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Our Reference: 21445
Your Reference:

4 July 2022

The Bathla Group
(by email)

Stormwater Management Plan for DA
412 – 414 Cessnock Road, Gillieston Heights (Lot 21 & 22 DP 1092105)

Thank you for your instruction to prepare a stormwater management plan and concept Civil Engineering Design for your proposed development, to accompany a Development Application (DA) with Maitland City Council.

This letter summarises the drainage context for the development and the proposed stormwater management approach.

1. Development Description

A residential subdivision is proposed at the subject site.

The site is bounded by Russell Road to the north, Cessnock Road to the east, rural land to the south and the existing "Gillieston Grove" development to the west.

The site area is approximately 3.96ha and is to be subdivided into 63 lots and two drainage reserves, with lot areas ranging between 450 – 500 m^2.

A subdivision plan of the proposed development is provided in *Attachment 1.*

2. Existing Downstream Drainage Network

The site is situated upstream of the existing Gillieston Grove development.

A stormwater strategy has previously been prepared for this development, which was primarily for Lot 1 DP 197680 & Lot 1 DP 986923, however it also included both Lots 21 & 22 DP 1092105 (the subject site) as part of the overall catchment. The existing network was delivered under Council ref: DA10-791.

The existing drainage network comprises of a combination of pit & pipe networks and overland flow paths that ultimately discharge into a nutrient pond / detention basin prior to discharge into the existing waterway. The existing nutrient pond / detention basin was appropriately modelled and sized to ensure that post-development water quality and peak flows for the overall catchment would be equivalent to or less than the pre-development state in accordance with Maitland City Council standard guidelines.

The overall catchment plan from the strategy is provided in *Attachment 2* (proposed development site highlighted). The full drainage strategy report provided in *Attachment 3.*

The site will discharge directly into 'Stage 6' of the existing Gillieston Grove development (CC 17-141 / DA10-791) . The detailed engineering design for Stage 6, including stormwater design, was prepared by GCA and approved by Maitland City Council for construction. The drainage design for this stage adopted the catchment extents as modelled in the overall drainage strategy and ensured that the pipe sizing and vertical profiles allowed for the anticipated development of the subject site.

Extracts from the approved engineering plans are provided in *Attachment 4.*

3. Proposed Stormwater Management

The site will discharge directly into the existing Gillieston Grove, Stage 6 through a pit & pipe network and overland flow paths. Any existing flows from upstream catchments that will be received will be collected and conveyed through appropriate drainage lines and overland flow paths/swales.

Given that the catchment area of the site has been accounted for in the modelling for the abovementioned drainage strategy, it will not be required to provide water quality or detention measures as part of this development.

Pipe sizes throughout the existing Gillieston Grove development have also been sized and designed with the anticipated development of this site in mind, ensuring that there would be sufficient capacity within the network.

Yours sincerely,

Adam Shaw
Principal Engineer / Director
GCA Engineering Solutions

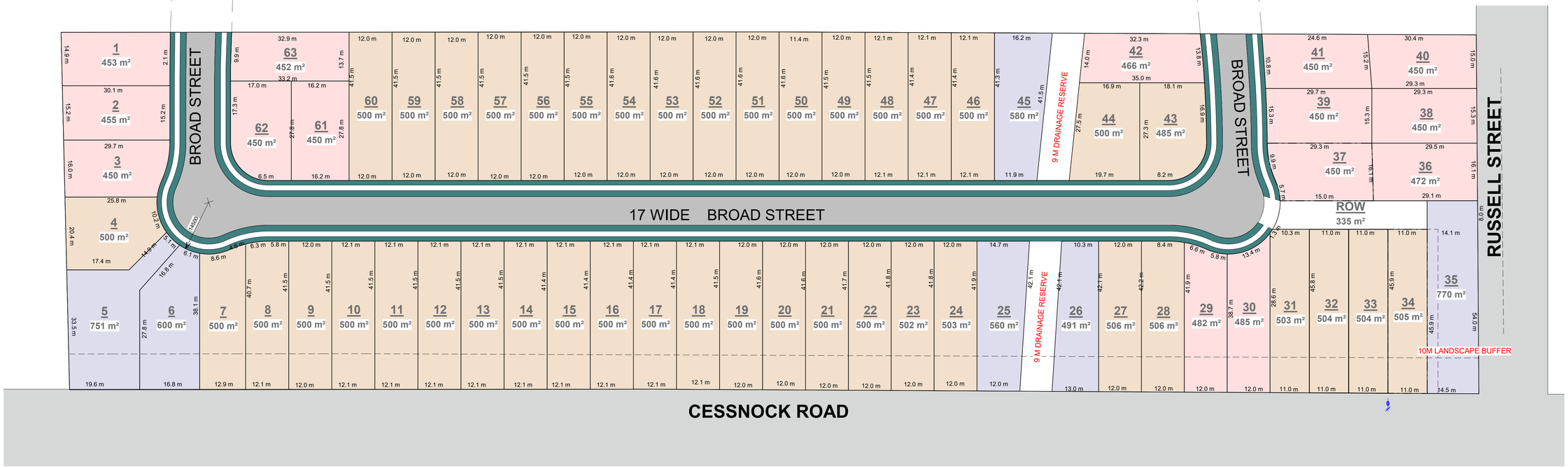
ATTACHMENT 1:

Subdivision Plan

CODE	LOT AREA
	450 SQMT LOTS
	500 SQMT LOTS
	VARIABLE
TOTAL NO OF LOTS - 63	

LEGEND
SITE BOUNDARY
PROPOSED LOT BOUNDARY

OVERALL SITE AREA - 39600 SQM



1 / DA02 SUPERLOT - SUBDIVISION PLAN
1 : 600

DO NOT SCALE

USE FIGURED DIMENSIONS AT ALL TIMES. IF IN DOUBT CHECK WITH THE BUILDER. CONTRACTOR/S TO CHECK AND VERIFY ALL LEVELS, DATUMS AND DIMENSIONS ON SITE AND SHALL REPORT ANY DISCREPANCIES OR OMMISSIONS TO THE BUILDER PRIOR TO COMMENCEMENT OF WORK AND DURING THE CONSTRUCTION PHASE.

20 10 0 10 20 30 40 50 70mm

DA ISSUE

REV	DATE	DESCRIPTION	BY
1	30/11/2021	ISSUED FOR DA APPLICATION	SS

GENERAL NOTES:

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"Building dreams together"

PROJECT:
Cessnock Road 412-414, Gillieston Heights

LOT NUMBER:
Lot 123 & 124 DP 10157

DRAWING TITLE:
SUBDIVISION PLAN

PROJECT No.	DATE:	DRAWING No:	REV:
	10/12/2021	DA02	1
DRAWN BY: SS	SCALE: As indicated		ISSUED BY: SS

Z:\Projects- Current\Cessnock Road 412-414, Gillieston Heights\03 DA\ARCHITECTURAL\REVIT\PROJECT\Cessnock Road 412-414, Gillieston Heights_R01_Russell Street.rvt

19/05/2022 1:44:50 PM

A1

ATTACHMENT 2:

Overall Catchment Plan

PROPOSED DEVELOPMENT

DP 1092105

CESSNOCK ROAD

ROAD 1

ROAD 2

ROAD 3

ROAD 4

ROAD 5

ROAD 6

RUSSELL STREET

LEGEND

- CATCHMENT 1 AREA = 18.69 ha
- CATCHMENT 2 AREA = 28.50 ha
- CATCHMENT 3 AREA = 9.68 ha
- CATCHMENT 4 AREA =11.35 ha
- CATCHMENT 5 AREA = 8.04 ha

Client: HUNTER LAND PTY LTD

Project: PROPOSED RESIDENTIAL SUBDIVISION

Location: CNR CESSNOCK ROAD & RUSSELL STREET, GILLIESTON HEIGHTS

PROJECT NUMBER: 10050C dF04r2
DATE: 29.02.12

1:4000 0 80 160 240 320 m

GCA ENGINEERING SOLUTIONS

CATCHMENT PLAN

FIGURE 4

ATTACHMENT 3:

Gillieston Grove Drainage Strategy

Proposed Residential Subdivision

Lot 1 DP 197680, Lot 1 DP 986923 and Lots 21 & 22 DP 1092105

Gillieston Heights

Stormwater Drainage Report

Revision: 2
Version Date: 29 February 2012

Geoff Craig & Associates Pty Ltd
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Revision	Description	Author		Review		Approved	
1	Original Issue	AA	09.02.12	AJF	09.02.12	IH	
2	Detention Basin Pipe Amendment	AA	29.02.12	AJF	29.02.12	IH	

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Appendix B DRAINS Results Spreadsheets
Appendix C Hydrograph
Appendix D Nutrient Control Pond Calculations
Appendix E DRAINS Nodal Layout

List of acronyms

ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
GCA	GCA Engineering Solutions
RCP	Reinforced Concrete Pipe
RL	Reduced Level
MCC	Maitland City Council
MOES	Manual of Engineering Standards
DLWC	Department of Land and Water Conservation
IFD	Intensity Frequency Duration

1. INTRODUCTION

1.1 Background

GCA Engineering Solutions has been engaged to formulate a stormwater drainage report for a proposed residential subdivision located off Cessnock Road, Gillieston Heights. The drainage report addresses both water quality and water quantity requirements for the proposed development.

1.2 Site Description

The proposed development is bounded by Cessnock Road to the east, Russell Street to the north, rural land to the south, and the South Maitland Railway track to the west. The site comprises Lot 1 DP 197680 and Lot 1 DP 986923. Lots 21 & 22 DP 1092105 have been included in this study. The proposed development site is approximately 19.7 ha in area and with the inclusion of Lots 21 & 22 the study area is 23.6ha. The Locality Layout and Existing Site Plan are shown in Figure 1 and Figure 2 respectively.

The runoff from the site flows toward the north western corner of the catchment where an existing flood zone area is located (Refer to Figure 2 - Existing Site Plan). The site contains slopes typically in the order of 4% to 8% along the ridgelines and gullies. The site varies in level from approximately RL 28 in its eastern and southern extremity to RL 6 at the lowest point on the north western portion of the catchment.

There are four existing farm dams on the site, which typically overflow to the existing watercourse which drains from the south eastern corner of the site to the north western corner of the site. The existing water course has a low lying section which typically retains stormwater flow. (Refer to Figure 2 - Existing Site Plan)

The north western portion of the site is inundated in the 1 in 100 year storm event. The 1 in 100 year flood level is RL 10.2m AHD (supplied by RPS Harper Somers O'Sullivan).

Figure 3 shows the proposed residential subdivision plan.

1.3 Scope of Work

1.3.1 Water Quality

1. To provide adequate water quality control facilities for the site to minimise the effects of the development on the receiving waterway and to ensure that the existing level of water quality present on the site is not detrimentally affected by the proposed residential subdivision development.

1.3.2 Water Quantity (Detention)

1. To design the residential subdivision such that the Post Development flow is limited to 100% of the Pre Development flow for Average Recurrence Intervals (ARI) from 1 to 100 years.
2. To calculate the pre-developed and post-developed flowrates from the site in order to determine detention requirements.

1.3.3 Conveyance of Major Flows through the Site

1. To ensure that major flows are conveyed through the site with minimal impact on the proposed allotments.

2. METHODOLOGY

2.1 Proposed Methodology

Water quality and stormwater detention measures will be required such that developed flowrates do not exceed undeveloped flowrates for all storm events from 1 in 1 year to 1 in 100 year Average Recurrence Interval (ARI), and major flows are conveyed through the site with minimal impact on existing watercourses and proposed allotments.

This strategy proposes a simplistic measure for water quality and quantity control, which is to construct a combined nutrient control pond and detention basin at the downstream outlet of the catchment prior to its discharge. The nutrient control pond has been designed in accordance with the requirements of the "*The Constructed Wetlands Manual*" (DLWC).

Typically, stormwater will flow into the nutrient control pond / detention basin up to the active water level with excess flows stored above the active water level. Discharge will be controlled by suitable outlet controls such that the developed outflows are no greater than the undeveloped flowrate.

2.1.1 Proposed Water Quality Measures

Nutrient removal is proposed by means of a nutrient control pond. A nutrient control pond is proposed based upon the *"The Constructed Wetlands Manual" (Department of Land and Water Conservation, DLWC).* This nutrient control pond is to be part of a wet detention basin.

2.1.2 Proposed Water Quantity Measures

The site was divided into five catchments. Figure 4 shows the location of the catchment boundaries where the external catchment has been taken into account. The catchments were modelled in two differing scenarios using the DRAINS – Urban Drainage Model, firstly in the existing state and secondly as a developed catchment. In DRAINS the ILSAX model was used to determine the 1 to 100 year ARI peak flows for the catchment in its existing and developed states.

These two models were then evaluated for design storms with durations varying from 5 minutes to 4.5 hours, and Average Recurrence Interval from 1 to 100 years. The relevant Intensity Frequency Duration (IFD) data was obtained from the tables supplied in "*Australian Rainfall and Runoff"* and is listed below.

Latitude = 32.75 ^{o} S

Longitude = 151.63 ^{o} E

Skewness = 0.04

2-year ARI,	1 hour intensity =	30.00 mm/hr
	12 hour intensity =	6.25 mm/hr
	72 hour intensity =	2.10 mm/hr
50-year ARI,	1 hour intensity =	58.00 mm/hr
	12 hour intensity =	13.00 mm/hr
	72 hour intensity =	4.25 mm/hr

The critical storm was then selected for each ARI, based on the peak discharge from the site. The hydrographs of these 'critical' storms were plotted to determine the approximate volume of storage required. Typical drainage layouts were adopted for the total catchment with developed flows calculated at the outlet of the development site. Refer to Appendix E for DRAINS nodal layout.

2.2 Modelling

The following parameters were utilised in the model:

- Soil Type = 3.5
- Grassed Depression Storage = 5mm
- Paved Depression Storage = 1mm

2.2.1 Pre-development Flow

The following data was utilised for the pre-developed catchment:

Undeveloped Area

- Impervious Percentage = 0%
- Flow Path Roughness Coefficient = 0.1

Existing Developed Residential Area

- Residential Lot Area Impervious Percentage = 60% (MCC MOES 6.3.4)
- Road Reserve Impervious Percentage = 85% (MCC MOES 6.3.4)
- Road Reserve Surface Roughness Coefficient = 0.011

A copy of the data spreadsheets from DRAINS used for the analysis has been included in Appendix A.

2.2.2 Post-Development Flow

The following data was utilised for the post-developed catchment:

Undeveloped Area

- Impervious Percentage = 0%
- Flow Path Roughness Coefficient = 0.1

Developed Area

- Residential Lot Area Impervious Percentage = 60% (MCC MOES 6.3.4)
- Road Reserve Impervious Percentage = 85% (MCC MOES 6.3.4)
- Road Reserve Surface Roughness Coefficient = 0.011

A copy of the data spreadsheets from DRAINS used for the analysis has been included in Appendix A.

2.2.3 Detention Basin

The detention basin was modelled using the DRAINS program. The data used for this design stage is the same as that used for the developed catchment with the addition of a detention basin at the outlet of the developed Catchment 1, 2 and 3. Proposed Lots 137, 138, and 139 (part of Catchment 4) will bypass the detention basin. The detention basin was oversized to compensate the developed flow of Lots 137, 138, and 139, so that the peak flow determined the downstream outlet point is less or equal to the undeveloped flow. The 1 in 100 year flood level of RL 10.2m AHD was taken into account in determining the 100 year peak discharge flow from the detention basin. RL 10.2m AHD is specified in the DRAINS program as the tailwater level at the outlet point.

A copy of the data spreadsheet from DRAINS used for the analysis has been included in Appendix A.

3. RESULTS

3.1 Water Quality

Details of the proposed Nutrient Control Pond are shown in Figure 5. The Nutrient Control Pond was designed generally in accordance with the requirements of "The Constructed Wetlands Manual" (DLWC). The calculations of the nutrient control pond are shown in Appendix D. The specifics of this pond are presented in Table 1.

Table 1: Nutrient Control Pond Data

Nutrient Control Pond	Contributing Area (ha)	Required Pond Surface Area (m^2)	Actual Pond Surface Area (m^2)
1	18.57	5641	6618

3.2 Water Quantity

The model for the catchment was run for various design storm durations. The peak discharge for the various ARIs was calculated along with the required detention volume. These results are shown below in Table 2.

Table 2: Peak Flow Results

ARI	Peak Flow (Pre-Development State) (m^3/s)	Peak Flow (Post-Development State) (m^3/s)	Peak Flow (Post-Development State with Detention) (m^3/s)
1	2.86	4.22	2.20
2	4.45	6.23	3.46
5	6.74	9.03	5.58
10	8.16	10.63	7.10
20	10.20	12.60	9.19
50	12.80	15.10	11.80
100	14.73	17.25	14.57

The detention volume required is shown below in Table 3.

Table 3: Detention Volume

Minimum Detention Volume (m^3)
8171

Hydrographs for 100 year peak ARI events showing both existing and developed flowrates are contained in Appendix C. The DRAINS output spreadsheets for the 1 year, 10 year and 100 year ARIs for all states are shown in Appendix B.

The outlet control devices were calculated to be:

4 x Ø900 RCP outflow pipes at RL 9.50 AHD

1 x 27m wide spillway at RL 10.23 AHD

Drawings showing the basin size within the proposed development are included **in Figure 5.**

4. SUMMARY AND CONCLUSIONS

This stormwater drainage report for the residential development at Gillieston Heights proposes to utilise a combined nutrient control pond and detention basin for the management of stormwater quality and quantity.

The determined levels of stormwater detention will reduce peak developed flows to peak undeveloped flows leaving the development site for all ARI events from 1 year to 100 years. The approximate total detention volume required for the development is 8171m^3.

The determined minimum surface area for the pond is 5641m^2 and was designed generally in accordance with the requirements of "The Constructed Wetlands Manual" (DLWC).

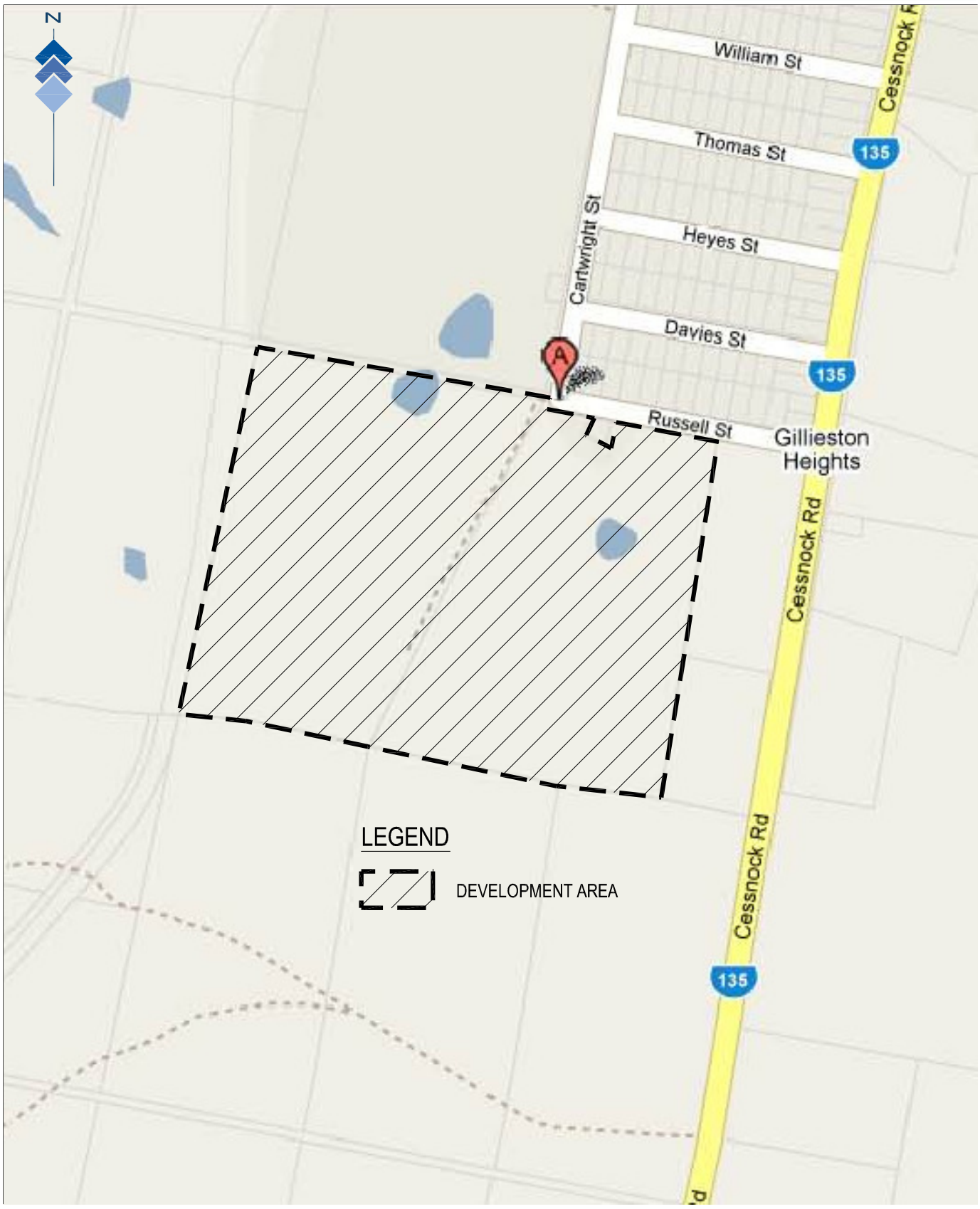
This stormwater drainage report clearly demonstrates that there are no impediments to developing the site with respect to provision of suitable water quality and quantity measures.

5. REFERENCES

Stormwater Drainage Strategy, Gillieston Heights, prepared by Geoff Craig & Associates (Project Number: 10050, March 2010, Rev 1).

Maitland City Council, 2008, Manual of Engineering Standards

Figures



Client: HUNTER LAND PTY LTD
Project: PROPOSED RESIDENTIAL SUBDIVISION
Location: CNR CESSNOCK ROAD & RUSSELL STREET, GILLIESTON HEIGHTS

PROJECT NUMBER: 10050C dF01r2
DATE: 29.02.12

LOCALITY PLAN

FIGURE 1

N

EXISTING CREEK

EXISTING DAM

RUSSELL STREET

2
DP 197680

4
DP 998274

1
DP 986923

100 YEAR FLOOD LEVEL 10.2m

EXISTING WATER BODY

21
DP 1092105

DP 1070026

SOUTH MAITLAND RAILWAY SYSTEM

EXISTING DAM

EXISTING DAM

1
DP 197680

22
DP 1092105

CESSNOCK ROAD

3
DP 456946

DP 975994

22
DP 975994

1
DP 456946

LEGEND:

- EXISTING WATER BODIES
- 100 YEAR ARI FLOOD LEVEL
- EXISTING OVERHEAD POWER LINES
- EXISTING TOP OF BANK
- EXISTING TOE OF BANK
- EXISTING POWER POLE

Client: HUNTER LAND PTY LTD

Project: PROPOSED RESIDENTIAL SUBDIVISION

Location: CNR CESSNOCK ROAD & RUSSELL STREET, GILLIESTON HEIGHTS

PROJECT NUMBER: 10050C dF02r2
DATE: 29.02.12

1:2500 0 5 10 15 20 m

GCA ENGINEERING SOLUTIONS

EXISTING SITE PLAN

FIGURE 2

N

DP 1070026

SOUTH MAITLAND RAILWAY SYSTEM

4
DP 998274

2
DP 197680

RUSSELL STREET

CESSNOCK ROAD

ROAD 1
ROAD 2
ROAD 3
ROAD 4
ROAD 5
ROAD 6
ROAD 8

DP 1092105 21

DP 1092105 22

3
DP 456946

DP 975994

22
DP 975994

1
DP 456946

Client: HUNTER LAND PTY LTD

Project: PROPOSED RESIDENTIAL SUBDIVISION

Location: CNR CESSNOCK ROAD & RUSSELL STREET, GILLIESTON HEIGHTS

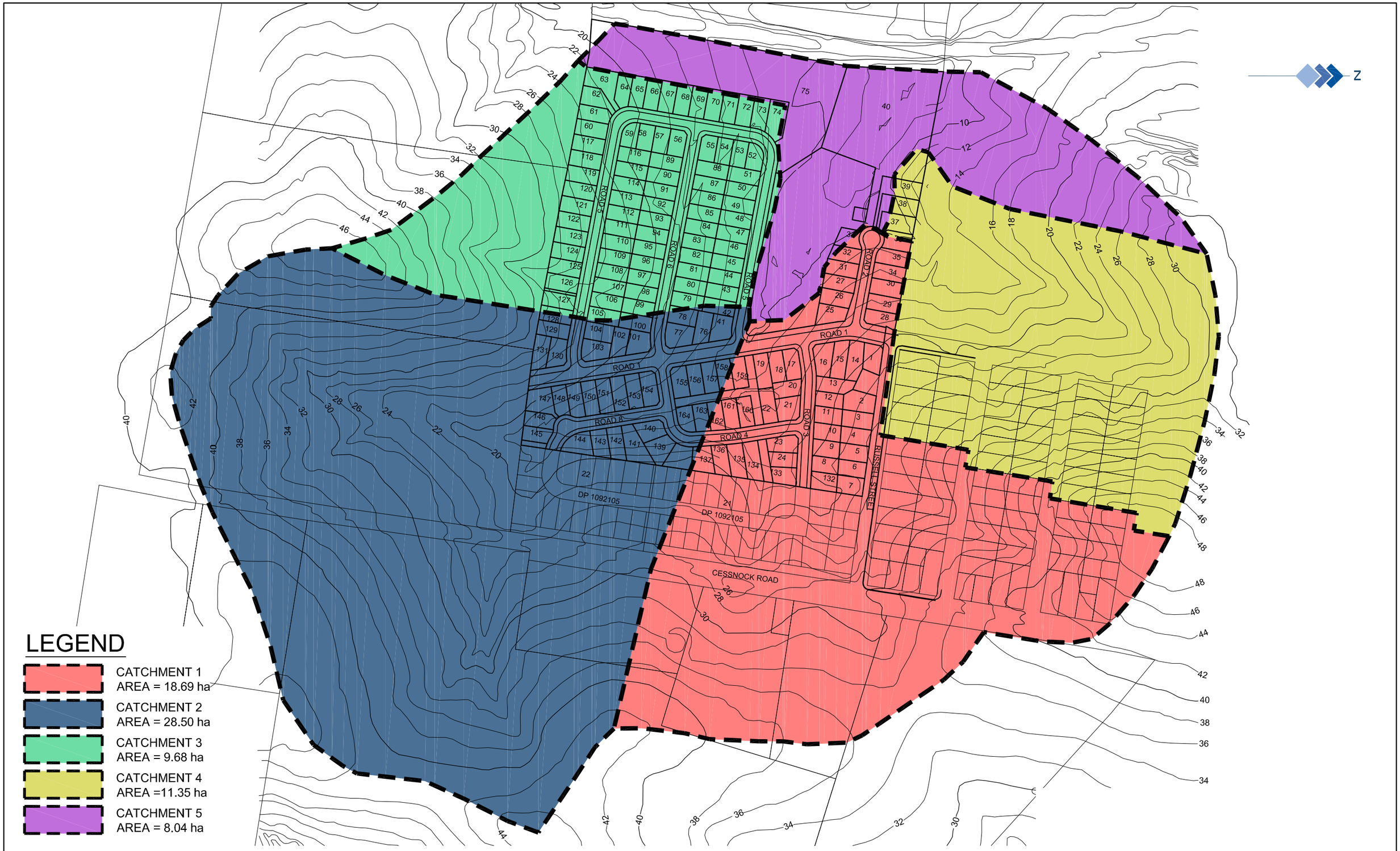
PROJECT NUMBER: 10050C dF03r2
DATE: 29.02.12

1:2500 0 5 10 15 20 m

GCA ENGINEERING SOLUTIONS

PROPOSED RESIDENTIAL SUBDIVISION PLAN

FIGURE 3



LEGEND

- CATCHMENT 1 AREA = 18.69 ha
- CATCHMENT 2 AREA = 28.50 ha
- CATCHMENT 3 AREA = 9.68 ha
- CATCHMENT 4 AREA =11.35 ha
- CATCHMENT 5 AREA = 8.04 ha

Client: HUNTER LAND PTY LTD

Project: PROPOSED RESIDENTIAL SUBDIVISION

Location: CNR CESSNOCK ROAD & RUSSELL STREET, GILLIESTON HEIGHTS

PROJECT NUMBER: 10050C dF04r2
DATE: 29.02.12

1:4000 0 80 160 240 320 m

GCA ENGINEERING SOLUTIONS

CATCHMENT PLAN

FIGURE 4

PROPOSED DETENTION BASIN / NUTRIENT CONTROL POND

POND TOP OF BANK (T.O.B)	= R.L 10.80
POND TOP OF WATER LEVEL (T.W.L)	= R.L 10.50
POND ACTIVE WATER LEVEL (A.W.L)	= R.L 9.50
POND PERMANENT WATER LEVEL (P.W.L)	= R.L 9.30
MINIMUM DETENTION VOLUME	= 8171m³
ACTUAL DETENTION VOLUME	= 8195m³
MINIMUM PERMANENT WATER LEVEL SURFACE AREA	= 5641m³
ACTUAL PERMANENT WATER LEVEL SURFACE AREA	= 6618m³

PROPOSED SITE REGRADING
ACTUAL EXTENT TO BE DETERMINED
DURING DETAILED DESIGN OF
RELEVANT CONSTRUCTION STAGE

N

4 x Ø900 RCP AT R.L 9.50

27m WIDE SPILLWAY AT R.L 10.23

ROAD 1

ROAD 2

ROAD 4

ROAD 5

1:1000 0 20 40 60 80m

LEGEND

- MACROPHYTE ZONE
- DEEP WATER ZONE
- MACROPHYTE PLANTING ZONE 10m WIDE
- PROPOSED SITE REGRADING
- PROPOSED PIPE
- PROPOSED HEADWALL

Client: HUNTER LAND PTY LTD

Project: PROPOSED RESIDENTIAL SUBDIVISION

Location: CNR CESSNOCK ROAD & RUSSELL STREET, GILLIESTON HEIGHTS

PROJECT NUMBER: 10050C dF05r2
DATE: 29.02.12

1:4000 0 80 160 240 320 m

GCA ENGINEERING SOLUTIONS

DETENTION BASIN / NUTRIENT CONTROL POND DETAILED PLAN

FIGURE 5

Appendix A

DRAINS Data Spreadsheet

Undeveloped Catchment

DRAINS Data Spreadsheet

DRAINS Data Spreadsheet - Undeveloped Catchment

PIT / NODE DETAILS Version 9

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id
N2	Node					11		0		1901.579	-580.909		35
detbasin	Node					10.2		0		1152.851	-384.756		251
outlet	Node					9		0		772.506	-272.327		326
OUT	Node					0		0		442.396	-186.211		77
N3	Node					11		0		1150.459	-743.572		260
N1	Node					11		0		1822.64	-131.193		311
N4	Node					10.2		0		916.032	-25.94		331

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %
Catchment2	N2	28.5	0	100	0	1	5	0	0	700	0	0	4.5
Catchment5	outlet	8.04	0	100	0	1	5	0	0	350	0	0	6
Catchment3	N3	9.68	0	100	0	1	5	0	0	500	0	0	7
Catchment1	N1	18.69	25.4	74.6	0	1	5	0	600	550	0	6.5	5.5
Catchment4	N4	11.35	31.6	68.4	0	1	5	0	500	400	0	8	5

SUB-CATCHMENT DETAILS

Name	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor
Catchment2	0	0.011	0.1	0	0			
Catchment5	0	0.011	0.1	0	0			
Catchment3	0	0.011	0.1	0	0			
Catchment1	0	0.011	0.1	0	0			
Catchment4	0	0.011	0.1	0	0			

CHANNEL DETAILS

Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Width (m)	L.B. Slope (1:?)	R.B. Slope (1:?)	Manning n	Depth (m)	Roofed
dummyCh2	N2	detbasin	Prismatic	1	11	10.2	80	10	1	1	0.035	1	No
Chdetbasin	detbasin	outlet	Prismatic	1	10.2	9	120	10	1	1	0.035	1	No
ChnlOUT	outlet	OUT	Prismatic	1	10.2	0	1020	10	1	1	0.035	1	No
dummyCh3	N3	detbasin	Prismatic	1	11	10.2	80	10	1	1	0.035	1	No
dummyCh1	N1	detbasin	Prismatic	1	11	10.2	80	10	1	1	0.035	1	No
dummyCh4	N4	outlet	Prismatic	1	10.2	9	120	10	1	1	0.035	1	No

Developed Catchment

DRAINS Data Spreadsheet

DRAINS Data Spreadsheet - Developed Catchment

PIT / NODE DETAILS Version 9

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id
N2	Node					11		0		1901.579	-580.909		35
detbasin	Node					10.2		0		1152.851	-384.756		251
outlet	Node					9		0		772.506	-272.327		326
OUT	Node					0		0		442.396	-186.211		77
N3	Node					11		0		1150.459	-743.572		260
N1	Node					11		0		1822.64	-131.193		311
N4	Node					10.2		0		916.032	-25.94		331

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %
Catchment2	N2	28.5	12.5	87.5	0	1	5	0	400	600	0	3	3
Catchment5	outlet	8.04	0	100	0	1	5	0	0	350	0	0	6
Catchment3	N3	9.68	42.2	57.8	0	1	5	0	400	500	0	3	3
Catchment1	N1	18.69	48	52	0	1	5	0	600	550	0	3	3
Catchment4	N4	11.35	33.2	66.8	0	1	5	0	500	400	0	8	5

SUB-CATCHMENT DETAILS

Name	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor
Catchment2	0	0.011	0.1	0	0			
Catchment5	0	0.011	0.1	0	0			
Catchment3	0	0.011	0.1	0	0			
Catchment1	0	0.011	0.1	0	0			
Catchment4	0	0.011	0.1	0	0			

CHANNEL DETAILS

Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Width (m)	L.B. Slope (1:?)	R.B. Slope (1:?)	Manning n	Depth (m)	Roofed
dummyCh2	N2	detbasin	Prismatic	1	11	10.2	80	10	1	1	0.035	1	No
Chdetbasin	detbasin	outlet	Prismatic	1	10.2	9	120	10	1	1	0.035	1	No
ChnlOUT	outlet	OUT	Prismatic	1	10.2	0	1020	10	1	1	0.035	1	No
dummyCh3	N3	detbasin	Prismatic	1	11	10.2	80	10	1	1	0.035	1	No
dummyCh1	N1	detbasin	Prismatic	1	11	10.2	80	10	1	1	0.035	1	No
dummyCh4	N4	outlet	Prismatic	1	10.2	9	120	10	1	1	0.035	1	No

Developed Catchment with Detention Basin

DRAINS Data Spreadsheet

DRAINS Data Spreadsheet - Developed Catchment with Detention Basin

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Name	Type	Family	Version 10 Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id
N2	Node					11		0		1901.579	-580.909		35
Nout	Node					7.7		0		935.169	-320.169		413
outlet	Node					7		0		772.506	-272.327		326
OUT	Node					6		0		442.396	-186.211		77
N3	Node					11		0		1150.459	-743.572		260
N1	Node					11		0		1822.64	-131.193		311
N4	Node					10		0		916.032	-25.94		331

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Init Vol. (cu	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL
Basin	9.5	7040	5482.45	Culvert	0.5					1150.459	-387.148	No	
	10.5	9350											
	10.8	10003											

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %
Catchment2	N2	28.5	12.5	87.5	0	1	5	0	400	600	0	3	3
Catchment5	outlet	8.04	0	100	0	1	5	0	0	350	0	0	6
Catchment3	N3	9.68	42.2	57.8	0	1	5	0	400	500	0	3	3
Catchment1	N1	18.69	48	52	0	1	5	0	600	550	0	3	3
Catchment4	N4	11.35	33.2	66.8	0	1	5	0	500	400	0	8	5

SUB-CATCHMENT DETAILS

Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFactor
0	0.011	0.1	0	0			
0	0.011	0.1	0	0			
0	0.011	0.1	0	0			
0	0.011	0.1	0	0			
0	0.011	0.1	0	0			

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From
PipeBasin	Basin	Nout	25	9.5	7.7	7.2	Concrete, r	900	900	0.011	NewFixed	4	Basin

CHANNEL DETAILS

Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Width (m)	L.B. Slope (1:?)	R.B. Slope (1:?)	Manning n	Depth (m)	Roofed
dummyCh2	N2	Basin	Prismatic	1	11	9.5	150	10	1	1	0.035	1	No
Chdetbasin	Nout	outlet	Prismatic	1	9.3	7	230	10	1	1	0.035	1	No
ChnlOUT	outlet	OUT	Prismatic	1	7	6	100	10	1	1	0.035	1	No
dummyCh3	N3	Basin	Prismatic	1	11	9.5	150	10	1	1	0.035	1	No
dummyCh1	N1	Basin	Prismatic	1	11	9.5	150	10	1	1	0.035	1	No
dummyCh4	N4	outlet	Prismatic	1	10.2	7	320	10	1	1	0.035	1	No

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Storr (m)	Safe Depth Minor Storr (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %
OF	Basin	Nout	6	10.23	27	1.7	spillway	0.3	0.3	0.6	1	0

Appendix B

DRAINS Results Spreadsheet

Undeveloped Catchment

DRAINS Results Spreadsheet

DRAINS Results Spreadsheet - Undeveloped 1 year ARI

DRAINS results prepared 04 March, 2010 from Version 2009.07

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivir (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N2	11.09		0.861				
detbasin	10.36		0				
outlet	10.4		0.372				
OUT	10.2		0				
N3	11.06		0.395				
N1	11.11		1.056				
N4	10.4		0.805				

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)	Supp. Tc (min)	Due to Storm
Catchment2	0.861	0	0.861	1	75.69	0	AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1
Catchment5	0.372	0	0.372	1	47.78	0	AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1
Catchment3	0.395	0	0.395	1	55.6	0	AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1
Catchment1	1.056	0.749	0.336	11.94	46.05	0	AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
Catchment4	0.805	0.608	0.216	10.22	39.9	0	AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1

Outflow Volumes for Total Catchment (8.33 impervious + 67.9 pervious = 76.3 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 1 year, 5 minutes storm, average 76 mm/h, Zone 1	4829.8	481.59 (10.0%)	444.47 (84.2%)	37.11 (0.9%)
AR&R 1 year, 10 minutes storm, average 58 mm/h, Zone 1	7371.8	1744.10 (23.7%)	722.27 (89.7%)	1021.83 (15.6%)
AR&R 1 year, 15 minutes storm, average 48.4 mm/h, Zone 1	9227.46	3256.91 (35.3%)	925.06 (91.7%)	2331.85 (28.4%)
AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1	10727.24	4469.57 (41.7%)	1088.96 (92.9%)	3380.61 (35.4%)
AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1	11947.4	5434.15 (45.5%)	1222.30 (93.6%)	4211.85 (39.6%)
AR&R 1 year, 30 minutes storm, average 34.2 mm/h, Zone 1	13040.46	6200.26 (47.5%)	1341.75 (94.2%)	4858.51 (41.8%)
AR&R 1 year, 45 minutes storm, average 27.4 mm/h, Zone 1	15671.43	7970.10 (50.9%)	1629.27 (95.1%)	6340.83 (45.4%)
AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1	17692.32	9382.76 (53.0%)	1850.12 (95.7%)	7532.64 (47.8%)
AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1	20704.59	11063.02 (53.4%)	2179.30 (96.3%)	8883.72 (48.2%)
AR&R 1 year, 2 hours storm, average 15.1 mm/h, Zone 1	23030.52	11980.47 (52.0%)	2433.49 (96.7%)	9546.98 (46.5%)
AR&R 1 year, 3 hours storm, average 11.6 mm/h, Zone 1	26538.48	12995.60 (49.0%)	2816.84 (97.1%)	10178.76 (43.1%)
AR&R 1 year, 4.5 hours storm, average 8.96 mm/h, Zone 1	30748.04	13452.29 (43.8%)	3276.87 (97.5%)	10175.42 (37.2%)

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm
dummyCh2	0.861	0.9			AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1
Chdetbasin	1.941	1.2			AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
ChnlOUT	2.859	1.4			AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
dummyCh3	0.395	0.7			AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1
dummyCh1	1.056	1			AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
dummyCh4	0.805	0.5			AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1

CONTINUITY CHECK for AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N2	3665.89	3665.89	0	0
detbasin	8018.8	8018.81	0	0
outlet	11063.04	11063.03	0	0
OUT	11063.03	11063.03	0	0
N3	1282.47	1282.47	0	0
N1	3070.44	3070.44	0	0
N4	1968.63	1968.63	0	0

DRAINS Results Spreadsheet - Undeveloped 10 year ARI

DRAINS results prepared 04 March, 2010 from Version 2009.07

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivir (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N2	11.2		2.853				
detbasin	10.52		0				
outlet	10.6		1.159				
OUT	10.2		0				
N3	11.12		1.243				
N1	11.19		2.661				
N4	10.6		1.917				

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)	Supp. Tc (min)	Due to Storm
Catchment2	2.853	0	2.853	1	59.94	0	AR&R 10 year, 1.5 hours storm, average 34 mm/h, Zone 1
Catchment5	1.159	0	1.159	1	35.18	0	AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1
Catchment3	1.243	0	1.243	1	40.7	0	AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1
Catchment1	2.661	1.571	1.311	9.89	38.34	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
Catchment4	1.917	1.22	0.84	8.48	33.34	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1

Outflow Volumes for Total Catchment (8.33 impervious + 67.9 pervious = 76.3 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 5 minutes storm, average 144 mm/h, Zone 1	9151.2	4093.63 (44.7%)	916.72 (91.7%)	3176.91 (39.0%)
AR&R 10 year, 10 minutes storm, average 110 mm/h, Zone 1	13981	8496.43 (60.8%)	1444.54 (94.5%)	7051.89 (56.6%)
AR&R 10 year, 15 minutes storm, average 91 mm/h, Zone 1	17349.15	11523.67 (66.4%)	1812.61 (95.6%)	9711.05 (62.8%)
AR&R 10 year, 20 minutes storm, average 79 mm/h, Zone 1	20081.8	13972.55 (69.6%)	2111.25 (96.2%)	11861.30 (66.3%)
AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1	22560.25	16121.23 (71.5%)	2382.10 (96.6%)	13739.13 (68.4%)
AR&R 10 year, 30 minutes storm, average 64 mm/h, Zone 1	24403.2	17615.95 (72.2%)	2583.50 (96.9%)	15032.45 (69.2%)
AR&R 10 year, 45 minutes storm, average 51 mm/h, Zone 1	29169.45	21500.94 (73.7%)	3104.36 (97.4%)	18396.58 (70.8%)
AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1	33020.58	24631.31 (74.6%)	3525.22 (97.7%)	21106.09 (71.8%)
AR&R 10 year, 1.5 hours storm, average 34 mm/h, Zone 1	38892.6	28985.13 (74.5%)	4166.93 (98.0%)	24818.20 (71.6%)
AR&R 10 year, 2 hours storm, average 28.5 mm/h, Zone 1	43468.2	31977.71 (73.6%)	4666.96 (98.2%)	27310.75 (70.5%)
AR&R 10 year, 3 hours storm, average 22.2 mm/h, Zone 1	50789.16	36639.23 (72.1%)	5467.02 (98.5%)	31172.21 (68.9%)
AR&R 10 year, 4.5 hours storm, average 17.3 mm/h, Zone 1	59368.39	40977.23 (69.0%)	6404.57 (98.7%)	34572.65 (65.4%)

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm
dummyCh2	2.853	1.4			AR&R 10 year, 1.5 hours storm, average 34 mm/h, Zone 1
Chdetbasin	5.809	1.7			AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1
ChnlOUT	8.156	1.9			AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1
dummyCh3	1.243	1.1			AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1
dummyCh1	2.661	1.4			AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
dummyCh4	1.917	0.6			AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1

CONTINUITY CHECK for AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N2	8791.89	8791.89	0	0
detbasin	18162.19	18162.19	0	0
outlet	24631.29	24631.26	0	0
OUT	24631.26	24631.26	0	0
N3	3024.64	3024.64	0	0
N1	6345.66	6345.66	0	0
N4	3945.19	3945.19	0	0

Outflow Volumes for Total Catchment (8.33 impervious + 67.9 pervious = 76.3 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1	13981	9042.51 (64.7%)	1444.54 (94.5%)	7597.97 (61.0%)
AR&R 100 year, 10 minutes storm, average 167 mm/h, Zone 1	21225.7	15852.75 (74.7%)	2236.25 (96.4%)	13616.50 (72.0%)
AR&R 100 year, 15 minutes storm, average 139 mm/h, Zone 1	26500.35	20758.99 (78.3%)	2812.68 (97.1%)	17946.31 (76.0%)
AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1	30504	24438.42 (80.1%)	3250.21 (97.5%)	21188.21 (78.0%)
AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1	33999.25	27562.65 (81.1%)	3632.17 (97.8%)	23930.47 (79.0%)
AR&R 100 year, 30 minutes storm, average 97 mm/h, Zone 1	36986.1	30223.81 (81.7%)	3958.58 (97.9%)	26265.23 (79.7%)
AR&R 100 year, 45 minutes storm, average 77 mm/h, Zone 1	44040.15	36397.49 (82.6%)	4729.46 (98.3%)	31668.02 (80.7%)
AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1	49569.01	41121.61 (83.0%)	5333.68 (98.5%)	35787.93 (81.1%)
AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1	59482.8	49460.97 (83.2%)	6417.06 (98.7%)	43043.91 (81.2%)
AR&R 100 year, 2 hours storm, average 43.4 mm/h, Zone 1	66193.69	54561.16 (82.4%)	7150.43 (98.8%)	47410.73 (80.4%)
AR&R 100 year, 3 hours storm, average 34 mm/h, Zone 1	77785.21	63284.89 (81.4%)	8417.20 (99.0%)	54867.69 (79.2%)
AR&R 100 year, 4.5 hours storm, average 26.7 mm/h, Zone 1	91626.39	72553.77 (79.2%)	9929.81 (99.2%)	62623.96 (76.7%)

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm
dummyCh2	5.312	1.7			AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1
Chdetbasin	10.668	2.1			AR&R 100 year, 45 minutes storm, average 77 mm/h, Zone 1
ChnlOUT	14.73	2.3			AR&R 100 year, 45 minutes storm, average 77 mm/h, Zone 1
dummyCh3	2.231	1.3			AR&R 100 year, 45 minutes storm, average 77 mm/h, Zone 1
dummyCh1	4.257	1.6			AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
dummyCh4	2.974	0.7			AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1

CONTINUITY CHECK for AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N2	14955.88	14955.88	0	0
detbasin	30460.34	30460.3	0	0
outlet	41121.63	41121.67	0	0
OUT	41121.67	41121.67	0	0
N3	5115.75	5115.75	0	0
N1	10388.69	10388.69	0	0
N4	6400.68	6400.68	0	0

DRAINS Results Spreadsheet - Undeveloped 100 year ARI

DRAINS results prepared 04 March, 2010 from Version 2009.07

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivir (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N2	11.3		5.312				
detbasin	10.68		0				
outlet	10.79		2.007				
OUT	10.2		0				
N3	11.17		2.231				
N1	11.26		4.257				
N4	10.79		2.974				

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)	Supp. Tc (min)	Due to Storm
Catchment2	5.312	0	5.312	1	47.39	0	AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1
Catchment5	2.007	0	2.007	1	30.66	0	AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1
Catchment3	2.231	0	2.231	1	33.35	0	AR&R 100 year, 45 minutes storm, average 77 mm/h, Zone 1
Catchment1	4.257	2.284	2.361	8.2	32.03	0	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
Catchment4	2.974	1.712	1.631	7.35	29.05	0	AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1

Developed Catchment

DRAINS Results Spreadsheet

DRAINS Results Spreadsheet - Developed 1 year ARI

DRAINS results prepared 04 March, 2010 from Version 2009.07

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivir (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N2	11.1		1.01				
detbasin	10.42		0				
outlet	10.46		0.372				
OUT	0.26		0				
N3	11.08		0.758				
N1	11.13		1.431				
N4	10.46		0.831				

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)	Supp. Tc (min)	Due to Storm
Catchment2	1.01	0.565	0.488	11.82	56.88	0	AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
Catchment5	0.372	0	0.372	1	47.78	0	AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1
Catchment3	0.758	0.648	0.121	11.82	51.5	0	AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
Catchment1	1.431	1.244	0.199	14.8	54.24	0	AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
Catchment4	0.831	0.638	0.211	10.22	39.9	0	AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1

Outflow Volumes for Total Catchment (20.4 impervious + 55.9 pervious = 76.3 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 1 year, 5 minutes storm, average 76 mm/h, Zone 1	4829.8	1116.11 (23.1%)	1087.30 (84.2%)	28.81 (0.8%)
AR&R 1 year, 10 minutes storm, average 58 mm/h, Zone 1	7371.8	2558.84 (34.7%)	1766.86 (89.7%)	791.98 (14.7%)
AR&R 1 year, 15 minutes storm, average 48.4 mm/h, Zone 1	9227.46	4111.20 (44.6%)	2262.94 (91.7%)	1848.26 (27.3%)
AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1	10727.24	5375.10 (50.1%)	2663.88 (92.9%)	2711.22 (34.5%)
AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1	11947.4	6384.15 (53.4%)	2990.07 (93.6%)	3394.08 (38.8%)
AR&R 1 year, 30 minutes storm, average 34.2 mm/h, Zone 1	13040.46	7216.04 (55.3%)	3282.29 (94.2%)	3933.75 (41.2%)
AR&R 1 year, 45 minutes storm, average 27.4 mm/h, Zone 1	15671.43	9135.26 (58.3%)	3985.63 (95.1%)	5149.63 (44.8%)
AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1	17692.32	10660.90 (60.3%)	4525.89 (95.7%)	6135.01 (47.3%)
AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1	20704.59	12589.31 (60.8%)	5331.16 (96.3%)	7258.16 (47.8%)
AR&R 1 year, 2 hours storm, average 15.1 mm/h, Zone 1	23030.52	13767.79 (59.8%)	5952.96 (96.7%)	7814.83 (46.3%)
AR&R 1 year, 3 hours storm, average 11.6 mm/h, Zone 1	26538.48	15227.52 (57.4%)	6890.77 (97.1%)	8336.76 (42.9%)
AR&R 1 year, 4.5 hours storm, average 8.96 mm/h, Zone 1	30748.04	16370.02 (53.2%)	8016.11 (97.5%)	8353.91 (37.1%)

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm
dummyCh2	1.01	1			AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
Chdetbasin	3.17	1.4			AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
ChnlOUT	4.217	1.6			AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
dummyCh3	0.758	0.9			AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
dummyCh1	1.431	1.1			AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
dummyCh4	0.831	0.3			AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1

CONTINUITY CHECK for AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N2	4128.78	4128.78	0	0
detbasin	9521.73	9521.72	0	0
outlet	12589.32	12589.33	0	0
OUT	12589.33	12589.33	0	0
N3	1793.8	1793.8	0	0
N1	3599.14	3599.14	0	0
N4	1992	1992	0	0

DRAINS Results Spreadsheet - Developed 10 year ARI

DRAINS results prepared 04 March, 2010 from Version 2009.07

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivir (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N2	11.2		2.766				
detbasin	10.59		0				
outlet	10.68		1.159				
OUT	0.48		0				
N3	11.15		1.747				
N1	11.22		3.348				
N4	10.67		1.962				

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)	Supp. Tc (min)	Due to Storm
Catchment2	2.766	1.181	1.908	9.79	47.13	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
Catchment5	1.159	0	1.159	1	35.18	0	AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1
Catchment3	1.747	1.354	0.472	9.79	42.77	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
Catchment1	3.348	2.7	0.78	12.21	44.99	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
Catchment4	1.962	1.281	0.82	8.48	33.34	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1

Outflow Volumes for Total Catchment (20.4 impervious + 55.9 pervious = 76.3 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 5 minutes storm, average 144 mm/h, Zone 1	9151.2	4802.85 (52.5%)	2242.56 (91.7%)	2560.29 (38.2%)
AR&R 10 year, 10 minutes storm, average 110 mm/h, Zone 1	13981	9279.39 (66.4%)	3533.72 (94.5%)	5745.67 (56.1%)
AR&R 10 year, 15 minutes storm, average 91 mm/h, Zone 1	17349.15	12367.86 (71.3%)	4434.14 (95.6%)	7933.72 (62.4%)
AR&R 10 year, 20 minutes storm, average 79 mm/h, Zone 1	20081.8	14865.56 (74.0%)	5164.67 (96.2%)	9700.89 (65.9%)
AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1	22560.25	17076.62 (75.7%)	5827.25 (96.6%)	11249.37 (68.1%)
AR&R 10 year, 30 minutes storm, average 64 mm/h, Zone 1	24403.2	18629.76 (76.3%)	6319.94 (96.9%)	12309.82 (68.8%)
AR&R 10 year, 45 minutes storm, average 51 mm/h, Zone 1	29169.45	22672.22 (77.7%)	7594.11 (97.4%)	15078.10 (70.6%)
AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1	33020.58	25934.21 (78.5%)	8623.64 (97.7%)	17310.56 (71.6%)
AR&R 10 year, 1.5 hours storm, average 34 mm/h, Zone 1	38892.6	30562.33 (78.6%)	10193.43 (98.0%)	20368.90 (71.5%)
AR&R 10 year, 2 hours storm, average 28.5 mm/h, Zone 1	43468.2	33839.88 (77.8%)	11416.65 (98.2%)	22423.23 (70.4%)
AR&R 10 year, 3 hours storm, average 22.2 mm/h, Zone 1	50789.16	38977.01 (76.7%)	13373.78 (98.5%)	25603.23 (68.8%)
AR&R 10 year, 4.5 hours storm, average 17.3 mm/h, Zone 1	59368.39	44066.79 (74.2%)	15667.31 (98.7%)	28399.48 (65.3%)

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm
dummyCh2	2.766	1.4			AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
Chdetbasin	7.861	1.9			AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
ChnlOUT	10.63	2.1			AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
dummyCh3	1.747	1.2			AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
dummyCh1	3.348	1.5			AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
dummyCh4	1.962	0.4			AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1

CONTINUITY CHECK for AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N2	9189	9189	0	0
detbasin	19445.05	19445.07	0	0
outlet	25934.19	25934.21	0	0
OUT	25934.21	25934.21	0	0
N3	3460.04	3460.04	0	0
N1	6796.02	6796.02	0	0
N4	3965.21	3965.21	0	0

DRAINS Results Spreadsheet - Developed 100 year ARI

DRAINS results prepared 04 March, 2010 from Version 2009.07

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivir (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N2	11.29		4.904				
detbasin	10.74		0				
outlet	10.86		2.007				
OUT	0.66		0				
N3	11.19		2.618				
N1	11.31		5.431				
N4	10.85		3.031				

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)	Supp. Tc (min)	Due to Storm
Catchment2	4.904	1.312	4.551	10.95	52.72	0	AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1
Catchment5	2.007	0	2.007	1	30.66	0	AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1
Catchment3	2.618	1.968	0.852	8.12	35.61	0	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
Catchment1	5.431	4.172	1.408	10.08	37.42	0	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
Catchment4	3.031	1.799	1.592	7.35	29.05	0	AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1

Outflow Volumes for Total Catchment (20.4 impervious + 55.9 pervious = 76.3 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1	13981	9736.90 (69.6%)	3533.72 (94.5%)	6203.17 (60.6%)
AR&R 100 year, 10 minutes storm, average 167 mm/h, Zone 1	21225.7	16621.56 (78.3%)	5470.47 (96.4%)	11151.08 (71.7%)
AR&R 100 year, 15 minutes storm, average 139 mm/h, Zone 1	26500.35	21592.88 (81.5%)	6880.56 (97.1%)	14712.32 (75.8%)
AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1	30504	25331.75 (83.0%)	7950.88 (97.5%)	17380.88 (77.8%)
AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1	33999.25	28520.58 (83.9%)	8885.27 (97.8%)	19635.31 (78.8%)
AR&R 100 year, 30 minutes storm, average 97 mm/h, Zone 1	36986.1	31240.34 (84.5%)	9683.75 (97.9%)	21556.59 (79.5%)
AR&R 100 year, 45 minutes storm, average 77 mm/h, Zone 1	44040.15	37569.51 (85.3%)	11569.55 (98.3%)	25999.97 (80.6%)
AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1	49569.01	42438.30 (85.6%)	13047.59 (98.5%)	29390.72 (80.9%)
AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1	59482.8	51060.56 (85.8%)	15697.89 (98.7%)	35362.67 (81.1%)
AR&R 100 year, 2 hours storm, average 43.4 mm/h, Zone 1	66193.69	56446.22 (85.3%)	17491.96 (98.8%)	38954.26 (80.3%)
AR&R 100 year, 3 hours storm, average 34 mm/h, Zone 1	77785.21	65681.66 (84.4%)	20590.78 (99.0%)	45090.89 (79.1%)
AR&R 100 year, 4.5 hours storm, average 26.7 mm/h, Zone 1	91626.39	75764.69 (82.7%)	24291.08 (99.2%)	51473.61 (76.7%)

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm
dummyCh2	4.904	1.7			AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1
Chdetbasin	12.734	2.2			AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
ChnlOUT	17.25	2.5			AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
dummyCh3	2.618	1.4			AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
dummyCh1	5.431	1.7			AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
dummyCh4	3.031	0.5			AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1

CONTINUITY CHECK for AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N2	15356.27	15356.27	0	0
detbasin	31756.69	31756.72	0	0
outlet	42438.24	42438.28	0	0
OUT	42438.28	42438.28	0	0
N3	5556.04	5556.04	0	0
N1	10844.4	10844.4	0	0
N4	6420.87	6420.87	0	0

Developed Catchment with Detention Basin

DRAINS Results Spreadsheet

DRAINS Results Spreadsheet - Developed with Detention Basin 1 year ARI

DRAINS results prepared 29 February, 2012 from Version 2012.02

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivir (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N2	11.1		1.01				
Nout	9.43		0				
outlet	7.17		0.372				
OUT	6.17		0				
N3	11.08		0.758				
N1	11.13		1.431				
N4	10.29		0.831				

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)	Supp. Tc (min)	Due to Storm
Catchment2	1.01	0.565	0.488	11.82	56.88	0	AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
Catchment5	0.372	0	0.372	1	47.78	0	AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1
Catchment3	0.758	0.648	0.121	11.82	51.5	0	AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
Catchment1	1.431	1.244	0.199	14.8	54.24	0	AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
Catchment4	0.831	0.638	0.211	10.22	39.9	0	AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1

Outflow Volumes for Total Catchment (20.4 impervious + 55.9 pervious = 76.3 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 1 year, 5 minutes storm, average 76 mm/h, Zone 1	4829.8	1116.12 (23.1%)	1087.31 (84.2%)	28.81 (0.8%)
AR&R 1 year, 10 minutes storm, average 58 mm/h, Zone 1	7371.8	2558.85 (34.7%)	1766.87 (89.7%)	791.98 (14.7%)
AR&R 1 year, 15 minutes storm, average 48.4 mm/h, Zone 1	9227.46	4111.20 (44.6%)	2262.94 (91.7%)	1848.25 (27.3%)
AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1	10727.24	5375.10 (50.1%)	2663.89 (92.9%)	2711.22 (34.5%)
AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1	11947.4	6384.16 (53.4%)	2990.07 (93.6%)	3394.08 (38.8%)
AR&R 1 year, 30 minutes storm, average 34.2 mm/h, Zone 1	13040.46	7216.05 (55.3%)	3282.28 (94.2%)	3933.77 (41.2%)
AR&R 1 year, 45 minutes storm, average 27.4 mm/h, Zone 1	15671.43	9135.27 (58.3%)	3985.63 (95.1%)	5149.64 (44.8%)
AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1	17692.32	10660.90 (60.3%)	4525.88 (95.7%)	6135.02 (47.3%)
AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1	20704.59	12589.39 (60.8%)	5331.16 (96.3%)	7258.23 (47.8%)
AR&R 1 year, 2 hours storm, average 15.1 mm/h, Zone 1	23030.52	13767.78 (59.8%)	5952.97 (96.7%)	7814.81 (46.3%)
AR&R 1 year, 3 hours storm, average 11.6 mm/h, Zone 1	26538.48	15227.55 (57.4%)	6890.76 (97.1%)	8336.79 (42.9%)
AR&R 1 year, 4.5 hours storm, average 8.96 mm/h, Zone 1	30748.04	16370.05 (53.2%)	8016.12 (97.5%)	8353.93 (37.1%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
PipeBasin	1.488	5.76	9.642	9.432	AR&R 1 year, 2 hours storm, average 15.1 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm
dummyCh2	1.01	0			AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
Chdetbasin	1.488	0			AR&R 1 year, 2 hours storm, average 15.1 mm/h, Zone 1
ChnlOUT	2.199	0			AR&R 1 year, 2 hours storm, average 15.1 mm/h, Zone 1
dummyCh3	0.758	0			AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
dummyCh1	1.431	0			AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1
dummyCh4	0.831	0			AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF	0	0	10.584	0	0	0	0	

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin	10.03	4080.4	1.488	1.488	0

CONTINUITY CHECK for AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N2	4128.77	4128.77	0	0
Basin	9521.72	7704.72	1817.19	0
Nout	7704.72	7704.31	0	0
outlet	10771.9	10771.49	0	0
OUT	10771.49	10771.49	0	0
N3	1793.81	1793.81	0	0
N1	3599.14	3599.14	0	0
N4	1992	1992	0	0

DRAINS Results Spreadsheet - Developed with Detention Basin 10 year ARI

DRAINS results prepared 29 February, 2012 from Version 2012.02

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivir (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N2	11.2		2.766				
Nout	9.59		1.648				
outlet	7.37		1.159				
OUT	6.37		0				
N3	11.15		1.747				
N1	11.22		3.348				
N4	10.36		1.962				

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)	Supp. Tc (min)	Due to Storm
Catchment2	2.766	1.181	1.908	9.79	47.13	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
Catchment5	1.159	0	1.159	1	35.18	0	AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1
Catchment3	1.747	1.354	0.472	9.79	42.77	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
Catchment1	3.348	2.7	0.78	12.21	44.99	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
Catchment4	1.962	1.281	0.82	8.48	33.34	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1

Outflow Volumes for Total Catchment (20.4 impervious + 55.9 pervious = 76.3 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 5 minutes storm, average 144 mm/h, Zone 1	9151.2	4802.84 (52.5%)	2242.55 (91.7%)	2560.29 (38.2%)
AR&R 10 year, 10 minutes storm, average 110 mm/h, Zone 1	13981	9279.38 (66.4%)	3533.71 (94.5%)	5745.67 (56.1%)
AR&R 10 year, 15 minutes storm, average 91 mm/h, Zone 1	17349.15	12367.80 (71.3%)	4434.09 (95.6%)	7933.71 (62.4%)
AR&R 10 year, 20 minutes storm, average 79 mm/h, Zone 1	20081.8	14865.56 (74.0%)	5164.67 (96.2%)	9700.89 (65.9%)
AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1	22560.25	17076.62 (75.7%)	5827.23 (96.6%)	11249.39 (68.1%)
AR&R 10 year, 30 minutes storm, average 64 mm/h, Zone 1	24403.2	18629.73 (76.3%)	6319.93 (96.9%)	12309.80 (68.8%)
AR&R 10 year, 45 minutes storm, average 51 mm/h, Zone 1	29169.45	22672.23 (77.7%)	7594.10 (97.4%)	15078.12 (70.6%)
AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1	33020.58	25934.19 (78.5%)	8623.65 (97.7%)	17310.54 (71.6%)
AR&R 10 year, 1.5 hours storm, average 34 mm/h, Zone 1	38892.6	30562.36 (78.6%)	10193.45 (98.0%)	20368.90 (71.5%)
AR&R 10 year, 2 hours storm, average 28.5 mm/h, Zone 1	43468.2	33839.86 (77.8%)	11416.63 (98.2%)	22423.23 (70.4%)
AR&R 10 year, 3 hours storm, average 22.2 mm/h, Zone 1	50789.16	38976.95 (76.7%)	13373.79 (98.5%)	25603.17 (68.8%)
AR&R 10 year, 4.5 hours storm, average 17.3 mm/h, Zone 1	59368.39	44066.68 (74.2%)	15667.34 (98.7%)	28399.34 (65.3%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
PipeBasin	3.323	6.88	9.72	9.591	AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm
dummyCh2	2.766	0			AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
Chdetbasin	4.95	0			AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1
ChnlOUT	7.096	0			AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1
dummyCh3	1.747	0			AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
dummyCh1	3.348	0			AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
dummyCh4	1.962	0			AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF	1.648	1.648	10.584	0.098	0.06	27.92	0.6	AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin	10.34	6704.6	4.971	3.323	1.648

CONTINUITY CHECK for AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N2	9189	9189	0	0
Basin	19445.09	16914.04	2531.41	0
Nout	16914.03	16913.26	0	0
outlet	23402.38	23401.59	0	0
OUT	23401.59	23401.59	0	0
N3	3460.04	3460.04	0	0
N1	6796.03	6796.03	0	0
N4	3965.2	3965.2	0	0

DRAINS Results Spreadsheet - Developed with Detention Basin 100 year ARI

DRAINS results prepared 29 February, 2012 from Version 2012.02

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivir (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
N2	11.29		4.904				
Nout	10.2		6.396				
outlet	10.2		2.007				
OUT	10.2		0				
N3	11.19		2.618				
N1	11.31		5.431				
N4	10.41		3.031				

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)	Supp. Tc (min)	Due to Storm
Catchment2	4.904	1.312	4.551	10.95	52.72	0	AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1
Catchment5	2.007	0	2.007	1	30.66	0	AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1
Catchment3	2.618	1.968	0.852	8.12	35.61	0	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
Catchment1	5.431	4.172	1.408	10.08	37.42	0	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
Catchment4	3.031	1.799	1.592	7.35	29.05	0	AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1

Outflow Volumes for Total Catchment (20.4 impervious + 55.9 pervious = 76.3 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1	13981	9736.89 (69.6%)	3533.72 (94.5%)	6203.17 (60.6%)
AR&R 100 year, 10 minutes storm, average 167 mm/h, Zone 1	21225.7	16621.55 (78.3%)	5470.47 (96.4%)	11151.08 (71.7%)
AR&R 100 year, 15 minutes storm, average 139 mm/h, Zone 1	26500.35	21592.88 (81.5%)	6880.57 (97.1%)	14712.31 (75.8%)
AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1	30504	25331.77 (83.0%)	7950.87 (97.5%)	17380.90 (77.8%)
AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1	33999.25	28520.58 (83.9%)	8885.26 (97.8%)	19635.32 (78.8%)
AR&R 100 year, 30 minutes storm, average 97 mm/h, Zone 1	36986.1	31240.39 (84.5%)	9683.76 (97.9%)	21556.63 (79.5%)
AR&R 100 year, 45 minutes storm, average 77 mm/h, Zone 1	44040.15	37569.54 (85.3%)	11569.54 (98.3%)	26000.00 (80.6%)
AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1	49569.01	42438.26 (85.6%)	13047.56 (98.5%)	29390.70 (80.9%)
AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1	59482.8	51060.61 (85.8%)	15697.97 (98.7%)	35362.64 (81.1%)
AR&R 100 year, 2 hours storm, average 43.4 mm/h, Zone 1	66193.69	56446.44 (85.3%)	17492.11 (98.8%)	38954.33 (80.3%)
AR&R 100 year, 3 hours storm, average 34 mm/h, Zone 1	77785.21	65681.67 (84.4%)	20590.71 (99.0%)	45090.97 (79.1%)
AR&R 100 year, 4.5 hours storm, average 26.7 mm/h, Zone 1	91626.39	75764.37 (82.7%)	24290.83 (99.2%)	51473.54 (76.7%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
PipeBasin	4.317	1.92	10.245	10.2	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm
dummyCh2	4.904	0			AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1
Chdetbasin	10.478	0			AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1
ChnlOUT	14.565	0			AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1
dummyCh3	2.618	0			AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
dummyCh1	5.431	0			AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
dummyCh4	3.031	0			AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF	6.396	6.396	10.584	0.221	0.23	27.94	1.04	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin	10.5	8170.5	10.713	4.317	6.396

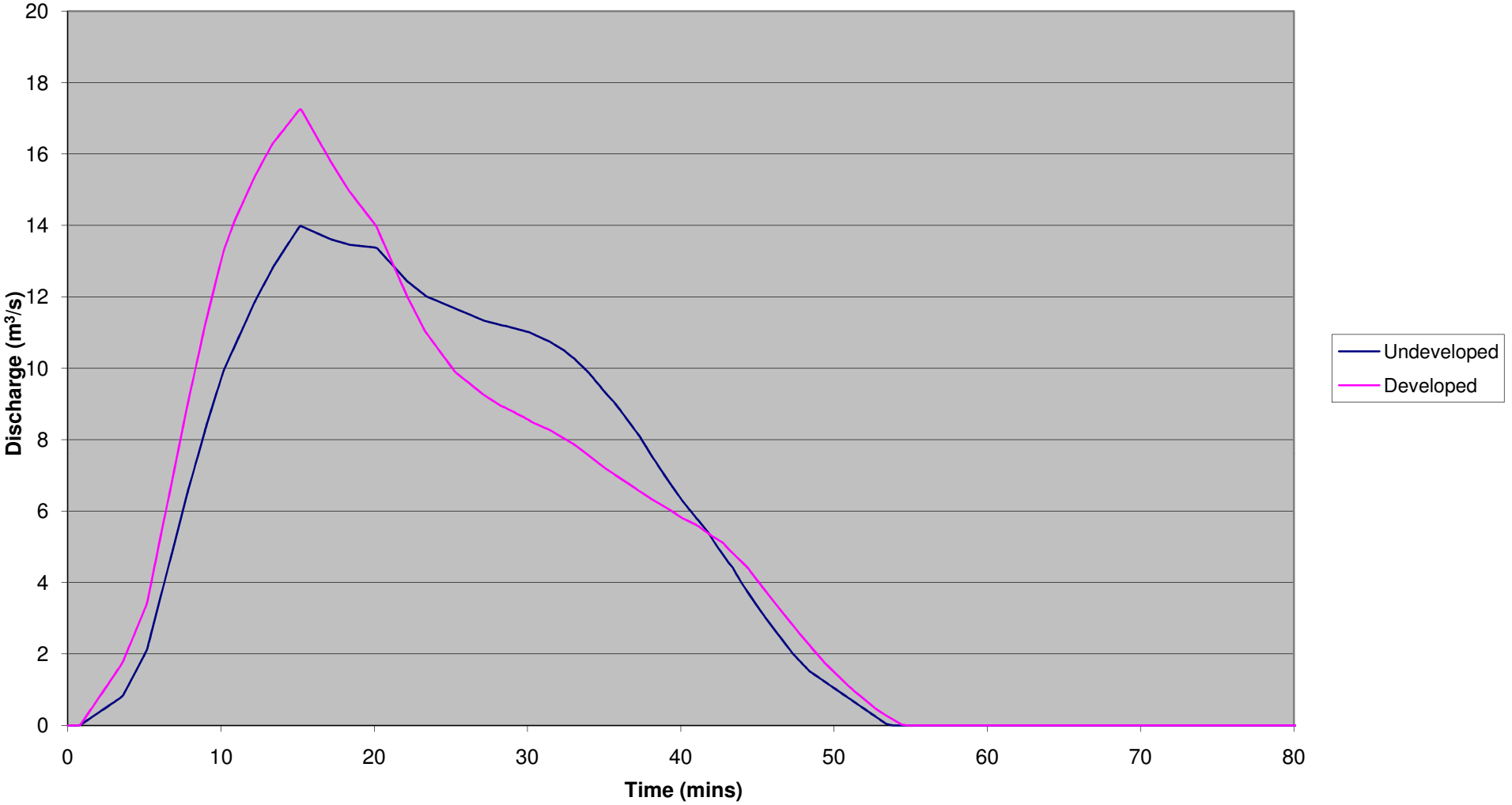
CONTINUITY CHECK for AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N2	15356.28	15356.28	0	0
Basin	31756.77	31756.7	0	0
Nout	31756.73	31756.74	0	0
outlet	42438.26	42438.19	0	0
OUT	42438.19	42438.19	0	0
N3	5556.02	5556.02	0	0
N1	10844.43	10844.43	0	0
N4	6420.88	6420.88	0	0

Appendix C

Hydrograph

100 year ARI - BASIN Peak Outflow Hydrograph



Appendix D

Nutrient Control Pond Calculations

Sizing of Wetlands
The Constucted Wetlands Manual (DL&WC) 1998

(example page 254 Volume 2)
Determine average daily runoff ($Runoff_{DA}$)

Land Use Type	Area (ha)	% yield (Table10-5)	$Runoff_{DA}$ (m^3/day)
Residential	18.57	45	261.9
Medium Density Res.	0	50	0.0
Industrial	0	80	0.0
Rural Residential	0	10	0.0
	18.57	$Runoff_{DA}$	**261.9** m^3/day

Mean Annual Rainfall for Newcastle **1143.8mm**
Wetland to be designed to achieve 50-70% removal of phosphorus

Average Depths

Generic Curve Method (from fig 16-8)

choose Volume Open Water: Volume Reed Bed Ratio (typ. 2:1)
3 :1
Average Depth d_{AV} **0.9** m (fig 16-8)

Modified mean annual runoff method
choose area reed bed:area open water for **macrophyte** zone (typ 3:1)
water quality (4:1), habitat (1.5:1) **3** :1

Average Depth Macrophyte zone **0.7** m (fig 16-9)

System Sizing

Generic Curve Method
i) determine the % of phosphorus removal rate (50 or 70%)
50 %
ii) determine hydralic residence time

Hydraulic Retention Time (HRT) **12** days

iii) determine wetland system volume (eq'n 16-3)

volume = $Runoff_{DA}$ * HRT = **3142** m^3

iv) determine wetland area (eq'n 16-4)

area = volume/d_{av} **3492** m^2

ZONE SIZING

Deep Water Zone (removal of sediment)
NB: Council standard GPT is designed to capture 75% of >0.04mm
Deep Water zone to capture finer sediments than GPT

i) determine min. diam of particales to be captured
0.05 mm
ii) Settling Velocity & 0.0019 m/s Table 16-6
ii) sedimentation efficiency e_f 76

iii) design flow rate (Q)

Q_1	2.17	m^3/s	(DRAINS)

iv) Surface Area Required (eqn 16-5)

A_s	**1503**	m^2

v) Calculate pond dimensions (eqn 16-6 & 16-7)

width	**22.4**	m
length	**67.1**	m

Macrophyte Zone

NB: Flows in excess of 2 year ARI should be diverted around this zone

i) determine the required detention factor D_f

RD_{AV}	132	mm	table 16-7 (Newcastle)
for	50	%	dissolved phosphorus removal
D_f	11.1		eqn 16-8

ii) calculate volume of macrophyte zone (eqn 16-10)

Volume = $D_f * Runoff_{DA}$	**2896**	m^3	Macrophyte Zone
			3103 reed bed m^2
Area = vol/d_{AV}	**4138**	m^2	**1034** open water m^2

Total Wetland Area (Zone Sizing)	**5641**	m^2	(final sizing) = Deep Water Zone + Macrophyte Zone
Total Wetland Area (Generic method)	**3492**	m^2	(preliminary sizing)

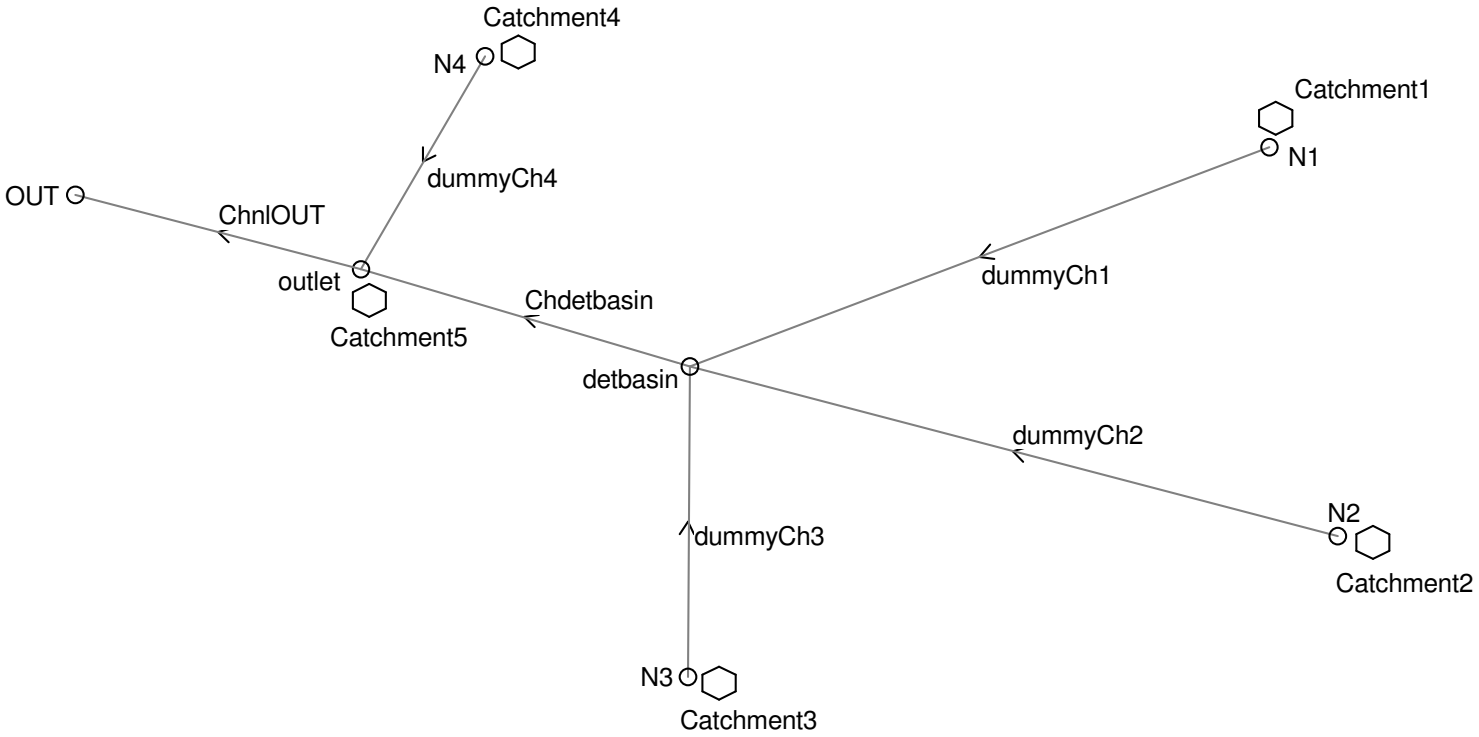
Design of Surcharging in Macrophyte Zone

Aim to capture 'first flush'. ie first 10mm (Catchment <40ha)
or first 25mm (Catchment >40ha)

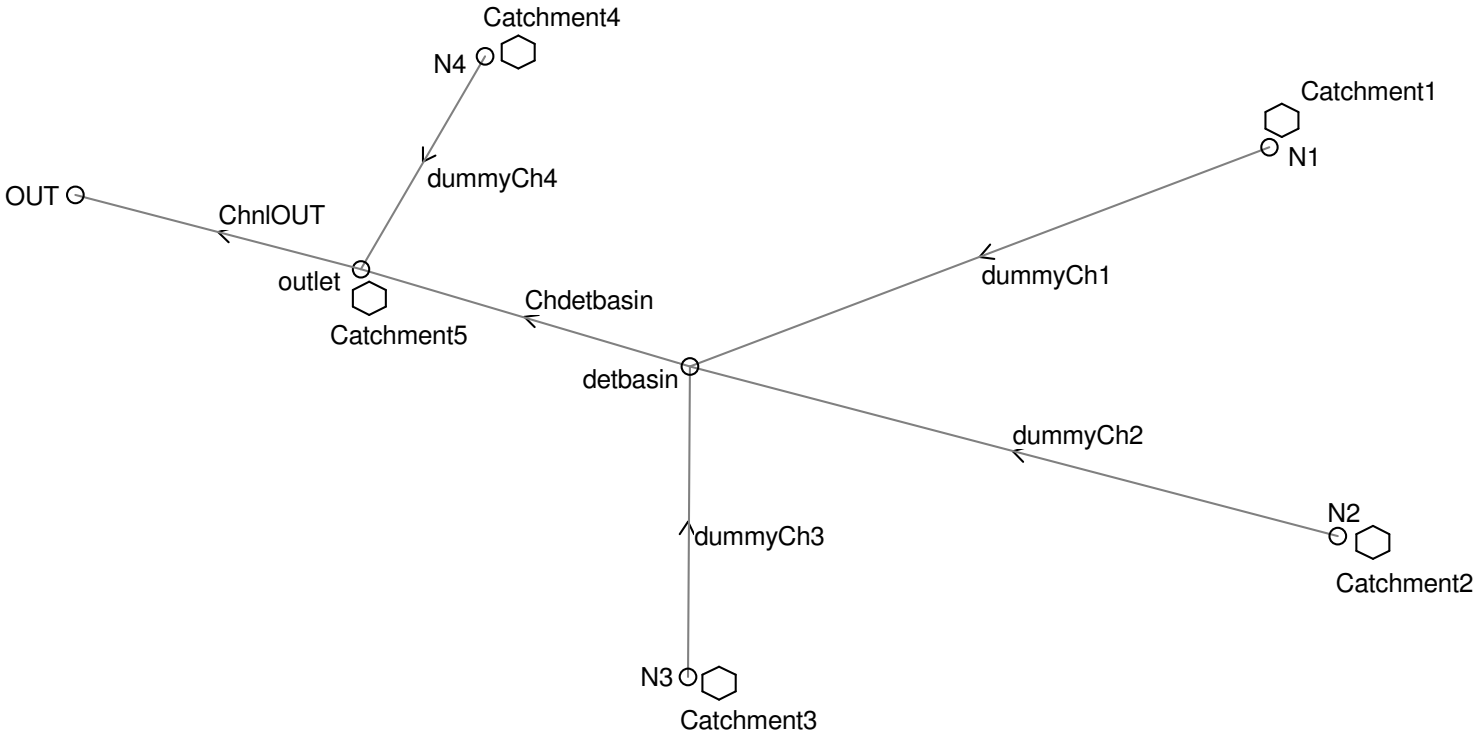
Fraction impervious (%)	**45**	%
Catchment Area (ha)	**18.57**	ha
volume of surcharge pool	**835.65**	**m^3**
min. depth of surcharge pool	**0.20**	m (assumes depth over macrophyte zone only - zone sizing method)

Appendix E

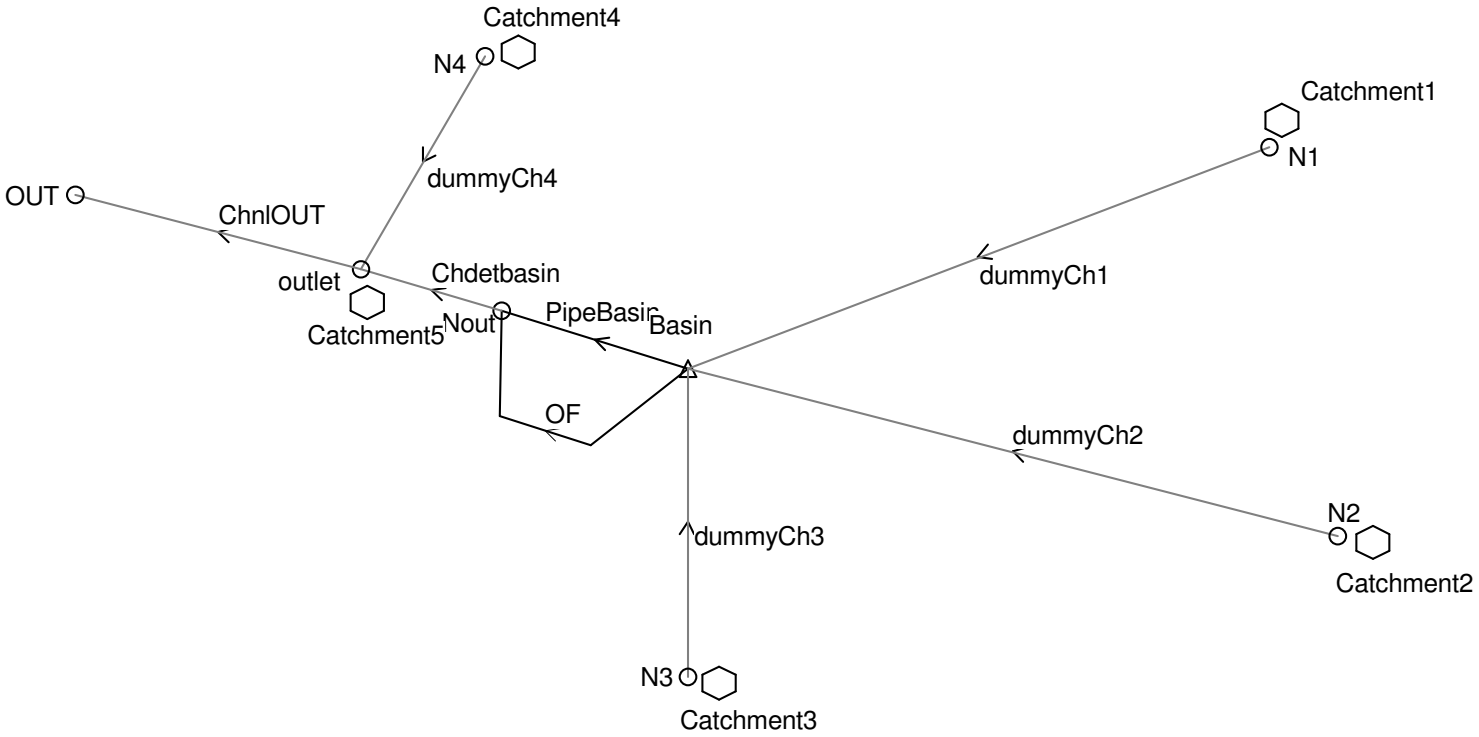
DRAINS Nodal Layout



OFF RUSSELL STREET
GILLIESTON HEIGHTS
UNDEVELOPED CATCHMENT



OFF RUSSELL STREET
GILLIESTON HEIGHTS
DEVELOPED CATCHMENT



OFF RUSSELL STREET
GILLIESTON HEIGHTS
DEVELOPED CATCHMENT WITH DETENTION BASIN

ATTACHMENT 4:

Gillieston Grove, Stage 6 – Engineering Plan Extracts

maitland city council

Approved Plans
CC 17-141 / DA10-791
Engineering Construction
CC Issue Date : 05/10/2017

LEGEND:

- STAGE 6

RUSSELL STREET

CESSNOCK ROAD

LAVENDER CLOSE

BROAD STREET

ARDENNES CIRCUIT

BOURBON STREET

JERSEY STREET

AUBURN STREET

HOLLAND CIRCUIT

LAND SYSTEM

OLD

DP 998274

DP 1070026

DP 1092105

DP 975994

EXISTING STAGE 1

EXISTING DEVELOPMENT

FUTURE DEVELOPMENT

PROPOSED FUTURE DEVELOPMENT

134 DETENTION BASIN

DWG C02

DWG C03

Pt 133

Pt 610

Pt 323

Pt 229

Pt 430

1:1000 0 20 40 60 80 100 m

Amendment	Description	Drawn	App'd	Date
3	COUNCIL COMMENTS	P.K	S.H	30.03.17
2	GENERAL AMENDMENTS	P.K	S.H	17.01.17
1	CC ISSUE	P.K	S.H	05.12.16

Designed	A.M
Cad Reference	16628C dC01r3
Scale	1:1000
	A1 SHEET
Project Approval	IAN HILL (B.E) Consulting Civil Engineer

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PO BOX 3337, THORNTON NSW 2322
PHONE: (02) 4964 1811 ◆ FAX: (02) 4964 1822

PROPOSED SUBDIVISION - STAGE 6
AUBURN STREET GILLIESTON HEIGHTS
GILLIESTON GROVE

GENERAL ARRANGEMENT PLAN

Project No	
16628C	
Drawing No	Revision
C01	3

PLOT DATE: 28/08/2017 12:19:22 PM CAD FILE: Q:\16\16628 Gillieston Grove - Stage 6\02_CAD\AutoCAD\Civil\16628C dC01r3.dwg

maitland city council

Approved Plans
CC 17-141 / DA10-791
Engineering Construction
CC Issue Date : 05/10/2017

DEMOLISH AND REMOVE TEMPORARY HEADWALL AND PIPE BACK TOWARDS PIT No.3

PROPOSED OVERFLOW CHANNEL. REFER TO DWG C20 FOR DETAILS.

PROVIDE MONOWILLS SAFETY FENCE TO TOP OF WALL

ALLAN BLOCK RETAINING WALL. MAX. 1.2m HIGH. REFER TO DWG C14 FOR DETAILS.

ERECT CHEVRON BOARD

PLACE REFLECTORISED GUIDE POST PAINTED WHITE AT 1.2m CENTRES

CONSTRUCT TEMPORARY TURNING HEAD IN ACCORDANCE WITH MCC STANDARD DRAWING SD028, OPTION 2. REFER DWG C26

KOPPERS LOG RETAINING WALL TO BE WHOLLY WITHIN LOT 603. MAX. 1.0m HIGH. REFER TO DWG C14 FOR DETAILS.

REGRADING ON UPSTREAM LAND TO RECIFY PREVIOUS EROSION

PROPOSED OVERLAND FLOW CHANNEL 2.0m WIDE BASE WITH 1:4 SIDE SLOPE

DEMOLSH AND REMOVE TEMPORARY HEADWALL. EXTEND Φ1050 RCP TO PIT No.6.

SAWCUT EXISTING WEARING COURSE 300mm BACK FROM LOC & EXCAVATE BASE COURSE TO SUBBASE INTERFACE MAKE SMOOTH CONNECTION TO EXISTING PAVEMENT. REFER MCC STD DWG SD032

PROPOSED 900mm x 1200mm PIT I.L 13.00

EXISTING OVERLAND FLOW CHANNEL 2.0m WIDE BASE WITH 1:4 SIDE SLOPE

BROAD STREET

HOLLAND AVENUE

Pt 133 Pt 610 Pt 610 Pt 323

E: 361941.770 N: 6373598.624

E: 361902.743 N: 6373600.746

IP 104.086

TP 9.218 TP 24.293 TP 21.898

LOC 47.937

LEGEND

- PROPOSED SITE REGRADE
- PROPOSED FOOTPATH 125mm THICK ONE LAYER SL72 MESH
- PROPOSED HEAVY DUTY FOOTPATH 150mm THICK TWO LAYERS SL72 MESH
- 16.70 – PROPOSED SITE REGRADING LEVELS
- 18.00 – PROPOSED DESIGN CONTOUR
- 18.00 – EXISTING CONTOUR
- –STORMWATER PIPE
- –IAD DRAINAGE LINE
- –SUBSOIL LINE
- GAS –EXISTING GAS
- S –EXISTING SEWER
- S –PROPOSED SEWER
- –SAG PIT
- –EXISTING SAG PIT
- –EKI PIT (EXTENTED KERB INLET PIT)
- –EXISTING EKI PIT
- (25) –PIT NUMBER
- (154) –EXISTING PIT NUMBER
- –SUBSOIL DRAINAGE PIPE
- –SUBSOIL FLUSH POINT

1:250 0 5 10 15 20 25 m

ALL EXISTING UNDERGROUND SERVICES MUST BE LOCATED AND EXPOSED PRIOR TO EARTHWORKS COMMENCING AND IT IS THE RESPONSIBILITY OF THOSE PERSONS USING THIS PLAN TO CONFIRM BOTH POSITION & LEVEL OF THESE UTILITIES IN CONJUNCTION WITH THE APPROPRIATE AUTHORITY.

Amendment	Description	Drawn	App'd	Date
6	COUNCIL COMMENTS	K.S	S.H	11.07.17
5	COUNCIL COMMENTS	P.K	S.H	27.06.17
4	COUNCIL COMMENTS	K.S	S.H	05.06.17
3	COUNCIL COMMENTS	P.K	S.H	30.03.17
2	GENERAL AMENDMENTS	P.K	S.H	17.01.17
1	ORIGINAL ISSUE	P.K	S.H	06.12.16

Designed	SH
Cad Reference	16628C dC02r6
Scale	1:250
	A1 SHEET
Project Approval	IAN HILL (B.E) Consulting Civil Engineer

GCA ENGINEERING SOLUTIONS
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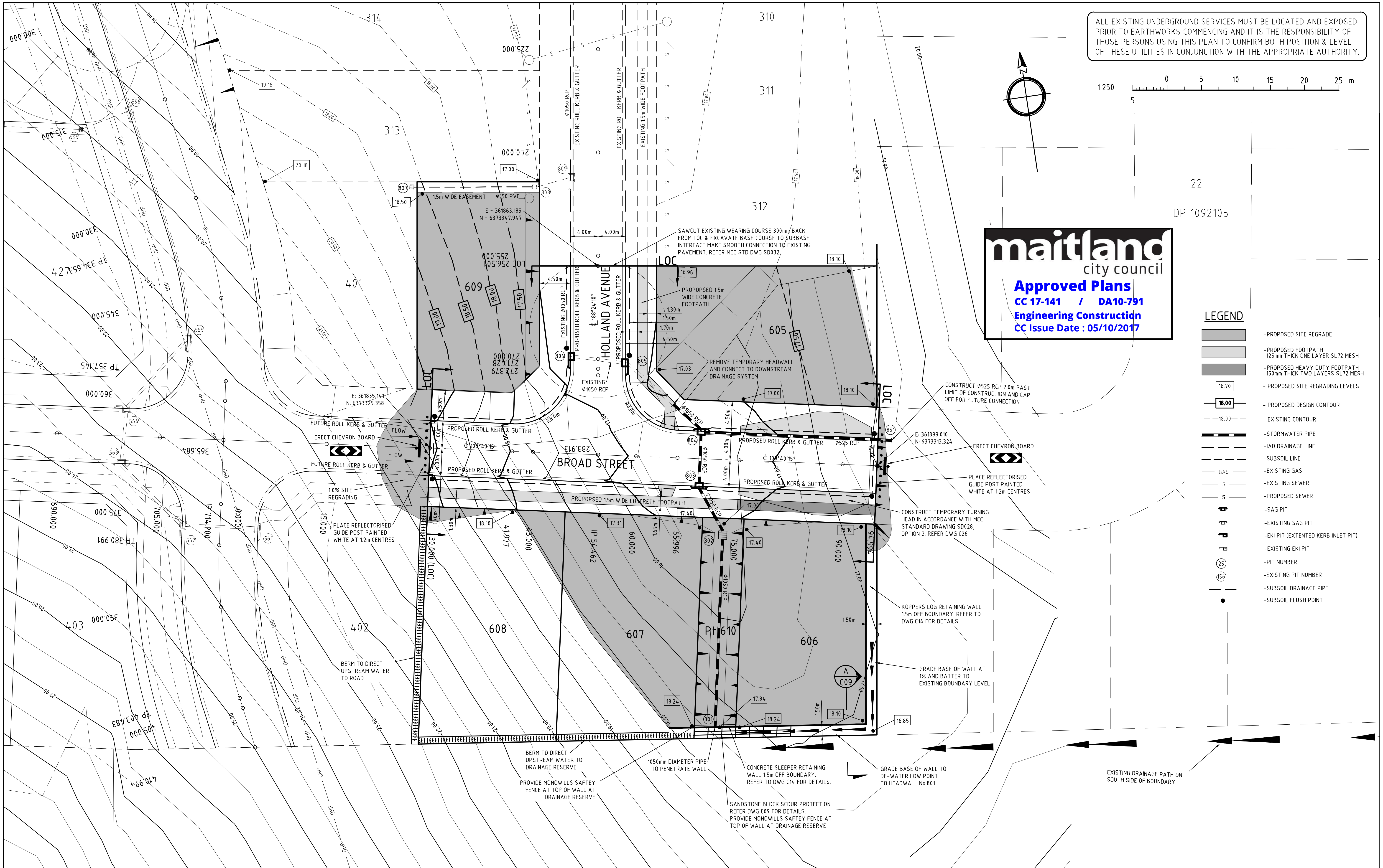
PROPOSED SUBDIVISION - STAGE 6
AUBURN STREET GILLIESTON HEIGHTS
GILLIESTON GROVE

PLAN SHEET (1 OF2)

Project No	
16628C	
Drawing No	Revision
C02	6

PLOT DATE: 28/08/2017 12:19:26 PM CAD FILE: Q:\16\16628 Gillieston Grove - Stage 6\02_CAD\AutoCAD\Civil\16628C dC02r6.dwg



Amendment	Description	Drawn	App'd	Date
5	COUNCIL COMMENTS	P.K	S.H	27.06.17
4	COUNCIL COMMENTS - REV 2	K.S	S.H	05.06.17
3	COUNCIL COMMENTS	P.K	S.H	30.03.17
2	GENERAL AMENDMENTS	P.K	S.H	17.01.17
1	ORIGINAL ISSUE	P.K	S.H	06.12.16

Designed: SH
Cad Reference: 16628C dC03r5
Scale: 1:250
A1 SHEET
Project Approval: IAN HILL (B.E) Consulting Civil Engineer

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PROPOSED SUBDIVISION - STAGE 6
AUBURN STREET GILLIESTON HEIGHTS
GILLIESTON GROVE

PLAN SHEET (2 OF2)

Project No: 16628C
Drawing No: C03
Revision: 5

PLOT DATE: 28/08/2017 12:19:29 PM   CAD FILE: Q:\16\16628 Gillieston Grove - Stage 6\02__CAD\AutoCAD\Civil\16628C dC03r5.dwg

maitland city council

Approved Plans
CC 17-141 / DA10-791
Engineering Construction
CC Issue Date : 05/10/2017

LEGEND:

- SUB CATCHMENT BOUNDARY
- Q_{100} =0.01 — Q_{100} PIT BYPASS (m^3/s)
- (6) — PIT NUMBER
- (9) — FUTURE/EXISTING PIT NUMBER

NOTES:

1. ALL NOMINATED EKI LINTEL LENGTHS ARE OVERALL (EXTERNAL) LENGTHS
2. ALL KERB INLET PITS TO BE CAST IN-SITU IN ACCORDANCE WITH COUNCILS STANDARD REQUIREMENTS.
3. ALL IAD PIT DEEPER THAN 1.2m ARE TO BE CONSTRUCTED WITH STEP IRONS IN ACCORDANCE WITH DEPARTMENT OF HOUSING STANDARD DRAWING RM3.
4. ALL IAD PITS DEEPER THAN 0.9m ARE TO BE CONSTRUCTED WITH INTERNAL DIMENSIONS IN ACCORDANCE WITH AS3500.3-2003 TABLE 8.2.

DRAINAGE PIT SCHEDULE

PIT No.	ROAD	CHAINAGE	PIT DETAILS
4	LOT Pt 133	-	GSIP
5	LOT Pt 610	-	GSIP
5A	BROAD STREET	171.329	2400 SAG
5B	BROAD STREET	170.547	2400 SAG
5C	LOT Pt 610	-	JUNCTION BOX
5D	LOT 604	-	IAD PIT
5E	LOT 603	-	IAD PIT
6	LOT Pt 323	-	GSIP
801	LOT Pt 610	-	HEADWALL
802	LOT Pt 610	-	GSIP
803	BROAD STREET	69.287	2400 SAG
804	BROAD STREET	69.287	2400 SAG
805	HOLLAND AVENUE	270.568	2400 EKI
806	HOLLAND AVENUE	269.628	2400 EKI
807	LOT 401	-	IAD PIT
851	BROAD STREET	-	CAP

1:1000 0 20 40 60 80 100 m (20)

ALL EXISTING UNDERGROUND SERVICES MUST BE LOCATED AND EXPOSED PRIOR TO EARTHWORKS COMMENCING AND IT IS THE RESPONSIBILITY OF THOSE PERSONS USING THIS PLAN TO CONFIRM BOTH POSITION & LEVEL OF THESE UTILITIES IN CONJUNCTION WITH THE APPROPRIATE AUTHORITY.

Amendment	Description	Drawn	App'd	Date
4	COUNCIL COMMENTS - REV 2	K.S	S.H	05.06.17
3	COUNCIL COMMENTS	P.K	S.H	30.03.17
2	GENERAL AMENDMENTS	P.K	S.H	17.01.17
1	ORIGINAL ISSUE	P.K	S.H	07.12.16

Designed	Cad Reference
SH	16628C dC11r4
Scale 1:1000	A1 SHEET
Project Approval IAN HILL (B.E) Consulting Civil Engineer	

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PROPOSED SUBDIVISION - STAGE 6
AUBURN STREET GILLIESTON HEIGHTS
GILLIESTON GROVE
CATCHMENT PLAN

Project No	
16628C	
Drawing No	Revision
C11	4

PLOT DATE: 28/08/2017 12:19:41 PM CAD FILE: Q:\16\16628 Gillieston Grove - Stage 6\02_CAD\AutoCAD\Civil\16628C dC11r4.dwg

Q_{10} DRAINAGE CALCULATION SHEET

Overland flow

PIT	ARI	Area 4	Runoff Coefficient 4	length 4	slope 4	Surface Roughness 4	Area 5	Runoff Coefficient 5	length 5	slope 5	Surface Roughness 5	Area 6	Runoff Coefficient 6	length 6	slope 6	Surface Roughness 6	Gutter area 7	Runoff Coefficient 7	length 7	slope 7	Surface Roughness 7
	yrs	Ha		m	%		Ha		m	%		Ha		m	%		Ha		m	%	
801	10	22.922	0.400	450.0	5.8	0.100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
802	10	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
803	10	0.157	0.400	60.0	14.0	0.100	0.120	0.899	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.086	0.817	70.0	10.0	0.011
851	10	1.849	0.705	100.0	8.0	0.060	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
804	10	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.031	0.817	25.0	4.8	0.011
805	10	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.008	0.817	0.0	0.0	0.100
806	10	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.048	0.817	50.0	10.0	0.011
807	10	-	0.000	-	0.0	0.000	0.030	0.899	0.0	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
808	10	-	0.000	-	0.0	0.000	0.030	0.899	0.0	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
809	10	0.033	0.400	40.0	10.0	0.100	-	0.500	-	0.0	0.000	-	0.000	-	0.0	0.000	0.022	0.817	25.0	1.0	0.011
810	10	0.089	0.400	40.0	5.0	0.100	0.090	0.899	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.051	0.817	60.0	1.0	0.011
811	10	0.122	0.400	55.0	6.5	0.100	0.060	0.899	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.034	0.817	40.0	1.0	0.011
812	10	0.096	0.400	40.0	5.0	0.100	0.120	0.899	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.057	0.817	65.0	1.0	0.011
813	10	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.056	0.817	65.0	1.0	0.011
814	10	0.279	0.400	60.0	8.0	0.100	0.180	0.899	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.128	0.817	85.0	3.0	0.011
815	10	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.114	0.817	80.0	3.0	0.011
816	10	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
1H	10	0.531	0.705	110.0	5.0	0.100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
1	10	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.045	0.817	36.0	2.0	0.011
2	10	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.817	-	2.0	0.011
3	10	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
4	10	-	0.000	-	0.0	0.000	-	0.700	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
5	10	-	0.000	-	0.0	0.000	-	0.700	-	0.0	0.000	-	0.500	-	0.0	0.000	-	0.500	-	0.0	0.000
5A	10	3.110	0.400	270.0	5.0	0.100	0.580	0.705	100.0	8.0	0.060	0.060	0.899	-	0.0	0.000	0.089	0.817	60.0	3.0	0.011
5B	10	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.063	0.817	55.0	3.0	0.011
5C	10	-	0.000	0.0	0.0	0.000	-	0.000	0.0	0.0	0.000	-	0.000	0.0	0.0	0.000	-	0.000	0.0	0.0	0.000
5D	10	-	0.000	-	0.0	0.000	0.030	0.899	0.0	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
5E	10	-	0.000	-	0.0	0.000	0.030	0.899	0.0	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
6	2	4.060	0.293	250.0	8.0	0.100	1.080	0.600	115.0	6.0	0.060	-	0.000	-	0.0	0.000	-	0.425	-	0.0	0.000

Sub-catchment / Inlet design

PIT	Time of conc.	Intensity	Area	C×Area	O/land Flow	Total gutter	Eff gutter	Width	depth	Velocity	Total inflow	Flow into Pit	Bypass	Bypass Pit
	mins	mm/hr	Ha	Ha	L/s	L/s	L/s	m	mm	m/s	L/s	L/s	L/s	
801	30.32	64	22.922	9.160	1628	2280	1628	6.090	264	2.043	1628	1628	0	802
802	6.00	135	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	803
803	12.87	98	0.363	0.241	65	91	65	1.526	93	1.053	65	65	0	804
851	6.10	135	1.849	1.304	489	685	489	5.139	183	1.563	489	489	0	804
804	6.00	135	0.031	0.025	9	13	9	0.403	36	1.321	9	9	0	805
805	6.00	135	0.008	0.007	2	3	2	0.328	29	0.515	2	2	0	810
806	6.00	135	0.048	0.039	15	21	15	0.576	46	1.203	15	15	0	809
807	6.00	135	0.030	0.027	10	14	10	0.637	49	0.719	10	10	0	808
808	6.00	135	0.030	0.027	10	14	10	0.637	49	0.719	10	10	0	809
809	6.00	135	0.055	0.031	12	16	12	0.690	52	0.740	12	12	0	811
810	13.24	96	0.230	0.158	42	59	42	1.270	81	0.957	42	42	0	812
811	13.76	94	0.216	0.130	34	48	34	1.158	75	0.916	34	34	0	813
812	13.28	96	0.273	0.193	51	72	51	1.382	86	0.999	51	51	0	814
813	6.00	135	0.056	0.046	17	24	17	0.840	59	0.796	17	17	0	815
814	14.17	93	0.587	0.378	98	137	98	1.801	107	1.154	98	98	0	815
815	6.00	135	0.114	0.093	35	49	35	0.909	63	1.424	35	35	0	816
816	6.00	135	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	
1H	10.96	110	0.531	0.375	114	330	174	2.552	145	1.419	236	174	62	1
1	6.00	135	0.045	0.037	14	106	76	1.623	98	1.089	76	76	0	2
2	6.00	135	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	3
3	6.00	135	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	4
4	6.00	135	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	5
5	6.00	135	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	5A
5A	20.00	79	3.839	1.779	390	546	390	4.270	171	1.533	390	390	0	5B
5B	6.00	135	0.063	0.051	19	27	19	0.890	62	0.815	19	19	0	5C
5C	6.00	135	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	6
5D	6.00	135	0.030	0.027	10	14	10	0.637	49	0.719	10	10	0	5E
5E	6.00	135	0.030	0.027	10	14	10	0.637	49	0.719	10	10	0	6
6	6.00	92	5.140	1.837	469	657	469	4.978	181	1.558	469	469	0	6B

Total catchment / Design

PIT	Time of conc	Intensity	Sum C×A	Cumulative Flow	Num. Pipes	Pipe Class	Nom Diam	Pipe Length	Pipe Grade	HGL Grade	Manning's n	Roughness
	mins	mm/Hr	Ha	L/s			mm	m	%	%		mm
801	30.32	64	9.160	1628	1	3	1050	32.0	4.70	0.1	0.011	0.300
802	30.86	64	9.160	1628	1	3	1050	6.6	1.00	0.2	0.011	0.300
803	30.97	64	9.401	1671	1	3	1050	8.0	1.01	0.3	0.011	0.300
851	6.10	135	1.304	489	1	3	525	27.1	4.64	0.6	0.011	0.300
804	31.10	63	10.730	1869	1	3	1050	14.8	1.00	0.3	0.011	0.300
805	31.35	62	10.737	1862	1	3	1050	8.1	1.01	0.3	0.011	0.300
806	31.48	62	10.776	1864	1	3	1050	26.0	1.02	0.2	0.011	0.300
807	6.00	135	0.027	10	1	P	150	17.8	8.71	0.2	0.009	0.012
808	6.30	135	0.054	20	1	P	150	5.4	39.63	0.9	0.009	0.120
809	31.91	62	10.861	1865	1	3	1050	40.5	1.00	0.2	0.011	0.300
810	13.24	96	0.158	42	1	3	375	10.7	12.48	0.0	0.011	0.300
811	32.59	61	11.150	1892	1	3	1050	65.6	1.09	0.3	0.011	0.300
812	13.28	96	0.193	51	1	3	375	9.5	14.38	0.1	0.011	0.300
813	33.68	60	11.388	1897	1	3	1050	78.4	1.00	0.3	0.011	0.300
814	14.17	93	0.378	98	1	3	375	8.0	11.95	0.2	0.011	0.300
815	34.99	59	11.859	1933	1	3	1050	6.9	0.64	0.3	0.011	0.300
816	35.10	59	11.859	1930	1	3	1200	-	0.00	0.0	0.011	0.300
1H	18.87	81	2.932	661	1	2	600	8.0	4.00	0.6	0.011	0.300
1	19.00	81	2.968	668	1	2	675	9.9	6.48	0.4	0.011	0.300
2	19.17	81	2.968	665	1	2	675	10.6	7.33	0.4	0.011	0.300
3	19.34	80	2.968	662	1	2	675	19.3	6.95	0.4	0.011	0.300
4	19.67	80	2.968	657	1	2	675	28.6	9.70	0.4	0.011	0.300
5	20.14	79	2.968	651	1	2	675	7.0	4.77	0.4	0.011	0.300
5A	20.00	79	4.747	1042	1	3	675	8.0	7.63	0.9	0.011	0.300
5B	20.79	79	4.798	1053	1	2	675	10.5	4.46	0.9	0.011	0.300
5C	20.96	79	4.798	1053	1	2	675	32.9	3.00	0.9	0.011	0.300
5D	6.00	135	0.027	10	1	P	150	14.1	3.54	0.2	0.009	0.012
5E	6.23	135	0.054	20	1	P	150	8.2	21.59	0.8	0.009	0.012
6	6.00	92	5.965	1524	1	2	1050	43.5	7.07	0.2	0.011	0.300

Head Loss & Partial Flow / Remarks / Hydraulic check

PIT	Surcharge	HGL grade (Backwater)	Q/A	K factor	Pipe vel (Colebrook & White)	Part depth (Colebrook & White)	Capacity (Colebrook & White)	Pipe vel (Manning's)	Part depth (Manning's)	Remarks	D/S HGL.BW.	Pit loss	Pipe loss	Total loss	U/S HGL	Gutter level (N/S)
		%	m/s		m/s	m	L/s	m/s	m		m	m	m	m	m	m
801		0.1	1.176	3.00	5.941	0.269	7528	5.944	0.269		16.710	0.212	0.033	0.244	17.778	17.840
802		0.2	1.824	1.31	3.719	0.525	3340	3.735	0.523		16.472	0.222	0.016	0.238	16.710	17.000
803		0.3	1.871	0.69	3.750	0.532	3349	3.767	0.530		16.329	0.123	0.020	0.143	16.472	16.623
851		0.6	1.866	3.78	4.838	0.219	1187	4.712	0.223		16.329	0.671	0.159	0.830	17.205	18.000
804		0.3	2.092	1.20	3.846	0.570	3340	3.863	0.567		16.015	0.267	0.047	0.313	16.329	16.623
805		0.3	2.086	0.46	3.852	0.568	3349	3.869	0.566		15.888	0.102	0.025	0.127	16.015	16.726
806		0.2	1.774	1.92	3.721	0.513	3375	3.737	0.512		15.412	0.307	0.059	0.367	15.888	16.721
807		0.2	0.573	7.40	2.973	0.037	76	2.672	0.040		16.790	0.124	0.039	0.163	18.222	18.550
808		0.9	1.145	3.62	5.601	0.039	139	5.590	0.039		15.412	0.242	0.050	0.292	16.790	17.000
809		0.2	1.790	0.59	3.700	0.519	3340	3.716	0.517		15.211	0.096	0.094	0.191	15.412	16.525
810		0.0	0.371	7.40	3.736	0.059	806	3.596	0.061		15.211	0.052	0.004	0.056	15.611	16.191
811		0.3	2.120	1.31	3.987	0.560	3487	4.003	0.557		14.332	0.300	0.213	0.513	15.211	16.120
812		0.1	0.451	7.40	4.162	0.063	866	4.006	0.065		14.332	0.077	0.005	0.082	14.961	15.516
813		0.3	2.125	0.59	3.860	0.575	3340	3.882	0.572		13.833	0.136	0.256	0.392	14.332	15.464
814		0.2	0.858	5.93	4.710	0.091	789	4.529	0.093		13.833	0.222	0.016	0.237	14.071	14.686
815		0.3	2.166	1.77	3.257	0.673	2667	3.275	0.669		13.366	0.423	0.023	0.447	13.833	14.686
816		0.0	0.000	0.00	0.000	0.000	0	0.000	0.000		0.000	0.000	0.000	0.000	0.000	13.800
1H		0.6	2.051	1.21	4.988	0.262	1561	4.885	0.267		23.233	0.259	0.048	0.307	23.659	24.150
1		0.4	1.817	0.47	6.064	0.232	2695	5.962	0.236		22.511	0.079	0.040	0.119	23.233	23.902
2		0.4	1.805	-0.03	6.327	0.224	2866	6.222	0.227		21.795	-0.004	0.043	0.039	22.511	23.630
3		0.4	1.803	0.35	6.204	0.227	2789	6.100	0.230		20.390	0.058	0.078	0.136	21.795	22.390
4		0.4	1.778	-0.05	6.976	0.207	3299	6.850	0.210		17.619	-0.008	0.112	0.105	20.390	21.050
5		0.4	1.765	-0.03	5.385	0.249	2310	5.293	0.252		17.367	-0.005	0.027	0.022	17.619	18.473
5A		0.9	2.729	0.20	7.196	0.277	2923	7.067	0.281		16.756	0.076	0.074	0.150	17.367	17.944
5B		0.9	2.761	0.20	5.916	0.325	2232	5.814	0.329		16.212	0.078	0.098	0.176	16.756	17.944
5C		0.9	2.763	0.00	5.097	0.365	1830	5.012	0.370		15.781	0.000	0.309	0.309	16.212	17.195
5D		0.2	0.572	2.70	2.106	0.047	47	1.934	0.050		16.768	0.045	0.031	0.076	16.995	17.500
5E		0.8	1.142	4.75	5.112	0.041	122	4.497	0.045		15.781	0.316	0.062	0.378	16.768	17.950
6		0.2	1.671	1.23	7.418	0.295	8924	7.419	0.294		12.730	0.175	0.088	0.264	15.781	16.500

EXISTING CONSTRUCTION

EXISTING CONSTRUCTION

Q_2 DRAINAGE CALCULATION SHEET

Overland flow

PIT	ARI	Area 4	Runoff Coefficient 4	length 4	slope 4	Surface Roughness 4	Area 5	Runoff Coefficient 5	length 5	slope 5	Surface Roughness 5	Area 6	Runoff Coefficient 6	length 6	slope 6	Surface Roughness 6	Gutter area 7	Runoff Coefficient 7	length 7	slope 7	Surface Roughness 7
	yrs	Ha		m	%		Ha		m	%		Ha		m	%		Ha		m	%	
801	2	22.922	0.600	450.0	5.8	0.100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
802	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
803	2	0.157	0.340	60.0	14.0	0.100	0.120	0.765	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.086	0.694	70.0	10.0	0.011
851	2	1.849	0.600	100.0	8.0	0.060	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
804	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.031	0.694	25.0	4.8	0.011
805	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.008	0.694	0.0	0.0	0.100
806	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.048	0.694	50.0	10.0	0.011
807	2	-	0.000	-	0.0	0.000	0.030	0.765	0.0	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
808	2	-	0.000	-	0.0	0.000	0.030	0.765	0.0	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
809	2	0.033	0.340	40.0	10.0	0.100	-	0.425	-	0.0	0.000	-	0.000	-	0.0	0.000	0.022	0.694	25.0	1.0	0.011
810	2	0.089	0.340	40.0	5.0	0.100	0.090	0.765	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.051	0.694	60.0	1.0	0.011
811	2	0.122	0.340	55.0	6.5	0.100	0.060	0.765	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.034	0.694	40.0	1.0	0.011
812	2	0.096	0.340	40.0	5.0	0.100	0.120	0.765	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.057	0.694	65.0	1.0	0.011
813	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.056	0.694	65.0	1.0	0.011
814	2	0.279	0.340	60.0	8.0	0.100	0.180	0.765	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.128	0.694	85.0	3.0	0.011
815	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.114	0.694	80.0	3.0	0.011
816	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
1H	2	0.531	0.600	110.0	5.0	0.100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
1	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.045	0.694	36.0	2.0	0.011
2	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.694	-	2.0	0.011
3	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
4	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
5	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
5A	2	3.110	0.600	270.0	5.0	0.100	0.580	0.600	100.0	8.0	0.060	0.060	0.765	-	0.0	0.000	0.089	0.694	60.0	3.0	0.011
5B	2	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.063	0.694	55.0	3.0	0.011
5C	2	-	0.000	0.0	0.0	0.000	-	0.000	0.0	0.0	0.000	-	0.000	0.0	0.0	0.000	-	0.000	0.0	0.0	0.000
5D	2	-	0.000	-	0.0	0.000	0.030	0.765	0.0	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
5E	2	-	0.000	-	0.0	0.000	0.030	0.765	0.0	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000
6	2	4.060	0.600	250.0	8.0	0.100	1.080	0.600	115.0	6.0	0.060	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000

Sub-catchment / Inlet design

PIT	Time of conc.	Intensity	Area	C×Area	O/land Flow	Total gutter	Eff gutter	Width	depth	Velocity	Total inflow	Flow into Pit	Bypass	Bypass Pit
	mins	mm/hr	Ha	Ha	L/s	L/s	L/s	m	mm	m/s	L/s	L/s	L/s	
801	36.86	39	22.922	13.744	1500	2100	1500	6.090	257	1.988	1500	1500	0	802
802	6.00	92	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	803
803	14.08	64	0.363	0.205	36	51	36	1.188	77	0.927	36	36	0	804
851	7.34	85	1.849	1.109	261	366	261	2.656	150	1.454	261	261	0	804
804	6.00	92	0.031	0.022	5	8	5	0.329	29	1.152	5	5	0	805
805	6.00	92	0.008	0.006	1	2	1	0.268	24	0.449	1	1	0	810
806	6.00	92	0.048	0.033	9	12	9	0.426	38	1.061	9	9	0	809
807	6.00	92	0.030	0.023	6	8	6	0.457	40	0.640	6	6	0	808
808	6.00	92	0.030	0.023	6	8	6	0.457	40	0.640	6	6	0	809
809	6.00	92	0.055	0.026	7	9	7	0.501	42	0.662	7	7	0	811
810	14.53	63	0.230	0.134	23	33	23	0.976	66	0.847	23	23	0	812
811	15.16	62	0.216	0.111	19	27	19	0.882	61	0.812	19	19	0	813
812	14.57	63	0.273	0.164	29	40	29	1.068	71	0.882	29	29	0	814
813	6.00	92	0.056	0.039	10	14	10	0.637	49	0.717	10	10	0	815
814	15.64	61	0.587	0.321	54	76	54	1.411	88	1.010	54	54	0	815
815	6.00	92	0.114	0.079	20	28	20	0.689	52	1.281	20	20	0	816
816	6.00	92	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	
1H	13.53	65	0.531	0.318	57	141	101	1.823	108	1.162	101	101	0	1
1	6.00	92	0.045	0.031	8	11	8	0.556	45	0.686	8	8	0	2
2	6.00	92	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	3
3	6.00	92	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	4
4	6.00	92	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	5
5	6.00	92	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	5A
5A	20.00	54	3.839	2.320	348	487	348	3.835	165	1.516	348	348	0	5B
5B	6.00	92	0.063	0.044	11	16	11	0.673	51	0.733	11	11	0	5C
5C	6.00	92	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	6
5D	6.00	92	0.030	0.023	6	8	6	0.457	40	0.640	6	6	0	5E
5E	6.00	92	0.030	0.023	6	8	6	0.457	40	0.640	6	6	0	6
6	6.00	92	5.140	3.082	788	1103	788	6.090	211	1.661	788	788	0	6B

Total catchment / Design

PIT	Time of conc	Intensity	Sum C×A	Cumulative Flow	Num. Pipes	Pipe Class	Nom Diam	Pipe Length	Pipe Grade	HGL Grade	Manning's n	Roughness
	mins	mm/Hr	Ha	L/s			mm	m	%	%		mm
801	36.86	39	13.744	1500	1	3	1050	32.0	4.70	-	0.011	0.300
802	37.39	39	13.744	1488	1	3	1050	6.6	1.00	5.1	0.011	0.300
803	37.50	39	13.949	1508	1	3	1050	8.0	1.01	0.5	0.011	0.300
851	7.34	85	1.109	261	1	3	525	27.1	4.64	2.1	0.011	0.300
804	37.63	39	15.079	1627	1	3	1050	14.8	1.00	0.8	0.011	0.300
805	37.88	39	15.084	1621	1	3	1050	8.1	1.01	0.6	0.011	0.300
806	38.01	39	15.118	1622	1	3	1050	26.0	1.02	0.2	0.011	0.300
807	6.00	92	0.023	6	1	P	150	17.8	8.71	0.7	0.009	0.012
808	6.30	92	0.046	12	1	P	150	5.4	39.63	3.9	0.009	0.120
809	38.45	38	15.190	1619	1	3	1050	40.5	1.00	0.2	0.011	0.300
810	14.53	63	0.134	23	1	3	375	10.7	12.48	0.4	0.011	0.300
811	39.12	38	15.435	1629	1	3	1050	65.6	1.09	0.4	0.011	0.300
812	14.57	63	0.164	29	1	3	375	9.5	14.38	0.6	0.011	0.300
813	40.22	37	15.638	1625	1	3	1050	78.4	1.00	0.4	0.011	0.300
814	15.64	61	0.321	54	1	3	375	8.0	11.95	2.1	0.011	0.300
815	41.52	37	16.038	1637	1	3	1050	6.9	0.64	2.1	0.011	0.300
816	41.64	37	16.038	1635	1	3	1200	-	0.00	0.0	0.011	0.300
1H	22.04	51	2.492	356	1	2	600	8.0	4.00	0.8	0.011	0.300
1	22.17	51	2.523	359	1	2	675	9.9	6.48	1.0	0.011	0.300
2	22.33	51	2.523	358	1	2	675	10.6	7.33	0.4	0.011	0.300
3	22.51	51	2.523	357	1	2	675	19.3	6.95	0.6	0.011	0.300
4	22.83	51	2.523	354	1	2	675	28.6	9.70	0.4	0.011	0.300
5	23.31	50	2.523	351	1	2	675	7.0	4.77	0.3	0.011	0.300
5A	20.00	54	4.843	726	1	3	675	8.0	7.63	1.4	0.011	0.300
5B	23.56	50	4.887	675	1	2	675	10.5	4.46	1.4	0.011	0.300
5C	23.73	50	4.887	673	1	2	675	32.9	3.00	0.9	0.011	0.300
5D	6.00	92	0.023	6	1	P	150	14.1	3.54	0.4	0.009	0.012
5E	6.23	92	0.046	12	1	P	150	8.2	21.59	3.3	0.009	0.012
6	6.00	92	8.015	2048	1	2	1050	43.5	7.07	-	0.011	0.300

Head Loss & Partial Flow / Remarks / Hydraulic check

PIT	Surcharge	HGL grade (Backwater)	Q/A	K factor	Pipe vel (Colebrook & White)	Part depth (Colebrook & White)	Capacity (Colebrook & White)	Pipe vel (Manning's)	Part depth (Manning's)	Remarks	D/S HGL.BW.	Pit loss	Pipe loss	Total loss	U/S HGL	Gutter level (N/S)
		%	m/s		m/s	m	L/s	m/s	m		m	m	m	m	m	m
801		0.2	1.680	3.00	6.578	0.323	7528	6.583	0.322		16.553	0.432	0.066	0.497	17.998	17.840
802		0.2	1.666	1.31	3.633	0.498	3340	3.649	0.496		16.355	0.185	0.013	0.198	16.553	17.000
803		0.2	1.692	0.69	3.655	0.502	3349	3.671	0.500		16.238	0.100	0.017	0.117	16.355	16.623
851		0.2	1.167	3.78	4.251	0.170	1187	4.141	0.173		16.238	0.262	0.063	0.325	16.796	18.000
804		0.2	1.821	1.20	3.717	0.525	3340	3.734	0.523		16.000	0.202	0.036	0.238	16.238	16.623
805		0.2	1.815	0.46	3.722	0.523	3349	3.738	0.521		15.904	0.077	0.019	0.096	16.000	16.726
806		0.2	1.818	1.92	3.744	0.521	3375	3.760	0.519		15.415	0.323	0.062	0.385	15.904	16.721
807		0.1	0.331	7.40	2.536	0.028	76	2.280	0.030		16.629	0.041	0.015	0.056	18.140	18.550
808		0.3	0.662	3.62	4.776	0.029	139	4.767	0.029		15.415	0.081	0.018	0.098	16.629	17.000
809		0.2	1.813	0.59	3.713	0.523	3340	3.729	0.521		15.133	0.099	0.097	0.196	15.415	16.525
810		0.0	0.205	7.40	3.132	0.045	806	3.010	0.046		15.133	0.016	0.001	0.017	15.575	16.191
811		0.2	1.824	1.31	3.841	0.512	3487	3.856	0.510		14.296	0.222	0.158	0.381	15.133	16.120
812		0.0	0.250	7.40	3.495	0.047	866	3.361	0.049		14.296	0.024	0.002	0.025	14.908	15.516
813		0.2	1.821	0.59	3.721	0.524	3345	3.737	0.522		13.713	0.100	0.189	0.289	14.296	15.464
814		0.1	0.474	5.93	3.960	0.068	789	3.810	0.069		13.713	0.068	0.005	0.073	13.786	14.686
815		0.2	1.833	1.77	3.139	0.603	2667	3.157	0.601		13.366	0.303	0.017	0.320	13.713	14.686
816		0.0	0.000	0.00	0.000	0.000	0	0.000	0.000		0.000	0.000	0.000	0.000	0.000	13.800
1H		0.2	1.216	1.21	4.326	0.198	1561	4.237	0.201		23.177	0.091	0.017	0.108	23.491	24.150
1		0.1	0.978	0.47	5.087	0.169	2695	4.998	0.171		22.514	0.023	0.012	0.035	23.177	23.902
2		0.1	0.972	-0.03	5.306	0.164	2866	5.212	0.165		21.754	-0.001	0.013	0.012	22.514	23.630
3		0.1	0.970	0.35	5.202	0.166	2789	5.110	0.167		20.395	0.017	0.023	0.040	21.754	22.390
4		0.1	0.960	-0.05	5.842	0.151	3299	5.738	0.153		17.623	-0.002	0.034	0.031	20.395	21.050
5		0.1	0.949	-0.03	4.520	0.180	2310	4.446	0.182		17.331	-0.001	0.008	0.007	17.623	18.473
5A		0.5	1.971	0.20	6.582	0.233	2923	6.466	0.236		16.712	0.040	0.039	0.078	17.331	17.944
5B		0.4	1.829	0.20	5.303	0.258	2232	5.215	0.261		16.212	0.034	0.043	0.078	16.712	17.944
5C		0.4	1.832	0.00	4.589	0.288	1830	4.514	0.291		15.937	0.000	0.137	0.137	16.212	17.195
5D		0.1	0.332	2.70	1.802	0.036	47	1.657	0.038		16.558	0.015	0.012	0.027	16.965	17.500
5E		0.3	0.661	4.75	4.364	0.031	122	3.843	0.034		15.937	0.106	0.023	0.129	16.558	17.950
6		0.4	2.294	1.23	8.115	0.347	8924	8.116	0.347		12.607	0.331	0.165	0.496	15.937	16.500

EXISTING CONSTRUCTION

EXISTING CONSTRUCTION

Amendment	Description	Drawn	App'd	Date
5	COUNCIL COMMENTS	P.K	S.H	27.06.17
4	COUNCIL COMMENTS - REV 2	K.S	S.H	05.06.17
3	NOT ISSUED			
2	NOT ISSUED			
1	NOT ISSUED			

Designed: KS
Cad Reference: 16628C dC13Ar5
Scale: A1 SHEET
Project Approval: IAN HILL (B.E) Consulting Civil Engineer

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PROPOSED SUBDIVISION - STAGE 6
AUBURN STREET GILLIESTON HEIGHTS
GILLIESTON GROVE
DRAINAGE CALCULATION SHEET (1 OF 2)

Project No: 16628C
Drawing No: C13A
Revision: 5

Q_{100} DRAINAGE CALCULATION SHEET

PIT	ARI	Overland flow																					Sub-catchment					Inlet design									Total catchment				Design										Head Loss & Partial Flow									Remarks	Hydraulic check						
		Area 4	Runoff Coefficient 4	length 4	slope 4	Surface Roughness 4	Area 5	Runoff Coefficient 5	length 5	slope 5	Surface Roughness 5	Area 6	Runoff Coefficient 6	length 6	slope 6	Surface Roughness 6	Gutter area 7	Runoff Coefficient 7	length 7	slope 7	Surface Roughness 7	Time of conc.	Intensity	Area	CxArea	Q/land Flow	Total gutter	Eff gutter	Width	depth	Velocity	Total inflow	Flow into Pit	Bypass	Bypass Pit	Time of conc	Intensity	Sum CxA	Cumulative Flow	Num. Pipes	Pipe Class	Nom Diam	Pipe Length	Pipe Grade	HGL Grade	Manning's n	Roughness	Surcharge	HGL grade (Backwater)	Q/A	K factor	Pipe vel (Colebrook & White)	Part depth (Colebrook & White)	Capacity (Colebrook & White)	Pipe vel (Manning's)	Part depth (Manning's)		D/S HGL BW.	Pit loss	Pipe loss	Total loss	U/S HGL	Gutter level (N/S)
	yrs	Ha		m	%		Ha		m	%		Ha		m	%		Ha		m	%		mins	mm/hr	Ha	Ha	L/s	L/s	L/s	m	mm	m/s	L/s	L/s	L/s		mins	mm/Hr	Ha	L/s			mm	m	%	%		mm			%	m/s		m/s		L/s	m/s			m	m	m	m	m	m
801	100	22.922	0.846	450.0	5.8	0.100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000		24.63	108	22.922	19.403	5798	8117	5798	6.090	425	3.260	5798	5798	0	802	24.63	108	19.403	5798	1	3	1050	32.0	4.70	-	0.011	0.300	X	3.0	6.492	3.00	8.543	0.757	6788	8.556	0.756		16.850	12.451	0.956	13.406	30.256	17.840
802	100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000		6.00	206	0.000	0.000	0	0	0	0.000	0	0.000	0	0	0	803	25.17	106	19.403	5733	1	3	1050	6.6	1.00	-	0.011	0.300	X	2.9	6.423	1.31	6.423	1.066	3340	3.765	1.066		16.473	1.922	0.194	2.116	18.589	17.000
803	100	0.157	0.480	60.0	14.0	0.100	0.120	1.000	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.086	0.980	70.0	10.0	0.011	11.68	155	0.363	0.280	120	169	120	1.958	115	1.211	120	120	0	804	25.28	106	19.683	5802	1	3	1050	8.0	1.01	1.0	0.011	0.300	X	1.0	3.753	0.69	3.753	1.066	3349	4.304	0.868		16.473	0.494	0.000	0.494	16.967	16.623
851	100	1.849	0.846	100.0	8.0	0.060	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000		6.00	206	1.849	1.565	896	1254	896	6.090	219	1.710	896	896	0	804	6.00	206	1.565	896	1	3	525	27.1	4.64	-	0.011	0.300	X	2.6	3.997	2.83	5.823	0.346	1187	5.656	0.355		16.473	2.306	0.717	3.024	19.497	18.000
804	100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.031	0.980	25.0	4.8	0.011	6.00	206	0.031	0.030	17	24	17	0.547	45	1.526	17	17	0	805	25.41	106	21.278	6255	1	3	1050	14.8	1.00	-	0.011	0.300	X	0.8	3.298	1.20	4.223	0.777	3340	4.245	0.773		16.576	0.663	-	0.560	17.136	16.623
805	100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.008	0.980	0.0	0.0	0.100	6.00	206	0.008	0.008	4	6	4	0.412	36	0.599	4	4	0	810	25.66	105	21.286	6226	1	3	1050	8.1	1.01	1.0	0.011	0.300	X	1.0	3.753	0.46	3.754	1.066	3349	4.304	0.868		16.571	0.329	0.005	0.334	16.905	16.726
806	100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.048	0.980	50.0	10.0	0.011	6.00	206	0.048	0.047	27	38	27	0.800	57	1.353	27	27	0	809	25.79	105	21.333	6222	1	3	1050	26.0	1.02	-	0.011	0.300	X	0.7	3.193	1.90	4.240	0.751	3375	4.261	0.748		16.375	0.989	0.189	1.178	17.553	16.721
807	100	-	0.000	-	0.0	0.000	0.030	1.000	0.0	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000		6.00	206	0.030	0.030	17	24	17	0.840	59	0.797	17	17	0	808	6.00	206	0.030	17	1	P	150	17.8	8.71	-	0.009	0.012		0.6	0.971	3.19	3.459	0.049	76	3.102	0.053		16.850	0.153	0.101	0.254	18.252	18.550
808	100	-	0.000	-	0.0	0.000	0.030	1.000	0.0	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000		6.00	206	0.030	0.030	17	24	17	0.840	59	0.797	17	17	0	809	6.30	206	0.060	34	1	P	150	5.4	39.63	-	0.009	0.120	X	2.6	1.942	3.62	6.507	0.051	139	6.494	0.051		16.375	0.695	0.138	0.833	17.243	17.000
809	100	0.033	0.480	40.0	10.0	0.100	-	0.600	-	0.0	0.000	-	0.000	-	0.0	0.000	0.022	0.980	25.0	1.0	0.011	6.00	206	0.055	0.037	21	30	21	0.935	64	0.832	21	21	0	811	26.23	104	21.430	6196	1	3	1050	40.5	1.00	1.0	0.011	0.300	X	1.0	3.742	0.66	3.743	1.066	3340	4.292	0.868		15.970	0.474	0.405	0.879	16.849	16.525
810	100	0.089	0.480	40.0	5.0	0.100	0.090	1.000	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.051	0.980	60.0	1.0	0.011	12.07	153	0.230	0.183	77	108	54	1.638	99	1.094	77	54	0	812	26.97	103	0.183	77	1	3	375	10.7	12.48	-	0.011	0.300		0.1	0.473	4.26	4.019	0.067	806	3.867	0.069		15.970	0.049	0.007	0.055	16.025	16.191
811	100	0.122	0.480	55.0	6.5	0.100	0.060	1.000	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.034	0.980	40.0	1.0	0.011	12.48	150	0.216	0.152	63	89	30	1.508	93	1.046	63	30	0	813	26.90	103	21.765	6210	1	3	1050	65.6	1.09	1.1	0.011	0.300	X	1.1	3.908	1.32	4.454	1.066	3487	4.480	0.868		15.314	1.028	0.656	1.684	16.998	16.120
812	100	0.096	0.480	40.0	5.0	0.100	0.120	1.000	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.057	0.980	65.0	1.0	0.011	12.10	152	0.273	0.222	94	164	54	1.938	116	1.204	94	54	0	814	12.10	152	0.222	94	1	3	375	9.5	14.38	0.0	0.011	0.300	X	0.1	0.472	4.26	4.222	0.064	866	4.058	0.066		15.314	0.048	0.006	0.054	15.368	15.516
813	100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.056	0.980	65.0	1.0	0.011	6.00	206	0.056	0.055	31	91	30	1.051	63	1.051	63	30	35	815	27.99	101	22.042	6159	1	3	1050	78.4	1.00	1.0	0.011	0.300	X	1.0	3.747	0.59	3.748	1.066	3345	4.298	0.868		14.215	0.423	0.786	1.209	15.424	15.464
814	100	0.279	0.480	60.0	8.0	0.100	0.180	1.000	0.0	0.0	0.000	-	0.000	-	0.0	0.000	0.128	0.980	85.0	3.0	0.011	12.83	148	0.587	0.439	181	342	145	2.988	192	1.431	244	145	99	815	12.83	148	0.439	181	1	3	375	8.0	11.95	-	0.011	0.300		0.4	1.271	3.01	5.275	0.111	789	5.071	0.114		14.215	0.248	0.033	0.281	14.497	14.686
815	100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.114	0.980	80.0	3.0	0.011	6.00	206	0.114	0.112	64	216	145	1.918	113	2.072	198	145	53	816	29.30	98	22.593	6163	1	3	1050	6.9	0.64	0.6	0.011	0.300		0.6	2.988	1.77	2.989	1.066	2667	3.431	0.867		13.366	0.805	0.044	0.849	14.215	14.686
816	100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000		6.00	206	0.000	0.000	0	74	0	1.400	87	1.006	53	0	53		29.42	98	22.593	6151	1	3	1200	-	0.00	0.0	0.011	0.300		0.0	0.000	0.00	0.000	0.000	0	0.000	0.000		0.000	0.000	0.000	0.000	0.000	13.800
1H	100	0.531	0.846	110.0	5.0	0.100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000		9.14	173	0.531	0.449	216	1263	145	6.090	220	1.713	902	145	757	1	16.02	133	3.518	1304	1	2	600	8.0	4.00	1.1	0.011	0.300		0.5	1.870	1.21	4.869	0.249	1561	4.766	0.253		23.240	0.215	0.040	0.255	23.615	24.150
1	100	-	0.413	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.045	0.980	36.0	2.0	0.011	6.00	206	0.045	0.044	25	109	145	6.090	220	1.659	902	145	757	1	16.15	133	3.562	1315	1	2	675	9.9	6.68	0.3	0.011	0.300		0.4	1.893	0.47	6.137	0.238	2695	6.029	0.241		22.511	0.086	0.044	0.130	23.240	23.902
2	100	-	0.980	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.980	-	2.0	0.011	6.00	206	0.000	0.000	0	868	0	6.080	197	1.598	620	0	620	2	16.31	132	3.562	1308	1	2	675	10.6	7.33	0.4	0.011	0.300		0.4	1.866	-0.03	6.391	0.228	2866	6.279	0.231		21.799	-0.004	0.046	0.041	22.511	23.630
3	100	-	0.980	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000		6.00	206	0.000	0.000	0	868	0	6.080	197	1.598	620	0	620	3	16.49	132	3.562	1302	1	2	675	19.3	6.95	0.4	0.011	0.300		0.4	1.864	0.35	6.265	0.232	2789	6.155	0.234		20.390	0.062	0.083	0.145	21.799	22.390
4	100	-	0.840	-	0.0	0.000	-	0.840	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000		6.00	206	0.000	0.000	0	868	0	6.080	197	1.598	620	0	620	4	16.68	131	3.562	1296	1	2	675	28.6	9.70	0.4	0.011	0.300		0.4	1.815	-0.05	7.017	0.209	3299	6.889	0.212		17.619	-0.008	0.117	0.109	20.390	21.050
5	100	-	0.840	-	0.0	0.000	-	0.840	-	0.0	0.000	-	0.600	-	0.0	0.000	-	0.600	-	0.0	0.000		6.00	206	0.000	0.000	0	868	0	6.080	197	1.598	620	0	620	5A	16.81	130	3.562	1290	1	2	675	7.0	4.77	0.4	0.011	0.300		0.4	1.769	-0.03	5.389	0.249	2310	5.296	0.252		17.346	-0.005	0.027	0.022	17.619	18.473
5A	100	3.110	0.846	270.0	5.0	0.100	0.580	0.846	100.0	8.0	0.060	0.060	1.000	-	0.0	0.000	0.089	0.980	60.0	3.0	0.011	20.00	120	3.839	3.271	1090	2395	287	6.090	268	2.077	1711	287	1424	5B	20.00	120	6.833	2278	1	3	675	8.0	7.63	1.2	0.011	0.300		0.7	2.317	0.20	6.883	0.254	2923	6.761	0.257		16.941	0.055	0.053	0.108	17.346	17.944
5B	100	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000	0.063	0.980	55.0	3.0	0.011	6.00	206	0.063	0.062	35	2042	287	6.090	255	1.970	1459	287	1172	5C	20.69	120	6.895	2298	1	2	675	10.5	4.46	0.8	0.011	0.300		1.1	3.055	0.20	6.069	0.344	2232	5.963	0.349		16.726	0.095	0.120	0.215	16.941	17.944
5C	100	-	0.000	0.0	0.0	0.000	-	0.000	0.0	0.0	0.000	-	0.000	0.0	0.0	0.000	-	0.000	0.0	0.0	0.000		6.00	206	0.000	0.000	0	1641	0	6.090	238	1.841	1172	0	1172	6	20.86	120	6.895	2298	1	2	675	32.9	3.00	0.9	0.011	0.300		1.1	3.053	0.00	5.218	0.388	1829	5.130	0.394		16.350	0.000	0.376	0.376	16.726	17.195
5D	100	-	0.000	-	0.0	0.000	0.030	1.000	0.0	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000		6.00	206	0.030	0.030	17	24	17	0.840	59	0.797	17	17	0	5E	6.00	206	0.030	17	1	P	150	14.1	3.54	-	0.009	0.012	X	0.6	0.971	6.45	2.436	0.063	47	2.232	0.067		17.427	0.310	-	0.232	17.660	17.500
5E	100	-	0.000	-	0.0	0.000	0.030	1.000	0.0	0.0	0.000	-	0.000	-	0.0	0.000	-	0.000	-	0.0	0.000		6.00	206	0.030	0.030	17	24	17	0.840	59	0.797	17	17	0	6	6.23	206	0.060	34	1	P	150	8.2	21.59	-	0.009	0.012		2.0	1.943	4.75	5.935	0.054	122	5.212	0.060		16.350	0.913	0.164	1.077	17.427	17.950
6	100	4.060	0.846	250.0	8.0	0.100	1.080	0.846	115.0	6.0	0.060	-	0.000	-	0.0	0.000	-	0.600	-	0.0	0.000		6.00	206	5.140	4.351	2490	5126	3662	6.090	353	2.734	3662	3662	0	6B	6.00	206	11.305	6469	1	2	1050	43.5	7.07	-	0.011	0.300	X	3.7	7.247	1.23	10.898	0.673	8924	10.906	0.672		13.349	3.303	1.618	4.921	18.909	16.500

EXISTING CONSTRUCTION

EXISTING CONSTRUCTION

maitland city council

Approved Plans

CC 17-141 / DA10-791

Engineering Construction

CC Issue Date : 05/10/2017

5	COUNCIL COMMENTS	P.K	S.H	27.06.17
4	COUNCIL COMMENTS - REV 2	K.S	S.H	05.06.17
3	COUNCIL COMMENTS	P.K	S.H	30.03.17
2	AMENDED DRAINAGE DESIGN	K.S	S.H	25.01.17
1	ORIGINAL ISSUE	P.K	S.H	07.12.16
Amendment	Description	Drawn	App'd	Date

Designed	Cad Reference
SH	16628C dC13r5
Scale	A1 SHEET
Project Approval	
IAN HILL (B.E)	
Consulting Civil Engineer	

GCA ENGINEERING SOLUTIONS

A.B.N. 92 086 017 745
1 HARTLEY DRIVE, THORNTON NSW 2322
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PHONE: (02) 4964 1811 ◆ FAX: (02) 4964 1822

PROPOSED SUBDIVISION - STAGE 6
AUBURN STREET GILLIESTON HEIGHTS
GILLIESTON GROVE

DRAINAGE CALCULATION SHEET (2 OF 2)

Project No	
16628C	
Drawing No	Revision
C13	5

PLOT DATE: 28/08/2017 12:19:46 PM CAD FILE: Q:\16\16628 Gilliston Grove - Stage 6\02__CAD\AutoCAD\Civil\16628C dC13r5.dwg