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Reference: 14139_RPT01-A-SWMP

24th November 2017

Gary Keighran
Rynan Constructions
9 Rynan Avenue
EDMONDSON PARK, NSW 2174

Dear Gary,

**RESIDENTIAL DEVELOPMENT – 15 RYNAN AVENUE, EDMONDSON PARK (EAST)**
**CONCEPT STORMWATER DRAINAGE AND WSUD STRATEGY**

Diversi Consulting has been engaged to prepare a Concept Stormwater Drainage Strategy and Concept Water Sensitive Urban Design (WSUD) for the proposed residential subdivision located at No. 15 Rynan Avenue, Edmondson Park.

Following is a summary of the concept stormwater drainage design including the sizing of the street drainage system and WSUD facilities.

This should be read in conjunction with the Civil Engineering Works Drawings 14139-DA01 to DA08 accompanying the Development Application submission requirements.

This assessment has been developed in accordance with Liverpool City Council's requirements for the purposes of describing the analysis undertaken and to explain the concept behind the proposed stormwater drainage infrastructure.

If you have any questions or require any clarifications please call me on 0421 484 152 or (02) 8883 1113.

Yours faithfully

**Diversi Consulting**

Phil Diversi
Director

# 1 BACKGROUND INFORMATION

## 1.1 Site

The subject development area is located in the suburb of Edmondson Park within the Liverpool City Council Local Government Area (LGA). The site is bounded by Rynan Avenue to the East and adjoins rural and residential properties along all other boundaries. **Figure 1** below shows the location and boundary of the proposed site.

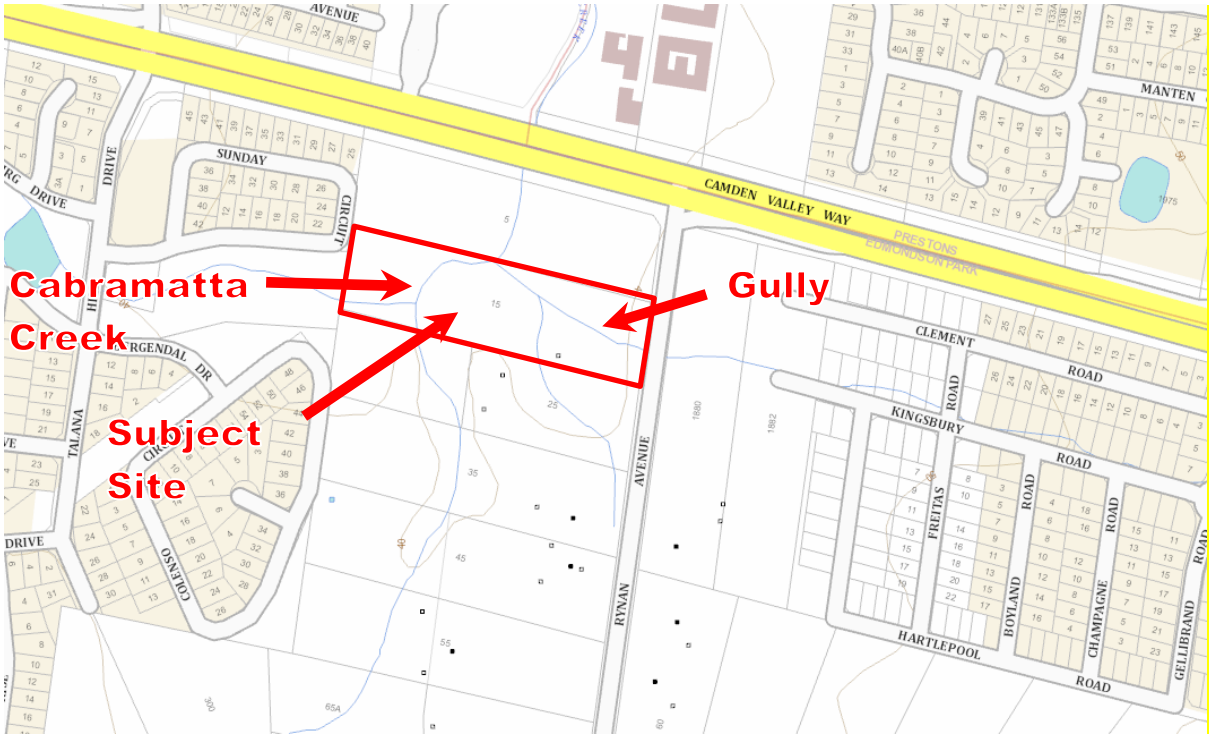



***Figure 1:*** *Locality Plan (NSW SIX maps 2015)*

Cabramatta Creek traverses the site draining generally in a northerly direction almost through the centre of the lot, as indicated by the blue line in Figure 1. There is also a gully draining a significant catchment to the East of the site to Cabramatta Creek as shown in Figure 1 above.

Slopes across the site vary between 1-4%, with a total lot area of approximately 2.02ha. This proposal is for the development of the eastern portion of the lot only (east of Cabramatta Creek) which has a total site area of approximately 0.71ha. Survey plans for the site are contained within **Attachment A**.

## 1.2 Proposed Development

The proposed development is for a residential subdivision creating 2 lots and 3 apartment buildings with associated roadways and basement parking. Part of the proposed buildings connect to the building proposed at No. 5 Rynan Avenue. The rear portion of the site (closest to the Creek) is to remain undeveloped as part of this proposal. The rear portion of the site will in future include two (2) raingardens in accordance with Liverpool Council's S.94 Contributions plan. The total developed site area is approximately 6300m$^2$.

## 1.3 Pre-Lodgement Application Advice

A pre-lodgement meeting (reference No. PL-124/2015) was held with Council on the 18th November 2015 to discuss requirements for the proposed development at 5 and 15 Rynan Avenue.

The following list below summarises the Pre-Lodgement application advice relating to stormwater drainage for the site, along with any further conversations with Council regarding these items;

Stormwater

- Stormwater drainage for the site must be in accordance with Council's Development Control Plan.
- A stormwater concept plan shall be submitted with the application.
- The stormwater concept plan shall be accompanied by a supporting report and calculations.
- On-site detention is required to be provided for the site.
- The on-site detention system must be within common property and accessible from the street without going through dwellings or private courtyards.
- A water quality treatment device shall be provided in accordance with Council's Development Control Plan.

Further discussions have occurred with Councils Engineers to clarify the requirements around OSD and WSUD for the site. In discussions with Liverpool Councils Coordinator Land Development Charlie Caraballo it has been confirmed that;

1. OSD is not required for the site, and
2. Temporary WSUD measures are required for the site i.e. bio-basin and/or GPT sized using MUSIC or alternatively construct the permanent bio-retention basin as works in kind and offset the losses against Section 94 contributions for the project.

## 1.4 Council and Authority Requirements

The site is located within the Liverpool City Council local government area and as such the following specific requirements and guidelines have been adopted;

- **Liverpool City Council** Development Control Plan Part 1 Water Cycle Management (2008),
- **Liverpool City Council** WSUD Technical Guidelines (2016),
- **Catchment Management Authority (CMA)** Draft NSW MUSIC Modelling Guidelines (2010),
- **UPRCT** WSUD Technical Guidelines for Western Sydney (2014) and
- **FAWB** Stormwater Biofiltration Systems Adoption Guidelines (2009).

# 2 STORMWATER DRAINAGE CONCEPT DESIGN

## 2.1 General

In order to determine the size and appropriate discharge controls for the proposed site hydrological/hydraulic modelling has been undertaken using a stormwater computer program called DRAINS by Watercom Pty Ltd which was developed for the design and analysis of urban stormwater drainage.

DRAINS is a simulation program which converts rainfall patterns into stormwater runoff and routes flows through networks of pipes and channels. It develops hydrographs and calculates hydraulic grade lines throughout drainage systems, enabling the users to determine the sizes and positions of pipes in new systems and to analyse on-site detention systems.

DRAINS draws on parts of the PIPES and ILSAX programs developed by Watercom Pty Ltd and Geoffrey O'Loughlin (formerly of the University of Technology, Sydney). In particular DRAINS uses the ILSAX hydrological model but substantially improves on ILSAX's hydraulic methods.

In order to determine and model the proposed water quality treatment train for the site, a water quality model was developed using a stormwater computer program called Model for Urban Stormwater Improvement and Conceptualisation (MUSIC) by eWater which was developed for the design and analysis of urban stormwater quality.

## 2.2 Hydrological Model characteristics

The DRAINS model for the OSD basins was based on the ILSAX submodule and on the following characteristics:

- Soil type = 3 (moderate infiltration rates)
- Depression storage:
  - Paved areas = 1 mm
  - Supplementary areas = 1 mm
  - Grassed areas = 5 mm

The model was constructed using a combination of pits, pipes and nodes. Rainfall data was entered directly from Councils available IFD data.

## 2.3 Existing Drainage

Rynan Avenue is predominately a rural road with table drains along both sides of the road. There is a crest near No. 35 Rynan Avenue resulting in some waters draining north towards Camden Valley Way and the remainder of waters draining south towards Jardine Drive. As previously mentioned, there is an existing gully draining a significant upstream catchment through the site (as shown by the blue line in Figure 1). This gully is approximately in line with the proposed roadway as per the Edmondson Park DCP road network plan that connects Kingsbury Road to Rynan Avenue and continues west through No. 15 Rynan Avenue towards Cabramatta Creek.

A schematic of the Edmondson Park DCP road network system is provided in **Attachment B**. It is envisaged that the main trunk drainage line to facilitate future development of Edmondson Park will be along this roadway following the existing gully. In order to ensure this catchment drains along Road 1 a low point has been created at the intersection of Rynan Avenue. Please refer to the road design plans contained within **Attachment C.** Further information on the proposed drainage strategy and overland flow path is provided in following sections.

## 2.4 Contributing Catchment

A combination of orthophoto map imagery, site inspection and detailed ground survey prepared was used to determine the catchment areas for the stormwater drainage design. Approximately half of Rynan Avenue drains in a northerly direction towards Camden Valley Way, with the crest occurring between No. 35 and 45 Rynan Avenue.

There is a significant catchment area to the east of the site that drains towards Cabramatta Creek, extending some 650m east of the site past Gellibrand Road, with a total catchment in the order of 12.325ha. The upstream catchment drains to two existing gully that passes under No. 15 and 5 Rynan Avenue. To be more conservative, the whole external catchment of 12.325 ha has been considered to discharge to No. 15 Rynan Avenue. A copy of the catchment plan is attached in **Attachment D**.

## 2.5 Overland Flow Route

The Drains modelling shows that the proposed main trunk drainage system within development safely conveys overland flows in the 1% AEP storm event. Copy of DRAINS model layout, typical cross section and flow widths, flow depths and velocity x flow depth (V x D) ratio results are attached in **Attachment F**. The peak overland flow, flow depths and velocity x flow depth (V x D) ratio at main trunk drainage line are shown in **Table 2.1**. Peak pipe flow for proposed drainage pipe for 10 year and 100 year ARI storm event are shown in **Table 2.2**.

**Table 2.1:** Results of Overland Flow Path for 100 year ARI storm event

| Cross Section | Major Storm (100 year ARI) Results | | |
|---|---|---|---|
| | Peak Overland Flow (m3/s) | Maximum Flow Depth (m) | Velocity x Depth (V x D) (m2/s) |
| OF P-1 | 2.010 | 0.104 | 0.18 |
| OF E-6 | 1.310 | 0.199 | 0.39 |
| OF E-5 | 0.846 | 0.176 | 0.29 |
| OF E-4 | 0.499 | 0.135 | 0.23 |
| OF E-3 | 0.111 | 0.093 | 0.09 |

**Table 2.2:** Peak Pipe Flow for Proposed Drainage Pipe

| Pipe Number | Minor Storm (10 year ARI) | Major Storm (100 year ARI) |
|---|---|---|
| | Peak Pipe Flow (m3/s) | Peak Pipe Flow (m3/s) |
| P P-1a | 4.58 | 6.28 |
| P P-1 | 4.59 | 4.90 |
| P E-6 | 4.73 | 5.28 |
| P E-5 | 4.78 | 5.61 |
| P E-4 | 4.80 | 5.90 |
| P E-3 | 4.92 | 6.31 |
| P E-2 | 4.93 | 6.34 |

# 3 WATER QUALITY MODELLING

## 3.1 General

The WSUD strategy for the site has been driven by a number of requirements and guidelines provided by Council and the relevant authorities. These guidelines have been utilised in conjunction with industry best practice to develop the proposed WSUD strategy.

A water quality analysis of the stormwater discharge leaving the site was undertaken to demonstrate compliance with the objectives set out in Liverpool City Council WSUD Technical Guideline (2016). The requirements for Liverpool Council are;

- 45% reduction in the mean annual load of total nitrogen,
- 65% reduction in the mean annual load of total phosphorus, and
- 85% reduction in the mean annual load of total suspended solids.

Model for Urban Stormwater Improvement Conceptualisation (MUSIC) is a stormwater quality modelling software program that has been developed by the Cooperative Research Centre for Catchment Hydrology (CRC) and has been used to simulate the performance of the proposed stormwater quality treatment train and demonstrate the effectiveness of the proposed measures against the stormwater water quality treatment targets listed above.

The analysis considered two (2) major WSUD components, as detailed below, to improve the quality of stormwater discharge leaving the site;

a) **Bio-Retention Basin:** A bio-retention basin will be provided at the downstream end of the site within No. 15 Rynan Avenue. The minimum filter area required to achieve Councils water quality objectives has been sized using MUSIC.

b) **Rainwater Re-use Tanks:** Rainwater tanks will be provided to collect a minimum of 40% of the stormwater roof run-off from each building in order to reduce potable

water demand by re-using the collected stormwater primarily for irrigation of the open space areas. Building A,B-C and D will have 1KL, 6KL and 3KL rainwater tanks respectively.

c) **Gross Pollutant Traps:** Two GPTs will be provided at the downstream end of the site within No. 15 Rynan Avenue as first treatment measures in the treatment train. Proposed GPTs are as below:

- GPT allocated for 5 Rynan Avenue site: Rocla CDS P1015
- GPT allocated for 15 Rynan Avenue site: Rocla CDS P1518

## 3.2 WSUD Subcatchments

Subcatchments for the site have been defined based on the type and use of each area to accurately define the likely pollutant loadings that will be generated from the site.

The proposed development site has been divided into three (3) major catchments for stormwater quality management. The three (3) catchments used for the water quality analysis include;

- **Roof Area (of all buildings)** with a total area of 0.413ha. It has been assumed that 60% of the roof area bypasses the rainwater tanks based on the BASIX requirement.

- **Residential Lot area** with a total area of 0.705ha. Based on the footprint of the lots, including pathways and patios the impervious percentage is approximately 50%.

- **Road Reserve** with a total area of 0.561ha. Based on the road way and footpath widths this area has been modelled with an impervious percentage of 80%.

## 3.3 Model Parameters

Input parameters are based on the recommended stormwater quality, soil and groundwater parameters for MUSIC modelling provided Liverpool City Council WSUD Technical Guideline (2016).

Rainfall data from the Liverpool Witlam Centre, No. 067035 from 1967 to 1976 was used in combination with Parramatta's monthly averages for potential evapotranspiration (PET). The meteorological template for the site is based on a 6 minute time step as recommended in the Liverpool City Council WSUD Technical Guideline.

Source node information including rainfall threshold values, pervious area parameters, base flow concentration parameters and storm flow concentration parameters for each land use (subcatchment) has been derived from the Liverpool City Council WSUD Technical Guideline. **Tables 3.1** and **3.2** list the input parameters used within MUSIC.

**Table 3.1:** Soil properties for MUSIC Source Nodes

| Parameter | Unit | Value |
|---|---|---|
| **Impervious Area Properties** | | |
| Rainfall Threshold | mm | 1.5 (for roads/paths etc.)<br>0.3 (for roofs) |
| **Soil Type** | | Clay |
| **Pervious Area Properties** | | |
| Soil Storage Capacity | mm | 187 |
| Initial Storage | % | 30 |
| Field Capacity | mm | 127 |
| Infiltration Capacity Coefficient – a | | 135 |
| Infiltration Capacity Exponent – b | | 4 |
| **Groundwater Properties** | | |
| Initial Depth | mm | 10 |
| Daily Recharge Rate | % | 10 |
| Daily Baseflow Rate | % | 10 |
| Deep Seepage | % | 0 |

**Table 3.2:** Stormwater Quality Parameters for MUSIC Source Nodes

| Land-use | | Storm Flow ($log_{10}$ mg/l) | | | Base Flow ($log_{10}$ mg/l) | | |
|---|---|---|---|---|---|---|---|
| | | TSS | TP | TN | TSS | TP | TN |
| **Roof Areas** | Mean | 1.30 | -0.89 | 0.3 | - | - | - |
| | Std Dev | 0.32 | 0.25 | 0.19 | - | - | - |
| **Road Areas** | Mean | 2.43 | -0.3 | 0.34 | - | - | - |
| | Std Dev | 0.32 | 0.25 | 0.19 | - | - | - |
| **Residential** | Mean | 2.15 | -0.6 | 0.3 | 1.20 | -0.85 | 0.11 |
| | Std Dev | 0.32 | 0.25 | 0.19 | 0.17 | 0.19 | 0.12 |

## 3.4 Model setup

The stormwater quality treatment train has been developed for the proposed development area with water quality controls as shown in **Figure 3.1**.

The treatment train was designed to ensure the selected measures function effectively to meet Council's water quality objectives.

To best model the treatment train, the MUSIC model required twelve (12) catchment nodes and six (6) treatment nodes which consists of rainwater tanks, two GPTs and a bio-retention basin as shown in **Figure 3.1**. Primary links were used in MUSIC to route flows from the

source nodes to the treatment nodes as per CMA modelling guidelines and as such represents all three flow types comprising of impervious storm flow, pervious storm flow and base flow.

The proposed treatment train has been designed to treat the 3 month ARI flow in accordance with industry best practice. A bypass pit upstream of the bio-retention basin has been designed to ensure flow in excess of the 3 month ARI bypasses the basin. This bypass pit will also ensure that upstream catchments external to the site also bypass the basin. As previously noted in Section 1.2 and 1.3 of this report it is expected that external catchments to the site will provide their own temporary WSUD measures as required.

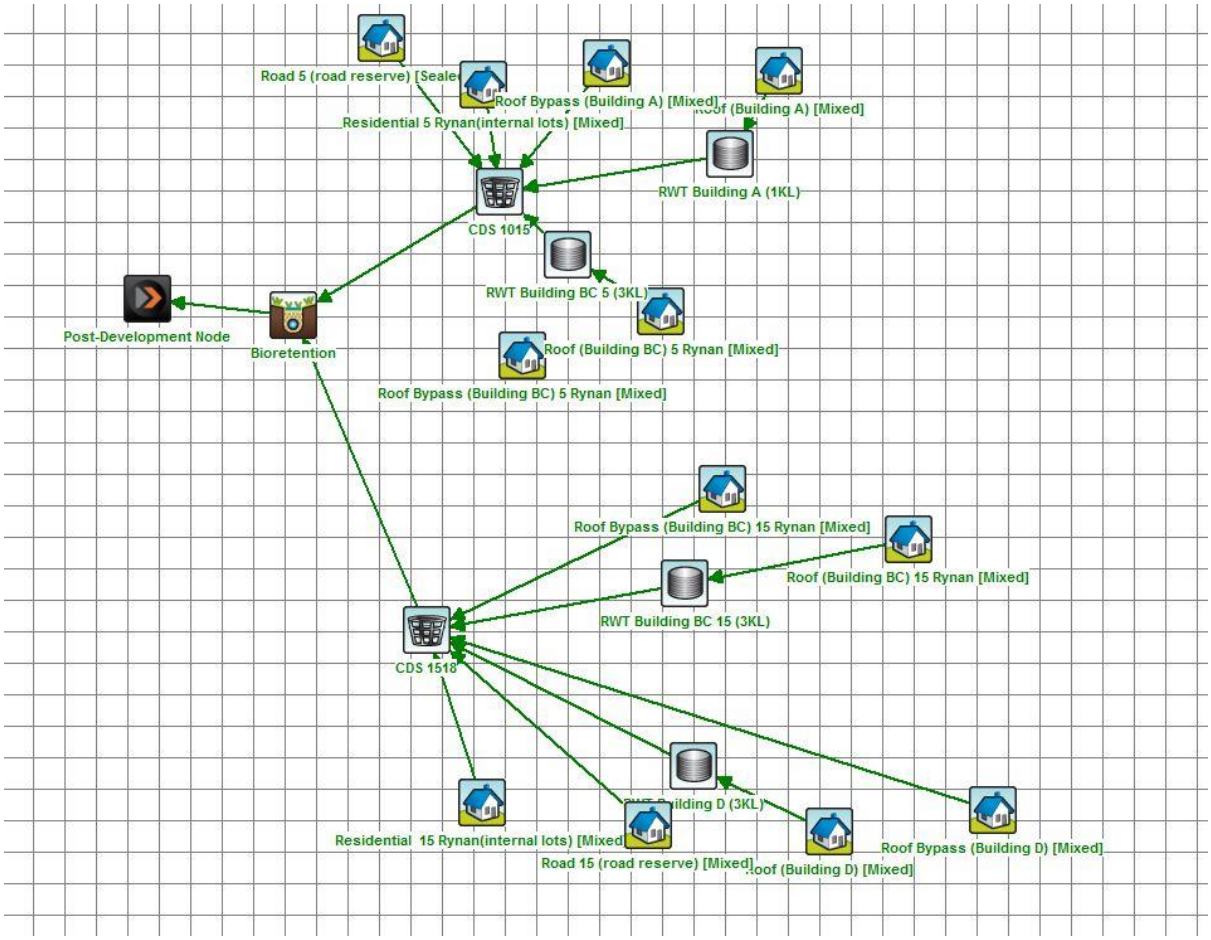



**Figure 3.1:** MUSIC Model Layout

## 3.5 Treatment Nodes

### 3.5.1 Rainwater Tanks

Rainwater tanks have been provided on each building with varying capacity as noted in Section 3.1 to collect a minimum of 40% of the roof runoff that will be utilised for irrigation purposes. The rainwater tanks for the residential lots have been modelled as four (4)

treatment nodes for each building in accordance with the CMA modelling guidelines. **Figure 3.2** below shows the input parameters for the rainwater tank node for Building A (typical).

CMA guidelines recommend a rate of 112/kL/yr per dwelling for external irrigation purposes however re-use rates for a high density development such as that proposed for this site are not included within the guidelines. A conservative approach has been undertaken to estimate the re-use of each building, with the tank re-use set to just 112kL/yr for each building rather than per unit. A higher re-use rate from each tank will increase the pollutant capture efficiency of the rainwater tanks and reduce the bio-retention filter media required. Given there are no available re-use rates for high density units we consider this conservative approach acceptable.

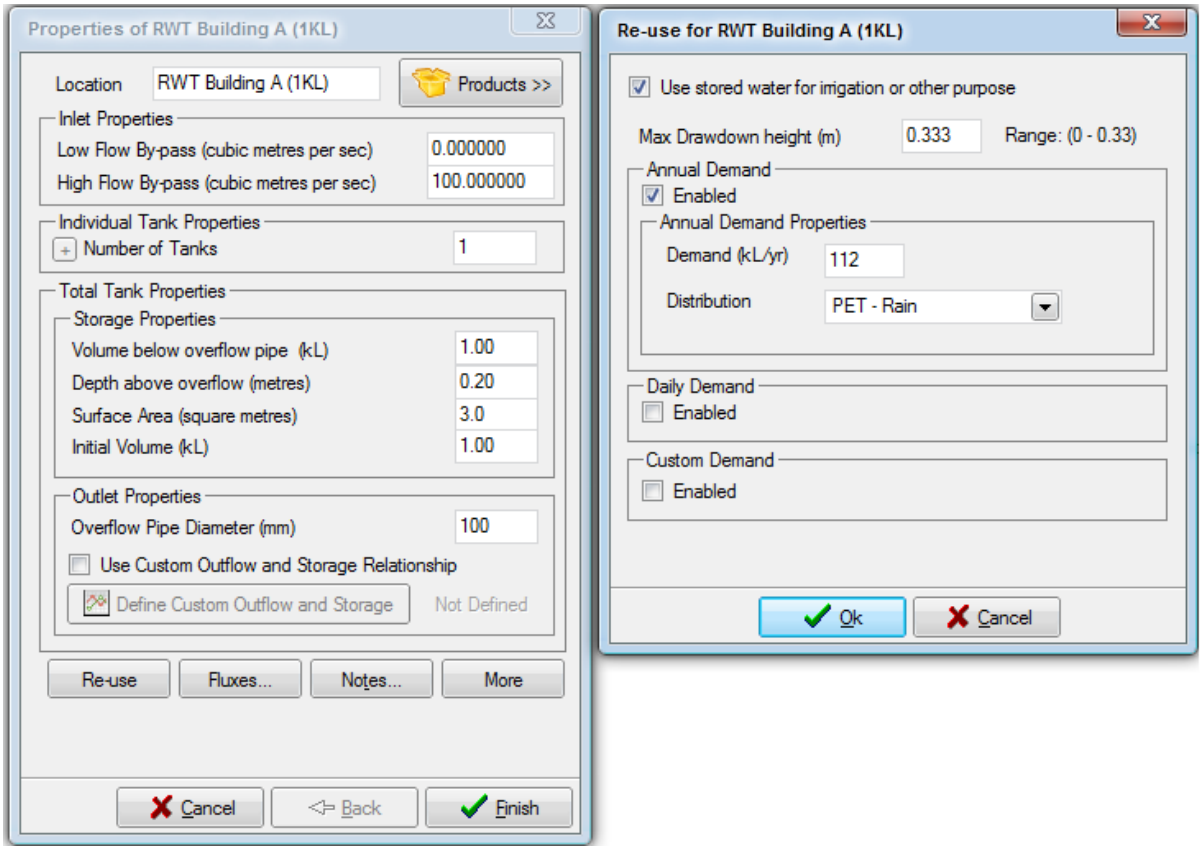



**Figure 3.2:** Rainwater Tank Parameters

**3.5.2 Gross Pollutant Traps:** Two GPTs will be provided at the downstream end of the site within No. 15 Rynan Avenue as first treatment measures in the treatment train. Proposed GPTs are as below:

- GPT allocated for 5 Rynan Avenue site: Rocla CDS P1015
- GPT allocated for 15 Rynan Avenue site: Rocla CDS P1518

### 3.5.3 Bio-retention basin

A bio-retention basin will be constructed within No. 15 Rynan Avenue to collect runoff from the road and lots via a conventional pit and pipe system. To reduce the risk of clogging filter material and increase the lifespan of the bio-retention, we recommend a silt trap/screen is to be located upstream of the basin. The performance parameters adopted for the treatment device has been derived from the Liverpool City WSUD Technical Guideline and in accordance with ewater recommendations as shown in **Figure 3.3**.

The minimum filter area required to achieve Councils target water quality objectives is in the order of 130m$^2$. The filler medium is to be at least 400mm deep with an extended detention storage depth of 200mm. The parameters adopted for the bioretention basin are shown in **Figure 3.3** below.

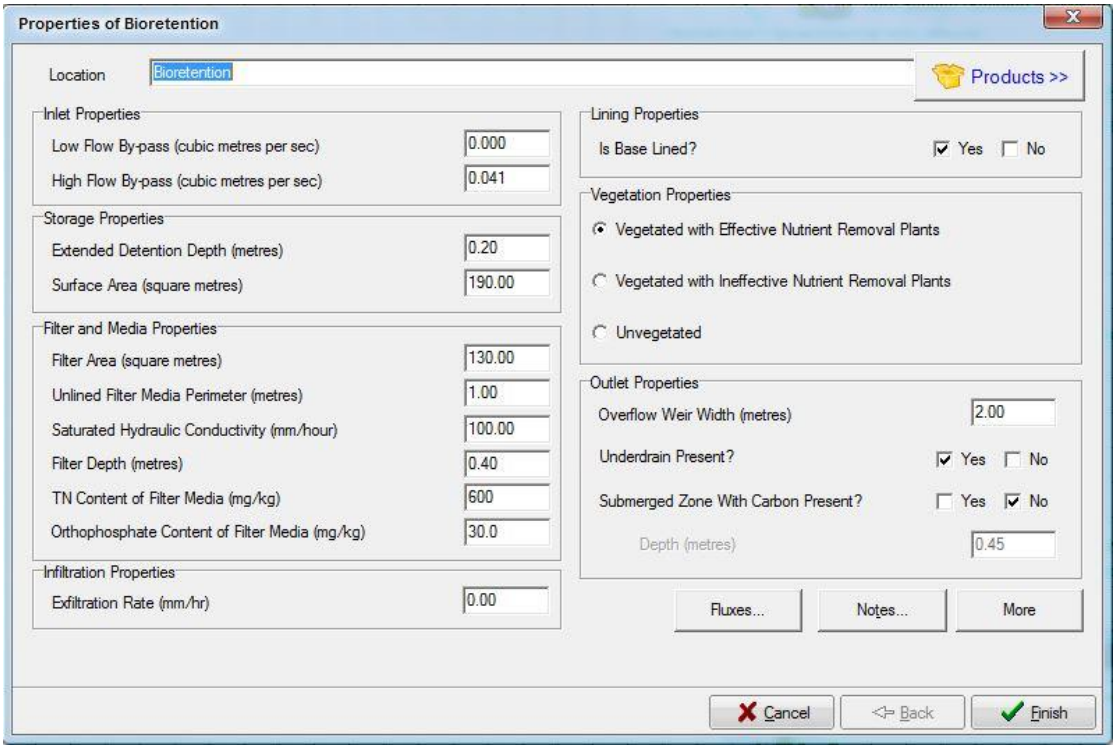
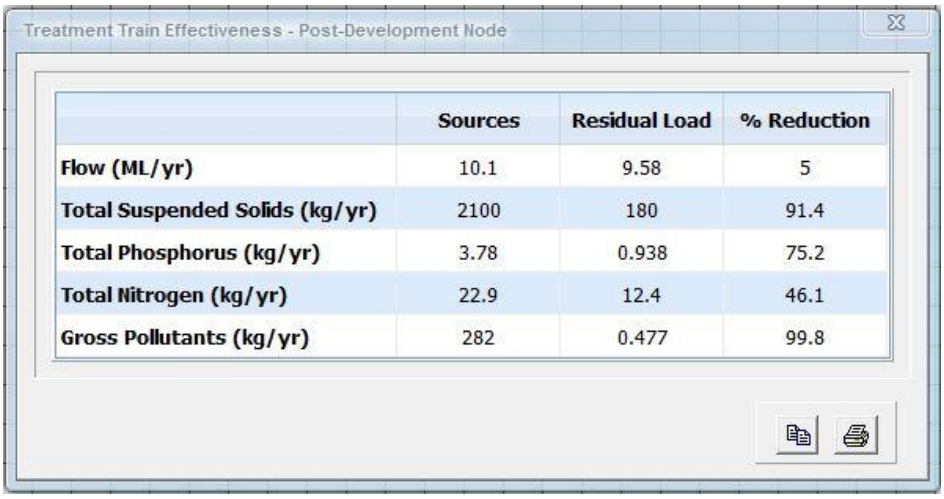



**Figure 3.3:** Bio-retention basin Parameters

## 3.6 Modelling Results

The estimated total pollution source loads and treatment train reductions have been determined from the MUSIC modelling results and are summarised in **Table 3.4**.




| | Sources | Residual Load | % Reduction |
|---|---|---|---|
| Flow (ML/yr) | 10.1 | 9.58 | 5 |
| Total Suspended Solids (kg/yr) | 2100 | 180 | 91.4 |
| Total Phosphorus (kg/yr) | 3.78 | 0.938 | 75.2 |
| Total Nitrogen (kg/yr) | 22.9 | 12.4 | 46.1 |
| Gross Pollutants (kg/yr) | 282 | 0.477 | 99.8 |

**Table 3.4**: MUSIC Modelling Results

Based on the results in **Table 3.4** above the proposed treatment train achieved and exceeded the storm water management objectives for water quality set out in the Liverpool Councils DCP. It is therefore considered that the proposed design is acceptable.

## 4. CONCLUSION

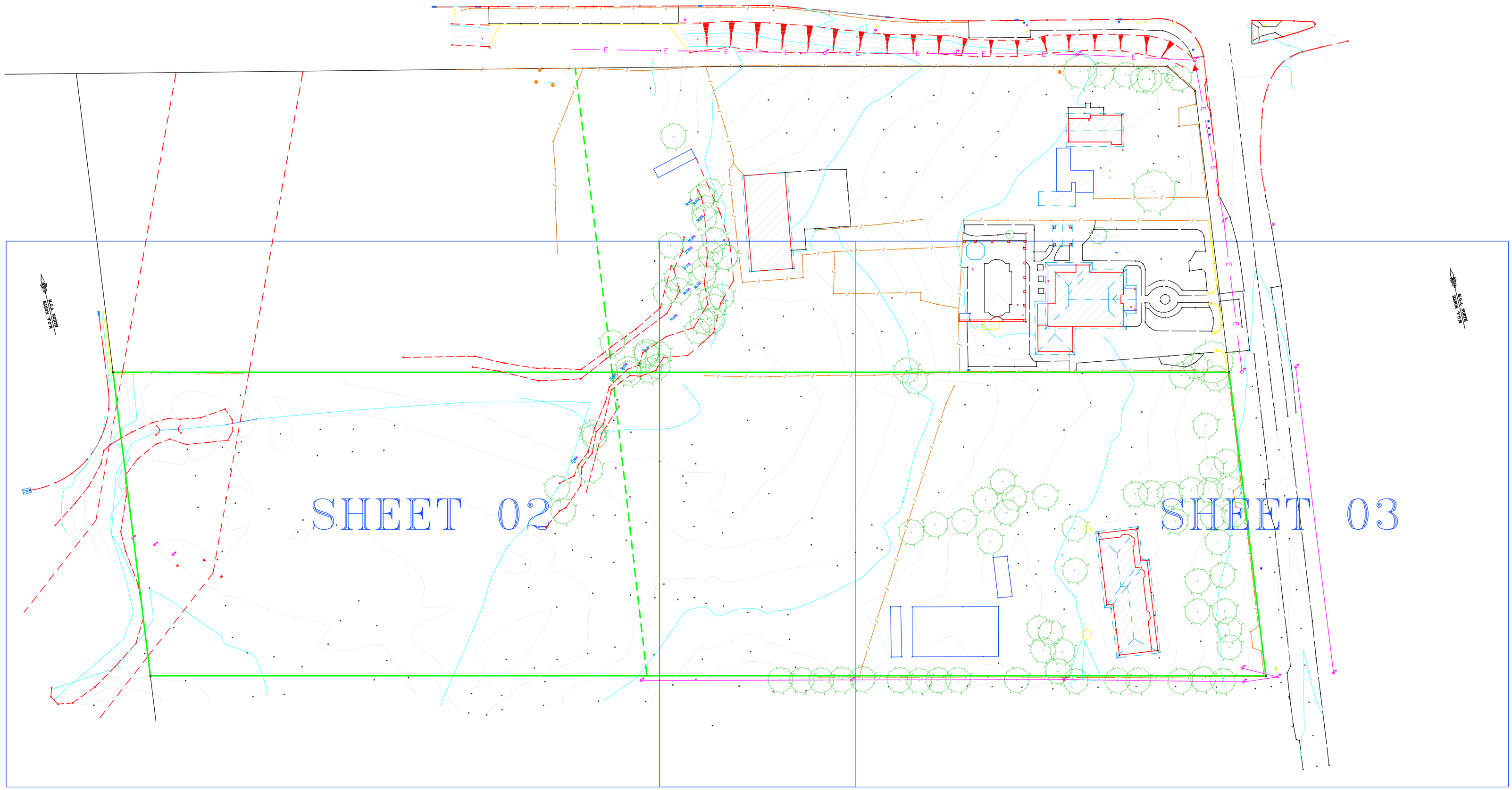
This report is submitted for Council's review and approval and should be read in conjunction with the engineering plans submitted for the Development Application for the proposed development.

Based on the proposed stormwater drainage design and WSUD design shown in Engineering Plans 14139-DA01 to DA08 we summarise the following:

- The piped drainage system through the site is to be been designed for the 5yr ARI event;
- The proposed local access road (Road 1) has sufficient capacity to convey the resulting overland flows in the 100yr storm event; and
- External catchments to the site will be catered for via Road 1 and the proposed sag in Rynan Avenue.
- Two treatment devices are proposed to treat stormwater runoff being rainwater tanks GPT CDS units and a bio-retention basin;
- A temporary bio-retention basin with a minimum surface area of 190 $m^2$ achieves Councils water quality objectives; and
- External catchments to the site will bypass the proposed basin via a bypass pit.

It is therefore concluded that the drainage and WSUD design for the site addressed Councils requirements.

# ATTACHMENT A: SURVEY PLANS




NOTES:
1. NO BOUNDARY SURVEY HAS BEEN UNDERTAKEN. BEARINGS & DISTANCES HAVE BEEN COMPILED FROM TITLE AND/OR DEED INFORMATION SUPPLIED BY DEPARTMENT OF LANDS NSW.
2. RELATIONSHIP OF IMPROVEMENTS AND DETAIL TO BOUNDARIES IS DIAGRAMMATIC ONLY AND SPECIFIC DETAILS, IF CRITICAL, WILL REQUIRE FURTHER SURVEY.
3. NO SERVICES OR UNDERGROUND SERVICES SEARCH HAS BEEN UNDERTAKEN. SERVICES SHOWN ARE BASED ON VISIBLE SURFACE INDICATORS EVIDENT AT THE DATE OF SURVEY & ARE CHARTED AS A GUIDE TO THE POSITION & NATURE OF THE SERVICE. ALL SERVICE AUTHORITIES SHOULD BE CONTACTED PRIOR TO ANY DEVELOPMENT.
4. RIDGE, EAVE & GUTTER HEIGHTS HAVE BEEN OBTAINED BY AN INDIRECT METHOD AND ARE ACCURATE FOR PLANNING PURPOSES ONLY.
5. ADJOINING BUILDINGS AND DWELLINGS HAVE BEEN PLOTTED FOR DIAGRAMMATIC PURPOSES ONLY AND SPECIFIC DETAILS, IF CRITICAL, WILL REQUIRE FURTHER SURVEY.
6. THE SPREAD & HEIGHT OF EACH TREE IS INDICATIVE ONLY AND SPECIFIC DETAILS, IF CRITICAL, WILL REQUIRE FURTHER SURVEY.
7. CONTOURS ARE AN INDICATION OF THE TOPOGRAPHY ONLY. SPOT LEVELS SHOULD BE USED IF DETAILED DESIGN IS TO BE UNDERTAKEN.
   CONTOUR INTERVALS: MAJOR – 1m, MINOR – 0.25m.

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| B | 16.02.2016 | PART OF CREEK ADDED | A.L./I.S. |
| A | 04.07.2013 | ORIGINAL ISSUE | A.L./I.S. |

HORIZONTAL SYSTEM: M.G.A
COORD SYS: MARK ADOPTED:
PM 50471 E 301 370.523
N 6 241 064.000
VERTICAL SYSTEM:
DATUM A.H.D.
BM ADOPTED PM 50471
R.L.42.292
CLASS LC ORDER L3

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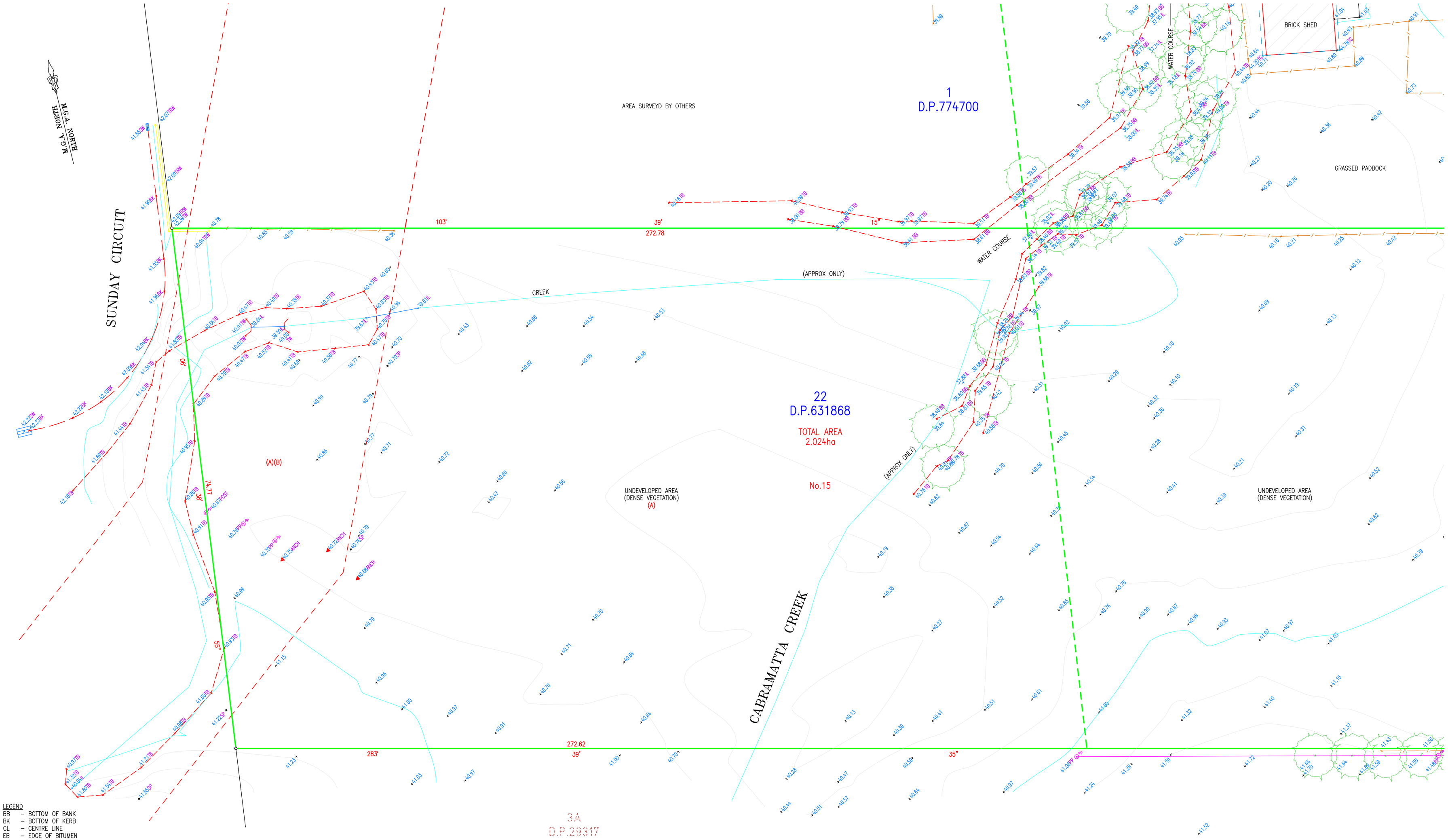
PROJECT:
# PLAN SHOWING DETAIL AND LEVELS AT No.15 RYNAN AVENUE EDMONDSON PARK

CLIENT: MR MICHAEL TAOUK

| | |
|---|---|
| SCALE: HOR 1:500 VER 1:500 | A1 |
| LGA: LIVERPOOL | |
| SHEET 1 OF 3 SHEETS | |
| DRAWN | SURVEYED |
| A.L. | I.S. |
| REFERENCE | REVISION |
| 140608–DET | B |




LEGEND

| | | |
|---|---|---|
| BB | – | BOTTOM OF BANK |
| BK | – | BOTTOM OF KERB |
| CL | – | CENTRE LINE |
| EB | – | EDGE OF BITUMEN |
| FL | – | FLOOR LEVEL |
| HYD | – | HYDRANT |
| IL | – | INVERT LEVEL |
| PP | – | POWER POLE |
| RR | – | ROOF RIDGE |
| SMH | – | SEWER MANHOLE |
| SP | – | SIGN POST |
| SW | – | STORM WATER |
| TB | – | TOP OF BANK |
| TEL | – | TELSTRA PIT |
| TG | – | TOP OF GUTTER |
| TRW | – | TOP OF RETAINING WALL |
| WT | – | TOP OF WALL |

(A) – COVENANT (G737245).
(B) – EASEMENT FOR TRANSMISSION LINE 30.48 WIDE & VARIABLE WIDTH (K135418).

NOTES:
1. NO BOUNDARY SURVEY HAS BEEN UNDERTAKEN. BEARINGS & DISTANCES HAVE BEEN COMPILED FROM TITLE AND/OR DEED INFORMATION SUPPLIED BY DEPARTMENT OF LANDS NSW.
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CONTOUR INTERVALS: MAJOR – N/A, MINOR – N/A.

| REV | DATE | DESCRIPTION | BY |
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| B | 16.02.2016 | PART OF CREEK ADDED | A.L./I.S. |
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HORIZONTAL SYSTEM: M.G.A
COORD SYS: PM 50471 — MARK ADOPTED: E 301 370.523 N 6 241 064.000
VERTICAL SYSTEM:
DATUM A.H.D.
BM ADOPTED PM 50471
R.L.42.292
CLASS LC ORDER L3

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PROJECT:
# PLAN SHOWING DETAIL AND LEVELS AT No.15 RYNAN AVENUE EDMONDSON PARK

CLIENT: MR MICHAEL TAOUK

| | |
|---|---|
| SCALE: HOR 1:250 VER 1:250 | A1 |
| LGA: LIVERPOOL | |
| SHEET 2 OF 3 SHEETS | |
| DRAWN | SURVEYED |
| A.L. | I.S. |
| REFERENCE | REVISION |
| 140608–DET | B |


LEGEND

| | | |
|---|---|---|
| BB | – | BOTTOM OF BANK |
| BK | – | BOTTOM OF KERB |
| CL | – | CENTRE LINE |
| EB | – | EDGE OF BITUMEN |
| FL | – | FLOOR LEVEL |
| HYD | – | HYDRANT |
| IL | – | INVERT LEVEL |
| PP | – | POWER POLE |
| RR | – | ROOF RIDGE |
| SMH | – | SEWER MANHOLE |
| SP | – | SIGN POST |
| SW | – | STORM WATER |
| TB | – | TOP OF BANK |
| TEL | – | TELSTRA PIT |
| TG | – | TOP OF GUTTER |
| TRW | – | TOP OF RETAINING WALL |
| WT | – | TOP OF WALL |

(A) – COVENANT (G737245).
(B) – EASEMENT FOR TRANSMISSION LINE 30.48 WIDE & VARIABLE WIDTH (K135418).

3
D.P.29317

NOTES:
1. NO BOUNDARY SURVEY HAS BEEN UNDERTAKEN. BEARINGS & DISTANCES HAVE BEEN COMPILED FROM TITLE AND/OR DEED INFORMATION SUPPLIED BY DEPARTMENT OF LANDS NSW.
2. RELATIONSHIP OF IMPROVEMENTS AND DETAIL TO BOUNDARIES IS DIAGRAMMATIC ONLY AND SPECIFIC DETAILS, IF CRITICAL, WILL REQUIRE FURTHER SURVEY.
3. NO SERVICES OR UNDERGROUND SERVICES SEARCH HAS BEEN UNDERTAKEN. SERVICES SHOWN ARE BASED ON VISIBLE SURFACE INDICATORS EVIDENT AT THE DATE OF SURVEY & ARE CHARTED AS A GUIDE TO THE POSITION & NATURE OF THE SERVICE. ALL SERVICE AUTHORITIES SHOULD BE CONTACTED PRIOR TO ANY DEVELOPMENT.
4. RIDGE, EAVE & GUTTER HEIGHTS HAVE BEEN OBTAINED BY AN INDIRECT METHOD AND ARE ACCURATE FOR PLANNING PURPOSES ONLY.
5. ADJOINING BUILDINGS AND DWELLINGS HAVE BEEN PLOTTED FOR DIAGRAMMATIC PURPOSES ONLY AND SPECIFIC DETAILS, IF CRITICAL, WILL REQUIRE FURTHER SURVEY.
6. THE SPREAD & HEIGHT OF EACH TREE IS INDICATIVE ONLY AND SPECIFIC DETAILS, IF CRITICAL, WILL REQUIRE FURTHER SURVEY.
7. CONTOURS ARE AN INDICATION OF THE TOPOGRAPHY ONLY. SPOT LEVELS SHOULD BE USED IF DETAILED DESIGN IS TO BE UNDERTAKEN.
CONTOUR INTERVALS: MAJOR – 1m, MINOR – 0.25m.

| REV | DATE | DESCRIPTION | BY |
|---|---|---|---|
| B | 16.02.2016 | PART OF CREEK ADDED | A.L./I.S. |
| A | 04.07.2013 | ORIGINAL ISSUE | A.L./I.S. |

HORIZONTAL SYSTEM: M.G.A
COORD SYS: MARK ADOPTED:
PM 50471 E 301 370.523
N 6 241 064.000
VERTICAL SYSTEM:
DATUM A.H.D.
BM ADOPTED PM 50471
R.L.42.292
CLASS LC ORDER L3

C-SIDE SURVEYORS
CONSULTING SURVEYORS
ABN 81 158 970 373
P.O. BOX 1455 NEUTRAL BAY N.S.W. 2089
P H: +61 2 9029 4109
EMAIL: ADMIN@CSIDESURVEYORS.COM.AU
WEB: WWW.CSIDESURVEYORS.COM.AU

PROJECT:
# PLAN SHOWING DETAIL AND LEVELS AT No.15 RYNAN AVENUE EDMONDSON PARK
CLIENT: MR MICHAEL TAOUK

SCALE: HOR 1:250 VER 1:250 A1
LGA: LIVERPOOL
SHEET 3 OF 3 SHEETS
DRAWN A.L. SURVEYED I.S.
REFERENCE 140608–DET REVISION B

## ATTACHMENT B: DCP Road Network Map

Edmondson Park DCP 2.11 Street network

# ATTACHMENT C: Concept Engineering Plans

C:\USERS\YEL.MIN\APPDATA\LOCAL\TEMP\ACPUBLISH_11812\14139-DA05.DWG

Friday, 19 February 2018 2:39:41 PM

CABRAMATTA CREEK

SEDIMENT BASIN
212m³ WITHIN
SETTLING ZONE

COMBINED SEDIMENT BASIN FOR 5 & 15 RYAN AVENUE TO BE CONVERTED TO BIO-RETENTION BASIN

TRASHRACK TO BE PROVIDED TO HEADWALL

PROPOSED GPT CDS1518 OR APPROVED EQUIVALENT TO MANUFACTURER'S SPECIFICATION. THE GPT TO BE CAPPED WHEN THE FINAL WATER QUALITY BASIN IS PLANTED OUT AND IS OPERATIONAL.

PROPOSED LOADING BAY

PROPOSED PATH

BUILDING C
GFL 42.70

BUILDING B
GFL 43.76

BUILDING D
GFL 43.55

GFL 44.00

EXTENTS OF BASEMENT BELOW

EXTENTS OF BASEMENT BELOW

PROVIDE STUB CONNECTION FOR FUTURE DEVELOPMENT. CAP & BURY (TYP.)

PROVIDE STUB CONNECTION FOR FUTURE DEVELOPMENT. CAP & BURY (TYP.)

LIMIT OF WORKS

MAKE SMOOTH CONNECTION WITH EXISTING WORKS

LARGE INLET TO CAPTURE EXTERNAL CATCHMENT.

LOCATION AND DEPTH OF SERVICES TO BE DETERMINED PRIOR TO CONSTRUCTION

PROVIDE TEMPORARY PAVEMENT AND LOCAL REGRADING TO SUIT PROPOSED LEVELS

TO CAMDEN VALLEY WAY

TO JARDINE DRIVE

COWPER AVE

KINGSBURY ROAD

RYNAN AVENUE

2X⌀1050 @ 3.16%

2x⌀1050 @1%

⌀1200 @1%

⌀450

⌀375

R8.85

R16.15

1.70 7.20 4.00 12.90

4.00 2.60 5.20 3.15 2.70

4.00 2.60 5.20 10.06

7.20 15.20 4.00

CH 75 CH 84.768 CH 90 CH 94 CH 105 CH 103.440 CH 103.297 CH 120 CH 127.369 CH 135 CH 150 CH 165 CH 178.190 CH 195

CH 123.501 CH 135 TP 137.923 CH 150 TP 157.102 CH 15 CH 30 CH 43.331 CH 50 CH 180 CH 195 CH 210 CH 225 CH 240.116

E-1 E-2 E-3 E-4 E-5 E-6 E-7 F-1 F-2 G-1 H-1 H-2 J-1 P-1 P-1A

KG DD KO

## LEGEND:

- PROPOSED SITE BOUNDARY
- KG — PROPOSED KERB & GUTTER
- DD — PROPOSED KERB & GUTTER
- KO — PROPOSED KERB ONLY
- OVERLAND FLOW PATH
- PROPOSED STORMWATER PIT AND PIPE
- A-7 — STORMWATER PIT NUMBER
- SS — PROPOSED SUBSOIL DRAINAGE
- HER — PROPOSED SUBSOIL HIGH END RISER
- FP — PROPOSED SUBSOIL FLUSHING POINT
- EXISTING CONTOUR
- EXISTING STORMWATER PIT AND PIPE
- S — EXISTING SEWER
- PROPOSED TYPE F BARRIER
- GROSS POLLUTANT TRAP

| REV | DATE | AMENDMENT / DESCRIPTION | BY | APPD |
|---|---|---|---|---|
| D | 24/11/2017 | RE-ISSUED FOR DA APPROVAL | YMK | PGD |
| C | 5/04/2016 | ISSUED FOR DA APPROVAL | DT | PGD |
| B | 1/04/2016 | BASIN AMENDED | DT | BB |
| A | 2/03/2016 | ISSUED FOR DA APPROVAL | DT | PGD |



**NOT FOR CONSTRUCTION**

1:250 — 5.0m 2.5 0 5 10 15m

DRAWING DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE

| | | | |
|---|---|---|---|
| DESIGNED | DT | DATE | 2/03/2016 |
| CHECKED | VC | DATE | 2/03/2016 |
| APPROVED | PGD | DATE | 2/03/2016 |
| SCALE | 1:250 (A1) | | |

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E mail@diversi.com.au
W www.diversi.com.au

DIVERSI CREATIVE ENGINEERING SOLUTIONS

PROJECT: 15 RYNAN AVENUE, EDMONDSON PARK
PROPOSED RESIDENTIAL SUBDIVISION

TITLE: ROADWORKS AND DRAINAGE PLAN

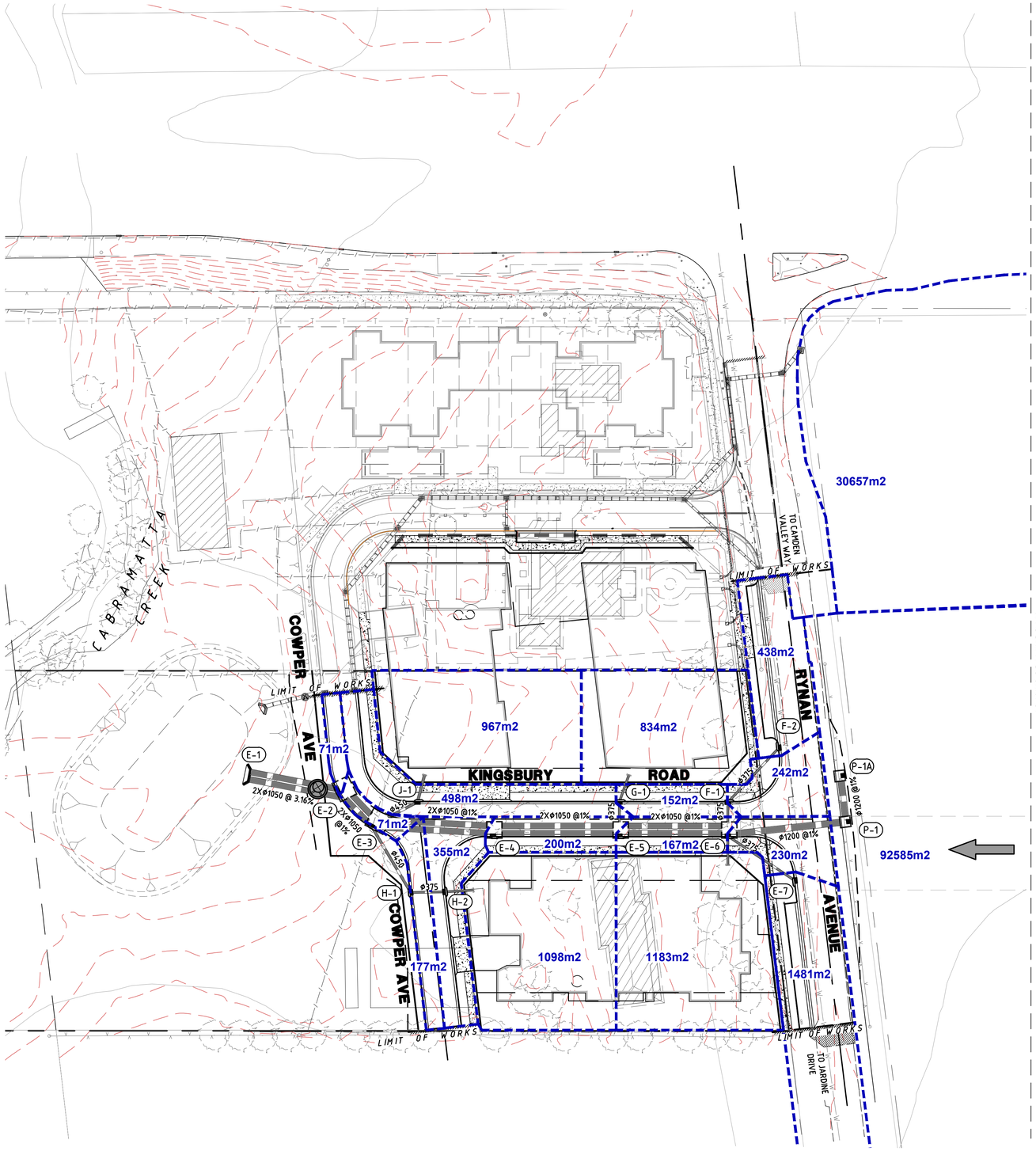
CLIENT: KMT Pty Ltd

PROJ No.: 14139 | DRG No.: DA05 | Rev.: D

# ATTACHMENT D: Catchment Plan

## LEGEND

- CATCHMENT BOUNDARY
- D-1 STORMWATER PIT TAGS
- 60 EXISTING CONTOUR (ORTHO PHOTO)
- PROPOSED STORMWATER PIT AND PIPE
- EXISTING STORMWATER PIT AND PIPE
- OVERLAND FLOW PATH




## CATCHMENT PLAN

SCALE 1:500

| REV | DATE | AMENDMENT / DESCRIPTION | BY | APP'D |
|---|---|---|---|---|
| A | 24/11/2017 | ISSUED FOR DA APPROVAL | YMK | PGD |



**NOT FOR CONSTRUCTION**

1:500 10.0m 5.0 0 10.0 20.0 30.0m

DRAWING DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE

| | | | |
|---|---|---|---|
| DESIGNED | DT | DATE | 16/11/2017 |
| CHECKED | VC | DATE | 16/11/2017 |
| APPROVED | PGD | DATE | 16/11/2017 |
| SCALE | AS SHOWN | | |

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DIVERSI CREATIVE ENGINEERING SOLUTIONS

PROJECT: 15 RYNAN AVENUE, EDMONDSON PARK
PROPOSED RESIDENTIAL SUBDIVISION

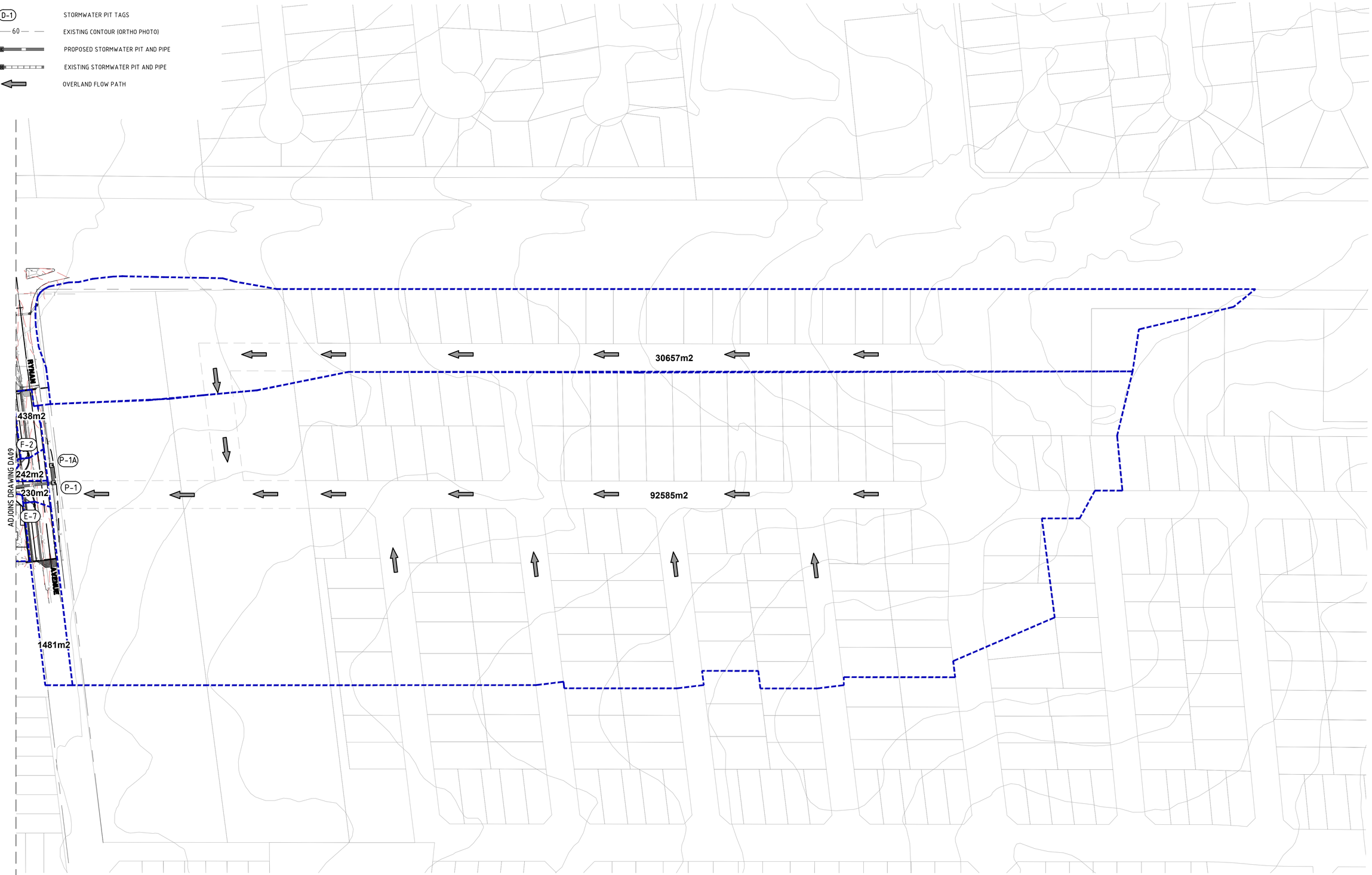
TITLE: CATCHMENT PLAN SHEET 1 OF 2

CLIENT: KMT Pty Ltd

PROJ No.: 14139 | DRG No.: DA09 | Rev.: A

## LEGEND

- CATCHMENT BOUNDARY
- (D-1) STORMWATER PIT TAGS
- 60 EXISTING CONTOUR (ORTHO PHOTO)
- PROPOSED STORMWATER PIT AND PIPE
- EXISTING STORMWATER PIT AND PIPE
- OVERLAND FLOW PATH




## CATCHMENT PLAN

SCALE 1:1000

| REV | DATE | AMENDMENT / DESCRIPTION | BY | APPD |
|---|---|---|---|---|
| A | 24/11/2017 | ISSUED FOR DA APPROVAL | YMK | PGD |



**NOT FOR CONSTRUCTION**

1:1000 20m 10 0 20 40 60m

DRAWING DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE

| | | |
|---|---|---|
| DESIGNED DT | DATE 16/11/2017 | |
| CHECKED VC | DATE 16/11/2017 | |
| APPROVED PGD | DATE 16/11/2017 | |
| SCALE AS SHOWN | | |

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W www.diversi.com.au
DIVERSI CREATIVE ENGINEERING SOLUTIONS

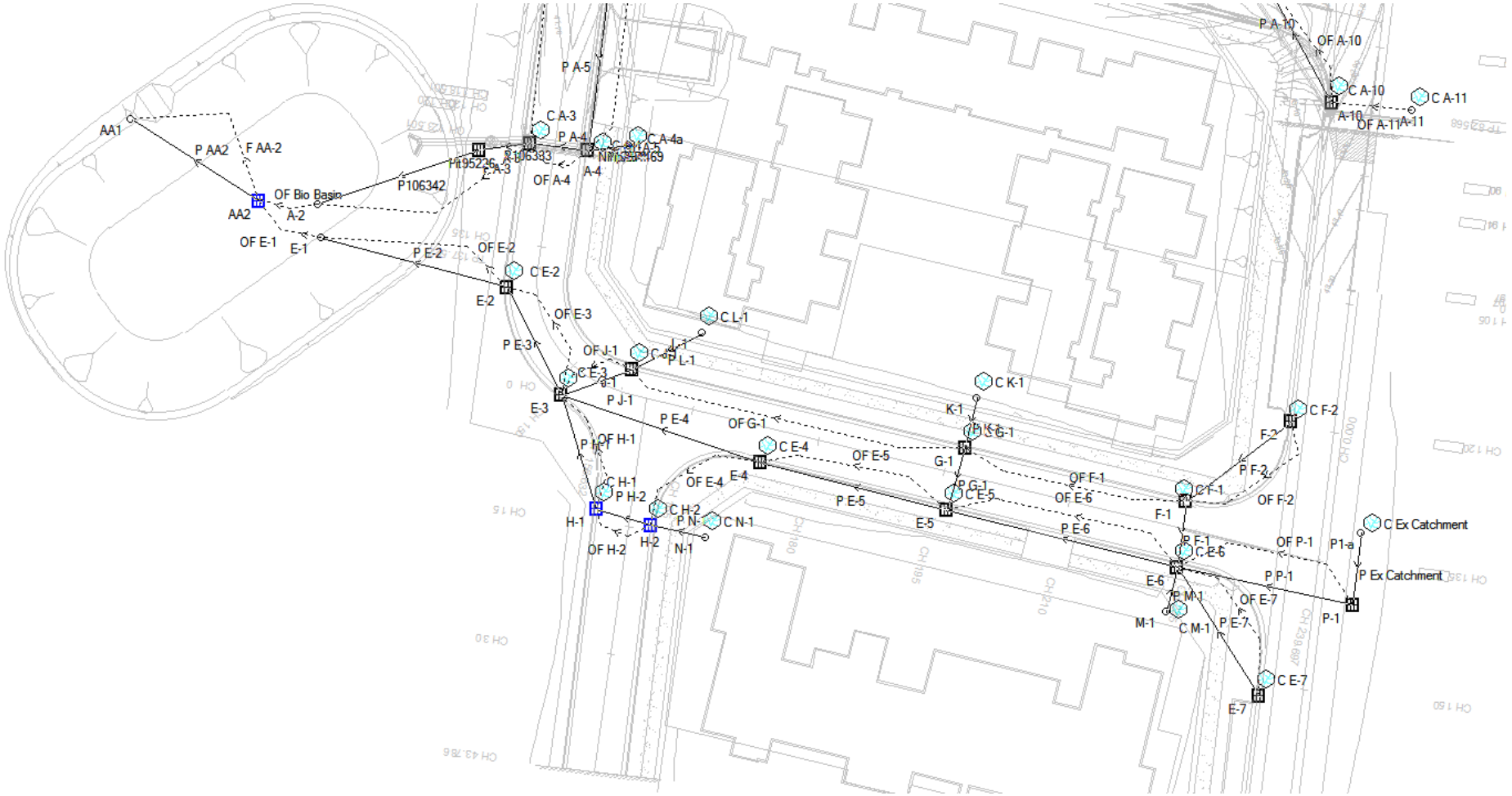
PROJECT: 15 RYNAN AVENUE, EDMONDSON PARK
PROPOSED RESIDENTIAL SUBDIVISION

TITLE: CATCHMENT PLAN SHEET 2 OF 2

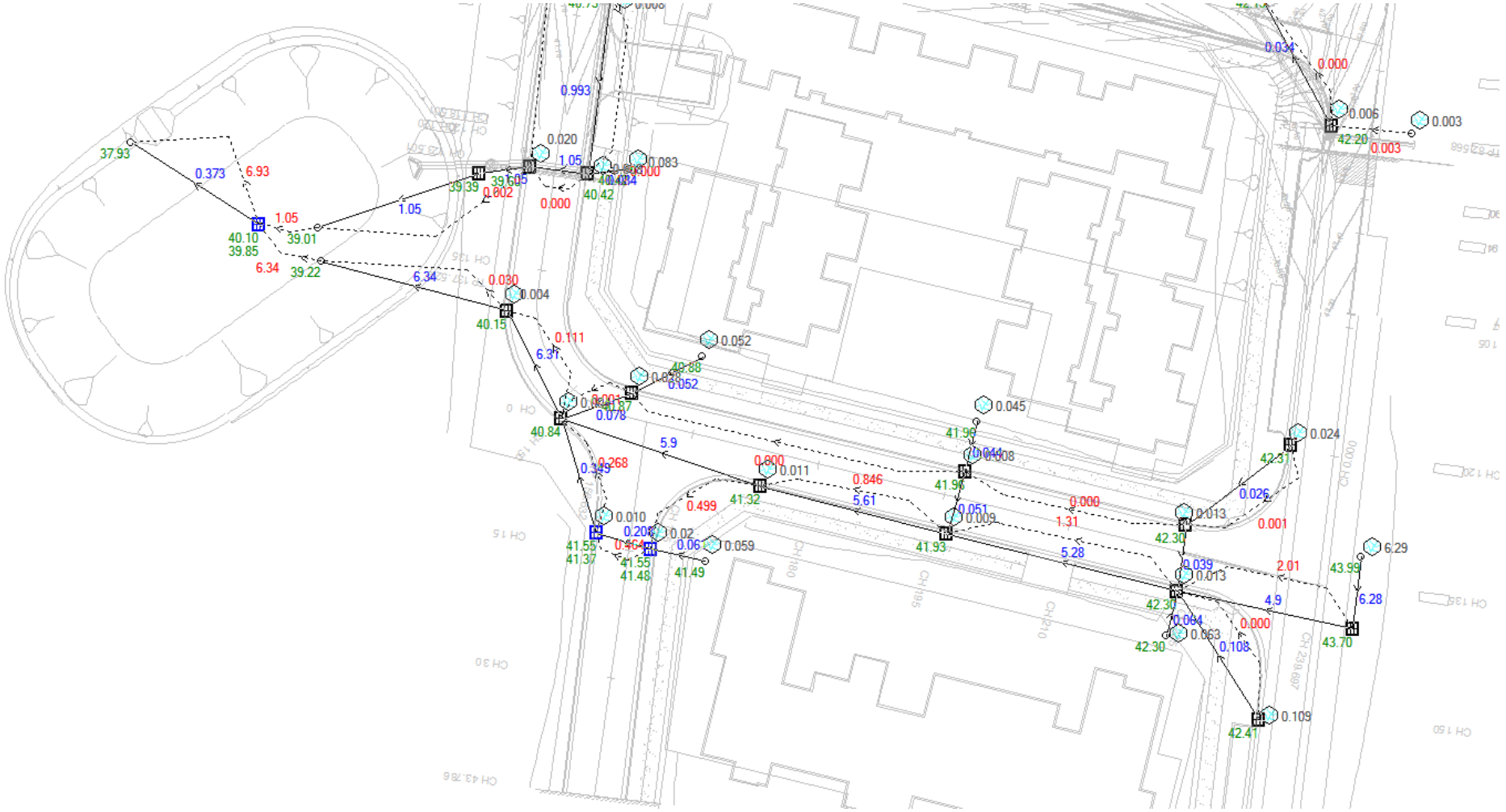
CLIENT: KMT Pty Ltd

PROJ No.: 14139 | DRG No.: DA10 | Rev.: A

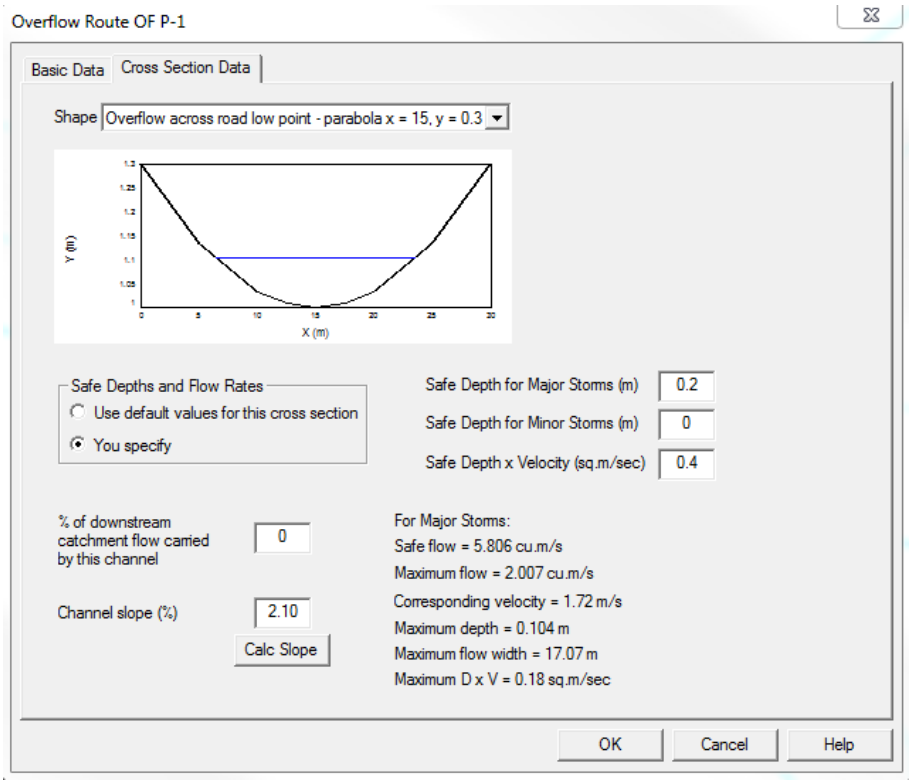
## ATTACHMENT E: DRAINS MODEL NETWORK

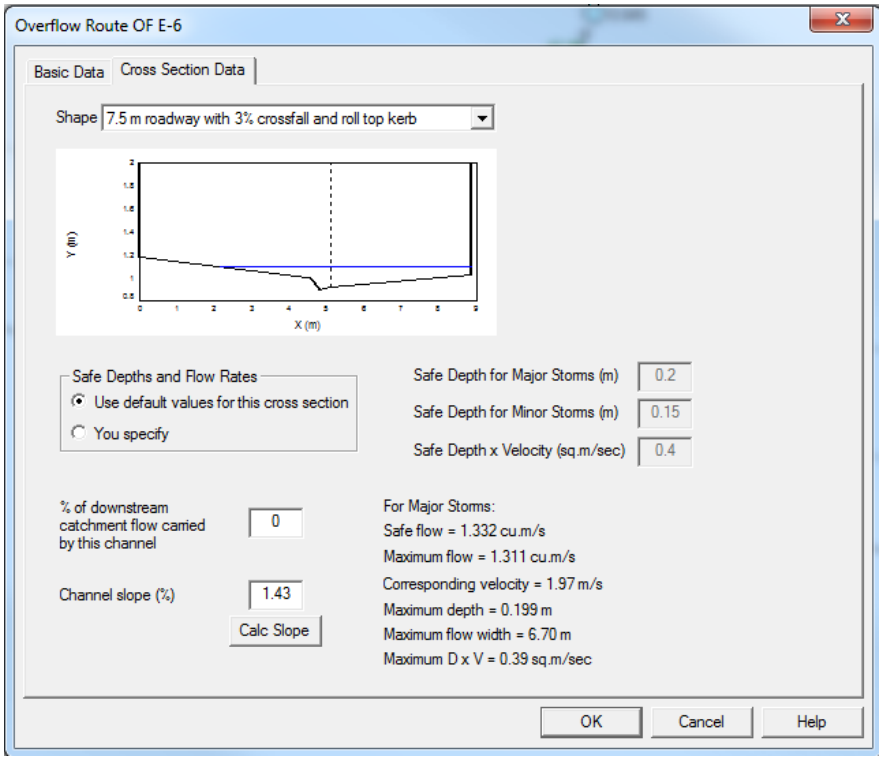


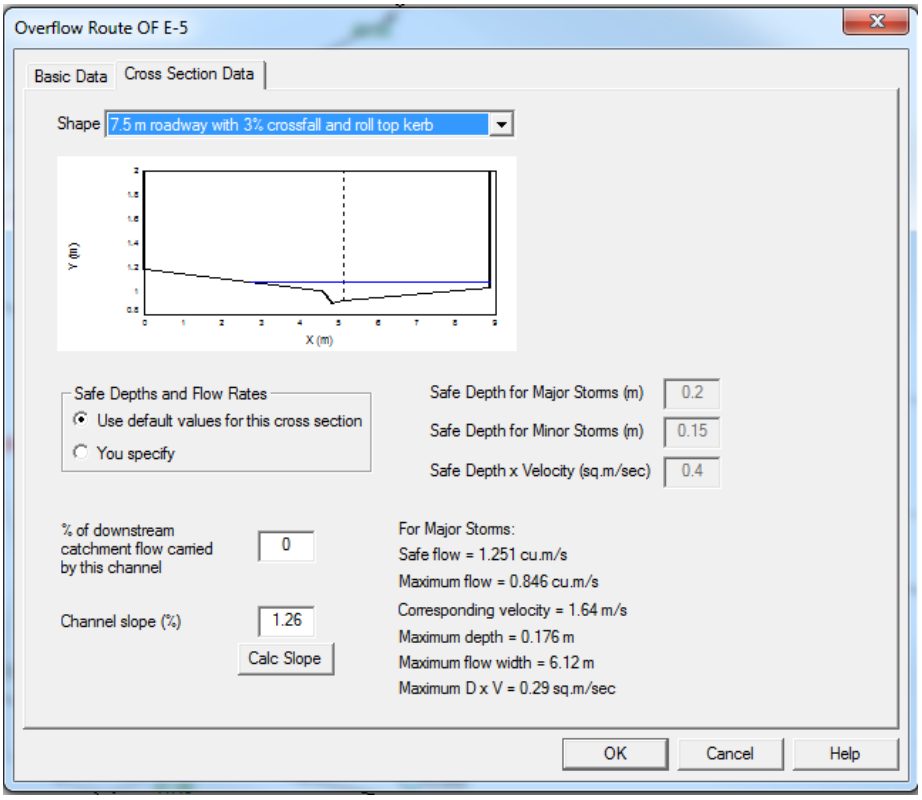
## 100 year ARI Drains result

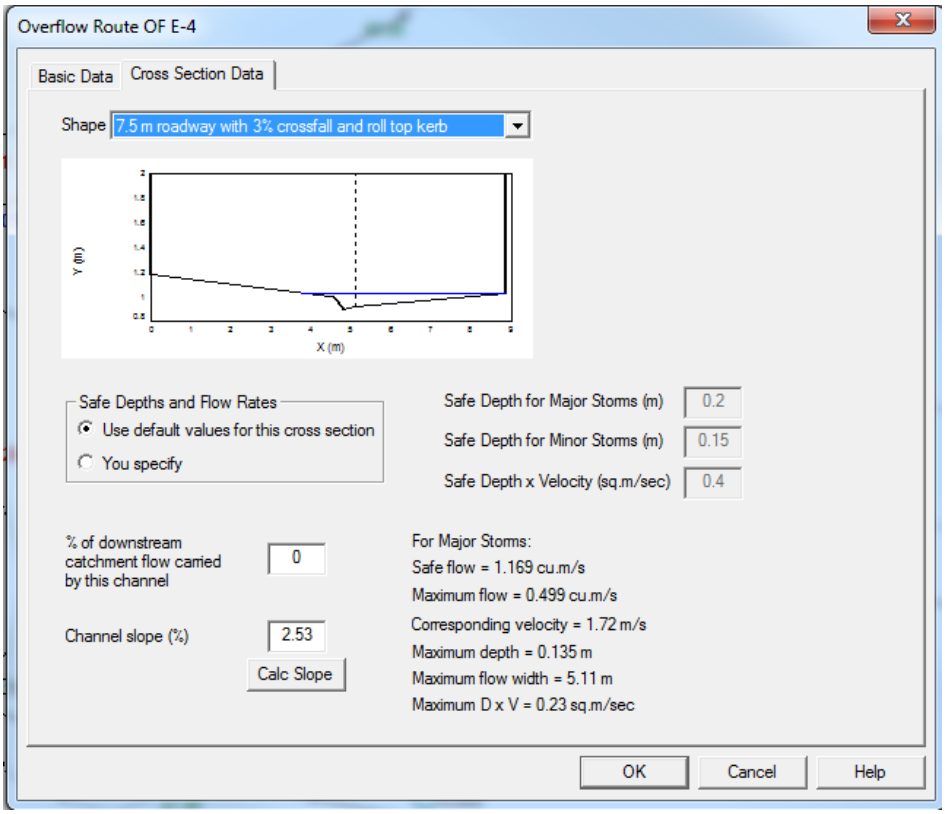


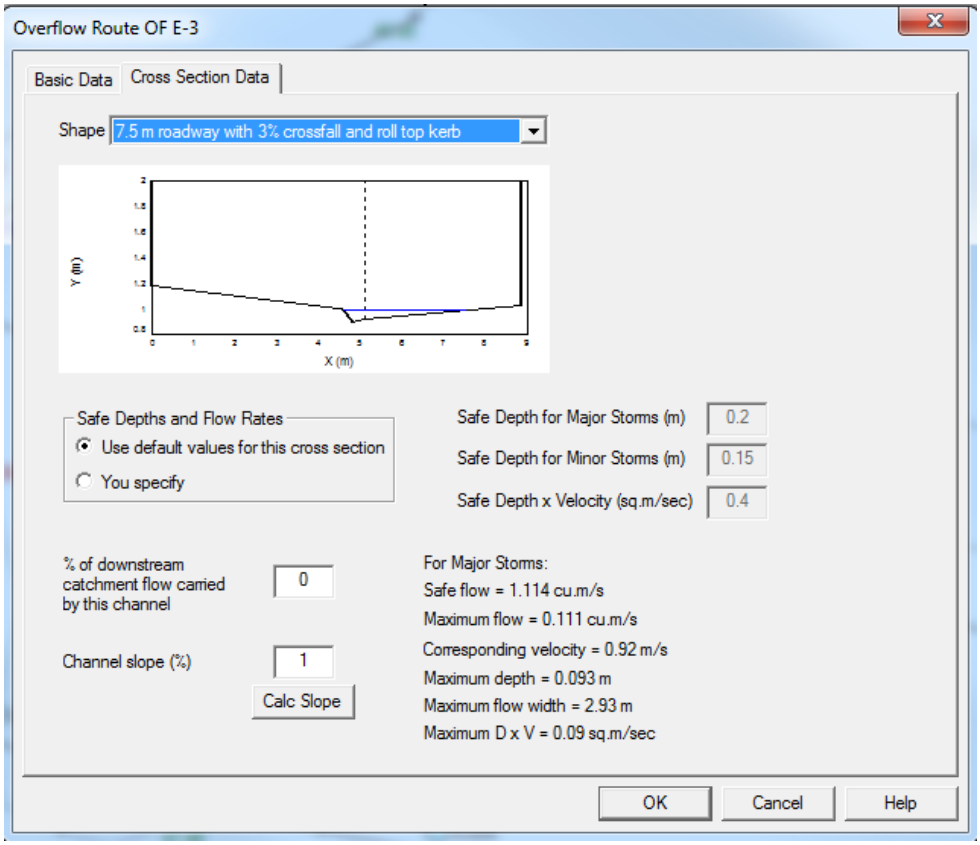
# ATTACHMENT F: OVERLAND FLOW STUDY RESULT




Overflow Route OF E-5
Basic Data
Cross Section Data
Shape
7.5 m roadway with 3% crossfall and roll top kerb
Y (m)
X (m)
Safe Depths and Flow Rates
Use default values for this cross section
You specify
Safe Depth for Major Storms (m)
0.2
Safe Depth for Minor Storms (m)
0.15
Safe Depth x Velocity (sq.m/sec)
0.4
% of downstream catchment flow carried by this channel
0
Channel slope (%)
1.26
Calc Slope
For Major Storms:
Safe flow = 1.251 cu.m/s
Maximum flow = 0.846 cu.m/s
Corresponding velocity = 1.64 m/s
Maximum depth = 0.176 m
Maximum flow width = 6.12 m
Maximum D x V = 0.29 sq.m/sec
OK
Cancel
Help


Overflow Route OF E-4
Basic Data
Cross Section Data
Shape
7.5 m roadway with 3% crossfall and roll top kerb
Y (m)
X (m)
Safe Depths and Flow Rates
Use default values for this cross section
You specify
Safe Depth for Major Storms (m)
0.2
Safe Depth for Minor Storms (m)
0.15
Safe Depth x Velocity (sq.m/sec)
0.4
% of downstream catchment flow carried by this channel
0
Channel slope (%)
2.53
Calc Slope
For Major Storms:
Safe flow = 1.169 cu.m/s
Maximum flow = 0.499 cu.m/s
Corresponding velocity = 1.72 m/s
Maximum depth = 0.135 m
Maximum flow width = 5.11 m
Maximum D x V = 0.23 sq.m/sec
OK
Cancel
Help


Overflow Route OF E-3
Basic Data
Cross Section Data
Shape
7.5 m roadway with 3% crossfall and roll top kerb
Y (m)
X (m)
Safe Depths and Flow Rates
Use default values for this cross section
You specify
Safe Depth for Major Storms (m)
0.2
Safe Depth for Minor Storms (m)
0.15
Safe Depth x Velocity (sq.m/sec)
0.4
% of downstream catchment flow carried by this channel
0
Channel slope (%)
1
Calc Slope
For Major Storms:
Safe flow = 1.114 cu.m/s
Maximum flow = 0.111 cu.m/s
Corresponding velocity = 0.92 m/s
Maximum depth = 0.093 m
Maximum flow width = 2.93 m
Maximum D x V = 0.09 sq.m/sec
OK
Cancel
Help

# ATTACHMENT G: MUSIC Link Report Liverpool City Council

LIVERPOOL CITY COUNCIL

music@link

# MUSIC-*link* Report

| Project Details | | Company Details | |
|---|---|---|---|
| **Project:** | 14139 - 15 Rynan Avenue, Edmondson Park | **Company:** | Diversi Consulting |
| **Report Export Date:** | 13/11/2017 | **Contact:** | Phil Diversi |
| **Catchment Name:** | 14139- 5 and 15 Rynan-WSUD-Rev D | **Address:** | 102/29/31 Solent Circuit, Baulkham Hills NSW 2153 |
| **Catchment Area:** | 1.612ha | **Phone:** | 02 8883 1113 |
| **Impervious Area*:** | 78.07% | **Email:** | Mail@diversi.com.au |
| **Rainfall Station:** | 67035 LIVERPOOL(WHITLAM | | |
| **Modelling Time-step:** | 6 Minutes | | |
| **Modelling Period:** | 1/01/1967 - 31/12/1976 11:54:00 PM | | |
| **Mean Annual Rainfall:** | 857mm | | |
| **Evapotranspiration:** | 1171mm | | |
| **MUSIC Version:** | 6.2.1 | | |
| **MUSIC-link data Version:** | 6.22 | | |
| **Study Area:** | Liverpool Clay Soil | | |
| **Scenario:** | Liverpool Development | | |

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

| Treatment Train Effectiveness | | Treatment Nodes | | Source Nodes | |
|---|---|---|---|---|---|
| **Node: Post-Development Node** | **Reduction** | **Node Type** | **Number** | **Node Type** | **Number** |
| **Flow** | 5% | Rain Water Tank Node | 4 | Urban Source Node | 12 |
| **TSS** | 91.4% | Bio Retention Node | 1 | | |
| **TP** | 75.2% | GPT Node | 2 | | |
| **TN** | 46.1% | | | | |
| **GP** | 99.8% | | | | |

## Comments

Only certain parameters are reported when they pass validation

## Passing Parameters

| Node Type | Node Name | Parameter | Min | Max | Actual |
|---|---|---|---|---|---|
| Bio | Bioretention | Exfiltration Rate (mm/hr) | 0 | None | 0 |
| Bio | Bioretention | Hi-flow bypass rate (cum/sec) | 0 | None | 0.041 |
| Bio | Bioretention | Orthophosphate Content in Filter (mg/kg) | 0 | 55 | 30 |
| Bio | Bioretention | PET Scaling Factor | 2.1 | 2.1 | 2.1 |
| Bio | Bioretention | Total Nitrogen Content in Filter (mg/kg) | 1 | 800 | 600 |
| GPT | CDS 1015 | Hi-flow bypass rate (cum/sec) | None | 99 | 0.18 |
| GPT | CDS 1518 | Hi-flow bypass rate (cum/sec) | None | 99 | 0.35 |
| Post | Post-Development Node | % Load Reduction | None | None | 5 |
| Post | Post-Development Node | GP % Load Reduction | 90 | None | 99.8 |
| Post | Post-Development Node | TN % Load Reduction | 45 | None | 46.1 |
| Post | Post-Development Node | TP % Load Reduction | 65 | None | 75.2 |
| Post | Post-Development Node | TSS % Load Reduction | 85 | None | 91.4 |
| Rain | RWT Building A (1KL) | % Reuse Demand Met | None | None | 34.112 |
| Rain | RWT Building BC 15 (3KL) | % Reuse Demand Met | None | None | 61.764 |
| Rain | RWT Building BC 5 (3KL) | % Reuse Demand Met | None | None | 62.19 |
| Rain | RWT Building D (3KL) | % Reuse Demand Met | None | None | 59.9891 |
| Urban | Residential 15 Rynan(internal lots) | Area Impervious (ha) | None | None | 0.147 |
| Urban | Residential 15 Rynan(internal lots) | Area Pervious (ha) | None | None | 0.147 |
| Urban | Residential 15 Rynan(internal lots) | Total Area (ha) | None | None | 0.295 |
| Urban | Residential 5 Rynan(internal lots) | Area Impervious (ha) | None | None | 0.204 |
| Urban | Residential 5 Rynan(internal lots) | Area Pervious (ha) | None | None | 0.205 |
| Urban | Residential 5 Rynan(internal lots) | Total Area (ha) | None | None | 0.41 |
| Urban | Road 15 (road reserve) | Area Impervious (ha) | None | None | 0.326 |
| Urban | Road 15 (road reserve) | Area Pervious (ha) | None | None | 0 |
| Urban | Road 15 (road reserve) | Total Area (ha) | None | None | 0.326 |
| Urban | Road 5 (road reserve) | Area Impervious (ha) | None | None | 0.235 |
| Urban | Road 5 (road reserve) | Area Pervious (ha) | None | None | 0 |
| Urban | Road 5 (road reserve) | Total Area (ha) | None | None | 0.235 |
| Urban | Roof (Building A) | Area Impervious (ha) | None | None | 0.041 |
| Urban | Roof (Building A) | Area Pervious (ha) | None | None | 0 |
| Urban | Roof (Building A) | Total Area (ha) | None | None | 0.041 |
| Urban | Roof (Building BC) 15 Rynan | Area Impervious (ha) | None | None | 0.043 |
| Urban | Roof (Building BC) 15 Rynan | Area Pervious (ha) | None | None | 0 |
| Urban | Roof (Building BC) 15 Rynan | Total Area (ha) | None | None | 0.043 |
| Urban | Roof (Building BC) 5 Rynan | Area Impervious (ha) | None | None | 0.045 |
| Urban | Roof (Building BC) 5 Rynan | Area Pervious (ha) | None | None | 0 |
| Urban | Roof (Building BC) 5 Rynan | Total Area (ha) | None | None | 0.045 |
| Urban | Roof (Building D) | Area Impervious (ha) | None | None | 0.036 |
| Urban | Roof (Building D) | Area Pervious (ha) | None | None | 0 |
| Urban | Roof (Building D) | Total Area (ha) | None | None | 0.036 |

Only certain parameters are reported when they pass validation

| Node Type | Node Name | Parameter | Min | Max | Actual |
|---|---|---|---|---|---|
| Urban | Roof Bypass (Building A) | Area Impervious (ha) | None | None | 0.062 |
| Urban | Roof Bypass (Building A) | Area Pervious (ha) | None | None | 0 |
| Urban | Roof Bypass (Building A) | Total Area (ha) | None | None | 0.062 |
| Urban | Roof Bypass (Building BC) 15 Rynan | Area Impervious (ha) | None | None | 0.064 |
| Urban | Roof Bypass (Building BC) 15 Rynan | Area Pervious (ha) | None | None | 0 |
| Urban | Roof Bypass (Building BC) 15 Rynan | Total Area (ha) | None | None | 0.064 |
| Urban | Roof Bypass (Building BC) 5 Rynan | Area Impervious (ha) | None | None | 0.067 |
| Urban | Roof Bypass (Building BC) 5 Rynan | Area Pervious (ha) | None | None | 0 |
| Urban | Roof Bypass (Building BC) 5 Rynan | Total Area (ha) | None | None | 0.067 |
| Urban | Roof Bypass (Building D) | Area Impervious (ha) | None | None | 0.055 |
| Urban | Roof Bypass (Building D) | Area Pervious (ha) | None | None | 0 |
| Urban | Roof Bypass (Building D) | Total Area (ha) | None | None | 0.055 |

Only certain parameters are reported when they pass validation

LIVERPOOL CITY COUNCIL

music@link

## Failing Parameters

| Node Type | Node Name | Parameter | Min | Max | Actual |
|---|---|---|---|---|---|
| Rain | RWT Building A (1KL) | Threshold Hydraulic Loading for C** (m/yr) | 0 | 0 | 3500 |
| Rain | RWT Building A (1KL) | Total Nitrogen - C** (mg/L) | 0 | 0 | 1.4 |
| Rain | RWT Building A (1KL) | Total Phosphorus - C** (mg/L) | 0 | 0 | 0.13 |
| Rain | RWT Building A (1KL) | Total Suspended Solids - C** (mg/L) | 0 | 0 | 12 |
| Rain | RWT Building BC 15 (3KL) | Threshold Hydraulic Loading for C** (m/yr) | 0 | 0 | 3500 |
| Rain | RWT Building BC 15 (3KL) | Total Nitrogen - C** (mg/L) | 0 | 0 | 1.4 |
| Rain | RWT Building BC 15 (3KL) | Total Phosphorus - C** (mg/L) | 0 | 0 | 0.13 |
| Rain | RWT Building BC 15 (3KL) | Total Suspended Solids - C** (mg/L) | 0 | 0 | 12 |
| Rain | RWT Building BC 5 (3KL) | Threshold Hydraulic Loading for C** (m/yr) | 0 | 0 | 3500 |
| Rain | RWT Building BC 5 (3KL) | Total Nitrogen - C** (mg/L) | 0 | 0 | 1.4 |
| Rain | RWT Building BC 5 (3KL) | Total Phosphorus - C** (mg/L) | 0 | 0 | 0.13 |
| Rain | RWT Building BC 5 (3KL) | Total Suspended Solids - C** (mg/L) | 0 | 0 | 12 |
| Rain | RWT Building D (3KL) | Threshold Hydraulic Loading for C** (m/yr) | 0 | 0 | 3500 |
| Rain | RWT Building D (3KL) | Total Nitrogen - C** (mg/L) | 0 | 0 | 1.4 |
| Rain | RWT Building D (3KL) | Total Phosphorus - C** (mg/L) | 0 | 0 | 0.13 |
| Rain | RWT Building D (3KL) | Total Suspended Solids - C** (mg/L) | 0 | 0 | 12 |
| Urban | Road 15 (road reserve) | Stormflow Total Nitrogen Mean (log mg/L) | 0.3 | 0.3 | 0.34 |
| Urban | Road 15 (road reserve) | Stormflow Total Phosphorus Mean (log mg/L) | -0.6 | -0.6 | -0.3 |
| Urban | Road 15 (road reserve) | Stormflow Total Suspended Solids Mean (log mg/L) | 2.15 | 2.15 | 2.43 |
| Urban | Roof (Building A) | Baseflow Total Nitrogen Mean (log mg/L) | 0.11 | 0.11 | 0.32 |
| Urban | Roof (Building A) | Baseflow Total Phosphorus Mean (log mg/L) | -0.85 | -0.85 | -0.82 |
| Urban | Roof (Building A) | Baseflow Total Suspended Solids Mean (log mg/L) | 1.2 | 1.2 | 1.1 |
| Urban | Roof (Building A) | Stormflow Total Phosphorus Mean (log mg/L) | -0.6 | -0.6 | -0.89 |
| Urban | Roof (Building A) | Stormflow Total Suspended Solids Mean (log mg/L) | 2.15 | 2.15 | 1.3 |
| Urban | Roof (Building BC) 15 Rynan | Baseflow Total Nitrogen Mean (log mg/L) | 0.11 | 0.11 | 0.32 |
| Urban | Roof (Building BC) 15 Rynan | Baseflow Total Phosphorus Mean (log mg/L) | -0.85 | -0.85 | -0.82 |
| Urban | Roof (Building BC) 15 Rynan | Baseflow Total Suspended Solids Mean (log mg/L) | 1.2 | 1.2 | 1.1 |
| Urban | Roof (Building BC) 15 Rynan | Stormflow Total Phosphorus Mean (log mg/L) | -0.6 | -0.6 | -0.89 |
| Urban | Roof (Building BC) 15 Rynan | Stormflow Total Suspended Solids Mean (log mg/L) | 2.15 | 2.15 | 1.3 |
| Urban | Roof (Building BC) 5 Rynan | Baseflow Total Nitrogen Mean (log mg/L) | 0.11 | 0.11 | 0.32 |
| Urban | Roof (Building BC) 5 Rynan | Baseflow Total Phosphorus Mean (log mg/L) | -0.85 | -0.85 | -0.82 |
| Urban | Roof (Building BC) 5 Rynan | Baseflow Total Suspended Solids Mean (log mg/L) | 1.2 | 1.2 | 1.1 |
| Urban | Roof (Building BC) 5 Rynan | Stormflow Total Phosphorus Mean (log mg/L) | -0.6 | -0.6 | -0.89 |
| Urban | Roof (Building BC) 5 Rynan | Stormflow Total Suspended Solids Mean (log mg/L) | 2.15 | 2.15 | 1.3 |
| Urban | Roof (Building D) | Baseflow Total Nitrogen Mean (log mg/L) | 0.11 | 0.11 | 0.32 |
| Urban | Roof (Building D) | Baseflow Total Phosphorus Mean (log mg/L) | -0.85 | -0.85 | -0.82 |
| Urban | Roof (Building D) | Baseflow Total Suspended Solids Mean (log mg/L) | 1.2 | 1.2 | 1.1 |
| Urban | Roof (Building D) | Stormflow Total Phosphorus Mean (log mg/L) | -0.6 | -0.6 | -0.89 |
| Urban | Roof (Building D) | Stormflow Total Suspended Solids Mean (log mg/L) | 2.15 | 2.15 | 1.3 |
| Urban | Roof Bypass (Building A) | Baseflow Total Nitrogen Mean (log mg/L) | 0.11 | 0.11 | 0.32 |

Only certain parameters are reported when they pass validation

| Node Type | Node Name | Parameter | Min | Max | Actual |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Urban | Roof Bypass (Building BC) 15 Rynan | Baseflow Total Nitrogen Mean (log mg/L) | 0.11 | 0.11 | 0.32 |
| Urban | Roof Bypass (Building BC) 15 Rynan | Baseflow Total Phosphorus Mean (log mg/L) | -0.85 | -0.85 | -0.82 |
| Urban | Roof Bypass (Building BC) 15 Rynan | Baseflow Total Suspended Solids Mean (log mg/L) | 1.2 | 1.2 | 1.1 |
| Urban | Roof Bypass (Building BC) 15 Rynan | Stormflow Total Phosphorus Mean (log mg/L) | -0.6 | -0.6 | -0.89 |
| Urban | Roof Bypass (Building BC) 15 Rynan | Stormflow Total Suspended Solids Mean (log mg/L) | 2.15 | 2.15 | 1.3 |
| Urban | Roof Bypass (Building BC) 5 Rynan | Baseflow Total Nitrogen Mean (log mg/L) | 0.11 | 0.11 | 0.32 |
| Urban | Roof Bypass (Building BC) 5 Rynan | Baseflow Total Phosphorus Mean (log mg/L) | -0.85 | -0.85 | -0.82 |
| Urban | Roof Bypass (Building BC) 5 Rynan | Baseflow Total Suspended Solids Mean (log mg/L) | 1.2 | 1.2 | 1.1 |
| Urban | Roof Bypass (Building BC) 5 Rynan | Stormflow Total Phosphorus Mean (log mg/L) | -0.6 | -0.6 | -0.89 |
| Urban | Roof Bypass (Building BC) 5 Rynan | Stormflow Total Suspended Solids Mean (log mg/L) | 2.15 | 2.15 | 1.3 |
| Urban | Roof Bypass (Building D) | Baseflow Total Nitrogen Mean (log mg/L) | 0.11 | 0.11 | 0.32 |
| Urban | Roof Bypass (Building D) | Baseflow Total Phosphorus Mean (log mg/L) | -0.85 | -0.85 | -0.82 |
| Urban | Roof Bypass (Building D) | Baseflow Total Suspended Solids Mean (log mg/L) | 1.2 | 1.2 | 1.1 |
| Urban | Roof Bypass (Building D) | Stormflow Total Phosphorus Mean (log mg/L) | -0.6 | -0.6 | -0.89 |
| Urban | Roof Bypass (Building D) | Stormflow Total Suspended Solids Mean (log mg/L) | 2.15 | 2.15 | 1.3 |

Only certain parameters are reported when they pass validation

## ATTACHMENT H: MUSIC Link Report Liverpool City Council

### WSUD Maintenance and Monitoring Schedule

| Maintenance Action | Frequency | Responsibility | Procedure |
|---|---|---|---|
| **Rainwater Tanks** | | | |
| Prevent mosquito breeding | *Monthly | Owner | In accordance with tank manufacturer maintenance specifications |
| Clean tank of sludge | 2-3 yearly | Maintenance Contractor | In accordance with tank manufacturer maintenance specifications |
| **Bio-Retention Basins and Swales** | | | |
| Inspect screen and clean | *Six monthly | Owner | Remove grate(s) and screens if required to clean them. |
| Check attachment of screens to wall of pits | *Annually | Maintenance Contractor | Remove grate(s) and screen(s). Ensure screen fixings are secure. Repair as required. |
| Check screen(s) for corrosion | *Annually | Maintenance Contractor | Remove grate(s) and examine screen(s) for rust or corrosion, especially at corners or welds. |
| Inspect walls (internal and external, if appropriate) for cracks or spalling | *Annually | Maintenance Contractor | Remove grate(s) to inspect internal walls. Repair as required. Clear vegetation from external walls if necessary and repair as required. |
| Inspect grate(s) for damage or blockage | *Six monthly | Owner | Check both sides of a grate for corrosion, (especially corners and welds) damage or blockage. |
| Inspect outlet pipe & remove any blockage | *Six monthly | Maintenance Contractor | Remove grate(s) and screen(s). Ventilate underground storage if present. Check orifices and remove any blockages in outlet pipe. Flush outlet pipe to confirm it drains freely. Check for sludge/debris on upstream side of return line. |
| Inspect subsoil drainage system | *Six monthly | Maintenance Contractor | Inspect, clean and flush subsoil drainage system. |
| Basin vegetated/open areas | *Two monthly | Owner | Inspect basins for litter, debris and weeds and clear as required. |