SYDNEY INTERNATIONAL CONVENTION, EXHIBITION AND ENTERTAINMENT PRECINCT
NOTH EAST PLOT DARLING SQUARE

FLOODING, STORMWATER & WSUD

FOR SSDA7

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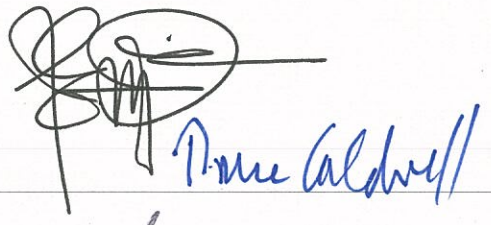
SICEEP – SYDNEY INTERNATIONAL CONVENTION, EXHIBITION AND ENTERTAINMENT PRECINCT

DARLING SQUARE NORTH EAST PLOT

FLOODING, STORMWATER & WSUD FOR SSDA7



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EXECUTIVE SUMMARY

Hyder Consulting has been engaged by Lend Lease to provide a stormwater management and Water Sensitive Urban Design (WSUD) strategy to support a Stage 2 Development Application (referred to as SSDA7), to be submitted in relation to the North East Plot in Darling Square (formerly known as “The Haymarket”) precinct to be developed on part of the Darling Harbour area known as the Sydney International Convention, Exhibition & Entertainment Precinct (SICEEP).

This report addresses Secretary’s Environmental Assessment Requirements (SEARs) for this site relevant to flooding, stormwater and Water Sensitive Urban Design (WSUD).

Flooding and Stormwater

The SICEEP site is downstream of several large stormwater catchments totalling approximately 190 ha, as outlined in Figure A.

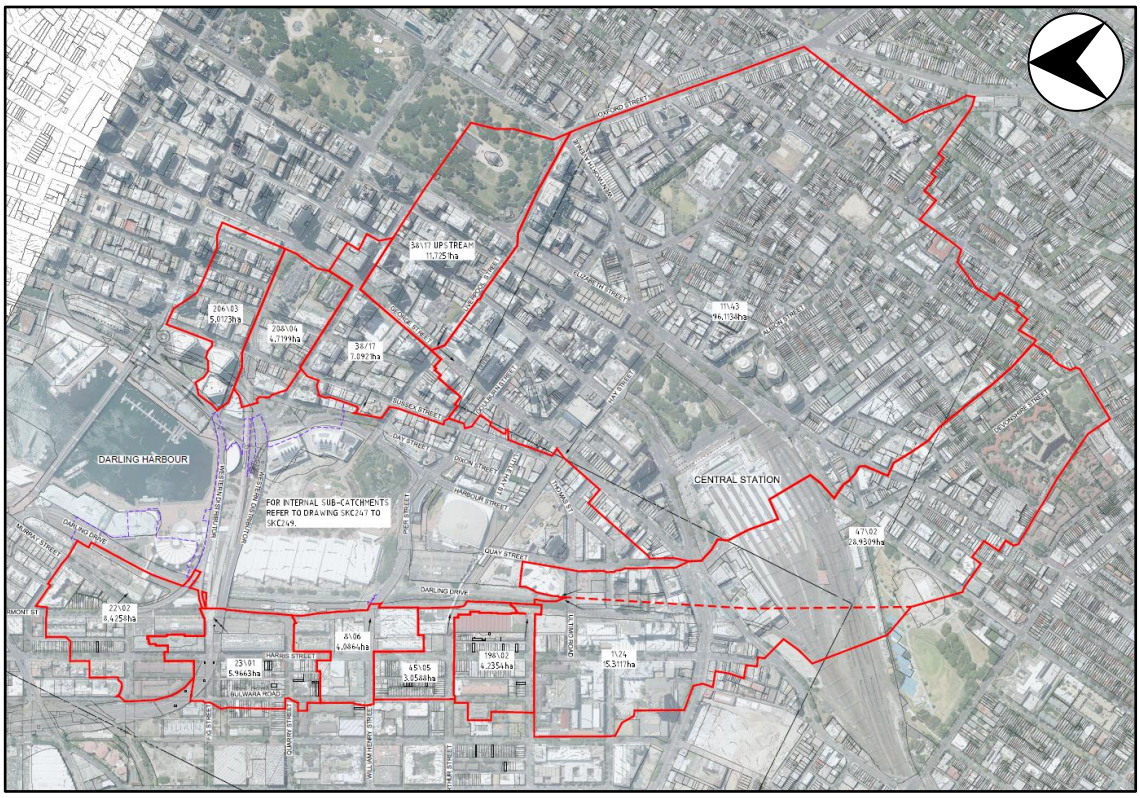

Figure A: Darling Harbour Catchments

There are a number of large Sydney Water underground culvert systems that convey the Darling Harbour catchment runoff through the site and into Darling Harbour. However these underground systems do not convey all runoff up to the 100 year ARI flood event and as a result there are a number of significant overland flow paths that run through the site.

The general flood assessment and design approach for the proposed development has been to retain the existing Sydney Water box culvert systems, and mitigate the potential flood impact on overland flows by amplifying the underground culvert system.

To demonstrate no adverse flood impacts as a result of the proposed development, a flood assessment has also been carried out for existing conditions. Existing conditions, proposed development conditions and flood impact figures are all included within Hyder’s Flooding and Stormwater Report No. DN00341 dated 18th March 2013 (refer to Appendix A for a copy of this

report which was also annexed to Hyder's Flooding and Stormwater Report No. DN00342 dated 15th March 2013 submitted with the SSDA2) and demonstrate conformance to the SEARs.

The concept civil works and stormwater plan for the North East Plot is provided in Appendix C. Hydraulic (TUFLOW) modelling results are summarised in Appendix C and indicate that the proposed North East Plot works would not adversely impact on flooding or existing drainage system capacities in areas neighbouring the SICEEP area.

Proposed grading and flood levels within the North East Plot are provided in Appendix D with flooding and stormwater planning requirements provided in Appendix G to facilitate the setting of minimum architectural floor levels.

Works that impact on Sydney Water culverts

The site is located adjacent to existing Sydney Water assets. This report recommends that further consultation with authorities is required.

Water Quality Analysis and Water Sensitive Urban Design (WSUD)

The SEARs specify the provision of "an Integrated Water Management Plan including alternative water supply, proposed end uses of potable and non-potable water, water sensitive urban design and water conservation measures."

The Development Control Plan (DCP) of the City of Sydney Council, the adjoining LGA, stipulates that for developments greater than 1,000 m^2 a stormwater quality assessment must be undertaken to demonstrate the following:

- The baseline annual pollutant load for **litter and vegetation larger than 5mm** is reduced by **90%**.
- The baseline annual pollutant load for **Total Suspended Solids (TSS)** is reduced by **85%**.
- The baseline annual pollutant load for **Total Phosphorous (TP)** is reduced by **65%**.
- The baseline annual pollutant load for **Total Nitrogen (TN)** is reduced by **45%**.

The above pollutant reduction targets were adopted as reference targets in developing a stormwater quality control strategy for Darling Square precinct which includes the North East Plot.

Hyder undertook a detailed water quality analysis to develop a Water Sensitive Urban Design (WSUD) strategy for Darling Square precinct with site-specific opportunities and constraints identified to allow the development of the plot while achieving industry accepted / best practice water quality targets.

The MUSIC modelling for the proposed development scenario, for the North East Plot in particular and for Darling Square in general, which incorporates the proposed WSUD initiatives has demonstrated that the combination of some or all of rainwater tanks, green roofs, bioretention systems, swales, gross pollutant traps and filtration systems will meet the SEARs pollution reduction objectives and the City of Sydney Council targets for Gross Pollutants, TSS, TP and TN .

1 INTRODUCTION

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

The Application (referred to as SSDA 7) follows the approval of a staged SSD DA (SSDA 2) in December 2013. SSDA 2 sets out a Concept Proposal for a new mixed use residential neighbourhood at Haymarket referred to as “Darling Square”, previously known as “The Haymarket”. Darling Square forms part of the Sydney International Convention, Exhibition and Entertainment precinct (SICEEP) Project, which will deliver Australia’s global city with new world class convention, exhibition and entertainment facilities and support the NSW Government’s goal to “make NSW number one again”.

More specifically this subsequent DA seeks approval for mixed use development within the North East Plot of Darling Square and associated public domain works. The DA has been prepared and structured to be consistent with the Concept Proposal DA.

2 OVERVIEW OF PROPOSED DEVELOPMENT

The proposal relates to a detailed (‘Stage 2’) DA for a mixed use residential development in the North East Plot of Darling Square together with associated public domain works. The Darling Square Site is to be developed for a mix of residential and non-residential uses, including but not limited to residential buildings, commercial, retail, community and open space. The North East Plot is one of six development plots (refer Figure 2) identified within the approved Concept Proposal.

Under the Concept Proposal, the North East Plot is planned to accommodate a mixed use podium and three residential buildings (NE1, NE2, and NE3) above and within the podium structure. More specifically, this SSD DA seeks approval for the following components of the development:

- Demolition of existing site improvements, including the existing Sydney Entertainment Centre (SEC);
- Associated tree removal and planting;
- Construction and use of a predominantly 6 storey mixed use podium, including:
  - retail floor space and residential lobbies on Ground Level;
  - above ground parking;
  - residential apartments; and
  - communal facilities.
- Construction and use of three residential buildings above podium;
- Public domain improvements surrounding the site, including interim works;
- Provision of vehicle access to the development from Harbour Street;
- Landscaping works to the podium roof level; and
- Extension and augmentation of physical infrastructure / utilities as required.

3 BACKGROUND

The NSW Government considers that a precinct-wide renewal and expansion of the existing convention, exhibition and entertainment centre facilities at Darling Harbour is required, and is committed to Sydney reclaiming its position on centre stage for hosting world-class events with the creation of SICEEP.

Following an extensive and rigorous Expressions of Interest and Request for Proposals process, a consortium comprising AEG Ogden, Lend Lease, Capella Capital and Spotless was announced by the NSW Government in December 2012 as the preferred proponent to transform Darling Harbour and create SICEEP.

Key features of the Preferred Master Plan include:

- Delivering world-class convention, exhibition and entertainment facilities, including:
  - Up to 40,000m2 exhibition space;
  - Over 8,000m2 of meeting rooms space, across 40 rooms;
  - Overall convention space capacity for more than 12,000 people;
  - A ballroom capable of accommodating 2,000 people; and
  - A premium, red-carpet entertainment facility with a capacity of 8,000 persons.
- Providing a hotel complex at the northern end of the precinct.
- A vibrant and authentic new neighbourhood at the southern end of the precinct, now called ‘Darling Square’, including apartments, student accommodation, shops, cafes and restaurants.
- Renewed and upgraded public domain that has been increased by a hectare, including an outdoor event space for up to 27,000 people at an expanded Tumbalong Park; and
- Improved pedestrian connections linking to the proposed Ultimo Pedestrian Network drawing people between Central, Chinatown and Cockle Bay Wharf as well as east-west between Ultimo/Pyrmont and the City.

On 21 March 2013 a critical step in realising the NSW Government’s vision for the SICEEP Project was made, with the lodgement of the first two SSD DAs with the Department of Planning and Infrastructure. The key components of these proposals are outlined below.

Public Private Partnership SSD DA (SSD 12_5752)

The Public-Private Partnership (PPP) SSD DA (SSDA 1) includes the core facilities of the SICEEP Project, comprising the new, integrated and world-class convention, exhibition and entertainment facilities along with ancillary commercial premises and public domain upgrades. SSDA1 was approved on 22 August 2013.

Concept Proposal SSD DA (SSD 13_5878)

The Concept Proposal SSD DA (SSDA 2) establishes the vision and planning and development framework which will be the basis for the consent authority to assess detailed development proposals within the Darling Square Site. SSDA2 was approved on 5 December 2013. The Stage 1 Concept Proposal approved the following key components and development parameters:

- Indicative staging of demolition and development of future development plots;
- Land uses across the site including residential and non-residential uses;
- Street and laneway layouts and pedestrian routes;

- Open spaces and through-site links;
- Six separate development plots, development plot sizes and separation, building envelopes, building separation, building depths, building alignments, and benchmarks for natural ventilation and solar access provisions;
- A maximum total gross floor area of 197,236m2 (excluding ancillary above ground parking), comprised of:
  - A maximum of 49,545m2 non-residential GFA; and
  - A maximum of 147,691m2 residential GFA
- Above ground car parking including public car parking;
- Residential car parking rates;
- Design Guidelines to guide future development and the public domain; and
- A remediation strategy.

In addition to the approval of SSDA1 and SSDA2, the following approvals have been granted for various stages of Darling Square site:

- Darling Drive (part) development plot (SSDA3) for the construction and use of a residential building (student accommodation) and the provision of associated public domain works approved on 7 May 2014;
- North-West development plot (SSDA4) for the construction and use of a mixed use commercial development and public car park building and associated public domain works approved on 7 May 2014; and
- South-West development plot (SSDA5) – construction and use of a mixed use residential development and associated public domain works approved on 21 May 2014.

Approval was also granted on 15 June 2014 for SSDA6 which includes the construction and use of the International Convention Centre (ICC) Hotel and provision of public domain works.

This report has been prepared to support a detailed Stage 2 SSD DA for mixed use development and associated public domain works within Darling Square (SSDA 7), consistent with the approved Concept Proposal (SSDA 2).

4 SITE DESCRIPTION

The SICEEP 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.

With an area of approximately 20 hectares, the SICEEP Site is generally bound by the light rail Line to the west, Harbourside shopping centre and Cockle Bay to the north, Darling Quarter, the Chinese Garden and Harbour Street to the east, and Hay Street to the south (refer to Figure 1). The Darling Square Site is:

- located in the south of the SICEEP Site, within the northern portion of the suburb of Haymarket;
- bounded by the Powerhouse Museum to the west, the Pier Street overpass and Little Pier Street to the north, Harbour Street to the east, and Hay Street to the south; and
- irregular in shape and occupies an area of approximately 4.38 hectares.

Figure 1: SICEEP Site Location

The Concept Proposal DA provides for six (6) separate development plots across Darling Square Site (refer to Figure 2):

1. North Plot;
2. North East Plot;
3. South East Plot;
4. South West Plot;
5. North West Plot; and
6. Western Plot (Darling Drive).

The Application Site area relates to the North East Plot and surrounds as detailed within the architectural and landscape plans submitted in support of the DA.

Figure 2: Concept Proposal Development Plots

5 PLANNING APPROVALS STRATEGY

The SICEEP Project has resulted in the lodgement of numerous SSD DAs for the various components of the redevelopment project. Future applications will continue to be lodged in accordance with the Concept Proposal SSD DA for the remaining development plots of Darling Square Site.

The Site area for this Stage 2 DA relates to the North East Plot and surrounds as detailed within the architectural and landscape plans submitted in support of the DA (refer to Figure 3).

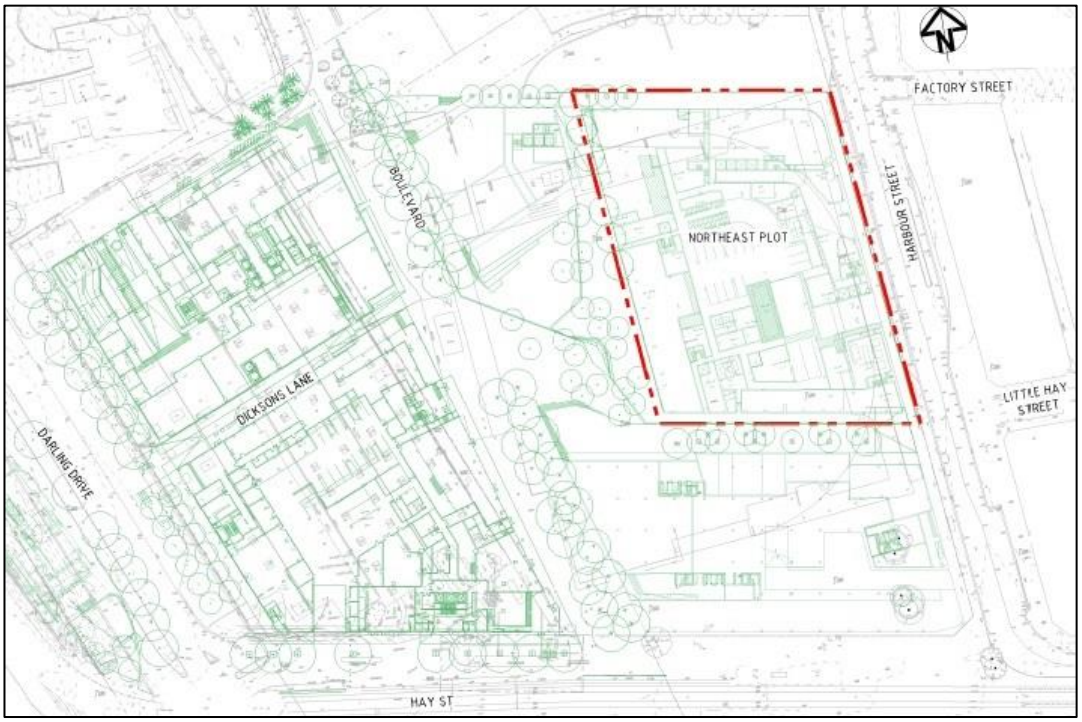

Figure 3: Works Boundary for Subject DA

6 PURPOSE OF REPORT

This report has been prepared to accompany the Stage 2 DA for the North East Plot component of Darling Square. It addresses the relevant requirements of the Secretary's Environmental Assessment Requirements (SEARs) for the project, issued on the 19 August 2014. A summary of the relevant SEARs is provided in Table 1.

Section 7 of this report provides a drainage concept for the site which addresses the flooding and sea-level rise risks on the site. Section 8 of this report then discusses initial WSUD analysis and initiatives proposed to be adopted to achieve pollutant reduction targets. However this report does not address potential groundwater risks or impacts as these are of a geotechnical nature.

Table 1: Secretary's Environmental Assessment Requirements (SEARs)

SEARs Reference	Key Assessment Requirement
4 – Public Domain and Urban Design	Address Water Sensitive Urban Design opportunities within the public domain and landscaping.
5 – Ecologically Sustainable Development (ESD)	Provide an integrated Water Management Plan including alternative water supply, proposed end uses of potable and non-potable water, water sensitive urban design and water conservation measures.
9 – Drainage, Flooding, Climate Change and Sea Level Rise	Provide a drainage concept for the site incorporating Water Sensitive Urban Design
9 – Drainage, Flooding, climate change and Sea Level Rise	Address the likely groundwater, flooding and sea level rise risks on the site and measures to ameliorate any impacts
14 – Water Quality	Address water quality impacts during construction including details of the source, volume, frequency and on-going monitoring methods
14 – Water Quality	Provide mitigation and management measures to minimise soil and stormwater impacts to the surrounding area.

7 FLOODING & STORMWATER DRAINAGE

Flood mapping and flow regimes through Darling Square area, for both existing conditions and the proposed development, is provided in the precinct-wide Flooding & Stormwater report (Appendix A).

Concept design plans in Appendix C outline the proposed stormwater management strategy for the North East Plot.

An overview of the flood regimes for this and the adjacent sites, and stormwater management is described in the following sections.

7.1 INTRODUCTION

Figure 4 shows the extent of the 0.62ha North East Plot proposed site works boundary for SSDA7. Located in Darling Square at the southern end of the SICEEP site, the site area is generally bound by existing Entertainment Centre car park to the west, Harbour Street to the east, Hay Street to the south and Little Pier Street to the north.

Under existing conditions there are a number of overland flow paths which converge along Hay Street to then be directed north through or adjacent to Darling Square precinct via one of three defined overland flow paths – through the Entertainment Centre car park, the service corridor in-between the car park and the Entertainment Centre, and Harbour Street. Additionally, flows along Harbour Street can spill westward along Little Pier Street as illustrated in Figure 4. As such, the proposed North East Plot development may be affected by, or impact upon, the overland flows.

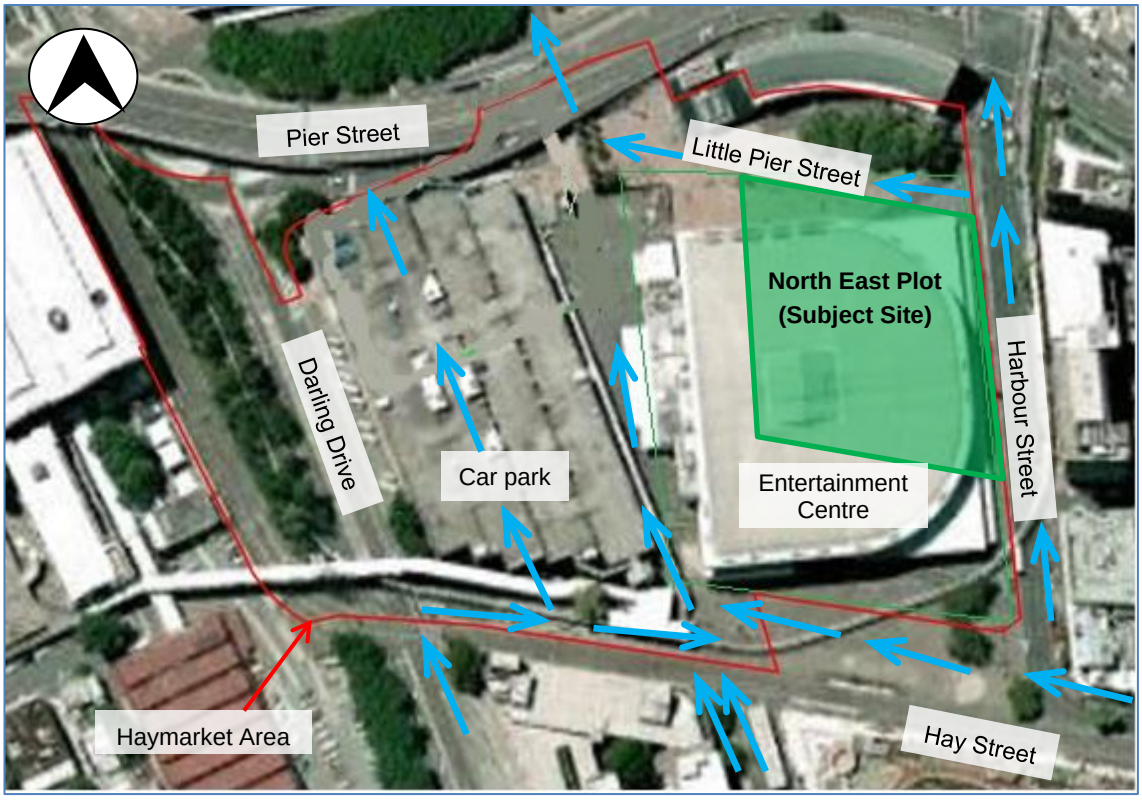

Figure 4: Subject Site Indicating Existing (1% AEP) Overland Flow Paths (denoted by arrows)

7.2 PROPOSED FLOODING & STORMWATER MANAGEMENT

The proposed flooding and stormwater management for this development includes:

- modifications to the existing stormwater systems in accordance with the intent of the precinct-wide Flooding & Stormwater report (Appendix A);
- works that impact on the Sydney Water underground conduit system;
- sediment and erosion control measures during construction; and
- New local drainage systems which connect to existing systems.

Each of these items is discussed further in the sections below.

7.2.1 MODIFICATIONS TO EXISTING STORMWATER SYSTEM

The Flooding & Stormwater report submitted with the Stage 1 DA (SSDA2) foreshadowed modifications / amplifications required to the existing stormwater system for Darling Square precinct including the North East Plot (Refer Appendix A).

Flood modelling has been revised from the precinct-wide Flooding & Stormwater report (Appendix A) to assess an alternate amplification option at the south east corner of Darling Square. The proposed amplification option will run parallel with Hay Street (refer Appendix E) This proposal will, where possible, improve on the existing overland flow conditions through the site ensuring that they are no worse than existing conditions. This revised flood model has been used to determine flood levels for the site and adjacent areas as documented in Appendix D.

To facilitate the construction of the North East Plot two existing stormwater systems discharging eastward from the existing Entertainment Centre and connecting into the Harbour Street trunk drainage system are to be reconstructed at a lower level to accommodate proposed stormwater treatment devices (discussed in report Section 8). This drainage modification (shown in Appendix C) is consistent with the Stage 1 (SSDA2) strategy for the control of stormwater through Darling Square precinct.

7.2.2 WORKS THAT IMPACT ON SYDNEY WATER CONDUITS

The Flooding & Stormwater report (Appendix A) provides details of the Sydney Water conduit systems, capacities and performances. The North East Plot development, while not directly impacting on the nearby existing Sydney Water stormwater culverts, is part of the broader Darling Square development which requires culvert amplification works. As such, consultation with relevant authorities to secure approval for these works has commenced and is on-going.

7.2.3 SEDIMENT AND EROSION CONTROLS

An erosion and sediment control plan (refer Appendix B) 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; and
- stabilised site access and truck wash-down area.

7.2.4 LOCAL STORMWATER MANAGEMENT

As proposed in the precinct Flooding & Stormwater report (Appendix A):

- building hydraulic and ground surface connections are to discharge into existing conduits;
- proposed local drainage systems will be sized to convey 20 year ARI (including climate change) flows, although their performance may be limited by the existing downstream system capacities;
- no on-site detention is proposed for Darling Square.

A conceptual stormwater layout is provided in Appendix C.

DRAINS modelling was carried out to facilitate the design of the North East Plot drainage systems. Model data and outputs are included in Appendix C.

TUFLOW modelling was carried out to assess potential flood impacts on neighbouring areas. TUFLOW model results of the existing and proposed stormwater trunk drainage systems and overland flows in the vicinity of the North East Plot are also summarised in Appendix C.

Appendix C Table C.1 indicates a reduction overland flows, with minor hydraulic grade line (HGL) increases along the most southern Sydney Water culvert in Hay Street, however Figures C-3 and C-4 indicate that the HGL increases dissipate along the local stormwater connections from the south (e.g. along Quay Street) since these systems are at a higher level (than the Sydney Water culvert invert).

Overall the results indicate that the proposed North East Plot works would not adversely impact on flooding or existing drainage system capacities in areas neighbouring the SICEEP area.

7.3 FLOOD PLANNING LEVELS

The mapping provided in the precinct Flooding & Stormwater report (Appendix A) has been provided to allow Architects and the developer to determine initial floor levels.

Floor levels are prescribed in the flood planning level requirements of Infrastructure NSW (INSW) and the local authority, City of Sydney (CoS), as part of their flood risk management plan which is developed with the input of numerous 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 INSW and CoS flood planning level requirements for the project are included in Appendix G.

Hyder has provided Drawing SKCPD025 (Appendix D) to assist project Architects and the developer with the setting of minimum floor levels.

For flood evacuation purposes, local refuge areas are required to be no lower than the probable maximum flood level of 4.6mAHD (Dwg SKCPD025 location S).

It should also be noted that final flood levels and flow regimes may change as a result of future refinement of the flood model (due to design adjustments and issues identified in the Flooding & Stormwater report (Appendix A)). If so, this may impact on the minimum floor levels.

7.4 CONSTRUCTION PHASE

Hyder have assessed potential flood impacts during the Darling Square construction phase of the North East Plot. The assessment approach and findings are discussed as follows.

7.4.1 BACKGROUND

The Flooding & Stormwater report (Appendix A) modelled the proposed development based on ultimate construction of the SICEEP precinct and does not include discussion on construction staging. As indicated in the Flooding & Stormwater report (Appendix A), Darling Square portion of the SICEEP precinct is located at the downstream of two large catchments totalling approximately 150ha. Subject to the limitations of the Flooding & Stormwater report (Appendix A); this current investigation of Darling Square precinct quantifies potential flood impacts during the construction of the North East Plot with the demolition of the Entertainment Centre.

7.4.2 MODELLING METHODOLOGY

The TUFLOW model used in the Flooding & Stormwater report (Appendix A) (to represent SICEEP development conditions) has been modified to represent the construction development phase of the NE, SW and Student Accommodation plots with associated ground levels.

7.4.3 RESULTS

TUFLOW model flood impact figures for 20 and 100 year ARI events presented in Appendix F indicate that during the construction development phase adverse flood impacts in areas neighbouring the North East Plot would be negligible for events up to the 20 year ARI. In a 100 year ARI event, flood levels in Hay Street may increase by up to approximately 50mm in an area localised to the south eastern corner of the North East Plot, noting also that the risk of flooding beyond the 20 year ARI, during the construction period, is small.

8 WATER SENSITIVE URBAN DESIGN

The Water Sensitive Urban Design (WSUD) component of the precinct-wide Flooding & Stormwater Report (Appendix A) focuses on the PPP precinct within SICEEP whilst also assessing Darling Square precinct at a conceptual level. This report sets out a more specific WSUD strategy for Darling Square precinct, particularly for the North East Plot, and assesses this Stage 2 DA (SSDA7) in the context of that overall strategy.

A detailed water quality analysis has been undertaken by Hyder to develop the WSUD strategy for Darling Square with site-specific opportunities and constraints identified to allow the re-development of the precinct while achieving the SEARs water quality objectives (see Section 6) and meeting the adopted water quality targets specified in the City of Sydney Council DCP (see Section 8.3.2).

Darling Square precinct has been subdivided into the following seven sub-catchments for the purposes of developing and assessing the performance of the WSUD strategy:

1. the Western Plot (North Site);
2. the Western Plot (South Site);
3. the North West Plot;
4. the South West Plot;
5. the North East Plot;
6. the South East Plot; and
7. the Boulevard, the North Plot and public square.

The WSUD boundaries of these sub-catchments have been established with reference to the developed site's hydrology rather than the Stage 2 DA boundaries. These WSUD boundaries have been determined based on how the site is graded and hence is consistent with how stormwater runoff will be likely conveyed and discharged within these sub-catchments.

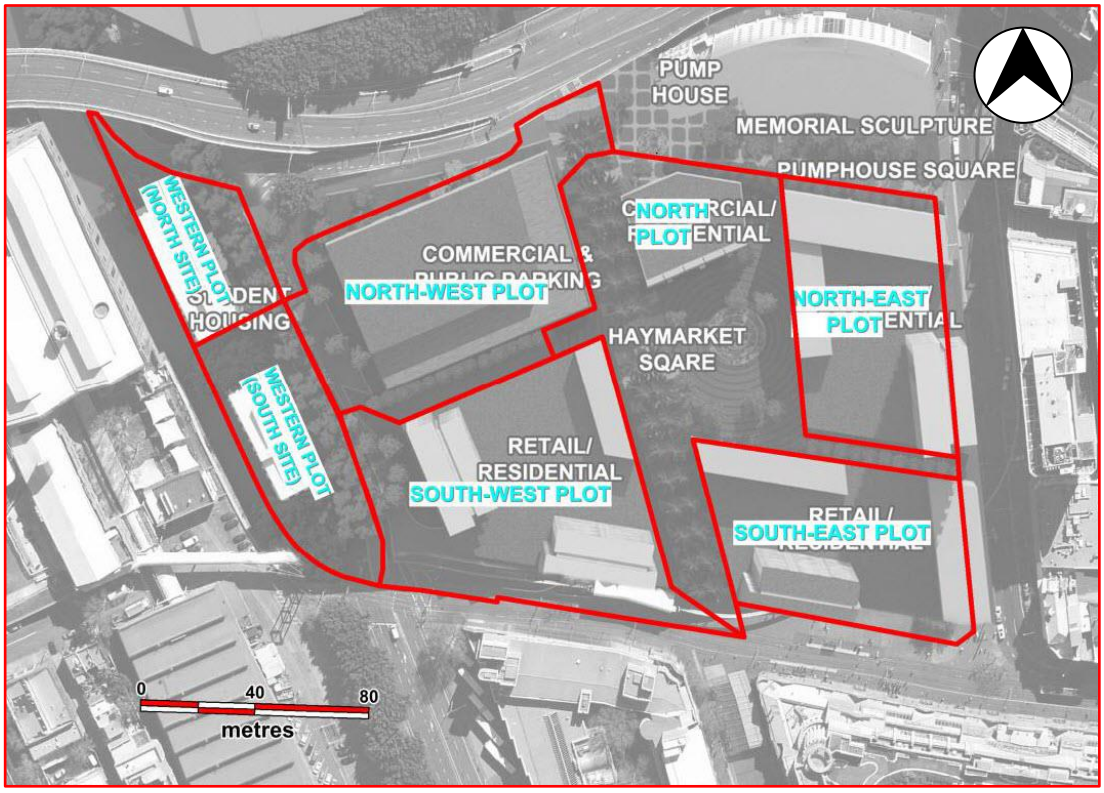

Figure 5: Extents of Darling Square Sub-catchments Adopted in MUSIC Modelling

8.1 WATER QUALITY MODELLING SETUP & SCENARIOS

The water quality analysis for this study was undertaken using the industry standard software MUSIC (Model for Urban Stormwater Improvement Conceptualisation) Version 6.0 (Build 4.692). 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.

The model provides a number of features relevant to the Darling Square development:

- It is capable of modelling the potential sediment and nutrient reduction benefits of gross pollutant traps, green roofs, bioretention and filtration systems, and it incorporates mechanisms to model stormwater reuse as a treatment technique; and
- It provides mechanisms to evaluate the attainment of water quality objectives.

The North East Plot (i.e. Sub-catchment 5) has an area of approximately 0.66 ha. Occupying about 0.52 ha of the site will be a building intended for retail and residential purposes. The northern, western and southern edges of the North East Plot generally drain towards the Boulevard and are included as part of Sub-catchment 7. The footpath along the eastern edge of the building will bypass the site's water quality treatment scheme. The existing bus bay along Harbour Street including the drainage system will be retained and is excluded from the water quality model. The boundary of the North East Plot sub-catchment adopted for MUSIC modelling is as shown in Figure 5.

MUSIC modelling was undertaken to estimate the stormwater runoff pollutant loads within the North East Plot for the following scenarios:

- existing Conditions;
- proposed development without treatment (Baseline Scenario); and
- proposed development with treatment (Treated Scenario).

The first two models enable the determination of the changes in the annual pollutant loads, attributed to the proposed development. An increase in developed areas or a change in surface type (e.g. from roof to road) will result in changes in the loadings of the stormwater runoff pollutants from the development and vice versa.

8.2 MODELLING DATA & PARAMETERS

Rainfall and evapotranspiration data used in the MUSIC modelling of the proposed SICEEP PPP development (Appendix A), located to the north of Darling Square, are used in this study. Being in close proximity to each other suggests similar climate conditions and hence warrants the use of identical rainfall and evapotranspiration data for both the PPP and Darling Square sites.

The soil / groundwater parameters used in the MUSIC model were obtained from the Draft NSW MUSIC Modelling Guidelines (BMT-WBM, 2010). The soil and groundwater parameters are reported in the precinct wide Flooding & Stormwater report (Appendix A).

The pollutant loading rates adopted for the site for Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN) are based on the recommended parameters provided by the Cooperative Research Centre for Catchment Hydrology (CRC, 2004). The adopted parameters are consistent with the values adopted in the MUSIC model for the proposed PPP development (Appendix A).

8.3 WATER QUALITY TREATMENT TARGETS

The treatment targets for the Stormwater Quality Management Strategy for Darling Square were derived from the following sources.

8.3.1 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS (SEARS)

The Secretary's Environmental Assessment Requirements (SEARs) relevant to stormwater quality management are listed under "Public Domain and Urban Design" and "Ecologically Sustainable Development (ESD)", which are Items 4 and 5 respectively in Table 1 (see Section 6).

The SEARs specified that "Water Sensitive Urban Design opportunities be addressed within the public domain and landscaping (Item 4)" and the "provision of "an Integrated Water Management Plan including alternative water supply, proposed end uses of potable and non-potable water, Water Sensitive Urban Design and water conservation measures (Item 5)"

This report has identified and presented WSUD opportunities for the North East Plot development.

8.3.2 CITY OF SYDNEY COUNCIL DCP 2012

Section 3 of the City of Sydney Council's 2012 Development Control Plan (DCP) (City of Sydney Council, 2012) stipulates that for developments greater than 1,000 m^2 a stormwater quality assessment must be undertaken to demonstrate that the development achieves the pollutant load reductions as follows:

- the baseline annual pollutant load for **litter and vegetation larger than 5 mm** is reduced by **90%**;
- the baseline annual pollutant load for **Total Suspended Solids (TSS)** is reduced by **85%**;
- the baseline annual pollutant load for **Total Phosphorous (TP)** is reduced by **65%**; and
- the baseline annual pollutant load for **Total Nitrogen (TN)** is reduced by **45%**.

8.3.3 WATER HARVESTING AND REUSE

The development will need to incorporate measures into the design of the development that will ensure harvested water is fit for reuse. These measures are to clean the water to exclude contaminants such as litter, sediment and oil.

8.3.4 WATER SENSITIVE URBAN DESIGN (WSUD)

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; and
- 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; and
- localised water harvesting for various uses.

8.4 MUSIC MODEL & ASSUMPTIONS

A MUSIC model (refer to Figure 6 for layout) was developed to represent the stormwater quality management strategy proposed for the North East Plot. This water quality model is an extract of the overall MUSIC model developed for the Darling Square precinct.

8.4.1 ASSUMPTIONS

As indicated in the layout of the MUSIC model developed for the site (see Figure 6), the following treatment devices were assumed:

- rainwater tank (volume=80 m^3) with first-flush device (Figure 6: Tank_RT6_80m^3);
- green roof (Figure 6: GreenRoof_GR4_657m^2);
- engineered filtration system (Figure 6: Filters_SF4A_4u and Filters_SF4B_6u);
- gross pollutant trap / pit insert (Figure 6: Pit Insert_PT4_1u); and
- bioretention tree pits (Figure 6: Bioret_TP9B_10u).

These devices are discussed in more detail in Section 8.5 of this report.

In addition, the following assumptions were taken into consideration in developing the MUSIC model:

- except for the general urban areas along the eastern edge of the North East Plot, urbanised and landscaped areas will generally discharge to the water quality elements prior to discharge from the site;
- the areas draining towards the Boulevard will be treated by the water quality treatment devices proposed for Sub-catchment 7 to meet or exceed the required pollutant reduction targets;
- all impervious areas are 100% impervious;
- all roofs of the three towers and the swimming pool area drain into the rainwater tank (i.e. NE1, NE2A, NE2B and NE3);
- 200 m^2 of the podium hardstand areas will drain towards and be treated by the adjoining vegetated garden areas;

- awnings are provided around the building perimeter and will be drained by a system of gutters and downpipes;
- the general urban areas north of the North East Plot building will be treated by bioretention tree pits;
- the podium bypasses the rainwater tank;
- rainwater tank will be constructed in-ground;
- drainage from the podium will drain to the north connection point at Harbour Street; and
- overflow pipe from the in-ground rainwater tank will connect to the southern stormwater connection pit (approximate invert level 2.7mAHD) at Harbour Street, and is to gravity discharge.

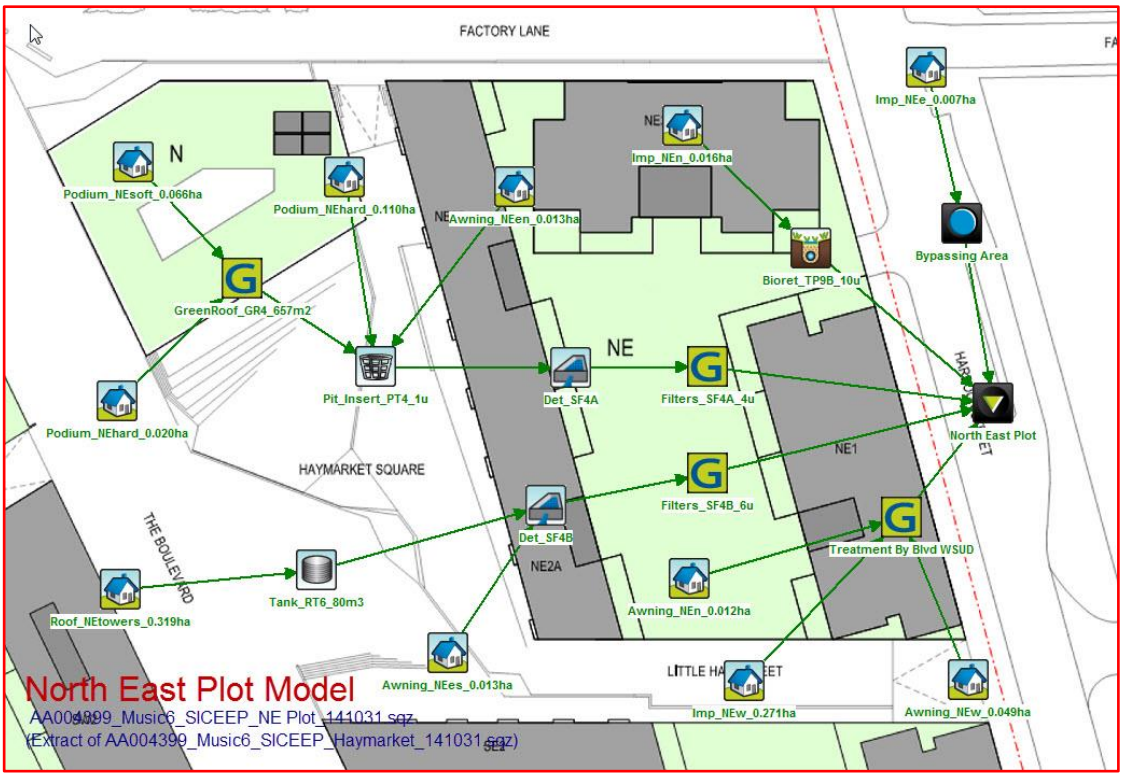

Figure 6: MUSIC Model Layout for the North East Plot

8.4.2 PERCENTAGE IMPERVIOUSNESS

Areas for the impervious components (i.e. roof, podium areas and paved areas) were estimated using the available architectural and landscape plans, prepared for the DA.

Impervious areas include the following components of the proposed development:

- roof of three towers;
- paved areas not covered by awnings;
- road or bus bay along Harbour Street; and
- paved or hardstand areas on the podium.

Pervious areas include the tree pits along the northern edge of the plot and the landscaped areas of the podium.

Under existing conditions, the site of the North East Plot is occupied by the Sydney Entertainment Centre (also known as Qantas Credit Union Arena) which is considered 100% impervious. In the proposed development, the impervious areas for the entire North East Plot total approximately 0.59 ha, making the post-developed site about 90% impervious. The pervious and impervious component areas for the North East Plot under Existing and Proposed Development scenarios are summarised in Table 2 and Table 3 respectively.

The reduction of the site's imperviousness is a result of providing tree pits north of the building and vegetated areas on the building's podium. However, even with imperviousness reduced, the resultant annual pollutant loads produced within the North East Plot could be more than current levels considering the existing site is dominated by roof which produces 'cleaner' water compared to general urban areas. In the proposed development, a stormwater quality treatment strategy will be put in place to ensure that the pollutant levels discharging from the site are below the base or untreated scenario and hence in compliance with SEARs objectives and Council's pollutant reduction targets.

Table 2: Pervious and Impervious Areas in the North East Plot – Existing Scenario

Sub-catchment	Component Areas (ha)		% Impervious
	Pervious	Impervious	
Roofs	-	0.530	**100%**
General Impervious	-	0.122	**100%**
Roads	-	0.006	**100%**
Entire North East Plot	**0.000**	**0.658**	**100%**

Table 3: Pervious and Impervious Areas in the North East Plot – Proposed Scenario

Sub-catchment	Component Areas (ha)		% Impervious
	Pervious	Impervious	
Roofs	-	0.406	**100%**
General Impervious	-	0.179	**100%**
Roads	-	0.006	**100%**
Landscaped Areas	0.067	-	**0%**
Entire North East Plot	**0.067**	**0.591**	**90%**

8.5 STORMWATER MANAGEMENT CONCEPT

The North East Plot, like all other sub-plots, is considered in the overall WSUD strategy for Darling Square. To assist in meeting the required pollutant reduction targets, various WSUD devices have been proposed to treat the rainfall falling both within and in the adjoining areas outside of the North East Plot building.

It is envisaged that the North East Plot development, when completed, will be a showcase of how the management of the urban water cycle can be seamlessly integrated with urban planning and design. It will demonstrate how the adoption of WSUD principles not only serves to reduce pollutant export but also integrates well with the urban landscape.

In addition to working with the various opportunities and constraints inherent in the proposed development, the Stormwater Management Strategy proposed for the North East Plot development was prepared with consideration of the requirements and guidelines listed in Section 8.3 of this report.

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 WSUD devices and concepts selected for North East Plot were applied as part of a treatment train. The “treatment train” approach is proposed where various types of pollutants are removed by a number of devices acting in series.

The Stormwater Quality Management Concept Plan proposed for the North East Plot that incorporates WSUD principles is shown in Figure H.1 of Appendix H.

8.5.1 SALIENT FEATURES OF THE STORMWATER QUALITY MANAGEMENT STRATEGY

The stormwater management strategy proposed for the North East Plot development utilises the latest technology for water quality management; is functional; delivers the required technical performance; avoids environmental degradation and pressure on downstream ecosystems and infrastructure; and provides for a sustainable solution for stormwater management within the site. In particular, the key features of the proposed strategy are as follows:

Social

- Enhanced visual amenity through landscaping;

Environmental

- Limited downstream discharge peaks and velocities;
- Provision of a rainwater tank, green roof, bioretention tree pits, gross pollutant trap and engineered filtration system to achieve water quality; and

Economic

- Proposed water quality improvement measures that keep recurrent maintenance tasks and costs to a minimum.

The Stormwater Quality Management Strategy proposed for the North East Plot development will consist of the following elements.

8.5.2 RAINWATER TANK

Rain falling on the tower roofs of the North East Plot building will be collected and stored in a rainwater tank with initial flows being diverted via a first flush diverter. Hydraulics of the building will be configured to allow this rainwater to be available for non-potable uses mainly for the irrigation of landscaped areas.

Table 4: Tank Properties and Tributary Area

Tank	Tributary Area (ha)	Tank Properties			
		Cross-Sectional Area (m^2)	Tank Height (m)	Tank Volume* (m^3)	Roof area per m^3 of Storage (m^2)
North East Plot	0.319	60	1.33	80	40

* - effective volume

In addition to water savings, rainwater tanks help reduce runoff volumes from the North East Plot 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 4. This tank is assumed to be located in-ground underneath the North East Plot building.

Stormwater Reuse

Except for the first flush flows, harvested rainwater will be directed to the tank. With the tank located below the podium, water from the tank will be conveyed by pressure to service the landscaped areas. Water from the rainwater tanks will be used for irrigation only.

Water Demand Volume

The assumed depth of irrigation required to maintain the tree pits and the landscaped areas on the building podium is 25 mm per week. This translates to a daily irrigation volume requirement of about 2.5 m^3. This is the reuse volume of stormwater used in the MUSIC model.

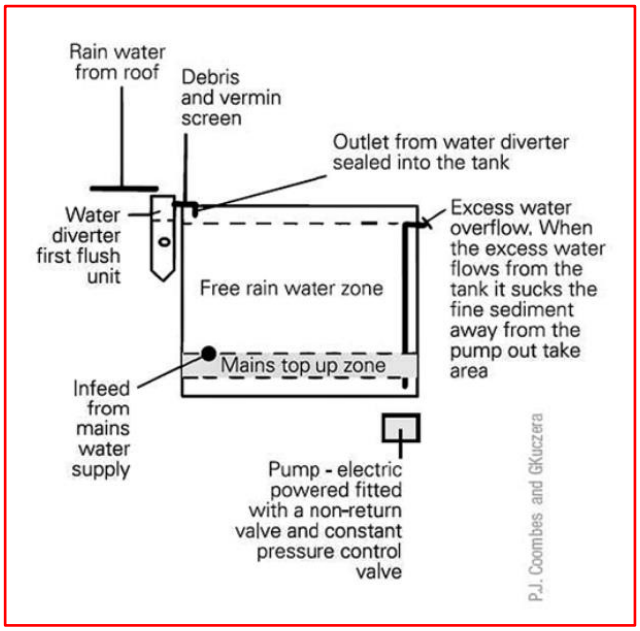

Figure 7: A Typical Configuration of the Rainwater Tank
(Source: Coomes and Kuzcera, 2001)

Tank Configuration

The North East Plot building rainwater tank will be supplemented by mains water during dry periods, days of no rainfall or to meet irrigation demand. The tank 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 the tank. 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 7.

Tank in the MUSIC model

The rainwater tank was included in the MUSIC model taking into consideration the following assumptions:

- the roofs of the three towers of the North East Plot will drain into the rainwater tank. Downpipes and related piped connections ensure no portions of the tributary areas bypass the tank;
- height of the tank above the overflow pipe is 0.2 m;
- overflow pipe diameter is 100 mm;
- height of the water tank is approximately 1.3 m; and
- daily irrigation water demand is constant.

Tank Reliability

The reliability of a reuse tank is a measure of how many days, in a typical year, water is available to service the irrigation requirement of the landscaped areas. A spreadsheet was developed for this study to calculate the reliability of the tank. The calculations were based on the following assumptions:

- all tributary areas leading to the tanks have a "capture efficiency" value of 0.85. Capture efficiency allows for losses due to gutter overflows, splashing of rain and other losses (e.g. system leaks, minimal evaporation) that occur. The value of 0.85 indicates that 85% of the non-absorbed rainfall is captured;
- a portion of the rain falling on the roof is absorbed by the roofing material. A "catchment absorption" value of 0.1 mm applies to all roofs; and
- first flush volume is taken as the first 1 mm non-absorbed rainfall multiplied by the tributary roof area. This volume gets diverted from the tank.

The tank reliability analysis shows the North East Plot tank has a 90% reliability which means that on average rainwater is available in the tank for 328 days in a year. The annual volume of mains water saved by reusing roof runoff is about 820 m^3. The calculator spreadsheet for tank reliability is included in Appendix H.

8.5.3 GREEN ROOF SYSTEMS

A green roof is a vegetated layer that can be installed on any roof, from private dwellings to industrial buildings (see Figure 8). They can vary from a 50 mm thick cover of hardy ground cover to a more intensive and thicker layer (>150 mm) complete with trees.

Green roofs are increasingly becoming popular due to the range of benefits they offer including:

- stormwater management – green roofs reduce and slow down roof runoff and filter pollutants from rainfall;
- mitigating urban heat islands - green roofs provide shade and remove heat from the air through evapotranspiration, reducing temperatures of the roof surface and the surrounding air;
- lower energy consumption - green roofs absorb heat and act as insulators for buildings, reducing energy needed to provide cooling and heating;
- reduced air pollution and greenhouse gas emissions – green roofs remove air pollutants and greenhouse gas emissions through the processes of deposition, sequestration and storage. Green roofs also indirectly decrease the production of associated air pollution and greenhouse gas emissions due to reduced air conditioning demand; and
- improved quality of life – with reduced heat transfer, green roofs can provide improved indoor comfort. They also provide aesthetic value and habitat for many species.

Commercially available green roofs typically consist of modular pre-vegetated engineered bioretention systems that are 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.

Figure 8: A Green Roof Installation on a Building Roof
(Source: www.igra-world.com)

The installation of a green roof would be suitable for the North East Plot, as a component of the landscaped areas of the podium. We note that the configuration of the green roof and the selection of plant species will be in accordance to the landscape architect's design specifications.

8.5.4 PROPRIETARY FILTRATION SYSTEMS

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

The WSUD strategy for the North East Plot includes Stormwater360's StormFilter system (see Figure 9) that serve as secondary treatment for runoff coming from the roofs and podium of the North East Plot building. Treatment efficiencies of the StormFilter cartridges, as a stand-alone treatment device, in reducing Gross Pollutants, TSS, TN and TP are 100%, 74%, 49% and 32% respectively. These efficiencies are based on the StormFilter stand-alone MUSIC transfer function nodes provided by Stormwater360 in 2013. Higher efficiencies are achieved when the cartridges are used in tandem with pit inserts (e.g. Enviropod) upstream.

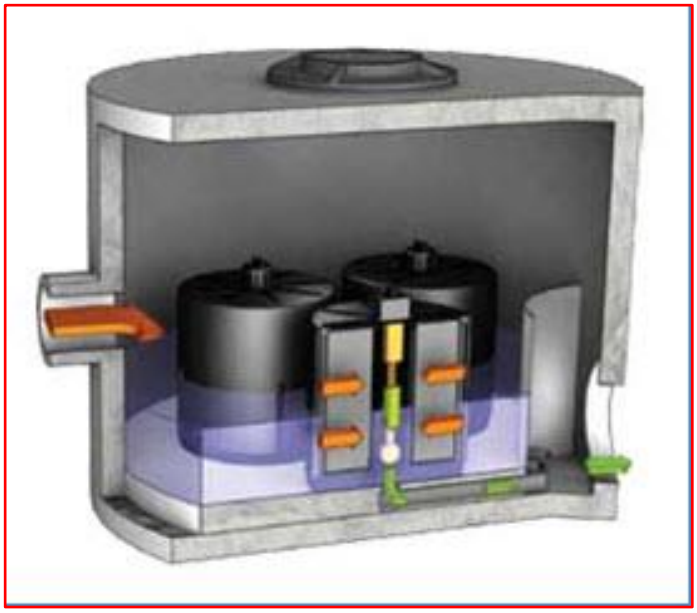

Figure 9: Filtration of Stormwater Pollutants in a StormFilter System
(Source: Stormwater360)

8.5.5 PIT INSERTS

A pit insert, also known as litter basket, is proposed for the North East Plot to treat the runoff from the building's podium. 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. Pit inserts, consisting of a capture basket and a filter mesh liner, are usually fitted below the road invert or surface of the pit and hence are visually unobtrusive (see Figure 10).

For highly urbanised and public areas, stormwater discharging into pits is expected to be heavily laden with sediments and gross pollutants. The proposed pit insert will be provided with a by-pass overflow mechanism to allow flows to eliminate the risk of ponding and flooding. The by-pass mechanism should also ensure that the already-captured pollutants are not remobilised.

Figure 10: A Typical Pit Insert Assembly
(Source: Stormwater360)

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

8.5.6 BIORETENTION TREE PITS

A stormwater bioretention system is a widely accepted WSUD concept that improves the quality of stormwater by filtering water through a biologically influenced media. A typical bioretention system consists of a vegetated surface overlaying a porous filter medium with a drainage pipe at the bottom. Stormwater directed into the bioretention system flows through vegetation, and temporarily ponds on the surface, before slowly filtering down through the filter media. Depending on the design, treated flows are either infiltrated to underlying soils, or collected in the underdrain system for conveyance to downstream drainage systems.

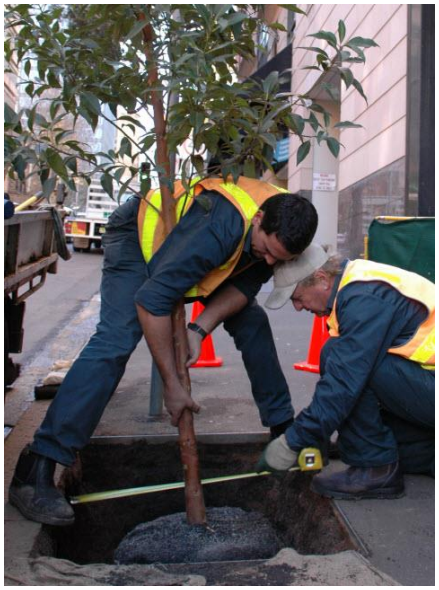

Figure 11: A Tree Pit Being Constructed
(Source: City of Sydney Council)

The bioretention tree pits (see Figure 11) proposed for the North East Plot will capture and treat stormwater flows from the adjoining urban catchment (e.g. paved surfaces) before they enter the development proprietary stormwater drainage system. The top layer filters sediment and gross pollutants (including plastics, bottles and wrappers) before water gets filtered through a series of layered media (e.g. soil, sand). Together with the tree's root system, the layered media treats the flows to remove nitrogen, phosphorus, sediment, grease and oils before it enters the stormwater system.

8.6 POLLUTANT LOAD ESTIMATES

8.6.1 EXISTING AND PROPOSED DEVELOPMENT BASE / 'NO TREATMENT' SCENARIOS

Total annual pollutant load estimates were derived using MUSIC for the North East Plot for both the Existing and Proposed Development (Without Treatment) Conditions. These estimates are presented in Table 5. The introduction of more urban non-roof areas has resulted in the increase of the mean annual pollutant loads for the untreated Proposed North East Plot Development. We note that the existing site of the proposed development is dominated by roof which produces 'cleaner' water compared to general urban areas.

Table 5: Summary of Estimated Mean Annual Pollutant Loads for the North East Plot under Existing and Untreated Developed (Base) Scenarios

Criteria	Mean Annual Loads (kg/yr)			
	Gross Pollutants	TSS	TP	TN
Existing Conditions				
North East Plot	197	421	1.4	17.3
Proposed development Conditions (Without Treatment)				
North East Plot	201	682	1.7	17.7

8.6.2 PROPOSED DEVELOPMENT 'TREATMENT' SCENARIO

Total annual pollutant load estimates were derived using MUSIC for the North East Plot incorporating the proposed stormwater quality management strategy. The estimated annual pollutant loads and reductions for this plan are presented in Table 6.

Table 6: Summary of Estimated Mean Annual Pollutant Loads and Reductions for the North East Plot Development

Criteria	Pollutant			
	Gross Pollutants	TSS	TP	TN
Total Development Source Loads (kg/yr)	201	682	1.7	18
Minimum Reduction Required (%)	**90%**	**85%**	**65%**	**45%**
Minimum Reduction Required (kg/yr)	181	580	1.1	8
Total Residual Load to Darling Harbour (kg/yr)	4	101	0.6	9
Total Reduction Achieved (kg/yr)	197	581	1.1	9
Total Reduction Achieved (%)	**98%**	**85%**	**65%**	**50%**

8.7 CONCLUSIONS

8.7.1 EXISTING AND PROPOSED DEVELOPMENT BASE / 'NO TREATMENT' SCENARIOS

Results of the MUSIC modelling for the Existing and Post Development Untreated Scenarios show a general increase in the mean annual pollutant loadings resulting from the proposed North East Plot development. Even with the landscaped areas on the building's podium, the introduction of more urban non-roof areas has resulted in the North East Plot producing more pollutants than the existing site. The existing site is dominated by roof which produces 'cleaner' water compared to general urban areas.

In the proposed development, a stormwater quality treatment strategy will be put in place to ensure that pollutant levels are below the base or untreated scenario and hence allowing the proposed development to comply with the SEARs objectives and achieve Council's nominated pollutant reduction targets.

8.7.2 PROPOSED DEVELOPMENT 'TREATMENT' SCENARIO

The MUSIC modelling for the Proposed Development Treated Scenario has demonstrated that the proposed water quality management strategy in the North East Plot will result in lower levels of Gross Pollutants, TSS, TP and TN compared to values resulting from the Base Scenario.

The performance of the proposed water quality management strategy for the proposed North East Plot development obtained from the MUSIC model, as summarised in Table 6 shows that:

- In order to achieve the objective of a 90% reduction in Gross Pollutants from the proposed North East Plot development, the minimum Gross Pollutants reduction is 181 kg/yr. The MUSIC modelling predicts that Gross Pollutants are reduced by 197 kg/yr. The water quality management strategy therefore achieves the target reduction for Gross Pollutants.

- In order to achieve the objective of an 85% reduction in TSS from the proposed North East Plot development, the minimum TSS reduction is 580 kg/yr. The MUSIC modelling predicts that TSS is reduced by 581 kg/yr. The water quality management strategy therefore achieves the objective reduction for TSS.
- In order to achieve the objective of a 65% reduction in TP from the proposed North East Plot development, the minimum TP reduction is 1.1 kg/yr. The MUSIC modelling predicts that TP is reduced by 1.1 kg/yr. The water quality management strategy therefore achieves the objective reduction for TP.
- In order to achieve the objective of a 45% reduction in TN from the proposed North East Plot development, the minimum TN reduction is 8 kg/yr. The MUSIC modelling predicts that TN is reduced by 9 kg/yr. The water quality management strategy therefore achieves the objective reduction for TN.

The combination of a rainwater tank for reuse, green roof, filtration systems, pit insert and bioretention tree pits as elements of the Stormwater Quality Management Strategy for the proposed North East Plot development, achieves the objectives specified in the SEARs and the nominated pollution reduction targets for Gross Pollutants, Total Suspended Solids, Total Phosphorus and Total Nitrogen specified in the City of Sydney Council DCP.

8.8 WSUD REFERENCES

BMT-WBM (2010). Draft NSW MUSIC Modelling Guidelines. Prepared for Sydney Metropolitan Catchment Management Authority.

City of Sydney Council (2012). Sydney Development Control Plan.

CRC for Catchment Hydrology (2005). MUSIC Model for Urban Stormwater Improvement Conceptualisation – User Guide Version 3.

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Coombes, P. and Kuczera, G. (2001). Rainwater tank design for water supply and stormwater management. Proceedings of the Fifth Stormwater Industry Association Regional Conference on Stormwater Management, Port Stephens, April 2001, Stormwater Industry Association.

Engineers Australia (2006). Australian Runoff Quality – A Guide To Water Sensitive Urban Design.

NSW Government (2000). Environmental Planning and Assessment Regulation 2000. Published in Gazette No. 117 8 September 2000 page 9935.

APPENDIX A

FLOODING AND STORMWATER REPORT

(Refer to *Flooding and Stormwater Report* No. DN00341 dated 18 March 2013 by Hyder Consulting)

APPENDIX B

SEDIMENT AND EROSION CONTROL PLAN

SYDNEY INTERNATIONAL CONVENTION, EXHIBITION AND ENTERTAINMENT PRECINCT

NOTES

1. REFER DRAWING PD-CI-7221 FOR DETAILS

LEGEND

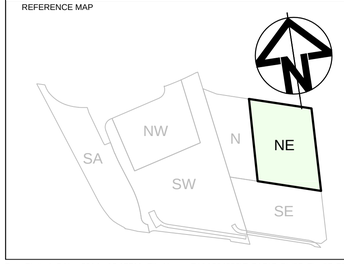
- PROPOSED CONTOUR
- EXISTING CONTOUR
- PROPOSED STORMWATER INLET PIT
- PROPOSED STORM FILTER
- GEOTEXTILE INLET FILTER
- ACCESS GATE
- STABALISED SITE ACCESS AND TRUCK WASH DOWN AREA
- SEDIMENT FENCE
- EARTH BUNDING
- GENERAL GRADING
- PLOT BOUNDARY

NOTES

1. THE CONTRACTOR AND ALL SUBCONTRACTORS TO ENSURE THAT ALL SEDIMENT & EROSION CONTROLS ARE TO BE IN ACCORDANCE WITH LANDCOM: MANAGING URBAN STORMWATER: SOILS AND CONSTRUCTION VOLUME 1: 4TH EDITION MARCH 2004, ALSO KNOWN AS "THE BLUE BOOK".
2. SEDIMENT CONTROL FENCES AND BARRIERS TO BE INSTALLED AROUND CONSTRUCTION STAGING PERIMETERS IN ACCORDANCE WITH COUNCIL REQUIREMENTS.
3. ALL SUBCONTRACTORS TO BE INFORMED OF THEIR RESPONSIBILITIES IN MINIMISING THE POTENTIAL FOR SOIL EROSION AND POLLUTION TO DOWNSLOPE AREAS.
4. WHERE PRACTICABLE, THE SOIL EROSION HAZARD ON THE SITE WILL BE KEPT AS LOW AS POSSIBLE AND AS RECOMMENDED BY THE CONTRACTOR.
5. EROSION AND SEDIMENT CONTROLS TO BE INSTALLED ON INLET PITS, IN ACCORDANCE WITH COUNCIL REQUIREMENTS E.G. MESH & GRAVEL FILTERS, GEOTEXTILE INLET FILTERS ETC.
6. CONSTRUCT LOW FLOW EARTH BANKS WHERE REQUIRED, IN ACCORDANCE WITH COUNCIL REQUIREMENTS.
7. CONSTRUCT STABILISED SITE ACCESSES WHERE NECESSARY, IN ACCORDANCE WITH COUNCIL REQUIREMENTS.
8. ALL STOCKPILES TO BE LOCATED CLEAR OF ALL POSSIBLE AREAS OF CONCENTRATED WATER FLOW, AND TO BE CONTAINED WITHIN A SEDIMENT FENCE.
9. STOCKPILES TO BE COVERED WHERE NECESSARY.
10. ALL WHEEL AND EQUIPMENT WASHING FACILITIES TO BE CONTAINED TO SPECIFIC BUNDED WASH AREAS.
11. ALL FUEL AND CHEMICALS TO BE SAFELY STORED TO PREVENT CONTAMINATION FROM SPILLAGES.

DARLING HARBOUR LIVE

REFERENCE MAP



NOTES:

1. DO NOT SCALE FROM DRAWINGS. USE WRITTEN DIMENSIONS ONLY.
2. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. ALL COORDINATES TO MGA. ALL LEVELS TO AHD.
4. ALL DIMENSIONS, COORDINATES AND LEVELS TO BE VERIFIED ON SITE BEFORE PROCEEDING WITH WORK. HYDER SHALL BE NOTIFIED IN WRITING OF ANY DISCREPANCIES.
5. THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT CONTRACTS, SPECIFICATIONS AND DRAWINGS.
6. THIS DRAWING CONTAINS COLOUR AND MUST ONLY BE PRINTED OR COPIED IN COLOUR.

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1 : 250

REV	DESCRIPTION	DATE
04	ISSUE FOR DA STORMWATER REPORT	05/11/2014
03	ISSUE FOR DEVELOPMENT APPLICATION	17/10/2014
02	ISSUE FOR TENDER	30/05/2014
00	ISSUE FOR CLIENT REVIEW	09/05/2014

CLIENT

Lend Lease

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CONSULTANTS

HASSELL

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Hyder

PROJECT

SICEEP - DARLING HARBOUR
DARLING SQUARE
NORTH EAST PLOT

DRAWING TITLE

SEDIMENT AND EROSION CONTROL PLAN

STATUS

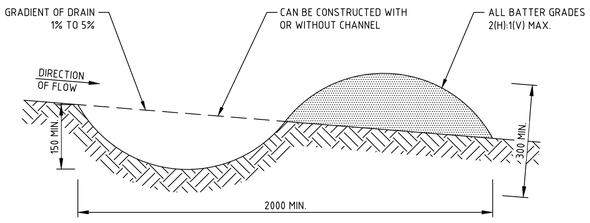
DEVELOPMENT APPLICATION

SCALE @ A1	DRAWN	DESIGNED	REVIEWED	APPROVED
1 : 250	LC	MBK	JJB	MAK

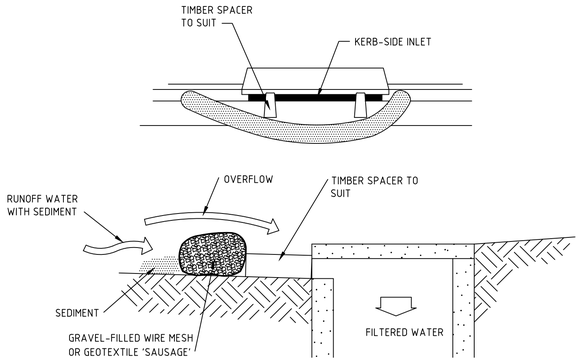
PROJECT NUMBER	DRAWING NUMBER	REV
AA004399	PD-CI-7201	04

Date Plotted: 5 Nov 2014 - 12:17PM File Name: F:\AA004399\E-CAD\C-Civil\D-Finall\B-PDA\C-NE Building (PD-CI-7001 - PD-CI-7999)\PD-CI-7201-SedimentAndErosionControlPlan.dwg

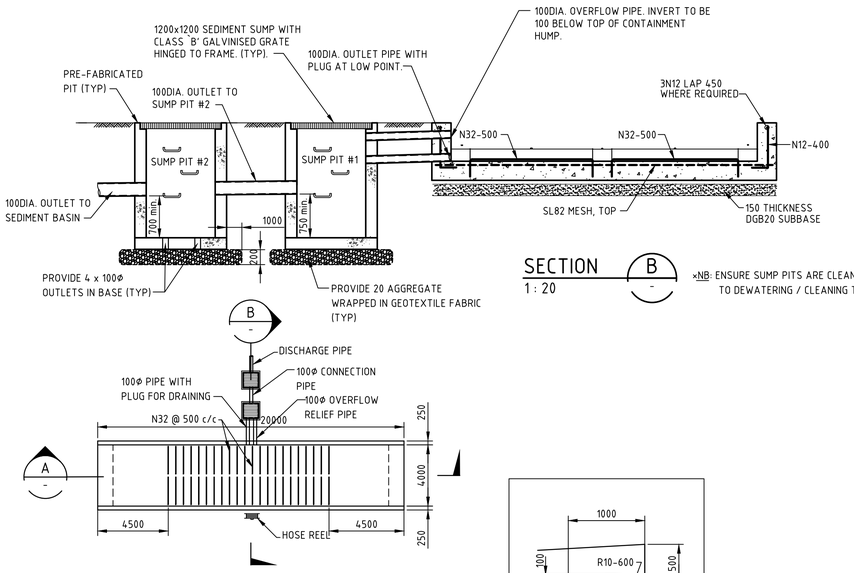
Original Sheet Size A1 - 841 x 594mm



EARTH BUND (SD5-5)
NTS

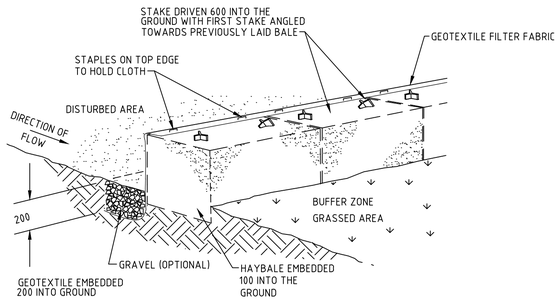


MESH AND GRAVEL INLET FILTER (SD 6-11)
NTS

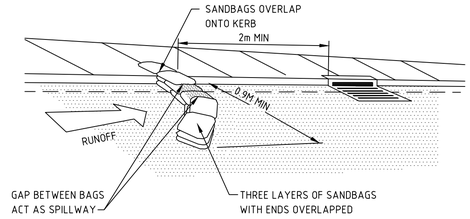


NB: ENSURE SUMP PITS ARE CLEANED OUT PRIOR TO DEWATERING / CLEANING TRUCK WASH.

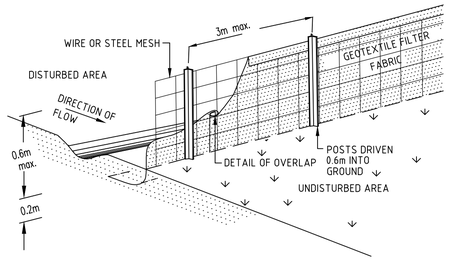
ALTERNATE CONCRETE TRUCK WASH DOWN DETAIL



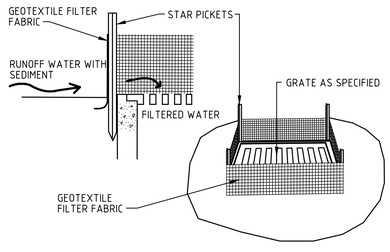
HAY BALE AND GEOTEXTILE SEDIMENT FILTER (SD6-7)
NTS



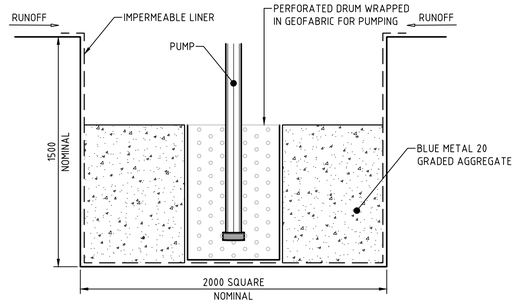
SANDBAG SEDIMENT TRAP FOR KERB INLET ON GRADE (SD6-11)
NTS



SEDIMENT FENCE (SD6-8)
NTS



GEOTEXTILE FILTER PIT SURROUND (SD6-12)
NTS



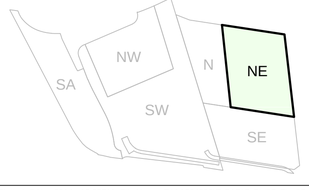
INDICATIVE SEDIMENT COLLECTION POINT
1 : 20

NOTE:
(SD_____) INDICATES STANDARD DRAWINGS, REFER MANAGING URBAN STORMWATER, SOIL AND CONSTRUCTION 4th EDITION MARCH 2004.

SYDNEY INTERNATIONAL CONVENTION, EXHIBITION AND ENTERTAINMENT PRECINCT

DARLING HARBOUR LIVE

REFERENCE MAP



NOTES:
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2. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. ALL COORDINATES TO MGA. ALL LEVELS TO AHD.
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6. THIS DRAWING CONTAINS COLOUR AND MUST ONLY BE PRINTED OR COPIED IN COLOUR.

REV	DESCRIPTION	DATE
04	ISSUE FOR DA STORMWATER REPORT	05/11/2014
03	ISSUE FOR DEVELOPMENT APPLICATION	17/10/2014
02	ISSUE FOR TENDER	30/05/2014
01	ISSUE FOR CLIENT REVIEW	09/05/2014

CLIENT
Lend Lease
LEND LEASE (HAYMARKET) PTY. LTD.
30 THE BOND, 30 HICKSON RD
MILLERS POINT, NSW 2000

CONSULTANTS
HASSELL
LANDSCAPE ARCHITECT
LEVEL 2, PIER 8/9, 23 HICKSON RD
MILLERS POINT, NSW 2000

Tzannes Associates
ARCHITECT
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Fax: +61 (0)2 8907 9001
www.hyderconsulting.com

PROJECT
SICEEP - DARLING HARBOUR
DARLING SQUARE
NORTH EAST PLOT

DRAWING TITLE
SEDIMENT AND EROSION CONTROL DETAILS

STATUS
DEVELOPMENT APPLICATION

SCALE @ A1	DRAWN	DESIGNED	REVIEWED	APPROVED
AS SHOWN	LC	MBK	JJB	MAK

PROJECT NUMBER	DRAWING NUMBER	REV
AA004399	PD-CI-7221	04

APPENDIX C

CIVIL WORKS AND STORMWATER PLANS AND DRAINAGE MODELLING

CIVIL WORKS AND STORMWATER PLANS

SYDNEY INTERNATIONAL CONVENTION, EXHIBITION AND ENTERTAINMENT PRECINCT

DARLING HARBOUR LIVE

LEGEND

- EXISTING PIPE/CULVERT TO BE RETAINED
- EXISTING PIPE/CULVERT TO BE DEMOLISHED
- EXISTING PIT TO BE RETAINED (OUTLINE SHOWN INDICATIVE ONLY)
- EXISTING PIT TO BE DEMOLISHED (OUTLINE SHOWN INDICATIVE ONLY)
- PROPOSED PIPE/CULVERT
- KERB INLET PIT
- SURFACE INLET PIT
- JUNCTION PIT
- DRAINAGE CHANNEL

PAVEMENT LEGEND

PAVEMENT TYPE 7 - FOOTPATH TO LANDSCAPE ARCHITECTS DETAILS (AREA = 555m²)

NOTES:

1. REFER TO CITY OF SYDNEY (C.O.S.) STANDARD DRAWINGS FOR KERB TYPE DETAILS 1.1.1 TO 1.1.16 INCLUSIVE.
2. ALL PAVEMENT SUBJECT TO DESIGN BY QUALIFIED GEOTECHNICAL ENGINEER
3. REFER CIVIL WORKS DETAILS DRAWING FOR PAVEMENT DEPTHS
4. PAVEMENTS SHOWN ARE ASSUMED ONLY AND FURTHER COORDINATION WITH LANDSCAPE ARCHITECTS IS REQUIRED.
5. RUNOFF FROM EXISTING ENTERTAINMENT CENTRE CATCHMENT EXTERNAL TO THE NORTH EAST BUILDING PLOT ARE TO BE DIVDERTED TO THE EXISTING 450mm Ø RCP BEFORE THE COMMENCEMENT OF NORTH BUILDING AND SOUTH EAST BUILDING WORKS
6. DESIGN CONTOURS OUTSIDE OF N.E. PLOT ARE INDICATIVE ONLY AND YET TO BE FINALISED.

FACTORY STREET

HARBOUR STREET

BOULEVARD

EXISTING ENTERTAINMENT CENTRE

LITTLE HAY STREET

NE-19\1 NE-19\2 NE-19\3 NE-19\4 NE-19\5

NE-D\1 NE-D\2 NE-D\3 NE-D\4

NE-E\1

NE-A\1 NE-A\2 NE-A\3 NE-A\4

NE-B\1

NE-C\1

INSET A

ACO DRAINS 200W 1% GRADE

REFERENCE MAP

NW N NE SA SW SE

NOTES:

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0 5 10 15 20 25m

1 : 250

REV	DESCRIPTION	DATE
06	ISSUE FOR DA STORMWATER REPORT	05/11/2014
05	ISSUE FOR DEVELOPMENT APPLICATION	17/10/2014
04	PAVEMENT TYPE AMENDED	19/08/2014
03	EXISTING STORMWATER TO BE DEMOLISHED ADDED	17/06/2014
02	ISSUE FOR TENDER	30/05/2014
01	ISSUE FOR CLIENT REVIEW	09/05/2014

CLIENT

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Fax: +61 (0)2 8907 9001
www.hyderconsulting.com

Hyder

PROJECT

SICEEP - DARLING HARBOUR
DARLING SQUARE
NORTH EAST PLOT

DRAWING TITLE

CIVIL WORKS AND STORMWATER PLAN

STATUS

DEVELOPMENT APPLICATION

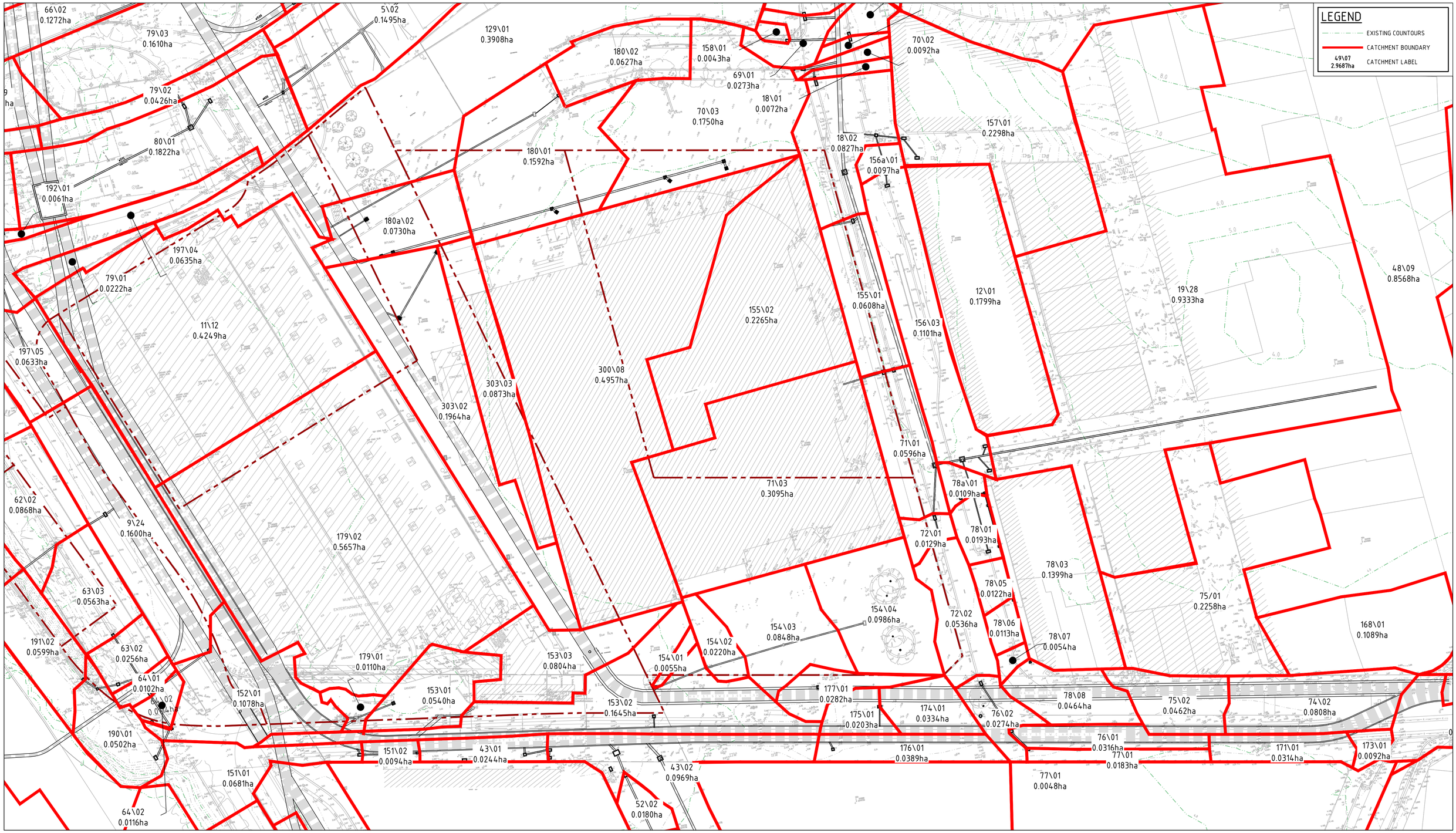
SCALE @ A1	DRAWN	DESIGNED	REVIEWED	APPROVED
1 : 250	LC	KM	JJB	MAK

PROJECT NUMBER	DRAWING NUMBER	REV
AA004399	PD-CI-7301	06

Date Plotted: 5 Nov 2014 - 12:14PM File Name: F:\AA004399\E-CAD\C-Civil\D-Final\B-PDA\C-NE Building {PD-CI-7001 - PD-CI-7999}\PD-CI-7301-CivilWorksAndStormwaterPlan.dwg

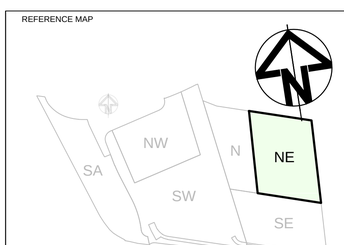
Original Sheet Size A1 - 841 x 594mm

SYDNEY INTERNATIONAL CONVENTION, EXHIBITION AND ENTERTAINMENT PRECINCT



DARLING HARBOUR LIVE

REFERENCE MAP



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0 10 20 30 40 50m

1 : 500

REV	DESCRIPTION	DATE
02	ISSUE FOR DA STORMWATER REPORT	05/11/2014
01	ISSUE FOR DEVELOPMENT APPLICATION	17/10/2014

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Hyder

PROJECT

SICEEP - DARLING HARBOUR
DARLING SQUARE
NORTH EAST PLOT

DRAWING TITLE

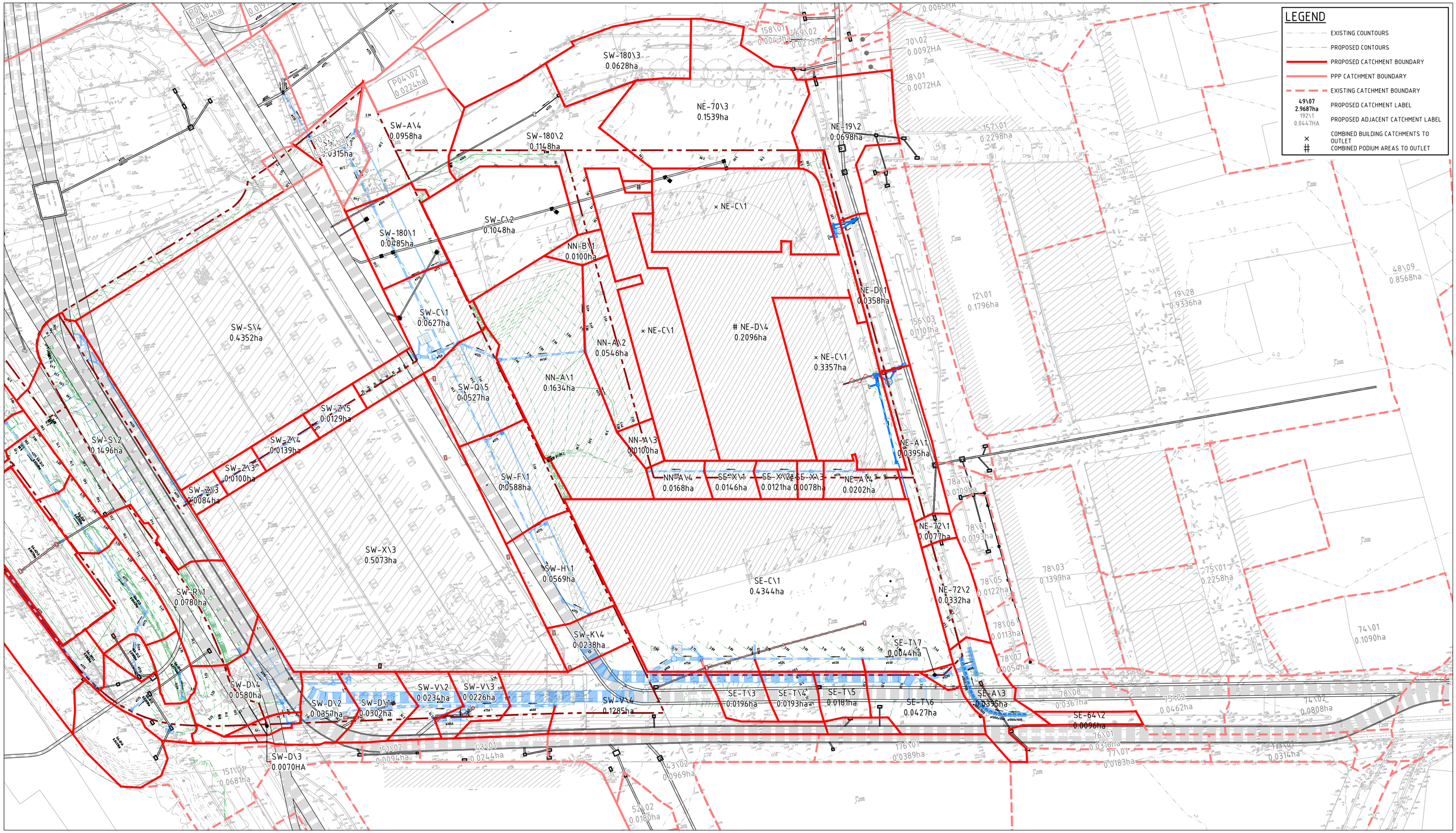
STORMWATER DRAINAGE
EXISTING CATCHMENT PLAN

STATUS

DEVELOPMENT APPLICATION

SCALE @ A1	DRAWN	DESIGNED	REVIEWED	APPROVED
1 : 500	LC	VN	JJB	MAK

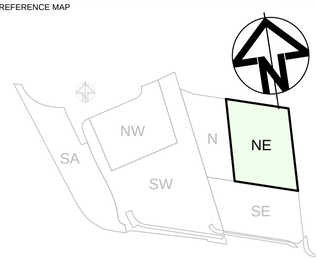
PROJECT NUMBER	DRAWING NUMBER	REV
AA004399	PD-CI-7532	02



SYDNEY INTERNATIONAL CONVENTION, EXHIBITION AND ENTERTAINMENT PRECINCT

DARLING HARBOUR LIVE

REFERENCE MAP



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0 10 20 30 40 50m

1 : 500

REV	DESCRIPTION	DATE
02	ISSUE FOR DA STORMWATER REPORT	
01	ISSUE FOR DEVELOPMENT APPLICATION	17/10/2014

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PROJECT

SICEEP - DARLING HARBOUR
DARLING SQUARE
NORTH EAST PLOT

DRAWING TITLE

STORMWATER DRAINAGE CATCHMENT PLAN

STATUS

DEVELOPMENT APPLICATION

SCALE @ A1	DRAWN	DESIGNED	REVIEWED	APPROVED
1 : 500	LC	VN	JJB	MAK

PROJECT NUMBER	DRAWING NUMBER	REV
AA004399	PD-CI-7531	01

DRAINS MODELLING INFORMATION

Proposed Development Conditions

Calculation Sheet

Job	PDA NE PLOT (DA)	Design	VN	Office	Sydney
		Date	5/11/2014	Job No	AA004399
		Checked	BC		
		Date	5/11/2014		

Sydney International Convention

Entertainment and Exhibition Precinct

PDA NE PLOT (DA)

Developed conditions model

DRAINS OUTPUT

November 2014

PROJECT	Sydney International Convention					
		JOB No		AA004399		
TITLE	PDA NE PLOT (DA)	PREPARED	VN	DATE	5/11/2014	**DATA**
		CHECKED	BC	DATE	5/11/2014	

DRAINS File Path:	F:\AA004399\D-Calcs\A-Civil\A-Stormwater\A-DRAINS\2014-02-26 PDA\141103_NE_DA\AA004399_PDA_dgn_141103_01.drn
DRAINS Version:	DRAINS Version 2014.08 - 29 August 2014
Modeller's Name:	Vincent Ng
Description:	Developed conditions model

PIT / NODE DETAILS			Version 12											
Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss
5\4	OnGrade	Existing City of S	Junction Pit		2	2.415		0	0.3	333714	6249992.7	No	80431550	1 x Ku
5\3	OnGrade	Existing City of S	1.00m x 1.00m Grate		3.3	2.495		0	0.3	333696.6	6249982.9	No	80431549	1 x Ku
5\2	OnGrade	Existing City of S	Junction Pit		1.3	2.118		0	0.3	333672.5	6249969.3	No	80431548	1 x Ku
5\1	Node					2.45		0		333663.1	6249965.9		80431547	
6\2	OnGrade	Existing City of S	0.9m Lintel 0.90m x 0.50m Grat		2	2.302		0	0.3	333680.1	6249975.6	No	80431552	1 x Ku
6\1	OnGrade	Existing City of S	0.9m Lintel 0.90m x 0.50m Grat		2	2.087		0	0.3	333672.6	6249972.9	No	80431551	1 x Ku
129\1	OnGrade	Existing City of S	0.80m x 0.80m Grate		2	2.47		0	0.3	333701	6249971.8	No	80431553	1 x Ku
189\1	OnGrade	Existing City of S	0.30m x 0.30m Grate		4.5	4.113		0	0.3	333542.6	6249920.1	No	80431554	1 x Ku
SA-15\5	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		2.5	3.573		0	0.3	333547.8	6249934	No	80431581	1 x Ku
SA-15\4	Sag	Standard Pits	2.4m lintel sag	1	1	3.325	0.1	0	0.5	333549.7	6249935	No	80431580	1 x Ku
SA-15\3	OnGrade	Existing City of S	Junction Pit		2.5	3.525		0	0.3	333557.4	6249938.9	No	80431579	1 x Ku
SA-15\2	OnGrade	Existing City of S	Junction Pit		1.5	3.375		0	0.3	333566.1	6249942.2	No	80431578	1 x Ku
SA-15\1	Node					3.133		0		333568.9	6249949.6		80431577	
NE-19\7	OnGrade	Interallotment Pits	Interallotment Pit 900x900		2	3.044		0	0.3	333849.3	6249840	No	80431563	1 x Ku
NE-19\6	OnGrade	Existing City of S	Junction Pit		0.5	3.138		0	0.3	333846.5	6249839.9	No	80431562	1 x Ku
NE-19\5	OnGrade	Existing City of S	Junction Pit		1.9	3.144		0	0.3	333843.8	6249839.8	No	80431561	1 x Ku
NE-19\4	OnGrade	Existing City of S	Junction Pit		2.3	2.98		0	0.3	333836.1	6249839.5	No	80431560	1 x Ku
NE-19\3	OnGrade	Existing City of S	Junction Pit		1.2	2.834		0	0.3	333831.8	6249868.3	No	80431559	1 x Ku
NE-19\2	OnGrade	Existing City of S	Junction Pit		1.2	2.69		0	0.3	333825.4	6249911.1	No	80431558	1 x Ku
NE-19\1	Node					2.591		0		333823.5	6249923.8		80431557	
NE-72\2	OnGrade	Existing City of S	0.90m x 0.50m Grate		4.5	2.965		0	0.3	333834.5	6249817.9	No	80431565	1 x Ku
NE-72\1	OnGrade	Existing City of S	0.90m x 0.50m Grate + Gatic		0.5	2.937		0	0.3	333833.4	6249826.3	No	80431564	1 x Ku
NE-78\1	OnGrade	Existing City of S	0.9m Lintel 0.90m x 0.50m Grat		2	3.145		0	0.3	333845.6	6249829.8	No	80431566	1 x Ku
NE-A\4	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		4.5	3.154		0	0.3	333825.6	6249842.4	No	80431569	1 x Ku
NE-A\3	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x900		2.5	3.12		0	0.3	333823.8	6249864.1	No	166363983	1 x Ku
NE-A\2	OnGrade	Existing Pits	Existing Gully Pit		0.2	3.12		0	0.3	333823.7	6249866.9	No	80431568	1 x Ku
NE_SPS_W1	OnGrade	Junction Pits	Junction Pit 600x900		0	3.2		0	0.3	333824.7	6249867.1	No	89653303	1 x Ku
NE_SPS_W2	OnGrade	Junction Pits	Junction Pit 600x600		0	3.2		0	0.3	333825.7	6249867.2	No	89653304	1 x Ku
NE_SPS_O	OnGrade	Junction Pits	Junction Pit 600x600		2.5	3.2		0	0.3	333826.8	6249867.3	No	89653305	1 x Ku
NE-A\1	Sag	NSW RTA SO V-	Single SO1 Pit	1	2.1	2.729	0.1	0	0.5	333828.8	6249867.5	No	80431567	1 x Ku
NE-B\2	OnGrade	Junction Pits	Junction Pit 600x600		0.5	3.115		0	0.3	333824.6	6249866.1	No	80431571	1 x Ku
NE-B\1	OnGrade	Storm Filter	Storm Filter		0.7	2.863		0	0.3	333826.9	6249864.4	No	80431570	1 x Ku
N203717	Node					2.5		0		333829.9	6249865.7		84847261	
NN-B\1	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		4.5	3.462		0	0.3	333747.6	6249909.2	No	80431576	1 x Ku
NN-A\2	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		2.4	2.999		0	0.3	333744.9	6249885.5	No	80431573	1 x Ku
NN-A\1	OnGrade	Surface Inlet Pits	Surface Inlet Pit 900x900		2.5	2.565		0	0.3	333720.9	6249886.7	No	80431572	1 x Ku
SW-Q\5	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1.5	2.418		0	0.3	333710.3	6249893.1	No	80431670	1 x Ku
SW-Q\4	OnGrade	Junction Pits	Junction Pit 900x900		3	2.501		0	0.3	333705.5	6249891.7	No	80431669	1 x Ku
SW-Q\3	OnGrade	Gross Pollutant T	GPT		1.5	2.549		0	0.3	333702.7	6249890.9	No	80431668	1 x Ku
SW-Q\2	OnGrade	Junction Pits	Junction Pit 900x900		0.5	2.611		0	0.3	333698.7	6249891.1	No	80431667	1 x Ku
SW-Q\1	Node					2.697		0		333696.2	6249891.6		80431666	
SA-15\6	OnGrade	Existing City of S	Junction Pit		4.5	4.162		0	0.3	333536.9	6249929	No	80431582	1 x Ku
SA-190\1	OnGrade	Existing City of S	0.30m x 0.30m Grate		4.5	3.474		0	0.3	333610.1	6249807.7	No	80431583	1 x Ku
SA-B\3	OnGrade	Interallotment Pits	Interallotment Pit 600x600		1.5	3.213		0	0.3	333610.6	6249809.6	No	80431601	1 x Ku
SA-45\5	OnGrade	Junction Pits	Junction Pit 900x900		0.3	4.123		0	0.3	333613.4	6249814.8	No	80431590	1 x Ku
SA-45\4	OnGrade	Junction Pits	Junction Pit 1200x1200		1	3.468		0	0.3	333616.8	6249817	No	80431589	1 x Ku

SA-45\3	OnGrade	Nodes	Pipe to Pipe Connection		0	3.423		0	0.3	333618.4	6249818.7	No	80431588	1 x Ku
SA-45\2	OnGrade	Junction Pits	Junction Pit 1200x1200		0.6	3.516		0	0.3	333621.6	6249824.7	No	80431587	1 x Ku
SA-45\1	Node					3.355		0		333622.4	6249829.2		80431586	
SA-191\2	Sag	Surface Inlet Pits	Surface Inlet Pit 600	1	2	2.65	0.5	0	0.5	333592.9	6249816.4	No	80431585	1 x Ku
SA-191\1	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		2.5	3.449		0	0.3	333596.4	6249813.2	No	80431584	1 x Ku
SA-S\2	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1.9	3.915		0	0.3	333608.2	6249814.7	No	80431610	1 x Ku
SA-S\1	OnGrade	Existing City of S	Junction Pit		2.3	3.621		0	0.3	333612.1	6249814.5	No	80431609	1 x Ku
SA-45\8	OnGrade	Existing Pits	Existing Gully Pit		0	8.581		0	0.3	333524.7	6249783.9	No	80431593	1 x Ku
SA-45\7	OnGrade	Existing City of S	Junction Pit		0.5	6.234		0	0.3	333562.3	6249799	No	80431592	1 x Ku
SA-45\6	OnGrade	Existing City of S	Junction Pit		0.5	6.046		0	0.3	333577.3	6249797.9	No	80431591	1 x Ku
SA-62\3	OnGrade	Interallotment Pits	Interallotment Pit 600x600		4.5	3.886		0	0.3	333593.1	6249855	No	80431596	1 x Ku
SA-62\2A	OnGrade	Surface Inlet Pits	Surface Inlet Pit 900x900		1.5	3.818		0	0.3	333598.7	6249857.6	No	160131419	1 x Ku
SA-62\2	OnGrade	Junction Pits	Junction Pit 600x600		1.5	3.613		0	0.3	333605.9	6249860.8	No	80431595	1 x Ku
SA-62\1	Node					3.471		0		333610	6249862.9		80431594	
SA-A\2	OnGrade	Interallotment Pits	Interallotment Pit 600x600		4.5	4		0	0.3	333557	6249917	No	80431598	1 x Ku
SA-A\1	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		2	3.72		0	0.3	333554.8	6249926.2	No	80431597	1 x Ku
SA-B\2	OnGrade	Junction Pits	Junction Pit 600x600		1.5	3.267		0	0.3	333619.3	6249814.2	No	80431600	1 x Ku
SA-B\1	Node					3.21		0		333628.6	6249818.9		80431599	
SA-D\1	Sag	Surface Inlet Pits	Surface Inlet Pit 600	7.9	4.5	3.36	0.2	0	0.5	333567.2	6249920.2	No	80431605	1 x Ku
SA-G\1	Sag	Surface Inlet Pits	Surface Inlet Pit 600	9.833	4.5	3.14	0.26	0	0.5	333619.4	6249807.3	No	80431606	1 x Ku
SA-R\2	OnGrade	Interallotment Pits	Interallotment Pit 600x600		4.5	3.553		0	0.3	333577.1	6249847.5	No	80431608	1 x Ku
SA-R\1	OnGrade	Junction Pits	Junction Pit 600x600		1	3.226		0	0.3	333588.7	6249825.7	No	80431607	1 x Ku
SA-S\5	Sag	Surface Inlet Pits	Surface Inlet Pit 600	4.225	2.5	3.14	0.1	0	0.5	333614.2	6249830.2	No	80431613	1 x Ku
SA-S\4	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1.5	4.268		0	0.3	333606.3	6249825.6	No	80431612	1 x Ku
SA-S\3	OnGrade	Gross Pollutant T	GPT		1.5	4.057		0	0.3	333607.6	6249818.5	No	80431611	1 x Ku
SA-U\2	Sag	Surface Inlet Pits	Surface Inlet Pit 600	7.133	4.5	3.425	0.21	0	0.5	333602.7	6249851.5	No	80431614	1 x Ku
SA-U\1	OnGrade	Junction Pits	Junction Pit 600x600		0.2	3.806		0	0.3	333599.5	6249856.1	Yes	160131421	1 x Ku
SA-T\2	Sag	Surface Inlet Pits	Surface Inlet Pit 600	1	4.5	3.843	0.15	0	0.5	333582.5	6249890.3	No	80431616	1 x Ku
SA-T\1	Sag	Surface Inlet Pits	Surface Inlet Pit 600	1	1	3.765	0.15	0	0.5	333593.5	6249869.3	No	80431615	1 x Ku
SE-64\2	OnGrade	Existing City of S	0.8m Lintel Only		2	3.517		0	0.3	333849.9	6249767.1	No	80431620	1 x Ku
SE-64\1	OnGrade	Existing City of S	0.8m Lintel Only		2	3.423		0	0.3	333836.9	6249773.9	No	80431617	1 x Ku
SE-A\2	OnGrade	Existing City of S	0.8m Lintel Only		2	3.392		0	0.3	333835.9	6249783	No	80431622	1 x Ku
SE-A\1	Node					3.347		0		333824.3	6249781.7		80431621	
SE-A\3	OnGrade	Existing City of S	0.8m Lintel Only		4	3.37		0	0.3	333835	6249790.7	No	80431623	1 x Ku
SE-C\1	OnGrade	Interallotment Pits	Interallotment Pit 600x600		0.5	2.912		0	0.3	333779	6249798.3	No	80431624	1 x Ku
SE-T\4	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		4.5	2.864		0	0.3	333778.3	6249793.9	No	80431631	1 x Ku
SE-T\3	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		2	2.725		0	0.3	333763.5	6249796.1	No	80431630	1 x Ku
SE-T\2	OnGrade	Junction Pits	Junction Pit 900x900		0.7	2.657		0	0.3	333756.2	6249797.2	No	80431629	1 x Ku
SE-T\1	Node					2.647		0		333750.7	6249795.1		80431628	
SE-T\7	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		4.5	3.281		0	0.3	333822.8	6249787.1	No	80431634	1 x Ku
SE-T\6	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1	3.142		0	0.3	333808	6249789.3	No	80431633	1 x Ku
SE-T\5	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1	3.004		0	0.3	333793.2	6249791.6	No	80431632	1 x Ku
SE-U\3	OnGrade	Junction Pits	Junction Pit 900x900		0.5	2.734		0	0.3	333763.8	6249796.7	No	80431637	1 x Ku
SE-U\2	OnGrade	Gross Pollutant T	GPT		1.5	2.738		0	0.3	333762.1	6249799	No	80431636	1 x Ku
SE-U\1	OnGrade	Storm Filter	Storm Filter		0.7	2.704		0	0.3	333758.5	6249799.6	No	80431635	1 x Ku
SE-X\4	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		4.5	3.538		0	0.3	333816.3	6249840.8	No	80431641	1 x Ku
SE-X\3	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1	3.576		0	0.3	333801.8	6249843	No	80431640	1 x Ku
SE-X\2	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1	3.584		0	0.3	333787	6249845.3	No	80431639	1 x Ku
SE-X\1	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1	3.545		0	0.3	333772.4	6249847.5	No	80431638	1 x Ku
NN-A\4	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1.5	3.503		0	0.3	333756.8	6249849.9	No	80431575	1 x Ku
NN-A\3	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1.5	3.194		0	0.3	333750.2	6249862	No	80431574	1 x Ku
SW-180\3	OnGrade	Existing City of S	0.50m x 0.50m Grate		2	2.362		0	0.3	333748.2	6249956.9	No	80431646	1 x Ku
SW-180\2	OnGrade	Existing City of S	0.90m x 0.50m Grate		1	2.863		0	0.3	333740.7	6249952.7	No	80431645	1 x Ku
SW-180\1	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1.5	2.37		0	0.3	333696.9	6249936.5	No	80431644	1 x Ku
SW-A\2	OnGrade	Junction Pits	Junction Pit 900x900		2.1	2.453		0	0.3	333692.3	6249934.8	No	80431648	1 x Ku
SW-A\1	OnGrade	Junction Pits	Junction Pit 900x900		1.5	2.477		0	0.3	333699	6249912.8	No	80431647	1 x Ku
SW-A\4	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		4.5	2.355		0	0.3	333691	6249955.9	No	80431650	1 x Ku
SW-A\3	OnGrade	Junction Pits	Junction Pit 900x900		2.2	2.289		0	0.3	333686.8	6249952.4	No	80431649	1 x Ku
SW-C\2	OnGrade	Surface Inlet Pits	Surface Inlet Pit 900x900		0.5	2.512		0	0.3	333710.5	6249916.3	No	80431652	1 x Ku
SW-C\1	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1	2.395		0	0.3	333703.8	6249914.3	No	80431651	1 x Ku

SW-D\4	Sag	Existing City of S	0.90m x 0.50m Grat	1	4.5	2.808	0.12	0	0.5	333647.3	6249795.7	No	80431655	1 x Ku
SW-D\3	OnGrade	Junction Pits	Junction Pit 900x900		1.5	2.992		0	0.3	333655.6	6249799.7	No	117544492	1 x Ku
SW-D\2	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1	2.857		0	0.3	333667.6	6249796.6	No	80431654	1 x Ku
SW-D\1	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1	2.726		0	0.3	333683.5	6249795.1	No	80431653	1 x Ku
SW-V\1A	OnGrade	Junction Pits	Junction Pit 900x900		3	2.655		0	0.3	333688.2	6249794.3	No	80431683	1 x Ku
SW-V\1	OnGrade	Gross Pollutant T	GPT		1.5	2.657		0	0.3	333688.1	6249793.4	No	80431678	1 x Ku
SW-GPT1-W1	OnGrade	Junction Pits	Junction Pit 900x900		0	3.5		0	0.3	333688	6249792.6	No	122468861	1 x Ku
SW-GPT1-W2	OnGrade	Junction Pits	Junction Pit 900x900		0	3.5		0	0.3	333688	6249791.9	No	122468862	1 x Ku
SW-GPT1-O	OnGrade	Junction Pits	Junction Pit 900x900		0.5	3.5		0	0.3	333687.9	6249791.2	No	122468863	1 x Ku
SW-153\2	OnGrade	Junction Pits	Junction Pit 1200x1200		0.1	2.706		0	0.3	333687.9	6249790.6	No	80431643	1 x Ku
SW-153\1	Node					2.788		0		333679.5	6249785.2		80431642	
SW-E\1	Sag	Standard Pits	2.4m lintel sag	1.313	4.5	2.805	0.12	0	0.5	333646.6	6249801.8	No	80431656	1 x Ku
SW-F\1	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		4.5	2.448		0	0.3	333718.4	6249866.6	No	80431657	1 x Ku
SW-K\1	OnGrade	Junction Pits	Junction Pit 600x600		1.9	2.532		0	0.3	333713.6	6249865.1	No	80431659	1 x Ku
SW-H\1	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		4.5	2.477		0	0.3	333726.7	6249839.9	No	80431658	1 x Ku
SW-K\2	OnGrade	Junction Pits	Junction Pit 600x600		2	2.561		0	0.3	333721.8	6249838.4	No	80431660	1 x Ku
SW-K\4	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		4.5	2.507		0	0.3	333734.9	6249813	No	80431662	1 x Ku
SW-K\3	OnGrade	Junction Pits	Junction Pit 600x600		2.2	2.584		0	0.3	333728.2	6249817.7	No	80431661	1 x Ku
SW-M\1	Sag	Surface Inlet Pits	Surface Inlet Pit 900	4.962	4.5	2.079	0.15	0	0.5	333677.6	6249958.1	No	80431663	1 x Ku
SW-P\2	OnGrade	Junction Pits	Junction Pit 600x600		2	2.55		0	0.3	333702.5	6249891.4	No	80431665	1 x Ku
SW-P\1	OnGrade	Storm Filter	Storm Filter		0.7	2.544		0	0.3	333701.3	6249895.7	No	80431664	1 x Ku
SW-R\2	Sag	Surface Inlet Pits	Surface Inlet Pit 900	33.252	4.5	2.695	0.362	0	0.5	333634.4	6249816.7	No	80431671	1 x Ku
SW-R\1	Node					2.695		0		333637	6249817.7		117544482	
SW-S\2	OnGrade	Surface Inlet Pits	Surface Inlet Pit 1200x1200		2	3.5		0	0.3	333627.1	6249869.5	No	80431675	1 x Ku
SW-S\1	Node					2.763		0		333624.7	6249869.4		143712882	
SW-V\4	Sag	Surface Inlet Pits	Surface Inlet Pit 600	34.086	4.5	2.541	0.1	0	0.5	333721.6	6249789.4	No	80431681	1 x Ku
SW-V\3	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1	2.582		0	0.3	333709.2	6249791.2	No	80431680	1 x Ku
SW-V\2	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1	2.653		0	0.3	333696.3	6249793.1	No	80431679	1 x Ku
SW-Y\2	OnGrade	Interallotment Pits	Interallotment Pit 900x900		1.5	3.033		0	0.3	333664.4	6249806	No	80431688	1 x Ku
SW-SF1-USC	OnGrade	Junction Pits	Junction Pit 600x600		0.1	3.5		0	0.3	333663.3	6249805.9	No	129436197	1 x Ku
SW-SF1-W1	OnGrade	Junction Pits	Junction Pit 600x600		0	3.5		0	0.3	333662.7	6249806	No	129436196	1 x Ku
SW-SF1-W2	OnGrade	Junction Pits	Junction Pit 600x600		0	3.5		0	0.3	333662.1	6249806.1	No	129436195	1 x Ku
SW-Y\1	OnGrade	Storm Filter	Storm Filter		1.5	3.054		0	0.3	333661.5	6249806.2	No	80431687	1 x Ku
SW-X\2	OnGrade	Junction Pits	Junction Pit 600x600		2.7	3.033		0	0.3	333661.3	6249804.8	No	80431685	1 x Ku
SW-X\1	Node					3.033		0		333654.6	6249805.8		80431684	
SW-Z\3	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		4.5	3.447		0	0.3	333665.8	6249878.5	No	80431691	1 x Ku
SW-Z\2	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1	3.448		0	0.3	333646	6249870	No	80431690	1 x Ku
SW-Z\1	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		2.5	3.5		0	0.3	333627.2	6249863.5	No	80431689	1 x Ku
SW_RG_01	Node					3.5		0		333625.8	6249866.8		143712915	
SW-Z\5	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		4.5	3.55		0	0.3	333683.6	6249883.7	No	80431693	1 x Ku
SW-Z\4	OnGrade	Surface Inlet Pits	Surface Inlet Pit 600x600		1	3.55		0	0.3	333698.3	6249889.2	No	80431692	1 x Ku
O 5\2	Node					2.118		0		333677.5	6249974.3		80431694	
O NE-19\2	Node					2.69		0		333830.4	6249916.1		80431695	
O SA-15\2	Node					3.375		0		333571.1	6249947.2		80431696	
O SA-45\2	Node					3.516		0		333626.6	6249829.7		80431697	
O SA-62\2	Node					3.613		0		333610.9	6249865.8		80431698	
O SA-B\2	Node					3.267		0		333624.3	6249819.2		80431699	
O SA-B\5	Node					3.178		0		333619.5	6249803.8		80431700	
O SE-T\2	Node					2.657		0		333761.2	6249802.2		80431702	
O SE-T\6	Node					3.142		0		333813	6249794.3		80431703	
O SW-153\2	Node					2.706		0		333690.7	6249786.2		80431704	
O SW-180\1	Node					2.37		0		333701.9	6249941.5		80431705	
O SW-C\1	Node					2.395		0		333708.8	6249919.3		80431706	
O SW-F\1	Node					2.448		0		333723.4	6249871.6		80431707	
O SW-Q\2	Node					2.611		0		333688.8	6249890.1		80431708	
O SW-V\4	Node					2.541		0		333726.6	6249794.4		80431710	
O SW-X\2	Node					3.017		0		333658.1	6249802.9		80431711	
175\01	Node					3.192		0		333802.2	6249773.3		81433600	
70\03	Node					3		0		333819	6249943.4		81433624	
NE-C\1	OnGrade	Existing Pits	Existing Gully Pit		4.5	3.179		0	0.3	333821.5	6249863.8	No	93303565	1 x Ku