STORMWATER MANAGEMENT REPORT

Eastlakes Town Centre – Southern Site

Gardeners Road
Eastlakes NSW 2018

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1. Introduction

1.1 Background

Van Der Meer Consulting has been commissioned by Crown Group to prepare a Stormwater Management Plan to support an amendment to an existing approved Development Application (DA) for the redevelopment of Eastlakes Town Centre.

The scope of this report includes a comprehensive assessment of the stormwater management requirements for the proposed development. Accordingly, this report includes findings of the assessment and proposes a best practice stormwater management strategy.

The following information and documents were utilised in this investigation:

- City of Botany Bay – Guidelines for the design of stormwater drainage systems within City of Botany Bay.
- City of Botany Bay – Stormwater Management Technical Guidelines.
- Botany Bay & Catchment Quality Water Improvement Plan
- Flood Assessment, Aug 2018 by GRC Hydro.
- Detailed site survey plans.
- Architectural plans defining proposed work and existing infrastructure by FJMT
- “Australian Runoff Quality – A Guide to Water Sensitive Urban Design”, Engineers Australia (2006)
- “Australian Rainfall and Runoff – A Guide to Flood Estimation”, Institute of Engineers, Australia (2016)
- eWater – MUSIC Version 6.3

1.2 Existing Site

The proposed development is situated approximately 200m south of Gardeners Road, Eastlakes and is within the Bayside Council Local Government Area. The site is bound by Evans Avenue to the north, Barber Avenue to the east and south and Eastlakes Reserve to the west. The site is 1.8 ha in area and consists of a medium to large shopping centre. The primary structure on the site is a single-story trading floor with underground parking and a small portion of rooftop parking.

Figure 1 – Site Area

The remainder of the site is a small single-story structure with an outdoor carpark adjacent to Evans Ave and Eastlakes Reserve. The site grades from northeast to southwest from RL 18.6 to RL 16.4 respectively. Currently the site discharges stormwater into an existing 825 diameter pipe in Barber Avenue. Refer to survey in Appendix E for further details.

1.3 Proposed Works

The proposed development consists of a new shopping centre with a supermarket and various retail and commercial tenancies at ground and level 1. There will be 4 levels of basement carparking and 11 levels of apartments. Refer to Appendix A for the proposed civil plans and Appendix C for the architectural drawings.

1.4 Key Issues

The key issues to be addressed in this report include:

• **Stormwater Discharge** – Increases in impervious areas as a result of the development (such as roofs, driveways, etc) has the potential to increase stormwater flows from the site during storm events. To avoid impacting the site and downstream properties, the site stormwater system must be designed to safely convey flows through the site and within the capacity of the downstream drainage system.

• **Water Quality** – Urban developments have the potential to increase gross pollutants, sediments and nutrient concentrations in storm water runoff. To limit the impact on the downstream water quality, pollution control measures will be provided within the site's stormwater management system prior to discharging into the drainage network.

2. Objectives & Targets

The objective of the drainage design is to provide stormwater controls that ensure the proposed development does not adversely impact on the quantity or quality of stormwater flows within, adjacent and downstream of the site.

Stormwater Discharge

- Guidelines for the design of stormwater drainage systems within City of Botany Bay Section 5.1 – Minimum Design Storm Criteria;
- Guidelines for the design of stormwater drainage systems within City of Botany Bay Section 4.0 – Stormwater Reuse.

Bayside Council policy aims to minimise flooding from stormwater runoff due to development. This is done by ensuring OSD systems meet the needs of the development site and the stormwater drainage system it connects to.

Water Quality

Guidelines: Botany Bay & Catchment Quality Water Improvement Plan.

The main objective for stormwater quality is to minimise the impacts on downstream water bodies. Bayside Council has adopted a stormwater management policy that incorporates principles of Water Sensitive Urban Design. The site-specific water quality targets are detailed in Table 2.1.

Pollutant	Criteria
Total Suspended Solids (kg/yr)	80% reduction of the annual load
Total Phosphorus (kg/yr)	55% reduction of the annual load
Total Nitrogen (kg/yr)	40% reduction of the annual load
Gross Pollutants (kg/yr)	90% reduction of the annual load

Table 2.1 - Pollution Reduction Targets

3. Stormwater Discharge Control

3.1 Proposed Drainage System

The drainage system for the proposed development will be designed to collect the majority of concentrated flows from impermeable surfaces such as access ways, parking areas and buildings. Where possible (and practical), runoff from pervious areas will also be collected.

The proposed stormwater management system for the development includes:

- A pit and pipe network to collect minor storm runoff from areas
- Roof-water harvesting & retention
- On-site detention (OSD) tanks with orifice and weir control

A reduced set of concept civil engineering drawings is included in Appendix A.

3.2 On-Site Detention (OSD)

Council requires that all stormwater events shall not exceed the 20% AEP event peak flow under 'State of Nature' conditions. As such all storm flows need to be reduced by means of an on-site stormwater detention system. Tanks with minimum water storage volumes of 350m^3 and 468m^3 respectively are required to meet the OSD requirement. Also, a tank with a storage volume of at least 30kL is required to meet the rainwater storage requirement (refer to Section 4.2 for further details of the rainwater tank design). The OSD and rainwater reuse storages have been designed as separate tanks with overflow from the rainwater storage directed to the OSD storage. Discharge from the OSD tanks is piped to stormwater pits in Barber Avenue and the adjoining Eastlakes Reserve. The OSD design calculations and details for the proposed tank layouts are documented on drawings C401 to C404 in Appendix A.

4. Water Quality Control

4.1 Introduction

The quality of runoff from a catchment depends upon many factors such as land use, degree of urbanisation, population density, sanitation, waste disposal practices, landform, soil types, and climate. Pollutants typically transported by runoff include litter, sediment, nutrients, oil, grease, and heavy metals. Whilst all these pollutants have a negative impact on the receiving water quality, suspended solids and nutrients cause the highest detrimental impact to the environment

Also, soil erosion during the construction phase presents a potential risk to water quality. The primary risk occurs while soils are exposed during earthworks when suspended sediment and associated pollutants can be washed into downstream watercourses.

4.2 Water Quality Control Measures

The measures proposed for the redevelopment are summarised below:

Erosion & Sediment Control Plan

During construction, water quality control is achieved by deposition and trapping of silts and clays which often have nutrients such as phosphorus and nitrogen attached to their surfaces. Silt fences will be erected prior to construction to control sediment runoff. This will reduce and isolate sediments and particulate matter.

An Erosion and Sediment Control Plan has been provided in accordance with City of Sydney Council DCP (2012) and with Landcom's "Managing Urban Stormwater – Soils and Construction (2004). This will ensure that a significant portion of sediments and attached nutrients can be contained on site during construction.

A copy of the preliminary Erosion and Sediment control plan is shown in Appendix A.

Filter Cartridges

- *StormFilter* is a proprietary device containing one or multiple cartridge units in a single system, thereby suitable for small or larger catchments where space is limited.
- Research has shown (Walker, Allison, Wong, Wootton, 1999) that 70% of oils can be associated with solids in the stormwater and that over a period of dry weather conditions the highest oil content was found in the sediment range of 200 to 400 microns. Field studies have demonstrated StormFilter's ability to effectively strip oil,

grease and hydrocarbon loadings at very low concentrations. Removal efficiencies (excluding anomalies) over a series of facilities conducted in two studies in the US found StormFilter to remove a weighted average of 64% of oil and grease loads that ranged in concentration from 7mg/l to 96mg/l and a weighted average removal of 76.9% of total petroleum hydrocarbons that ranged in concentration from 5 mg/l (non-detect) to 14.3mg/l.

- Site discharge will be treated by 8 no. '690m PSorb' StormFilters or approved equivalent.

Rainwater Tank

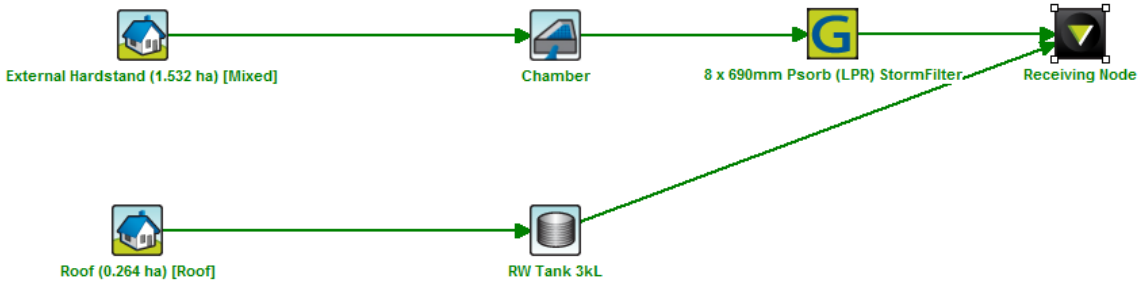
- Rainwater tanks are effective in removal of pollutant loads at source. The pollutant removal process is by harvesting runoff for reuse, thereby limiting the nutrients discharging to the waterways.
- Much of the exposed roof area for the development is utilised as terraces for the occupants and the run-off from these areas is unsuitable for reuse. The area of roof available for rainwater reuse is 2640m^2.
- The Council document 'Stormwater Management Technical Guidelines DCP for City of Botany Bay' outlines the methods for rainwater tank sizing. Clause 4.2 (iii) requires a minimum 10kL rainwater tank be provided for all other multi-unit developments to be utilised outdoor irrigation, laundry and toilet flushing in accordance with the requirements of Sydney Water and AS 3500.3.
- Two 30kL rainwater storage tanks will be constructed based upon the likely population and amenity.
- A mains changeover will be provided at the tank for low rain water tank level or pump fault. The rainwater reuse tank is designed such that mains water is only implemented during a significant drought period, or similar event.

4.3 Water Quality Modelling

4.3.1 "MUSIC" Program

The effectiveness of the proposed water quality measures has been assessed using numerical modelling. Water quality modelling has been conducted using the software program MUSIC (Model for Urban Stormwater Improvement Conceptualisation). This program is used to establish the effectiveness of the water quality treatment proposed for the development site. MUSIC has been developed by the Cooperative Research Centre for Catchment Hydrology and is designed as a planning tool for water quality treatment trains for catchment runoff. The program is able to model pollutant loads present in stormwater runoff from a catchment and assess the effectiveness of different treatment devices in terms of pollutant load reduction.

The rainfall data used was the six-minute time step from 1990 to 2010 from Sydney Airport Rainfall Station. Catchment characteristics were defined using a combination of roof areas and non-roof catchments with varying imperviousness ratios to replicate the catchment for the developed condition. The MUSIC model layout is shown below.



Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	11.9	11.7	2.1
Total Suspended Solids (kg/yr)	3590	574	84
Total Phosphorus (kg/yr)	6.28	1.61	74.4
Total Nitrogen (kg/yr)	28.4	15.3	45.9
Gross Pollutants (kg/yr)	347	0	100

Fig. 4.1 – Water Quality Treatment Train Diagram

4.3.2 Land Use

Table 4.1 details the various land use areas of the proposed development.

Land Use / Surface Type	Area (ha)
Roof	0.264
Paved Outdoor	1.532
Total	**1.796**

Table 4.1 – Land Use Areas

4.3.3 Results

Table 4.2 below shows the calculated mean annual pollutant loads for the proposed site conditions before and after the implementation of the treatment devices.

	Total Suspended Solids (kg/yr)	Total Phosphorus (kg/yr)	Total Nitrogen (kg/yr)	Gross Pollutants (kg/yr)
Pre-treatment	3590	6.28	28.4	347
Post-treatment	574	1.61	15.3	0

Table 4.2 – Summary of Treatment Train

The Botany Bay & Catchment Quality Water Improvement Plan outlines Council's requirements for the reduction of pollutants from stormwater before it can be discharged from the site. These targets are listed in Table 4.3 below together with the percentage pollution reductions that will be achieved by the proposed treatment train.

Pollutant	Reduction Target	Reduction Achieved	Target Achieved
Total Suspended Solids (kg/yr)	80%	84.0%	Y
Total Phosphorus (kg/yr)	55%	74.4%	Y
Total Nitrogen (kg/yr)	40%	45.9%	Y
Gross Pollutants (kg/yr)	90%	100%	Y

Table 4.3 – Comparison of Pollutant Reduction Target vs. Achieved

It is clear from the table above that the proposed water quality measures enable the reduction targets to be achieved for all key stormwater pollutants. Therefore, by implementing the proposed treatment train measures within the proposed development there will be no detrimental effect on the quality of stormwater running off from the site.

5. Flood Impact Assessment

GRC Hydro have prepared a Flood Impact Assessment for the development that is presented in Appendix B of this report.

The site is subject to flooding from overland flows that generally move around the subject site. The flood assessment identifies that in the 1% AEP event for the proposed development, flood levels are decreased on neighbouring lots and as such, impacts are compliant.

In accordance with the requirements of the project approval, finished floor levels for habitable areas shall be a minimum 300mm above the estimated 1% AEP flood level. The habitable areas are at or above podium level ensuring compliance with this requirement.

The flood assessment has also determined a flood level of RL 17.13m AHD at the northern entry on Evans Avenue and a flood level of RL 16.83m AHD at the southern entry on Barber Avenue. A freeboard of 300mm to the basement levels is recommended by the flood report setting the minimum levels at the basement entrances at RL 17.43m AHD for the Evans Avenue entry ramp and RL 17.13m AHD for the Barber Avenue entry ramp.

The 1% AEP peak flood levels and depths are documented in the GRC Hydro report in Appendix B.

6. Stormwater Easement Diversion

The existing development has two stormwater easements running through the site. Council does not allow construction over drainage easements and as such the easements are to be diverted.

The western easement connects to a drainage pipe crossing Evans Avenue on the North West corner of the site. The easement runs adjacent to the western boundary for a distance of approximately 95 m, then turns at a right angle to cross Eastlakes Reserve. It is proposed to divert the pipe within the road reserve west along Evans Avenue and then south through Eastlakes Reserve. The path chosen for the pipe has been selected to best preserve the existing trees within the park. The existing 600 mm diameter pipe will be replaced by a 600 mm diameter reinforced concrete pipe (RCP) that will convey the upstream flows around the site.

The southern easement contains a pipe that connects a pit on Barber Avenue at the south east corner of the site through to a pit near the intersection of St Helena Parade and Barber Avenue. This pipe is proposed to be diverted along the road under the existing kerb and gutter in Barber Avenue. Two additional pits will be constructed along Barber Avenue to

divert the replacement 600 mm diameter pipe around the south east corner of the site to the existing downstream 750 diameter pipe.

For details on the relocation of easements refer to drawings C401 and C402 in Appendix A.

7. Conclusion

The proposed development of the site could potentially lead to significant changes in water quantity and quality if a water sensitive urban design approach is not adopted as part of the development strategy.

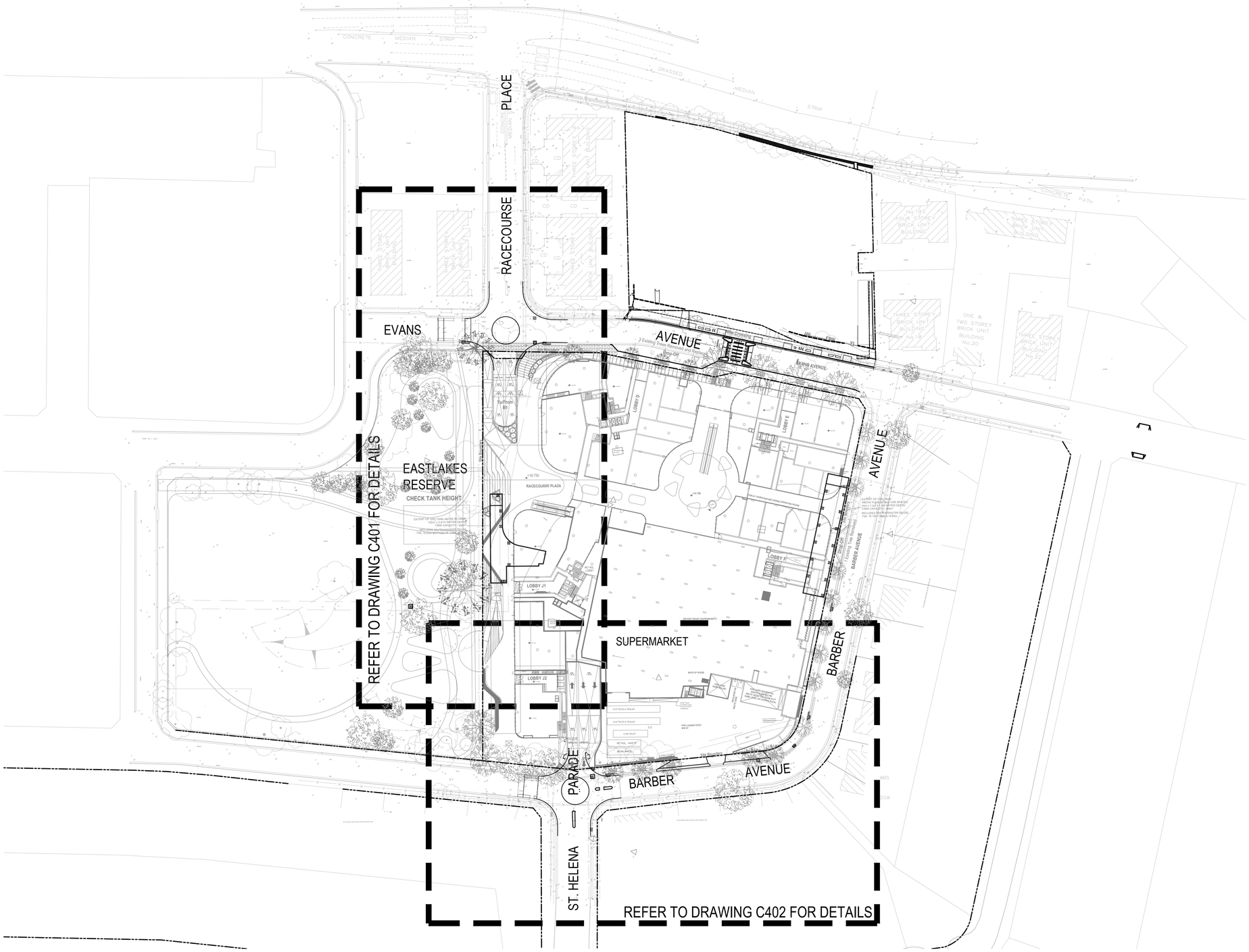
The key strategies to be adopted for this development include the following:

1. A pit and pipe network to collect minor storm runoff from surface areas which will minimise nuisance flooding.
2. Rainwater harvesting to allow on-site reuse of collected roof water which will provide improvement to the quality of stormwater runoff from the site.
3. Stormfilters to treat stormwater runoff before discharge into the downstream waterways.
4. On-site stormwater detention tanks to reduce peak flows from the site.

The results from the investigations and modelling for this project that have been summarised in this report indicate that the development with the proposed WSUD strategy and management can provide a safe and ecologically sustainable environment.

The proposed development and the proposed water quality treatment devices comply with the requirements of Bayside Council.

Appendix A – Civil Engineering Plans



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B	PRELIMINARY	PF	11.10.19
A	PRELIMINARY	NT	20.05.19
No.	REVISION DESCRIPTION	DRAWN	DATE

SCALE BAR

0 10 20 30 40 50 60 70m

SCALE 1:750

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PROJECT TITLE
EASTLAKES CENTRE - SOUTHERN SITE
GARDENERS ROAD
EASTLAKES NSW 2018

DRAWING TITLE
DRAWING SHEET LAYOUT

DRAWING STATUS
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

PROJECT LEADER	DESIGNER	SIGNATURE	
RJB	NT		
DRAFTSPERSON	SCALE	DATE	SHEET SIZE
BK		AUG 2018	A1
JOB No.		DRAWING No.	REVISION
SY182-033		C101	B

N

PIT SCHEDULE		
PIT No.	INLET DETAIL	PIT DETAIL
1-4	2.4m EKI	900x900
1-5	900x900 HD LID	900x900
1-6	2.4m EKI	900x900
1-7	900x900 LD GRATE	1200x1200
1-7A	900x900 LD GRATE	1200x1200

LEGEND

- PROPOSED STORMWATER PITS
- PROPOSED STORMWATER PIPES
- (1-1) STORMWATER PIT REFERENCE
- DENOTES 100 YEAR SURCHARGE PATH

EX 900Ø RCP @ 0.4%

900 x 900 PIT WITH HD SEALED LID

PIT 1-7
SL 16.60
IL 14.37

RELOCATED DRAINAGE EASEMENT

600Ø RCP @ 0.75%

3.00m

600Ø RCP @ 0.76%

EXISTING OUTDOOR ACTIVITY CENTRE

INCLUDES 30m³RAINWATER REUSE TWL 15.05m BOTTOM OF TANK 15.4m

EXTENT OF OSD TANK ABOVE B3 RAMP 92m² x 2.61m WATER DEPTH TANK CAPACITY - 500m³

START OF GROUND FLOOR RAMP ABOVE SLOPE - 1:50

100YR SURCHARGE PATH

GRATED GULLY PIT WITH 2.4m EKI

THREE STOREY BRICK UNIT BUILDING

3000Ø PVC @ 1%

MINIMUM 30kL RAINWATER REUSE TANK STORAGE IN OSD TANK. REFER TO C404 FOR DETAILS.

PIT 1-6
SL 16.62
IL 15.11

IL 15.25 ,RK EXHAUST PLENUM

RETAIN EXISTING STORMWATER PIPE AND CONNECT WITH NEW PIPE

EXTENT OF OSD TANK ABOVE B3 RAMP
235m² x 2.32m WATER DEPTH
TANK CAPACITY - 470m³
INCLUDES 30m³RAINWATER REUSE
TWL 17.77m BOTTOM OF TANK 15.45m

OSD TANK 2
REFER TO C404 FOR DETAILS

RESIDENTIAL ZONE

MEDICAL PARKING
TOTAL - 20

RACECOURSE

MODIFY EXISTING SEP PROVIDING SEALED HD LID

SL 16.66
IL 15.67

EXISTING DRAINAGE EASEMENT TO BE EXTINGUISHED

PIT 1-5
SL 17.16
IL 15.36

PIT 1-2
SL 17.23
IL 16.36

GRATED GULLY PIT WITH 2.4m EKI

100YR SURCHARGE PATH

SIGN

THREE STOREY BRICK UNIT BUILDING

PLAN

SCALE 1:250

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D	PRELIMINARY	NT	11.10.19
C	PRELIMINARY	NT	04.10.19
B	PRELIMINARY	NT	30.05.19
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SCALE BAR
0 1 2 3 4 5 10m 15 20m
SCALE 1:250

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EASTLAKES NSW 2018

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EVANS STREET DRAINAGE EASEMENT RELOCATION & OSD 2 LAYOUT

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BK		AUG 2018	A1
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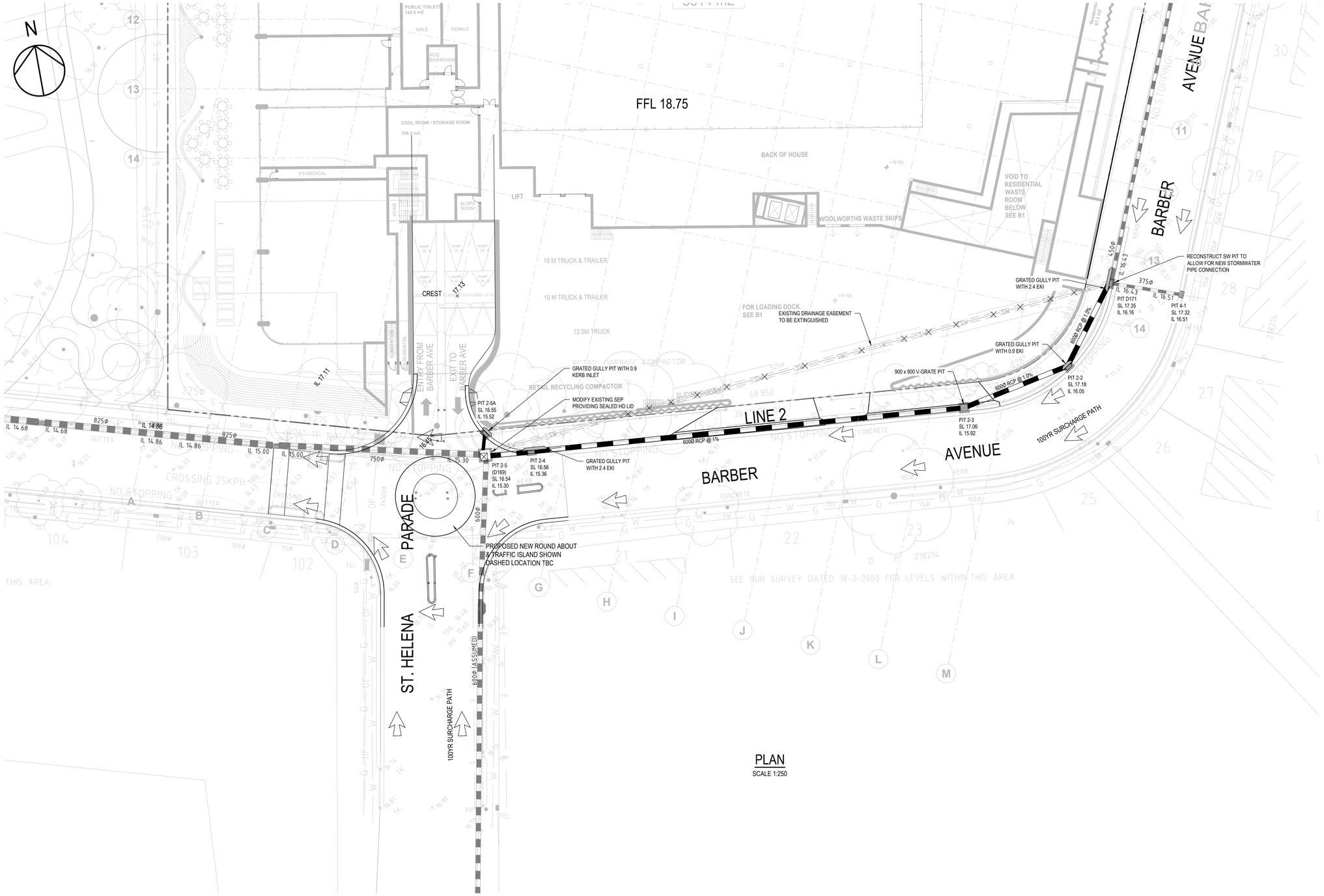
SY182-033		C401	D



LEGEND

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- PROPOSED STORMWATER PIPES
- (2-1) STORMWATER PIT REFERENCE
- DENOTES 100 YEAR SURCHARGE PATH

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PIT No.	INLET DETAIL	PIT DETAIL
2-1	2.4m EKI	900x900
2-2	0.9m KI	900x900
2-3	900x900 V-GRATE	900x900
2-4	2.4m EKI	900x900
2-5	900x900 HD LID	1200x1200
2-5A	0.9m KI	900x900
2-7	2.4m EKI	900x900

PLAN
SCALE 1:250

REVISIONS:

No.	REVISION DESCRIPTION	DRAWN	DATE
B	PRELIMINARY	NT	30.05.19
A	PRELIMINARY	AH	20.08.18

SCALE BAR
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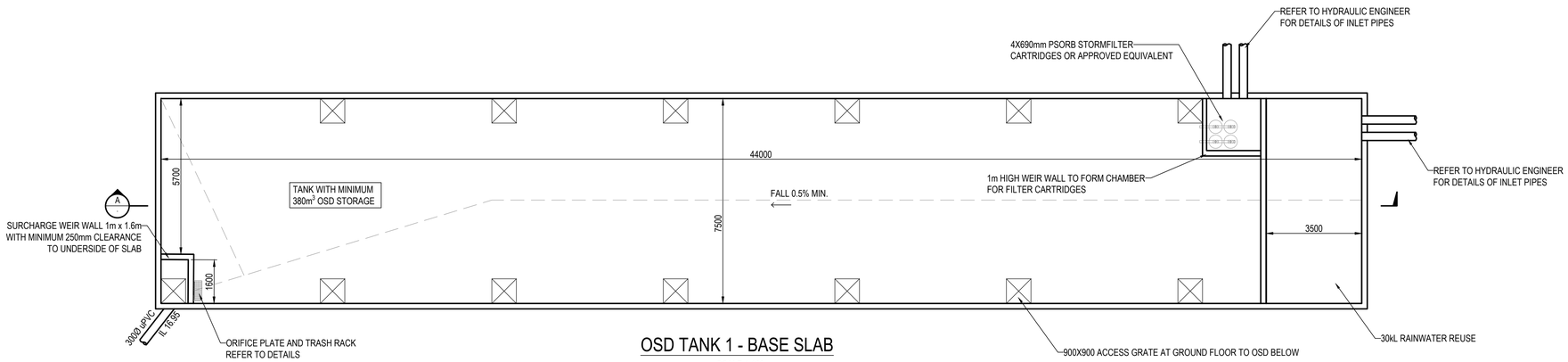
SY182-033		C402	B



OSD TANK 1 - BASE SLAB

SCALE 1:100

OSD DESIGN SUMMARY

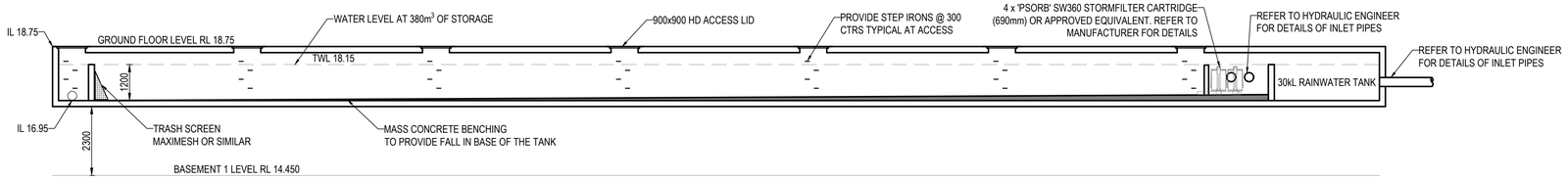
SUMMARY
TOTAL SITE AREA = 17,767m²
PSD = 0.521m³/s (5YR ARI FLOW PRE-DEVELOPED)
POST DEV. DISCHARGE = 0.508m³/s

OSD TANK 1
SITE AREA DRAINING TO TANK= 8,880m²
STORAGE VOLUME = 350m³
ORIFICE DIA = 235mm
POST DEV. DISCHARGE = 0.255m³/s (100YR ARI FLOW)

EMERGENCY OVERFLOW
100YR ARI 5 MIN, Q = 0.467m³/s
WEIR WIDTH = 1.8m
MAX H (ABOVE WEIR) = 0.25m

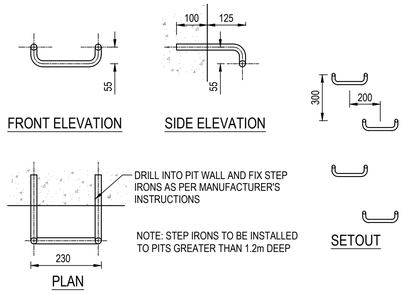
OSD TANK 2
SITE AREA DRAINING TO TANK= 8,887m²
STORAGE VOLUME = 468m³
ORIFICE DIA = 222mm
POST DEV. DISCHARGE = 0.253m³/s (100YR ARI FLOW)

EMERGENCY OVERFLOW
OVERFLOW AT PODIUM LEVEL



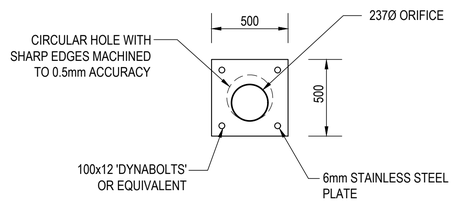
OSD TANK 1 - SECTION A

SCALE 1:100



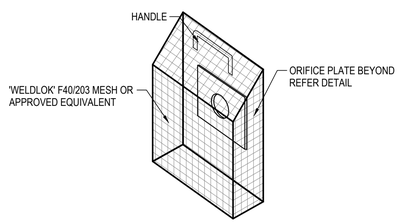
TYPICAL STEP IRON DETAIL

NTS



ORIFICE PLATE DETAIL

SCALE 1:25



TRASH SCREEN DETAIL

NTS

MESH TYPE	MESH SCREEN AREA
LYSAGHT RH3030 FOR ORIFICE 150Ø OR LESS	>50x ORIFICE DIA
'WELDLOK' F40/203 FOR ORIFICE GREATER THAN 150Ø	>20x ORIFICE DIA

NOTE: SCREEN AREA INCLUDES SIDES WHERE APPLICABLE

REVISIONS:

No.	REVISION DESCRIPTION	DRAWN	DATE
C	PRELIMINARY	NT	04.10.19
B	PRELIMINARY	NT	30.05.19
A	PRELIMINARY	NT	20.05.19

SCALE BAR
0 1 2 3 4 5m 10m
SCALE 1:100

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LVL 11, 68 ALFRED STREET, MILSONS POINT NSW 2061

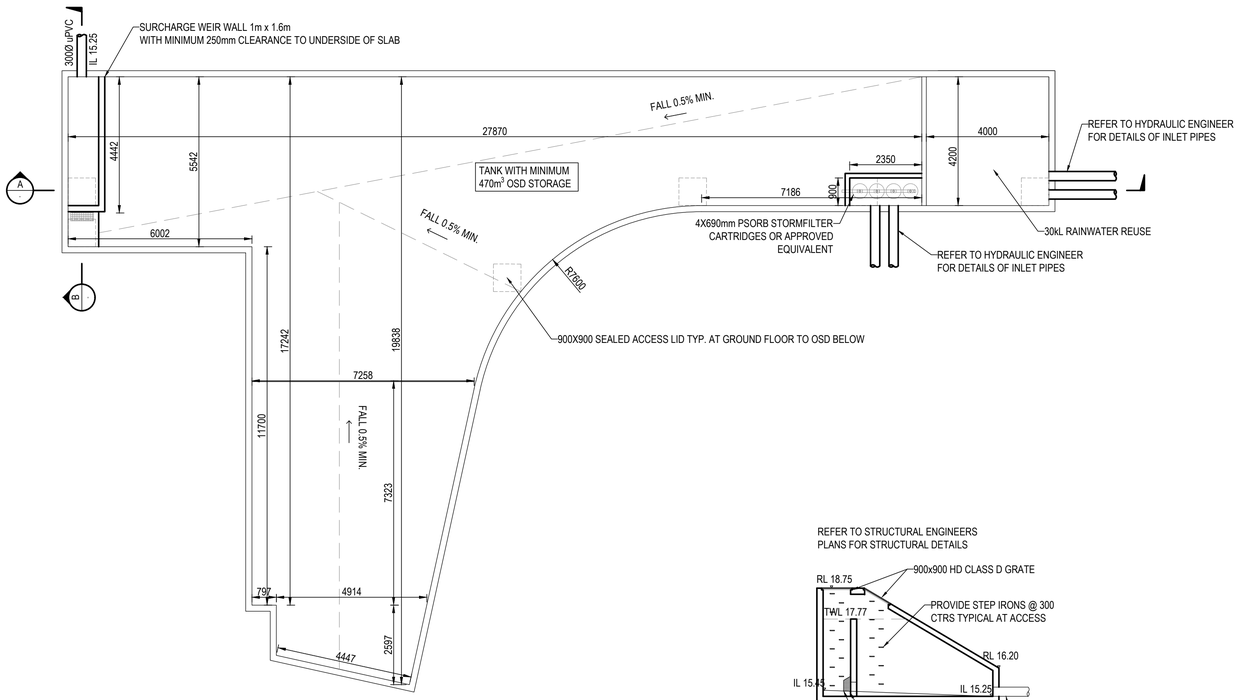
ARCHITECT
fjmt
LEVEL 5, 70 KING STREET, SYDNEY NSW 2000

PROJECT TITLE
EASTLAKES CENTRE - SOUTHERN SITE
GARDENERS ROAD
EASTLAKES NSW 2018

DRAWING TITLE
OSD TANK 1 DETAILS

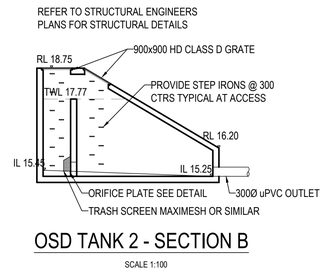
DRAWING STATUS
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

PROJECT LEADER	DESIGNER	SIGNATURE	
RJB	NT		
DRAFTSPERSON	SCALE	DATE	SHEET SIZE
BK		AUG 2018	A1
JOB No.		DRAWING No.	REVISION
SY182-033		C403	C



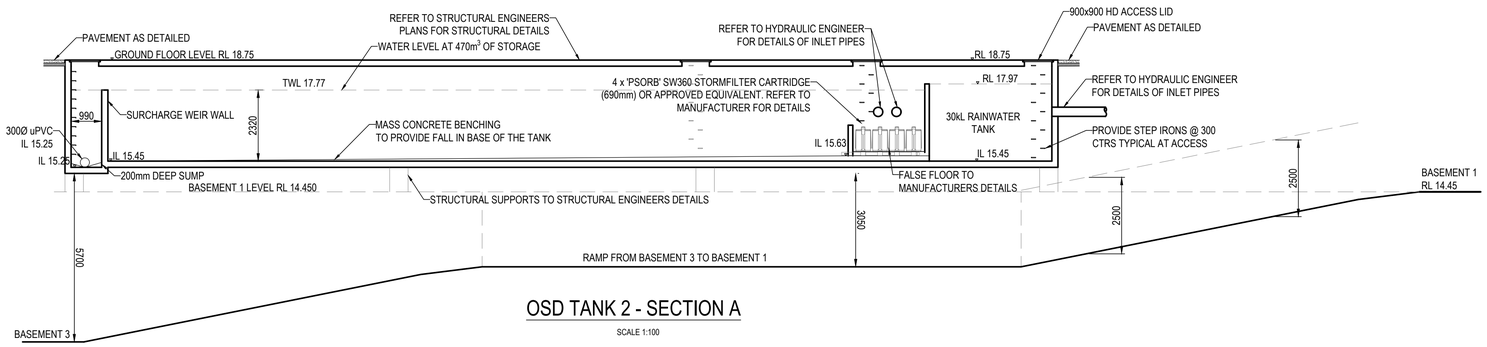
OSD TANK 2 - BASE SLAB

SCALE 1:100



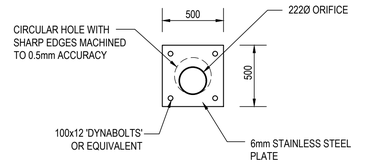
OSD TANK 2 - SECTION B

SCALE 1:100



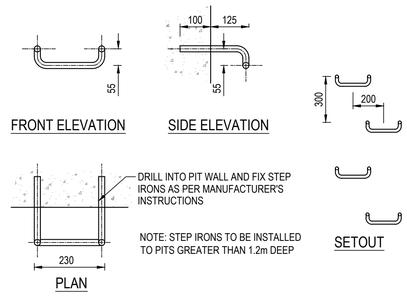
OSD TANK 2 - SECTION A

SCALE 1:100



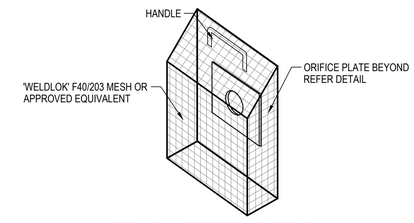
ORIFICE PLATE DETAIL

SCALE 1:25



TYPICAL STEP IRON DETAIL

NTS



TRASH SCREEN DETAIL

NTS

MESH TYPE	MESH SCREEN AREA
LYSAGHT RH3030 FOR ORIFICE 150Ø OR LESS	>50x ORIFICE DIA
'WELDLOK' F40/203 FOR ORIFICE GREATER THAN 150Ø	>20x ORIFICE DIA

NOTE: SCREEN AREA INCLUDES SIDES WHERE APPLICABLE

REVISIONS:

No.	REVISION DESCRIPTION	DRAWN	DATE
D	PRELIMINARY	NT	11.10.19
C	PRELIMINARY	NT	04.10.19
B	PRELIMINARY	NT	30.05.19
A	PRELIMINARY	NT	20.05.19

SCALE BAR
0 1 2 3 4 5m 10m
SCALE 1:100

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LVL 11, 68 ALFRED STREET, MILSONS POINT NSW 2061

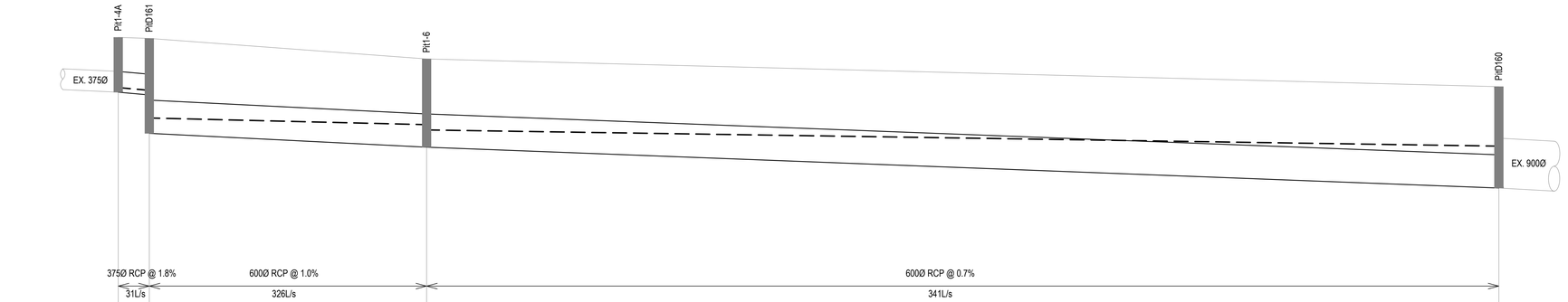
ARCHITECT
fjmt
LEVEL 5, 70 KING STREET, SYDNEY NSW 2000

PROJECT TITLE
EASTLAKES CENTRE - SOUTHERN SITE
GARDENERS ROAD
EASTLAKES NSW 2018

DRAWING TITLE
OSD TANK 2 DETAILS

DRAWING STATUS
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

PROJECT LEADER	DESIGNER	SIGNATURE	
RJB	NT		
DRAFTSPERSON	SCALE	DATE	SHEET SIZE
BK		AUG 2018	A1
JOB No.		DRAWING No.	REVISION
SY182-033		C404	D

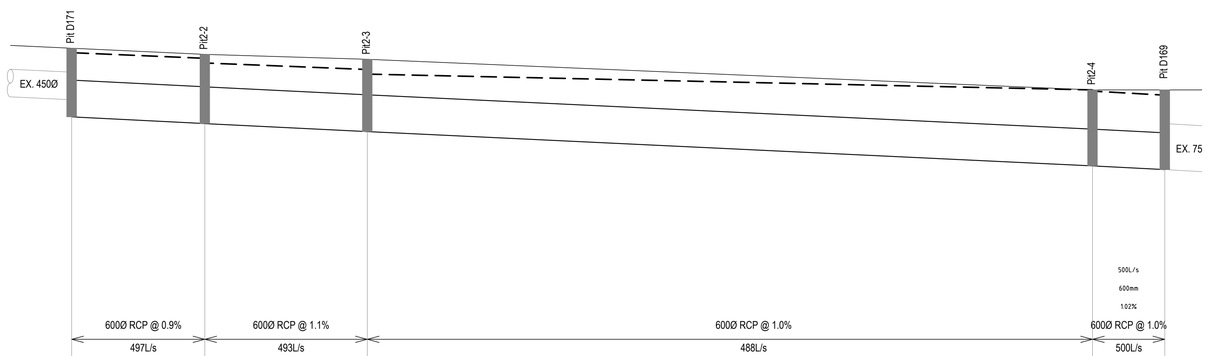


DATUM 12.0 (m)

HGL 5YR ARI	16.183	16.133 / 15.635		15.514 / 15.419		15.126
SURFACE LEVELS	17.09	17.07		16.7		16.2
INVERT LEVELS	16.100	16.050 / 15.357		15.107 / 15.107		14.370
CHAINAGE (m)	0	2.80		27.80		124.47

NORTH DIVERSION LINE

SCALE 1:250(H) 1:50(V)



DATUM 12.0 (m)

HGL 5YR ARI	17.207	17.116 / 17.040		16.933 / 16.658		16.600 / 16.581	16.514
SURFACE LEVELS	17.28	17.18		17.1		16.6	16.60
INVERT LEVELS	16.160	16.051 / 16.050		15.920 / 15.920		15.360 / 15.360	15.300
CHAINAGE (m)	0	10.87		24.13		83.32	89.22

SOUTH DIVERSION LINE

SCALE 1:250(H) 1:50(V)

0 1 2 3 4 5m
SCALE 1:50

0 1 2 3 4 5 10m 15 20m
SCALE 1:250

REVISIONS:

No.	REVISION DESCRIPTION	DRAWN	DATE
A	PRELIMINARY	NT	20.05.19

SCALE BAR

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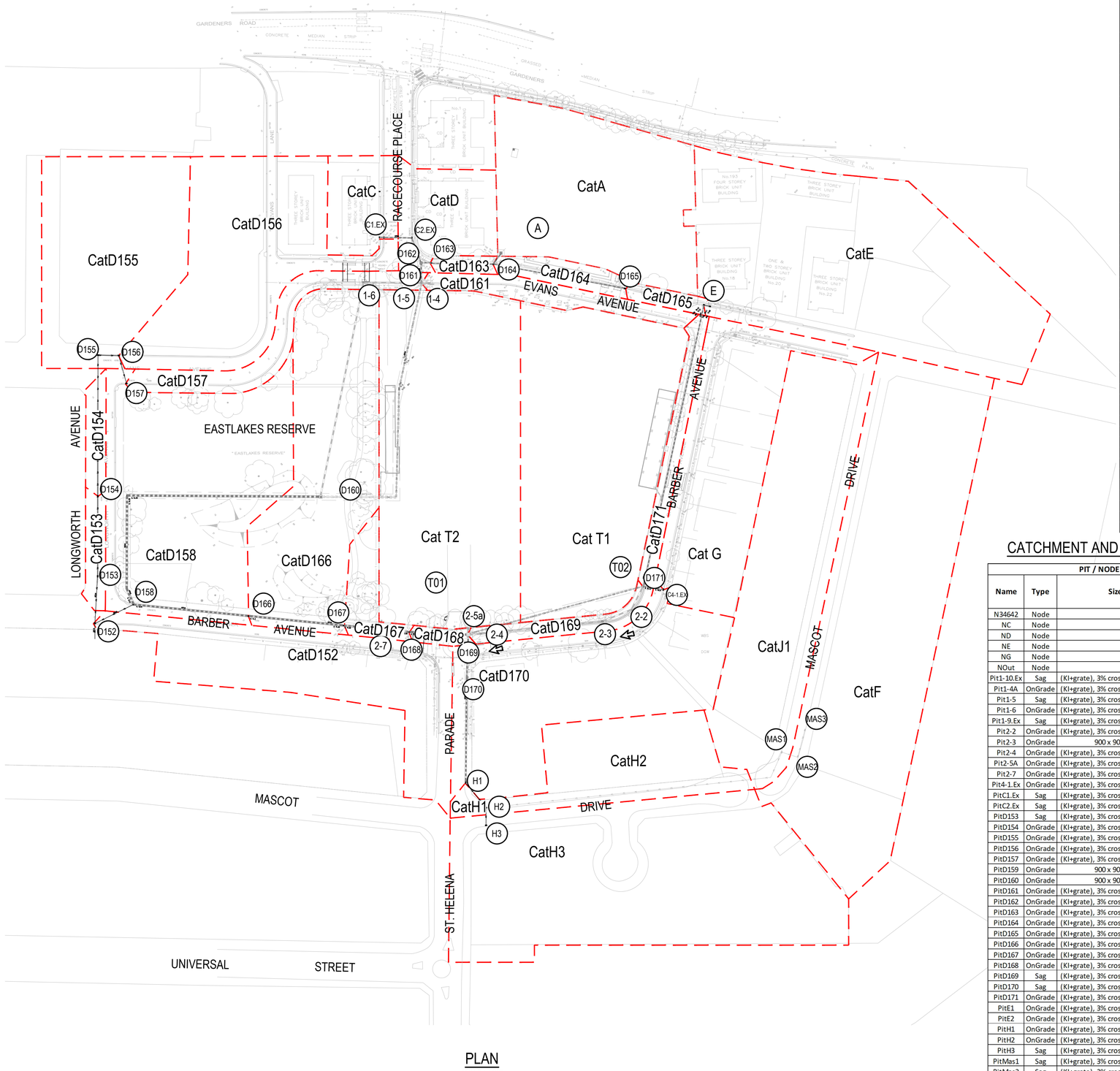
PROJECT TITLE
EASTLAKES CENTRE - SOUTHERN SITE
GARDENERS ROAD
EASTLAKES NSW 2018

DRAWING TITLE
DRAINAGE LONG. SECTIONS

DRAWING STATUS
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

PROJECT LEADER	DESIGNER	SIGNATURE	
RJB	NT		
DRAFTSPERSON	SCALE	DATE	SHEET SIZE
BK		AUG 2018	A1
JOB No.		DRAWING No.	REVISION
SY182-033		C405	A



PLAN
SCALE 1:1000

HYDRAULIC CALCULATIONS - 1 IN 100 YEAR ARI

PIT / NODE DETAILS				
Name	Max HGL	Max Surface Flow Arriving (cu.m/s)	Min Freeboard (m)	Overflow (cu.m/s)
NC	16.78	0.065		
ND	16.89	0.178		
NE	20.79	0.55		
NG	17.6	0.207		
NOut	14.41	2.842		
Pit1-10.Ex	14.92	2.446	0.14	2.317
Pit1-4A	16.43	0.067	0.66	0.021
Pit1-5	16.15	0.021	0.85	0
Pit1-6	15.94	0	0.76	0
Pit1-9.Ex	15.27	2.323	0	2.284
Pit2-2	17.15	0.019	0.13	0.004
Pit2-3	16.95	0.004	0.15	0
Pit2-4	16.6	0.047	0	0.184
Pit2-5A	16.53	0.184	0.02	0.154
Pit2-7	16.12	1.878	0.06	1.826
Pit4-1.Ex	17.32	0.062	0	0.293
PitC1.Ex	16.75	0.143	0	0.26
PitC2.Ex	16.81	0.173	0	0.143
PitD153	14.93	0.033	0.28	0
PitD154	14.94	0.028	0.38	0.005
PitD155	14.96	0.582	0.47	0.527
PitD156	14.99	0.462	0.46	0.403
PitD157	15	0.1	0.42	0.047
PitD159	15.32	0	0.37	
PitD160	15.39	0	0.81	
PitD161	16.42	0	0.65	
PitD162	16.78	0	0.43	
PitD163	17.12	0.234	0.07	0.173
PitD164	17.82	0.269	0	0.223
PitD165	17.88	0.294	0.45	0.233
PitD166	15.61	2.016	0	2.053
PitD167	15.96	1.856	0.01	1.811
PitD168	16.25	1.846	0	1.878
PitD169	16.52	0	0.08	
PitD170	16.75	1.72	0	1.687
PitD171	17.33	0.062	0.07	0.019
PitE1	18.17	0.313	0.23	0.278
PitE2	18.41	0	0	0.313
PitH1	17.48	0.579	0	0.555
PitH2	17.54	0.618	0.04	0.567
PitH3	17.65	0.566	0.03	0.453
PitMas1	18.2	0.799	0.5	0.611
PitMas2	18.31	0.585	0.39	0.415
PitMas3	18.34	0.637	0.66	0.585
Basin T1	23.09			
Basin T2	23.47			
Basin A	22.04			

SUB-CATCHMENT DETAILS					
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)
CatC	0.065	0.037	0.028	5	14
CatD	0.178	0.119	0.06	5	14
CatE	0.55	0.37	0.187	5	14
CatG	0.207	0.142	0.069	7	14
CatD152	0.309	0.214	0.095	5	7
CatD161	0.067	0.062	0.005	7	7
CatD158	0.388	0.055	0.333	5	7
CatD169	0.047	0.044	0.003	5	7
Cat22325	0.062	0.058	0.004	5	7
CatD153	0.028	0.017	0.011	5	7
CatD154	0.028	0.017	0.011	5	7
CatD155	0.21	0.038	0.175	5	14
CatD156	0.245	0.083	0.168	5	14
CatD157	0.1	0.085	0.014	5	7
CatD163	0.015	0.014	0.001	5	7
CatD164	0.043	0.04	0.003	5	7
CatD165	0.019	0.018	0.001	5	7
CatD166	0.315	0.045	0.271	5	7
CatD167	0.04	0.012	0.028	5	10
CatD168	0.014	0.013	0.001	5	7
CatD170	0.332	0.223	0.113	5	14
CatD171	0.062	0.058	0.004	5	7
CatH1	0.013	0.012	0.001	5	7
CatH2	0.166	0.111	0.056	5	14
CatH3	0.566	0.38	0.193	5	14
CatJ1	0.404	0.311	0.093	5	14
CatF	0.637	0.428	0.217	5	14
Cat T1	0.559	0.559	0	10	7
Cat T2	0.56	0.56	0	10	7
CatA	0.397	0.384	0.014	7	7

PIPE DETAILS				
Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)
PipeC	0.067	0.42	16.777	16.75
PipeD	0.179	1.12	16.886	16.815
PipeE3	0.543	4.91	20.791	18.41
PipeG	0.208	1.88	17.597	17.32
Pipe1-10.Ex	1.974	3.29	14.677	14.409
Pipe1-4A	0.046	0.46	16.419	16.419
Pipe1-5	0.517	1.83	16.038	15.937
Pipe1-6	0.501	1.77	15.825	15.391
PipeD157	1.713	2.69	15.096	14.922
Pipe2-2	0.523	1.85	17.069	16.947
Pipe2-3	0.512	1.81	16.865	16.6
Pipe2-4	0.535	1.89	16.582	16.521
Pipe2-5A	0.036	0.33	16.526	16.521
PipeD174b	1.252	2.34	16.093	15.959
Pipe2-1.Ex	0.164	1.49	17.32	17.334
PipeC1.Ex	0.083	0.75	16.75	16.815
PipeC2.Ex	0.174	1.1	16.797	16.784
PipeD156	0.212	0.4	14.927	14.922
PipeD158	0.184	0.38	14.937	14.929
PipeD159	0.16	0.45	14.95	14.939
PipeD160	0.106	0.67	14.975	14.956
PipeD161	0.053	0.33	14.989	14.985
PipeD165	0.503	0.79	15.294	15.267
PipeD167	0.501	0.79	15.369	15.316
Pipe1-4	0.509	1.8	16.315	16.151
PipeD169	0.474	2.19	16.572	16.419
PipeD170	0.362	2.28	16.99	16.784
PipeD171	0.315	2.85	17.631	17.117
PipeD172	0.065	0.6	17.877	17.815
PipeD166	1.298	2.43	15.495	15.267
PipeD173	1.289	2.41	15.827	15.61
PipeD174a	1.213	2.27	16.182	16.117
PipeD175	1.169	2.65	16.392	16.25
PipeD176	0.7	2.48	16.708	16.521
Pipe2-1	0.523	1.85	17.256	17.151
PipeE1	0.315	1.98	18.069	17.334
PipeE2	0.305	1.92	18.337	18.166
PipeH	0.573	2.65	17.298	16.752
PipeH1-H2	0.164	1.03	17.529	17.476
PipeH2-H3	0.117	1.06	17.596	17.539
PipeF2	0.398	2.45	18.066	17.476
PipeF1	0.228	1.43	18.295	18.197
PipeF3	0.061	0.55	18.332	18.315
Pipe T1	0.255	6.78	18.879	17.334
Pipe T2	0.251	5.87	17.251	16.117
PipeBasinA	0.221	2	18.071	17.815

CATCHMENT AND PIPELINE DETAILS

PIT / NODE DETAILS				
Name	Type	Size	Pressure Change Coeff. Ku	Surface Elev (m)
N34642	Node			17.1
NC	Node			18
ND	Node			18
NE	Node			20
NG	Node			17.5
NOut	Node			15
Pit1-10.Ex	Sag	(KI+grate), 3% crossfall, all grades	0.5	15.06
Pit1-4A	OnGrade	(KI+grate), 3% crossfall, all grades	1.5	17.09
Pit1-5	Sag	(KI+grate), 3% crossfall, all grades	0.7	17
Pit1-6	OnGrade	(KI+grate), 3% crossfall, all grades	0.7	16.7
Pit1-9.Ex	Sag	(KI+grate), 3% crossfall, all grades	0.5	15.2
Pit2-2	OnGrade	(KI+grate), 3% crossfall, all grades	0.5	17.28
Pit2-3	OnGrade	900 x 900 SIP	0.5	17.1
Pit2-4	OnGrade	(KI+grate), 3% crossfall, all grades	0.2	16.6
Pit2-5A	OnGrade	(KI+grate), 3% crossfall, all grades	1.5	16.55
Pit2-7	OnGrade	(KI+grate), 3% crossfall, all grades	0.1	16.18
Pit4-1.Ex	OnGrade	(KI+grate), 3% crossfall, all grades	0.7	17.32
PitC1.Ex	Sag	(KI+grate), 3% crossfall, all grades	1	16.65
PitC2.Ex	Sag	(KI+grate), 3% crossfall, all grades	1	16.66
PitD153	Sag	(KI+grate), 3% crossfall, all grades	0.2	15.21
PitD154	OnGrade	(KI+grate), 3% crossfall, all grades	0.2	15.32
PitD155	OnGrade	(KI+grate), 3% crossfall, all grades	0.7	15.43
PitD156	OnGrade	(KI+grate), 3% crossfall, all grades	0.5	15.45
PitD157	OnGrade	(KI+grate), 3% crossfall, all grades	1.5	15.42
PitD159	OnGrade	900 x 900 SIP	0.7	15.69
PitD160	OnGrade	900 x 900 SIP	0.7	16.2
PitD161	OnGrade	(KI+grate), 3% crossfall, all grades	0.7	17.07
PitD162	OnGrade	(KI+grate), 3% crossfall, all grades	1	17.21
PitD163	OnGrade	(KI+grate), 3% crossfall, all grades	0.5	17.19
PitD164	OnGrade	(KI+grate), 3% crossfall, all grades	0.5	17.82
PitD165	OnGrade	(KI+grate), 3% crossfall, all grades	0.5	18.33
PitD166	OnGrade	(KI+grate), 3% crossfall, all grades	0.5	15.61
PitD167	OnGrade	(KI+grate), 3% crossfall, all grades	0.5	15.97
PitD168	OnGrade	(KI+grate), 3% crossfall, all grades	0.5	16.25
PitD169	Sag	(KI+grate), 3% crossfall, all grades	0.5	16.6
PitD170	Sag	(KI+grate), 3% crossfall, all grades	0.2	16.5
PitD171	OnGrade	(KI+grate), 3% crossfall, all grades	0.5	17.4
PitE1	OnGrade	(KI+grate), 3% crossfall, all grades	0.7	18.4
PitE2	OnGrade	(KI+grate), 3% crossfall, all grades	0.7	18.41
PitH1	OnGrade	(KI+grate), 3% crossfall, all grades	0.5	17.48
PitH2	OnGrade	(KI+grate), 3% crossfall, all grades	0.2	17.58
PitH3	Sag	(KI+grate), 3% crossfall, all grades	1	17.68
PitMas1	Sag	(KI+grate), 3% crossfall, all grades	1	18.7
PitMas2	Sag	(KI+grate), 3% crossfall, all grades	0.2	18.7
PitMas3	OnGrade	(KI+grate), 3% crossfall, all grades	0.7	19
Basin T1	Basin			23.6
Basin T2	Basin			28
Basin A	Basin			23.5

SUB-CATCHMENT DETAILS					
Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	
CatC	NC	0.133	40	60	
CatD	ND	0.34	50	50	
CatE	NE	1.054	50	50	
CatG	NG	0.429	50	50	
CatD152	Pit1-10.Ex	0.494	60	40	
CatD161	Pit1-4A	0.103	90	10	
CatD158	Pit1-9.Ex	0.769	10	90	
CatD169	Pit2-4	0.067	90	10	
Cat22325	Pit4-1.Ex	0.089	90	10	
CatD153	PitD153	0.047	50	50	
CatD154	PitD154	0.046	50	50	
CatD155	PitD155	0.548	10	90	
CatD156	PitD156	0.591	20	80	
CatD157	PitD157	0.148	80	20	
CatD163	PitD163	0.022	90	10	
CatD164	PitD164	0.062	90	10	
CatD165	PitD165	0.027	90	10	
CatD166	PitD166	0.625	10	90	
CatD167	PitD167	0.082	20	80	
CatD168	PitD168	0.02	90	10	
CatD170	PitD170	0.635	50	50	
CatD171	PitD171	0.089	90	10	
CatH1	PitH1	0.018	90	10	
CatH2	PitH2	0.317	50	50	
CatH3	PitH3	1.083	50	50	
CatJ1	PitMas1	0.719	60	40	
CatF	PitMas3	1.22	50	50	
Cat T1	T1	0.888	100	0	
Cat T2	T2	0.889	100	0	
CatA	BasinA	0.604	95	5	

PIPE DETAILS										
Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	Rough
PipeC	NC	PitC1.Ex	20	15.95	15.75	1	Concrete, under roads	450	0.3
PipeD	ND	PitC2.Ex	20	15.866	15.666	1	Concrete, under roads	450	0.3
PipeE3	NE	PitE2	38.3	17.92	17.52	1.04	Concrete, under roads	375	0.3
PipeG	NG	Pit4-1.Ex	29.4	16.804	16.51	1	Concrete, under roads	375	0.3
Pipe1-10.Ex	Pit1-10.Ex	NOut	20	13.764	13.604	0.8	Concrete, under roads	900	0.3
Pipe1-4A	Pit1-4A	PitD161	2.8	16.1	16.05	1.79	Concrete, under roads	375	0.3
Pipe1-5	Pit1-5	Pit1-6	22.28	15.33	15.107	1	Concrete, under roads	600	0.3
Pipe1-6	Pit1-6	PitD160	95.6	15.107	14.4	0.74	Concrete, under roads	600	0.3
PipeD157	Pit1-9.Ex	Pit1-10.Ex	18.3	13.91	13.764	0.8	Concrete, under roads	900	0.3
Pipe2-2	Pit2-2	Pit2-3	14	16.05	15.9	1.07	Concrete, under roads	600	0.3
Pipe2-3	Pit2-3	Pit2-4	54.45	15.9	15.36	0.99	Concrete, under roads	600	0.3
Pipe2-4	Pit2-4	PitD169	5.9	15.36	15.3	1.02	Concrete, under roads	600	0.3
Pipe2-5A	Pit2-5A	PitD169	2	15.52	15.5	1	Concrete, under roads	375	0.3
PipeD174b	Pit2-7	PitD167	16.6	14.86	14.68	1.08	Concrete, under roads	825	0.3
Pipe2-1.Ex	Pit4-1.Ex	PitD171	8.7	16.51	16.43	0.92	Concrete, under roads	375	0.3
PipeC1.Ex	PitC1.Ex	PitC2.Ex	12.3	15.75	15.666	0.68	Concrete, under roads	375	0.3
PipeC2.Ex	PitC2.Ex	PitD162	11.7	15.666	15.549	1	Concrete, under roads	450	0.3
PipeD156	PitD153	Pit1-10.Ex	14.9	14.08	13.91	1.14	Concrete, under roads	825	0.3
PipeD158	PitD154	PitD153	41.2	14.24	14.08	0.39	Concrete, under roads	825	0.3
PipeD159	PitD155	PitD154	63.4	14.43	14.24	0.3	Concrete, under roads	825	0.3
PipeD160	PitD156	PitD155	9.3	14.44	14.44	0	Concrete, under roads	450	0.3
PipeD161	PitD157	PitD156	13	14.5	14.44	0.46	Concrete, under roads	450	0.3
PipeD165	PitD159	Pit1-9.Ex	49	14.03	13.91	0.24	Concrete, under roads	900	0.3
PipeD167	PitD160	PitD159	95.2	14.4	14.03	0.39	Concrete, under roads	900	0.3
Pipe1-4	PitD161	Pit1-5	3.7	15.37	15.33	1.08	Concrete, under roads	600	0.3
PipeD169	PitD162	PitD161	8.958	15.549	15.37	2	Concrete, under roads	525	0.3
PipeD170	PitD163	PitD162	4.592	16.36	16.314	1	Concrete, under roads	450	0.3
PipeD171	PitD164	PitD163	27.771	17.03	16.36	2.41	Concrete, under roads	375	0.3
PipeD172	PitD165	PitD164	59.603	17.52	17.03	0.82	Concrete, under roads	375	0.3
PipeD166	PitD166	Pit1-9.Ex	51.9	14.3	13.91	0.75	Concrete, under roads	825	0.3
PipeD173	PitD167	PitD166	43	14.68	14.3	0.88	Concrete, under roads	825	0.3
PipeD174a	PitD168	Pit2-7	12.5	15	14.86	1.12	Concrete, under roads	825	0.3
PipeD175	PitD169	PitD168	25.79	15.3	15	1.16	Concrete, under roads	750	0.3
PipeD176	PitD170	PitD169	18.496	15.6	15.3	1.62	Concrete, under roads	600	0.3
Pipe2-1	PitD171	Pit2-2	11.717	16.16	16.05	0.94	Concrete, under roads	600	0.3
PipeE1	PitE1	PitD171	128.456	17.51	16.43	0.84	Concrete, under roads	450	0.3
PipeE2	PitE2	PitE1	2	17.52	17.51	0.5	Concrete, under roads	450	0.3
PipeH	PitH1	PitD170	45.92	16.443	15.6	1.84	Concrete, under roads	525	0.3
PipeH1-H2	PitH2	PitH1	14	16.58	16.443	0.98	Concrete, under roads	450	0.3
PipeH2-H3	PitH3	PitH2	7.4	16.65	16.58	0.95	Concrete, under roads	375	0.3
PipeF2	PitMas1	PitH1	154.5	17.73	16.443	0.83	Concrete, under roads	600	0.3
PipeF1	PitMas2	PitMas1	12	17.83	17.73	0.83	Concrete, under roads	450	0.3
PipeF3	PitMas3	PitMas2	12.6	17.93	17.83	0.79	Concrete, under roads	375	0.3
Pipe T1	T1	PitD171	15	18.75	16.3	16.33	Concrete, under roads	450	0.3
Pipe T2	T2	Pit2-7	20.3	17.11	14.86	11.08	Concrete, under roads	450	0.3
PipeBasinA	BasinA	PitD164	15	17.632	17.03	4.01	Concrete, under roads	375	0.3

REVISIONS:

No.	REVISION DESCRIPTION	DRAWN	DATE
A	PRELIMINARY	NT	20.05.19

SCALE BAR
0 10 20 30 40 50m 100m
SCALE 1:1000

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ARCHITECT
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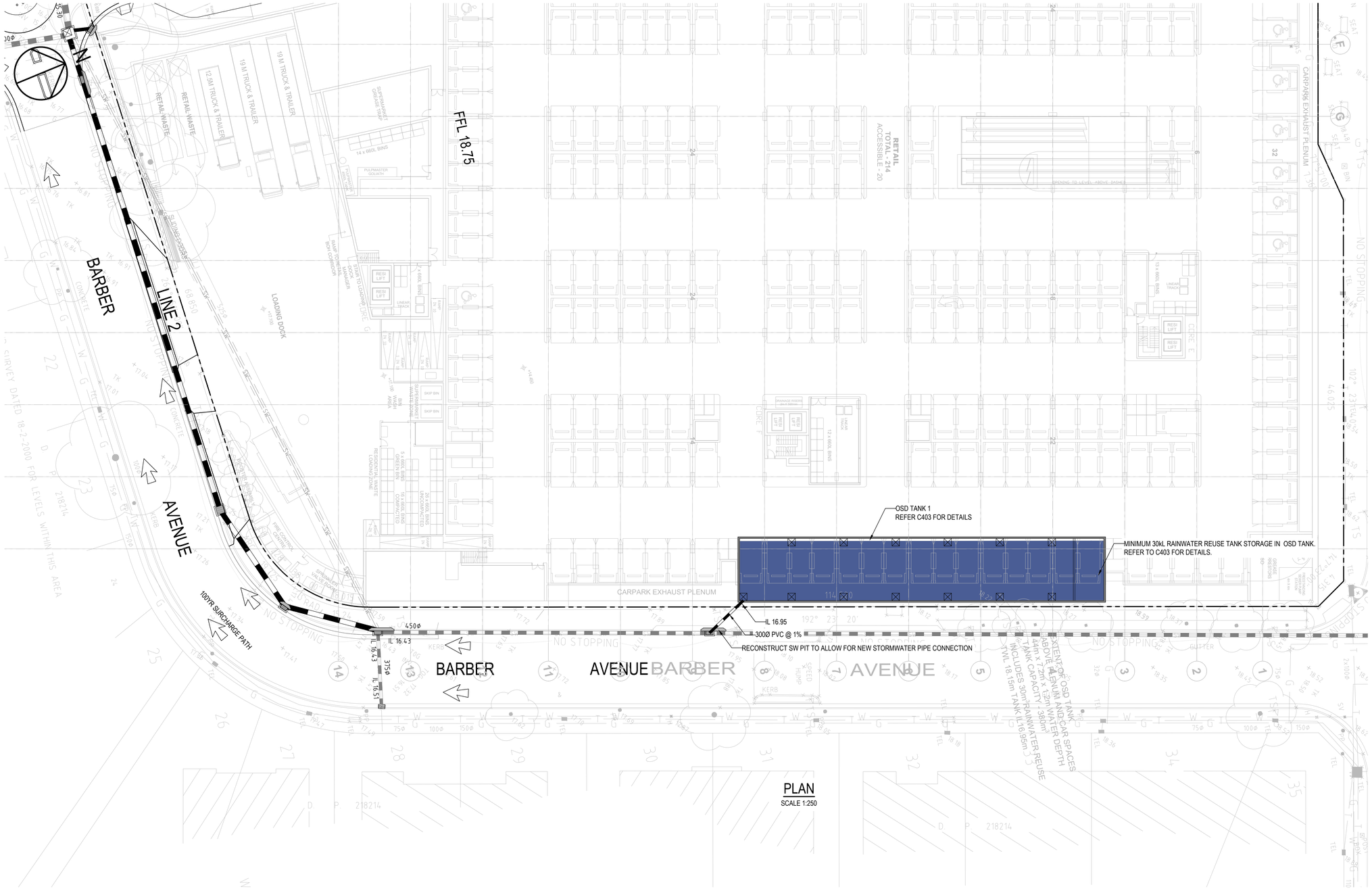
LEVEL 5, 70 KING STREET, SYDNEY NSW 2000

PROJECT TITLE
EASTLAKES CENTRE - SOUTHERN SITE
GARDENERS ROAD
EASTLAKES NSW 2018

DRAWING TITLE
CATCHMENT PLAN
SHEET 1

DRAWING STATUS
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

PROJECT LEADER	DESIGNER	SIGNATURE	
RJB	NT		
DRAFTSPERSON	SCALE	DATE	SHEET SIZE
BK		AUG 2018	A1
JOB No.		DRAWING No.	REVISION
SY182-033		C406	A



LEGEND

- PROPOSED STORMWATER PITS
- PROPOSED STORMWATER PIPES
- (2-1) STORMWATER PIT REFERENCE
- DENOTES 100 YEAR SURCHARGE PATH

PIT SCHEDULE		
PIT No.	INLET DETAIL	PIT DETAIL
2-1	2.4m EKI	900x900
2-2	0.9m KI	900x900
2-3	900x900 V-GRATE	900x900
2-4	2.4m EKI	900x900
2-5	900x900 HD LID	1200x1200
2-5A	0.9m KI	900x900
2-7	2.4m EKI	900x900

PLAN
SCALE 1:250

REVISIONS:			
B	PRELIMINARY	NT	04.10.19
A	PRELIMINARY	NT	30.05.19
No.	REVISION DESCRIPTION	DRAWN	DATE

SCALE BAR
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SCALE 1:250

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ARCHITECT
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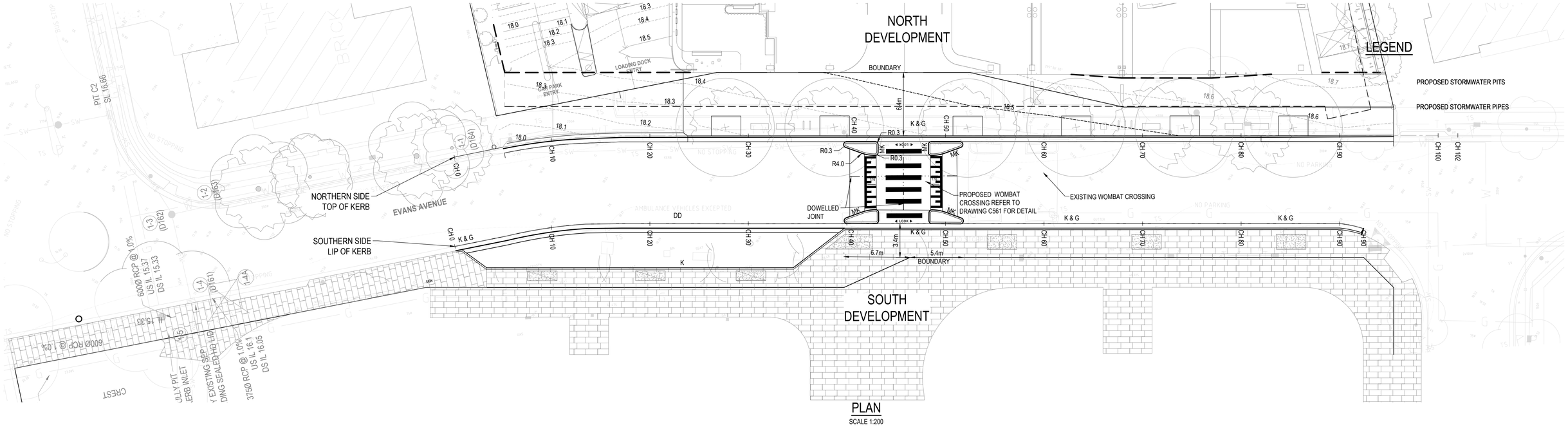
PROJECT TITLE
EASTLAKES CENTRE - SOUTHERN SITE
GARDENERS ROAD
EASTLAKES NSW 2018

DRAWING TITLE
OSD TANK 1 PLAN

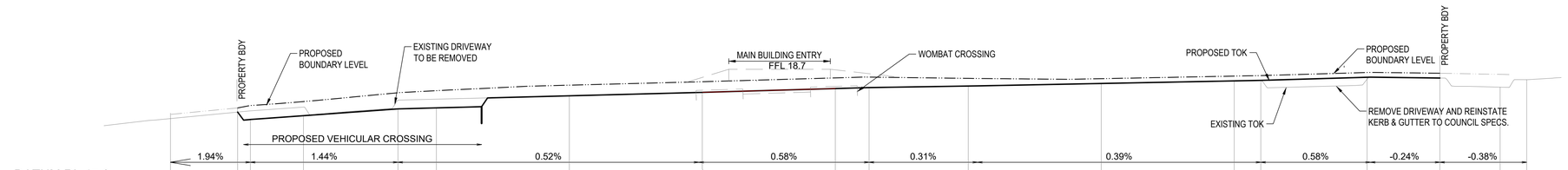
DRAWING STATUS
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

PROJECT LEADER	DESIGNER	SIGNATURE	
RJB	NT		
DRAFTSPERSON	SCALE	DATE	SHEET SIZE
BK		AUG 2018	A1
JOB No.		DRAWING No.	REVISION
SY182-033		C407	B



PLAN

SCALE 1:200



DATUM RL 17.0

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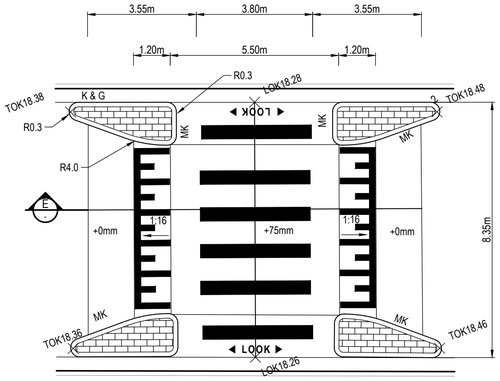

EVANS AVENUE WOMBAT CROSSING
PLAN (TYP.)
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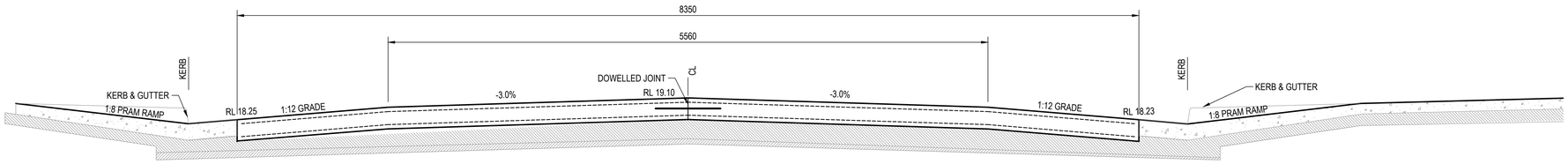
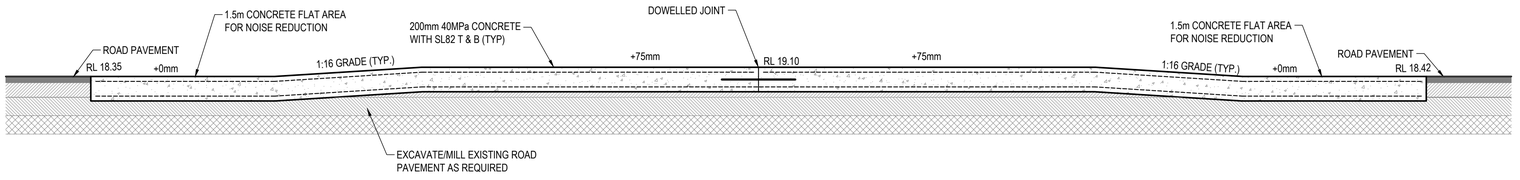


SECTION F
SCALE 1:25



SECTION E
SCALE 1:25

LEGEND

PROPOSED STORMWATER PITS

PROPOSED STORMWATER PIPES

REVISIONS:			
		NT	04.10.19
A	PRELIMINARY	RG	11.10.19
No.	REVISION DESCRIPTION	DRAWN	DATE

SCALE BAR
0 1 2 3 4 5m 10m
SCALE 1:100
0 1 2 3 4 .5 1m 1.5 2m
SCALE 1:25

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PROJECT TITLE
EASTLAKES CENTRE - SOUTHERN SITE
GARDENERS ROAD
EASTLAKES NSW 2018

DRAWING TITLE
EVANS AVE WOMBAT CROSSING - SECTIONS

DRAWING STATUS
PRELIMINARY
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PROJECT LEADER	DESIGNER	SIGNATURE	
RJB	NT		
DRAFTSPERSON	SCALE	DATE	SHEET SIZE
BK	AS SHOWN	AUG 2018	A1
JOB No.		DRAWING No.	REVISION
SY182-033		C561	AC

Appendix B – GRC Hydro Flood Assessment

Job Number: *180046*
Date: *15 August 2018*

GRC Hydro
Level 9, 233 Castlereagh Street
Sydney NSW 2000

Tel: +61 413 631 447
www.grchydro.com.au

Rod Burrough
Van Der Meer Consulting
Level 6, 39 Chandos Street
St Leonards NSW 2065

Dear Rod,

Re: Redevelopment of Eastlakes Shopping Centre – Flood Assessment

Thank you for providing GRC Hydro with the opportunity to undertake a flood assessment for the above referenced site.

INTRODUCTION

Development is proposed for Eastlakes Shopping Centre (the subject site) situated in the Bayside Council (Council) Local Government Area.

Figure 1 presents the site's locality (see rear of report for figures). This flood study has been carried out using the 2D hydrodynamic modelling program, TUFLOW.

The site is subject to flooding from overland flows originating at the catchment upstream boundary along Southern Cross Drive and Gardeners Road as defined in the Mascot, Rosebery and Eastlakes Flood Study. Generally overland flow moves around the subject site. Along the site's eastern and southern boundaries overland flow is contained to the kerb/gutter system along Barber Avenue. The northern subject site boundary (at Evans Avenue), overland flow generally flows in an easterly direction.

This letter examines existing and proposed flood behaviour for the subject site, including:

- Flood impacts of the proposed development; and
- Flood affection of the proposed development.

PREVIOUS STUDIES

The Mascot, Rosebery and Eastlakes Flood Study (the Flood Study) was completed by WMAwater in May 2015 on behalf of the City of Botany Bay Council (now Bayside Council). The Flood Study provides information on flood conditions throughout the catchment for a range of design floods, from relatively frequent events to more extreme floods.

The Flood Study produced a DRAINS/TUFLOW hydrologic/hydraulic modelling system to model design flood behaviour. The Flood Study DRAINS and TUFLOW models were provided by Council and used as the basis of this study.

RELEVANT POLICY

The Botany Bay Development Control Plan (DCP) 2013 came into effect in September 2017 and is applicable to this development proposal. Part 10 (Stormwater Management Technical Guidelines) of the DCP outlines the Finished Floor Level requirements that pertain to the subject site:

(i) For a site within Council's identified flood area or within the vicinity of Council or Sydney Water drainage easement/reserve or stormwater drainage system (including open/covered channel, watercourse and underground drainage pipes/culverts), the finished floor levels shall be minimum 500 mm (habitable buildings/structures) and 300mm (non-habitable buildings/structures, such as garages, ramps to the basement car parking area) above the estimated 1% AEP flood level.

(v) For a site with a below ground basement, the crest levels of ramps and steps at the entry points shall be minimum of 300 mm above the following:

- *1% AEP flood level where such is known; or*
- *Top of kerb adjacent to the layback; or*
- *Overflow RL from any on-site stormwater systems;*

EXISTING FLOOD BEHAVIOUR

Figure 2 shows the 1% AEP existing flood behaviour in the vicinity of the subject site. In the 1% AEP event, the capacity of the existing drainage system is exceeded and additional flow is conveyed overland. This flow is contained within the kerb/gutter system along Evans Avenue and Barber Avenue. Some minor flood storage occurs in Eastlakes Reserve located downstream of the subject site (to the west) where flood depths are up to 0.37 m.

Survey was undertaken of the drainage system surrounding the subject site and is presented in Appendix A. Pipe sizes and invert levels from this survey were incorporated into the existing case TUFLOW model.

PROPOSED DEVELOPMENT

The proposed design was implemented in the Council DRAINS and TUFLOW model based on the following information:

- OSD details from DRAINS modelling undertaken by Van Der Meer Consulting was incorporated into the Council DRAINS model; and
- The proposed pipe realignment (shown in Figure 3) was implemented based on the design shown in Appendix B.

Figure 3 shows the 1% AEP proposed flood behaviour in the vicinity of the subject site.

FLOOD IMPACT ASSESSMENT

A flood impact assessment has been undertaken which assessed the proposed development using the Flood Study TUFLOW model. The flood level impacts associated with the proposed development, inclusive of the measures listed above, are shown in Figure 4. These impacts present the change in flood level between the existing and proposed conditions for the 1% AEP event.

Figure 4 indicates that the in the 1% AEP event, flood levels are decreased on neighbouring residential lots in the proposed scenario and as such, impacts are compliant.

ENTRANCE LEVELS COMPLIANCE

In accordance with Council's DCP, entrances to the development and to underground carparks must be 0.3 m above the peak 1% AEP level. As such, the proposed entrance locations for the development have been shown in Figure 3 (as a green circle) and the proposed 1% AEP flood level and complying floor level has been labelled. The northern entry on Evans Avenue must be 17.43 m AHD (based on the 1% AEP flood level plus 0.3 m freeboard). Similarly, the southern entry to the shopping centre on Barber Avenue must be at least 17.13 m AHD (1% AEP flood level plus 0.3 m freeboard).

CONCLUSIONS

Council's DRAINS and TUFLOW models, developed as a part of the Mascot, Rosebery and Eastlakes Flood Study (WMAwater, 2015), has been used to analyse the proposed development at the Eastlakes Shopping Centre and advise the complying entrance and floor levels. The details of the proposed development are presented in Appendix B.

Please do not hesitate to contact me either by email or phone if you require any further clarification on the information presented above.

Yours Sincerely,

Steve Gray
Director

Email: gray@grchydro.com.au
Tel: +61 413 631 447

FIGURES

FIGURE 1
REDEVELOPMENT EASTLAKES SHOPPING CENTRE
SUBJECT SITE LOCATION

Zetland
Kensington
Beaconsfield
Kingsford
Rosebery
Eastlakes
Eastlakes Shopping Centre
Mascot

Source: Google Earth

SOUTHERN CROSS DRIVE
GARDENERS ROAD
EVANS AVENUE
BARBER AVENUE
MASCOT DRIVE
ST HELENA PARADE
George St

N
1

Subject Site
Cadastral boundaries

grc HYDRO

0 200
metres

FIGURE 2
REDEVELOPMENT EASTLAKES SHOPPING CENTRE
EXISTING CASE
1% AEP PEAK FLOOD DEPTHS & LEVELS

SOUTHERN CROSS DRIVE
GARDENERS ROAD
BARBER AVENUE
MASCOT DRIVE
ST HELENA PARADE
EVANS AVENUE

Flood Depths (m)
- 0 to 0.05
- 0.05 to 0.1
- 0.1 to 0.3
- 0.3 to 0.5
- 0.5 to 1
- >1

Major Flood Level Contours (1m Spacing)
Minor Flood Level Contours (0.1m Spacing)
Existing Pits
Existing Pipes
Subject Site
Cadastral boundaries

N
1

grc HYDRO

0 200
metres

FIGURE 3
REDEVELOPMENT EASTLAKES SHOPPING CENTRE
PROPOSED CASE
1% AEP PEAK FLOOD DEPTHS & LEVELS

SOUTHERN CROSS DRIVE
GARDENERS ROAD
EVANS AVENUE
BARBER AVENUE
MASCOT DRIVE
ST HELENA PARADE

17.13
17.43
16.83
17.13

Flood Depths (m)
- 0 to 0.05
- 0.05 to 0.1
- 0.1 to 0.3
- 0.3 to 0.5
- 0.5 to 1
- >1

Major Flood Level Contours (1m Spacing)
Minor Flood Level Contours (0.1m Spacing)
Aa 1% AEP Flood Level
Aa Proposed Floor Level (Based on 1% AEP + 0.3 m)
Entrance Locations
Proposed Pits
Proposed Pipes
Existing Pits
Existing Pipes
Subject Site
Cadastral boundaries

N
1

grc HYDRO

0 200
metres

FIGURE 4
REDEVELOPMENT EASTLAKES SHOPPING CENTRE
PROPOSED CASE
1% AEP PEAK FLOOD LEVEL IMPACTS

SOUTHERN CROSS DRIVE
GARDENERS ROAD
EVANS AVENUE
BARBER AVENUE
MASCOT DRIVE
ST HELENA PARADE

Change in Flood Level (m)
- < -0.3
- -0.3 to -0.2
- -0.2 to -0.1
- -0.1 to -0.01
- No Impact
- 0.01 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- > 0.3
- Newly Flooded
- No Longer Flooded
- Proposed Pits
- Proposed Pipes
- Existing Pits
- Existing Pipes
- Subject Site
- Cadastral boundaries

N

grc HYDRO

0 200
metres

APPENDIX A

SCHEDULE OF EASEMENTS :-

(A) RIGHT OF CARRIAGEWAY 6.7l WIDE (RI03877)

(B) EASEMENT TO STAND MOTOR VEHICLES (RI03877)

(C) RIGHT OF CARRIAGEWAY 6.7l WIDE (RI03876)

(D) EASEMENT TO STAND MOTOR VEHICLES (RI03876)

(E) RIGHT OF CARRIAGEWAY 6.7l WIDE (T850832)

(F) RIGHT OF CARRIAGEWAY 6.7l WIDE (T850830 & T850831)

(G) EASEMENT TO DRAIN WATER 6.7l WIDE (RI03874)

(H) EASEMENT FOR SERVICES 6.7l WIDE (RI03874)

(J) EASEMENT TO DRAIN WATER 6.7l WIDE (RI03873)

(K) EASEMENT FOR SERVICES 6.7l WIDE (RI03873)

(L) DRAINAGE EASEMENT 1.83 WIDE (J947588)

(M) EASEMENT FOR DRAINAGE 3.05 WIDE (K295646)

(N) EASEMENT FOR ELECTRICITY PURPOSES 1.83 WIDE & VARIABLE WIDTH (T670099)

(O) RIGHT OF WAY VARIABLE WIDTH

(P) RIGHT OF CARRIAGEWAY 6 WIDE & VARIABLE WIDTH (D.P.601517)

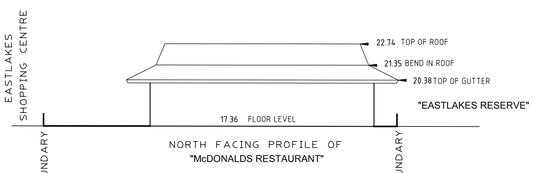
(Q) EASEMENTS FOR ACCESS 5.485, 6.56 WIDE & VARIABLE WIDTH (D.P.601517)

(R) EASEMENT FOR ACCESS 5.485 WIDE (D.P601517)

(S) RIGHT OF WAY VARIABLE WIDTH (X756548)

(T) EASEMENT FOR ELECTRICITY PURPOSES 2.955 WIDE & VARIABLE WIDTH (X756548)

(U) RIGHT OF WAY & EASEMENT FOR ELECTRICITY PURPOSES (X756548)



NORTH FACING PROFILE OF "McDONALDS RESTAURANT"

THIS PROFILE IS THE SAME FOR THE EAST, WEST AND SOUTH FACING WALLS

DIAGRAM
SCALE 1:200

NOTES:- THE PURPOSE OF THIS SURVEY WAS TO OBTAIN TOPOGRAPHICAL DETAIL AS REPRESENTED ON THIS PLAN

BOUNDARIES HAVE NOT BEEN DEFINED OR MARKED

BEARINGS, DIMENSIONS & AREAS HAVE BEEN COMPILED FROM PUBLIC RECORDS AND ARE SUBJECT TO SURVEY

LEVELS SHOWN HEREON ARE RELATED TO AUSTRALIAN HEIGHT DATUM (A.H.D.)

SERVICES ON THIS PLAN HAVE BEEN PLOTTED BY STATED DIMENSIONS SCALING OR INTERPRETING THE RELEVANT SERVICE AUTHORITY DRAWINGS.

THE LOCATION OF OVERHEAD LOW VOLT AND STREET LIGHTING CABLES HAVE NOT BEEN SHOWN ON THIS PLAN

PIPE SIZES ON THIS PLAN HAVE BEEN PLOTTED & SHOWN IF INDICATED ON THE RELEVANT SERVICE AUTHORITY DRAWINGS.

THE LOCATION OF SERVICES IS APPROXIMATE ONLY.

APPROXIMATE TRUE NORTH

APPROXIMATE MAGNETIC NORTH

LEGEND:-

B	BITUMEN PAVING	AC	SEWER ACCESS CHAMBER
BB	BASE OF BANK	AC	UNIDENTIFIED ACCESS CHAMBER
BC	BASEMENT CARPARK	C(6)	CASUARINA (ABOUT 6 HIGH)
BR	BEND IN ROOF	ELP	ELECTRIC LIGHT POLE
CD	CONCRETE DRIVEWAY	G(10)	GUM (ABOUT 10 HIGH)
CTI	CONCRETE TRAFFIC ISLAND	H	HYDRANT
G	GUTTER	INV	INVERT
GRF	GARAGE FLOOR LEVEL	P(5)	PAPERBARK (ABOUT 5 HIGH)
GS	GUTTER SOFFIT	PI(18)	PINE (ABOUT 18 HIGH)
P	PARAPET	PP	POWER POLE
RC	ROOF TOP CARPARK	SIC	SEWER INSPECTION COVER
RR	ROOF RIDGE	SV	STOP VALVE
TB	TOP OF BANK	SCC	UPRIGHT ELECTRICITY
TG	TOP OF GUTTER	T(9)	TREE (ABOUT 9 HIGH)
TK	TOP OF KERB	TEL	TELSTRA
TRF	TOP OF ROOF	TOG	TOP OF GRATE
UE	UNDERSIDE OF EAVES	TL	TRAFFIC LIGHT
		TS	TRAFFIC SIGN
		WM	WATER METER

E—E DENOTES ELECTRICITY CABLE
G—G DENOTES MINOR GAS MAIN
S—S DENOTES MINOR SEWER PIPE
W—W DENOTES MINOR WATER MAIN
DENOTES STORMWATER PIPE
T—T DENOTES TELSTRA/TELECOMMUNICATIONS MAIN CABLE
OF—OF DENOTES TELECOMMUNICATIONS OPTICAL FIBRE CABLE
T—T DENOTES TELECOMMUNICATIONS LOCAL CABLE
RTA—RTA DENOTES ROADS AND TRAFFIC AUTHORITY LINE
DENOTES ROADS AND TRAFFIC SENSORS

TITLE:

PLAN
SHOWING LEVELS, STREETS AND PROPERTIES SURROUNDING EASTLAKES SHOPPING CENTRE

AMENDMENTS:

26-7-2004 ADDED EXTRA LEVELS ON McDONALDS ROOF, GARDENERS ROAD INTERSECTION AND DRIVEWAYS ON EAST SIDE OF RACECOURSE PLACE
27-2-2012 DETAIL ADDED

CLIENT: CROWN INTERNATIONAL / EASTLAKES SHOPPING CENTRE

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DRAWN: WBS
SURVEYED: DGW
DESIGNED:

DUNLOP THORPE & CO. PTY. LTD.
SURVEYORS
ABN 74 003 512 150
447 KENT STREET
SYDNEY 2000
PHONE 9283 6677
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DX 988 SYDNEY
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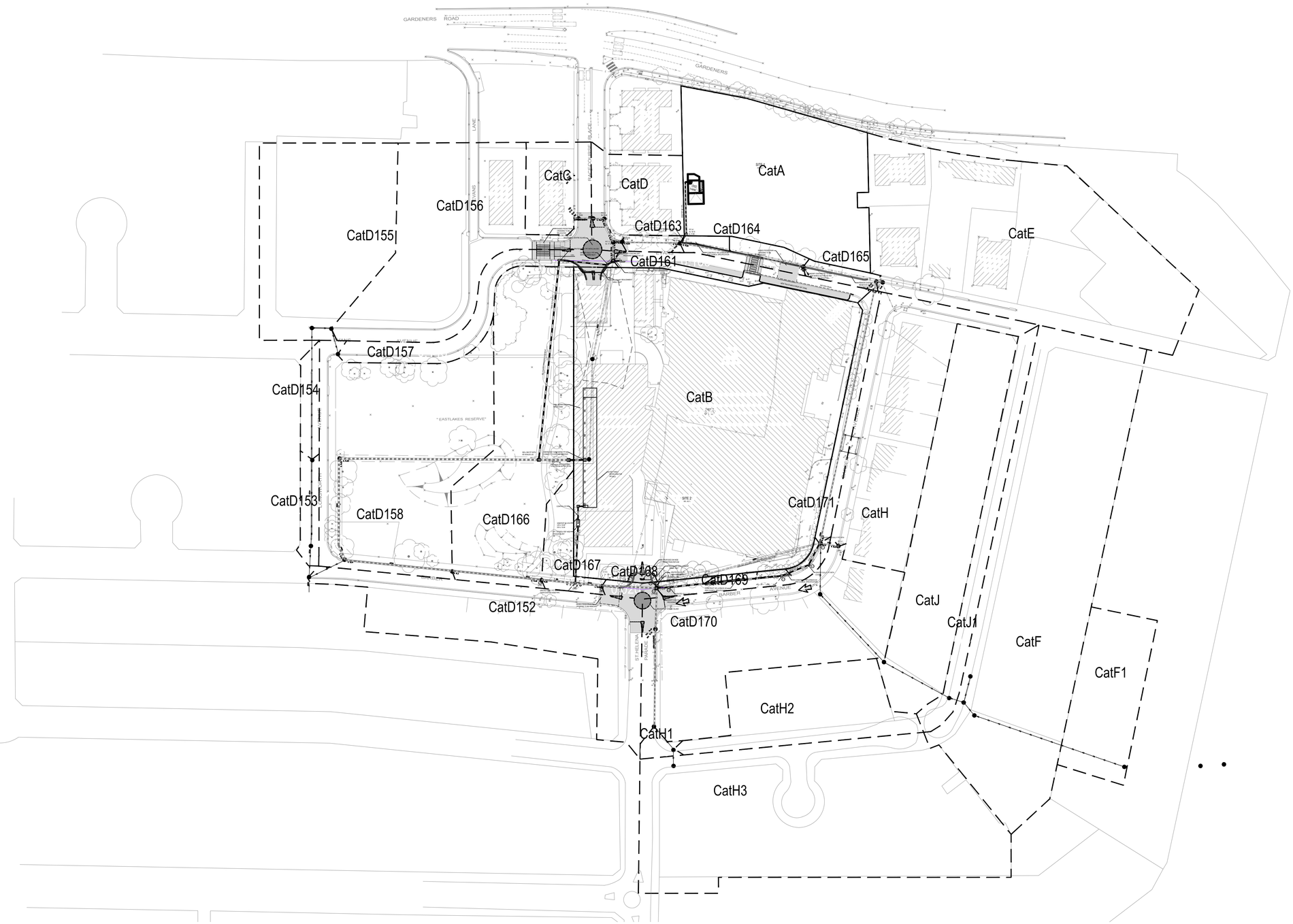
REDUCTION RATIO 1:500
LEVEL DATUM A.H.D.
DATE 8-7-2004
SHEET 1 OF 1 SHEETS
REFERENCE No. 10116-4

APPENDIX B



PLAN

SCALE 1:1000

REVISIONS:			
A	FOR INFORMATION	RB	24.10.17
No.	REVISION DESCRIPTION	DRAWN	DATE

SCALE BAR

0 10 20 30 40 50m 100m

SCALE 1:1000

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CLIENT
CROWN GROUP
LEVEL 29, 1 MARKET STREET
SYDNEY NSW 2000

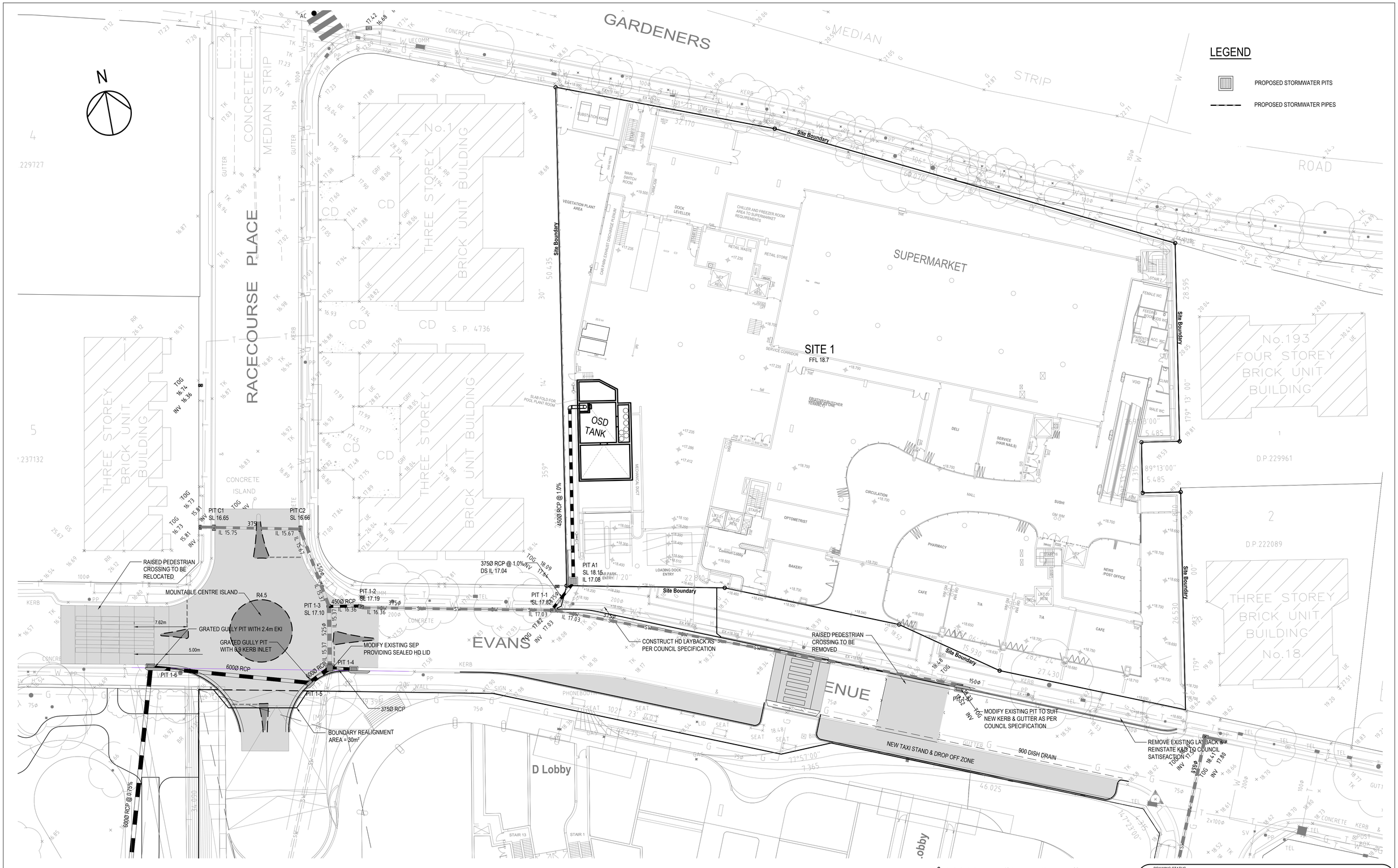
ARCHITECT
FJMT
LVL 5, 70 KINGS STREET SYDNEY NSW 2000

PROJECT TITLE
EASTLAKES CENTRE SITE
GARDENERS ROAD
EASTLAKES, NSW 2018

DRAWING TITLE
CATCHMENT PLAN

DRAWING STATUS
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

PROJECT LEADER	DESIGNER	SIGNATURE	
RJB	NT		
DRAFTSPERSON	SCALE	DATE	SHEET SIZE
NT	AS SHOWN	OCT 2015	A1
JOB No.		DRAWING No.	REVISION
SY151-030		SK20	A



LEGEND

- PROPOSED STORMWATER PITS
- PROPOSED STORMWATER PIPES

0 1 2 3 4 5 10m 15 20m

SCALE 1:250

DRAWING STATUS

APPROVAL ISSUE

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G	REISSUED FOR APPROVAL	N.T.	20.10.15
F	REISSUED FOR APPROVAL	N.T.	26.04.13
E	REISSUED FOR APPROVAL	N.T.	23.04.13
D	ISSUED FOR APPROVAL	N.T.	04.03.13
C	AMENDED OSD TANK 1	N.T.	13.04.12
B	RELOCATED OSD TANK	N.T.	02.04.12
A	PRELIMINARY	N.T.	12.03.12
No.	REVISION DESCRIPTION	DRAWN	DATE

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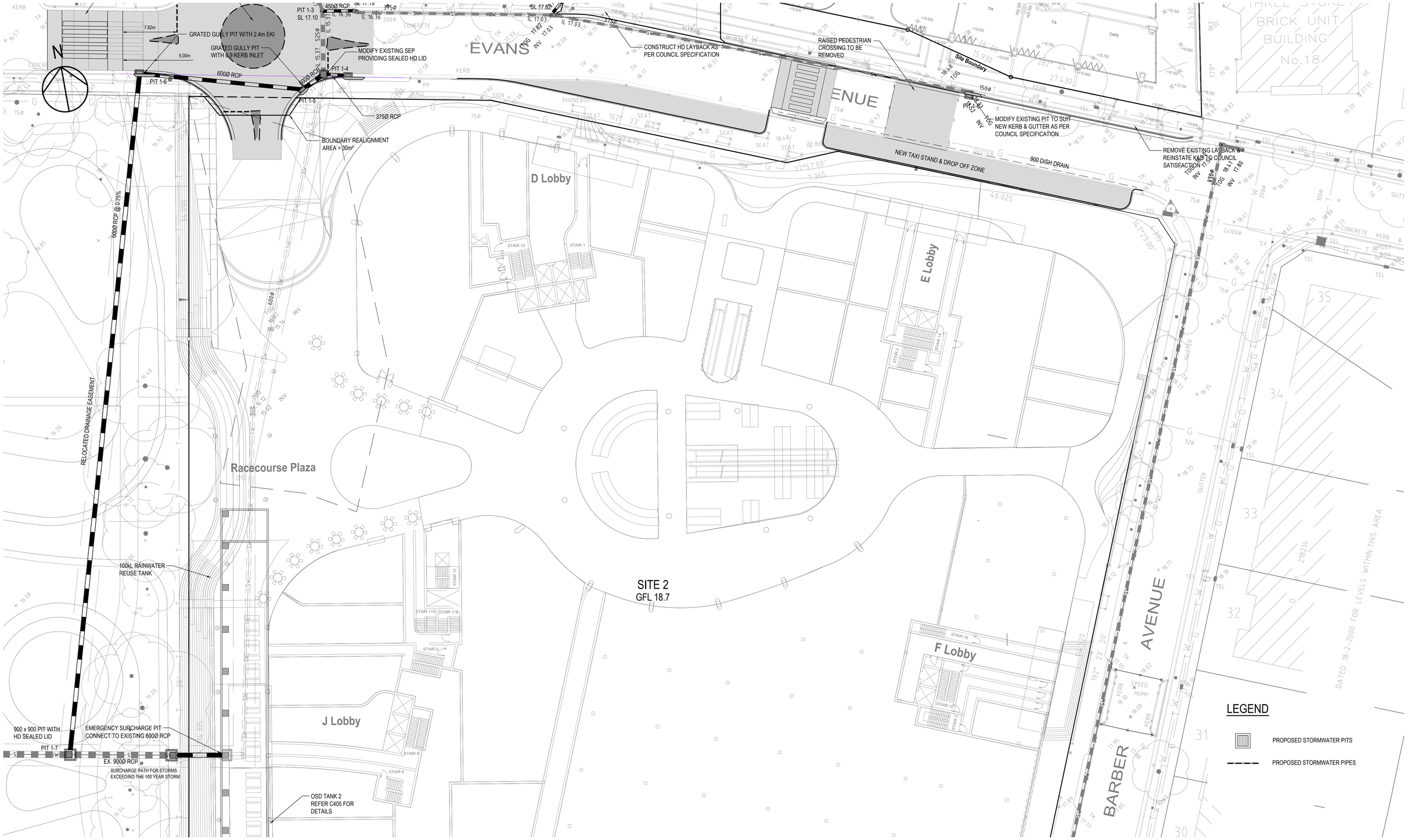
LVL 11, 68 ALFRED STREET
MILSONS POINT NSW 2061

ARCHITECT
RICE DAUBNEY
LVL 1, 110 WALKER STREET NORTH SYDNEY NSW 2060

PROJECT TITLE
EASTLAKES TOWN CENTRE
GARDENERS ROAD
EASTLAKES NSW 2018

DRAWING TITLE
DRAINAGE & ROAD MODIFICATION LAYOUT
SHEET 1

PROJECT LEADER: RJB	SIGNATURE:
DESIGNER: NT	
DRAFTSPERSON: NT	DATE: FEBRUARY 2012
SCALE: 1:250	SHEET SIZE: A1
JOB No.: SY121-012	DRAWING No.: DA011
	REVISION: G



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SCALE 1:250

DRAWING STATUS

APPROVAL ISSUE

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REVISIONS:			
G	REISSUED FOR APPROVAL	N.T.	20.10.15
F	REISSUED FOR APPROVAL	N.T.	26.04.13
E	REISSUED FOR APPROVAL	N.T.	23.04.13
D	ISSUED FOR APPROVAL	N.T.	04.03.13
C	AMENDED OSD TANK 1 & 2	N.T.	13.04.12
B	AMENDED OSD TANK LOCATION	N.T.	02.04.12
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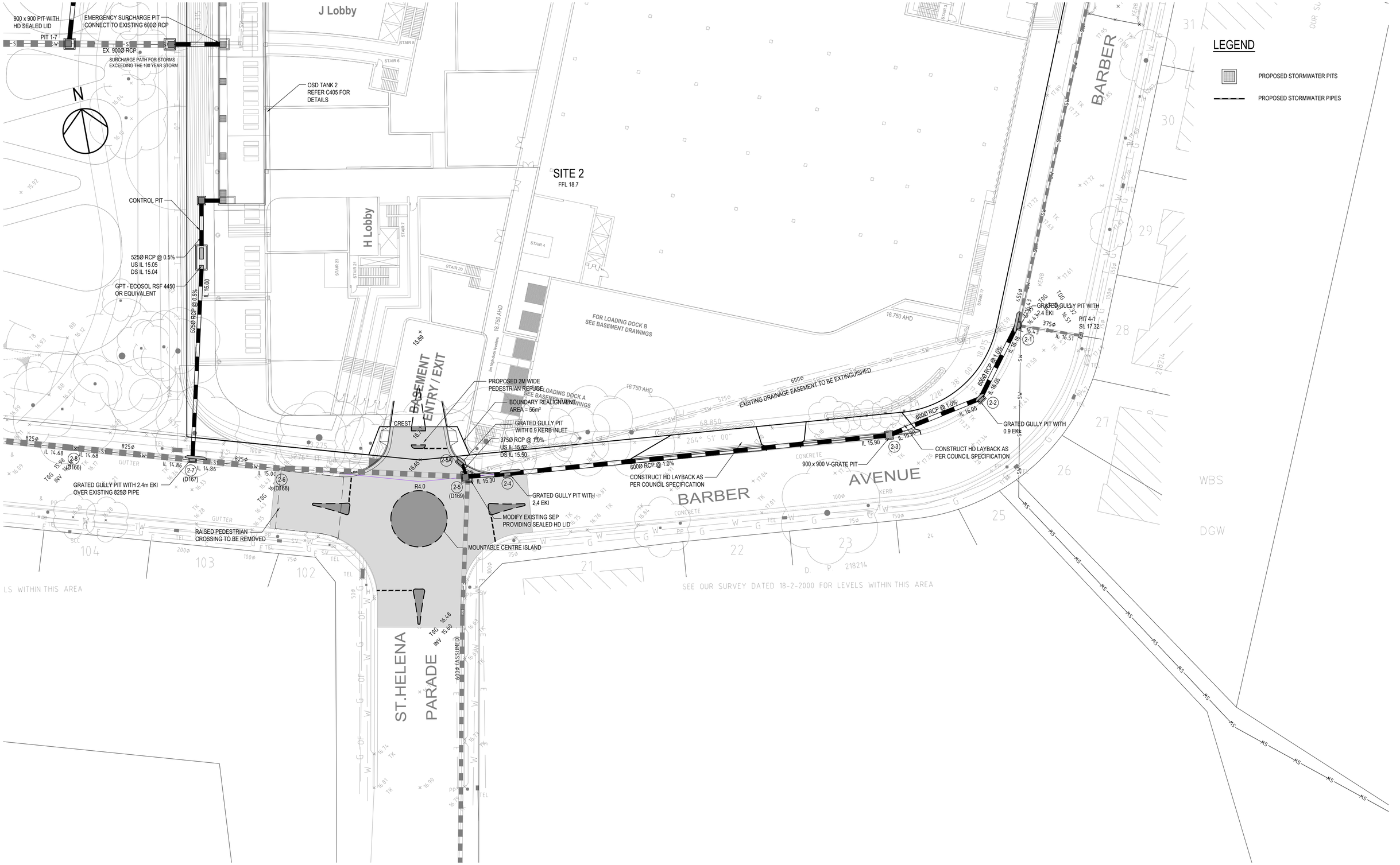
ARCHITECT
RICE DAUBNEY
LVL 1, 110 WALKER STREET NORTH SYDNEY NSW 2060

PROJECT TITLE
EASTLAKES TOWN CENTRE
GARDENERS ROAD
EASTLAKES NSW 2018

DRAWING TITLE
DRAINAGE & ROAD MODIFICATION LAYOUT
SHEET 2

PROJECT LEADER: RJB	SIGNATURE:		
DESIGNER: NT			
DRAFTSPERSON: NT	DATE: FEBRUARY 2012		
SCALE: 1:250	SHEET SIZE: A1		
JOB No.: SY121-012	DRAWING No.: DA012	REVISION: G	



DRAWING STATUS

APPROVAL ISSUE

NOT TO BE USED FOR CONSTRUCTION

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F	ADDED 2M WIDE PEDESTRIAN REFUGE	N.T.	06.05.13
E	REISSUED FOR APPROVAL	N.T.	23.04.13
D	ISSUED FOR APPROVAL	N.T.	04.03.13
C	AMENDED OSD TANK 2	N.T.	13.04.12
B	UPDATED LOADING DOCK ACCESS & RELOCATED OSD TANK	N.T.	02.04.12
A	PRELIMINARY	N.T.	12.03.12
No.	REVISION DESCRIPTION	DRAWN	DATE

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MILSONS POINT NSW 2061

ARCHITECT
RICE DAUBNEY
LVL 1, 110 WALKER STREET NORTH SYDNEY NSW 2060

PROJECT TITLE
EASTLAKES TOWN CENTRE
GARDENERS ROAD
EASTLAKES NSW 2018

DRAWING TITLE
DRAINAGE & ROAD MODIFICATION LAYOUT
SHEET 3

PROJECT LEADER: RJB	SIGNATURE:		
DESIGNER: NT			
DRAFTSPERSON: NT	DATE: FEBRUARY 2012		
SCALE: 1:250	SHEET SIZE: A1		
JOB No.: SY121-012	DRAWING No.: DA013	REVISION: G	

Appendix C – Architectural Plans

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0 4 10 20m

GENERAL NOTES

- ALL DIMENSIONS AND EXISTING CONDITIONS SHALL BE CHECKED AND VERIFIED BY THE CONTRACTOR BEFORE PROCEEDING WITH THE WORK.
- ALL LEVELS RELATIVE TO AUSTRALIAN HEIGHT DATUM.
- DO NOT SCALE DRAWINGS. USE FIGURED DIMENSIONS ONLY.

legend

M01 – Work in WIP Progress
M00 31/5/18 For Approval

rev	date	name	by	chk
01	31/5/18	For Approval	JS	
			JS	

Work in Progress

fjmt studio architecture interiors landscape urban community
sydney melbourne uk
Level 5, 70 King Street t +61 2 9251 7277 fjmtstudio.com

project
EASTLAKES TOWN CENTRE - SOUTH SITE
Evans Avenue Eastlakes
SYDNEY NSW 2018

title
2000 General Arrangement Plans
SITE PLAN 1:500

scale	1:400 @ A0	first issued	31/8/18
	ARC-FJMT		
project code		sheet no.	revision
CGES		2000.00	M01 - WIP

For Approval

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0 2 5 10m

GENERAL NOTES

- ALL DIMENSIONS AND EXISTING CONDITIONS SHALL BE CHECKED AND VERIFIED BY THE CONTRACTOR BEFORE PROCEEDING WITH THE WORK.
- ALL LEVELS RELATIVE TO AUSTRALIAN HEIGHT DATUM.
- DO NOT SCALE DRAWINGS. USE FIGURED DIMENSIONS ONLY.

legend

SS-101 CHILDCARE OUTDOOR 555.9 m2

SS-101 CHILDCARE (NOM 75 PAX) CHILDCARE 732.5 m2

CHILDCARE LIFT

FS-01

FS-02

FS-03

SS-104 RETAIL/COMMERCIAL 341.8 m2

SS-103 RETAIL/COMMERCIAL 220.0 m2

GF Retail Exh. 6.7 m2

SS-102 RETAIL/COMMERCIAL 138.2 m2

SS-109 CAFE CAFE 66.7 m2

LEVEL 1 RETAIL +23.950

+23.950

VOID

LIFT

SS-105 RETAIL/COMMERCIAL 242.6 m2

SS-106 RETAIL 78.2 m2

LOBBY E

SS-E E105 BAL 51.0 m2 / 8.4 m2

SS-E E104 BAL 51.1 m2 / 8.3 m2

SS-E E103 BAL 78.1 m2 / 10.0 m2

SS-E E102 BAL 75.2 m2 / 10.7 m2

SS-E E101 BAL 75.1 m2 / 10.2 m2

BARBEQUE PAVILION

GLASS CEILING OVER THOROUGHFARE BELOW

SS-107 RETAIL/COMMERCIAL 1,814.6 m2

SS-108 RETAIL/COMMERCIAL 450.7 m2

PUBLIC TOILETS 41.3 m2

LIFT

POOL ABOVE

RESIDENTIAL HEATING HOT WATER PLANT [Required 150kg/m3/m CH] 167.5 m2

POOL PLANT & MAINTENANCE SPACE 169.4 m2

POOL EQUIPMENT/ OUTDOOR FURNITURE STORAGE

SUPERMARKET PLANT [Required 100sqm/4m CH] 116.4 m2

LOUVRES FOR PLANT

BUILDING ABOVE

CORE F

H.O.

SS-F F101 99.3 m2 / F101 BAL 18.5 m2

SS-F F102 105.7 m2 / F102 BAL 22.6 m2

SS-F F103 105.4 m2 / F103 BAL 22.6 m2

SS-F F104 105.4 m2 / F104 BAL 22.5 m2

SS-J1/2 J2-103 99.6 m2 / J2-103 BAL 47.5 m2

SS-J1/2 J2-104 51.0 m2 / J2-104 BAL 23.3 m2

SS-J1/2 J2-105 50.6 m2 / J2-105 BAL 23.3 m2

SS-J1/2 J2-106 50.5 m2 / J2-106 BAL 23.3 m2

SS-J1/2 J2-107 51.2 m2 / J2-107 BAL 23.3 m2

SS-J1/2 J2-108 92.5 m2 / J2-108 BAL_W 20.4 m2 / J2-108 BAL_E 12.4 m2

GF Retail Exh. 10.5 m2

T/K Ex

LOBBY J2

LR

SS-J1/2 J2-102 64.7 m2 / J2-102 BAL 8.0 m2

SS-J1/2 J2-101 98.0 m2 / J2-101 BAL 14.4 m2

SS-J1/2 J2-109 51.1 m2 / J2-209 BAL 8.0 m2

LOWER PODIUM

GRASS AREA

PLAYGROUND

Ref : Taylor Brammers Landscape Dwgs

LOBBY G

SS-G G107 78.8 m2 / G107 BAL 10.0 m2

SS-G G106 40.0 m2 / G106 BAL 4.5 m2

SS-G G105 52.9 m2 / G105 BAL 8.4 m2

SS-G G104 55.3 m2 / G104 BAL 8.3 m2

SS-G G103 78.1 m2 / G103 BAL 10.0 m2

SS-G G108 75.2 m2 / G108 BAL 10.7 m2

SS-G G109 59.7 m2 / G109 BAL 9.4 m2

SS-G G101 75.1 m2 / G101 BAL 10.2 m2

SS-G G102 75.2 m2 / G102 BAL 10.7 m2

BARBEQUE PAVILION

1 PLAN Level 1
1:200

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LEVEL 1 LOWER PODIUM

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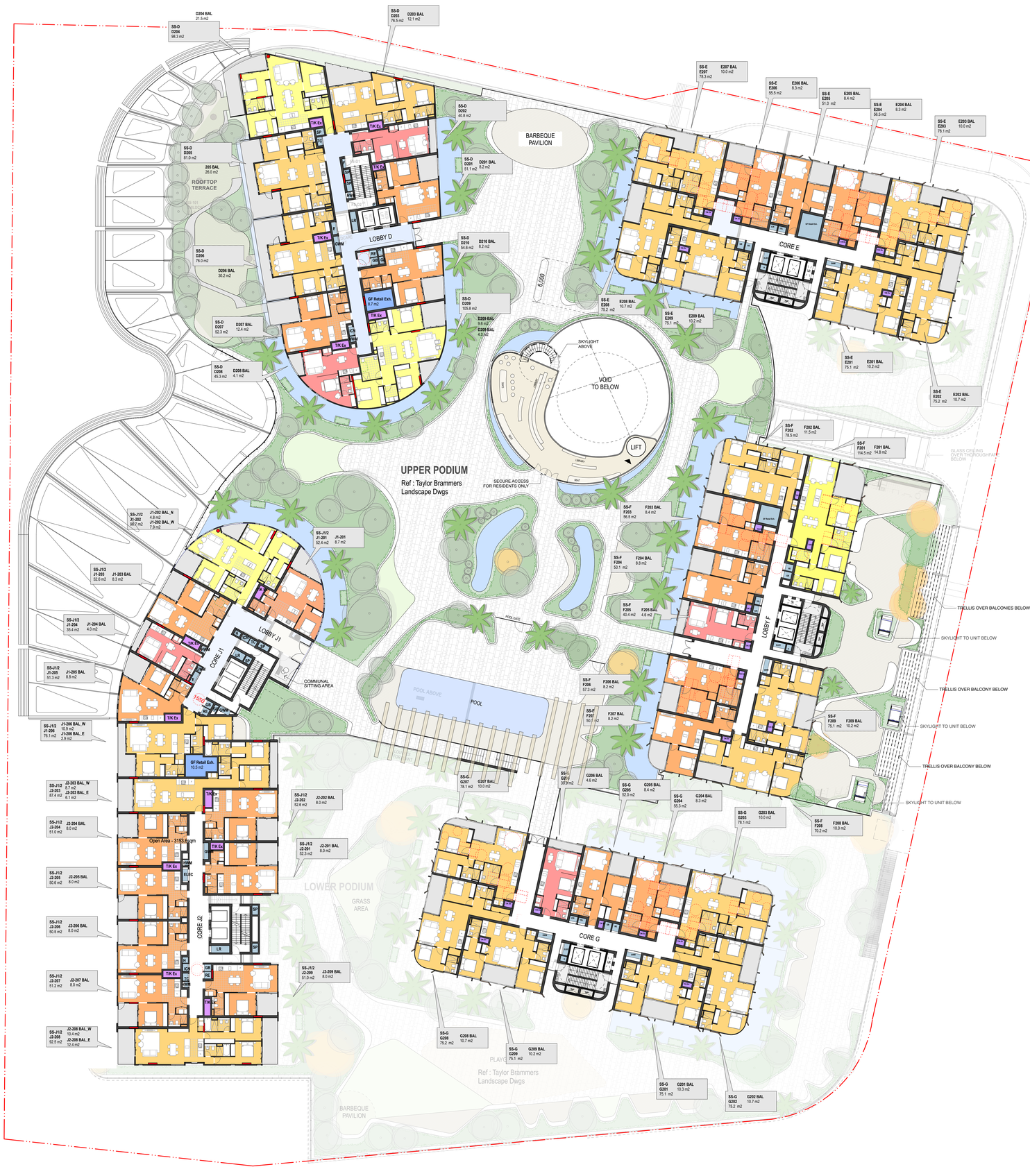

1 PLAN Level 2
1:200

0 2 5 10m

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LEVEL 2 UPPER PODIUM

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0 2 5 10m

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legend

CARPARKING NUMBERS / LEGEND

BASEMENT 1

RETAIL PARKING	171
ACCESSIBLE (INCL.)	20
MEDICAL PARKING	20
CHILDCARE PARKING	27
LEISURE USE	12
COMMERCIAL	19
MOTORBIKE (2% MIN)	16
BICYCLE STORE	50
RESIDENTIAL LOADING	2

BASEMENT 2

RETAIL PARKING	167
VISITOR PARKING	72
ACCESSIBLE (INCL.)	3

BASEMENT 3

RESIDENTIAL PARKING	191
ACCESSIBLE (INCL.)	72
COMMERCIAL	28

BASEMENT 4

RESIDENTIAL PARKING	209

- END OF TRIP FACILITIES
- RETAIL STORAGE
- RESIDENTIAL STORAGE
- SERVICES
- RESIDENTIAL WASTE ROOM
- RETAIL WASTE ROOM
- GREASE TRAP

1 PLAN Basement 1
1:200

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BASEMENT 1

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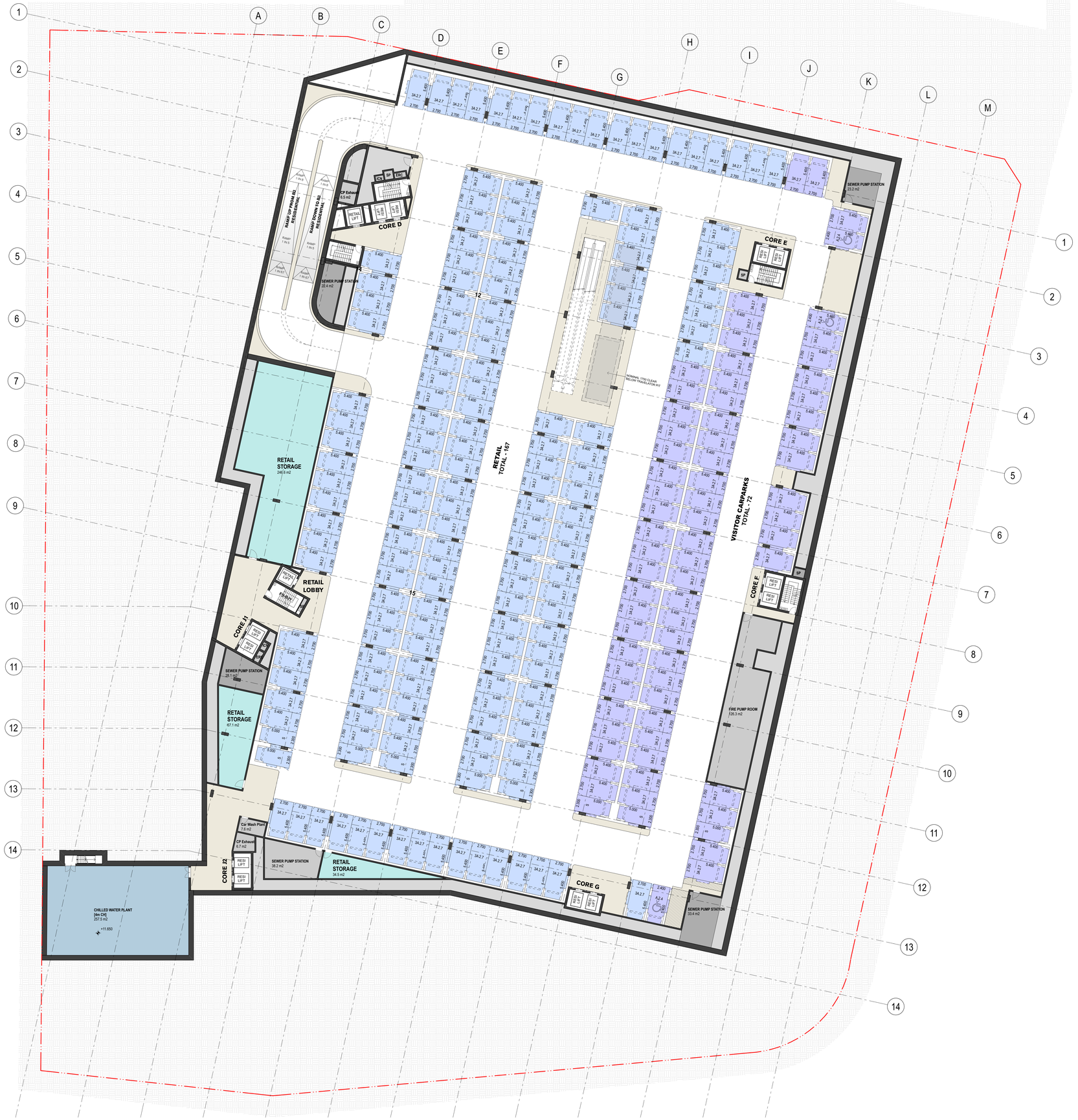

CARPARKING NUMBERS / LEGEND

BASEMENT 1

RETAIL PARKING	171
ACCESSIBLE (INCL.)	20
MEDICAL PARKING	20
CHILDCARE PARKING	27
LEISURE USE	12
COMMERCIAL	19
MOTORBIKE (2% MIN)	16
BICYCLE STORE	50
RESIDENTIAL LOADING	2

BASEMENT 2

RETAIL PARKING	167
VISITOR PARKING	72
ACCESSIBLE (INCL.)	3

BASEMENT 3

RESIDENTIAL PARKING	191
ACCESSIBLE (INCL.)	72
COMMERCIAL	28

BASEMENT 4

RESIDENTIAL PARKING	209

- END OF TRIP FACILITIES
- RETAIL STORAGE
- RESIDENTIAL STORAGE
- SERVICES
- RESIDENTIAL WASTE ROOM
- RETAIL WASTE ROOM
- GREASE TRAP

1 PLAN Basement 2
1:200

0 2 5 10m

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BASEMENT 2

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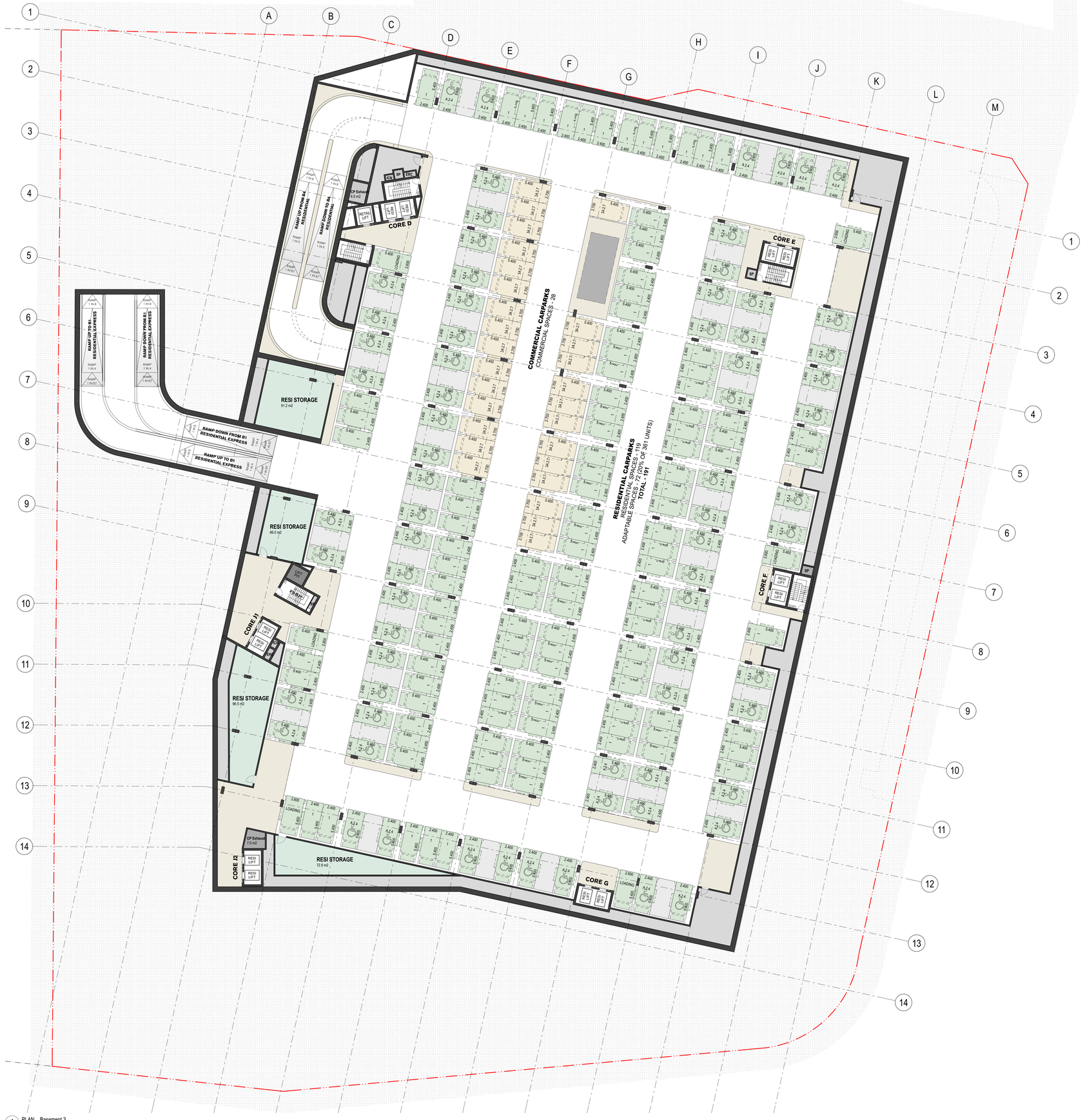

1 PLAN Basement 3
1:200

CARPARKING NUMBERS / LEGEND

BASEMENT 1

RETAIL PARKING	171
ACCESSIBLE (INCL.)	20
MEDICAL PARKING	20
CHILDCARE PARKING	27
LEISURE USE	12
COMMERCIAL	19
MOTORBIKE (2% MIN)	16
BICYCLE STORE	50
RESIDENTIAL LOADING	2

BASEMENT 2

RETAIL PARKING	167
VISITOR PARKING	72
ACCESSIBLE (INCL.)	3

BASEMENT 3

RESIDENTIAL PARKING	191
ACCESSIBLE (INCL.)	72
COMMERCIAL	28

BASEMENT 4

RESIDENTIAL PARKING	209

END OF TRIP FACILITIES
RETAIL STORAGE
RESIDENTIAL STORAGE
SERVICES
RESIDENTIAL WASTE ROOM
RETAIL WASTE ROOM
GREASE TRAP

0 2 5 10m

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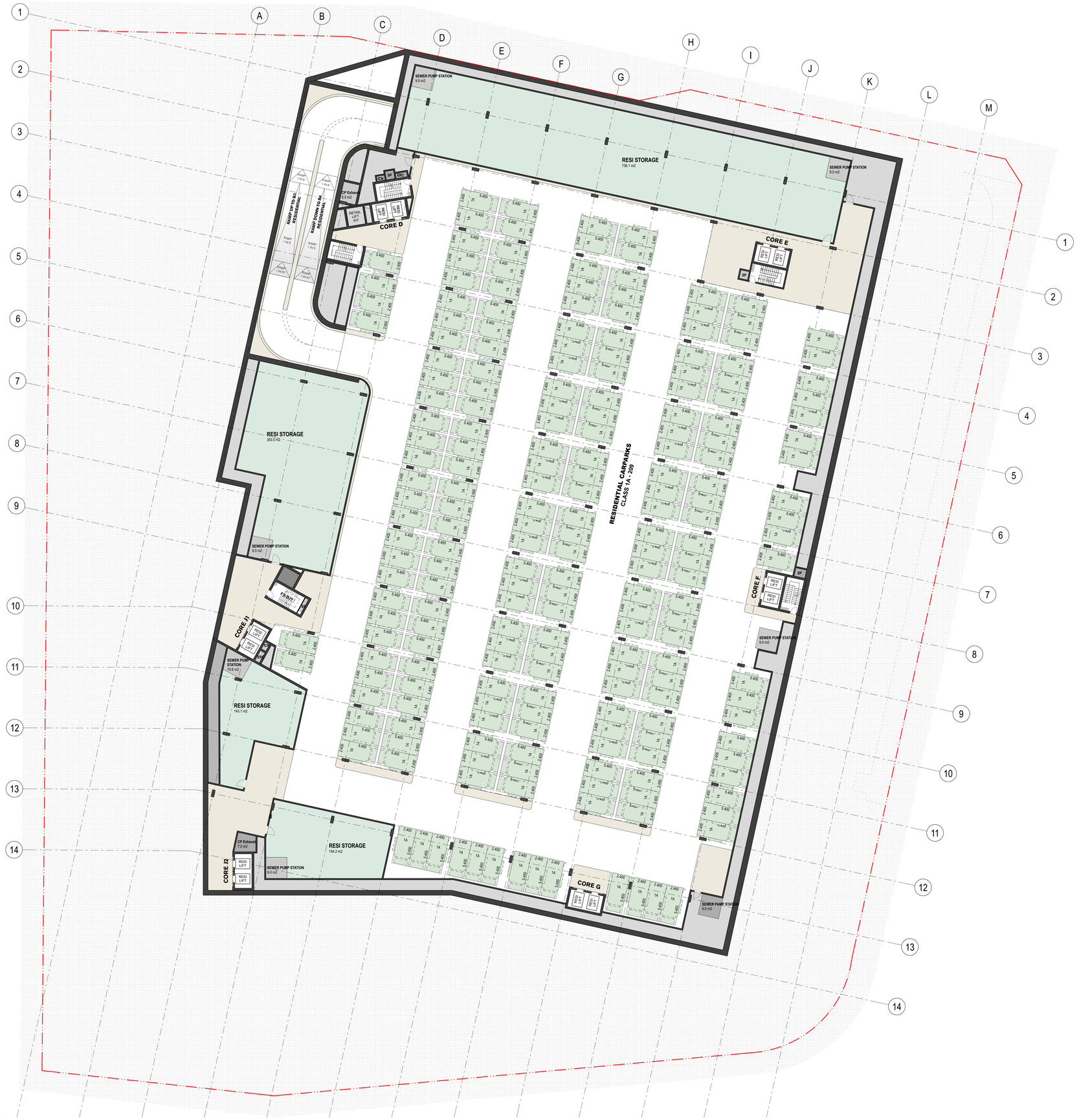

1 PLAN Basement 4
1:200

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CARPARKING NUMBERS / LEGEND

BASEMENT 1

RETAIL PARKING	171
ACCESSIBLE (INCL.)	20
MEDICAL PARKING	20
CHILDCARE PARKING	27
LEISURE USE	12
COMMERCIAL	19
MOTORBIKE (2% MIN)	16
BICYCLE STORE	50
RESIDENTIAL LOADING	2

BASEMENT 2

RETAIL PARKING	167
VISITOR PARKING	72
ACCESSIBLE (INCL.)	3

BASEMENT 3

RESIDENTIAL PARKING	191
ACCESSIBLE (INCL.)	72
COMMERCIAL	28

BASEMENT 4

RESIDENTIAL PARKING	209

- END OF TRIP FACILITIES
- RETAIL STORAGE
- RESIDENTIAL STORAGE
- SERVICES
- RESIDENTIAL WASTE ROOM
- RETAIL WASTE ROOM
- GREASE TRAP

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BASEMENT 4

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legend

Site Boundary
3 Existing Trees Removed and Replaced
Drop-Off
EVANS AVENUE
1 Existing Tree Removed
BARBER AVENUE
RACECOURSE PLAZA
+18.750
+17.094
+18.497
+18.284
+16.325
+16.574
+16.482
To/From B1
TRANSFORMER/SWITCH
PERSONNEL AND SMALL EQUIPMENT HATCH
RAMP 1 IN 20
RAMP 1 IN 10
RAMP 1 IN 8
RAMP 1 IN 5
FLOOD LEVEL
PUBLIC TOILETS 67.4 m2
SUB FDCIE / EWCIE
GF Air Supply 8.6 m2
GF Retail Exh. 8.7 m2
SS-G31 RETAIL 203.9 m2 +18.750
SS-G30 RETAIL 108.2 m2 +18.750
SS-G29 RETAIL 101.9 m2
SS-G28 RETAIL 77.1 m2
SS-G27 RETAIL 63.1 m2
SS-G26 RETAIL 69.5 m2
SS-G25 RETAIL 113.3 m2
SS-G24 RETAIL 81.1 m2
SS-G34 RETAIL 142.8 m2
SS-G33 RETAIL 206.1 m2
SS-G32 RETAIL 396.7 m2 +18.750
SS-G35 CAFE FOOD RETAIL 16.8 m2
SS-G22 CAFE FOOD RETAIL 16.4 m2
SS-G23 RETAIL 132.1 m2
SS-G19 RETAIL 94.7 m2
SS-G18 RETAIL 70.3 m2 +18.750
SS-G20 RETAIL 47.2 m2
SS-G21 RETAIL 113.3 m2
SS-G17 RETAIL 136.8 m2 +18.750
SS-G16 RETAIL 193.3 m2 +18.750
SS-G15 RETAIL 126.0 m2
SS-G12 RETAIL 92.1 m2
SS-G13 RETAIL 69.1 m2
SS-G14 RETAIL 62.4 m2
SS-G41 SHOE REPAIR RETAIL 17.3 m2
SS-G40 NUTS/CHOC FOOD RETAIL 17.3 m2
SS-G39 JUICE FOOD RETAIL 17.3 m2
SS-G38 CAFE FOOD RETAIL 16.4 m2
MARKET SQUARE 1,434.9 m2
SS-G36 CAFE FOOD RETAIL 16.4 m2
SS-G37 SUSHI FOOD RETAIL 16.4 m2
PUBLIC THOROUGHFARE DURING OPERATING HOURS
SS-G08 RETAIL 94.8 m2
SS-G09 RETAIL 104.9 m2
SS-G10 RETAIL 112.4 m2
SS-G11 RETAIL 113.5 m2
SS-G07 RETAIL 99.8 m2
SS-G05 RETAIL 91.2 m2
SS-G04 RETAIL 243.4 m2
SS-G03 RETAIL 420.1 m2 +18.750
RETAIL LOBBY
LOBBY J1 +18.555
LOBBY J2 +17.695
LOBBY D
LOBBY E
LOBBY F
RETAIL STORAGE 26.0 m2
RETAIL STORAGE 27.1 m2
LIFT
PUBLIC TOILETS 121.1 m2
GF Retail Exh. 10.5 m2
SS-G02 RETAIL 365.6 m2 +18.130
SS-G02 MEZZ RETAIL 222.2 m2
COOL ROOM / STORAGE ROOM 45.5 m2
SS-G01 COMMUNITY ROOM 286.5 m2 +17.425
ANCHOR TENANT [SUPERMARKET]
SS-G06 RETAIL 3,943.8 m2
BACK OF HOUSE
VOID OVER RAMP BELOW
WOOLWORTHS WASTE ZONE
VOID OVER RESIDENTIAL WASTE ROOM BELOW SEE B1 (NOTE THIS ROOM IS AT SAME LEVEL AS LOADING DOCK)
Dock Manager 48.8 m2
RAMP FROM LOADING DOCK TO RETAIL BOH CORRIDOR
19 M TRUCK & TRAILER
19 M TRUCK & TRAILER
12.5M TRUCK
RETAIL WASTE
RETAIL WASTE
FOR LOADING DOCK SEE B1
RETAIL STORAGE: ACCESSED FROM LOADING DOCK
MRV
SLIDING DOORS
CP Supply 6.4 m2
CP Supply 5.6 m2
CP Supply 6.8 m2
AWC
EXTENT OF OSD TANK ABOVE B3 RAMP
192m² x 2.61m WATER DEPTH
TANK CAPACITY - 500m³
INCLUDES 30m³ RAINWATER REUSE
TWL 18.05m BOTTOM OF TANK 15.44m
EXTENT OF OSD TANK ABOVE PLENUM AND CAR SPACES
44m x 7.2m x 1.2m WATER DEPTH
TANK CAPACITY - 380m³
INCLUDES 30m³ RAINWATER REUSE
TWL 18.15m TANK IL16.95m

1 PLAN Ground Floor 1:200

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2000 General Arrangement Plans GROUND LEVEL

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Appendix D – Water Quality Device Details

StormFilter®

Operation, Design, Maintenance & Performance Manual

Stormwater360
AUSTRALIA

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3. MAINTENANCE **12**

4. PERFORMANCE DATA **15**

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1. INTRODUCTION

Stormwater360 has adopted a comprehensive research and design program, which is unparalleled by any manufacturer in Australasia, to strategically provide our clients, both consulting engineers and regulators alike, the reassurance of our products in-field performance, validity and longevity.

This document has been produced as a guideline to assist engineers and designers with the development application process when utilizing Stormwater360's Stormwater Management StormFilter.

The StormFilter, a passive, flow-through, stormwater filtration system, improves the quality of stormwater runoff from the urban environment before it enters receiving waterways by removing non-point source pollutants, including sediment (TSS), oil and grease, soluble metals, nutrients, organics, and trash and debris. The StormFilter is used in a wide variety of applications to treat runoff from various sites including: retail and commercial developments, residential streets, urban roadways, freeways, and industrial sites such as shipyards, foundries, and high tech developments. For developers and contractors, the StormFilter is cost-effective, easy to install, and uses no additional land (completely underground). For engineers, full design support is provided by Stormwater360. Finally for local government authorities (LGA's), Stormwater360 offers flexible maintenance options ensuring units are operating at their optimal efficiency thereby protecting LGA's downstream assets.

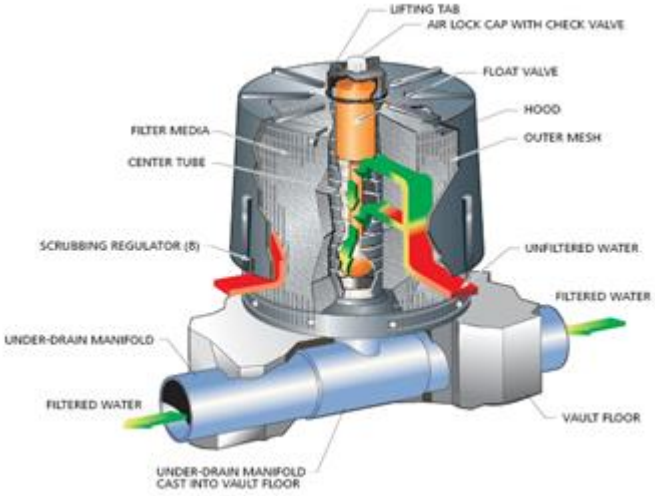


Figure 1. Filter Cartridge

Operation

The StormFilter system is typically comprised of a vault that houses the rechargeable, media-filled, filter cartridges (Figure 3). Stormwater from storm drains is percolated through these media-filled cartridges, which trap particulates and remove pollutants such as dissolved metals, nutrients, and hydrocarbons. During the filtering process, the StormFilter system also removes surface scums and floating oil and grease. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged to an open channel drainage way.

Priming System Function

The treated stormwater collects in the centre tube of the cartridge, which is equipped with a self-priming siphon system. Figure 1 illustrates this system. The key component of the system is the plastic float. The float consists of a ball located at the base leading up to a larger portion, which provides increased buoyancy. Initially the ball rests in a seat effectively closing off the port to the drainage manifold.

As a result, the filter fills the centre drainage tube until the water level has raised high enough to purge the air from the filter cartridges and displaces the float. For the standard cartridges, at water depth of 460mm the float pulls loose and allows the filtered water to drain out through the manifold. This effectively "primes" a siphon within the drainage tube and greatly increases the potential across the filter. The priming system increases StormFilter's ability to be loaded with sediment. A related feature is the cartridge "hood". This hood maintains the siphon effect by preventing air from being drawn into the cartridge until the external water level drops below the bottom of the hood.

Figure 2. Cartridge Operation from left to right: Priming – Filtering – Surface Cleaning & Dewatering

Cartridges are connected to the manifold with a plastic connector.

Depending on individual site characteristics, some systems are equipped with high and/or low flow bypasses. High flow bypasses are installed when the calculated peak storm event generates a flow that overcomes the overflow capacity of the system. This is especially important for precast systems. Low flow bypasses are sometimes installed to bypass continuous inflows caused by ground water seepage, which usually do not require treatment. All StormFilter units are designed with an overflow and operate when the inflow rate is greater than the infiltration capacity of the filter media.

2. DESIGN

The first step when designing your StormFilter is to calculate the treatable flow rate required to meet the stormwater quality targets for your site. There are several methods for determining the flow rate required, however, the most common is by using software packages. The Model for Conceptual MUSIC is the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) is available from eWater Limited. MUSIC is now the industry standard aiding the design of various Water Sensitive Urban Design treatment measures in demonstrating compliance with regulator's water quality objectives. In this section you will find step-by-step instructions on how to determine the number of filter cartridges required for your StormFilter.

Once you have determined the treatable flow rate of your StormFilter system required to treat the runoff from your site, the next step when designing your system is to select the StormFilter cartridge and configuration that will best handle the runoff water quality flow rate or volume at your site. The StormFilter is offered in several configurations: manhole, detention, vault, cast in place or panel.

After selecting one of these StormFilter configurations, you can size the selected configuration using the data tables that we have provided for you in this section of the manual.

Using the cartridge number and the system size that you calculated in the first two design steps, the final step in the design process is to integrate the StormFilter into your site plans.

In this section you will find information on factors that you must consider when integrating the StormFilter into your site plans. Factors discussed in this section include: selecting a site location, evaluating system depth and maintenance access requirements, determining pretreatment and bypassing needs, evaluating system hydraulics, and selecting a cartridge media type.

Determining the treatable flow rate of your StormFilter - MUSIC Modelling

Modeling the StormFilter within MUSIC should be undertaken by people who are familiar with MUSIC's functions and limitations. Should you require further information, or to make use of Stormwater360's design services, please contact Stormwater360's Engineering Services & Support.

The StormFilter technology is usually placed downstream of any pre-treatment devices such as gully pit inserts, gross pollutant traps, porous paving etc, and consequently the node is simply placed in-line or end-of-pipe near the outlet of the catchment model.

Given below is a simplified procedure for modeling the StormFilter technology.

1. Setup a MUSIC model utilizing the desired meteorological data and source nodes applicable for the site to be modeled.

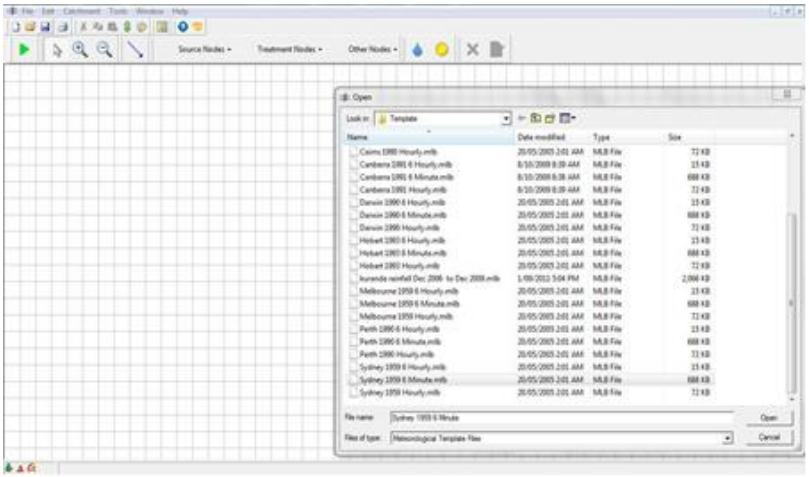


Figure 3. Rainfall setup

2. Construct or copy source nodes for your site and modify by using the edit properties dialogue box.

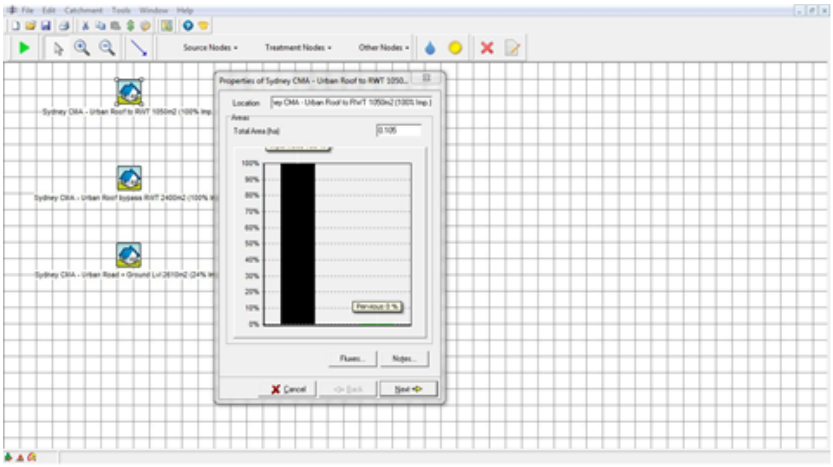


Figure 4. Source Node setup

3. Create copy and edit ALL pre-treatment after perusing all known information from the site plans etc. Details on the Stormwater360 treatment nodes are available upon request. Modify the Stormwater360 pre-treatment nodes by changing the high flow bypass only. As a starting point for StormFilter, modify the high-flow bypass and initially estimate 1L/s of treatment per 250m2 of upstream catchment area.

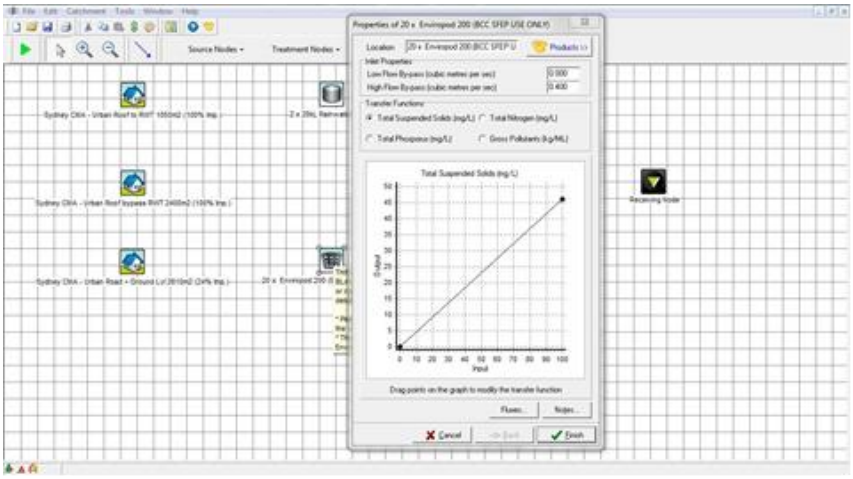


Figure 5. Create, Copy and Edit Treatment Nodes

4. Link all nodes and then run the model. After the model has finished, check the results obtained and compare them to the water quality targets. Adjust the high-flow bypass to refine the design and re-run the model.

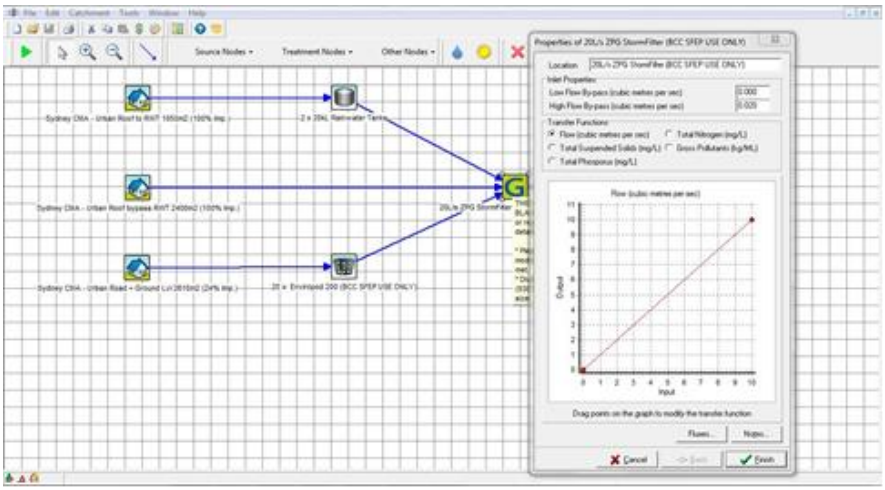


Figure 6. First Model Simulation

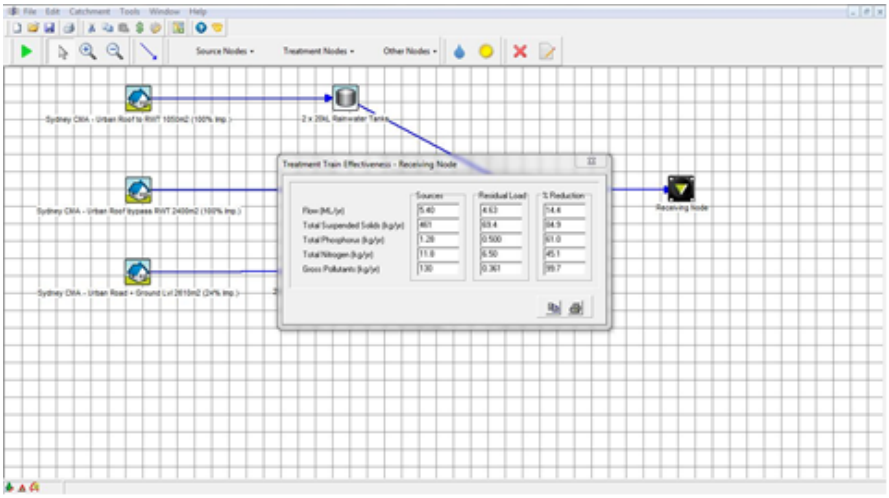


Figure 7. Results

Selecting and sizing your StormFilter

Peruse you site plans and determine the amount of fall or hydraulic loss that is available for your site. Once determined, select the most appropriate StormFilter cartridge that best suits your needs from the table below.

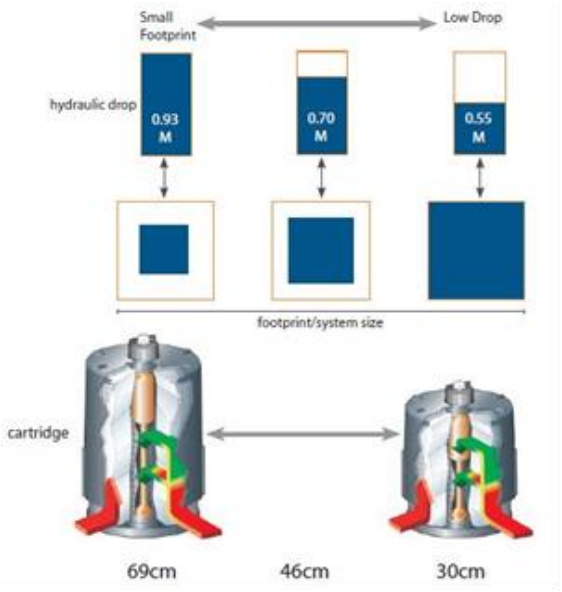


Figure 8. Filter Cartridge height options

The peak flow rates for each cartridge immeadiately prior to bypass are shown above in red. Simply divide the high flow bypass from your MUSIC modelling results to determine the number of cartridges required. You will need to record the cartridge height used in each design.

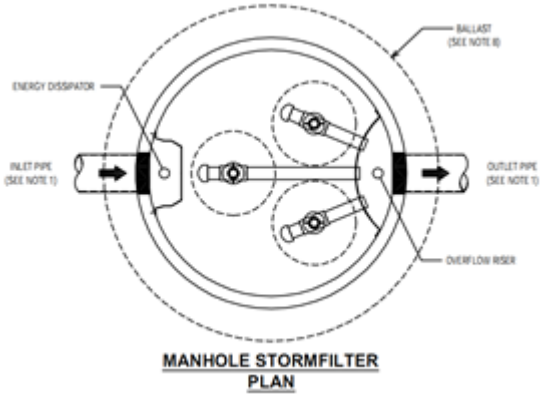
Please note that Stormwater360 prefers to drop the hydraulic loss across the unit (head drop). If this cannot be achieved, the StormFilter CAN be configured for a zero drop system. Please contact Stormwater360 for more details.

After the number of cartridges have been selected, determine the system size from the table below and contact Stormwater360, or go online and register at www.stormwater360.com.au to download the applicable drawing for your site. For more configurations contact Stormwater360.

Configuration	System Cartridge Capacity	System Footprint
Manhole	1 – 2 3 – 4 5 – 7 8 – 22	1200mm dia 1500mm dia 1800mm dia 3100mm dia
Vault	23 – 44	5.4 x2.4m
Large Vault	45 – 70 71 - 140	10.8m x 2.4m 10.8m x 4.9m
Cast In-Place or Panel	140+	Contact Stormwater360

Table 1. System Configurations

Manhole StormFilter



The Manhole StormFilter™ consists of a 1200mm dia to 3100mm concrete manhole that can contain up to twenty-two StormFilter cartridges. The Manhole StormFilter can be installed flush with the finished grade. The top of the unit has an either 600mm sq or 900mm sq, Class D rated traffic-bearing access cover (or grate) that allows the filter to be installed in paved areas and, for all practical purposes, takes up no land area.

The Manhole StormFilter unit treats peak water quality design flows up to 35L/s and has an internal bypass capability of 80L/s.

Design Operation

The Manhole StormFilter is installed online with the stormwater drainage system, typically downstream of an existing catch basin or of a detention system. Runoff enters the Manhole StormFilter through an inlet pipe discharging directly to the unit and, therefore, may require an additional upstream pretreatment system depending on local agency requirements.

An inherent benefit of the manhole design is the flexibility in piping orientation. The inlet pipe may be placed in the manhole at any angle relative to the outlet pipe. Access to the cartridges is provided by manhole opening. Installation of the Manhole StormFilter is identical to that of a typical manhole.

Applications

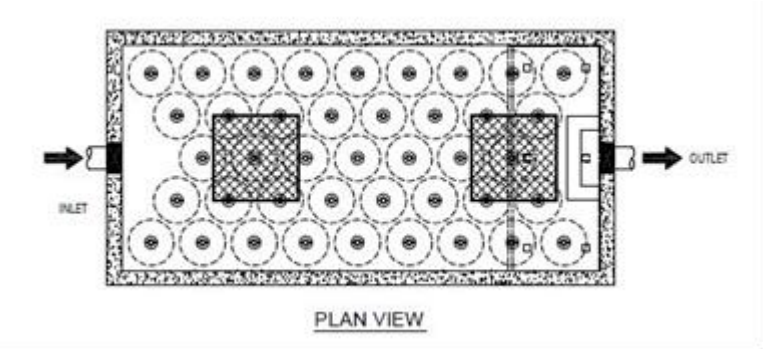
The Manhole StormFilter is particularly useful where small flows are being treated.

Special Considerations

When designing the Manhole StormFilter into your system, you should consider the following:

- The unit should maintain sufficient drop from the invert of the inlet to the invert of the outlet.
- For depths with cover greater than 2.0m, contact Stormwater360 for information on additional requirements.

Vault StormFilter



Overview

The Vault (and large vault) StormFilter can consist of one or more precast concrete structures 5.4 x 2.4m (ID). These units treat peak water quality design flows up to 70L/s. StormFilter vaults can be placed in series or in parallel to treat higher flows if needed (Large Vault type). A Vault StormFilter can be installed online or offline with the stormwater drainage system. It is installed with 900mm sq Class D traffic-bearing lids for parking lot applications, and it takes up no land area.

Design Operation

The typical Vault StormFilter is composed of a filtration bay, with inlet energy dissipation and an outlet baffled overflow riser. Stormwater first enters the StormFilter vault through the inlet pipe. The stormwater is then directed over an energy dissipater into the filtration bay for full treatment. The outlet overflow riser acts as a baffle, trapping some floatables, oils, and surface scum as the stormwater is filtered through the filtration bay.

Once in the filtration bay, the stormwater begins to pond and percolate horizontally through the media contained in the filter cartridges. After passing through the media, treated water that has collected in the cartridge center tube is directed into the outlet bay by an under-drain manifold. The treated water in the outlet bay is then discharged through the single outlet pipe. The Vault StormFilter has an internal bypass capability of 80L/s. If peak flows to the system exceed 50L/s, a high flow bypass is needed. See Stormwater360 for more information.

Applications

The Vault StormFilter can be used for the following applications:

- Parking lots
- Roadways
- Residential developments
- Retail/commercial developments
- Business/industrial sites
- Maintenance facilities

Special Considerations

When designing the Vault StormFilter into your system, you should consider the following:

- Stormwater360 recommends a minimum of 1500m of head room inside the vault for maintenance access.
- For depths with cover greater than 2.0m, contact Stormwater360 for information on additional requirements.

3. MAINTENANCE

Overview

The primary purpose of the StormFilter is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness. Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. To assist the owner with maintenance issues, Stormwater360 provides detailed Operation & Maintenance Guidelines with each unit.

Stormwater360 can provide maintenance services completely, or in part. Available services include tracking of installed systems, advising the system's owner of maintenance needs, and notification of the regulatory agency once the system has been maintained.

Maintenance is usually performed in the dryer periods to rejuvenate the filter media and prepare the system for the next rainy period. Maintenance activities can also be required in the event of a chemical spill or excessive sediment loading due to site erosion or extreme storms. It is good practice to inspect the system after severe storm events.

Types of Maintenance

Presently, procedures have been developed for two levels of maintenance: Inspection/minor maintenance and major maintenance. Inspection/minor maintenance activities are combined since the minor maintenance does not require special equipment and typically little or no materials are in need of disposal. Inspection/minor maintenance typically involves a visual inspection and cleanup of vegetation and debris should it be required. Major maintenance typically includes cartridge recharging. Major maintenance may involve disposal of materials that require consideration of regulatory guidelines.

Maintenance Frequency

The primary factor controlling timing of maintenance for the StormFilter is sedimentation. A properly functioning system will remove solids from water by trapping these particulates within the porous structure of the media. The flow through the system will naturally decrease as more and more solids are trapped. Eventually the flow through a system will be low enough to require replacement of the cartridges. Sediment should be removed from upstream trapping devices on an as needed basis to prevent material from being re-suspended and discharged to the system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction should be inspected and maintained more often than those in fully established areas. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after large storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual filter. It is recommended that the maintenance agency develop a database to properly manage StormFilter maintenance programs.

Prior to the development of the maintenance database, maintenance frequencies shown in Table 2 should be followed as a minimum.

	INSPECTION/MINOR MAINTENANCE (TIMES/YEAR)	MAJOR MAINTENANCE (TIMES/YEAR)
StormFilter	2 (and after major storms)	1 (except in case of a spill)

Table 2. Frequency of Maintenance (typ.)

Determining Maintenance Frequency from Modelling Design

The procedure below however provides a method to estimate the cartridge replacement frequency.

1. Using the results obtained from the modeling in figure 7 earlier; determine the mass of TSS removed by the StormFilter technology itself. This usually involves deducting the quantity removed by the pre-treatment devices upstream. This can is done by determining the residual load from each immediate upstream node(s) only and then subtracting the residual load at the StormFilter node.

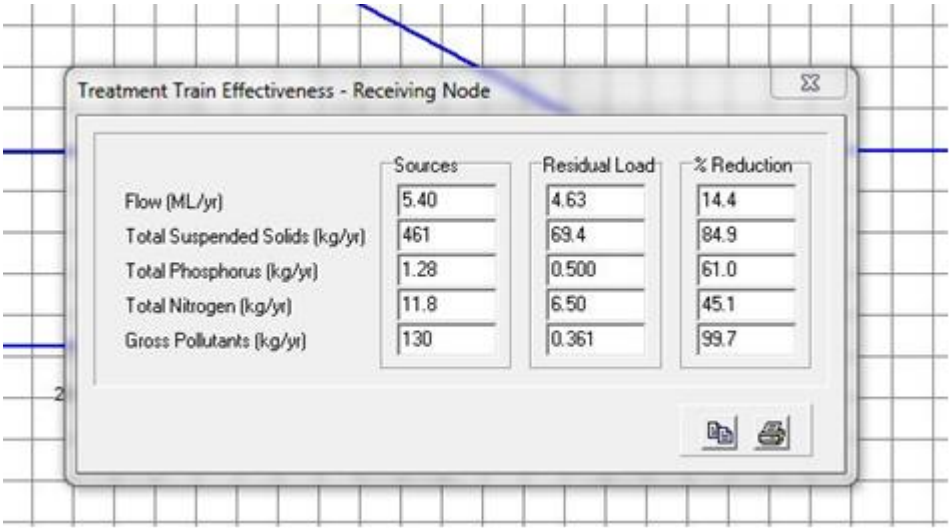
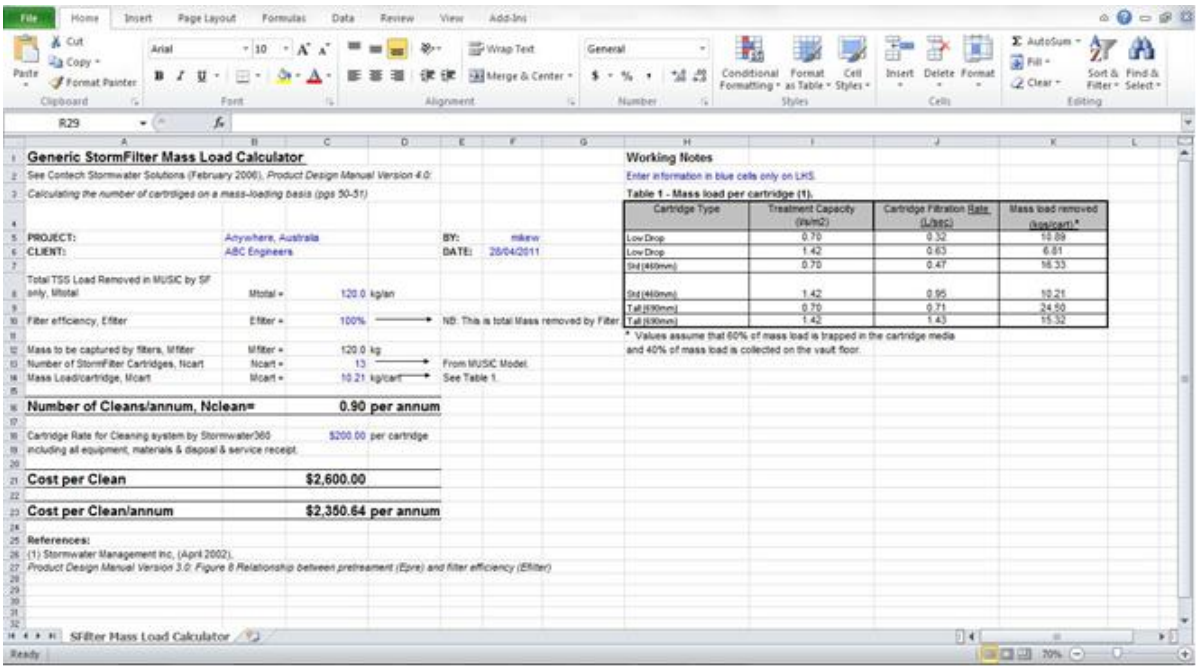


Figure 9. Results

2. Open the StormFilter Maintenance Frequency Calculator spreadsheet (shown below) and enter the load removed by the filter into cell C8. Also enter the number of cartridges from the previous design section into cell C13.



Generic StormFilter Mass Load Calculator

See Contech Stormwater Solutions (February 2006), *Product Design Manual Version 4.0:*
Calculating the number of cartridges on a mass-loading basis (pgs 50-51)

PROJECT: Anywhere, Australia — BY: mkew
CLIENT: ABC Engineers — DATE: 28/04/2011

Total TSS Load Removed in MUSIC by SF only, Mtotal	Mtotal =	120.0 kg/an	
Filter efficiency, Efilter	Efilter =	100%	NB: This is total Mass removed by Filter
Mass to be captured by filters, Mfilter	Mfilter =	120.0 kg	
Number of StormFilter Cartridges, Ncart	Ncart =	13	From MUSIC Model.
Mass Load/cartridge, Mcart	Mcart =	10.21 kg/cart	See Table 1.

Number of Cleans/annum, Nclean= 0.90 per annum

Cartridge Rate for Cleaning system by Stormwater360 including all equipment, materials & disposal & service receipt: $200.00 per cartridge

Cost per Clean $2,600.00

Cost per Clean/annum $2,350.64 per annum

References:
(1) Stormwater Management Inc, (April 2002),
Product Design Manual Version 3.0: Figure 8 Relationship between pretreatment (Epre) and filter efficiency (Efilter)

Working Notes
Enter information in blue cells only on LHS.

Table 1 - Mass load per cartridge (1).

Cartridge Type	Treatment Capacity (l/s/m2)	Cartridge Filtration Rate (L/sec)	Mass load removed (kgs/cart)*
Low Drop	0.70	0.32	10.89
Low Drop	1.42	0.63	6.81
Std (460mm)	0.70	0.47	16.33
Std (460mm)	1.42	0.95	10.21
Tall (690mm)	0.70	0.71	24.50
Tall (690mm)	1.42	1.43	15.32

* Values assume that 60% of mass load is trapped in the cartridge media and 40% of mass load is collected on the vault floor.

SFilter Mass Load Calculator

Figure 10. StormFilter Maintenance Frequency Spreadsheet

3. See table 1 on the spreadsheet. For each given cartridge height (column h) find the corresponding mass load per cartridge (column k) removed by the filter and enter into cell into cell C14.

Calculating the number of cartridges on a mass-loading basis (pgs 50-51)

PROJECT: Anywhere, Australia — BY: mkew
CLIENT: ABC Engineers — DATE: 28/04/2011

Total TSS Load Removed in MUSIC by SF only, Mtotal	Mtotal =	120.0 kg/an	
Filter efficiency, Efilter	Efilter =	100%	NB: This is total Mass removed by Filter
Mass to be captured by filters, Mfilter	Mfilter =	120.0 kg	
Number of StormFilter Cartridges, Ncart	Ncart =	13	From MUSIC Model.
Mass Load/cartridge, Mcart	Mcart =	10.21 kg/cart	See Table 1.

Number of Cleans/annum, Nclean= 0.90 per annum

Table 1 - Mass load per cartridge (1).

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Std (460mm)	0.70	0.47	16.33
Std (460mm)	1.42	0.95	10.21
Tall (690mm)	0.70	0.71	24.50
Tall (690mm)	1.42	1.43	15.32

* Values assume that 60% of mass load is trapped in the cartridge media and 40% of mass load is collected on the vault floor.

Figure 11. StormFilter Maintenance Frequency Spreadsheet

Once complete see cell C16 to determine the maintenance frequency of the cartridge replacement. Always check that the cartridge replacement period is no less than 12months. Contact Stormwater360 for further information.

4. PERFORMANCE DATA

Suspended Solids

The transfer function for suspended solids for the StormFilter node has been derived from the results of the "The Portland Submittal". This paper details the results from 5 separate StormFilter's. Figure 12 shows the influent / effluent relationship developed in the paper.

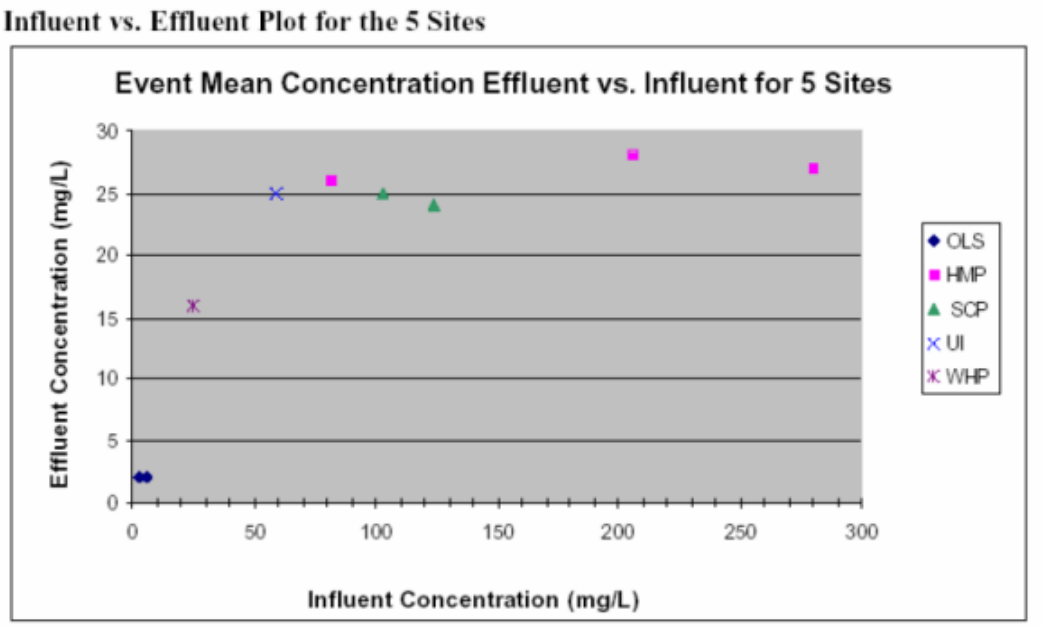


Figure 12. Portland Submittal Influent/Effluent Relationship

Source: City of Portland Submittal 2002

Also attached as supporting information is the paper; "Total Suspended Solids (TSS) Removal Using Different Particle Size Distributions with the Stormwater Management StormFilter". The particle size distribution in Stormwater is highly variable and greatly affects the performance of the treatment device. This paper details Laboratory testing of the StormFilter with different particle size distributions of synthetic sediment.

NJCAT Technology Verification Stormwater Management StormFilter. Portland, OR (USA).

NJCAT is a not-for-profit corporation to promote in New Jersey the retention and growth of Technology-based businesses in emerging fields such as environmental and energy technologies. NJCAT provides innovators with the regulatory, commercial, technological and financial assistance required to bring their ideas to market successfully.

The technology verification program specifically encourages collaboration between vendors and users of technology. Through this program, teams of academic and business professionals are formed to implement a comprehensive evaluation of vendor specific performance claims. Thus, suppliers have the competitive edge of an independent third party confirmation of claims.

A major condition of Conditional Interim Certification by the NJDEP is the execution of a subsequent field trial conducted in accordance with TARP (2003) and NJDEP (2006) to verify performance relative to the certified claims. Accordingly, a Project Plan for field verification testing was completed in accordance with the applicable protocols and accepted in June 2004, resulting in the commencement of monitoring activities. In December 2004, Conditional Interim Certification was extended based upon demonstrable project progress.

As part of a performance assessment of the StormFilter® in the State of New Jersey, a system using perlite media, installed at Greenville Yards, Jersey City, NJ, was evaluated. This StormFilter system treats stormwater runoff draining from a parking lot and commercial loading dock area.

This project was managed by CONTECH Stormwater Solutions Inc. (CONTECH) in Co-operation with the site owner and the New Jersey Department of Environmental Protection (NJDEP). Independent oversight of all aspects of the project was provided by Dr. Qizhong Guo of Rutgers University. Sample handling services were provided by Sovereign Consulting Inc. of Parsippany, NJ, and analytical work was conducted by Chemtech of Mountainside, NJ, and North Creek Analytical of Beaverton, OR.

Flow, level, and precipitation measurement equipment collected continuous data. Samplers were programmed to enable the sampling program after a minimum flow rate condition of >5 gpm (0.3L/s) was met. Once enabled, the equipment collected samples on a volume-paced basis allowing the specified pacing volume to pass before taking a sample.

The sample collection program input into each automated sampler was a two-part program developed to: 1) maximize the number of discrete samples (aliquots); 2) maximize the coverage of the precipitation event while at the same time maximizing aliquot volume.

Upon collection of samples following a precipitation event, CONTECH personnel communicated remotely with the automated sampling equipment to confirm sample collection and dispatch personnel from Sovereign to retrieve the samples and reset the automated sampling equipment. Samples were delivered to the Analytical Laboratory by Sovereign using cold transport and accompanied by chain-of-custody documentation. Discrete composite sample bottles were combined by the Analytical Laboratory to create bulk influent and effluent composite samples through identification of those bottles best representing the precipitation event based upon the hydrograph. Subsamples of the bulk influent and effluent composite samples to be used for analysis were created using an 8-L or 14-L.

Assessment of the mass of materials captured by the StormFilter as a whole over the course of the monitoring period revealed a net capture and retention of 2750 lbs (1248 kg) of material.11% of this material was found inside of the cartridges and 89% was found outside of the cartridges in the inlet bay and on the floor of the cartridge bay.

The results of the Coulter Counter influent PSD analysis revealed an average d50 of 13um. The average particle size distribution was comprised of 15% sand, 68% silt and 18% clay.

As per NJDEP (2006) both TSS and SSC demonstrate a linear relationship between influent and influent suspended solids EMCs that is significant at the >99.9% confidence level, indicating that the regression statistics can be used for the direct comparison of the field test observations to the performance claim.

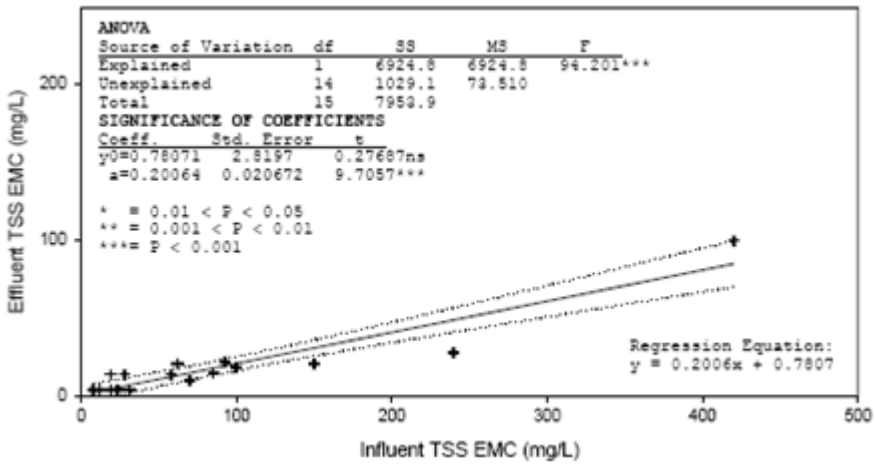


Figure 13. Regression of EMC for TSS Removal.

The regression statistics suggest a mean TSS removal efficiency of 80% with a standard error of 2.1% and a mean SSC removal efficiency of 84% with a standard error of 1.9%.

				Regression of EMC				Aggregate Load Reduction	
Analyte	*n*	Range of Influent EMCs (mg/L)	Median Influent EMC (mg/L)	Mean Removal Efficiency Estimate (%)	95% Confidence Interval for the Mean Removal Efficiency Estimate (%)	Median Effluent EMC Estimate (mg/L)	95% Confidence Interval for the Median Effluent EMC Estimate (mg/L)	Mean Removal Efficiency Estimate (%)	One-Tailed Sign Test* (H0=H1=0.5)
SSC	16	11.0 to 462	56.0	84***	80 to 88	10.7	5.60 to 15.9	80	R
TVSS	10	10.0 to 420	31.0	93**	89 to 96	9.20	4.19 to 14.2	78	R
SSC<500-um	13	6.00 to 170	26.0	89***	84 to 94	9.55	6.76 to 12.3	68	R
TVSS<500-um	7	12.0 to 130	29.0	---	--- to ---	---	--- to ---	76	R
TSS	16	8.00 to 420	60.0	80***	76 to 84	12.8	8.05 to 17.6	77	R

*** = P < 0.001
** = 0.01 > P > 0.001
* = 0.05 > P > 0.01
bold = equivalent to non-detect
--- = undeterminable due to insufficient data quantity
R = removal is significant at the 5% level or less
~ = no significant difference
A = addition is significant at the 5% level or less

Table 2. Total Suspended Solids (SSC in this case) Reduction for StormFilter.

In conclusion NJCAT verified that the claim that the Greenville Yards StormFilter system field test has demonstrated:

The Stormwater Management StormFilter® system operating at a specific flow rate of 2.05 gpm/ft2 per cartridge (15 gpm, 57 l/m) using perlite media has demonstrated a TSS (EPA Method 160.2) removal efficiency of 80% with 95% confidence limits of 76% and 84% for a sandy loam texture sediment (or finer) in the field using the NJDEP TARP/Tier II Protocol.

Total Phosphorous

The transfer function for total phosphorus has been developed from sampling 9 different StormFilters over 55 storms. The results are detailed and discussed in the paper "The Stormwater Management StormFilter Performance for Removal of Total Phosphorus". The Influent / Effluent relationship was developed through liner regression of the 55 storms as shown in figure 14 below.

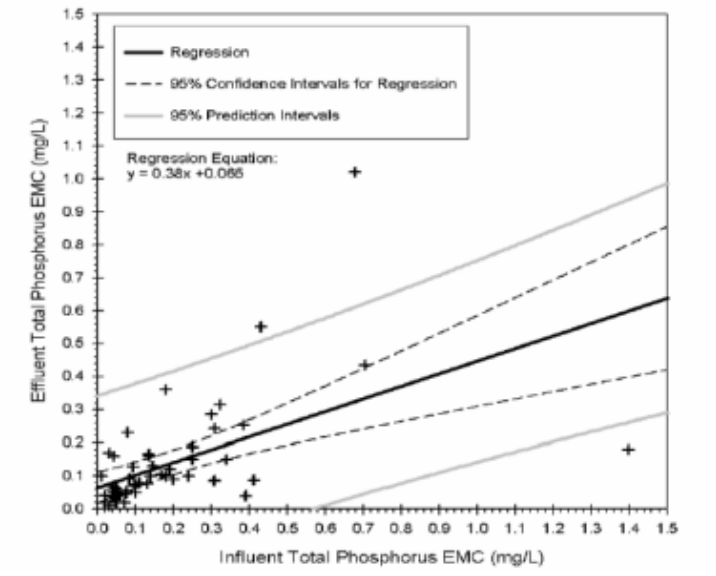


Figure 14. Influent TP vs. Effluent TP Linear Regression

Source: The Stormwater Management StormFilter Performance for Removal of Total Phosphorus

Total Nitrogen

A StormFilter system was installed in the Ski Run Marina parking lot by the City of South Lake Tahoe (CA, USA) in 2001. The City of South Lake Tahoe established automated storm water monitoring equipment at the inlet and outlet of the StormFilter system to quantitatively evaluate the in-situ ability of the StormFilter to reduce nutrient and fine sediment loads from stormwater runoff at Ski Run Marina in South Lake Tahoe. A total of 2.5 years of storm water quality monitoring (10 events) was completed at the site (2nd Nature Consulting, 2004).

The City of South Lake Tahoe (CSLT) installed two Sigma 900 MAX automated water samplers with area velocity flow meters at both the inlet (Site Sin) and the outlet (Site Sout) of the StormFilter vault to collect flow weighted stormwater samples during a variety of runoff events. Both sampling units were equipped with 24 sample bottles (1L) and flow pacing was adjusted to collect a number of samples during each individual event that provided a representative selection of the entire storm hydrograph at both the inlet and outlet. The instruments were well maintained and serviced prior to each anticipated runoff event. The two monitoring systems and the associated data were installed, maintained and managed primarily by Russ Wigart, an engineer with CSLT. A total of 10 events were successfully monitored at both the inlet and outlet for flow and water sample collection. All samples were placed on ice and submitted to WetLab Analytical and processed for the constituents listed in Table 3 within 48 hours of collection by the auto samplers. Analysis of pollutants, including nitrate, nitrite, ammonium and orthophosphate, phosphorus and suspended solids was untaken (2nd Nature Consulting, 2004).

		volume reductions	REMOVAL EFFICIENCIES					BLACK VALUE INDICATES REDUCTION IN POLLUTANT RED VALUE INDICATED INCREASE IN POLLUTANT				
EVENT	EVENT TYPE		NO3-N	NO2-N	NH3-N	TKN	TN	OP	DP	PP	TP	TSS
11/22/01	rain	11%	-3%	-17%	46%	-22%	-16%	0%	16%		23%	-80%
11/24/01	rain	23%	15%	1%	38%	31%	28%	2%	10%		59%	-28%
12/2/01	snow melt	22%	42%	16%	68%	47%	46%	16%	64%	5%	43%	88%
4/30/02	snow melt	23%	21%	-92%	61%	32%	24%	-57%	0%		-28%	95%
7/18/02	thunderstorm	82%	-94%	84%	96%	95%	86%	96%	95%	97%	97%	99%
11/8/02	rain	21%	-6%	-45%	10%	17%	9%	17%	16%	39%	26%	44%
11/10/02	rain	24%	39%	24%	30%	56%	51%	-75%	-33%	89%	65%	97%
3/15/03	rain on snow	14%	32%	14%	11%	37%	37%	20%	18%	65%	55%	57%
6/21/03	thunderstorm	16%	69%	7%	46%	19%	32%	73%	61%	23%	35%	89%
1/8/04	rain	11%	-66%	11%	11%	55%	47%	49%	-47%	66%	56%	63%
			NO3-N	NO2-N	NH3-N	TKN	TN	OP	DP	PP	TP	TSS
STORMFILTER PERFORMANCE	average removal		5 ± 57 %	0 ± 46%	42 ± 28%	37 ± 30 %	34 ± 28 %	14 ± 52 %	22 ± 46 %	55 ± 34 %	43 ± 32 %	52 ± 60 %
	PROJECT EFFICIENCY		14%	-12%	36%	34%	29%	23%	6%	70%	50%	63%
Project Efficiency: treatment efficiency for sum of all inflow and outflow loads over monitoring duration												
[2] with first 2 events removed	PROJECT EFFICIENCY [2]		15%	-36%	35%	39%	32%	7%	5%	70%	51%	79%

Table 3. Performance Summary for StormFilter.

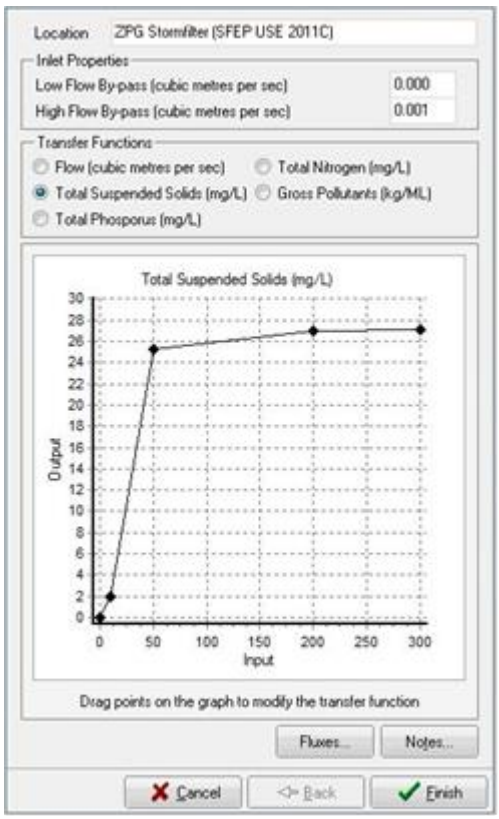
The project efficiency of the system with the anomalies removed indicated a removal efficiency of 79% for Suspended Solids, 51% Total Phosphorus & 32% for Total Nitrogen.

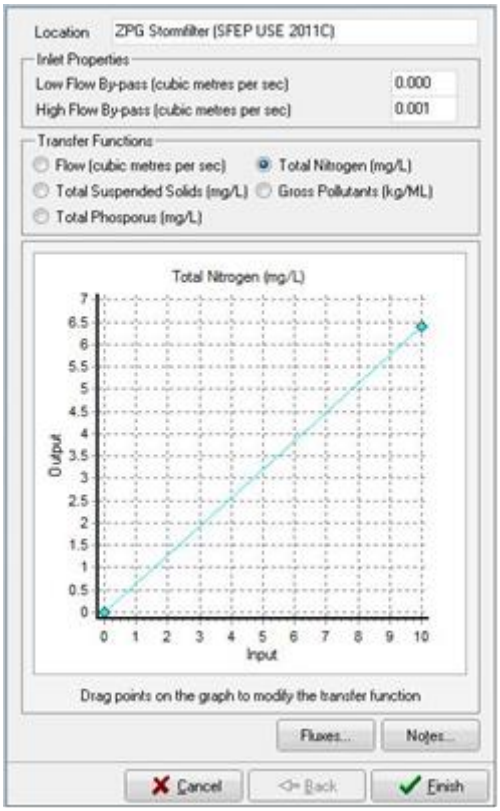
There has been various studies relating to nutrient reduction of the StormFilter technology. A summary of these studies of the StormFilter technology in the United States, the system has achieved 60% TP reduction (across 9 different sites & 55 storms) and 36% TN reduction (older style wet sump fore bay StormFilter across 3 sites & 33 storms) as a standalone technology which has been used in modeling the StormFilter technology.

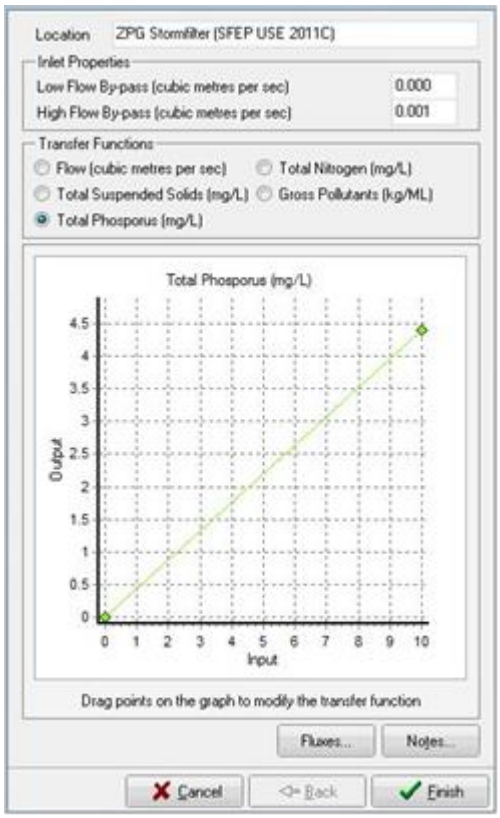
Please note the data used above is for the standalone StormFilter treatment system. For modelling the SFEP treatment train consult the SFEP MUSIC Modelling Guidelines for details and published performance data.

Appendix A – Transform Functions

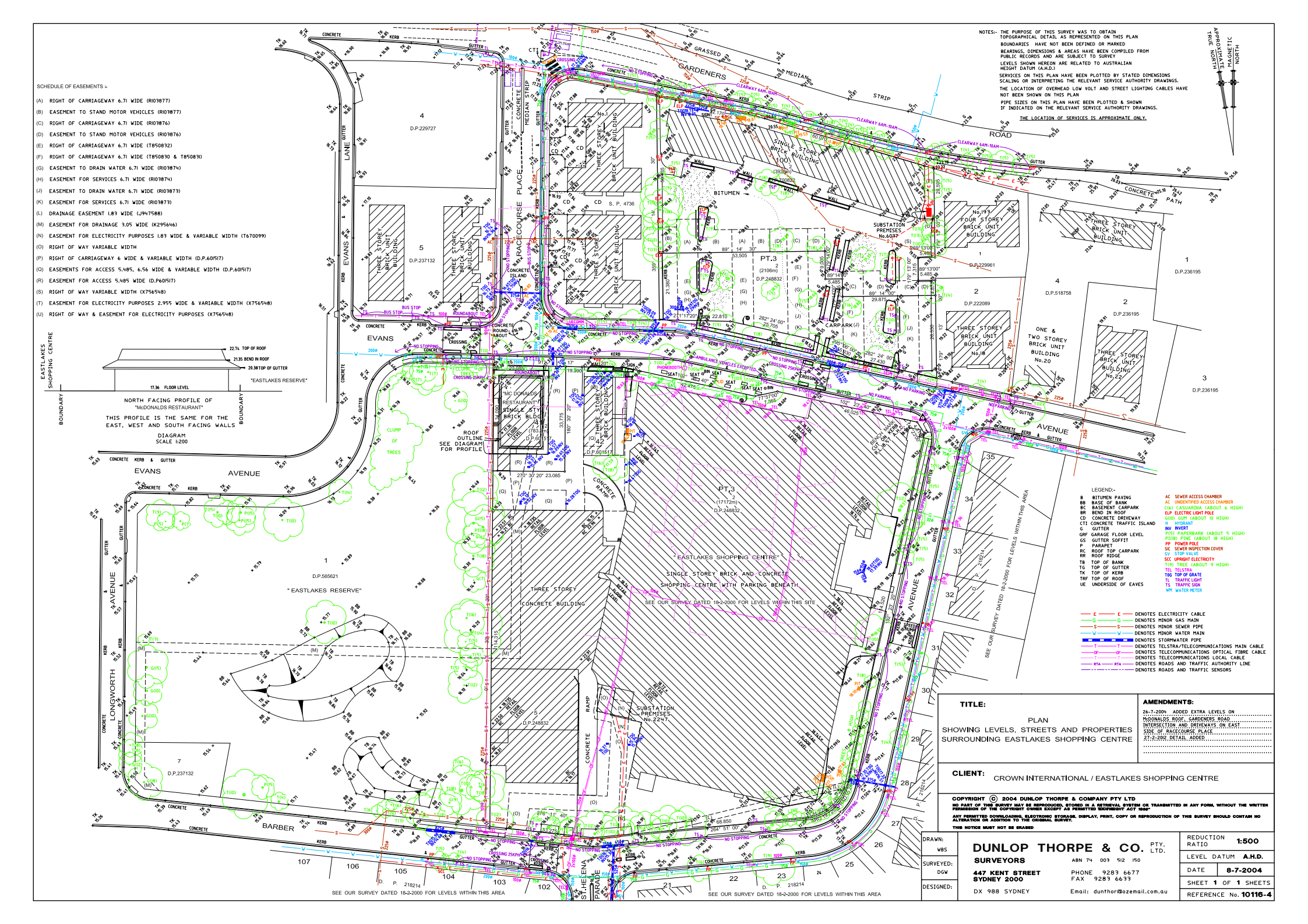
StormFilter







Appendix E – Survey


SCHEDULE OF EASEMENTS :-
(A) RIGHT OF CARRIAGEWAY 6.71 WIDE (RI03877)
(B) EASEMENT TO STAND MOTOR VEHICLES (RI03877)
(C) RIGHT OF CARRIAGEWAY 6.71 WIDE (RI03876)
(D) EASEMENT TO STAND MOTOR VEHICLES (RI03876)
(E) RIGHT OF CARRIAGEWAY 6.71 WIDE (T850832)
(F) RIGHT OF CARRIAGEWAY 6.71 WIDE (T850830 & T850831)
(G) EASEMENT TO DRAIN WATER 6.71 WIDE (RI03874)
(H) EASEMENT FOR SERVICES 6.71 WIDE (RI03874)
(J) EASEMENT TO DRAIN WATER 6.71 WIDE (RI03873)
(K) EASEMENT FOR SERVICES 6.71 WIDE (RI03873)
(L) DRAINAGE EASEMENT 1.83 WIDE (J947588)
(M) EASEMENT FOR DRAINAGE 9.05 WIDE (K295646)
(N) EASEMENT FOR ELECTRICITY PURPOSES 1.83 WIDE & VARIABLE WIDTH (T670099)
(O) RIGHT OF WAY VARIABLE WIDTH
(P) RIGHT OF CARRIAGEWAY 6 WIDE & VARIABLE WIDTH (D.P.601517)
(Q) EASEMENTS FOR ACCESS 5.485, 6.56 WIDE & VARIABLE WIDTH (D.P.601517)
(R) EASEMENT FOR ACCESS 5.485 WIDE (D.P601517)
(S) RIGHT OF WAY VARIABLE WIDTH (X756548)
(T) EASEMENT FOR ELECTRICITY PURPOSES 2.955 WIDE & VARIABLE WIDTH (X756548)
(U) RIGHT OF WAY & EASEMENT FOR ELECTRICITY PURPOSES (X756548)
NOTES:- THE PURPOSE OF THIS SURVEY WAS TO OBTAIN TOPOGRAPHICAL DETAIL AS REPRESENTED ON THIS PLAN
BOUNDARIES HAVE NOT BEEN DEFINED OR MARKED
BEARINGS, DIMENSIONS & AREAS HAVE BEEN COMPILED FROM PUBLIC RECORDS AND ARE SUBJECT TO SURVEY
LEVELS SHOWN HEREON ARE RELATED TO AUSTRALIAN HEIGHT DATUM (A.H.D.)
SERVICES ON THIS PLAN HAVE BEEN PLOTTED BY STATED DIMENSIONS SCALING OR INTERPRETING THE RELEVANT SERVICE AUTHORITY DRAWINGS.
THE LOCATION OF OVERHEAD LOW VOLT AND STREET LIGHTING CABLES HAVE NOT BEEN SHOWN ON THIS PLAN
PIPE SIZES ON THIS PLAN HAVE BEEN PLOTTED & SHOWN IF INDICATED ON THE RELEVANT SERVICE AUTHORITY DRAWINGS.
THE LOCATION OF SERVICES IS APPROXIMATE ONLY.
APPROXIMATE TRUE NORTH
MAGNETIC NORTH
EASTLAKES SHOPPING CENTRE
22.74 TOP OF ROOF
21.35 BEND IN ROOF
20.38 TOP OF GUTTER
17.36 FLOOR LEVEL
"EASTLAKES RESERVE"
BOUNDARY
BOUNDARY
NORTH FACING PROFILE OF "McDONALDS RESTAURANT"
THIS PROFILE IS THE SAME FOR THE EAST, WEST AND SOUTH FACING WALLS
DIAGRAM SCALE 1:200
ROOF OUTLINE SEE DIAGRAM FOR PROFILE
"MC DONALDS RESTAURANT" SINGLE STY BRICK BLDG
"EASTLAKES SHOPPING CENTRE" SINGLE STOREY BRICK AND CONCRETE SHOPPING CENTRE WITH PARKING BENEATH
SEE OUR SURVEY DATED 18-2-2000 FOR LEVELS WITHIN THIS SITE
THREE STOREY CONCRETE BUILDING
SUBSTATION PREMISES No.2247
SUBSTATION PREMISES No.6097
SINGLE STOREY BRICK BUILDING No.100
FOUR STOREY BRICK UNIT BUILDING No.193
THREE STOREY BRICK UNIT BUILDING No.18
ONE & TWO STOREY BRICK UNIT BUILDING No.20
THREE STOREY BRICK UNIT BUILDING No.22
GARDENERS ROAD
RACECOURSE PLACE
EVANS LANE
EVANS AVENUE
LONGWORTH AVENUE
BARBER AVENUE
ST HELENA PARADE
CONCRETE PATH
GRASSED MEDIANS
CONCRETE MEDIAN STRIP
CONCRETE ISLAND
CONCRETE ROUNDABOUT
BITUMEN
CARPARK
CONCRETE RAMP
CLUMP OF TREES
BUS STOP
PROHIBITED
CROSSING 25KPH
NO STOPPING
NO PARKING
CLEARWAY 6AM-10AM
CLEARWAY 6AM-9AM
LEGEND:-
B BITUMEN PAVING
BB BASE OF BANK
BC BASEMENT CARPARK
BR BEND IN ROOF
CD CONCRETE DRIVEWAY
CTI CONCRETE TRAFFIC ISLAND
G GUTTER
GRF GARAGE FLOOR LEVEL
GS GUTTER SOFFIT
P PARAPET
RC ROOF TOP CARPARK
RR ROOF RIDGE
TB TOP OF BANK
TG TOP OF GUTTER
TK TOP OF KERB
TRF TOP OF ROOF
UE UNDERSIDE OF EAVES
AC SEWER ACCESS CHAMBER
AC UNIDENTIFIED ACCESS CHAMBER
C(6) CASUARINA (ABOUT 6 HIGH)
ELP ELECTRIC LIGHT POLE
G(10) GUM (ABOUT 10 HIGH)
H HYDRANT
INV INVERT
P(5) PAPERBARK (ABOUT 5 HIGH)
P(10) PINE (ABOUT 18 HIGH)
PP POWER POLE
SIC SEWER INSPECTION COVER
SV STOP VALVE
SCC UPRIGHT ELECTRICITY
T(9) TREE (ABOUT 9 HIGH)
TEL TELSTRA
TOG TOP OF GRATE
TL TRAFFIC LIGHT
TS TRAFFIC SIGN
WM WATER METER
E DENOTES ELECTRICITY CABLE
G DENOTES MINOR GAS MAIN
S DENOTES MINOR SEWER PIPE
W DENOTES MINOR WATER MAIN
DENOTES STORMWATER PIPE
T DENOTES TELSTRA/TELECOMMUNICATIONS MAIN CABLE
OF DENOTES TELECOMMUNICATIONS OPTICAL FIBRE CABLE
T DENOTES TELECOMMUNICATIONS LOCAL CABLE
RTA DENOTES ROADS AND TRAFFIC AUTHORITY LINE
DENOTES ROADS AND TRAFFIC SENSORS
SEE OUR SURVEY DATED 18-2-2000 FOR LEVELS WITHIN THIS AREA
SEE OUR SURVEY DATED 18-2-2000 FOR LEVELS WITHIN THIS AREA
SEE OUR SURVEY DATED 18-2-2000 FOR LEVELS WITHIN THIS AREA
TITLE:
PLAN SHOWING LEVELS, STREETS AND PROPERTIES SURROUNDING EASTLAKES SHOPPING CENTRE
AMENDMENTS:
26-7-2000 ADDED EXTRA LEVELS ON McDONALDS ROOF, GARDENERS ROAD INTERSECTION AND DRIVEWAYS ON EAST SIDE OF RACECOURSE PLACE.
27-2-2012 DETAIL ADDED
CLIENT: CROWN INTERNATIONAL / EASTLAKES SHOPPING CENTRE
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REFERENCE No. 10116-4

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