Appendix C

Stormwater Strategy

Proposed Development

Ravensfield South, Owl Pen Lane, Farley

Stormwater Management Report

Revision: 1
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1	Original Issue	S.H	15.11.18	S.H	15.11.18	S.H	15.11.18

Contents

1. INTRODUCTION

This report is to support a development application for a manufactured home estate off Owl Pen Lane at Farley. It discusses drainage measures to meet engineering best practice requirements to ensure the proposed development does not impact on downstream water quality or flooding.

1.1 Study Area

The parent parcel currently comprises lots 100 and 101 on DP 1230313, together known as 207 Wollombi Road, Farley. It is the subject of development application 14-724 to Maitland City Council for a 354 lot subdivision. The manufactured home estate is proposed to be established on the southern residue allotment and will be accessed internally from Oxpring Road and Harington Avenue.

The parent parcel is bisected by an existing first order watercourse, which runs in a west to east direction. The proposed development site generally comprises the western half of the southern side of the watercourse, Refer Figure 1.

The site of the development also stretches over a ridgeline in the local topography, dividing it into two principal catchments. The northern catchment drains to the aforementioned easterly draining watercourse, while the southern catchment drains to a number of gullies that discharge directly to Wentworth Swamp.

DA 14-724 was approved in consideration of a drainage report (GCA reference 13330C) that described a combination detention and water quality control basin (Basin 10) to be located upstream of Owl Pen Lane on the main first order watercourse. The northern catchment of the proposed development drains to Basin 10 and accordingly, this report reconsiders the catchment to Basin 10 by adding some area from the proposed development (part of Catchment 10B) and removing some catchment (Catchment 1B).

Assuming catchment 10B is directed to Bain 10 by a combination of major / minor systems on Darton Drive, Catchments 1A, B, C and D form the remaining natural catchment to Bain 1, hence the nomenclature.

Topography divides the southern catchment into four separate sub catchments, with each one at the head of a local first order watercourse. It should be noted that it was originally conceived that there were five natural sub catchments, however, the catchment to Outlet 4 was determined to be negligible and accordingly, it has been consolidated into Catchment 5.

The southern sub catchments are named Catchment 2, 3, 5 and 6 respectively.

Figure 2 presents a catchment plan.

1.2 Proposed Development

The proposed development is a manufactured home estate. For the purposes of stormwater analysis, it has been assumed that:

- Gross density of the estate is 20 lots per hectare (includes roads, verges, curtilage and community facilities)
- Each lot will contain a dwelling with 150m^2 roof area
- Each dwelling will contain a 2000L rainwater tank with appropriate internal uses to reduce potable water demand.
- Gross impervious area fraction is 65%, resulting in a residue after the roof area is removed of 50% impervious. While the proposed development density is higher than for general residential development, the impervious fractions are comparable.

Water quality and on-site detention for each catchment is to be catered for in a basin named for the catchment.

- Basin 10 is the basin proposed in DA 14-724. It is not proposed to modify this basin in any way.
- Basin 1 is to be a wet basin to be located upstream of the Harlington Avenue crossing of the watercourse.
- Basins 2,3,5 and 6 are to be dry basins located downhill of the main loop road for the proposed development and are to be sized for detention such that outflows to the individual watercourses will be less than for the predevelopment case, while demonstrating sufficient treatment capacity to meet Council's water quality criteria for suspended solids, nitrogen, phosphorous and gross pollutants.

2. External Catchment

Refer Figure 2.

Catchments 1A and 10A, while being in the natural catchments to basins 1 and 10 respectively, are outside the considered development footprint.

For the purpose of calculating on site detention requirements, it is assumed that they are developed to 65% impervious fraction. Accordingly, detention for these sub catchments is provided for in Basins 1 and 10 respectively.

However, for the purpose of calculating water quality requirements, it is assumed that runoff from these sub catchments will be treated to Councils requirements prior to discharge.

For both water quality, and volume rate of flow calculations, these sub catchments are built into the models and accordingly, their runoff is appropriately considered.

3. ON SITE DETENTION

3.1 Criteria

Maitland City Council publishes on-site detention requirements for subdivision development in their Manual of Engineering Standards (MOES).

When developed, the peak rate of discharge measured at the site boundary for each sub catchment separately is to be lower than the predevelopment scenario for the 1, 10 and 100-year ARI events.

3.2 Methodology

DRAINS is a time area hydrograph model that uses the ILSAX engine to convert rainfall hyetographs to runoff hydrographs using an initial and continuing loss model with differing parameters for impervious, supplementary and grassed areas.

Input rainfall comprises discrete storms of various durations. The average intensity is distributed according to regional Australian Rainfall and Runoff temporal patterns which are broken down to the desired time step, usually 5 minutes. In this way, the total volume of a storm is considered in lieu of just generating a peak rate of flow (as per the probabilistic rational method) and detention basins can appropriately be modelled for their efficacy.

Total durations for input rainfall range from 5 minutes to 72 or more hours, however for the small catchments modelled in urban drainage scenarios, it is unlikely that long durations will generate critical flow results. Longer durations are nonetheless modelled to confirm the tails of the hydrographs do not extend or overtop basin storages.

A pre-development DRAINS model was constructed using catchments to the pre-defined 5 separate site outlets using predevelopment site contours and fully pervious catchment types with long kinematic wave flow paths at predevelopment topography slopes. The model was run for the 1, 10 and 100 - year ARI events of 5, 10, 15,20 25,30,45 minutes and 1, 1.5, 2, 3 and 4.5-hour durations. Critical peak flow rates for the 1, 10 and 100-year ARI were then adopted as maximum permissible site discharges for each outlet. In the case of Catchment 1, the upstream flow rate to the Harlington Avenue Crossing was adopted as the peak flow rate to be achieved in Basin 1.

A new DRAINS model was then constructed using post development catchments defined by the post development topography (considering road patterns) to the same five outlet points.

Basins were then inserted into the model upstream of the outlets to Catchments 1, 2,3,5, 6 and 10 with outlet flow characteristics to match the permissible site discharges.

The post development DRAINS model was then iteratively run with successive basin volumes to arrive the required basin sizes.

Drains model data are presented in Appendix A.

3.3 Modelling Parameters

Maitland City Council publishes parameters to be adopted in DRAINS models in its Manual of Engineering Standards:

Soil Type	as reported (3)
Antecedent Moisture Content	3
Grassed Depression Storage	5mm
Paved Depression Storage	1mm

0.65 fraction impervious was adopted for the developed catchment having conservative regard for the mix of Residential lots < 1000m2 (0.6) and road reserve (0.7).

Design rainfall was adopted from the Australian Bureau of Meteorology's online IFD 1997 tool for the Farley Locality (32.7316^{O}S, 151.5111^{O}E)

3.4 Results

The model was run for various design storm durations. The peak discharges for the various ARI's were calculated along with their required total detention volume and the results are shown below:

Basin 10

(Approved in DA 14-724) but re modelled with developed catchments in accordance with Figure 2:

Adopted outlet configuration:

Low flow control	1 x 150 Pipe at IL15.00
Mid level control	2 x 600mm RCP at IL 16.00
Overflow	12.5m Spillway at RL 17.20
Q 100 Top water level	17.93

ARI (years)	Pre Developed Permissible site discharge (m^3/s)	Peak Flow with Detention Basin at Outlet (m^3/s)	Detention Volume (m^3)
1	2.55	2.36	5707
10	8.24	7.55	9959
100	14.80	14.77	12694

Basin 1

Modelled with developed catchments in accordance with Figure 2:

Adopted outlet configuration:

Low flow control	875mm RCP at IL 20.00
Mid level control	1050mm RCP at IL 20.0
Overflow	4.0m Spillway at RL 21.5
Q 100 Top water level	21.39*

ARI (years)	Pre Developed Permissible site discharge (m^3/s)	Peak Flow with Detention Basin at Outlet (m^3/s)	Detention Volume (m^3)
1	Outlet is internal, flow control only required to reduce volume in basin 10	1.02	342
10		3.20	738
100		4.33	1074

*Note that the spillway is not required to control Basin 1 flow. Accordingly, the spillway can be regarded to be the Harling Ave Road Crossing, which will not be overtopped in events more frequent that the 100 Year ARI in accordance with Council's standards.

Basin 2

Modelled with developed catchments in accordance with Figure 2:

Adopted outlet configuration:

Low flow control	225mm PVC at IL 36.0
Mid level control	375mm RCP at IL 37.0
Overflow	2.0m Spillway at RL 37.5
Q 100 Top water level	37.2*

*Note that the spillway is not required to control Basin 2 flow and is an emergency spillway for events rarer than 100 years ARI only.

ARI (years)	Pre Developed Permissible site discharge (m^3/s)	Peak Flow with Detention Basin at Outlet (m^3/s)	Detention Volume (m^3)
1	0.099	0.069	106
10	0.285	0.251	218
100	0.516	0.360	279

Basin 3

Modelled with developed catchments in accordance with Figure 2:

Adopted outlet configuration:

Low flow control	225mm PVC at IL 36.0
Mid level control	375mm RCP at IL 37.0
Overflow	2.0m Spillway at RL 37.5
Q 100 Top water level	37.25*

ARI (years)	Pre Developed Permissible site discharge (m^3/s)	Peak Flow with Detention Basin at Outlet (m^3/s)	Detention Volume (m^3)
1	0.124	0.088	130
10	0.359	0.357	278
100	0.649	0.469	364

*Note that the spillway is not required to control Basin 3 flow and is an emergency spillway for events rarer than 100 years ARI only.

Basin 5

Modelled with developed catchments in accordance with Figure 2:

Adopted outlet configuration:

Low flow control	150mm PVC at IL 32.0
Mid level control	225mm PVC at IL 33.0
Overflow	2.0m Spillway at RL 33.5
Q 100 Top water level	33.34*

*Note that the spillway is not required to control Basin 5 flow and is an emergency spillway for events rarer than 100 years ARI only.

ARI (years)	Pre Developed Permissible site discharge (m^3/s)	Peak Flow with Detention Basin at Outlet (m^3/s)	Detention Volume (m^3)
1	0.035	0.020	663
10	0.101	0.094	1344
100	0.183	0.134	1884

Basin 6

Modelled with developed catchments in accordance with Figure 2:

Adopted outlet configuration:

Low flow control	225mm PVC at IL 24.0
Mid level control	375mm RCP at IL 25.0
Overflow	1.5m Spillway at RL 25.5
Q 100 Top water level	33.34*

*Note that the spillway is not required to control Basin 6 flow and is an emergency spillway for events rarer than 100 years ARI only.

ARI (years)	Pre Developed Permissible site discharge (m^3/s)	Peak Flow with Detention Basin at Outlet (m^3/s)	Detention Volume (m^3)
1	0.102	0.071	303
10	0.296	0.261	594
100	0.535	0.392	827

Detailed results are presented in Appendix B.

3.5 Discussion

The results show that in all cases, discharge to the respective watercourses is less than the predevelopment rates.

Detailed design will be required at Construction Certificate stage to confirm final basin layout, outlet configurations and volumes.

4. RUNOFF QUALITY

4.1 Criteria

Treatment targets for the proposed development were adopted from Maitland City Council Manual of Engineering Standards 2014, Section 8.2 (Stormwater Quality) and are shown in Table 3-1:

Table 4-1: Stormwater Treatment Objectives

Pollutant	Stormwater treatment objective
Total Suspended Solids (TSS)	80% retention of average annual load
Total Phosphorus (TP)	45% retention of average annual load
Total Nitrogen (TN)	45% retention of average annual load
Gross Pollutants (GP)	70% retention of average annual load

4.2 Methodology

The proposed development was modelled using MUSIC, the Model for Urban Stormwater Improvement Conceptualisation published by eWater Limited, which is the current best practice tool for estimating the ameliorating effects of proposed stormwater quality improvement devices (SQUIDS) in a treatment train approach.

MUSIC uses real historical continuous rainfall records (over several years) as input and compares the theoretical pollutant generation within the catchment to the final theoretical export rate (usually expressed in kg/year) to determine a treatment train effectiveness expressed in percentage points that are directly comparable to the guidelines in Table 3-1.

The MUSIC model was constructed with a catchment comprising the pavement area, roof and landscaping, with the catchments discharging to the proposed bio-retention / detention basin at the north-eastern corner of the site.

For each catchment, the number of lots was estimated using a gross development density of 9 lots per hectare (includes allowance for roads and curtilage) for standard residential development and 20 lots per hectare for the proposed manufactured home estate.

Roof areas were separated so runoff could be disposed of through internal re use via rainwater tanks. 250 litres per standard residential dwelling per day and 150 litres per manufactured home dwelling per day was built into the model for re use.

For Basin 10, the configuration for DA 14-724 was adopted and modelled, while for Basins 2,3,5 and 6, a dry basin with a floor / filter area the same as assumed for the DRAINS model invert was adopted.

4.3 Results

Input data is shown in Appendix D, including the model layout. Modelled basins are assumed to have a bioretention filter media layer 400mm thick with 400mm of extended detention on top.

Proposed bio-retention / detention basin areas as indicated, which are compatible with the modelled detention volume, would achieve pollutant retention as indicated in table 3-2.

Table 4-2: Stormwater Treatment Objectives

Basin	Basin Surface Area	Retained Total Suspended Solids	Retained Total Phosphorous	Retained Total Nitrogen	Retained Gross Pollutants
	(m^2)	(%)	(%)	(%)	(%)
10	3621	93	69.2	79.6	100
2	210	93.6	54.2	69.1	100
3	254	93.5	53.9	68.5	100
5	1320	97.8	60.2	76.5	100
6	573	95.9	56.5	72.7	100

4.4 Discussion

The above results indicate the proposed stormwater strategy will produce an outcome that complies with Council's standards for water quality control .

5. SUMMARY AND CONCLUSION

The proposed development of part of the land at 207 Wollombi Road as a manufactured home estate has the potential to impact on downstream drainage.

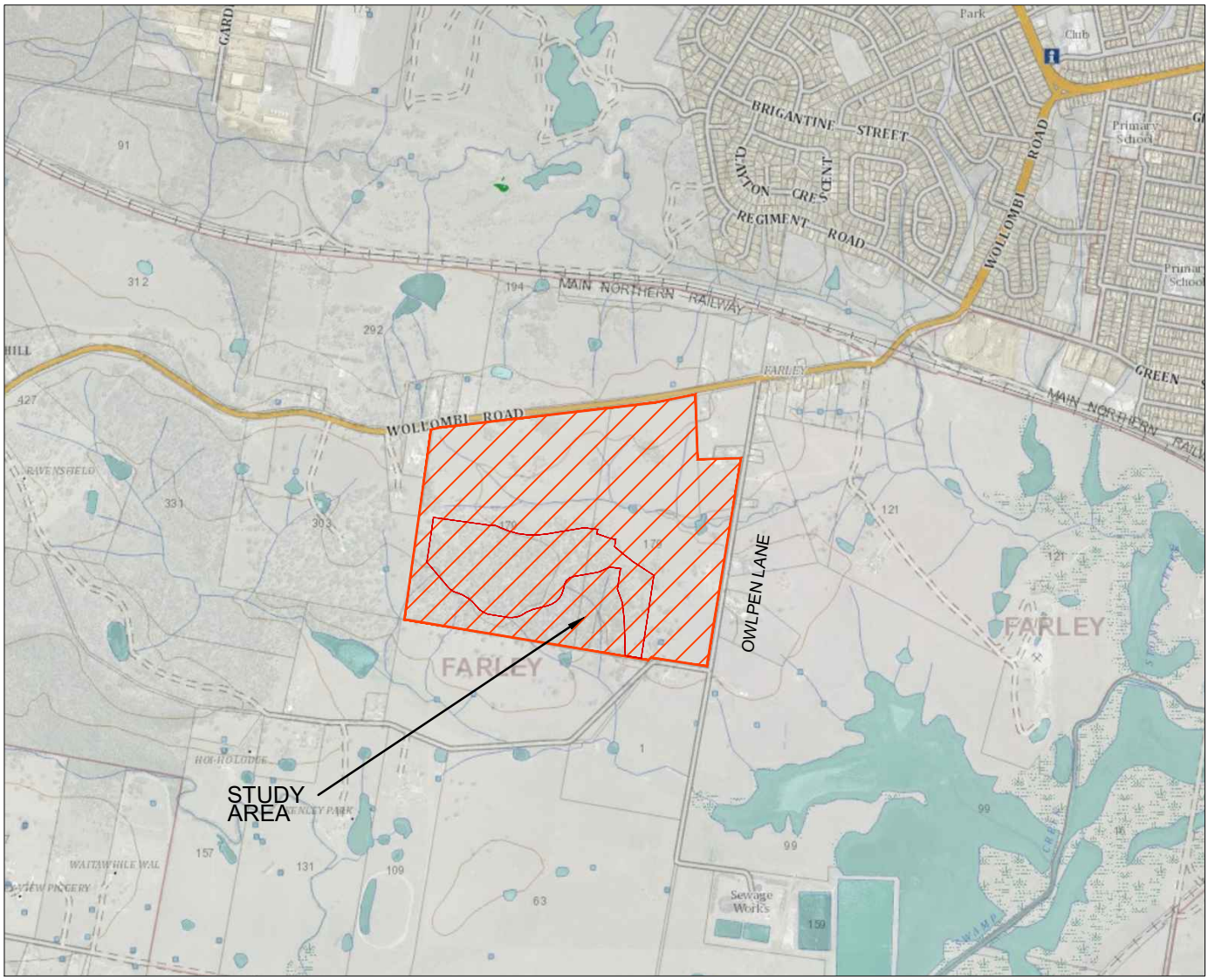
However, the combined wet detention basin and water quality control basin constructed pursuant to DA 17-724 (Basin 10) can be augmented by an additional basin to be constructed upstream of the Harling Avenue creek crossing (Basin 1) to achieve compliance for flow and water quality at the Owl Pen Lane Outlet.

Proposed Basins 2,3 5 and 6 in the southern catchment can control both water quality and quantity requirements to ensure no impact on their respective watercourses.

Figures

Client: RAVENSFIELD DOWNS PTY. LTD.
Project: STORMWATER DRAINAGE REPORT
Location: WOLLOMBI ROAD, FARLEY

DWG REF: 18383 Figure1 r1 DATE: 07.12.16



NTS

LEGEND

STUDY AREA

PROPOSED DEVELOPMENT SITE

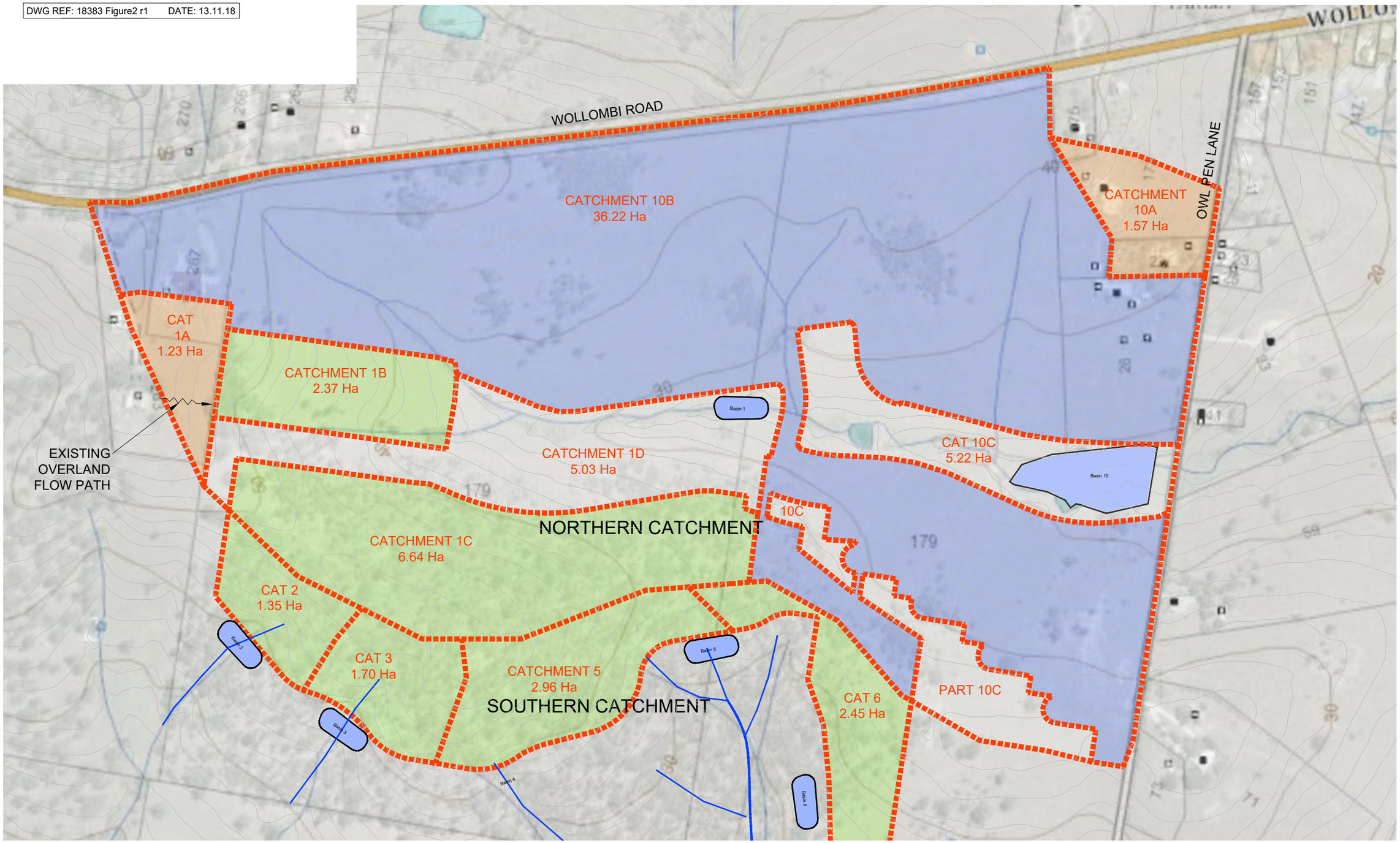
LOCALITY PLAN

FIGURE 1

Client: RAVENSFIELD DOWNS PTY. LTD.
Project: STORMWATER DRAINAGE STRATEGY
Location: WOLLOMBI ROAD, FARLEY

DWG REF: 18383 Figure2 r1 DATE: 13.11.18

GCA ENGINEERING SOLUTIONS



LEGEND:

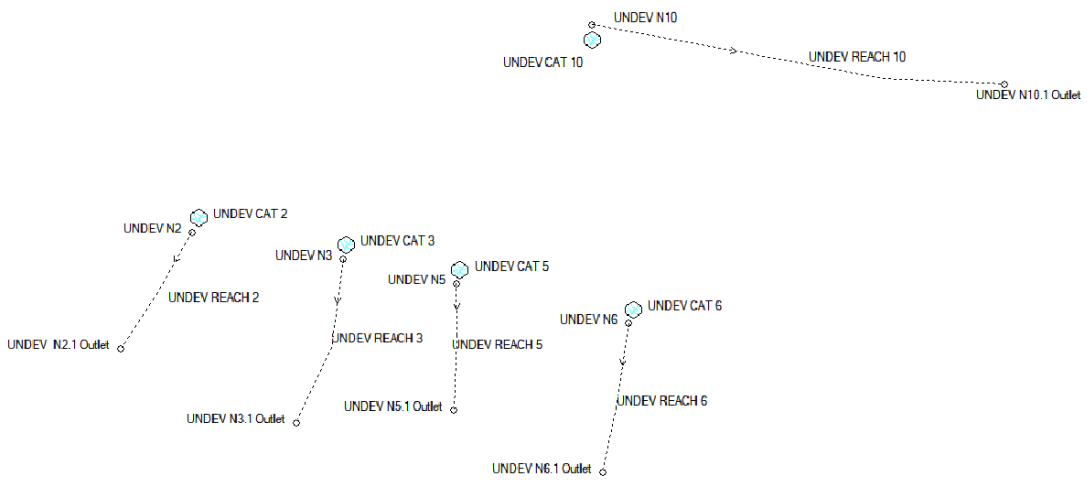
- DEVELOPED CATCHMENT TO EXISTING BASIN 10
- DEVELOPED CATCHMENT OSD ON OWN SITE
- DEVELOPED CATCHMENT TO NEW BASIN
- UNDEVELOPED CATCHMENT TO BASIN

1:2000 0 40 80 120 m

CATCHMENT PLAN
FIGURE 2

Appendix A

DRAINS Data Spreadsheets



RAVENSFIELD SOUTH
RESIDENTIAL SUBDIVISION
UNDEVELOPED CATCHMENT

PIT / NODE DETAILS Version 13

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is
UNDEV N10.1 Outlet	Node					11		0		3132.305	-1372.19		16885		No	
UNDEV N10	Node					15		0		2231.242	-1243.47		16896		No	
UNDEV N2	Node					36		0		1356.92	-1697.72		19741		No	
UNDEV N3	Node					36		0		1687.744	-1755.98		19754		No	
UNDEV N5	Node					32		0		1935.656	-1808.42		19767		No	
UNDEV N6	Node					24		0		2312.29	-1896.62		19780		No	
UNDEV N2.1 Outlet	Node					34		0		1201.976	-1950.4		19850		No	
UNDEV N3.1 Outlet	Node					34		0		1585.243	-2113.54		19863		No	
UNDEV N5.1 Outlet	Node					30		0		1930.888	-2084.94		19877		No	
UNDEV N6.1 Outlet	Node					22		0		2255.08	-2223.2		19890		No	

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Leng	id

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 %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough
UNDEV CAT 10	UNDEV N10	58.28	0	100	0	5	0	0	-1	145	0	-1	7	0	-1	0.35	0
UNDEV CAT 2	UNDEV N2	1.35	0	100	0	5	0	0	-1	45	0	-1	5	0	-1	0.35	0
UNDEV CAT 3	UNDEV N3	1.7	0	100	0	5	0	0	-1	45	0	-1	5	0	-1	0.35	0
UNDEV CAT 5	UNDEV N5	0.48	0	100	0	5	0	0	-1	45	0	-1	5	0	-1	0.35	0
UNDEV CAT 6	UNDEV N6	1.4	0	100	0	5	0	0	-1	45	0	-1	5	0	-1	0.35	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	At Chg	Chg (m)	RI (m)	Chg (m)

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	etc etc

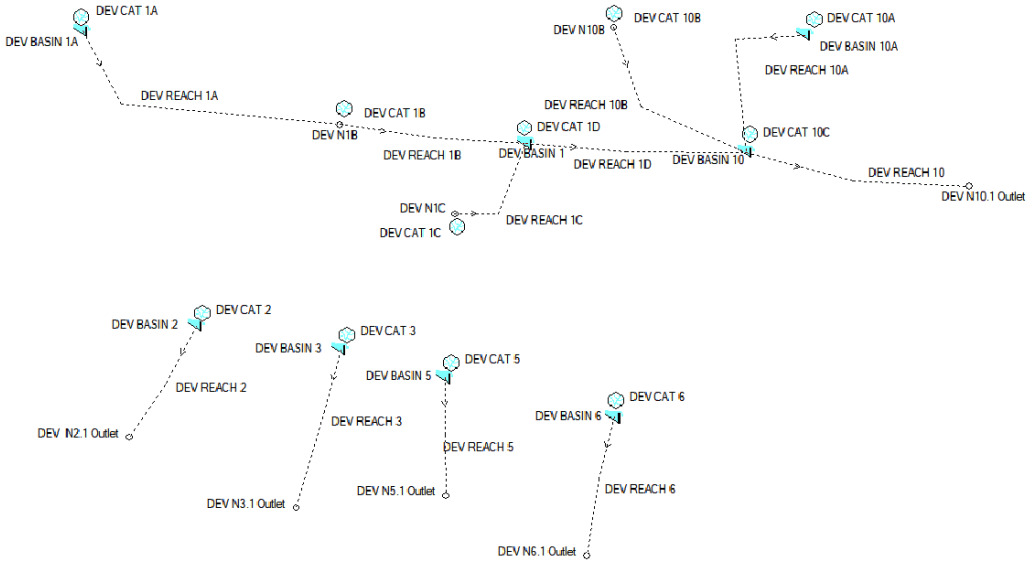
CHANNEL DETAILS

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

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Stor (m)	Safe Depth Minor Stor (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	
UNDEV REACH 10	UNDEV N10	UNDEV N10.1 Outlet	0.2				overflow	1	1	2	3	0	16889	80
UNDEV REACH 2	UNDEV N2	UNDEV N2.1 Outlet	0.2				overflow	1	1	2	3	0	19909	80
UNDEV REACH 3	UNDEV N3	UNDEV N3.1 Outlet	0.2				overflow	1	1	2	3	0	19926	80
UNDEV REACH 5	UNDEV N5	UNDEV N5.1 Outlet	0.2				overflow	1	1	2	3	0	19939	80
UNDEV REACH 6	UNDEV N6	UNDEV N6.1 Outlet	0.2				overflow	1	1	2	3	0	19952	80

PIPE COVER DETAILS



RAVENSFIELD SOUTH
RESIDENTIAL SUBDIVISION
DEVELOPED CATCHMENT

PIT / NODE DETAILS

Version 13

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is
DEV N10.1 Outlet	Node					11		0		3132.305	-1372.19		16885		No	
DEV N2.1 Outlet	Node					34		0		1201.976	-1950.4		19850		No	
DEV N3.1 Outlet	Node					34		0		1585.243	-2113.54		19863		No	
DEV N5.1 Outlet	Node					30		0		1930.888	-2084.94		19877		No	
DEV N6.1 Outlet	Node					22		0		2255.08	-2223.2		19890		No	
DEV N10B	Node					20		0		2315.027	-1006.7		21807		No	
DEV N1B	Node					34		0		1684.959	-1230.42		21831		No	
DEV N1C	Node					23		0		1949.77	-1435.88		26910		No	

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length	id
DEV BASIN 10	15.4	1		None						2623.213	-1296.62	No			21748
	15.8	3505													
	16	3870													
	17.92	8255													
	18.22	8908													
	18.72	8908													
DEV BASIN 10A	30	284		None						2755.619	-1024.96	No			21797
	30.1	290													
	30.2	296													
	30.3	302													
	30.4	308													
	30.5	314													
	30.6	320													
	30.7	327													
	30.8	333													
	30.9	340													
	31	346													
	31.1	353													
	31.2	360													
	31.3	366													
	31.4	373													
	31.5	380													
	31.6	387													
	31.7	394													
	31.8	401													
	31.9	408													
	32	415													
DEV BASIN 1A	51	232		None						1093.698	-1015.83	No			21816
	51.1	238													
	51.2	243													
	51.3	249													
	51.4	254													
	51.5	260													
	51.6	266													
	51.7	272													
	51.8	278													
	51.9	284													

	52	290					
	52.1	296					
	52.2	302					
	52.3	308					
	52.4	314					
	52.5	320					
	52.6	327					
	52.7	333					
	52.8	340					
	52.9	346					
	53	353					
DEV BASIN 1	20	707	None	2115.911	-1275.95	No	34211
	20.1	716					
	20.2	726					
	20.3	735					
	20.4	745					
	20.5	755					
	20.6	765					
	20.7	774					
	20.8	784					
	20.9	794					
	21	804					
	21.1	814					
	21.2	824					
	21.3	835					
	21.4	845					
	21.5	855					
	21.6	866					
	21.7	876					
	21.8	887					
	21.9	897					
	22	908					
DEV BASIN 2	36	201	None	1358.129	-1693.84	No	35584
	36.1	206					
	36.2	211					
	36.3	216					
	36.4	222					
	36.5	227					
	36.6	232					
	36.7	238					
	36.8	243					
	36.9	249					
	37	254					
	37.1	260					
	37.2	266					
	37.3	272					
	37.4	278					
	37.5	284					
	37.6	290					
	37.7	296					
	37.8	302					
	37.9	308					

	38	314					
DEV BASIN 3	36	254	None	1687.241	-1748.63	No	46104
	36.1	260					
	36.2	266					
	36.3	272					
	36.4	278					
	36.5	284					
	36.6	290					
	36.7	296					
	36.8	302					
	36.9	308					
	37	314					
	37.1	320					
	37.2	327					
	37.3	333					
	37.4	340					
	37.5	346					
	37.6	353					
	37.7	360					
	37.8	366					
	37.9	373					
	38	380					
DEV BASIN 5	32	1320	None	1929.224	-1812.55	No	48856
	32.1	1333					
	32.2	1346					
	32.3	1359					
	32.4	1372					
	32.5	1385					
	32.6	1399					
	32.7	1412					
	32.8	1425					
	32.9	1439					
	33	1452					
	33.1	1466					
	33.2	1479					
	33.3	1493					
	33.4	1507					
	33.5	1521					
	33.6	1534					
	33.7	1548					
	33.8	1562					
	33.9	1576					
	34	1590					
DEV BASIN 6	24	573	None	2318.832	-1905	No	55269
	24.1	581					
	24.2	590					
	24.3	598					
	24.4	607					
	24.5	616					
	24.6	625					
	24.7	633					
	24.8	642					

24.9	651
25	661
25.1	670
25.2	679
25.3	688
25.4	697
25.5	707
25.6	716
25.7	726
25.8	735
25.9	745
26	755

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 %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough
DEV CAT 10C	DEV BASIN 10	5.22	0	100	0	0	0	0	15	15	15	1	1	0	0.01	0.35	0
DEV CAT 10A	DEV BASIN 10A	1.57	65	35	0	5	5	5	15	15	15	1	1	0	0.01	0.35	0
DEV CAT 10B	DEV N10B	36.22	65	35	0	5	5	5	15	15	15	1	1	0	0.01	0.35	0
DEV CAT 1A	DEV BASIN 1A	1.23	65	35	0	2	2	2	15	15	15	1	1	0	0.01	0.35	0
DEV CAT 1B	DEV N1B	2.37	65	35	0	5	5	5	15	15	15	1	1	0	0.01	0.35	0
DEV CAT 1C	DEV N1C	6.64	65	35	0	5	5	5	15	15	15	1	1	0	0.01	0.35	0
DEV CAT 1D	DEV BASIN 1	5.03	0	100	0	5	5	5	15	15	15	1	1	0	0.01	0.35	0
DEV CAT 2	DEV BASIN 2	1.35	65	35	0	5	5	0	15	15	0	1	1	0	0.01	0.35	0
DEV CAT 3	DEV BASIN 3	1.7	65	35	0	0	0	0	15	15	0	1	1	0	0.01	0.35	0
DEV CAT 5	DEV BASIN 5	2.96	65	35	0	0	0	0	15	15	0	1	1	0	0.01	0.35	0
DEV CAT 6	DEV BASIN 6	2.45	65	35	0	5	0	0	15	15	0	1	1	0	0.01	0.35	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	At Chg	Chg (m)	Rl (m)	Chg (m)

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	etc etc

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

OVERFLOW ROUTE DETAILS

Name	From	To	Travel Time (min)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Depth Major Stor (m)	Safe Depth Minor Stor (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %	id	
DEV REACH 10	DEV BASIN 10	DEV N10.1 Outlet	0.2	15.5			overflow	1	1	2	3	0	16889	80
DEV REACH 10A	DEV BASIN 10A	DEV BASIN 10	0.2	30			overflow	1	1	2	3	0	21800	80
DEV REACH 10B	DEV N10B	DEV BASIN 10	0.2				overflow	1	1	2	3	0	21763	80
DEV REACH 1A	DEV BASIN 1A	DEV N1B	0.2	51			overflow	1	1	2	3	0	21821	80
DEV REACH 1B	DEV N1B	DEV BASIN 1	0.2				overflow	1	1	2	3	0	21843	80
DEV REACH 1C	DEV N1C	DEV BASIN 1	0.2				overflow	1	1	2	3	0	21865	80
DEV REACH 1D	DEV BASIN 1	DEV BASIN 10	0.2	20			overflow	1	1	2	3	0	21849	80

DEV REACH 2	DEV BASIN 2	DEV N2.1 Outlet	0.2	36	overflow	1	1	2	3	0	19909	80
DEV REACH 3	DEV BASIN 3	DEV N3.1 Outlet	0.2	36	overflow	1	1	2	3	0	46111	80
DEV REACH 5	DEV BASIN 5	DEV N5.1 Outlet	0.2	32	overflow	1	1	2	3	0	48860	80
DEV REACH 6	DEV BASIN 6	DEV N6.1 Outlet	0.2	24	overflow	1	1	2	3	0	55274	80

PIPE COVER DETAILS

Name	Type	Dia (mm)	Safe Cover Cover (m)

This model has no pipes with non-return valves

Appendix B

DRAINS Result Spreadsheets

DRAINS results prepared from Version 2017.11

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint

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
UNDEV CAT 10	2.547	0	2.547	5	51.05	0	AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1
UNDEV CAT 2	0.099	0	0.099	5	25.34	0	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
UNDEV CAT 3	0.124	0	0.124	5	25.34	0	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
UNDEV CAT 5	0.035	0	0.035	5	25.34	0	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
UNDEV CAT 6	0.102	0	0.102	5	25.34	0	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1

Outflow Volumes for Total Catchment (0.00 impervious + 63.2 pervious = 63.2 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	4003.3	47.94 (1.2%)	0.00 (0.0%)	47.94 (1.2%)
AR&R 1 year, 10 minutes storm, average 58 mm/h, Zone 1	6110.3	1229.14 (20.1%)	0.00 (0.0%)	1229.14 (20.1%)
AR&R 1 year, 15 minutes storm, average 48.4 mm/h, Zone 1	7648.41	2474.95 (32.4%)	0.00 (0.0%)	2474.95 (32.4%)
AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1	8891.54	3448.81 (38.8%)	0.00 (0.0%)	3448.81 (38.8%)
AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1	9902.9	4206.94 (42.5%)	0.00 (0.0%)	4206.94 (42.5%)
AR&R 1 year, 30 minutes storm, average 34.2 mm/h, Zone 1	10808.91	4779.22 (44.2%)	0.00 (0.0%)	4779.22 (44.2%)
AR&R 1 year, 45 minutes storm, average 27.4 mm/h, Zone 1	12989.66	6158.23 (47.4%)	0.00 (0.0%)	6158.23 (47.4%)
AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1	14664.72	7235.09 (49.3%)	0.00 (0.0%)	7235.09 (49.3%)
AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1	17161.52	8437.57 (49.2%)	0.00 (0.0%)	8437.57 (49.2%)
AR&R 1 year, 2 hours storm, average 15.1 mm/h, Zone 1	19089.42	9010.53 (47.2%)	0.00 (0.0%)	9010.53 (47.2%)
AR&R 1 year, 3 hours storm, average 11.6 mm/h, Zone 1	21997.08	9579.25 (43.5%)	0.00 (0.0%)	9579.25 (43.5%)
AR&R 1 year, 4.5 hours storm, average 8.96 mm/h, Zone 1	25486.28	9518.35 (37.3%)	0.00 (0.0%)	9518.35 (37.3%)

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

CHANNEL DETAILS

DRAINS results prepared from Version 2017.11

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint

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
UNDEV CAT 10	2.547	0	2.547	5	51.05	0	AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1
UNDEV CAT 2	0.099	0	0.099	5	25.34	0	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
UNDEV CAT 3	0.124	0	0.124	5	25.34	0	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
UNDEV CAT 5	0.035	0	0.035	5	25.34	0	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1

UNDEV CAT 6	0.102	0	0.102	5	25.34	0 AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1

Outflow Volumes for Total Catchment (0.00 impervious + 63.2 pervious = 63.2 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	4003.3	47.94 (1.2%)	0.00 (0.0%)	47.94 (1.2%)
AR&R 1 year, 10 minutes storm, average 58 mm/h, Zone 1	6110.3	1229.14 (20.1%)	0.00 (0.0%)	1229.14 (20.1%)
AR&R 1 year, 15 minutes storm, average 48.4 mm/h, Zone 1	7648.41	2474.95 (32.4%)	0.00 (0.0%)	2474.95 (32.4%)
AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1	8891.54	3448.81 (38.8%)	0.00 (0.0%)	3448.81 (38.8%)
AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1	9902.9	4206.94 (42.5%)	0.00 (0.0%)	4206.94 (42.5%)
AR&R 1 year, 30 minutes storm, average 34.2 mm/h, Zone 1	10808.91	4779.22 (44.2%)	0.00 (0.0%)	4779.22 (44.2%)
AR&R 1 year, 45 minutes storm, average 27.4 mm/h, Zone 1	12989.66	6158.23 (47.4%)	0.00 (0.0%)	6158.23 (47.4%)
AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1	14664.72	7235.09 (49.3%)	0.00 (0.0%)	7235.09 (49.3%)
AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1	17161.52	8437.57 (49.2%)	0.00 (0.0%)	8437.57 (49.2%)
AR&R 1 year, 2 hours storm, average 15.1 mm/h, Zone 1	19089.42	9010.53 (47.2%)	0.00 (0.0%)	9010.53 (47.2%)
AR&R 1 year, 3 hours storm, average 11.6 mm/h, Zone 1	21997.08	9579.25 (43.5%)	0.00 (0.0%)	9579.25 (43.5%)
AR&R 1 year, 4.5 hours storm, average 8.96 mm/h, Zone 1	25486.28	9518.35 (37.3%)	0.00 (0.0%)	9518.35 (37.3%)

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

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

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
UNDEV REACH 10	2.547	2.547	24.007	0.091	0.21	12.02	2.32	AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1
UNDEV REACH 2	0.099	0.099	24.007	0.013	0.01	12	0.62	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
UNDEV REACH 3	0.124	0.124	24.007	0.015	0.01	12	0.68	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
UNDEV REACH 5	0.035	0.035	24.007	0.007	0	12	0.4	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
UNDEV REACH 6	0.102	0.102	24.007	0.013	0.01	12	0.65	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

CONTINUITY CHECK for AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
UNDEV N10.1 Outlet	6650.31	6650.31	0	0
UNDEV N10	6650.31	6650.31	0	0
UNDEV N2	160.13	160.13	0	0
UNDEV N3	201.65	201.65	0	0
UNDEV N5	56.94	56.94	0	0
UNDEV N6	166.06	166.06	0	0
UNDEV N2.1 Outlet	160.13	160.13	0	0
UNDEV N3.1 Outlet	201.65	201.65	0	0
UNDEV N5.1 Outlet	56.94	56.94	0	0
UNDEV N6.1 Outlet	166.06	166.06	0	0

Run Log for 18383 Undev r1 20181114.drn run at 12:52:46 on 14/11/2018

Flows were safe in all overflow routes.

DRAINS results prepared from Version 2017.11

PIT / NODE DETAILS

Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint

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
UNDEV CAT 10	8.235	0	8.235	5	36.02	0	AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1
UNDEV CAT 2	0.285	0	0.285	5	16.2	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
UNDEV CAT 3	0.359	0	0.359	5	16.2	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
UNDEV CAT 5	0.101	0	0.101	5	16.2	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
UNDEV CAT 6	0.296	0	0.296	5	16.2	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1

Outflow Volumes for Total Catchment (0.00 impervious + 63.2 pervious = 63.2 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	7585.2	3255.36 (42.9%)	0.00 (0.0%)	3255.36 (42.9%)
AR&R 10 year, 10 minutes storm, average 110 mm/h, Zone 1	11588.5	6851.78 (59.1%)	0.00 (0.0%)	6851.78 (59.1%)
AR&R 10 year, 15 minutes storm, average 91 mm/h, Zone 1	14380.27	9310.61 (64.7%)	0.00 (0.0%)	9310.61 (64.7%)
AR&R 10 year, 20 minutes storm, average 79 mm/h, Zone 1	16645.3	11306.27 (67.9%)	0.00 (0.0%)	11306.27 (67.9%)
AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1	18699.63	13033.05 (69.7%)	0.00 (0.0%)	13033.05 (69.7%)
AR&R 10 year, 30 minutes storm, average 64 mm/h, Zone 1	20227.2	14242.97 (70.4%)	0.00 (0.0%)	14242.97 (70.4%)
AR&R 10 year, 45 minutes storm, average 51 mm/h, Zone 1	24177.83	17361.69 (71.8%)	0.00 (0.0%)	17361.69 (71.8%)
AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1	27369.93	19848.36 (72.5%)	0.00 (0.0%)	19848.36 (72.5%)
AR&R 10 year, 1.5 hours storm, average 34 mm/h, Zone 1	32237.1	23276.42 (72.2%)	0.00 (0.0%)	23276.42 (72.2%)
AR&R 10 year, 2 hours storm, average 28.5 mm/h, Zone 1	36029.7	25581.48 (71.0%)	0.00 (0.0%)	25581.48 (71.0%)
AR&R 10 year, 3 hours storm, average 22.2 mm/h, Zone 1	42097.85	29141.17 (69.2%)	0.00 (0.0%)	29141.17 (69.2%)
AR&R 10 year, 4.5 hours storm, average 17.3 mm/h, Zone 1	49208.97	32289.63 (65.6%)	0.00 (0.0%)	32289.63 (65.6%)

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

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

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
UNDEV REACH 10	8.235	8.235	24.007	0.186	0.69	12.04	3.68	AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1
UNDEV REACH 2	0.285	0.285	24.007	0.025	0.02	12	0.95	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
UNDEV REACH 3	0.359	0.359	24.007	0.028	0.03	12.01	1.07	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
UNDEV REACH 5	0.101	0.101	24.007	0.013	0.01	12	0.64	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
UNDEV REACH 6	0.296	0.296	24.007	0.025	0.02	12	0.99	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

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 Change (cu.m)	Difference %
UNDEV N10.1 Outlet	18281.43	18281.43	0	0
UNDEV N10	18281.43	18281.43	0	0
UNDEV N2	429.08	429.08	0	0
UNDEV N3	540.32	540.32	0	0
UNDEV N5	152.56	152.56	0	0
UNDEV N6	444.97	444.97	0	0
UNDEV N2.1 Outlet	429.08	429.08	0	0
UNDEV N3.1 Outlet	540.32	540.32	0	0
UNDEV N5.1 Outlet	152.56	152.56	0	0
UNDEV N6.1 Outlet	444.97	444.97	0	0

Run Log for 18383 Undev r1 20181114.drn run at 12:53:15 on 14/11/2018

Flows were safe in all overflow routes.

DRAINS results prepared from Version 2017.11

PIT / NODE DETAILS

Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint

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
UNDEV CAT 10	14.819	0	14.819	5	26.08	0	AR&R 100 year, 30 minutes storm, average 97 mm/h, Zone 1
UNDEV CAT 2	0.516	0	0.516	5	13.13	0	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
UNDEV CAT 3	0.649	0	0.649	5	13.13	0	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
UNDEV CAT 5	0.183	0	0.183	5	13.13	0	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
UNDEV CAT 6	0.535	0	0.535	5	13.13	0	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1

Outflow Volumes for Total Catchment (0.00 impervious + 63.2 pervious = 63.2 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	11588.5	7358.99 (63.5%)	0.00 (0.0%)	7358.99 (63.5%)
AR&R 100 year, 10 minutes storm, average 167 mm/h, Zone 1	17593.45	12952.53 (73.6%)	0.00 (0.0%)	12952.53 (73.6%)
AR&R 100 year, 15 minutes storm, average 139 mm/h, Zone 1	21965.47	16969.69 (77.3%)	0.00 (0.0%)	16969.69 (77.3%)
AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1	25284	19970.11 (79.0%)	0.00 (0.0%)	19970.11 (79.0%)
AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1	28181.13	22524.13 (79.9%)	0.00 (0.0%)	22524.13 (79.9%)
AR&R 100 year, 30 minutes storm, average 97 mm/h, Zone 1	30656.85	24691.90 (80.5%)	0.00 (0.0%)	24691.90 (80.5%)
AR&R 100 year, 45 minutes storm, average 77 mm/h, Zone 1	36503.77	29702.67 (81.4%)	0.00 (0.0%)	29702.67 (81.4%)
AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1	41086.5	33518.09 (81.6%)	0.00 (0.0%)	33518.09 (81.6%)
AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1	49303.8	40246.91 (81.6%)	0.00 (0.0%)	40246.91 (81.6%)
AR&R 100 year, 2 hours storm, average 43.4 mm/h, Zone 1	54866.29	44312.38 (80.8%)	0.00 (0.0%)	44312.38 (80.8%)
AR&R 100 year, 3 hours storm, average 34 mm/h, Zone 1	64474.2	51221.31 (79.4%)	0.00 (0.0%)	51221.31 (79.4%)
AR&R 100 year, 4.5 hours storm, average 26.7 mm/h, Zone 1	75946.81	58417.72 (76.9%)	0.00 (0.0%)	58417.72 (76.9%)

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

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

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
UNDEV REACH 10	14.819	14.819	24.007	0.265	1.23	12.05	4.65	AR&R 100 year, 30 minutes storm, average 97 mm/h, Zone 1
UNDEV REACH 2	0.516	0.516	24.007	0.035	0.04	12.01	1.24	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
UNDEV REACH 3	0.649	0.649	24.007	0.041	0.05	12.01	1.34	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
UNDEV REACH 5	0.183	0.183	24.007	0.019	0.02	12	0.8	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
UNDEV REACH 6	0.535	0.535	24.007	0.036	0.04	12.01	1.25	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

CONTINUITY CHECK for AR&R 100 year, 30 minutes storm, average 97 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
UNDEV N10.1 Outlet	22744.73	22744.73	0	0
UNDEV N10	22744.73	22744.73	0	0
UNDEV N2	533.21	533.21	0	0
UNDEV N3	671.45	671.45	0	0
UNDEV N5	189.59	189.59	0	0
UNDEV N6	552.96	552.96	0	0
UNDEV N2.1 Outlet	533.21	533.21	0	0
UNDEV N3.1 Outlet	671.45	671.45	0	0
UNDEV N5.1 Outlet	189.59	189.59	0	0
UNDEV N6.1 Outlet	552.96	552.96	0	0

Run Log for 18383 Undev r1 20181114.drn run at 12:54:54 on 14/11/2018

Flows were safe in all overflow routes.

DRAINS results prepared from Version 2017.11

PIT / NODE DETAILS

Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint

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
DEV CAT 10C	0.428	0	0.428	2.52	21.25	0	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
DEV CAT 10A	0.216	0.191	0.031	7.07	22.51	5	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
DEV CAT 10B	4.989	4.398	0.725	7.07	22.51	5	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
DEV CAT 1A	0.186	0.163	0.028	4.07	19.51	2	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
DEV CAT 1B	0.288	0.288	0.047	7.07	22.51	5	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
DEV CAT 1C	0.915	0.806	0.133	7.07	22.51	5	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
DEV CAT 1D	0.359	0	0.359	7.52	26.25	5	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
DEV CAT 2	0.186	0.164	0.027	7.07	22.51	0	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
DEV CAT 3	0.261	0.225	0.044	2.07	17.51	0	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
DEV CAT 5	0.454	0.392	0.076	2.07	17.51	0	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
DEV CAT 6	0.349	0.298	0.063	7.07	17.51	0	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1

Outflow Volumes for Total Catchment (36.7 impervious + 30.0 pervious = 66.7 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	4226.87	1995.34 (47.2%)	1958.32 (84.2%)	37.02 (1.9%)
AR&R 1 year, 10 minutes storm, average 58 mm/h, Zone 1	6451.53	3933.99 (61.0%)	3182.27 (89.7%)	751.71 (25.9%)
AR&R 1 year, 15 minutes storm, average 48.4 mm/h, Zone 1	8075.54	5417.65 (67.1%)	4075.75 (91.7%)	1341.90 (36.9%)
AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1	9388.09	6609.74 (70.4%)	4797.88 (92.9%)	1811.86 (42.9%)
AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1	10455.93	7536.40 (72.1%)	5385.38 (93.6%)	2151.02 (45.7%)
AR&R 1 year, 30 minutes storm, average 34.2 mm/h, Zone 1	11412.54	8339.12 (73.1%)	5911.68 (94.2%)	2427.44 (47.3%)
AR&R 1 year, 45 minutes storm, average 27.4 mm/h, Zone 1	13715.07	10257.12 (74.8%)	7178.46 (95.1%)	3078.66 (49.9%)
AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1	15483.68	11714.36 (75.7%)	8151.48 (95.7%)	3562.88 (51.2%)
AR&R 1 year, 1.5 hours storm, average 18.1 mm/h, Zone 1	18119.91	13691.81 (75.6%)	9601.88 (96.3%)	4089.93 (50.2%)
AR&R 1 year, 2 hours storm, average 15.1 mm/h, Zone 1	20155.48	15048.30 (74.7%)	10721.81 (96.7%)	4326.49 (47.7%)
AR&R 1 year, 3 hours storm, average 11.6 mm/h, Zone 1	23225.52	17007.91 (73.2%)	12410.78 (97.1%)	4597.13 (44.0%)
AR&R 1 year, 4.5 hours storm, average 8.96 mm/h, Zone 1	26909.57	18989.52 (70.6%)	14437.66 (97.5%)	4551.86 (37.6%)

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

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

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
DEV REACH 10	2.358	2.358	24.007	0.087	0.2	12.02	2.25	AR&R 1 year, 2 hours storm, average 15.1 mm/h, Zone 1
DEV REACH 10A	0.06	0.06	24.007	0.009	0.01	12	0.54	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
DEV REACH 10B	4.989	4.989	24.007	0.137	0.42	12.03	3.03	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
DEV REACH 1A	0.073	0.073	24.007	0.011	0.01	12	0.55	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1

DEV REACH 1B	0.345	0.345	24.007	0.028	0.03	12.01	1.03	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
DEV REACH 1C	0.915	0.915	24.007	0.049	0.08	12.01	1.54	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
DEV REACH 1D	1.015	1.015	24.007	0.052	0.08	12.01	1.62	AR&R 1 year, 25 minutes storm, average 37.6 mm/h, Zone 1
DEV REACH 2	0.069	0.069	24.007	0.01	0.01	12	0.56	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
DEV REACH 3	0.088	0.088	24.007	0.012	0.01	12	0.6	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
DEV REACH 5	0.02	0.02	24.007	0.005	0	12	0.31	AR&R 1 year, 4.5 hours storm, average 8.96 mm/h, Zone 1
DEV REACH 6	0.071	0.071	24.007	0.01	0.01	12	0.58	AR&R 1 year, 2 hours storm, average 15.1 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
DEV BASIN 10	16.94	5707	2.358	0	2.358
DEV BASIN 10A	30.5	150.9	0.06	0	0.06
DEV BASIN 1A	51.34	81.2	0.073	0	0.073
DEV BASIN 1	20.47	342.4	1.015	0	1.015
DEV BASIN 2	36.49	105.5	0.069	0	0.069
DEV BASIN 3	36.49	130.4	0.088	0	0.088
DEV BASIN 5	32.49	663.4	0.02	0	0.02
DEV BASIN 6	24.51	303.3	0.071	0	0.071

CONTINUITY CHECK for AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
DEV N10.1 Outlet	7801.27	7801.27	0	0
DEV N2.1 Outlet	250.73	250.73	0	0
DEV N3.1 Outlet	316.26	316.26	0	0
DEV N5.1 Outlet	166.79	166.79	0	0
DEV N6.1 Outlet	427.73	427.73	0	0
DEV BASIN 10	10139.74	7801.27	2338.79	0
DEV BASIN 10A	291.64	290.79	0.85	0
DEV N10B	6728.17	6728.17	0	0
DEV BASIN 1A	228.71	228.7	0.01	0
DEV N1B	668.94	668.94	0	0
DEV N1C	1233.44	1233.44	0	0
DEV BASIN 1	2498.2	2498.05	0.14	0
DEV BASIN 2	250.77	250.73	0.05	0
DEV BASIN 3	316.29	316.26	0.03	0
DEV BASIN 5	550.72	166.79	383.99	0
DEV BASIN 6	455.83	427.73	28.14	0

Run Log for 18383 DEVELOPED r1 20181114.drn run at 11:06:47 on 15/11/2018

Flows were safe in all overflow routes.

DRAINS results prepared from Version 2017.11

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint

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
DEV CAT 10C	1.26	0	1.26	1.61	13.58	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV CAT 10A	0.454	0.366	0.105	6.61	18.58	5	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV CAT 10B	10.478	8.433	2.426	6.61	18.58	5	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV CAT 1A	0.39	0.307	0.094	3.61	15.58	2	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV CAT 1B	0.552	0.552	0.159	6.61	18.58	5	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV CAT 1C	1.921	1.546	0.445	6.61	18.58	5	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV CAT 1D	0.972	0	0.972	6.96	21.55	5	AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1
DEV CAT 2	0.391	0.314	0.09	6.61	18.58	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV CAT 3	0.556	0.425	0.144	1.61	13.58	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV CAT 5	0.969	0.74	0.25	1.61	13.58	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV CAT 6	0.76	0.57	0.207	6.61	13.58	0	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1

Outflow Volumes for Total Catchment (36.7 impervious + 30.0 pervious = 66.7 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	8008.8	5704.90 (71.2%)	4039.04 (91.7%)	1665.86 (46.2%)
AR&R 10 year, 10 minutes storm, average 110 mm/h, Zone 1	12235.67	9749.70 (79.7%)	6364.55 (94.5%)	3385.16 (61.5%)
AR&R 10 year, 15 minutes storm, average 91 mm/h, Zone 1	15183.35	12538.15 (82.6%)	7986.28 (95.6%)	4551.88 (66.6%)
AR&R 10 year, 20 minutes storm, average 79 mm/h, Zone 1	17574.87	14794.14 (84.2%)	9302.02 (96.2%)	5492.12 (69.5%)
AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1	19743.92	16808.18 (85.1%)	10495.39 (96.6%)	6312.79 (71.1%)
AR&R 10 year, 30 minutes storm, average 64 mm/h, Zone 1	21356.8	18274.67 (85.6%)	11382.74 (96.9%)	6891.93 (71.7%)
AR&R 10 year, 45 minutes storm, average 51 mm/h, Zone 1	25528.05	22052.12 (86.4%)	13677.65 (97.4%)	8374.47 (72.9%)
AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1	28898.42	25070.26 (86.8%)	15531.95 (97.7%)	9538.31 (73.4%)
AR&R 10 year, 1.5 hours storm, average 34 mm/h, Zone 1	34037.4	29507.37 (86.7%)	18359.23 (98.0%)	11148.13 (72.8%)
AR&R 10 year, 2 hours storm, average 28.5 mm/h, Zone 1	38041.8	32801.73 (86.2%)	20562.38 (98.2%)	12239.35 (71.5%)
AR&R 10 year, 3 hours storm, average 22.2 mm/h, Zone 1	44448.84	37987.63 (85.5%)	24087.37 (98.5%)	13900.26 (69.5%)
AR&R 10 year, 4.5 hours storm, average 17.3 mm/h, Zone 1	51957.08	43595.93 (83.9%)	28218.23 (98.7%)	15377.69 (65.8%)

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

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

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
DEV REACH 10	7.551	7.551	24.007	0.176	0.63	12.04	3.56	AR&R 10 year, 2 hours storm, average 28.5 mm/h, Zone 1
DEV REACH 10A	0.23	0.23	24.007	0.022	0.02	12	0.87	AR&R 10 year, 2 hours storm, average 28.5 mm/h, Zone 1
DEV REACH 10B	10.478	10.478	24.007	0.215	0.87	12.04	4.05	AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV REACH 1A	0.11	0.11	24.007	0.014	0.01	12	0.65	AR&R 10 year, 1 hour storm, average 43.3 mm/h, Zone 1

DEV REACH 1B	0.642	0.642	24.007	0.04	0.05	12.01	1.35 AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV REACH 1C	1.921	1.921	24.007	0.077	0.16	12.02	2.09 AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV REACH 1D	3.201	3.201	24.007	0.105	0.27	12.02	2.54 AR&R 10 year, 25 minutes storm, average 71 mm/h, Zone 1
DEV REACH 2	0.251	0.251	24.007	0.023	0.02	12	0.91 AR&R 10 year, 1.5 hours storm, average 34 mm/h, Zone 1
DEV REACH 3	0.357	0.357	24.007	0.028	0.03	12.01	1.07 AR&R 10 year, 1.5 hours storm, average 34 mm/h, Zone 1
DEV REACH 5	0.094	0.094	24.007	0.012	0.01	12	0.64 AR&R 10 year, 4.5 hours storm, average 17.3 mm/h, Zone 1
DEV REACH 6	0.261	0.261	24.007	0.023	0.02	12	0.95 AR&R 10 year, 2 hours storm, average 28.5 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
DEV BASIN 10	17.58	9958.7	7.551	0	7.551
DEV BASIN 10A	30.97	302.5	0.23	0	0.23
DEV BASIN 1A	51.89	230.2	0.11	0	0.11
DEV BASIN 1	20.98	738.2	3.201	0	3.201
DEV BASIN 2	36.97	218.8	0.251	0	0.251
DEV BASIN 3	36.98	277.5	0.357	0	0.357
DEV BASIN 5	32.97	1344.5	0.094	0	0.094
DEV BASIN 6	24.97	594.5	0.261	0	0.261

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 Change (cu.m)	Difference %
DEV N10.1 Outlet	19368.55	19368.55	0	0
DEV N2.1 Outlet	520.88	520.88	0	0
DEV N3.1 Outlet	656.82	656.82	0	0
DEV N5.1 Outlet	248.83	248.83	0	0
DEV N6.1 Outlet	816.12	816.12	0	0
DEV BASIN 10	21794.27	19368.55	2425.84	0
DEV BASIN 10A	606.08	599.37	6.73	0
DEV N10B	13982.3	13982.3	0	0
DEV BASIN 1A	475.14	475.07	0.08	0
DEV N1B	1389.98	1389.97	0	0
DEV N1C	2563.29	2563.29	0	0
DEV BASIN 1	5549.76	5549.51	0.25	0
DEV BASIN 2	521.15	520.88	0.27	0
DEV BASIN 3	656.99	656.82	0.17	0
DEV BASIN 5	1143.93	248.83	895.18	0
DEV BASIN 6	946.83	816.12	130.87	0

Run Log for 18383 DEVELOPED r1 20181114.drn run at 11:07:35 on 15/11/2018

Flows were safe in all overflow routes.

DRAINS results prepared from Version 2017.11

PIT / NODE DETAILS

Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint

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
DEV CAT 10C	2.228	0	2.228	1.3	11.01	0	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
DEV CAT 10A	0.658	0.502	0.181	6.37	16.53	5	AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1
DEV CAT 10B	15.182	11.57	4.165	6.37	16.53	5	AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1
DEV CAT 1A	0.574	0.489	0.085	3.02	10.64	2	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
DEV CAT 1B	0.789	0.789	0.25	6.23	15.38	5	AR&R 100 year, 15 minutes storm, average 139 mm/h, Zone 1
DEV CAT 1C	2.783	2.121	0.764	6.37	16.53	5	AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1
DEV CAT 1D	1.68	0	1.68	6.3	16.01	5	AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1
DEV CAT 2	0.566	0.431	0.155	6.37	16.53	0	AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1
DEV CAT 3	0.82	0.675	0.144	1.02	8.64	0	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
DEV CAT 5	1.427	1.176	0.252	1.02	8.64	0	AR&R 100 year, 5 minutes storm, average 220 mm/h, Zone 1
DEV CAT 6	1.132	0.783	0.35	6.37	11.53	0	AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1

Outflow Volumes for Total Catchment (36.7 impervious + 30.0 pervious = 66.7 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	12235.67	9954.25 (81.4%)	6364.55 (94.5%)	3589.70 (65.2%)
AR&R 100 year, 10 minutes storm, average 167 mm/h, Zone 1	18575.97	16109.62 (86.7%)	9852.80 (96.4%)	6256.82 (74.9%)
AR&R 100 year, 15 minutes storm, average 139 mm/h, Zone 1	23192.15	20560.70 (88.7%)	12392.50 (97.1%)	8168.19 (78.3%)
AR&R 100 year, 20 minutes storm, average 120 mm/h, Zone 1	26696	23911.93 (89.6%)	14320.21 (97.5%)	9591.71 (79.9%)
AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1	29754.92	26812.77 (90.1%)	16003.17 (97.8%)	10809.60 (80.8%)
AR&R 100 year, 30 minutes storm, average 97 mm/h, Zone 1	32368.9	29282.25 (90.5%)	17441.27 (97.9%)	11840.98 (81.3%)
AR&R 100 year, 45 minutes storm, average 77 mm/h, Zone 1	38542.35	35055.95 (91.0%)	20837.76 (98.3%)	14218.19 (82.0%)
AR&R 100 year, 1 hour storm, average 65 mm/h, Zone 1	43381.01	39526.94 (91.1%)	23499.76 (98.5%)	16027.18 (82.1%)
AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1	52057.2	47490.91 (91.2%)	28273.18 (98.7%)	19217.73 (82.1%)
AR&R 100 year, 2 hours storm, average 43.4 mm/h, Zone 1	57930.33	52661.07 (90.9%)	31504.43 (98.8%)	21156.64 (81.2%)
AR&R 100 year, 3 hours storm, average 34 mm/h, Zone 1	68074.81	61500.55 (90.3%)	37085.77 (99.0%)	24414.78 (79.7%)
AR&R 100 year, 4.5 hours storm, average 26.7 mm/h, Zone 1	80188.12	71581.41 (89.3%)	43750.05 (99.2%)	27831.36 (77.2%)

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

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

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
DEV REACH 10	14.771	14.771	24.007	0.265	1.23	12.05	4.63	AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1
DEV REACH 10A	0.345	0.345	24.007	0.028	0.03	12.01	1.03	AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1
DEV REACH 10B	15.182	15.182	24.007	0.269	1.26	12.05	4.69	AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1
DEV REACH 1A	0.391	0.391	24.007	0.03	0.03	12.01	1.09	AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1

DEV REACH 1B	1.139	1.139	24.007	0.056	0.09	12.01	1.69	AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1
DEV REACH 1C	2.783	2.783	24.007	0.096	0.23	12.02	2.41	AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1
DEV REACH 1D	4.332	4.332	24.007	0.125	0.36	12.03	2.87	AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1
DEV REACH 2	0.36	0.36	24.007	0.028	0.03	12.01	1.08	AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1
DEV REACH 3	0.469	0.469	24.007	0.033	0.04	12.01	1.19	AR&R 100 year, 1.5 hours storm, average 52 mm/h, Zone 1
DEV REACH 5	0.134	0.134	24.007	0.015	0.01	12	0.74	AR&R 100 year, 4.5 hours storm, average 26.7 mm/h, Zone 1
DEV REACH 6	0.392	0.392	24.007	0.03	0.03	12.01	1.1	AR&R 100 year, 2 hours storm, average 43.4 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
DEV BASIN 10	17.93	12694	14.771	0	14.771
DEV BASIN 10A	31.25	404.3	0.345	0	0.345
DEV BASIN 1A	52.06	276.7	0.391	0	0.391
DEV BASIN 1	21.39	1073.7	4.332	0	4.332
DEV BASIN 2	37.2	279.1	0.36	0	0.36
DEV BASIN 3	37.25	363.7	0.469	0	0.469
DEV BASIN 5	33.34	1884.1	0.134	0	0.134
DEV BASIN 6	25.31	827.3	0.392	0	0.392

CONTINUITY CHECK for AR&R 100 year, 25 minutes storm, average 107 mm/h, Zone 1

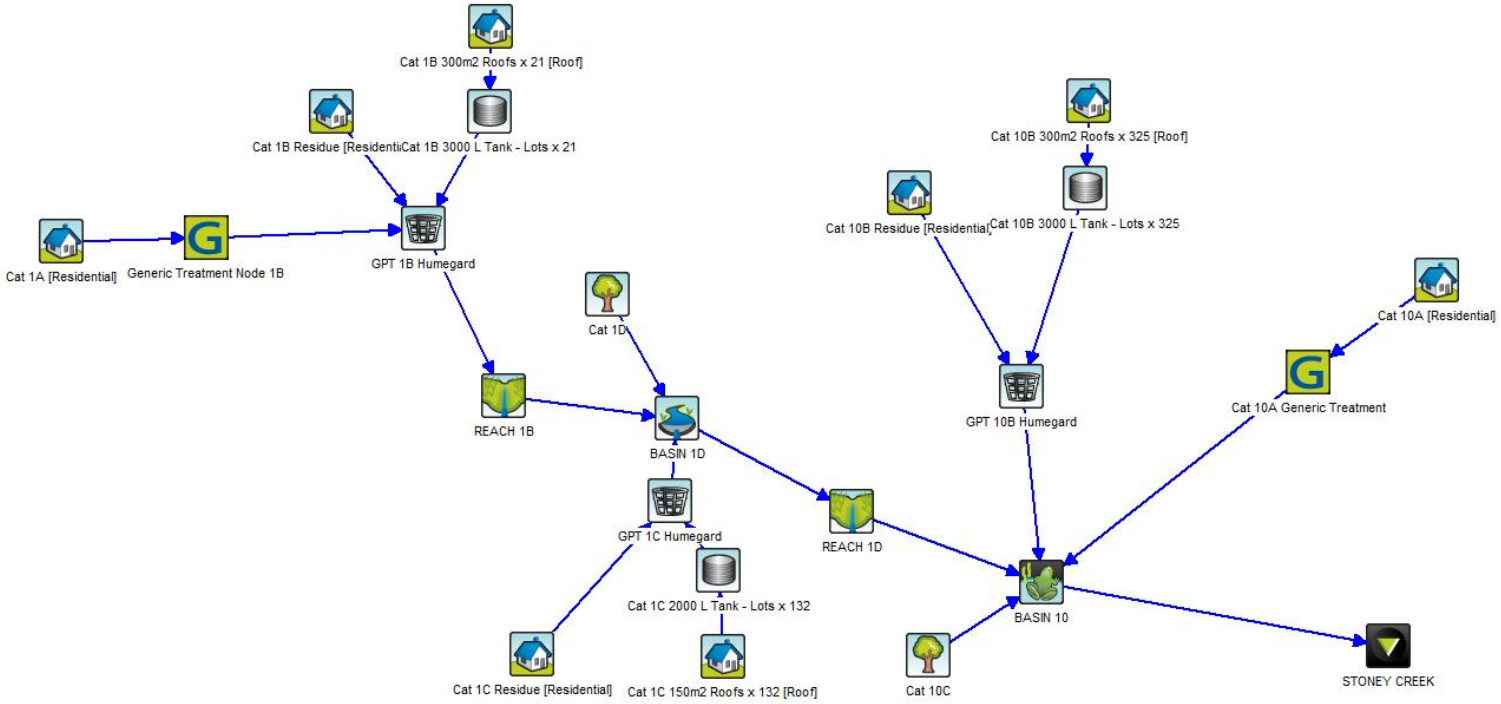
Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
DEV N10.1 Outlet	20814	20814	0	0
DEV N2.1 Outlet	550.8	550.8	0	0
DEV N3.1 Outlet	695.82	695.82	0	0
DEV N5.1 Outlet	186.98	186.98	0	0
DEV N6.1 Outlet	799.9	799.9	0	0
DEV BASIN 10	23322.05	20814	2508.07	0
DEV BASIN 10A	642.31	619.29	23.1	0
DEV N10B	14818.19	14818.19	0	0
DEV BASIN 1A	503.76	503.22	0.54	0
DEV N1B	1472.83	1472.81	0	0
DEV N1C	2716.53	2716.53	0	0
DEV BASIN 1	5997.62	5996.9	0.71	0
DEV BASIN 2	552.31	550.8	1.51	0
DEV BASIN 3	696.76	695.82	0.95	0
DEV BASIN 5	1213.19	186.98	1026.29	0
DEV BASIN 6	1004.16	799.9	204.44	0

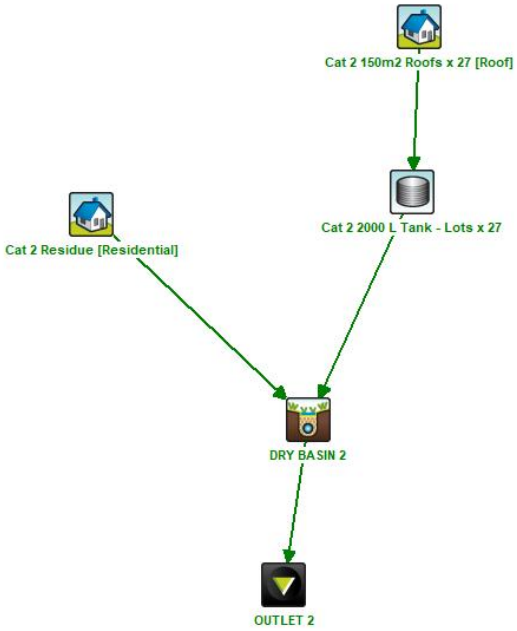
Run Log for 18383 DEVELOPED r1 20181114.drn run at 11:08:07 on 15/11/2018

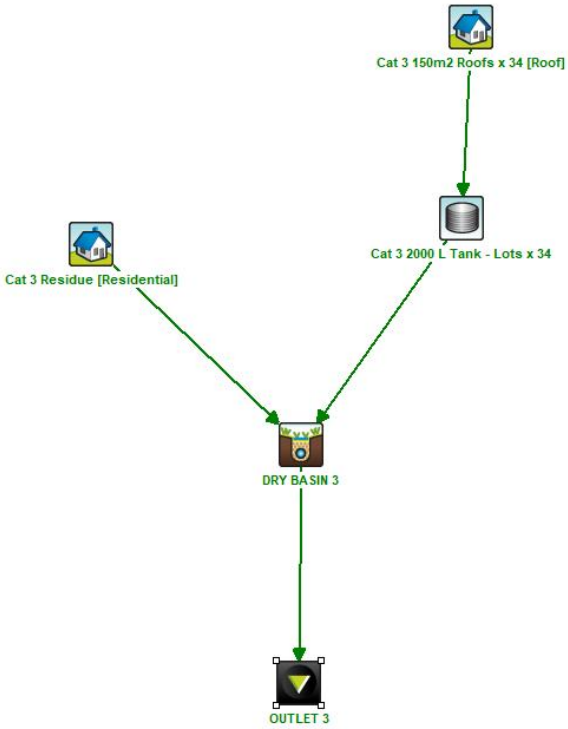
Flows were safe in all overflow routes.

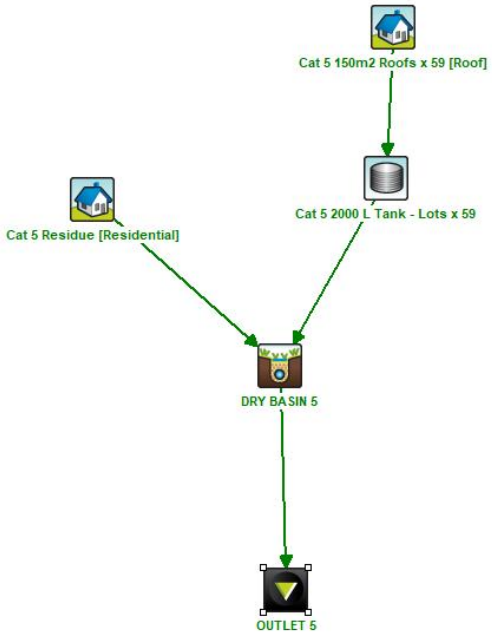
Appendix C

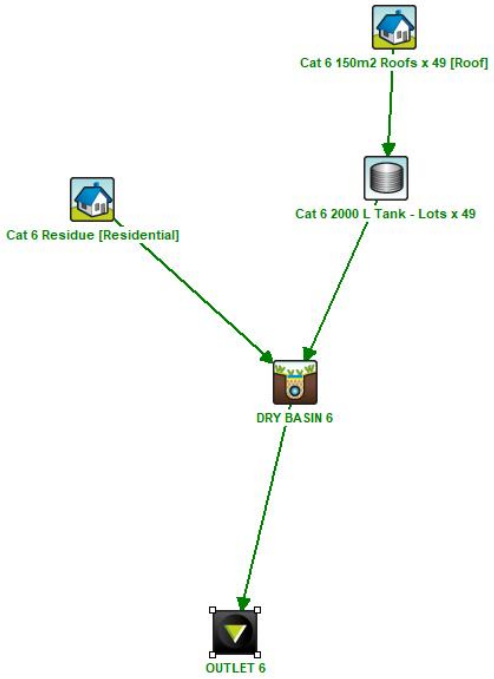
MUSIC Model Data


Cat 1B 300m2 Roofs x 21 [Roof]
Cat 1B Residue [Residenti
Cat 1B 3000 L Tank - Lots x 21
Cat 1A [Residential]
Generic Treatment Node 1B
GPT 1B Humegard
Cat 1D
REACH 1B
BASIN 1D
GPT 1C Humegard
REACH 1D
Cat 1C 2000 L Tank - Lots x 132
Cat 1C Residue [Residential]
Cat 1C 150m2 Roofs x 132 [Roof]
Cat 10B 300m2 Roofs x 325 [Roof]
Cat 10B Residue [Residential
Cat 10B 3000 L Tank - Lots x 325
GPT 10B Humegard
Cat 10A [Residential]
Cat 10A Generic Treatment
BASIN 10
Cat 10C
STONEY CREEK


Cat 2 150m2 Roofs x 27 [Roof]
Cat 2 2000 L Tank - Lots x 27
Cat 2 Residue [Residential]
DRY BASIN 2
OUTLET 2


Cat 3 150m2 Roofs x 34 [Roof]
Cat 3 2000 L Tank - Lots x 34
Cat 3 Residue [Residential]
DRY BASIN 3
OUTLET 3


Cat 5 150m2 Roofs x 59 [Roof]
Cat 5 2000 L Tank - Lots x 59
Cat 5 Residue [Residential]
DRY BASIN 5
OUTLET 5


Cat 6 150m2 Roofs x 49 [Roof]
Cat 6 2000 L Tank - Lots x 49
Cat 6 Residue [Residential]
DRY BASIN 6
OUTLET 6