharged water will be released to from the Hunter Street station temporary water treatment plant has been assessed against the ANZECC/ANZG guidelines as part of Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020) is provided in Table 4-5.

Table 4-5 Existing water quality conditions of watercourses relevant to the site

Watercourse	Water quality characteristic relevant to ANZECC/ARMCANZ (2000) indicators
Circular Quay	• elevated nutrient concentrations • elevated heavy metal concentrations • high turbidity.

4.3.2 Proposed stormwater quality strategy

The stormwater quality strategy has been developed in accordance with the requirements of Green Star and City of Sydney's stormwater quality reduction targets as well as the Local Planning for Healthy Waterways using NSW Water Quality Objectives (June 2006) and Managing Urban Stormwater – Harvesting and Reuse Guidelines (December 2006).

Modelling of the proposed works was undertaken using Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software. The software was utilised to simulate urban stormwater systems operating at a range of temporal and spatial scales.

MUSIC models the total amounts of gross pollutants and nutrients produced within various types of catchments. It allows the user to simulate the removal rates expected when implementing removal filters to reduce the increased gross pollutant and nutrient levels created by the proposed development.

The council and green star 5+ water quality targets are as follows:

- 90% reduction in post-development loads for Gross Pollutants (GP)
- 85% reduction in post-development loads for Total Suspended Solids (TSS)
- 65% reduction in post-development loads for Total Phosphorus (TP)
- 45% reduction in post-development loads for Total Nitrogen (TN).

The following methodology and parameters were incorporated into the MUSIC modelling for the proposed site.

4.3.3 Rainfall data and model parameters

Rainfall pluviograph and catchment data was implemented using the City of Sydney Council MUSIC-link within the model.

The pollutant concentration parameters used within the model were based on the recommended model defaults for different land use categories as specified in City of

Sydney Council's MUSIC-link data. The catchments utilised within the model were classified as summarised in Table 4-7 below.

Sandy loam soil properties were adopted as the site conditions at the proposed development were classified as Gymea according to City of Sydney WSUD Technical Guidelines (2014).

4.3.4 Proposed treatment train

The proposed treatment train is to treat stormwater runoff mostly through Filter Cartridges for the roof catchment area. A water quality treatment room will exist within the on-site detention tank, with inlet pipes directed towards this chamber first before discharging through the building's drainage reticulation system. Because the tank is within the plant room, not all of the podium roofs can be captured and will therefore be treated at ground level.

Treatment channels will be located on the ground level to take in the bypass flows, along with protecting entrances from overland flows. Gross Pollutant Traps will also be installed within gully pits to capture pollutants, before discharging to council's stormwater systems. The proposed water quality treatment process is summarised in Table 4-6.

Table 4-6 Proposed treatment train

Catchment	Treatment train
The site	• 2 x OceanGuard (Gross Pollutant Traps) within above ground pits • 10m SPEL HydroChannel (Treatment Channel) • 16 x 690mm PSORB Stormfilter (Filter Cartridges) within a 10.8m^2 chamber inside the on-site detention tank

The water quality treatment train has been modelled in MUSIC as shown in

Figure 4-3 below.

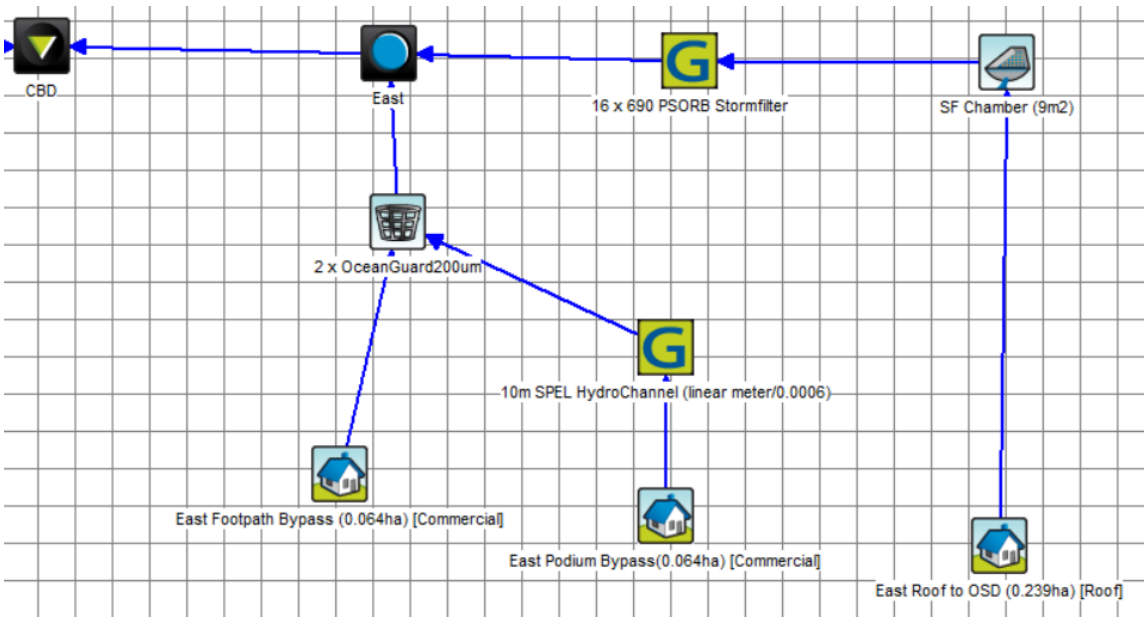

Figure 4-3 MUSIC model treatment train

The current design assumed that the catchment area will be 100% impervious, due to the lack of deep soil within the site. The catchment source nodes used in MUSIC has been summarised in Table 4-7. As the design further develops, the MUSIC model and catchment classifications will be updated.

Table 4-7 Water quality catchment areas of the site

Bypass catchment area (ha)	% Impervious	Roof catchment area (ha)	% Impervious
0.1277	100	0.2390	100

The resulting percentage reduction for each of the catchments for total suspended solids, phosphorus, nitrogen and gross pollutants are as summarised in Table 4-8 and for the total catchment are summarised in Table 4-7 above.

The overall total percentage reduction for the proposed treatment train meets the targets as set by City of Sydney and Green Star, therefore meeting the water quality requirements.

Table 4-8 MUSIC results for the site

Pollutant	CoS/Green star reduction targets (%)	% reduction	WQ target achieved
Total suspended solids (kg/yr)	85	85.6	Yes
Total phosphorus (kg/yr)	65	68.2	Yes
Total nitrogen (kg/yr)	45	51.3	Yes
Gross pollutants (kg/yr)	90	100	Yes

4.4 Authority consultation

As a part of this assessment process, consultation was undertaken with Sydney Water. Comments include the detention storage and permissible discharge requirement from the proposed development.

5 Conclusion

As outlined through this report, subject to detailed design development prepared in accordance with the standard industry practice, a suitable stormwater condition can be achieved on the site as a result of increased rainfall due to climate change and the high impervious area of the proposed site within the Planning Proposal. This Integrated Water Management Plan summarises the stormwater quantity and quality analysis process, results, and design.

The stormwater quantity design has been developed in accordance with CoS and Sydney Water guidelines, providing storage within the building development and connection to the existing council buried pipe network. The required on-site detention tank sizes is 50m³ with 170mm outlet with further details in section 4.2.2.

The stormwater quality design has been developed in accordance with CoS DCP and Green Star. The proposed WSUD measures have achieved the required mitigation targets. The recommended water quality treatment train is summarised below with further details in section 4.3.4:

- 16 x 690 mm Filter Cartridges within a 10.8 m² chamber inside the on-site detention tank, followed by 2 x Gross Pollutant Traps within pits and 10m Treatment Channel.

Future work that is required to finalise the stormwater and water quality design, will be part of the Detailed SSDA design process. This will include the following:

- design of connection to existing council drainage system
- final on-site detention requirements based on the finalised architectural scheme
- further authority coordination as required.

Appendix A Existing stormwater network

Appendix A Existing stormwater network