SITE BASED STORMWATER MANAGEMENT PLAN

For

Cintra Road Holdings Pty Ltd

Proposed Multi-unit Residential Development at

48 Cintra Road,

Bowen Hills

Job Ref: SC-4777

September 2014

EMPIRE
ENGINEERING

AUTHORSHIP INFORMATION

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Affected Properties	
Street Address	48 Cintra Road, Bowen Hills
RP Description	Lots 18&19 RP10094
Prepared For	Cintra Road Holdings Pty Ltd
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REVISION	DATE	Reviewed/ Approval
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1.0 Introduction

1.1 Background

This report is to accompany and be considered part of an application to Brisbane City Council for a proposed residential multi-unit development at 48 Cintra Road, Bowen Hills.

1.2 Scope

Empire Engineering Pty Ltd was commissioned by Cintra Road Holdings Pty Ltd to develop a Site Based Stormwater Management Plan (SBSWMP) to outline water management strategies for the proposed development that will comply with Council's relevant planning scheme policies, Queensland Urban Drainage Manual and the Environmental Protection Act (1994) and associated Environmental Protection (Water) Policy 1997.

This report presents the results of a SWMP and outlines the proposed measures to be adopted in relation to stormwater quantity and quality management for the subject site and the proposed development.

1.3 Existing Topography

The subject site is described as Lots 18&19 RP10094, with a combined area of 911m^2. The site is bounded by existing high-density residential lots to the north, south and western boundaries with road frontage to Cintra Road on the eastern boundary.

The existing use is a large residential dwelling with roof areas of approximately 275m^2. The site falls away from the road frontage to the rear north-western corner of the site at approximately 10%. See Fig 1.1.

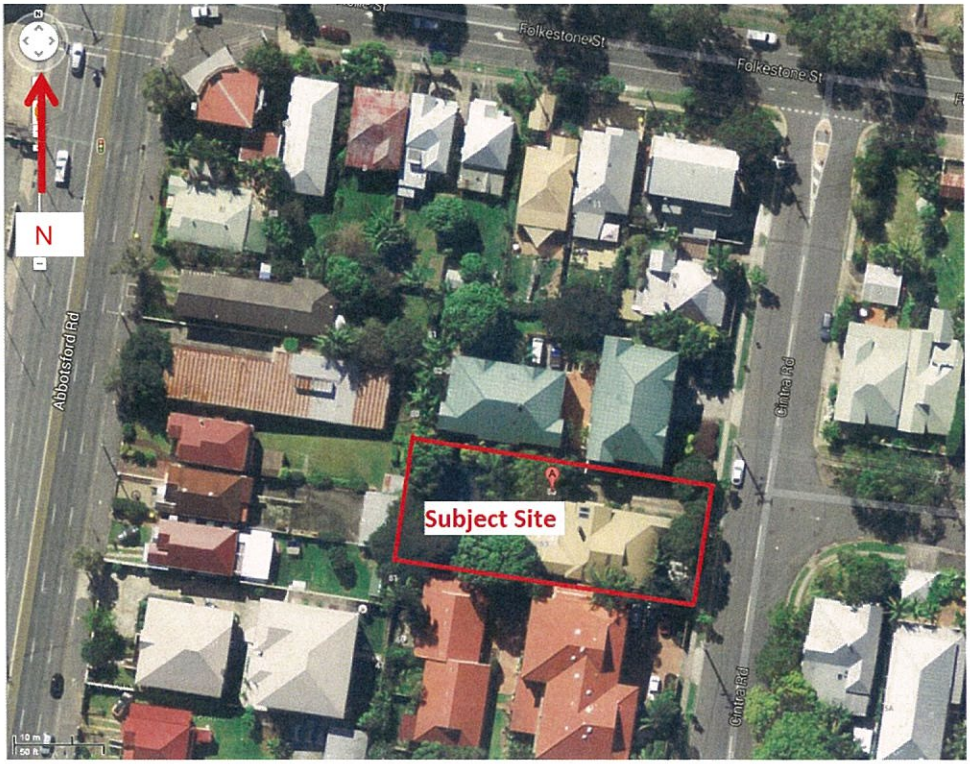


Figure 1.1 Site Location

1.4 Proposed Development

Preliminary drawings prepared by BRD Architects depict a proposed 4 storey multi-unit development with basement with associated driveway and hardstand areas. A large landscape open space area is available to the rear quarters of the proposed site layout. The proposed roof area makes up approximately 560m^2.

2.0 Water Cycle Management

2.1 Background

The purpose of this section of the SWMP is to outline water saving measures that will be implemented in the design and construction of the proposed development.

2.2 Wastewater Minimisation

To reduce the impact of water demand from the development and to minimise the loading on the existing sewerage network, it is intended to reduce the wastewater leaving the site through the use of "at source" measures. This will include:

- Water saving shower roses with a AAA rating or better
- Dual flush toilet cisterns that do not exceed 6 litres on full flush and 3 litres on half flush
- The use of 3 star (or higher) water efficient appliances

2.3 Stormwater Harvesting Tanks

In an effort to reduce the demand on the town's water supply and to improve the water quality objectives for this development, it is proposed to incorporate stormwater harvesting within the hydraulic design of the proposed development.

A minimum capacity of 9,600 litres proposed for this development in the form of an underground *Atlantis* modular infiltration tank (or approved equivalent). A minimum 50% roof area of the proposed residential building is to be connected to this rainwater storage, with first flush diversion capabilities in accordance with the QDC guidelines.

To achieve the reduction in loading to the town's water supply, it is intended that this volume of water be used to supply irrigation to external landscaped areas only.

3.0 Stormwater Quantity Management

3.1 Background

The proposed development has the potential to alter the existing hydrologic and hydraulic characteristics of the subject site unless suitable mitigation is achieved via careful hydraulic design of the proposed stormwater management drainage system. With urbanisation there is potential for sites to create or exacerbate drainage problems to downstream areas and/or drainage infrastructure. The purpose of this section of the SWMP is to determine the general requirements for bulk stormwater management for the proposed development. The design shall ensure that rainfall event discharges are mitigated and conveyed from the site in a manner that complies with Council's Urban Stormwater Planning Guidelines and does not result in a worsened drainage situation to downstream infrastructure, without causing a nuisance or annoyance to residents/property owners.

3.2 Site Drainage Constraints and Opportunities

3.2.1 Drainage Constraints

The site falls to the rear of the allotment. No drainage easement, reserve or road reserve exists to this boundary. As such, a suitable amount of detention will be required to ensure there is no increase in stormwater discharge to this boundary condition.

3.2.2 Drainage Opportunities

The development proposed will have eaves and gutters at a higher elevation than the Cintra Road kerb and channel. As such, it will be possible to discharge to this lawful point of discharge with an equal amount of roof area and equal discharge compared to the existing hydraulic scenario.

The development site layout has allowed adequate open space to the rear of the development site for landscape, underground infiltration (pump well) set-up and irrigation re-use opportunities. The grading of the site allows for retaining this portion of the site to ensure a level top of wall acting as a weir in major storm events. This arrangement would ensure that should the infiltration tank overtop, the discharge crossing rear of lot boundaries will be in a non-concentrated form.

3.3 Rational Method Calculations

Appendix B contains the Rational Method calculations undertaken to size the required detention tank. Pre-development were compared with post-development rational method calculations.

Catchment areas were identified based on the detailed site survey by Murray and Associates for the pre-development case. Areas of roof and pavement were measured from the DA architectural drawings undertaken by BRD architects.

Case	Description	% Impervious	Area (Ha)
PRE	Roof, landscape and Driveway Areas	40	0.036
POST	Roof, landscape and Driveway Areas	75	0.068

Table 3.1 - Sub-Catchment Areas

A Mannings "n" roughness coefficient value of 0.035 was used for the pre-development case. 0.015 was used for the post-development case. Mannings equation was used to determine the times of concentration. The standard inlet time of 5mins was used for the post-development case.

Storm recurrence intervals of 2, 5, 10, 20, 50 and 100yr ARI's were calculated for were setup using Australian Rainfall and Runoff storm patterns for Area 3 with intensity frequency duration data taken for the local area. Storm durations of 10, 15, 20, 25, 30, 45, 60, 90 & 120 minutes were investigated for the pre and post developed scenarios.

3.4 Results

ARI	Peak Flow PRE Development Discharge (m^3/s)	Peak Flow POST Development Discharge (m^3/s)
2	0.021	0.028
5	0.030	0.039
10	0.036	0.046
20	0.043	0.056
50	0.056	0.072
100	0.065	0.082

Table 3.2 – PRE/POST Development Peak Flow Rates

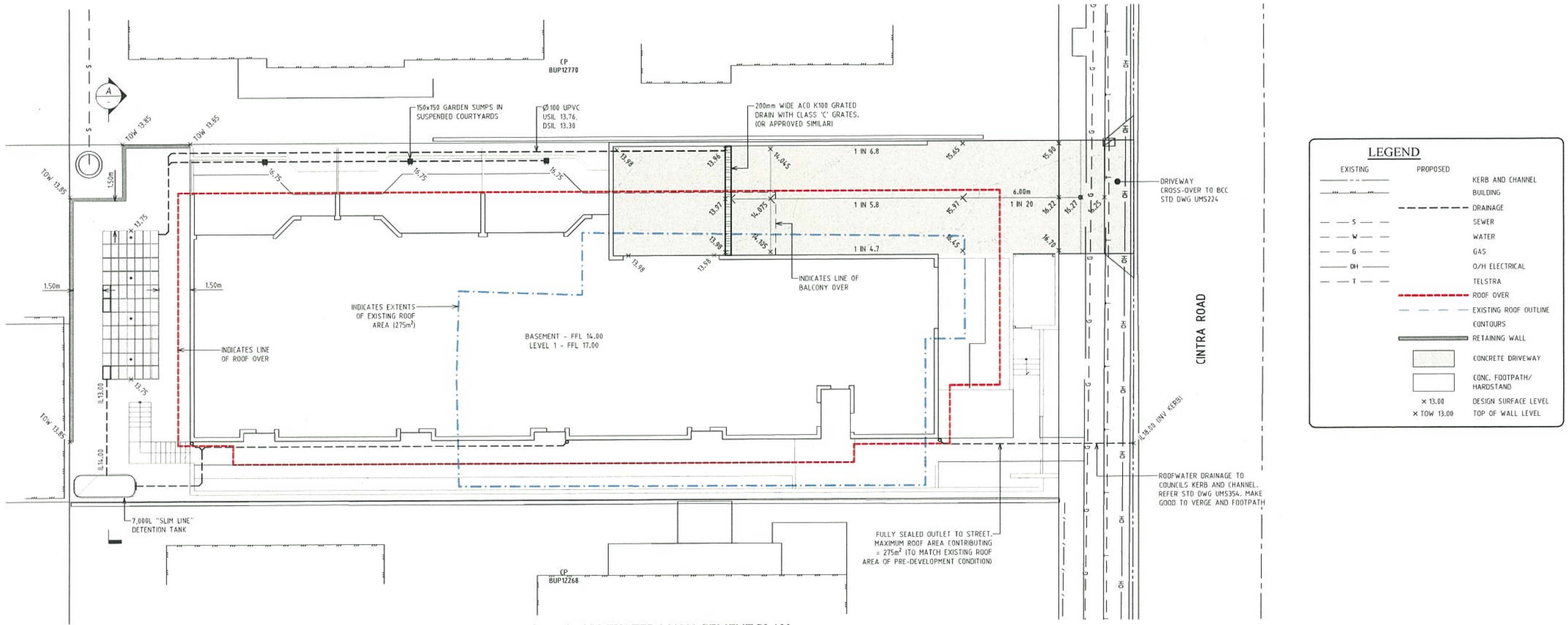
Comparing the results within of Tables 3.2 the calculated post-development peak flow rates would exceed the pre-development cases by approximately 30%. Initial detention basin sizing calculations based on QUDM section 5.05.1 indicates that approximately $7m^3$ of on-site detention will be required of the development to ensure post-development flow rates do not exceed that of the existing pre-development scenario.

4.0 Conclusions

This report has outlined a total water cycle strategy to be adopted in the operational works phase of the development which satisfies minimum targets as set out in Council's Infrastructure and Operational Work Code.

- Wastewater minimisation strategies will be adopted to reduce the demand on Council's existing infrastructure.
- Best practice and practical water quality improvement devices are proposed which include coarse sediment traps, rainwater harvesting, groundwater recharge and infiltration.
- $7m^3$ of stormwater detention mitigation measures are required. This is due to the increased impervious areas of the proposed development, predominantly the roof water areas.

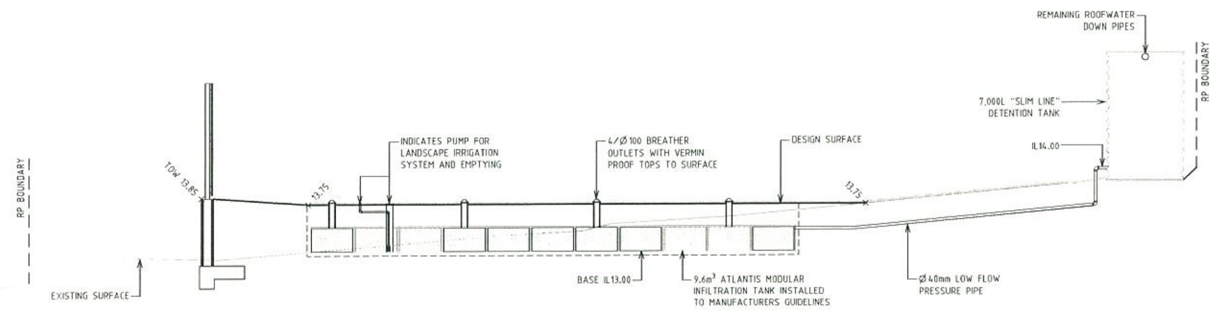
APPENDIX A – STORMWATER MANAGEMENT PLAN



CP BUP12770
150x150 GARDEN SUMPS IN SUSPENDED COURTYARDS
Ø100 UPVC USIL 13.76, DSIL 13.30
200mm WIDE ACO K100 GRATED DRAIN WITH CLASS 'C' GRATES. (OR APPROVED SIMILAR)
DRIVEWAY CROSS-OVER TO BCC STD DWG UMS224
TOW 13.85
1.50m
1 IN 6.8
1 IN 5.8
1 IN 4.7
1 IN 20
6.00m
INDICATES LINE OF BALCONY OVER
INDICATES EXTENTS OF EXISTING ROOF AREA (275m²)
BASEMENT - FFL 14.00
LEVEL 1 - FFL 17.00
INDICATES LINE OF ROOF OVER
CINTRA ROAD
IL18.00 (INV KERB)
ROOFWATER DRAINAGE TO COUNCILS KERB AND CHANNEL. REFER STD DWG UMS354. MAKE GOOD TO VERGE AND FOOTPATH
7,000L "SLIM LINE" DETENTION TANK
IL13.00
IL14.00
FULLY SEALED OUTLET TO STREET. MAXIMUM ROOF AREA CONTRIBUTING = 275m² (TO MATCH EXISTING ROOF AREA OF PRE-DEVELOPMENT CONDITION)
CP BUP12268
LEGEND
EXISTING
PROPOSED
KERB AND CHANNEL
BUILDING
DRAINAGE
SEWER
WATER
GAS
O/H ELECTRICAL
TELSTRA
ROOF OVER
EXISTING ROOF OUTLINE
CONTOURS
RETAINING WALL
CONCRETE DRIVEWAY
CONC. FOOTPATH/ HARDSTAND
× 13.00 DESIGN SURFACE LEVEL
× TOW 13.00 TOP OF WALL LEVEL

CONCEPT STORMWATER MANAGEMENT PLAN

SCALE A



REMAINING ROOFWATER DOWN PIPES
RP BOUNDARY
7,000L "SLIM LINE" DETENTION TANK
IL14.00
INDICATES PUMP FOR LANDSCAPE IRRIGATION SYSTEM AND EMPTYING
4/Ø100 BREATHER OUTLETS WITH VERMIN PROOF TOPS TO SURFACE
DESIGN SURFACE
TOW 13.85
13.75
EXISTING SURFACE
BASE IL13.00
9.6m³ ATLANTIS MODULAR INFILTRATION TANK INSTALLED TO MANUFACTURERS GUIDELINES
Ø40mm LOW FLOW PRESSURE PIPE

A SECTION - DETENTION/INFILTRATION DETAIL

SCALE 1:40

PROJECT NORTH

SCALES 1:100 at A1, 1:200 at A3

STATUS: FOR APPROVAL

Issue	Amendment	Date	Off
A	FOR APPROVAL	05.09.14	ACR

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2. Figured dimensions take precedence over scaled.
3. Verify all dimensions on site.

EMPIRE ENGINEERING

BUNDABERG · GLADSTONE · SUNSHINE COAST

Client: CINTRA ROAD HOLDINGS PTY. LTD.

Project: PROPOSED MULTI UNIT DEVELOPMENT, 48 CINTRA ROAD, BOWEN HILLS

Designed: SFD Drawn: ACR
Approved: TROY PAULSEN / RPEQ 6990

Title: CONCEPT STORMWATER MANAGEMENT PLAN

Date: SEPTEMBER 2014	Scale: AS NOTED	
Job Ref No	Drawing No	Issue
SC-4777	SKC01	A

APPENDIX B – RATIONAL METHOD CALCULATIONS

Project: 48 Cintra Rd Bowenfels. Date: 5/9/14

Description: Rational Calcs. Job No: SC. 4777. Page: of

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T_c Length = 53m. (Diagonal Site)

Slope = 10%.

$T_c = (107 n L^{1/3}) / S^{0.2}$

$= (107 \times .035 \times 53^{0.333}) / 10^{0.2}$

$= 8.9 min \rightarrow 9 min$ (Predevelopment)

Post Development $T_c = 107 \times 0.015 \times 53^{1/3} / 10^{0.2}$

$= 3.8 min < 5 min$ ∴ Use Std Inlet time of 5 min

Pre dev $F_i = 365 / 911 m^2$

$= 0.4$. ∴ $C_{10} = 0.78$

Post dev $F_i = 672 / 911 m^2$ ∴ $C_{10} = 0.85$

$= 0.75$

PRE

I_2	126 mm/hr.	C_2	0.66
I_5	161	C_5	0.74
I_{10}	181	C_{10}	0.78
I_{20}	209	C_{20}	0.82
I_{50}	246	C_{50}	0.9
I_{100}	274	C_{100}	0.94

Q_2 =	0.021 m^3/s
Q_5 =	0.030 m^3/s
Q_{10} =	0.036 m^3/s
Q_{20} =	0.043 m^3/s
Q_{50} =	0.056 m^3/s
Q_{100} =	0.065 m^3/s

POST.

I_2	151 mm/hr	C_2	0.72
I_5	191	C_5	0.81
I_{10}	215	C_{10}	0.95
I_{20}	248	C_{20}	0.89
I_{50}	291	C_{50}	0.98
I_{100}	325.	C_{100}	~~1.02~~ 1.0

		+ Increase
Q_2 =	0.028 m^3/s	30.6%
Q_5 =	0.039 m^3/s	29.3%
Q_{10} =	0.046 m^3/s	29.4%
Q_{20} =	0.056 m^3/s	29.3%
Q_{50} =	0.072 m^3/s	28.9%
Q_{100} =	0.082 m^3/s	26.7%

1.5 factor * Avg Culp, Boyd, Carroll detention tank stage volumes:

Basha Methods Results in the following

ARI	PRE (m3/s)	POST (m^3/s)	STORAGE (m^3)	Fs	DETENTION (m^3)
2	0.021	0.028	1.8	1.5	2.7
5	0.030	0.039	2.4	1.5	3.6
10	0.036	0.046	2.9	1.5	4.3
20	0.043	0.056	3.5	1.5	5.2
50	0.056	0.072	4.4	1.5	6.6
100	0.065	0.082	4.7	1.5	7.1

∴ 7kL DETENTION TANK REQD.

QUDM INITIAL DETENTION BASIN SIZE - 5.05.1

	Undeveloped Flow (Qo)	Developed Flow (Qa)
Catchment Name	**Existing**	**Developed**
Tc (Min)	9.00	5.00
fi	0.40	0.75
C_{10}	0.78	0.85
C1	0.62	0.68
C2	0.66	0.72
C5	0.74	0.81
C10	0.78	0.85
C20	0.82	0.89
C50	0.90	0.98
C100	0.94	1.02
C_2	0.66	0.72
I_2 (mm/hr)	126.00	151.00
A (ha)	0.091	0.091
Q_2 (m^3/s)	**0.021**	**0.028**
% Flow Increase		30.6%
r	0.23	
Vi (m^3)	11.04	
Sizing Method		
Culp (Vs) - (m^3)		1
Boyd (Vs) - (m^3)		3
Carroll (Vs) - (m^3)		1
Basha (Vs) - (m^3)		2
Average (Vs) - (m^3)		1.8
1.50 Safety factor (Vs) - (m^3)		**2.7**
1.25 Safety Factor (Vs) - (m^3)		**2.2**

QUDM INITIAL DETENTION BASIN SIZE - 5.05.1

	Undeveloped Flow (Qo)	Developed Flow (Qa)
Catchment Name	**Existing**	**Developed**
Tc (Min)	9.00	5.00
fi	0.40	0.75
C_{10}	0.78	0.85
C1	0.62	0.85
C2	0.66	0.72
C5	0.74	0.81
C10	0.78	0.85
C20	0.82	0.89
C50	0.90	0.98
C100	0.94	1.02
C_5	0.74	0.81
I_5 (mm/hr)	161.00	191.00
A (ha)	0.091	0.091
Q_5 (m^3/s)	**0.030**	**0.039**
% Flow Increase		29.3%
r	0.23	
Vi (m^3)	15.61	
Sizing Method		
Culp (Vs) - (m^3)		2
Boyd (Vs) - (m^3)		4
Carroll (Vs) - (m^3)		2
Basha (Vs) - (m^3)		3
Average (Vs) - (m^3)		2.4
1.50 Safety factor (Vs) - (m^3)		**3.6**
1.25 Safety Factor (Vs) - (m^3)		**3.0**

QUDM INITIAL DETENTION BASIN SIZE - 5.05.1

	Undeveloped Flow (Qo)	Developed Flow (Qa)
Catchment Name	**Existing**	**Developed**
Tc (Min)	9.00	5.00
fi	0.40	0.75
C_{10}	0.78	0.85
C1	0.62	0.85
C2	0.66	0.72
C5	0.74	0.81
C10	0.78	0.85
C20	0.82	0.89
C50	0.90	0.98
C100	0.94	1.02
C_{10}	0.78	0.85
I_{10} (mm/hr)	181.00	215.00
A (ha)	0.091	0.091
Q_{10} (m^3/s)	**0.036**	**0.046**
% Flow Increase		29.4%
r	0.23	
Vi (m^3)	18.50	
Sizing Method		
Culp (Vs) - (m^3)		2
Boyd (Vs) - (m^3)		4
Carroll (Vs) - (m^3)		2
Basha (Vs) - (m^3)		3
Average (Vs) - (m^3)		2.9
1.50 Safety factor (Vs) - (m^3)		**4.3**
1.25 Safety Factor (Vs) - (m^3)		**3.6**

QUDM INITIAL DETENTION BASIN SIZE - 5.05.1

	Undeveloped Flow (Qo)	Developed Flow (Qa)
Catchment Name	**Existing**	**Developed**
Tc (Min)	9.00	5.00
fi	0.40	0.75
C_{10}	0.78	0.85
C1	0.62	0.85
C2	0.66	0.72
C5	0.74	0.81
C10	0.78	0.85
C20	0.82	0.89
C50	0.90	0.98
C100	0.94	1.02
C_{20}	0.82	0.89
I_{20} (mm/hr)	209.00	248.00
A (ha)	0.091	0.091
Q_{20} (m^3/s)	**0.043**	**0.056**
% Flow Increase		29.3%
r	0.23	
Vi (m^3)	22.40	
Sizing Method		
Culp (Vs) - (m^3)		2
Boyd (Vs) - (m^3)		5
Carroll (Vs) - (m^3)		3
Basha (Vs) - (m^3)		4
Average (Vs) - (m^3)		3.5
1.50 Safety factor (Vs) - (m^3)		**5.2**
1.25 Safety Factor (Vs) - (m^3)		**4.4**

QUDM INITIAL DETENTION BASIN SIZE - 5.05.1

	Undeveloped Flow (Qo)	Developed Flow (Qa)
Catchment Name	**Existing**	**Developed**
Tc (Min)	9.00	5.00
fi	0.40	0.75
C_{10}	0.78	0.85
C1	0.62	0.85
C2	0.66	0.72
C5	0.74	0.81
C10	0.78	0.85
C20	0.82	0.89
C50	0.90	0.98
C100	0.94	1.02
C_{50}	0.90	0.98
I_{50} (mm/hr)	246.00	291.00
A (ha)	0.091	0.091
Q_{50} (m^3/s)	**0.056**	**0.072**
% Flow Increase		28.9%
r	0.22	
Vi (m^3)	28.79	
Sizing Method		
Culp (Vs) - (m^3)		3
Boyd (Vs) - (m^3)		6
Carroll (Vs) - (m^3)		3
Basha (Vs) - (m^3)		5
Average (Vs) - (m^3)		**4.4**
1.50 Safety factor (Vs) - (m^3)		**6.6**
1.25 Safety Factor (Vs) - (m^3)		**5.5**

QUDM INITIAL DETENTION BASIN SIZE - 5.05.1

	Undeveloped Flow (Qo)	Developed Flow (Qa)
Catchment Name	**Existing**	**Developed**
Tc (Min)	9.00	5.00
fi	0.40	0.75
C_{10}	0.78	0.85
C1	0.62	0.68
C2	0.66	0.72
C5	0.74	0.81
C10	0.78	0.85
C20	0.82	0.89
C50	0.90	0.98
C100	0.94	1.02
C_{100}	0.94	1.00
I_{100} (mm/hr)	274.00	325.00
A (ha)	0.091	0.091
Q_{100} (m^3/s)	**0.065**	**0.082**
% Flow Increase		26.7%
r	0.21	
Vi (m^3)	32.90	
Sizing Method		
Culp (Vs) - (m^3)		3
Boyd (Vs) - (m^3)		7
Carroll (Vs) - (m^3)		4
Basha (Vs) - (m^3)		5
Average (Vs) - (m^3)		4.7
1.50 Safety factor (Vs) - (m^3)		**7.1**
1.25 Safety Factor (Vs) - (m^3)		**5.9**