



Darlington Road Terraces Mixed Use Building Additions and Alterations to the Darlington Road Terraces and Public Domain Improvements

University of Sydney

Stormwater Management Report

1 November 2016

Document history and status

Revision	Date	Description	By	Review	Approved
0	15/06/16	CIS For Final Review	J Khor	B Wolelo	B Soo
0.1	16/06/16	CIS For Final Review	J Khor	B Wolelo	B Soo
0.2	15/07/16	CIS For Final Review	J Khor	B Wolelo	B Soo
1	01/11/16	Draft DA	J Khor	B Wolelo	B Soo

Distribution of copies

Revision	Issue approved	Date issued	Issued to	Comments
0	15/06/16	15/06/16	CIS	CIS For Final Review
0.1	16/06/16	16/06/16	CIS	CIS For Final Review
0.2	15/07/16	15/07/16	CIS	CIS For Final Review
1	01/11/16	01/11/16	CIS	Draft DA

Darlington Terrace Development

Project no: IA0105800
Document title:
Document No.: Document No.
Revision: 01
Date: 28 Jan 2016
Client name: CIS
Client no:
Project manager: Project Manager
Author: James Khor
File name: J:\IE\Projects\04_Eastern\IA105800\21 Deliverables\Reports\Stormwater Management Report Rev00.docx

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1. Civil Engineering Introduction

1.1 Background

The newly proposed development is located at the rear of the existing Darlington Road Terraces Student Accommodation as shown in Figure 1-1. The existing Darlington Road terraces have been determined as having Local Heritage significance and are currently occupied by University students and various business units. As part of the Campus Improvement Program, the University of Sydney is proposing building additions and alterations to the existing Darlington Road Terraces and H66 Darlington House for mixed uses integrating affordable student accommodation and other educational establishments.

The development will also include adaptive reuse of the existing Terraces and construction of four (4) separate mixed use buildings within the rear yards for use by residents and the wider University community.

This report is to enable a Development Application to be submitted and Schematic Designs for Tender by a Design and Construct contractor.

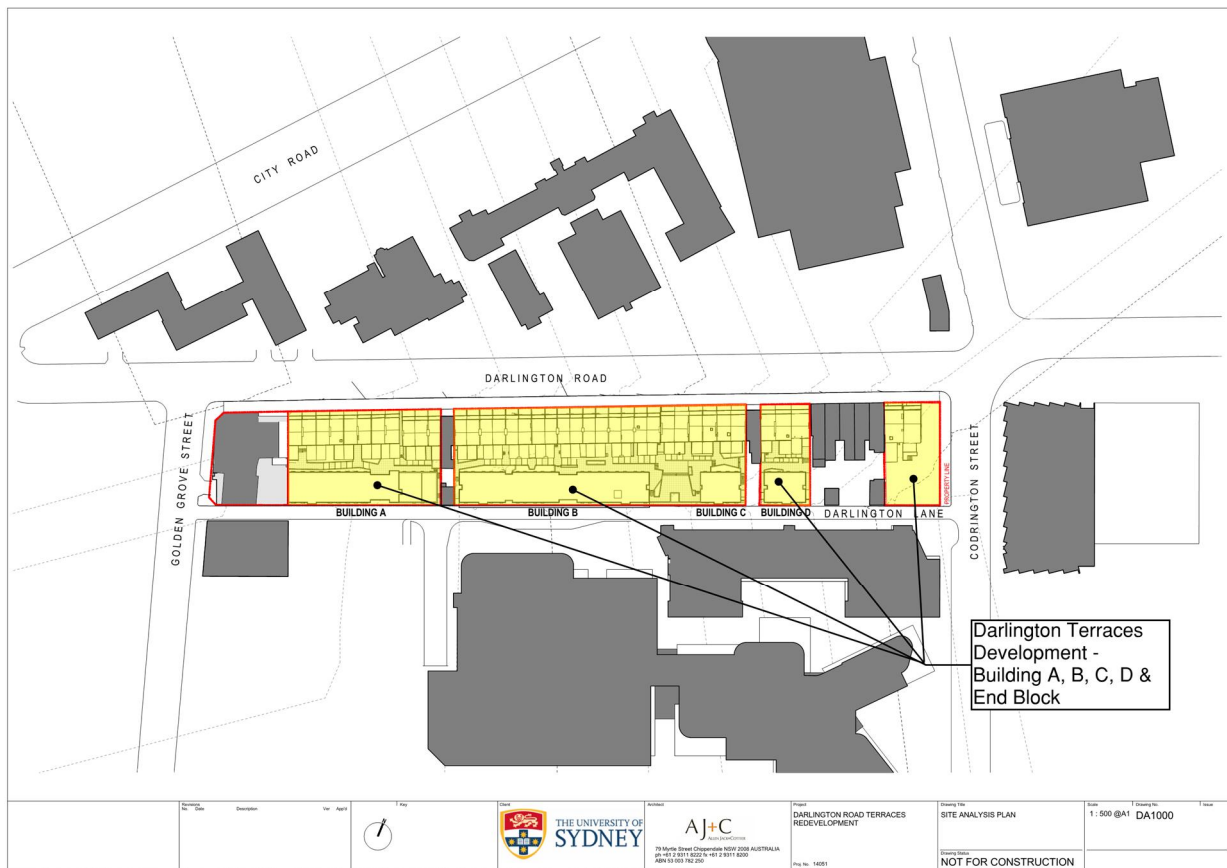


Figure 1-1 : General Arrange Plan

1.2 Objective

The objective of this report is to identify the issues and requirements for drainage and storm water management associated with Darlington Terrace development. The report includes the reviews of current flood studies and City of Sydney Interim Floodplain Management Policy. It also addresses concerns relating to the management of the storm water generated within the catchment area and that the site currently discharges to the kerbside along Darlington Road and Darlington Lane.

1.3 Methodology

The following methodology will be adopted when addressing concerns relating to drainage:-

- Review the current available flood studies and Council Floodplain management policy;
- Develop flood management plan;
- Investigate Operational Impact of Flooding; and
- Develop stormwater management plan using WSUD elements.

1.4 Legislative Context

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

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

2. Flood Management Plan

2.1 Existing environment

The Darlington Terraces Development site is within the Blackwattle Creek catchment as shown in yellow colour highlight in Figure 2-1 below.

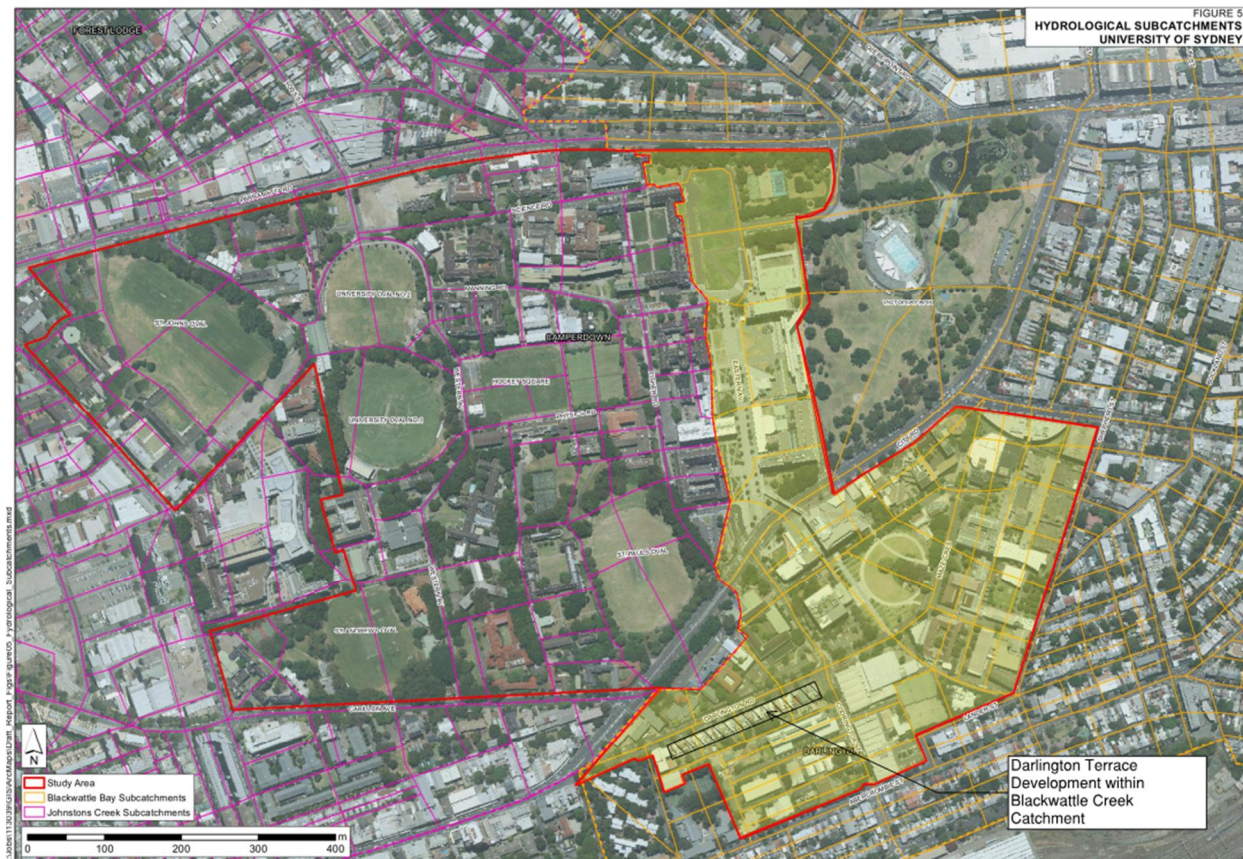


Figure 2-1: Extract from WMA Flood Risk Management Report showing Blackwattle Creek Catchment

2.2 Current Flood Management Document for the proposal

The main flood study reports relevant to this development was furnished by the Campus Infrastructure Services, University of Sydney. The report is titled: “University of Sydney Flood Risk Management Report Stage 1 – Campus Flood Study Review by WMA Water dated Dec 2013.

A number of legislation and policy documents are relevant to this project. Table 1 set out the documents..

Table 1: Reference documentation

No.	Title	Client	Received from Council/CIS Team	Copy on file
1	Interim Floodplain Management Policy May 2014, ref 2014/216277	City of Sydney	No	Yes ^{#1}
2	Design Standards – Hydraulic Services	The University of Sydney	Yes	Yes ^{#1}
3	Sustainability Framework	The University of Sydney	Yes	Yes ^{#1}
4	Drainage Design Standard A4	City of Sydney	No	Yes ^{#1}
5	University of Sydney Flood Risk Management Report Stage 1 – Campus Flood Study Review by WMA Water dated Dec 2013	The University of Sydney	Yes	Yes
6	The University of Sydney _ Utility Master Plan – Investigation onto the capacities of existing Utilities for planned CIP future developments, Nov 2013	Warren Smith & Partners Ltd	Yes	Yes
7	City of Sydney Development Control Plan 2012 – Stormwater Management Map	City of Sydney	No	Yes ^{#1}

Notes:

^{#1}Downloaded documents from web page

2.3 Context of Flooding in the Blackwattle Creek Catchment

The Darlington Terrace Development is located within the Blackwattle Creek catchment as shown the Figure 2-1 above. The WMA flood study dated Dec 2013 reported that for this catchment a number of flood prone areas were identified which include the low point on Codrington St in front of the Services Building and the generally low area bounded by Darlington Walk, Shepherd St and Maze Cres in the University's Darlington campus. The minor and major drainage systems are of limited capacity.

In order to alleviate the limited capacity of existing drainage system, Sydney water has imposed Onsite Detention Tanks and Permissible Site Discharge rate to new development before being allow o connect to existing Council stormwater pit.

A copy of Sydney Water requirements for OSD and PSD have been attached in Appendix A.

Figure 2-2 indicates that the Darlington Terrace development is located outside the flood hazard area but Figure 2-3 indicates that this development is affected by overland flow path. Figure 2-3 shows the overland flow path will rise above the existing road surface by 260mm high along Darlington Lane near building 94 and 140mm high along Darlington Road near the corner of Codrington Street.

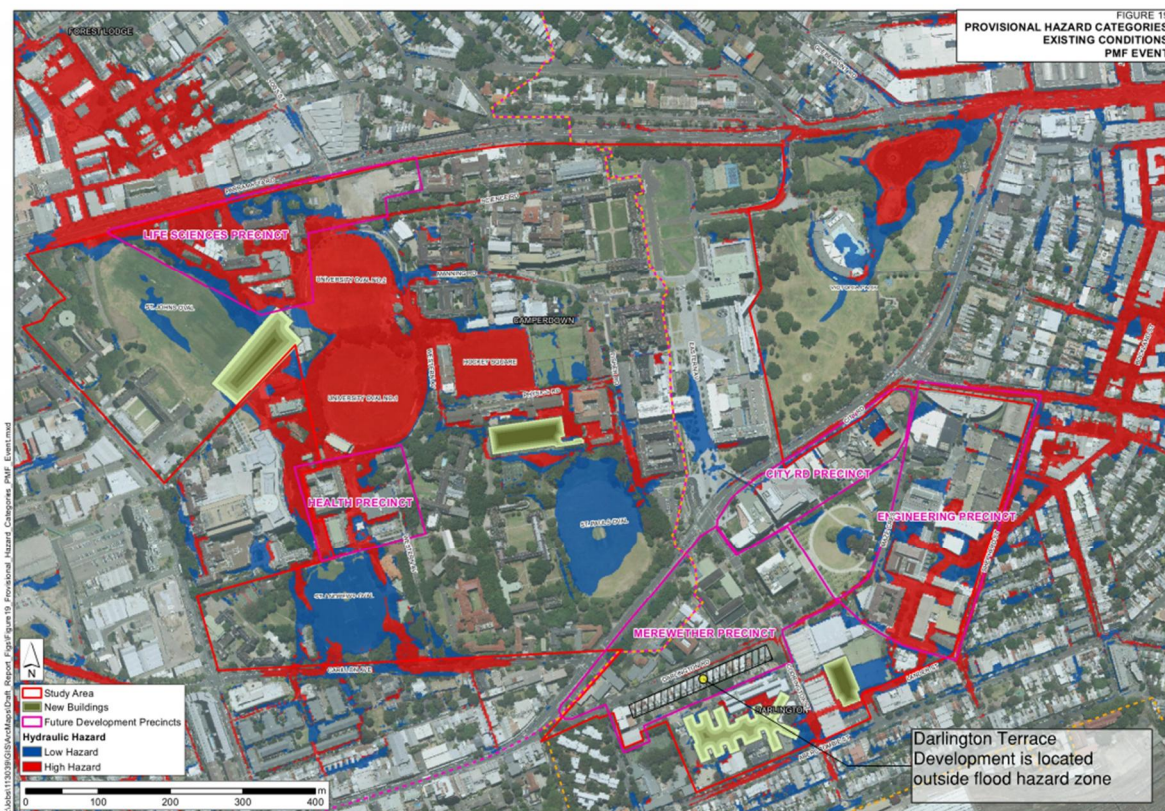


Figure 2-2: PMF Flood Hazard Map has been extracted from WMA Flood Risk Management Report



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2.4 City of Sydney Interim Floodplain Planning Policy

The City of Sydney Council interim Floodplain Management Policy provides direction with respect to how floodplains are managed. The Policy provides controls to facilitate a consistent, technically sound and best practice approach for the management of flood risk within the City's LGA.

In general, the application to include the followings information:-

- Development applications affected by this Policy shall be accompanied by a survey plan showing:
 - i. the position of the existing building/s or proposed building/s;
 - ii. the existing ground levels and features to Australian Height Datum around the perimeter of the site and contours of the site; and
 - iii. the existing or proposed floor levels to Australian Height Datum.
- Earthworks and filling of land is minimal during the early works phase so this will not be furnished;
- This flood assessment report.

2.5 Classification of Facilities

Figure 2-4 indicates that Darlington Terrace development is zoned as SP2 – Educational Establishment.

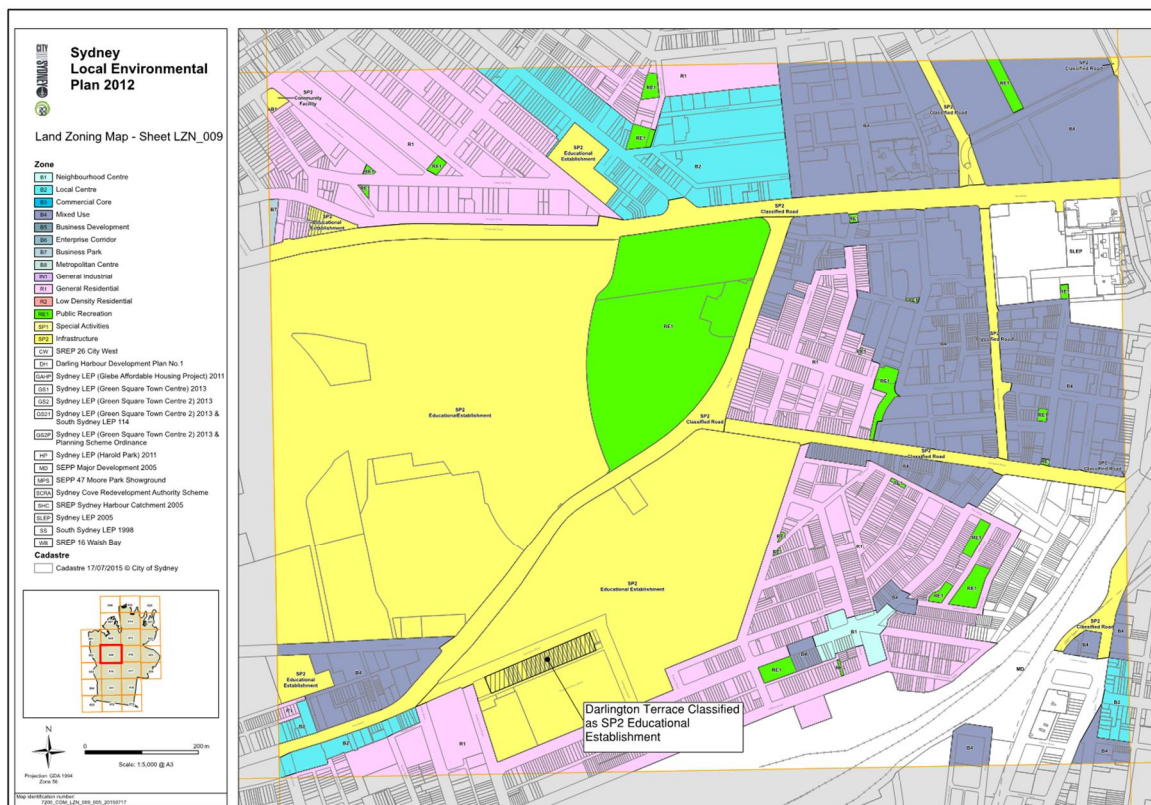


Figure 2-4 : Council Local Environmental Plan 2012

2.6 Adopted Design Flood Planning Level

With reference to Figure 2-2 and Figure 2-3 above, the Darlington Terrace development is located outside the flooding zone but is subjected to surface water rises from overland flow path at certain locations. Based on Table 2 below, the type of flooding that Darlington Terrace development will be categorised as outside floodplain.

The adopted design flood planning levels are as shown in Table 3.

5 Flood Planning Levels

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

Development		Type of flooding	Flood Planning Level
Residential	Habitable rooms	Mainstream flooding	1% AEP flood level + 0.5 m
		Local drainage flooding (Refer to Note 2)	1% AEP flood level + 0.5 m or Two times the depth of flow with a minimum of 0.3 m above the surrounding surface if the depth of flow in the 1% AEP flood is less than 0.25 m
		Outside floodplain	0.3 m above surrounding ground
	Non-habitable rooms such as a laundry or garage (excluding below-ground car parks)	Mainstream or local drainage flooding	1% AEP flood level

Table 2: Flood planning levels extract from section 5, City of Sydney Interim Floodplain Management Plan

Facilities	Zoning ^{*1}	Description	Classification	Flood Type	Adopted Design Flood Planning Level
Darlington Terrace Student Accommodation	SP2 – Educational Establishment	Residential	Residential-Habitable Rooms for Block “A”, “B&C”, “D” and End block	Outside Floodplain	0.3m above the surrounding surface (kerb invert)

Table 3: Adopted Flood Planning Level

Note ^{*1}:- Darlington Terraces Development is currently under zone no.SP2 which is for educational establishment under Sydney Local Environmental Plan, 2012.

3. Stormwater Management Plan

3.1 Existing Drainage Systems

The existing site is predominantly impervious. It consists of roadways, terrace roof rainwater down pipes and paved areas. The stormwater management map in Figure 3-1 below shows that the Darlington Terrace development drains to kerb and gutter at Darlington Road and Darlington Lane.

There is no council pit and pipe drainage system on both streets. This has been confirmed by utilities services survey carried out by the University.

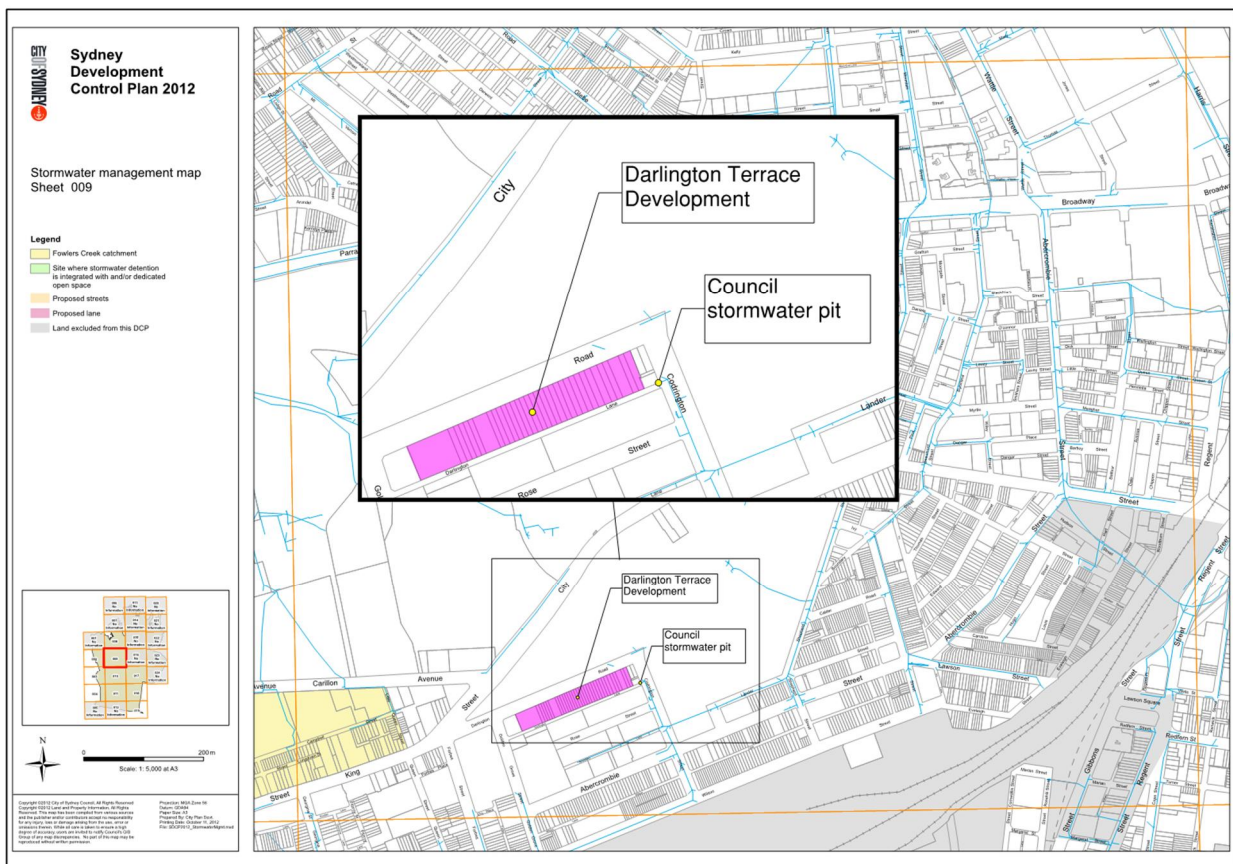


Figure 3-1: Stormwater Management Map Sheet 9 from Council Development Control Plan 2012

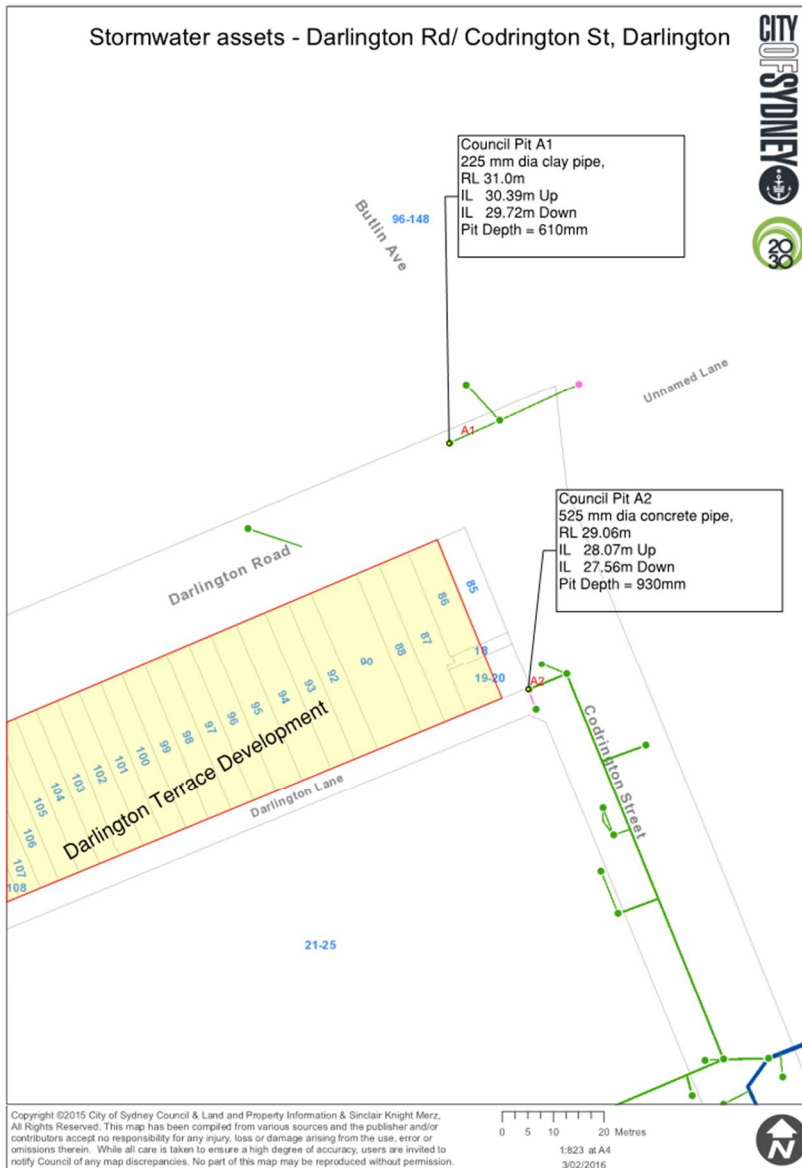


Figure 3-2: Information from Council about the nearest Council Pits

Referring to the Figure 3-2:

- a) Pit “A1” with depth of 610mm is too shallow to receive a new pipe connection; and
- b) Pit “A2” with depth of 930mm has adequate depth to receive a new pipe connection.

As pit “A1” is too shallow to receive new pipe connection and to maintain existing heritage roof arrangement, a small 6.6m strip roof plus front entry area (22%) on the existing Darlington Terrace will be drained to the kerb and gutter along Darlington Road as per the existing condition. The remainder of the Darlington Terrace development (78%) will be drained into Council pit “A2” at corner of Codrington St & Darlington Lane.

3.2 Proposed Drainage

3.2.1 Drainage Catchment

The proposed Darlington Terrace development drainage catchment is as shown in Figure 3-3 and in Jacobs Drawings.

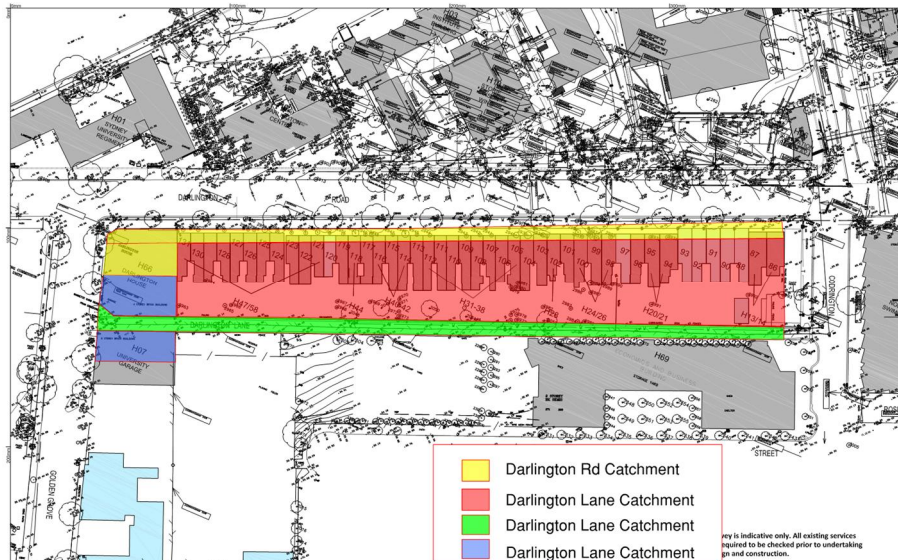


Figure 3-3 Catchment Plan

3.2.2 Design recurrence intervals

The design recurrence interval was sourced from bureau of Meteorology website for the location near Darlington Terrace as shown in Figure 3-4.

Intensity-Frequency-Duration Table

Location: 33.900S 151.200E NEAR.. USyd Darlington Terrace Issued: 14/6/2016

Rainfall intensity in mm/h for various durations and Average Recurrence Interval

Average Recurrence Interval							
Duration	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
5Mins	103	131	165	185	211	244	270
6Mins	96,0	123	155	173	197	229	253
10Mins	78,7	101	128	144	165	192	212
20Mins	57,8	74,5	96,1	109	125	147	163
30Mins	47,1	60,8	79,2	89,9	104	123	137
1Hr	31,8	41,3	54,2	61,8	71,8	84,9	95,0
2Hrs	20,6	26,7	35,1	40,1	46,6	55,2	61,8
3Hrs	15,7	20,4	26,8	30,6	35,6	42,1	47,1
6Hrs	9,90	12,8	16,8	19,1	22,2	26,2	29,2
12Hrs	6,30	8,15	10,6	12,1	14,0	16,5	18,4
24Hrs	4,08	5,28	6,89	7,83	9,07	10,7	11,9
48Hrs	2,62	3,40	4,43	5,04	5,84	6,88	7,68
72Hrs	1,96	2,53	3,29	3,75	4,33	5,10	5,69

(Raw data: 41.65, 8.13, 2.53, 86.56, 16.48, 5.11, skew=0.00, F2=4.29, F50=15.86)

© Australian Government, Bureau of Meteorology

Figure 3-4 : Intensity – Frequency Duration Table

3.2.3 Minimum ARI Table

The design recurrence interval for the proposed pit and pipe drainage system for the Darlington Terrace Development is as shown in Table 4.

Item	Minimum ARI	Reference
Pit and Pipe	5% AEP with overland flow path for 1% AEP	CIS Hydraulic Services Standard & City of Sydney A4 Drainage Design Guide

Table 4 : Minimum ARI Design

3.2.4 Proposed Drainage

The proposed drainage system involves capturing runoff generated from 78% of the development site with water re-use tanks and onsite detention tanks for each block to mitigate the flooding effect downstream of the catchment and then connect to a new City of Sydney pit and pipe drainage system along Darlington Lane.

A summary of the drainage proposal is shown in Table 5.

Table 5 : Summary of Drainage proposal

	Asset Owner	Type	Relevant Drawing
Existing Darlington Terrace along Darling Road(22% with 6.6m wide strip comprises of roof area plus front entry area)	The City of Sydney Council	Due to shallow depth of the Council pit "A1" (see section 3.1) and site constraint – only able to drain this area by kerb and gutter along Darlington Road as per existing condition.	Jacobs Stormwater Management Plan IA105800 - DG-0101 to 0103
Darlington Terrace(Old and New) and Court yard (78%)	University of Sydney	Rainwater Reuse Tanks OSD Tanks Pits & Pipes WSUD – Enviropods	Jacobs Stormwater Management Plan IA105800 - DG - 0101 to 0103
Darlington Lane Drainage	The City Of Sydney Council	375/450/525 mm dia concrete pipe and pits along Darlington Lane to Council pit "A2".	Jacobs Stormwater Management Plan IA105800 - DG - 0101 to 0103

3.2.5 Site Constraints

This development has site constraints that will affect full site coverage for overland flow path and installation of OSD tanks for Block “D”. The constraints are as follows:

- maintain existing building entrance level – Existing Terrace 131, 106/105 and 102;
- close proximity to existing heritage building which has shallow foundation;
- shallow depth of existing pit for drainage connection (not more than 900mm deep); and
- existing underground services along Darlington Lane.

The following will be affected by the above constraints:

- limited full coverage of the development with an overland flow path as constraint (a) will create pocket of low laying areas to match existing entrances. This will be addressed in section 3.2.7 below; and
- Installation of OSD tank with excavation depth of more than 1.2m for Block “D” will be constrained by item (b), (c) and (d) as not to undermine the existing heritage building footing. This will be addressed in section 3.2.8.3 below.

3.2.6 Overland Flow Path (OLFP)

In general the OLFP will travel over the surface of the proposed court-yard structure towards Darlington Lane. Jacobs Drawings set C-12 to14 show the internal overland flow path. Entrances facing the court-yard will have grated drain along the entrance and the ground surface from the entrance to fall towards the centre of the court-yard to keep water ingress from wind driven rain and OLFP away from the entrance. The cross-falls are as shown in Figure 3-5 and Figure 3-6 below for Block A & B respectively. The sections of the court-yard that requires cross-falls are at Block A between terrace 125 to 121 & terrace 129 and for Block B between terraces 111 to 104. (Refer to Drawing DG - 0201-0203).

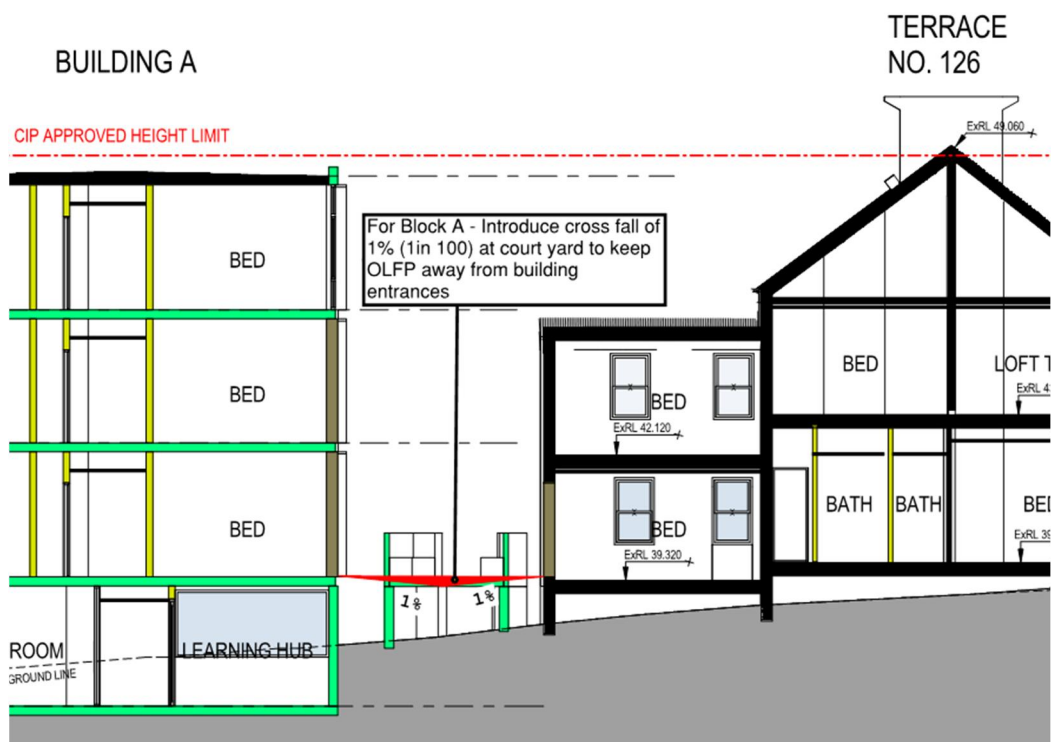


Figure 3-5: Courtyard slope at 1% AEP for Block A

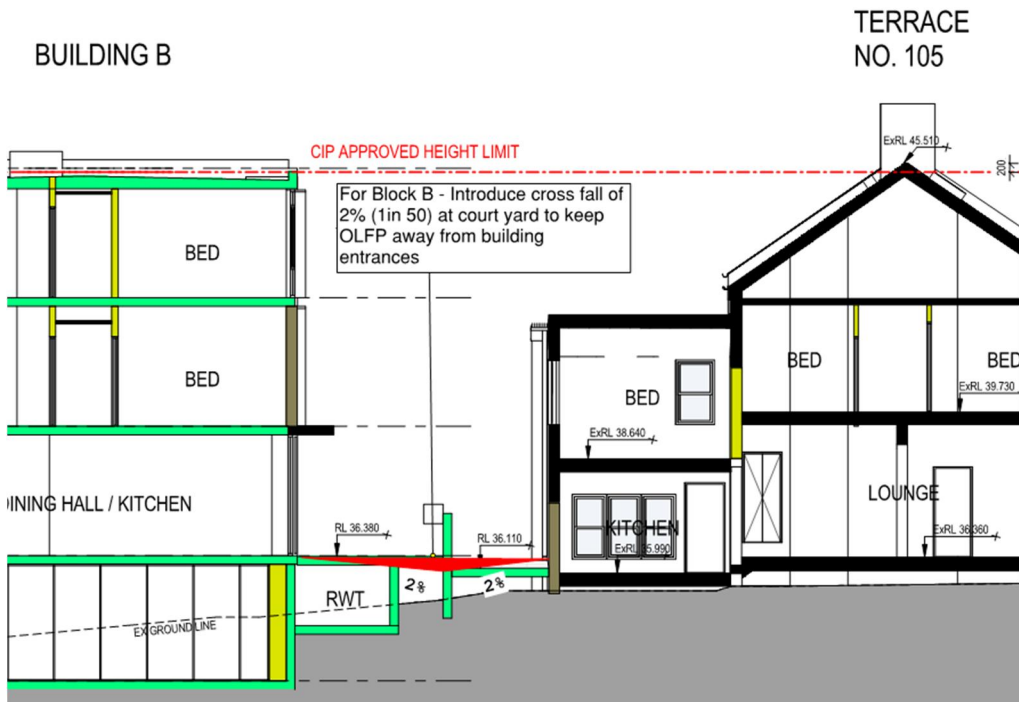


Figure 3-6 : Courtyard slope at 2% AEP for Block B

3.2.7 Pockets of Low Area within the Court Yard without OLFP

Due to site constraints as mentioned in section 3.2.5, five small pockets of low area have been identified that provision of overland flow path is not possible. The OLFP management of these areas are as shown in Table 6.

Block	Terraces	FFL (m)	Area (sq m)	1%AEP Flow (litres/s)	OLFP Management
A	131	38.55	7.6	0.5	Proposed to connect to the pump sump in the plant room.
B & C	115	36.38	10	0.7	The 150mm dia. drainage pipe connected to OSD has been sized to cater for the 1%AEP rainfall.
B & C	106/105	35.95	4.5	0.3	The 150mm dia. drainage pipe connected to OSD has been sized to cater for the 1%AEP rainfall.
B & C	102	35.54	10	0.7	Proposed to discharge via a 150mm dia drainage pipe under the tree decking area.
B & C	101	34.90	7.6	0.5	Proposed to discharge via a 150mm dia drainage pipe under the tree decking area.

Table 6: Low Areas without overland flow path

The proposal to manage these pocket of low areas are:-

- Pipe the 1% AEP rainfall event to OSD tank where the site ground level permits;

- Pipe the 1% AEP rainfall event under the courtyard structure to the tree deck area to drain to the kerbside if not able to connect to the OSD tanks; and
- Pipe the 1% AEP rainfall event to a pump sump in the plant room.

3.2.8 Drainage Modelling

3.2.8.1 General

The hydrological and hydraulic modelling of the proposed stormwater network was conducted using Drains and 12D civil engineering and surveying software package. The modelling was carried out to determine the flow depth during the 1% AEP storm event along the kerb invert on Darlington Lane and peak flow into the existing drainage pit. Jacobs Drawings DG 0402 to 0403 show the calculated 1% AEP water levels.

3.2.8.2 Preliminary On-Site Detention/Retention

It is noted that City of Sydney Council would seek to reduce peak flow generated from site for new developments. This will usually be achieved through installation of an on-site detention (OSD) structure and maintaining a prescribed peak site discharge (PSD). Sydney Water has sized the OSD and determined PSD limit for the site. The figures are shown in Table 7.

LOT	Total Area (m ²)	Preliminary Existing Impervious Area (m ²)	Preliminary Proposed Impervious Area (m ²)	OSD Volume (m ³)	PSD (l/s)
BLOCK A	1,546	1,546	1,546	24	56
BLOCK B AND BLOCK C	3,061	3,061	3,061	48	112
BLOCK D	534	534	534	9	19
END BLOCK - BUILDING 86 AND 87	619	619	619	10	22
TOTAL	5,760	5,760	5,760	91	209

Table 7 : Preliminary OSD and PSD Requirements

3.2.8.3 Current On-Site Detention/Retention

Since the initial discussion with Sydney Water, it is now proposed to consolidate OSD tanks from Block “D” and End Block 86/87 into Block “A” and Block “B&C”.

The reasons for this change are:

- End block 87& 86 is now mainly refurbishment of the existing building plus a small (40m²) single story shed for fire services pump and rest of landscape area to be maintained. This will result in a smaller OSD tank requirement but this volume has also been added to the consolidated tanks volume; and
- Constructability of a 9 m³ OSD on Block “D” is restricted by the shallow footing of the existing heritage building with excavation into existing ground of more than 1.2m deep.

A summary of the current OSD tanks arrangement is shown in Table 8 below.

LOT	Total Area (m ²)	Revised Existing Impervious Area (m ²)	Current Proposed Impervious Area (m ²)	OSD Volume (m ³)	PSD/ Peak Flow (l/s)
BLOCK A	1,350	1,229	1,207	33	56
BLOCK B AND BLOCK C	2,690	2,287	2,553	58	112
BLOCK D	610	525	590	Nil	Peak Flow=33 l/s
END BLOCK - BUILDING 86 AND 87	600	252	247	Nil	Peak Flow=22 l/s
TOTAL	5,250	4,293	4,597	91	223 l/s

Table 8 : Current OSD and PSD Due to Site Constraints and Revised Development

The function of the consolidated OSD tanks to limit the peak discharge downstream will not be severely affected. The reasons are:-

- The total development area contributing to Darlington Lane has been refined and reduced;
- The development for the end block 87& 86 is now mainly refurbishment of the existing building plus a small (40m²) single story shed for fire services pump and rest of landscape area to be maintained. This will result in a smaller OSD tank requirement but we have still added this volume into the consolidated tanks volume;
- The catchment area of Block D between terrace 96 to 94 is small (9.3%) compared the whole development;
- The PSD for the consolidated tanks increased the development flow marginally by 6.7% from 209 l/s to 223 l/s as shown in Table 8 above; and
- The consolidated OSD tanks reduced the overall peak flow at pit "A2" by 25% from 532 m³/s to 401 m³/s as shown in Table 9 below.

LOT	Overland Flow (m ³ /s) A	Pipe Flow (m ³ /s) B	Total Flow (m ³ /s) A + B
Existing Condition (without OSD Tanks)	287	245	532
Proposed Darlington Terrace Development (with Consolidated OSD tanks as shown in Table 8)	0	401	401
Proposed Darlington Terrace Development (with OSD tanks at each blocks as shown in Table 7)	0	381	381

Table 9: Comparison of Peak Flow at Pit “A2”

A copy of preliminary Sydney Water discussion is attached in Appendix A.

3.2.9 Water Sensitive Urban Design (WSUD)

The stormwater quality assessment of Darlington Terrace development was conducted using MUSIC software package to calculate the post-development pollutant load standards as prescribed in section 3.7.3, City of Sydney Council’s “DCP 2012.

The proposed WSUD devices will include the followings:-

- rain water re-use tanks,
- OSD to reduce the peak flow downstream,
- landscape garden; and
- catch pit insert that captures and retains litter, debris and other pollutants before entering the storm drain system.

A summary of the WSUD is as shown Table 10 below.

Description	% Retention of Annual Average Load (kg/ha/yr) Gross Pollutant	% Retention of Annual Average Load (kg/ha/yr) Total Suspended Solids	% Retention of Annual Average Load (kg/ha/yr) Total Phosphorus	% Retention of Annual Average Load (kg/ha/yr) Total Nitrogen
City of Sydney DCP 2012 Target Requirements	90%	85%	65%	45%
Proposed Darlington Terrace Development with WSUD devices	100%	83%	60%	49%
Compliance with City of Sydney DCP 2012 Target for WSUD	Comply	2% short to compliance	5% short to compliance	Comply

Table 10 : WSUD Results

It is noted that the result final result of the post-development load only marginally fall short of the City of Sydney target requirements for total suspended solids and phosphorous.

In general the University has implemented comprehensive campus wide water quality program and initiative for WSUD. In particular the WSUD implementation of Darlington Road catchment which consist of 5.4 hectare catchment including Darlington Road, Mereweather, Biochemistry and Microbiology and the Institute Buildings. Stormwater flows were diverted from an existing drain along Darlington Road between Maze Green and City Road into a wetland and bioretention system as the central landscape feature of Maze Green. Flows are treated in the permanent water system and collected for reuse as irrigation of Maze green and non-potable uses including cooling tower usage and toilet flushing in the campus.

Refer to Jacobs drawings set RP-0001 to 0005 for details.

3.2.10 Erosion and Sediment Control Plan (ESCP)

The design is to limit erosion during the construction phase. The elements recommended in the NSW bluebook guideline have been used to control the area of disturbance.

The proposed ESCP will include the followings geotextile filter socks, barrier fencing and sediment fencing.

Refer to Jacobs drawings IA105800 – DG - 0301-0303.

4. Conclusion

The proposed design has achieved the followings:-

- Habitable floor level are 300mm above the existing gutter invert level;
- OSD tank have reduced the peak flow; and
- WSUD features to meet the guideline where possible.

The proposed pit and pipe drainage system, WSUD features and ESCP will have the followings:-

- Pit and Pipe to limit the surface water level in the kerb and gutter;
- OSD tanks to reduce the peak flow from this development;
- Overland flow path within the courtyard to provide positive drainage where possible;
- WSUD features including rain water re-use tanks, OSD tanks, landscape garden and catchpit inserts;
- ESCP features including geotextile filter socks, barrier fencing and sediment fencing

Appendix A. Sydney Water OSD & PSD Requirements

Khor, James

From: JEYADEVAN, JEYA <JEYA.JEYADEVAN@sydneywater.com.au>
Sent: Friday, 5 February 2016 9:21 AM
To: Khor, James
Subject: RE: University of Sydney - Darlington Terraces Project

James,

You just need to add all four values.



Best regards,
Jeya Jeyadevan | **Waterway Planner**

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T 8849 6118 | M 0409 318 827
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From: Khor, James [mailto:James.Khor@jacobs.com]
Sent: Friday, 5 February 2016 9:12 AM
To: Stormwater <Stormwater@sydneywater.com.au>; JEYADEVAN, JEYA <JEYA.JEYADEVAN@sydneywater.com.au>
Subject: RE: University of Sydney - Darlington Terraces Project

Hi Jeya Jeyadevan,

Thanks for the information on the individual lots.
What would be the OSD volume and PSD if we combined all the four Lots (A,B,C,D) into a single OSD?

Regards
James Khor

From: Stormwater [mailto:Stormwater@sydneywater.com.au]
Sent: Friday, 5 February 2016 9:08 AM
To: Khor, James
Subject: RE: University of Sydney - Darlington Terraces Project

James,

The On Site Detention requirements at University of Sydney (Darlington Terraces Project) as follows

Lot A (Site Area 1546 square meter)

- On Site Detention 24 cubic meter
- Permissible Site Discharge 56 L/s

Lot B (Site Area 3061 square meter)

- On Site Detention 48 cubic meter
- Permissible Site Discharge 112 L/s

Lot C (Site Area 534 square meter)

- On Site Detention 9 cubic meter
- Permissible Site Discharge 19 L/s

Lot D (Site Area 619 square meter)

- On Site Detention 10 cubic meter
- Permissible Site Discharge 22 L/s

The 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 following details are to be included in your submission for On Site Detention approval:

- Location of the On Site Detention in relation to the development
- Location of the On Site Detention in relation to overall stormwater network of the property
- Plan and Elevation of the On Site Detention tank with all dimensions
- Orifice plate calculation



Best regards,
Jeya Jeyadevan | Waterway Planner

Liveable City Solutions | Sydney Water
Level 10, 1 Smith St Parramatta NSW 2150
PO Box 399 Parramatta NSW 2124
T 8849 6118 | M 0409 318 827
E jeya.jeyadevan@sydneywater.com.au
sydneywater.com.au

From: Khor, James [<mailto:James.Khor@jacobs.com>]
Sent: Friday, 29 January 2016 5:43 PM
To: Stormwater <Stormwater@sydneywater.com.au>
Subject: University of Sydney - Darlington Terraces Project

Hi,

Please find the attached plan and tables showing the proposed development at the corner of Darlington Road and Codrington St. The development aim to construct a new three to four storey building at the rear of the existing terraces to provide approximately 160 beds and associated facilities.

Please refer to the attached pdf for the development address, total site area , existing and proposed impervious area.

We write to request for PSD & SSR for two options:-

- a) Option 1 is PSD & SSR for each individual location A, B , C & D into four individual OSDs; and
- b) Option 2 is PSD & SSR for combined development (A,B,C,& D) into a single OSD

Regards

James Khor, B.Eng (Civil), MIEAust
Jacobs

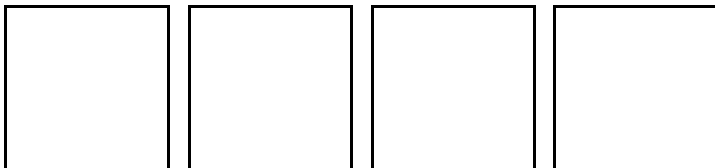
Senior Civil Engineer | ANZ Infrastructure & Environment
+ 61 (0) 2 9032 1237
+ 61 (0) 4 3061 8883 mobile

+ 61 (0) 2 9928 2500 fax
James.Khor@jacobs.com

Level 4, 100 Christie St, St Leonards, NSW, 2065
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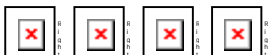
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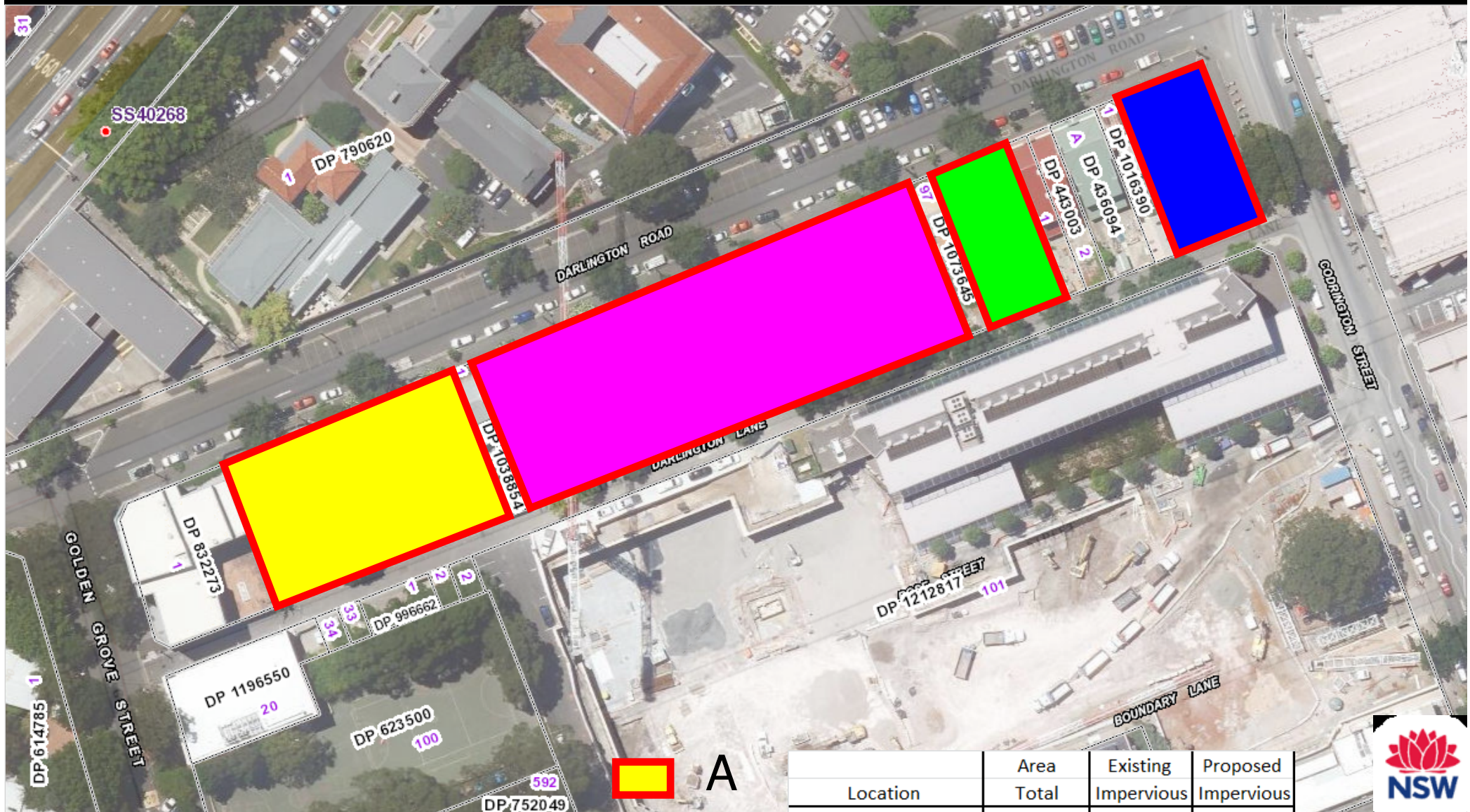
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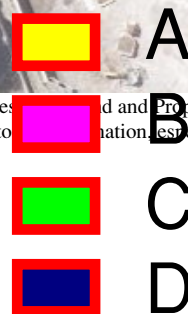


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USyd Darlington Terraces Project



Disclaimer: This report has been generated by various sources and is provided for information purposes only. LPI gives no warranty in relation to the accuracy, completeness, or reliability of the information, especially in relation to any use or reliance upon the information in this report.



Location	Area Total sq m	Existing Impervious sq m	Proposed Impervious sq m
A	1,546	1,546	1,546
B	3,061	3,061	3,061
C	534	534	534
D	619	619	619
Combined A, B, C & D	5,760	5,760	5,760



or represent that the
you may incur relating to

Appendix B. Drawings Set

Title	Drawing Number
Cover Sheet & Notes	DG-0001
Stormwater Management Plan - Sheet 1	DG-0101
Stormwater Management Plan – Sheet 2	DG-0102
Stormwater Management Plan – Sheet 3	DG-0103
Stormwater Management Details - Sheet 1	DG-0111
Stormwater Management Details – Sheet 2	DG-0112
Stormwater Management Details – Sheet 3	DG-0113
External Catchment Plan	DG-0401
Internal Overland Flow Path Plan Sheet 1	DG-0201
Internal Overland Flow Path Plan Sheet 2	DG-0202
Internal Overland Flow Path Plan Sheet 3	DG-0203
Erosion & Sediment Control Plan - Sheet 1	DG-0311
Erosion & Sediment Control Plan - Sheet 2	DG-0312
Erosion & Sediment Control Notes & Details - Sheet 1	DG-0301
Erosion & Sediment Control Notes & Details - Sheet 2	DG-0302
Erosion & Sediment Control Notes & Details - Sheet 3	DG-0303
100Year ARI Flood Extent - Sheet 1	DG-0402
100Year ARI Flood Extent - Sheet 2	DG-0403
Flood Planning Level Long Section along Gutter invert – Sheet 1	DG-0411
Flood Planning Level Long Section along Gutter invert – Sheet 2	DG-0412





















DATE: 2/11/2016 9:20:03 AM LOGIN NAME: HUANG, EDDIE
LOCATION: J:\IE\Projects\04_Easlema\IA1058001\Drawings\Civil\Drawings\IA1058001-ECC-DG-0001.dwg

PROPOSED DEVELOPMENT

No. 86-131 DARLINGTON ROAD, DARLINGTON

STORMWATER MANAGEMENT PLANS

LEGEND

	DENOTES ON-SITE DETENTION TANK
	DENOTES ON-SITE RETENTION TANK
	DENOTES DWELLING FOOTPRINT
	DENOTES 100mm DIA. STORMWATER/SURFACE WATER SYSTEM PIPE AT 1% MIN. GRADE U.N.O.
	DENOTES 100mm DIA. FULLY SEALED RAINWATER SYSTEM PIPE U.N.O.
	DENOTES RAINWATER PIPE AND DIA. WHEN PIPE EXCEEDS 100mm DIA.
	DENOTES STORMWATER/SURFACE WATER PIPE AND DIA. WHEN PIPE EXCEEDS 100mm DIA.
	DENOTES RISING MAIN AND PIPE DIA. U.N.O.
	DENOTES SUBSOIL DRAINAGE LINE AND DIA. WRAPPED IN GEOFABRIC U.N.O.
	DENOTES DOWNPIPE
	DENOTES INSPECTION OPENING WITH SCREW DOWN LID AT FINISHED SURFACE LEVEL
	DENOTES INSPECTION OPENING WITH SCREW DOWN LID AT FINISHED SURFACE LEVEL FOR SYSTEM FLUSHING PURPOSES
	STORMWATER PIT - SOLID COVER
	STORMWATER PIT - GRATED INLET
	DENOTES GRATED DRAIN
	NON RETURN VALVE
	PUMP
	STOP VALVE (ISOLATION VALVE)
	240v REQUIRED
	DENOTES LEVEL OF INLET /OUTLET OF STORMWATER PIPE. NOTE: UNLESS NOTED OTHERWISE, THE BASE OF THE PIT IS THE SAME AS THE PIPE INLET/OUTLET.

DIAL BEFORE YOU DIG



IMPORTANT: THE CONTRACTOR IS TO MAINTAIN A CURRENT SET OF "DIAL BEFORE YOU DIG" DRAWINGS ON SITE AT ALL TIMES.

SHEET INDEX

COVER SHEET & NOTES	SHEET 0001
STORMWATER MANAGEMENT PLAN SHEET 1	SHEET 0101
STORMWATER MANAGEMENT PLAN SHEET 2	SHEET 0102
STORMWATER MANAGEMENT PLAN SHEET 3	SHEET 0103
STORMWATER MANAGEMENT DETAILS SHEET 1	SHEET 0111
STORMWATER MANAGEMENT DETAILS SHEET 2	SHEET 0112
STORMWATER MANAGEMENT DETAILS SHEET 3	SHEET 0113
INTERNAL OVERLAND FLOW PATH PLAN SHEET 1	SHEET 0201
INTERNAL OVERLAND FLOW PATH PLAN SHEET 2	SHEET 0202
INTERNAL OVERLAND FLOW PATH PLAN SHEET 3	SHEET 0203
EROSION & SEDIMENT CONTROL PLAN SHEET 1	SHEET 0301
EROSION & SEDIMENT CONTROL PLAN SHEET 2	SHEET 0302
EROSION & SEDIMENT CONTROL PLAN SHEET 3	SHEET 0303
EROSION & SEDIMENT CONTROL NOTES & DETAILS SHEET 1	SHEET 0311
EROSION & SEDIMENT CONTROL NOTES & DETAILS SHEET 2	SHEET 0312
EXTERNAL CATCHMENT PLAN	SHEET 0401
100 YEAR ARI FLOOD EXTENT SHEET 1	SHEET 0402
100 YEAR ARI FLOOD EXTENT SHEET 2	SHEET 0403
FLOOD PLANNING LEVEL LONG SECTION ALONG GUTTER INVERT SHEET 1	SHEET 0411
FLOOD PLANNING LEVEL LONG SECTION ALONG GUTTER INVERT SHEET 2	SHEET 0412

GENERAL NOTES

- THESE PLANS SHALL BE READ IN CONJUNCTION WITH OTHER RELEVANT CONSULTANT'S PLANS, SPECIFICATIONS, CONDITIONS OF DEVELOPMENT CONSENT AND CONSTRUCTION CERTIFICATE REQUIREMENTS. WHERE DISCREPANCIES ARE FOUND JACOBS GROUP (AUSTRALIA) MUST BE CONTACTED IMMEDIATELY FOR VERIFICATION
- SUBSOIL DRAINAGE SHALL BE DESIGNED AND DETAILED BY THE STRUCTURAL ENGINEER. SUBSOIL DRAINAGE SHALL NOT BE CONNECTED INTO THE STORMWATER SYSTEM IDENTIFIED ON THESE PLANS UNLESS APPROVED BY JACOBS GROUP (AUSTRALIA)
- INSPECT THE SITE AND BE SATISFIED AS TO THE CONDITIONS UNDER WHICH THE WORK WILL BE CARRIED OUT PRIOR THE SUBMISSION OF A TENDER
- EXISTING SITE AND UTILITY SERVICES HAVE BEEN PLOTTED FROM SUPPLIED DATA, THERE IS NO GUARANTEE FOR THE ACCURACY OF THE DOCUMENTS AND IT IS THE CONTRACTORS RESPONSIBILITY TO ESTABLISH THE LOCATION OF ALL EXISTING SERVICES, SIZE AND SUITABILITY FOR USE PRIOR TO COMMENCEMENT OF ANY WORK
- CONDUCT "DIAL BEFORE YOU DIG" INVESTIGATION PRIOR TO COMMENCING WORK
- COORDINATE LOCATION OFF ALL PENETRATIONS, FITTINGS AND PIPE RUNS WITH ALL OTHER NEW AND EXISTING STRUCTURES AND SERVICES. ARRANGE WITH HEAD CONTRACTOR TO CUT-OUT AND MAKE GOOD ALL PENETRATIONS, ALL CORE HOLE LOCATIONS SHALL BE APPROVED BY THE PROJECT STRUCTURAL ENGINEER PRIOR TO COMMENCEMENT OF CORING
- CARRY OUT ALL NECESSARY TESTING OF SERVICES AS REQUIRED BE RESPECTIVE AUTHORITIES
- OBTAIN ALL NECESSARY CONTROLLING AUTHORITIES, CERTIFICATES SHOWING SATISFACTORY COMPLETION OF ALL SERVICES DOCUMENTED ON THESE DRAWINGS

STORMWATER CONSTRUCTION NOTES

- ALL WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH AS/NZS 3500 (CURRENT EDITION), THE REQUIREMENTS OF THE LOCAL COUNCIL'S POLICIES, CODES AND CIS HYDRAULIC SERVICES STANDARD VERSION : 002 ISSUED 18 SEPT 2015
- THE MINIMUM GRADIENT OF STORMWATER DRAINS SHALL BE 1%, UNLESS NOTED OTHERWISE
- COUNCIL'S TREE PRESERVATION ORDER IS TO BE STRICTLY ADHERED TO. NO TREES SHALL BE REMOVED UNTIL PERMIT IS OBTAINED
- PUBLIC UTILITY SERVICES ARE TO BE ADJUSTED AS NECESSARY AT THE CLIENT'S EXPENSE

STORMWATER CONSTRUCTION NOTES - CONT'D

- ALL PITS TO BE BENCHED AND STREAMLINED. PROVIDE STEP IRONS FOR ALL PITS OVER 1.2m DEEP
- MAKE SMOOTH JUNCTION WITH ALL EXISTING WORK
- VEHICULAR ACCESS AND ALL SERVICES TO BE MAINTAINED AT ALL TIMES TO ADJOINING PROPERTIES AFFECTED BY CONSTRUCTION
- SERVICES SHOWN ON THESE PLANS HAVE BEEN LOCATED FROM INFORMATION SUPPLIED BY THE RELEVANT AUTHORITIES AND FIELD INVESTIGATIONS AND ARE NOT GUARANTEED COMPLETE NOR CORRECT. IT IS THE CLIENT & CONTRACTOR'S RESPONSIBILITY TO LOCATE ALL SERVICES PRIOR TO CONSTRUCTION
- ANY VARIATION TO THE WORKS AS SHOWN ON THE APPROVED DRAWINGS ARE TO BE CONFIRMED BY JACOBS GROUP (AUSTRALIA) PRIOR TO THEIR COMMENCEMENT

STORMWATER SERVICE NOTES

- ALL WORK SHALL BE CARRIED OUT DURING DRY WEATHER
- COORDINATE LOCATION OF SERVICE PIPEWORK WITH ALL NEW AND EXISTING STRUCTURES AND SERVICES
- ALLOW TO LOCATE EXISTING SERVICE AND TREE ROOTS FROM EXISTING STORMWATER PIT AT CORNER OF DARLINGTON LANE AND CODRINGTON STREET TO OUTLET PIPES FROM DARLINGTON TERRACE DEVELOPMENT
- EXTEND NEW PUBLIC STORMWATER PIPE AND PITS ALONG DARLINGTON LANE TO NEW DARLINGTON TERRACE DEVELOPMENT OUTLET PIPES
- THE PUBLIC STORMWATER DRAIN SHALL BE A MINIMUM OF 375mm DIAMETER RCP CLASS "4" ALONG DARLINGTON LANE
- THE PRIVATE STORMWATER DRAINS SHALL NOT BE LESS THAN DN100 DIAMETER FOR DEVELOPMENT WITHIN DARLINGTON TERRACE
- ALLOW TO MARK OUT PROPOSED SERVICE TRENCH IN PREPARATION FOR CUTTING OF KERB, PAVEMENT AND EXCAVATION
- CUT PAVEMENT SURFACE LEAVING EDGES IN-TACT FOR REINSTATEMENT
- EXCAVATE TRENCH AND REMOVE ALL SPOIL FROM SITE
- STORMWATER PITS ON DARLINGTON LANE SHALL BE STANDARD GULLY PIT WITH 1.8m LONG EXTENDED KERB INLET AS SHOWN COUNCIL DRAINAGE 7.1.1 OR STANDARD JUNCTION PIT AS SHOWN IN COUNCIL DRAINAGE 7.1.7 WITH TYPE D GRATE
- BACKFILL DRAINAGE PIPE AS SHOWN IN COUNCIL DRAINAGE DRAWING 7.1.9
- REINSTATE PUBLIC PAVEMENT ALONG DARLINGTON LANE AS SHOWN IN COUNCIL ROADWAYS RESTORATION DRAWING 3.1.6 AND 3.1.7
- STORMWATER PIPEWORK EQUAL TO AND LESS THAN 300mm DIAMETER SHALL BE SEWER GRADE SN4 PVC WITH SOLVENT WELD JOINT. STORMWATER PIPEWORK GREATER THAN 300mm DIAMETER SHALL BE CLASS '4' RCP UNO.
- ALL PITS TO BE BENCHED AND STREAMLINED. PROVIDE STEPS IRONS FOR ALL PITS OVER 1.2m
- MAKE SMOOTH JUNCTION WITH ALL EXISTING WORKS
- VEHICULAR ACCESS AND ALL SERVICES TO BE MAINTAINED AT ALL TIME TO ADJOINING PROPERTIES AFFECTED BY CONSTRUCTION

AS-BUILT DOCUMENTATION

- CONTRACTOR TO PROVIDE "AS-BUILT" DOCUMENTATION UPON PRACTICAL COMPLETION OF THE PROJECT AND SHALL BE IN CAD FORMAT (AUTOCAD) AND "PDF" FORMAT (3X HARD COPY, 1X DIGITAL COPY AND PHOTOGRAPHIC RECORDS OF WORKS AS COMPLETED TO BE PROVIDED)
- AN INSTALLATION CERTIFICATE SHALL BE SUPPLIED TO UNIVERSITY OF SYDNEY MANAGEMENT WITH THE "AS RECORDED INFORMATION" PRIOR TO THE FINAL INSPECTION CERTIFICATE BEING ISSUED BY THE PLUMBING INSPECTORS, IN ACCORDANCE WITH AS/NZS 3500.3:2003
- SUPPLY OPERATION AND MAINTENANCE MANUALS TOGETHER WITH DRAINAGE "AS-BUILT" DRAWINGS. MANUALS SHALL INCLUDE DIGITAL "PDF" FORMAT (1X COPY) AND 3X HARD COPY

CITY OF SYDNEY COUNCIL REQUIREMENTS

SITE AREA (m ²)	5217.5
PRE DEVELOPED IMPERVIOUS AREA (%)	82
POST DEVELOPED IMPERVIOUS AREA (%)	85

STORMWATER MANAGEMENT

- REQUIREMENT FOR ON-SITE DETENTION (OSD)

- CONNECTION TO SYDNEY WATER OR OTHER PUBLIC UTILITY AUTHORITY DRAINAGE SYSTEM

FOR DEVELOPMENT SITES THAT CONNECT DIRECTLY TO THE SYDNEY WATER OR ANY OTHER PUBLIC UTILITY AUTHORITY DRAINAGE SYSTEM, APPROVAL IS SUBJECT TO THE OWNER COMPLYING WITH ON-SITE DETENTION CONDITIONS IMPOSED BY THE OWNER OF THE DRAINAGE SYSTEM.

- ALL OTHER DEVELOPMENT SITE AND SUBDIVISION SITES

FOR ALL SITES GENERALLY GREATER THAN 250m² OSD ISREQUIRED IN ACCORDANCE WITH THE CURRENT SYDNEY WATER GUIDELINES. THAT IS, THE 100 yr AVERAGE RECURRENCE INVERTAL (ARI) POST DEVELOPMENT SITE RUN-OFF MUST BE LIMITED TO THE PRE-DEVELOPMENT 5 yr ARI SITE RUN-OFF. ALL RUN-OFF MUST PASS THROUGH A SILT TRAP LOCATED ON SITE BEFORE ENTERING THE CITY'S DRAINAGE SYSTEM. FOR SITES <1000m² THE APPLICANT MAY MAKE A CASE TO THE CITY FOR EXEMPTION FROM THE OSD REQUIREMENTS BASED ON THE SITE SIZE, NATURE OF DEVELOPMENT AND PROXIMITY TO THE RECEIVED WATERS.

RESPONSE:

THE PSD AND SSR REQUIREMENTS ARE DETERMINED BY SYDNEY WATER LAND AND WATERWAYS TEAM

STORMWATER DESIGN SUMMARY

LOT	RAINWATER RE-USE (m ³)	ON-SITE DETENTION(m ³)	PSD (L/s)/ PEAK FLOW (PF)
BLOCK A	24	33	PSD = 56
BLOCK B & C	41	58	PSD = 112
BLOCK D	NIL	NIL	PF = 33
BUILDING 86 & 87	NIL	NIL	PF = 22

- STORMWATER DRAINAGE TO BE CONVEYED AND CONNECT TO EXISTING STORMWATER SYSTEM ON SITE. REFER TO SHEET C2 FOR DETAIL

DESIGN PREPARED IN ACCORDANCE WITH CITY OF SYDNEY'S DEVELOPMENT CONTROL PLAN 2012, GENERAL ENGINEERING PRACTICE AND AS/NZS3500 & AR&R

REV	DATE	DRAWN	REV'D	APP'D	REVISION
C	02.11.16	G.S.	B.S.	J.K.	ISSUED FOR DRAFT DA
B	15.06.16	R.J.C.B.	B.S.	J.K.	ISSUED FOR CIS FINAL REVIEW
A	15.06.16	R.J.C.B.	B.S.	J.K.	ISSUED FOR DRAFT DEVELOPMENT APPLICATION

DRAWING NUMBER	REFERENCE DRAWING TITLE

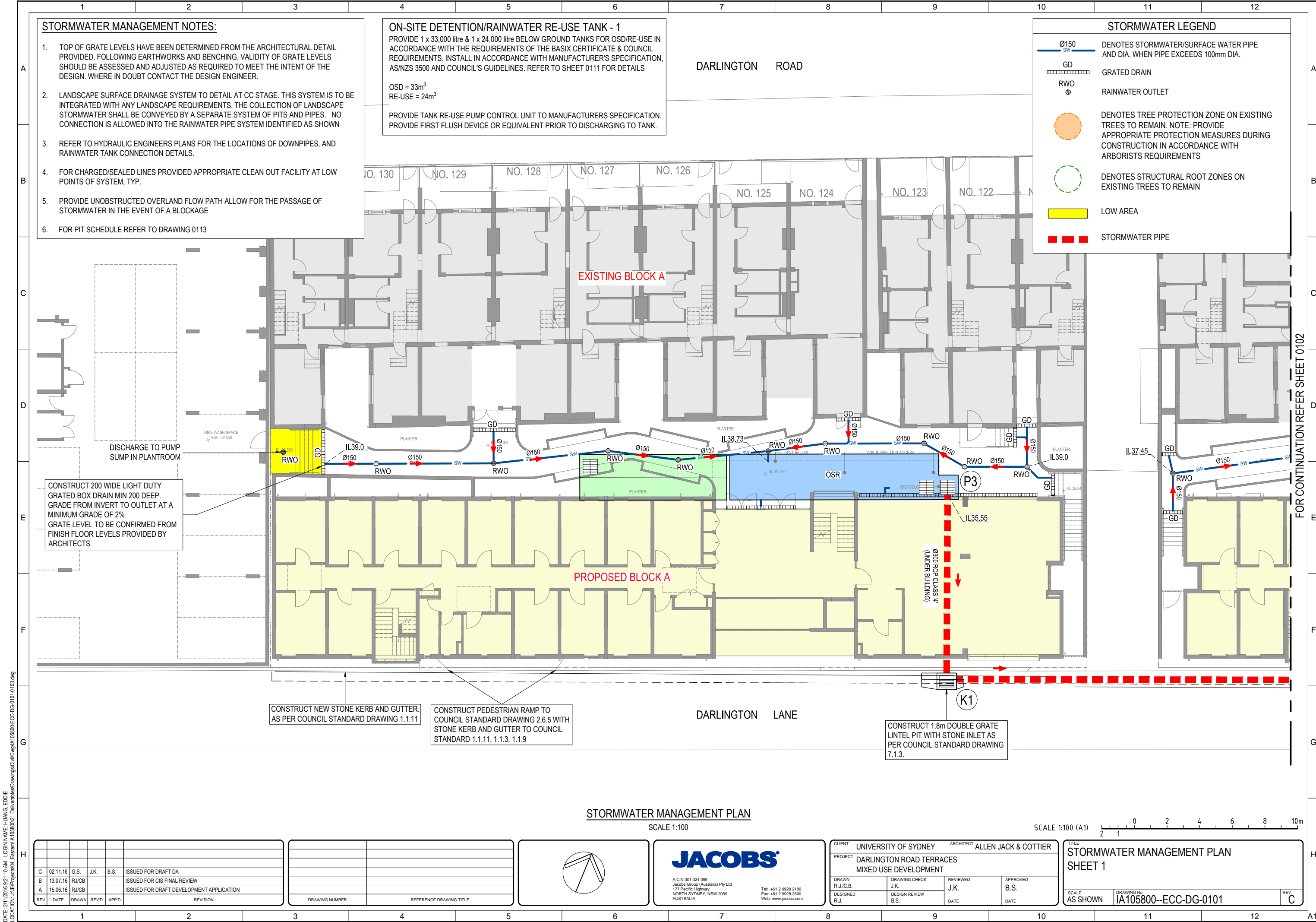
JACOBS

A.C.N 001 024 095
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177 Pacific Highway
NORTH SYDNEY, NSW 2059
AUSTRALIA

Tel: +61 2 9628 2100
Fax: +61 2 9628 2500
Web: www.jacobs.com

CLIENT	client	ARCHITECT	ALLEN JACK & COTTIER
PROJECT	DARLINGTON ROAD TERRACES MIXED USE DEVELOPMENT		
DRAWN	R.J.C.B.	DRAWING CHECK	J.K.
DESIGNED	R.J.	DESIGN REVIEW	B.S.
		DATE	rev date
		DATE	appdate

TITLE COVER SHEET & NOTES		
SCALE scale	DRAWING No IA105800-ECC-DG-0001	REV C



STORMWATER MANAGEMENT NOTES:

1. TOP OF GRATE LEVELS HAVE BEEN DETERMINED FROM THE ARCHITECTURAL DETAIL PROVIDED. FOLLOWING EARTHWORKS AND BENCHING, VALIDITY OF GRATE LEVELS SHOULD BE ASSESSED AND ADJUSTED AS REQUIRED TO MEET THE INTENT OF THE DESIGN. WHERE IN DOUBT CONTACT THE DESIGN ENGINEER.
2. LANDSCAPE SURFACE DRAINAGE SYSTEM TO DETAIL AT CC STAGE. THIS SYSTEM IS TO BE INTEGRATED WITH ANY LANDSCAPE REQUIREMENTS. THE COLLECTION OF LANDSCAPE STORMWATER SHALL BE CONVEYED BY A SEPARATE SYSTEM OF PITS AND PIPES. NO CONNECTION IS ALLOWED INTO THE RAINWATER PIPE SYSTEM IDENTIFIED AS SHOWN
3. REFER TO HYDRAULIC ENGINEERS PLANS FOR THE LOCATIONS OF DOWNPIPES, AND RAINWATER TANK CONNECTION DETAILS.
4. FOR CHARGED/SEALED LINES PROVIDED APPROPRIATE CLEAN OUT FACILITY AT LOW POINTS OF SYSTEM, TYP.
5. PROVIDE UNOBSTRUCTED OVERLAND FLOW PATH ALLOW FOR THE PASSAGE OF STORMWATER IN THE EVENT OF A BLOCKAGE
6. FOR PIT SCHEDULE REFER TO DRAWING 0113

ON-SITE DETENTION/RAINWATER RE-USE TANK - 1

PROVIDE 1 x 33,000 litre & 1 x 24,000 litre BELOW GROUND TANKS FOR OSD/RE-USE IN ACCORDANCE WITH THE REQUIREMENTS OF THE BASIX CERTIFICATE & COUNCIL REQUIREMENTS. INSTALL IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATION, AS/NZS 3500 AND COUNCIL'S GUIDELINES. REFER TO SHEET 0111 FOR DETAILS

OSD = 33m³
RE-USE = 24m³

PROVIDE TANK RE-USE PUMP CONTROL UNIT TO MANUFACTURERS SPECIFICATION. PROVIDE FIRST FLUSH DEVICE OR EQUIVALENT PRIOR TO DISCHARGING TO TANK.

STORMWATER LEGEND

- Ø150 SW DENOTES STORMWATER/SURFACE WATER PIPE AND DIA. WHEN PIPE EXCEEDS 100mm DIA.
- GD GRATED DRAIN
- RWO RAINWATER OUTLET
- DENOTES TREE PROTECTION ZONE ON EXISTING TREES TO REMAIN. NOTE: PROVIDE APPROPRIATE PROTECTION MEASURES DURING CONSTRUCTION IN ACCORDANCE WITH ARBORISTS REQUIREMENTS
- DENOTES STRUCTURAL ROOT ZONES ON EXISTING TREES TO REMAIN
- LOW AREA
- STORMWATER PIPE

EXISTING BLOCK A

PROPOSED BLOCK A

FOR CONTINUATION REFER SHEET 0102

STORMWATER MANAGEMENT PLAN

SCALE 1:100

SCALE 1:100 (A1)

REV	DATE	DRAWN	REV'D	APP'D	REVISION
C	02.11.16	G.S.	J.K.	B.S.	ISSUED FOR DRAFT DA
B	13.07.16	R.J/CB			ISSUED FOR CIS FINAL REVIEW
A	15.06.16	R.J/CB			ISSUED FOR DRAFT DEVELOPMENT APPLICATION

DRAWING NUMBER	REFERENCE DRAWING TITLE



JACOBS

A.C.N 001 024 095
Jacobs Group (Australia) Pty Ltd
177 Pacific Highway
NORTH SYDNEY, NSW 2059
AUSTRALIA

Tel: +61 2 9628 2100
Fax: +61 2 9628 2500
Web: www.jacobs.com

CLIENT	UNIVERSITY OF SYDNEY	ARCHITECT	ALLEN JACK & COTTIER
PROJECT	DARLINGTON ROAD TERRACES MIXED USE DEVELOPMENT		
DRAWN	R.J./C.B.	DRAWING CHECK	J.K.
DESIGNED	R.J.	DESIGN REVIEW	B.S.
REVIEWED	J.K.	APPROVED	B.S.
DATE		DATE	

TITLE		STORMWATER MANAGEMENT PLAN SHEET 1
SCALE	AS SHOWN	DRAWING No IA105800--ECC-DG-0101
REV	C	

NOTE:

1. FOR STORMWATER MANAGEMENT NOTES REFER TO DRAWING 0101

CONSTRUCT 200 WIDE LIGHT DUTY GRATED BOX DRAIN MIN 200 DEEP. GRADE FROM INVERT TO OUTLET AT A MINIMUM GRADE OF 2%
GRATE LEVEL TO BE CONFIRMED FROM FINISH FLOOR LEVELS PROVIDED BY ARCHITECTS

DARLINGTON ROAD

ON-SITE DETENTION/RAINWATER RE-USE TANK - 2

PROVIDE 1 x 58,000 litre & 1 x 41,000 litre BELOW GROUND TANKS FOR OSD/RE-USE IN ACCORDANCE WITH THE REQUIREMENTS OF THE BASIX CERTIFICATE & COUNCIL REQUIREMENTS. INSTALL IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATION, AS/NZS 3500 AND COUNCIL'S GUIDELINES. REFER TO SHEET 0112 FOR DETAILS

OSD = 58m³
RE-USE = 41m³

PROVIDE TANK RE-USE PUMP CONTROL UNIT TO MANUFACTURERS SPECIFICATION. PROVIDE FIRST FLUSH DEVICE OR EQUIVALENT PRIOR TO DISCHARGING TO TANK.

STORMWATER LEGEND

- Ø150 SW DENOTES STORMWATER/SURFACE WATER PIPE AND DIA. WHEN PIPE EXCEEDS 100mm DIA.
- GD GRATED DRAIN
- RWO RAINWATER OUTLET
- DENOTES TREE PROTECTION ZONE ON EXISTING TREES TO REMAIN. NOTE: PROVIDE APPROPRIATE PROTECTION MEASURES DURING CONSTRUCTION IN ACCORDANCE WITH ARBORISTS REQUIREMENTS
- DENOTES STRUCTURAL ROOT ZONES ON EXISTING TREES TO REMAIN
- LOW AREA
- STORMWATER PIPE

EXISTING BLOCK B

PROPOSED BLOCK B

STORMWATER MANAGEMENT PLAN

SCALE 1:100

SCALE 1:100 (A1)

REV	DATE	DRAWN	REV'D	APP'D	REVISION
C	02.11.16	G.S.	J.K.	B.S.	ISSUED FOR DRAFT DA
B	13.07.16	R.J/CB			ISSUED FOR CIS FINAL REVIEW
A	15.06.16	R.J/CB			ISSUED FOR DRAFT DEVELOPMENT APPLICATION

DRAWING NUMBER	REFERENCE DRAWING TITLE

**JACOBS**

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NORTH SYDNEY, NSW 2059
AUSTRALIA

Tel: +61 2 9628 2100
Fax: +61 2 9628 2500
Web: www.jacobs.com

CLIENT	UNIVERSITY OF SYDNEY	ARCHITECT	ALLEN JACK & COTTIER
PROJECT	DARLINGTON ROAD TERRACES MIXED USE DEVELOPMENT		
DRAWN	R.J./C.B.	DRAWING CHECK	J.K.
DESIGNED	R.J.	DESIGN REVIEW	B.S.
		REVIEWED	J.K.
		APPROVED	B.S.
		DATE	DATE

TITLE	STORMWATER MANAGEMENT PLAN SHEET 2
SCALE	AS SHOWN
DRAWING No	IA105800-ECC-DG-0102
REV	C

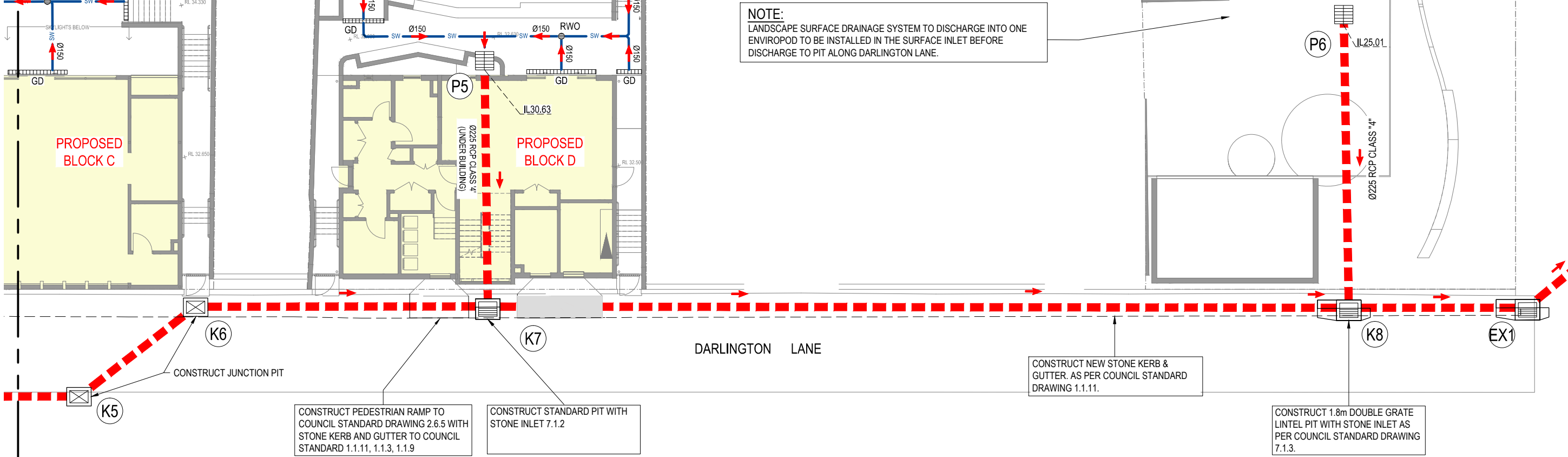
NOTE:
1. FOR STORMWATER MANAGEMENT NOTES REFER TO DRAWING 0101

DARLINGTON ROAD

STORMWATER LEGEND

- Ø150 SW DENOTES STORMWATER/SURFACE WATER PIPE AND DIA. WHEN PIPE EXCEEDS 100mm DIA.
- GD GRATED DRAIN
- RWO RAINWATER OUTLET
- DENOTES TREE PROTECTION ZONE ON EXISTING TREES TO REMAIN. NOTE: PROVIDE APPROPRIATE PROTECTION MEASURES DURING CONSTRUCTION IN ACCORDANCE WITH ARBORISTS REQUIREMENTS
- DENOTES STRUCTURAL ROOT ZONES ON EXISTING TREES TO REMAIN
- LOW AREA
- STORMWATER PIPE

FOR CONTINUATION REFER SHEET 0102



STORMWATER MANAGEMENT PLAN

SCALE 1:100

SCALE 1:100 (A1)

REV	DATE	DRAWN	REV'D	APP'D	REVISION
C	02.11.16	G.S.	J.K.	B.S.	ISSUED FOR DRAFT DA
B	13.07.16	R.J/CB			ISSUED FOR CIS FINAL REVIEW
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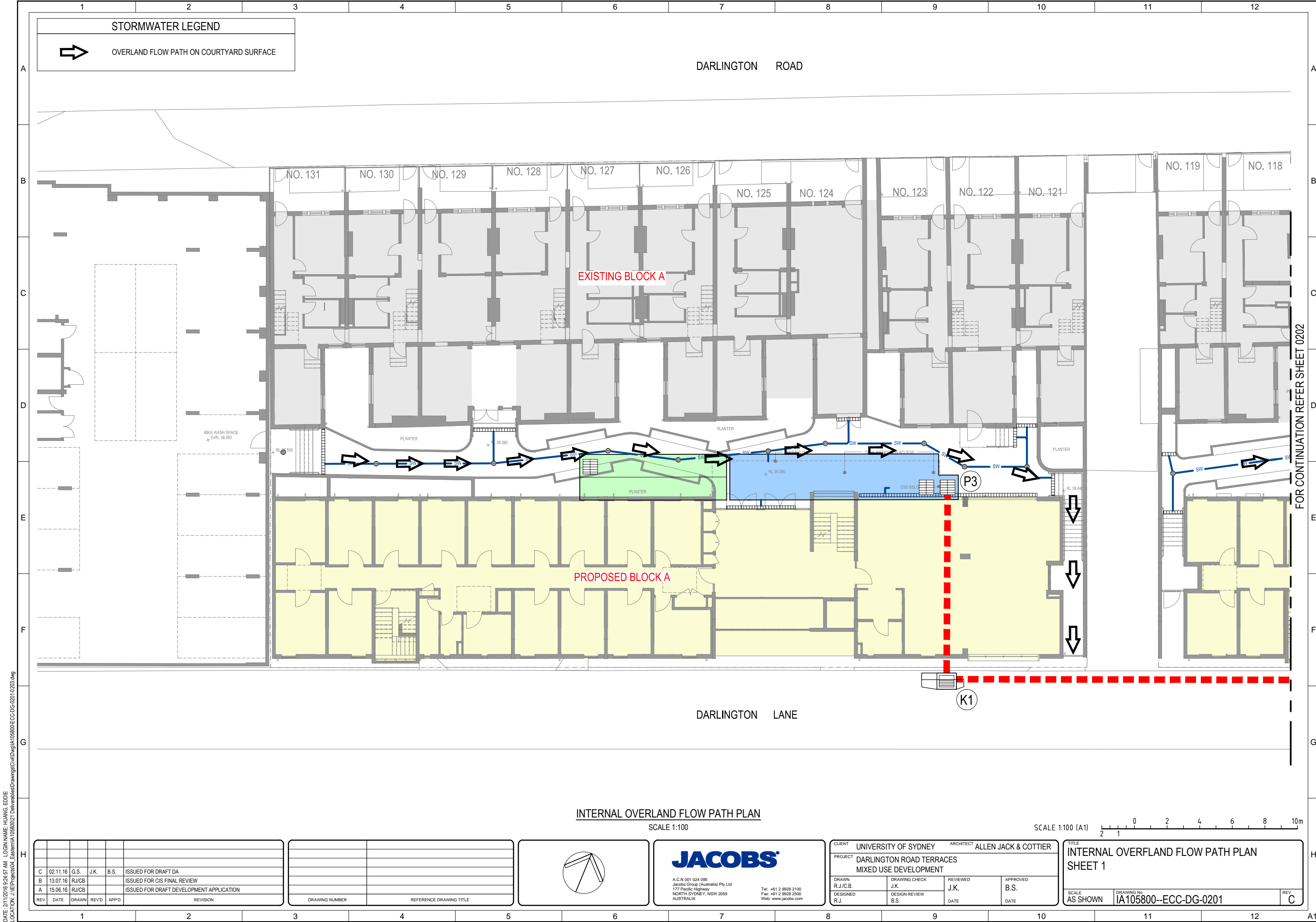


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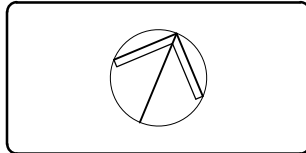
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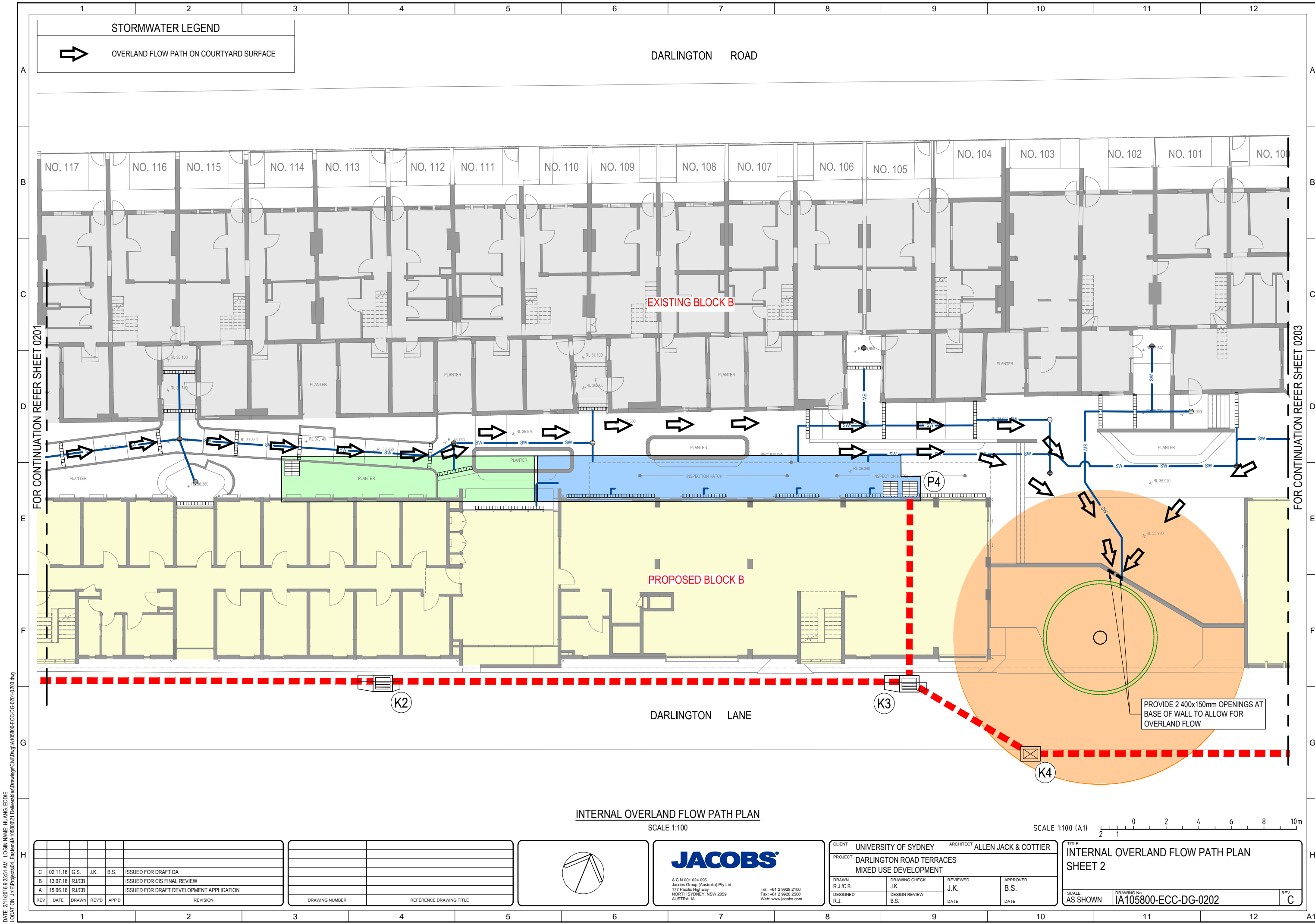
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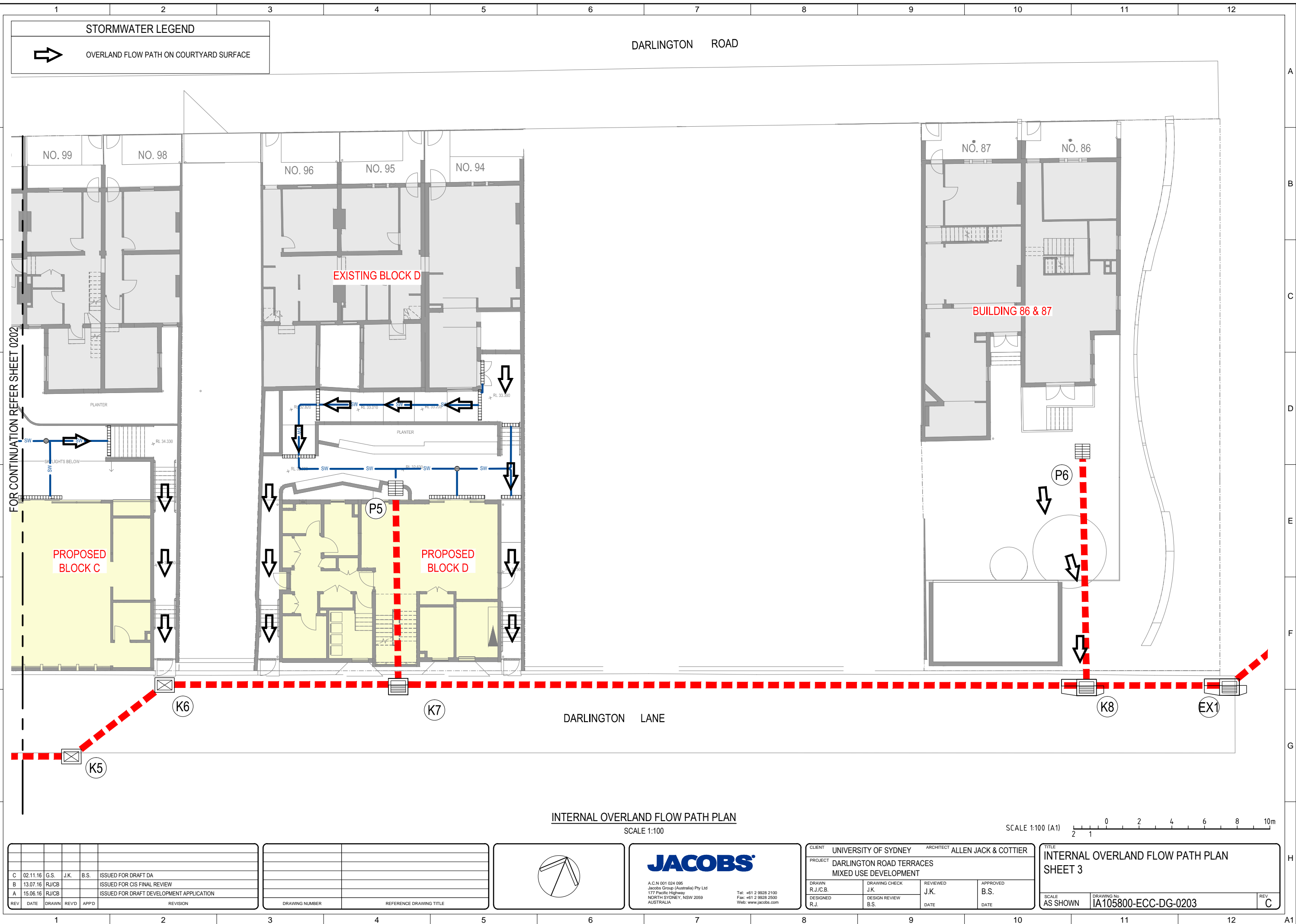
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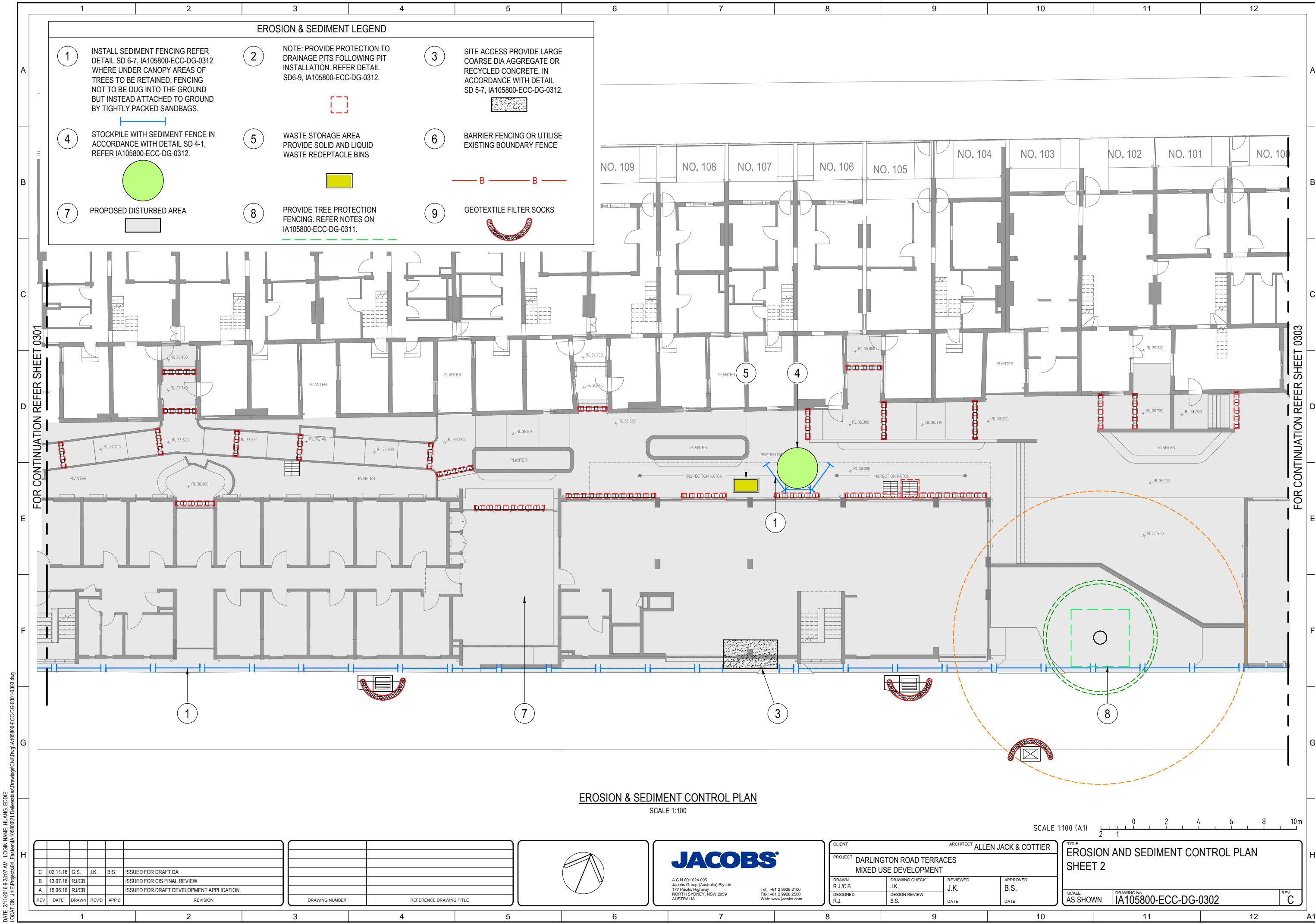
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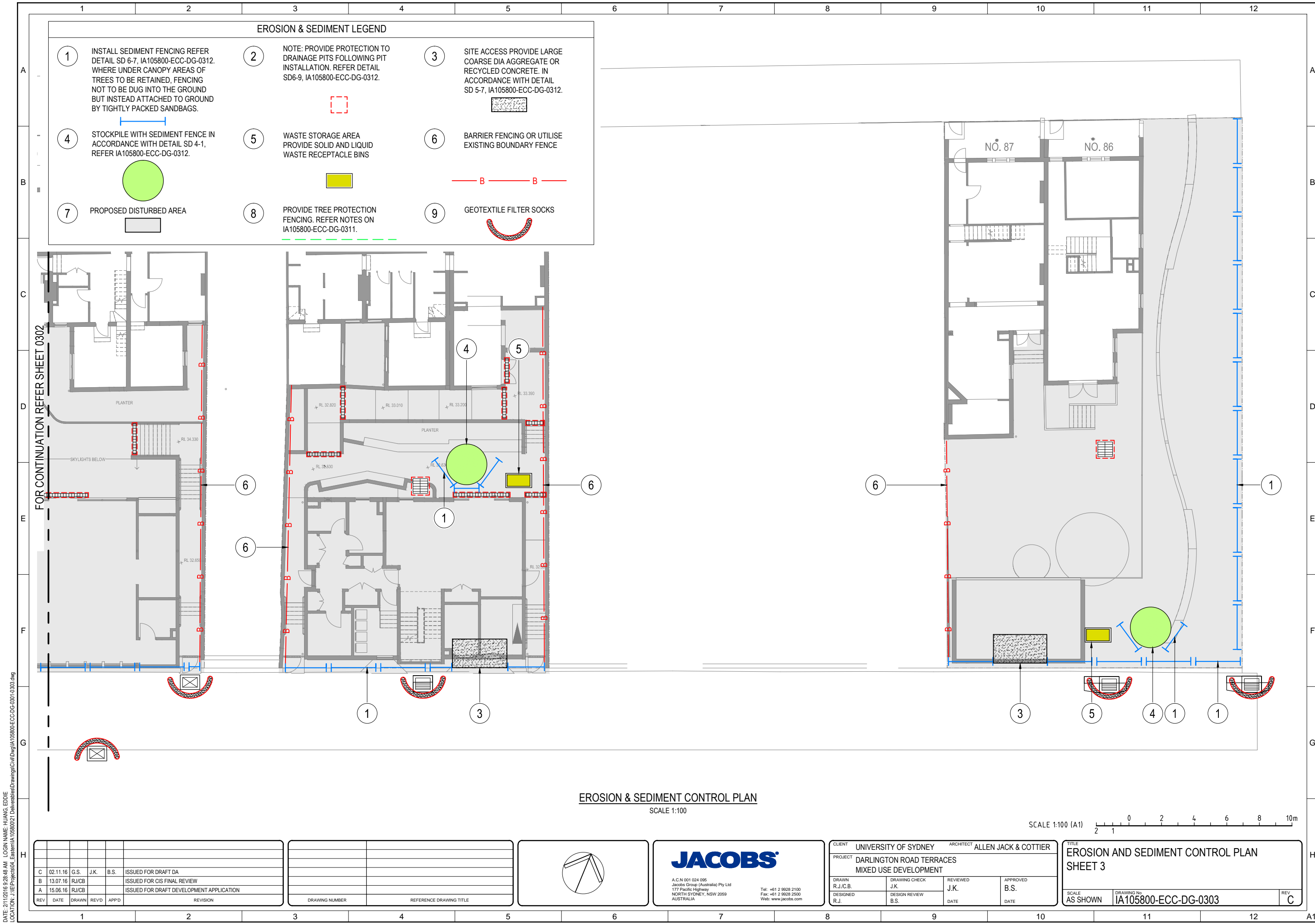
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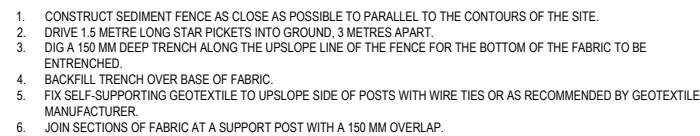
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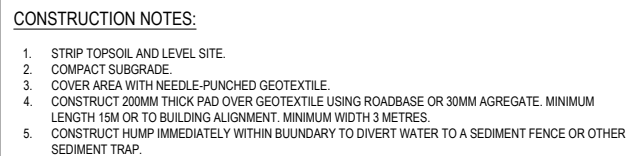




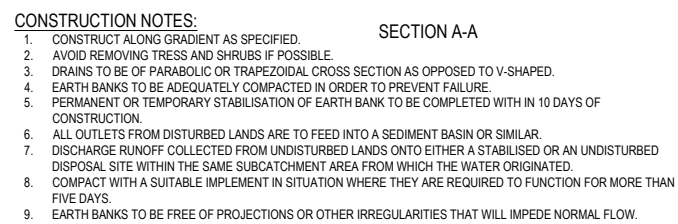




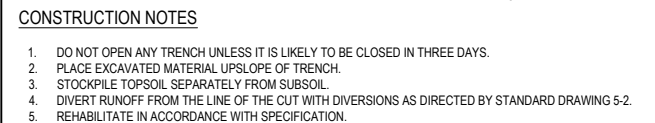
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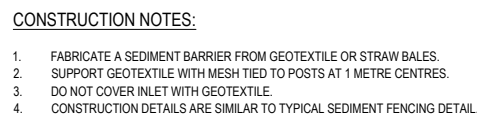
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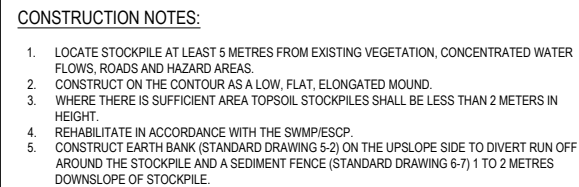
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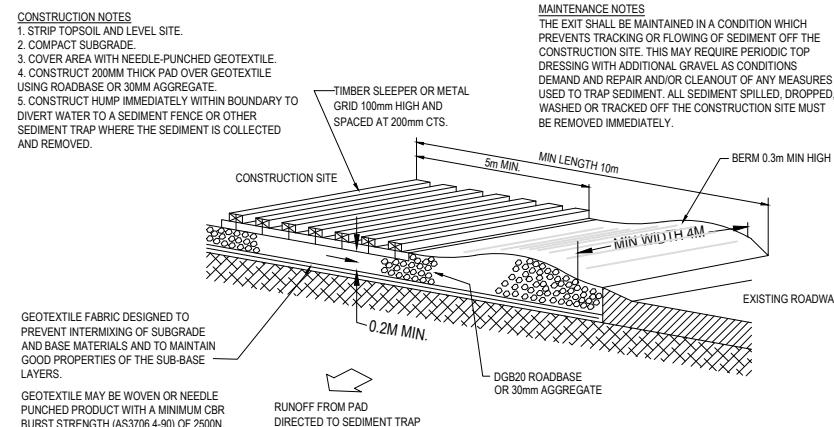
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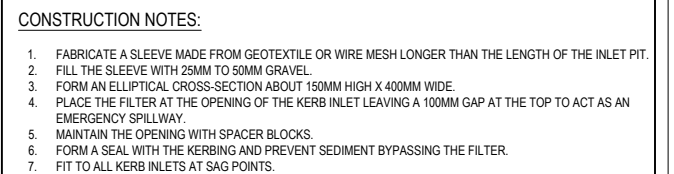
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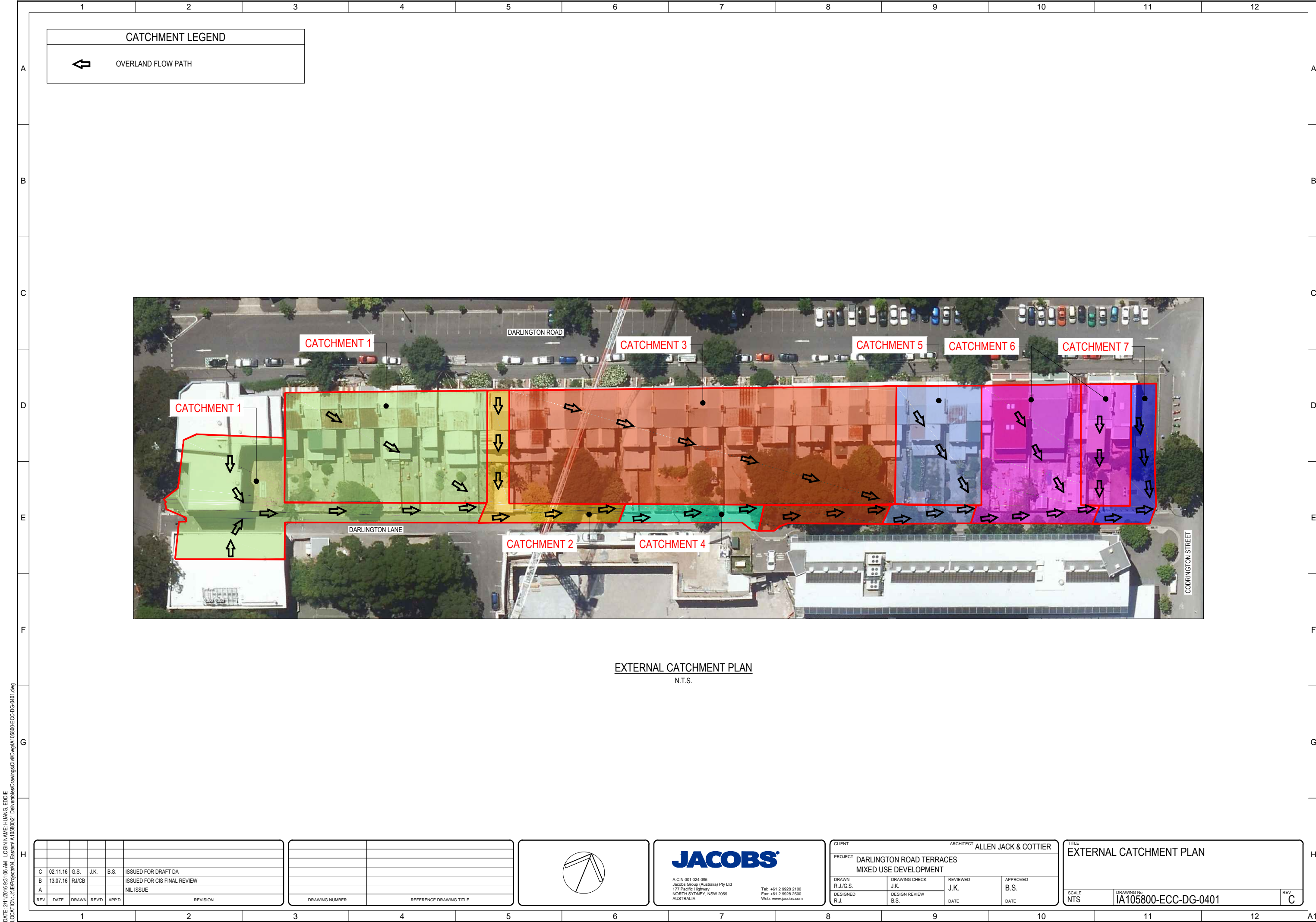


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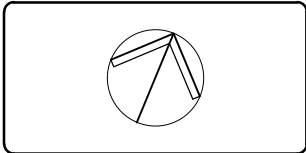


EXTERNAL CATCHMENT PLAN
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A					NIL ISSUE

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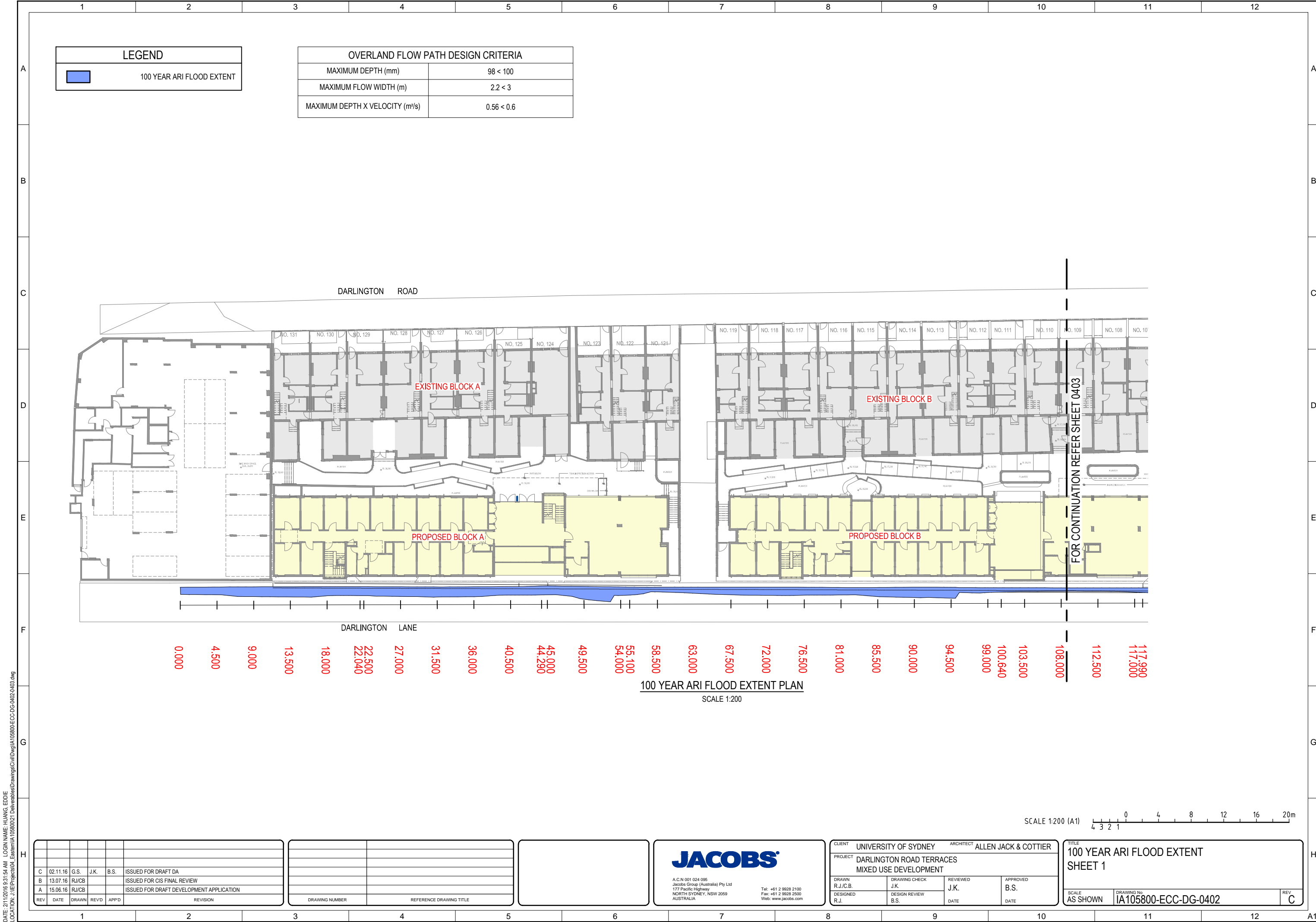
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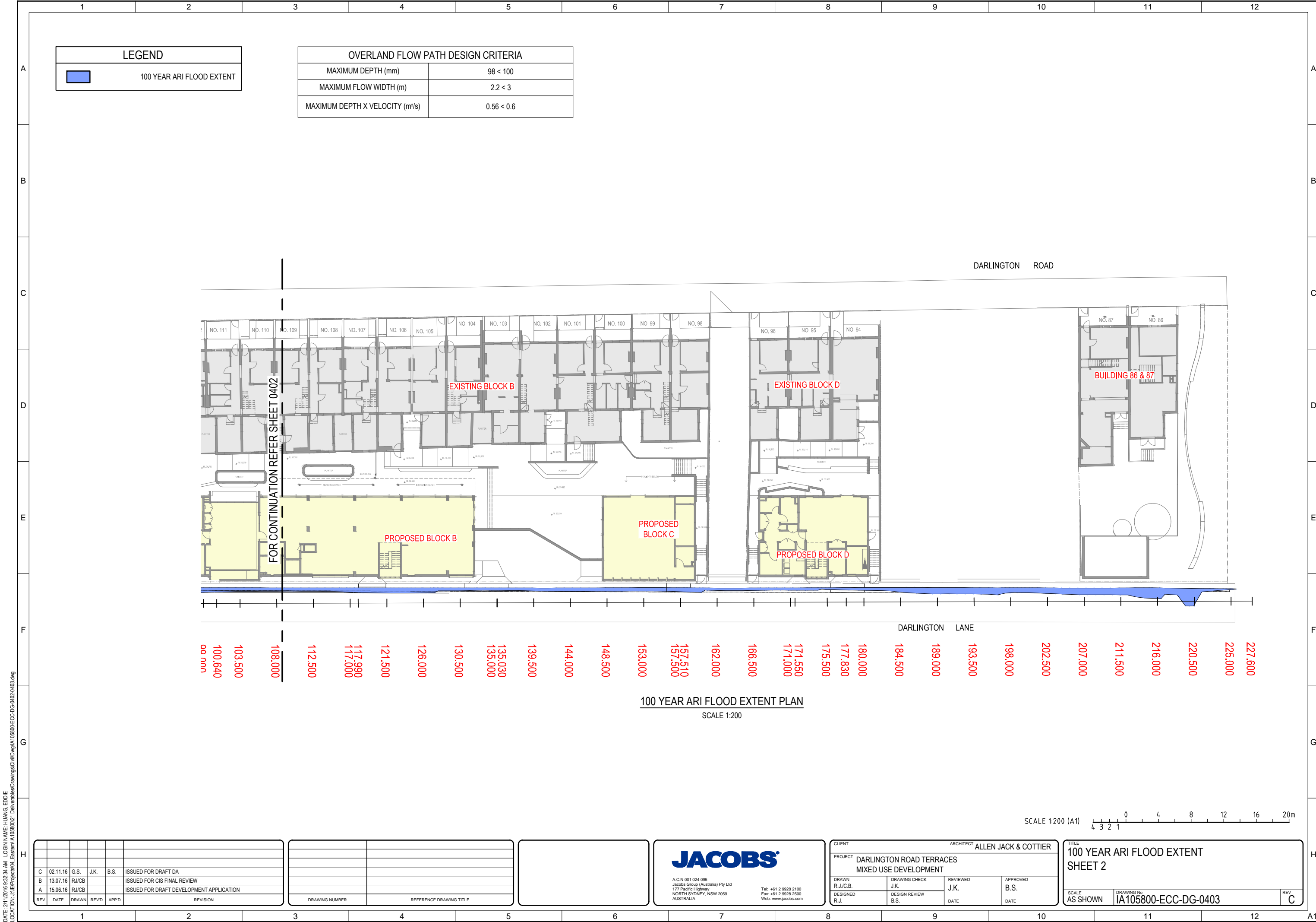
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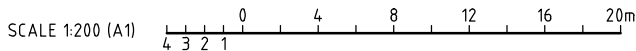
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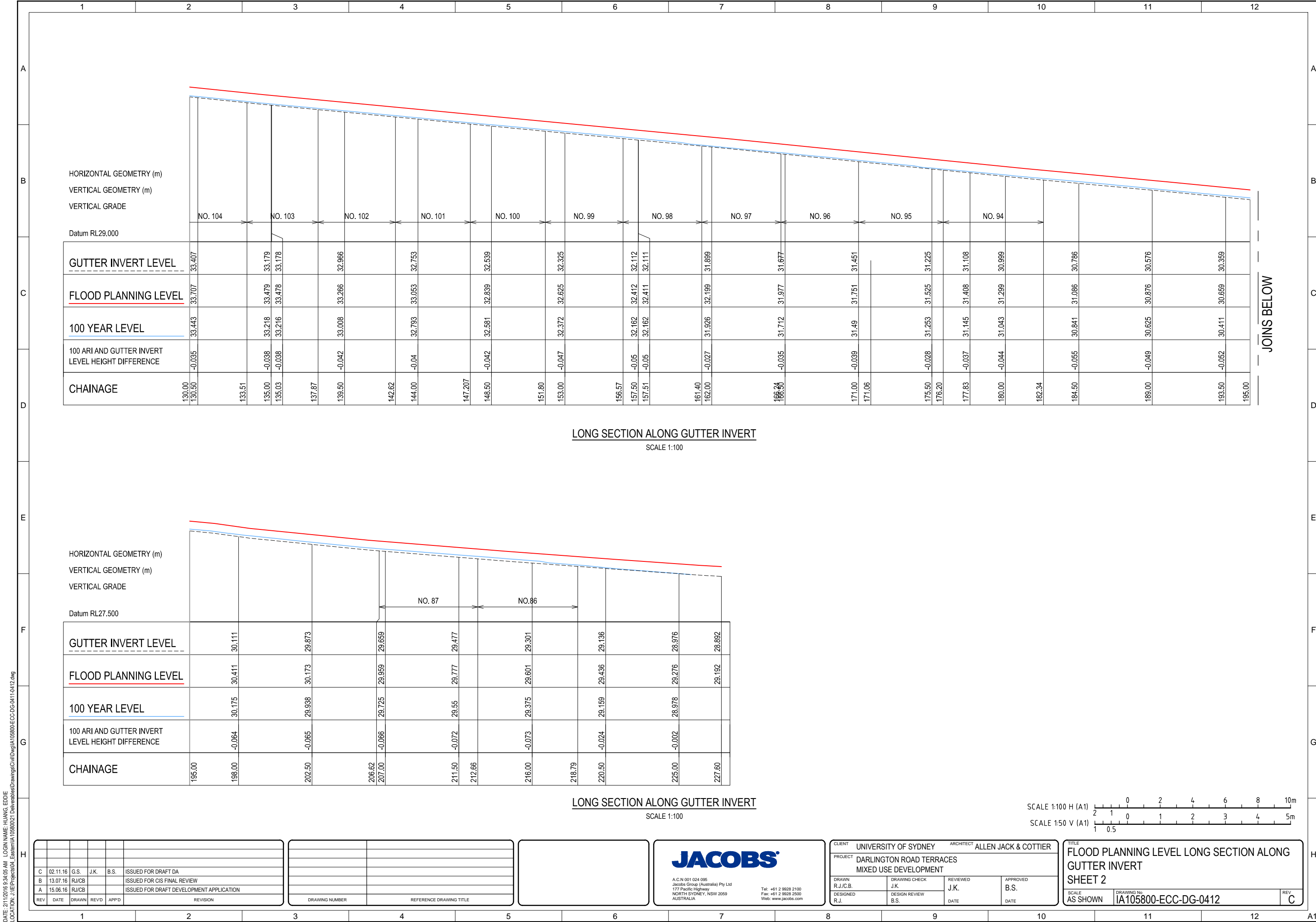
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SHEET 2

SCALE AS SHOWN

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IA105800-ECC-DG-0403

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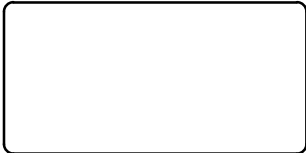




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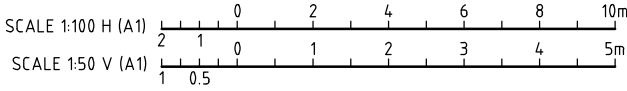
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TITLE
FLOOD PLANNING LEVEL LONG SECTION ALONG
GUTTER INVERT
SHEET 2

SCALE
AS SHOWN

DRAWING No
IA105800-ECC-DG-0412

REV
C



PROPOSED RESIDENTIAL DEVELOPMENT

No. 86-131 DARLINGTON ROAD, DARLINGTON

STORMWATER QUALITY REPORT

CONTENTS:

COVER SHEET

1.0 INTRODUCTION

2.0 STUDY METHODOLOGY

3.0 RAINFALL AND EVAPOTRANSPIRATION DATA

4.0 STORMWATER QUALITY MODELLING

4.1 GENERAL

4.2 RAINFALL/RUNOFF AND EVAPOTRANSPIRATION

4.3 CATCHMENT DEFINITION

5.0 MUSIC MODEL

5.1 WATER QUALITY PARAMETERS

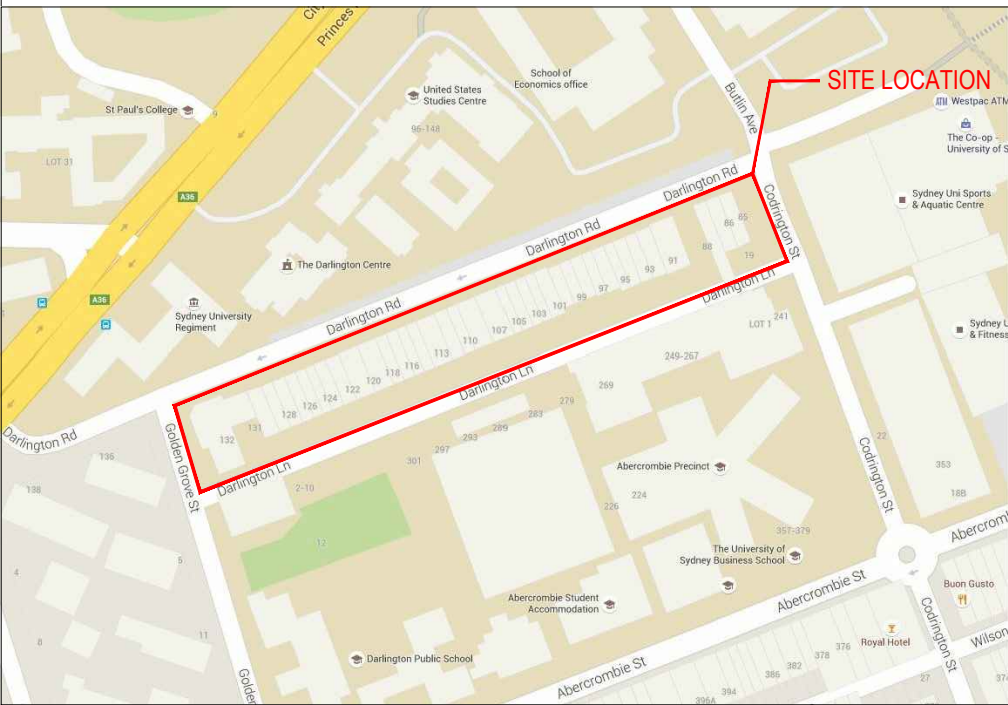
5.2 STORMWATER TREATMENT

5.3 MODEL DEFINITION

6.0 RESULTS AND CONCLUSION

7.0 PRE-DEVELOPMENT & POST-DEVELOPMENT MUSIC MODEL

LOCALITY MAP



(SOURCE: GOOGLE MAPS 2015)

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DESIGNED	R.J.	DESIGN REVIEW	BS
DATE	15.07.16	DATE	15.07.16
APPROVED	BS	DATE	15.07.16

TITLE	STORMWATER QUALITY REPORT COVER SHEET		
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1	2	3	4	5	6	7	8	9	10	11	12
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<p>A CATCHMENT BASED WATER QUALITY MODEL WAS DEVELOPED TO INVESTIGATE STORMWATER RUNOFF QUALITY FROM THE SUBJECT SITE IN ACCORDANCE WITH SYDNEY CITY COUNCIL'S "DCP 2012 - WATER AND FLOOD MANAGEMENT." THE REQUIREMENTS ARE TABLED FOLLOWING:</p>	<p>THE OBJECTIVES OF THIS REPORT ARE TO:</p> <ul style="list-style-type: none"> ASSESS THE EXISTING RUNOFF QUALITY ON THE PRE-DEVELOPMENT SCENARIO AND IDENTIFY STORMWATER QUALITY CONTROLS LIKELY TO IMPACT ON RUNOFF QUALITY. ASSESS THE STORMWATER QUALITY ON THE POST DEVELOPMENT SCENARIO AND PROVIDE 	<p>FOR THE PURPOSE OF THIS REPORT DATA HAS BEEN OBTAINED FROM NUMEROUS SOURCES, INCLUDING eWATER PLUVIOGRAPH RAINFALL DATA, BUREAU OF METEOROLOGY, ETC. THIS DATA IS REQUIRED FOR INPUT INTO THE STORMWATER QUALITY ASSESSMENT MODELS.</p> <p>4. <u>STORMWATER QUALITY MODELLING</u></p>
--	--	--

[illegible]

	<ul style="list-style-type: none"> ESTIMATE STORMWATER FLOW AND POLLUTION GENERATION BY SIMULATING THE PERFORMANCE OF STORMWATER TREATMENT DEVICES INDIVIDUALLY AND AS PART OF A TREATMENT TRAIN. 	<p>THE DETAIL MONTHLY AVERAGE OVER THE EVALUATION PERIOD DATA IN MUSIC MODEL OF SYDNEY WAS UTILISED IN THIS STUDY IN THE ABSENCE OF THE LOCAL DATA.</p> <p>THE DETAILS ARE SUMMARISED IN TABLE 4.1 AND 4.2 FOLLOWING:</p>
--	--	---

THE MODEL DEFINES WATER QUALITY PROFILES FOR THE PRE AND POST DEVELOPED SCENARIOS. THE POST DEVELOPED MODEL INCLUDES POLLUTANT REDUCTION PERCENTAGES, WHICH REFLECT WORKS THAT ARE ESSENTIAL TO MEET THE RELEVANT REQUIREMENTS PRESCRIBED BY COUNCIL FOR A PROJECT OF THIS NATURE.

TABLE 4.1 - DETAILS OF DAILY RAINFALL DATA			
STATION	NAME	PERIOD	TIMESTEP
066062	SYDNEY OBSERVATORY HILL	05/01/1962-31/12/1966	6 min

- | TABLE 4.2 - SUMMARY OF POTENTIAL EVAPOTRANSPIRATION (PET) | | | | | | |
|---|--------|--------|--------|--------|--------|--|
| JAN | FEB | MAR | APR | MAY | JUN | |
| 180.11 | 134.96 | 128.03 | 84.90 | 57.97 | 42.90 | |
| JUL | AUG | SEP | OCT | NOV | DEC | |
| 43.09 | 57.97 | 87.90 | 127.10 | 152.10 | 163.06 | |

[illegible]

- | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|----|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | A1 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|

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4. STORMWATER QUALITY MODELLING CONT

4.3 CATCHMENT DEFINITION

THE CATCHMENT AREA UNDER EXISTING CONDITIONS IS DEFINED BASED ON TOPOGRAPHIC FEATURES AND ANTICIPATED FLOW PATHS. THE DETAILS OF THE CATCHMENT ARE SUMMARISED IN FOLLOWING TABLE 4.3.

TABLE 4.3 - PRE DEVELOPMENT SUB CATCHMENT DETAILS			
SUB CATCHMENT ID	SUB CATCHMENT AREA (ha)	% IMPERVIOUS AREA	% PERVIOUS AREA
PRE-BLOCK A	0.141	91	9
PRE-BLOCK B & C	0.274	85	15
PRE-BLOCK D	0.048	86	14
BUILDING 86 & 87	0.058	42	58

THE CATCHMENT AREA UNDER POST DEVELOPMENT SCENARIO IS DIVIDED INTO EIGHT SUB-CATCHMENTS, WHICH WERE DEFINED BASED ON FUNCTIONAL AREAS AND ANTICIPATED OVERLAND FLOW PATHS. THE DETAILS OF THE SUB-CATCHMENTS ARE SUMMARISED IN FOLLOWING TABLE 4.4.

TABLE 4.4 - POST DEVELOPMENT SUB CATCHMENT DETAILS

SUB CATCHMENT ID	SUB CATCHMENT AREA (ha)	% IMPERVIOUS AREA	% PERVIOUS AREA
BLOCK A ROOF	0.094	100	0
BLOCK A OTHER AREA	0.041	65	35
BLOCK B & C ROOF	0.171	100	0
BLOCK B & C OTHER AREA	0.098	86	14
BLOCK D ROOF	0.029	100	0
BLOCK D OTHER AREA	0.032	93	7
BLDG 86 & 87 ROOF	0.018	100	0
BLDG 86 & 87 OTHER AREA	0.042	16	84

5. MUSIC MODEL

THE MUSIC MODEL WAS CREATED BASED ON A 6 min RAINFALL-RUNOFF MODEL IN CONJUNCTION WITH REPRESENTATIVE BASEFLOW AND STORMFLOW EVENT MEAN CONCENTRATION (EMCs).

5.1 WATER QUALITY PARAMETERS

THE ADOPTED VALUES OF VARIOUS MUSIC RAINFALL AND RUNOFF PARAMETERS ARE SUMMARISED IN TABLE 5.1.

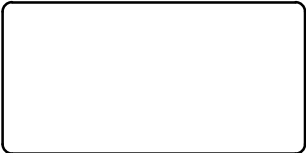
TABLE 5.1 - ADOPTED MUSIC RAINFALL/RUNOFF PARAMETERS

PARAMETER	VALUE
IMPERVIOUS AREA PROPERTIES	
RAINFALL THRESHOLD (mm/DAY)	1.0/0.3 (ROOF)
PERVIOUS AREA PROPERTIES	
SOIL STORAGE CAPACITY (mm)	120
SOIL INITIAL STORAGE (% OF CAPACITY)	25
FIELD CAPACITY (mm)	80
INFILTRATION CAPACITY COEFFICIENT - a	200
INFILTRATION CAPACITY EXPONENT - a	1
GROUNDWATER PROPERTIES	
INITIAL DEPTH (mm)	10
DAILY RECHARGE RATE (%)	25
DAILY BASEFLOW RATE (%)	5
DAILY DEEP SEEPAGE RATE (%)	0

STORMWATER QUALITY IS CHARACTERISED USING EVENT STOCHASTICALLY GENERATED CONCENTRATION UNDER STORM AND BASE FLOW CONDITIONS. THE VALUE OF WATER QUALITY PARAMETERS ADOPTED IN THIS STUDY IS SUMMARISED IN TABLE 5.2

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TABLE 5.2 - ADOPTED MUSIC WATER QUALITY PARAMETERS							
LAND-USE CATEGORY		Log ₁₀ TSS (mg/L)		Log ₁₀ TP (mg/L)		Log ₁₀ TN (mg/L)	
		STORM FLOW	BASE FLOW	STORM FLOW	BASE FLOW	STORM FLOW	BASE FLOW
RESIDENTIAL	MEAN	2.15	1.20	-0.60	-0.85	0.30	0.11
	STD DEV	0.32	0.17	0.25	0.19	0.19	0.12
ROOFS	MEAN	1.30	N/A	-0.89	N/A	0.30	N/A
	STD DEV	0.32	N/A	0.25	N/A	0.19	N/A

Properties of Rainwater Tank A

Location Rainwater Tank A

Inlet Properties

Low Flow By-pass (cubic metres per sec)0.000000

High Flow By-pass (cubic metres per sec)100.000000

Individual Tank Properties

Number of Tanks1

Total Tank Properties

Storage Properties

Volume below overflow pipe (kL)41.50

Depth above overflow (metres)0.20

Surface Area (square metres)36.9

Initial Volume (kL)0.00

Outlet Properties

Overflow Pipe Diameter (mm)225

Use Custom Outflow and Storage Relationship

Define Custom Outflow and StorageNot Defined

Re-use

Fluxes...

Notes...

More

Cancel

Back

Finish

Properties of Detention Basin A

Location Detention Basin A

Inlet Properties

Low Flow By-pass (cubic metres per sec)0.000000

High Flow By-pass (cubic metres per sec)100.000000

Storage Properties

Surface Area (square metres)27.5

Extended Detention Depth (metres)1.20

Exfiltration Rate (mm/hr)0.00

Evaporative Loss as % of PET100.00

Outlet Properties

Low Flow Pipe Diameter (mm)184

Overflow Weir Width (metres)0.9

Notional Detention Time (hrs)0.106

Use Custom Outflow and Storage Relationship

Define Custom Outflow and StorageNot Defined

Re-use...

Fluxes...

Notes...

More

Cancel

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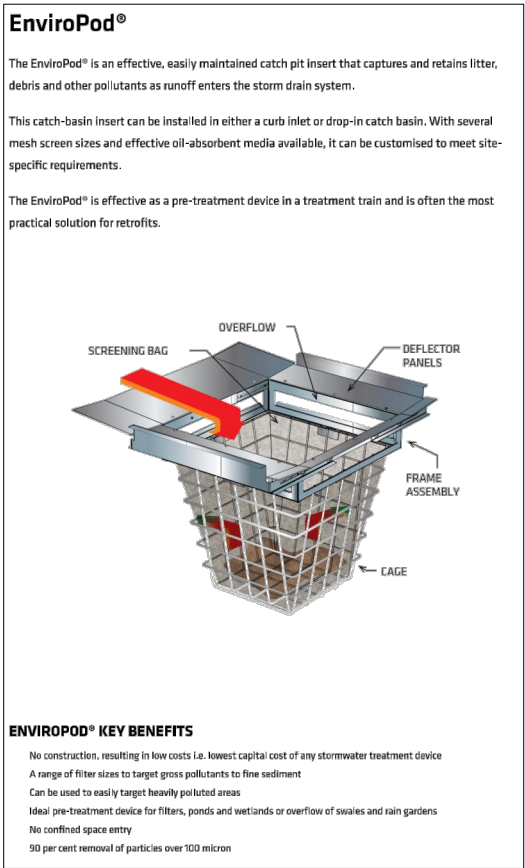
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FIGURE 5.1 OSD/OSR TANK PARAMETERS

5.2 STORMWATER TREATMENT MEASURES

THE STORMWATER TREATMENT MEASURES THAT WERE ASSESSED USING MUSIC INCLUDED TWO OSD/OSR TANKS FOR FUTURE DEVELOPMENT AND FOUR ENVIROPODS (GROSS POLLUTANT TRAPS). THE CONCEPTUAL PLAN FOR THE PROPERTY IS SHOWN IN 1.05. THE PROPERTIES OF THE ADOPTED DEVICES ARE LISTED IN TABLE 5.3, FIGURE 5.1 AND TABLE 5.4 FOLLOWING:

TABLE 5.3 - RAINWATER TANK AND OSD SIZES		
LOT NUMBER	OSD VOLUME	OSR VOLUME
BLOCK A	33 KL	24 KL
BLOCK B & C	58 KL	41 KL



DETAIL OF ENVIROPOD

TABLE 5.4 - ENVIROPOD PARAMETERS	
POLLUTANT	REMOVAL EFFICIENCY
TOTAL SUSPENDED SOLIDS	46%
TOTAL NITROGEN	79%
TOTAL PHOSPHORUS	70%
GROSS POLLUTANTS	100%

5.3 MODEL DEFINITION

THE MODEL LAYOUT FOR THE PRE AND POST DEVELOPED SCENARIOS IS DEPICTED ON PLAN 1.05.

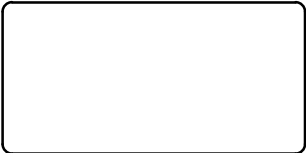
6. RESULTS & CONCLUSION

BASED ON THE FOREGOING THE PROPOSED NUTRIENT CONTROL COMPRISING ENVIROPOD MEASURES ACHIEVE THE REQUIRED NUTRIENT REMOVAL TARGET LEVELS. THE RESULTS OF MUSIC MODELLING ARE SUMMARISED IN TABLE 6.1 FOLLOWING

TABLE 6.1 - SUMMARY OF MUSIC RESULTS			
PARAMETER	SOURCE RUNOFF	DISCHARGE FROM SITE	REDUCTION
PRE-DEVELOPMENT			
FLOW (ML/y)	5.43	5.43	0%
TSS (kg/y)	965	965	0%
TP (kg/y)	1.59	1.59	0%
TN (kg/y)	11.7	11.7	0%
GROSS POLLUTANTS (kg/y)	131	131	0%
POST-DEVELOPMENT			
FLOW (ML/y)	5.9	4.05	31.4%
TSS (kg/y)	450	79.6	82.3%
TP (kg/y)	1.17	0.47	59.8%
TN (kg/y)	12.8	6.55	48.8%
GROSS POLLUTANTS (kg/y)	143	0	100%

REV	DATE	DRAWN	REV'D	APP'D	REVISION
C	01.11.16	L.B.	JK	BS	ISSUED FOR DRAFT D.A.
B	15.07.16	RJ/CB	JK	BS	ISSUED FOR FINAL CIS REVIEW
A	15.06.16	RJ/CB			ISSUED FOR DRAFT DEVELOPMENT APPLICATION

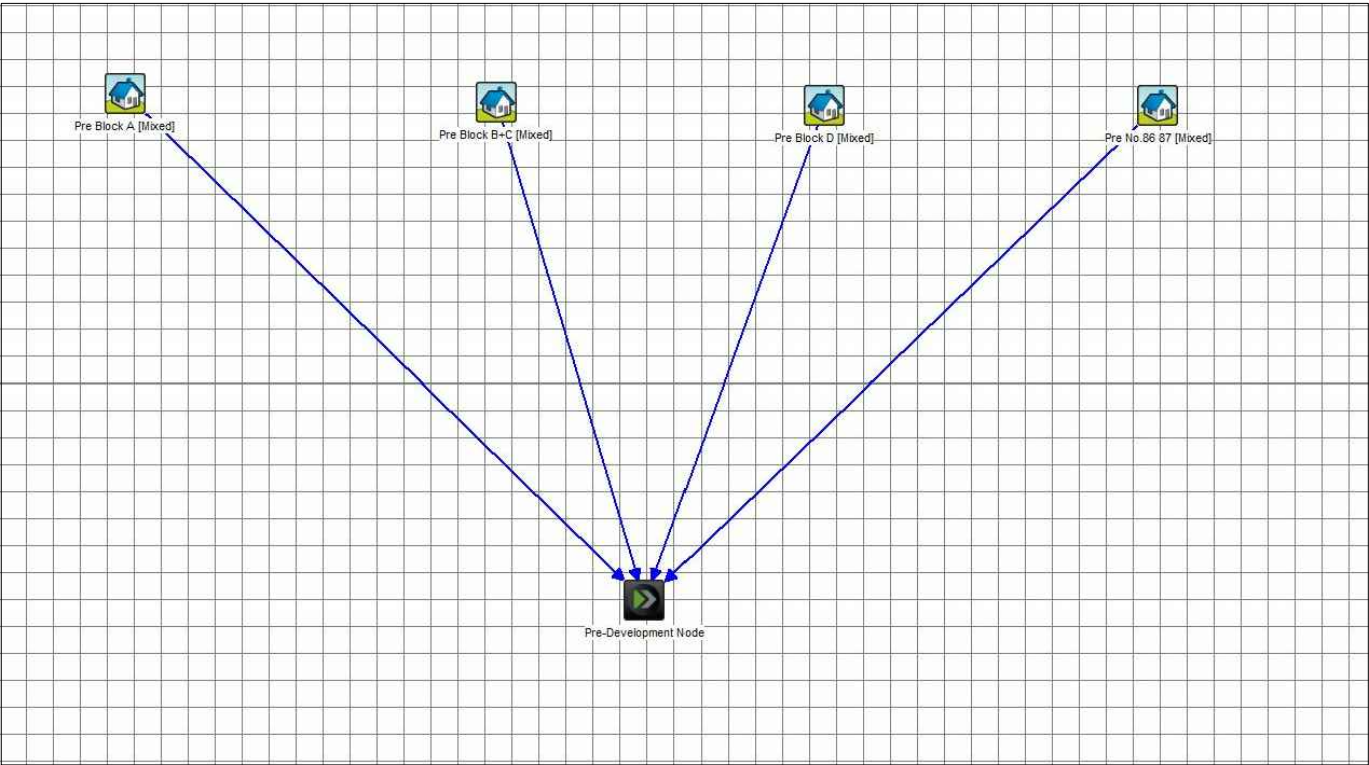
DRAWING NUMBER	REFERENCE DRAWING TITLE



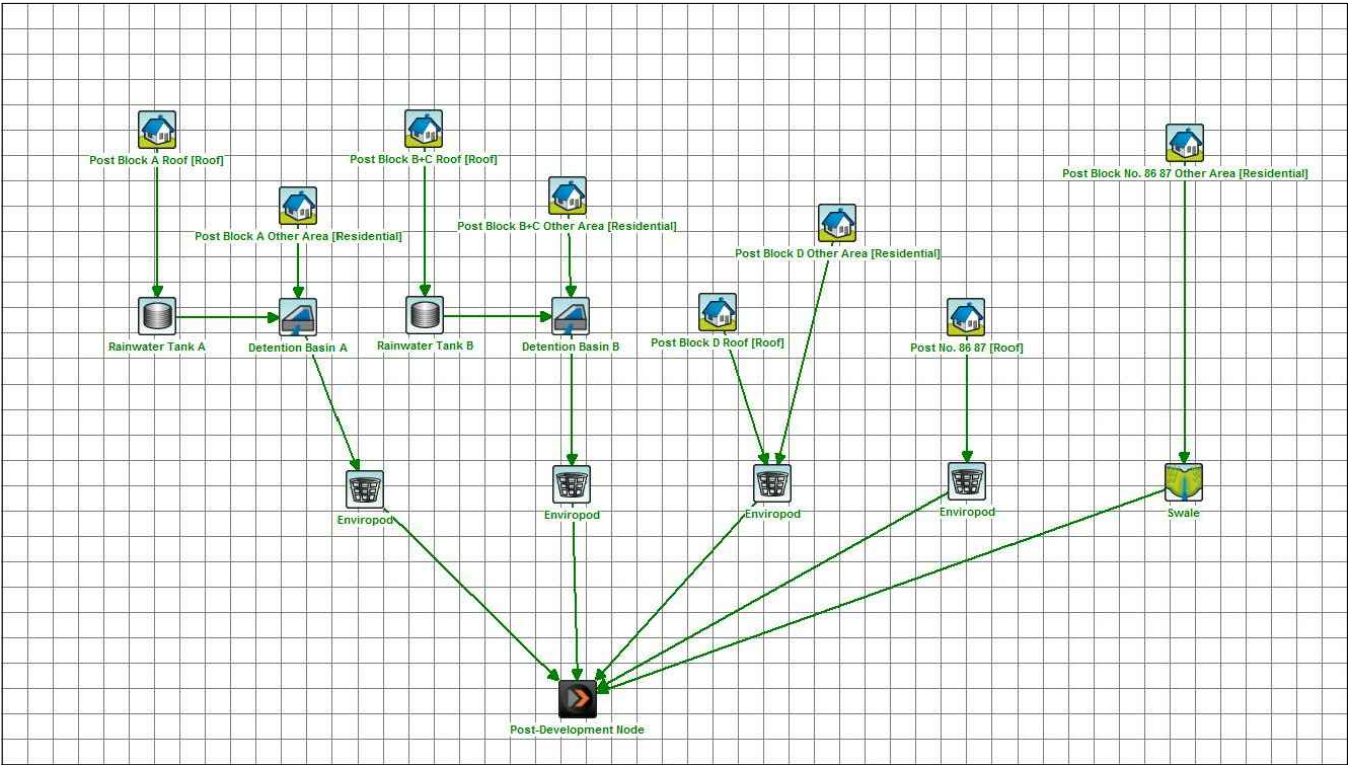
CLIENT		UNIVERSITY OF SYDNEY		ARCHITECT		ALLEN JACK & COTTIER	
PROJECT		DARLINGTON ROAD TERRACES MIXED USE DEVELOPMENT					
DRAWN R.J./C.B.		DRAWING CHECK JK		REVIEWED JK		APPROVED BS	
DESIGNED R.J.		DESIGN REVIEW BS		DATE 15.07.16		DATE 15.07.16	

TITLE STORMWATER QUALITY REPORT SHEET 3		
SCALE -	DRAWING No IA105800-ECC-RP-0004	REV C

7. PRE DEVELOPMENT AND POST DEVELOPMENT MODEL



PRE-DEVELOPMENT MUSIC MODEL
SCALE - NTS



POST-DEVELOPMENT MUSIC MODEL
SCALE - NTS

REV	DATE	DRAWN	REVD	APPD	REVISION
C	01.11.16	L.B.	JK	BS	ISSUED FOR DRAFT D.A.
B	15.07.16	R.J/CB	JK	BS	ISSUED FOR FINAL CIS REVIEW
A	15.06.16	R.J/CB			ISSUED FOR DRAFT DEVELOPMENT APPLICATION

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PROJECT	DARLINGTON ROAD TERRACES MIXED USE DEVELOPMENT		
DRAWN	R.J./C.B.	DRAWING CHECK	JK
DESIGNED	R.J.	DESIGN REVIEW	BS
REVIEWED	JK	DATE	15.07.16
APPROVED	BS	DATE	15.07.16

TITLE	STORMWATER QUALITY REPORT SHEET 4		
SCALE	DRAWING No	REV	
-	IA105800-ECC-RP-0005	C	