

Attachment A

Stormwater Management Strategy Elements and Water Quality Parameters

1.1 Water Quality Elements

On Lot Treatments

- Adoption of appropriate waterwise landscaping practices (resident education, native gardens, mulch, micro-irrigation).
- Implementation of water efficient fittings and appliances in all dwellings (dual flush toilet, AAA shower heads, water efficient taps and plumbing).
- Minimisation of impervious areas.
- The provision of a future reticulated recycled water main to the site, along with implementation of the above water efficient devices, will satisfy the requirements of BASIX.

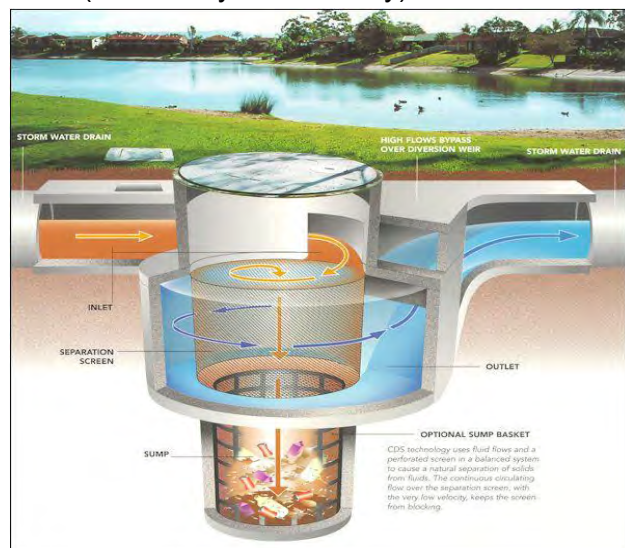


Street Level Treatments

Gross Pollutant Traps (GPTs)

GPT devices are typically provided at the outlet to stormwater pipes. These systems operate as a primary treatment to remove litter, vegetative matter, free oils and grease and coarse sediments prior to discharge to a downstream (Secondary and Tertiary) treatment devices.

They can take the form of trash screens or litter control pits, filter pit inserts and wet sump gross pollutant traps. Council approved GPT units are to be provided at the end of stormwater pipes from urbanised catchments prior to discharging to the receiving waters.



1.2 Water Quality Elements Standard Parameters

The general features and configuration of the various water quality elements are provide below.

	Pond
Storage	
Surface Area (m ²)	3000
Extended Detention Depth	0.3
Evaporative Loss as % of PET	100
Outlet	
Equivalent Pipe Diameter (mm)	50
Overflow Weir Width (m)	5
Notional Detention Time (hrs)	78.4

	Sand Filter
Storage	
Extended Detention Depth	0.3
Infiltration	
Filter Area (m ²)	700
Filter Depth (m)	0.6
Filter Particle Effective Diameter (mm)	1.00
Saturated Hydraulic Conductivity (mm/h)	3600
Outlet	
Overflow Weir Width (m)	5

	Raingarden
Storage	
Extended Detention Depth	0.3
Infiltration	
Filter Area (m ²)	750
Filter Depth (m)	0.6
Filter Particle Effective Diameter (mm)	0.45
Saturated Hydraulic Conductivity (mm/h)	100
Outlet	
Overflow Weir Width (m)	5

ADOPTED SOIL / GROUNDWATER PARAMETERS

	Units	Parks	Roofed*	Road*	Remaining Urban
Impervious Area Parameters					
Rainfall threshold	mm/day	1.4	0.5	1.0	1.4
Pervious Area Parameters					
Soil storage capacity	mm	210			170
Initial storage	% of capacity	30			30
Field capacity	mm	80			70
Infiltration capacity coefficient - a		175			210
Infiltration capacity coefficient - b		3.1			4.7
Groundwater Properties					
Initial depth	mm	10			10
Daily recharge rate	%	35			50
Daily baseflow rate	%	20			4
Daily deep seepage rate	%	0			0

* Roofed and Road catchments have been assumed to be 100% impervious

ADOPTED ANNUAL POLLUTANT EVENT MEAN CONCENTRATIONS

Pollutant	Roofed*		Road*		Remaining Urban		Parks	
	Base Flow (mg/l)	Storm Flow (mg/l)	Base Flow (mg/l)	Storm Flow (mg/l)	Base Flow (mg/l)	Storm Flow (mg/l)	Base Flow (mg/l)	Storm Flow (mg/l)
TSS	0.0	20.0	0.0	270	16.0	265.0	6.0	40.0
TP	0	0.13	0	0.50	0.140	0.18	0.030	0.08
TN	0.00	2.00	0.00	2.20	1.30	1.68	3.30	0.90

* Roofed and Road catchments have been assumed to be 100% impervious

1.3 Water Quality Device Performance Criteria

The expected sediment and nutrient removal performance of the proposed devices was determined using the default equations and parameters provided in the MUSIC model (Ref. 21). The water quality reduction mechanisms in MUSIC are based on an exponential decay equation referred to as the $k - C^*$ curve (refer to Wong et al. – Ref. 23).

MUSIC – PERFORMANCE PARAMETERS

Pollutant	Sand Filter		Pond		Bio- Retention	
	k (m/yr)	C* (mg/L)	k (m/yr)	C* (mg/L)	k (m/yr)	C* (mg/L)
TSS	8000	20.000	400	12.000	8000	20.000
TP	6000	0.130	300	0.090	6000	0.130
TN	500	1.400	40	1.000	500	1.400

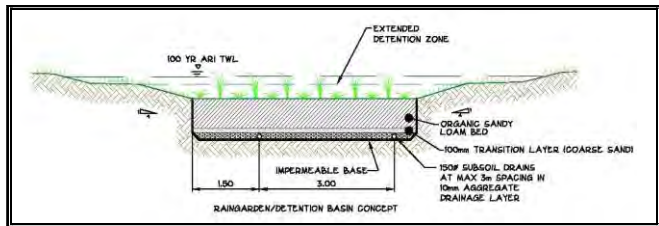
Ornamental Pond

The Ornamental Pond consists of an open water body with an extended detention zone typically from 100-300 mm deep designed to detain and treat first flush flows from the upstream catchment. Ornamental ponds are generally provided as an aesthetic amenity for the community and are typically located within focal open space areas. The overall depth of ornamental ponds are typically 1.5 – 2.5 m deep.



Bio-Retention Raingarden

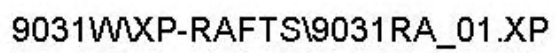
Bio-retention raingardens consist of a filtration bed with either gravel or sandy loam media and an extended detention zone typically from 100-300 mm deep designed to detain and treat first flush flows from the upstream catchment. They are typically located within bushland corridors or other open space areas. The depth of the bio-retention raingarden media beds are typically 400 - 600 mm deep.



The Bio-retention Raingardens will also function to assist in detaining first flush flows to replicate the natural wetting and drying regime discharging from the development. The locations of the raingardens are shown on Figure 3. (Refer to Section 6.6 for further discussion).

Attachment B

**Hydrological Modelling Results
Pre-Development Conditions
XP-RAFTS Model: 9031RA_01.xp**



PRE-DEVELOPMENT CONDITIONS
INGLEBURN DEFENCE LANDS
16/06/2010

9031RA_01.out
Run started at: 8th July 2010 9:16:14

INGLEBURN DEFENCE LANDS - Pre-Development Catchment
#####

ROUTING INCREMENT (MINS) = 2.00
STORM DURATION (MINS) = 270.
RETURN PERIOD (YRS) = 5.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 200.80
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 200.80

SUMMARY OF CATCHMENT AND RAINFALL DATA											
Link	Catch. Area		Slope		% Impervious		Pern		B		Link
Label	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	No.
	(ha)		(%)		(%)						
1.00	33.200	0.000	3.000	0.000	10.00	0.000	.050	0.00	.1023	0.000	1.000
1.01	21.400	0.000	3.000	0.000	5.000	0.000	.050	0.00	.0991	0.000	1.001
1.02	46.000	0.000	2.500	0.000	5.000	0.000	.050	0.00	.1615	0.000	1.002
1.03	13.400	0.000	2.200	0.000	5.000	0.000	.050	0.00	.0907	0.000	1.003
2.00	21.600	0.000	3.200	0.000	10.00	0.000	.050	0.00	.0792	0.000	2.000
2.01	10.000	0.000	3.000	0.000	5.000	0.000	.050	0.00	.0667	0.000	2.001
1.04d	.00001	0.000	4.000	0.000	1.000	0.000	.050	0.00	0.000	0.000	1.004
1.05	29.000	0.000	2.000	0.000	5.000	0.000	.050	0.00	.1420	0.000	1.005
3.00	26.200	0.000	8.000	0.000	5.000	0.000	.050	0.00	.0675	0.000	3.000
Outflows	.00001	0.000	5.000	0.000	1.000	0.000	.050	0.00	0.000	0.000	1.006

Link	Average	Init. Loss	Cont. Loss	Excess	Rain	Peak	Time	Link
Label	Intensity	#1	#2	#1	#2	Inflow	to	Lag
	(mm/h)	(mm)		(mm/h)	(mm)	(m^3/s)	Peak	mins
1.00	17.200	15.00	0.000	2.500	0.000	53.150	0.000	3.000
1.01	17.200	15.00	0.000	2.500	0.000	53.150	0.000	6.500
1.02	17.200	15.00	0.000	2.500	0.000	53.150	0.000	3.000
1.03	17.200	15.00	0.000	2.500	0.000	53.150	0.000	0.000
2.00	17.200	15.00	0.000	2.500	0.000	53.150	0.000	3.000
2.01	17.200	15.00	0.000	2.500	0.000	53.150	0.000	0.000
1.04d	17.200	15.00	0.000	2.500	0.000	53.150	0.000	5.300
1.05	17.200	15.00	0.000	2.500	0.000	53.150	0.000	0.000
3.00	17.200	15.00	0.000	2.500	0.000	53.150	0.000	0.000
Outflows	17.200	15.00	0.000	2.500	0.000	53.150	0.000	0.000

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 120.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 200.80
TOTAL OF SECOND SUB-AREAS (ha) = 0.00
TOTAL OF ALL SUB-AREAS (ha) = 200.80

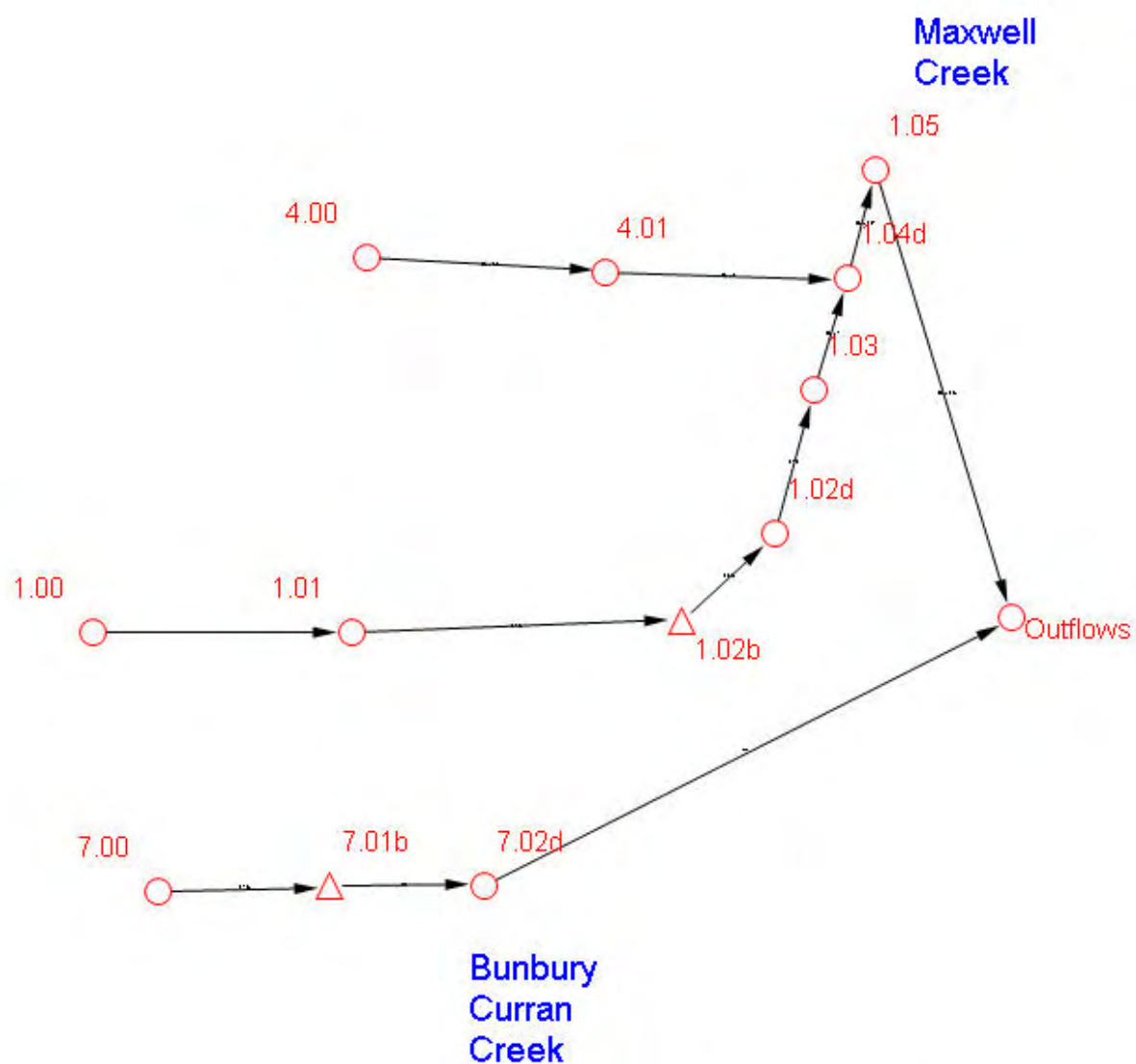
SUMMARY OF CATCHMENT AND RAINFALL DATA											
Link	Catch. Area		Slope		% Impervious		Pern		B		Link
Label	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	No.
	(ha)		(%)		(%)						
1.00	33.200	0.000	3.000	0.000	10.00	0.000	.050	0.00	.1023	0.000	1.000
1.01	21.400	0.000	3.000	0.000	5.000	0.000	.050	0.00	.0991	0.000	1.001
1.02	46.000	0.000	2.500	0.000	5.000	0.000	.050	0.00	.1615	0.000	1.002
1.03	13.400	0.000	2.200	0.000	5.000	0.000	.050	0.00	.0907	0.000	1.003
2.00	21.600	0.000	3.200	0.000	10.00	0.000	.050	0.00	.0792	0.000	2.000
2.01	10.000	0.000	3.000	0.000	5.000	0.000	.050	0.00	.0667	0.000	2.001
1.04d	.00001	0.000	4.000	0.000	1.000	0.000	.050	0.00	0.000	0.000	1.004
1.05	29.000	0.000	2.000	0.000	5.000	0.000	.050	0.00	.1420	0.000	1.005
3.00	26.200	0.000	8.000	0.000	5.000	0.000	.050	0.00	.0675	0.000	3.000
Outflows	.00001	0.000	5.000	0.000	1.000	0.000	.050	0.00	0.000	0.000	1.006

Link	Average	Init. Loss	Cont. Loss	Excess	Rain	Peak	Time	Link
Label	Intensity	#1	#2	#1	#2	Inflow	to	Lag
	(mm/h)	(mm)		(mm/h)	(mm)	(m^3/s)	Peak	mins
1.00	45.000	15.00	0.000	2.500	0.000	70.833	0.000	3.000
1.01	45.000	15.00	0.000	2.500	0.000	70.833	0.000	6.500
1.02	45.000	15.00	0.000	2.500	0.000	70.833	0.000	3.000
1.03	45.000	15.00	0.000	2.500	0.000	70.833	0.000	0.000
2.00	45.000	15.00	0.000	2.500	0.000	70.833	0.000	3.000
2.01	45.000	15.00	0.000	2.500	0.000	70.833	0.000	0.000
1.04d	45.000	15.00	0.000	2.500	0.000	70.833	0.000	5.300
1.05	45.000	15.00	0.000	2.500	0.000	70.833	0.000	0.000
3.00	45.000	15.00	0.000	2.500	0.000	70.833	0.000	0.000
Outflows	45.000	15.00	0.000	2.500	0.000	70.833	0.000	0.000

Run completed at: 8th July 2010 9:16:16

Attachment C

**Hydrological Modelling Results Stage 1
Interim Post-Development Conditions
XP-RAFTS Model: 9031RA_02_Interim.xp**



INTERIM POST-DEVELOPMENT CONDITIONS
INGLEBURN DEFENCE LANDS
30/07/2010

9031WXP-RAFTS\9031RA_02_Interim.XP

INGLEBURN DEFENCE LANDS - Post-Development Stage 1 Catchment
#####

ROUTING INCREMENT (MINS) = 2.00
STORM DURATION (MINS) = 540.
RETURN PERIOD (YRS) = 5.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 174.20
TOTAL OF SECOND SUB-AREAS (ha) = 28.90
TOTAL OF ALL SUB-AREAS (ha) = 203.10

SUMMARY OF CATCHMENT AND RAINFALL DATA											
Link	Catch. Area		Slope		% Impervious		Pern		B		Link
Label	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	No.
	(ha)		(%)		(%)						
1.00	22.500	16.000	3.000	5.000	1.000	100.0	.025	.015	.0725	.0028	1.000
1.01	15.800	0.000	3.000	0.000	1.000	0.000	.050	0.00	.1005	0.000	1.001
1.02b	40.000	3.800	1.000	1.000	1.000	100.0	.050	.015	.2818	.0030	1.002
1.02d	.00001	0.000	2.200	0.000	5.000	0.000	.050	0.00	0.000	0.000	1.003
1.03	15.900	0.000	2.000	0.000	5.000	0.000	.050	0.00	.1039	0.000	1.004
4.00	21.600	0.000	3.200	0.000	1.000	0.000	.050	0.00	.1145	0.000	2.000
4.01	10.000	0.000	1.000	0.000	1.000	0.000	.050	0.00	.1371	0.000	2.001
1.04d	.00001	0.000	4.000	0.000	1.000	0.000	.050	0.00	0.000	0.000	1.005
1.05	29.000	0.000	2.000	0.000	5.000	0.000	.050	0.00	.1420	0.000	1.006
7.00	19.250	8.500	8.000	8.000	1.000	100.0	.025	.015	.0410	.0016	3.000
7.01b	0.1500	0.6000	1.000	1.000	1.000	100.0	.025	.015	.0093	.0011	3.001
7.02d	.00001	0.000	5.000	0.000	1.000	0.000	.025	0.00	0.000	0.000	3.002
Outflows	.00001	0.000	5.000	0.000	1.000	0.000	.025	0.00	0.000	0.000	1.007

Link	Average	Init. Loss	Cont. Loss	Excess Rain	Peak	Time	Link
Label	Intensity	#1	#2	#1	#2	Inflow	to
	(mm/h)	(mm)	(mm/h)	(mm)		(m^3/s)	Peak
							mins
1.00	10.100	15.00	1.500	2.500	0.000	58.624	300.0
1.01	10.100	15.00	0.000	2.500	0.000	58.624	302.0
1.02b	10.100	15.00	1.500	2.500	0.000	58.624	308.0
1.02d	10.100	15.00	0.000	2.500	0.000	58.624	358.0
1.03	10.100	15.00	0.000	2.500	0.000	58.624	342.0
4.00	10.100	15.00	0.000	2.500	0.000	58.624	330.0
4.01	10.100	15.00	0.000	2.500	0.000	58.624	332.0
1.04d	10.100	15.00	0.000	2.500	0.000	58.624	334.0
1.05	10.100	15.00	0.000	2.500	0.000	58.624	336.0
7.00	10.100	15.00	1.500	2.500	0.000	58.624	300.0
7.01b	10.100	15.00	1.500	2.500	0.000	58.624	300.0
7.02d	10.100	15.00	0.000	2.500	0.000	58.624	304.0
Outflows	10.100	15.00	0.000	2.500	0.000	58.624	330.0

SUMMARY OF BASIN RESULTS

Link	Time	Peak	Time	Peak	Total	-----	Basin	-----
Label	to	Inflow	to	Outflow	Inflow	Vol.	Vol.	Stage
	Peak	(m^3/s)	Peak	(m^3/s)	(m^3)	Avail	Used	Used
1.02b	308.0	5.974	358.0	4.208	61804.7	10.000	9168.9	52.489
7.01b	300.0	2.565	304.0	2.280	19494.9	0.0000	1280.1	39.027

SUMMARY OF BASIN OUTLET RESULTS

Link	No.	S/D	Dia	Width	Pipe	Pipe
Label	of	Factor	(m)	(m)	Length	Slope
		(m)			(m)	(%)
1.02b	3.0	1.000		0.000	20.000	0.5000
7.01b	1.0	1.000		0.000	20.000	0.2000

ROUTING INCREMENT (MINS) = 2.00
STORM DURATION (MINS) = 540.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (ha) = 174.20
TOTAL OF SECOND SUB-AREAS (ha) = 28.90
TOTAL OF ALL SUB-AREAS (ha) = 203.10

SUMMARY OF CATCHMENT AND RAINFALL DATA											
Link	Catch. Area		Slope		% Impervious		Pern		B		Link
Label	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	No.
	(ha)		(%)		(%)						
1.00	22.500	16.000	3.000	5.000	1.000	100.0	.025	.015	.0725	.0028	1.000
1.01	15.800	0.000	3.000	0.000	1.000	0.000	.050	0.00	.1005	0.000	1.001
1.02b	40.000	3.800	1.000	1.000	1.000	100.0	.050	.015	.2818	.0030	1.002
1.02d	.00001	0.000	2.200	0.000	5.000	0.000	.050	0.00	0.000	0.000	1.003
1.03	15.900	0.000	2.000	0.000	5.000	0.000	.050	0.00	.1039	0.000	1.004
4.00	21.600	0.000	3.200	0.000	1.000	0.000	.050	0.00	.1145	0.000	2.000
4.01	10.000	0.000	1.000	0.000	1.000	0.000	.050	0.00	.1371	0.000	2.001
1.04d	.00001	0.000	4.000	0.000	1.000	0.000	.050	0.00	0.000	0.000	1.005

9031RA_02_Interim.out

1.05	29.000	0.000	2.000	0.000	5.000	0.000	.050	0.00	.1420	0.000	1.006
7.00	19.250	8.500	8.000	8.000	1.000	100.0	.025	.015	.0410	.0016	3.000
7.01b	0.1500	0.6000	1.000	1.000	1.000	100.0	.025	.015	.0093	.0011	3.001
7.02d	.00001	0.000	5.000	0.000	1.000	0.000	.025	0.00	0.000	0.000	3.002
Outflows	.00001	0.000	5.000	0.000	1.000	0.000	.025	0.00	0.000	0.000	1.007

Link Label	Average Intensity (mm/h)	Init. #1 (mm)	Loss #2 (mm)	Cont. #1 (mm/h)	Loss #2 (mm/h)	Excess #1 (mm)	Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
1.00	17.330	15.00	1.500	2.500	0.000	121.22	154.47	5.431	300.0	1.000
1.01	17.330	15.00	0.000	2.500	0.000	121.22	0.000	7.226	302.0	6.000
1.02b	17.330	15.00	1.500	2.500	0.000	121.22	154.47	10.696	308.0	0.000
1.02d	17.330	15.00	0.000	2.500	0.000	121.22	0.000	7.015	364.0	2.000
1.03	17.330	15.00	0.000	2.500	0.000	121.22	0.000	8.126	362.0	0.000
4.00	17.330	15.00	0.000	2.500	0.000	121.22	0.000	2.538	320.0	3.000
4.01	17.330	15.00	0.000	2.500	0.000	121.22	0.000	3.580	330.0	0.000
1.04d	17.330	15.00	0.000	2.500	0.000	121.22	0.000	10.984	332.0	5.300
1.05	17.330	15.00	0.000	2.500	0.000	121.22	0.000	14.144	332.0	0.000
7.00	17.330	15.00	1.500	2.500	0.000	121.22	154.47	4.086	300.0	0.000
7.01b	17.330	15.00	1.500	2.500	0.000	121.22	154.47	4.198	300.0	0.000
7.02d	17.330	15.00	0.000	2.500	0.000	121.22	0.000	3.622	306.0	0.000
Outflows	17.330	15.00	0.000	2.500	0.000	121.22	0.000	17.357	330.0	0.000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Vol. Avail	Basin Vol. Used	Stage Used
1.02b	308.0	10.70	364.0	7.015	122489.	10.000	25841.7	53.164
7.01b	300.0	4.197	306.0	3.621	37536.2	0.0000	2724.3	39.359

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
1.02b	3.0	1.000		0.000	20.000	0.5000
7.01b	1.0	1.000		0.000	20.000	0.2000

Run completed at: 24th August 2010 8:56:56

Attachment D

**Water Quality Modelling Layout –
Interim Post Development Catchment**

MUSIC Model: 9031MU_04.sqz

