



PROJECT No. 329620

CROSSROADS MALL – KWA THEMA

Portion of R/81 of the Farm Rietfontein 128IR

Revision A – November 2013

STORMWATER MANAGEMENT PLAN

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TITLE OF REPORT:

PROJECT No. 329620

CROSSROADS MALL – KWA THEMA

STORMWATER MANAGEMENT PLAN

CLIENT:

DIJALO PROPERTY DEVELOPMENTS (Pty) Ltd

PDNA REPORT NO:

329620/1

PREPARED BY:

R Bryant Pr Tech Eng

REVIEWED BY:

R Bryant Pr Tech Eng

SIGNED

APPROVED BY:

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SIGNED

DESCRIPTION	REVISION	DATE
<i>REPORT</i>	<i>A</i>	<i>5 November 2013</i>

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1. INTRODUCTION & DISCUSSION

1.1 Site Locality and General Information

The site, Portion of R/81 of the Farm Rietfontein 1281R, is located on the western corner of the intersection of Kgaswane / Rhokana Street and Tonk Meter Drive (M63). This is north of Kwa-Thema Township Extensions 1, 2 and 3 in Springs. The land is currently undeveloped open grassland with sparse vegetation and trees. The adjoining land or surrounding areas comprises of residential areas, open grassland with sporadic trees, and an industrial depot (Corobrik).

The area of the site measures 19.110 ha.

A locality and aerial plan is included in this report (drawing C001 and C002).

The site slopes to the northwest at an approximate gradient of 1 in 50 (2%).

1.2 Purpose of Report

The Ekurhuleni Metropolitan Municipality requires a Stormwater Management Plan for the development, which includes attenuation proposals for their approval. (The post development peak discharge should not exceed that of the pre- development site for both the 1 in 5 and 1 in 25 year R.I.s)

1.3 Pre-development Site

As mentioned above, the pre-development site is undeveloped open grassland with sparse vegetation and trees. There is no formal stormwater drainage in the vicinity of the site. The roads that border the site drain by road camber / cross-fall only with no visible open drains or culvert crossings

The site slopes to the northwest at an approximate gradient of 2% (1 in 50). This is away from the roads bordering the site. There is a small "pan" located north west of the site. The site and immediate surrounding area forms a gently sloping valley which drains towards the pan.

The pre-development impervious area of the site has been estimated at 1% (un-developed land)



1.4 Post – development Site

The proposed development comprises of the following business/commercial developments: petrol station, KFC and Builder’s Warehouse, shopping mall and taxi rank. The impervious areas of the site will consist predominantly of roof areas and concrete slabs for the proposed buildings along with parking areas, access roads and hard landscaping / pedestrian areas.

The impervious area of the proposed development has been ascertained as 90% as stipulated in the “Design Parameters” section of the report.

The proposed design utilizes 1 attenuation pond to reduce the peak discharge from the site to less than the pre-development peak.

The proposed attenuation pond and stormwater drainage are shown on drawing no. C003.

1.5 Stormwater Drainage and Attenuation

The stormwater design philosophy can be summarized. Stormwater run-off from the proposed impervious areas will be collected in stormwater pipes and discharged to the proposed attenuation pond. Certain portions of the roadways and parking areas will be utilized as channels for surcharge flows from the higher intensity storms. The proposed attenuation pond will reduce the peak discharge from the site to less than the pre-development peak discharge for both the 1 in 5 year and 1 in 25 year design storms. The major pipes within the proposed development (Pipes PIP0001 – PIP0005) have been analysed to determine their diameter and to provide a more accurate model as it would relate to the time of concentration for determining peak flows to the proposed attenuation pond. All pipes within the development will be designed to accommodate at least the peak flow from the 1 in 5 year recurrence interval storm. The major roads within the development have been analysed as channels (Channels CHA0001 – CHA0003) which would convey surcharge flows.

The design standards to be adopted will generally follow the Ekurhuleni Metropolitan Municipality standards as a guideline and would be supplemented with the SANS 1200 series of specifications and SANS 1936 – Part 3 (Development of Dolomite Land). The means for the control and disposal of stormwater around buildings will be in accordance with the requirements of SANS 10400 – Part R.



Some key parameters are listed below;

- Minimum pipe diameter - 450 mm (in roads)
- 300 mm (in parking areas and around buildings)
- Minimum pipe class – 75D
- Pipe specification - Spigot and Socket Joint Pipes to SANS 677
- Minimum pipe gradient 1 in 140, maximum pipe gradient 1 in 20.
- Manholes & chambers – Engineering brickwork – FBSE30 to SANS 227 – 1986 with water absorption < 14% and efflorescence < 10 in English bond.
- Kerb Inlets – Salberg pre-cast concrete units or similar approved.
- Headwalls – Either engineering brickwork (specification as per manholes and chambers) or 25 MPa insitu concrete.

The proposed design of the attenuation pond will capture stormwater run-off from the site, attenuate it in accordance with EMM requirements and then discharge it to surface as a point discharge. Although the attenuation requirements will be met, this approach will create a consequential problem with scour and erosion created by a point discharge. This will be addressed by incorporating energy dissipation measures into the apron of the outlet structure and by providing a suitably increased apron width.

The stormwater attenuation pond will be rendered impervious by the use of an approved membrane lining sandwiched within the fill layers. The time lag between the peak inflow and peak outflow for a 1 in 25 year design storm of 25 minutes duration is 16 minutes. The time taken for the pond to completely fill and empty for a 1 in 25 year design storm of 25 minutes duration is approximately 128 minutes.

This report provides analysis of the hydrology and hydraulics associated with the design of the proposed stormwater infrastructure and statements relating to the detailed design of pipes, outlet structures etc. Construction drawings of the required infrastructure will be submitted to EMM for their approval.

1.6 Stormwater Management During Construction Activities

Construction activities and the progression of construction works will increase the peak run-off from the site and will also increase the sediment and pollutant load.

Sediment fences will be erected to minimise the sediment load in overland flow. Temporary cut off drains will be provided on the downstream side of the site. These drains will typically be unlined vee drains. The bulk cut / fill operation for the attenuation pond along with a temporary outlet structure will be constructed at the commencement of the construction works. The cut off drains will discharge to the attenuation pond.



A silt trap will be provided within the attenuation pond. The sediment fences and silt trap will be routinely checked, maintained and the silt trap emptied.

The implementation and maintenance of the proposed measures will ensure that no additional run-off, silting and pollution will adversely affect the surrounding land.

2. ANALYSIS RESULTS

The “**Analysis Summary**” included in this report provides the relevant data for the size of the attenuation pond and the peak discharge rates for the 2 analysed return intervals. (1in5 and 1in25)

The attenuation requirements of the Ekurhuleni Metropolitan Municipality have been satisfied. The post development peak discharge from the site does not exceed the pre-development peak for both the 1 in 5 and 1 in 25 year return intervals. The attenuation pond has been designed to safely route the peak flows for the 1 in 50 year return period.

The storage / attenuation volume provided is 5760 m³ which equates to 301 m³ per hectare. This is within the normal attenuation volume expected for this type of development.

On completion of the project maintenance manuals will be provided to the facilities management team for the development detailing the appropriate inspection and maintenance regimes required for the attenuation pond and stormwater infrastructure.

3. ANALYSIS SUMMARY

CROSSROADS MALL

DESIGN SUMMARY STORMWATER ATTENUATION

AREA (ha)	PRE-DEV PEAK RUN-OFF (m3/s)		POST-DEV PEAK RUN-OFF (NOT ATTEN) (m3/s)		ATT POND No	STORAGE VOLUME REQUIRED (m3/s)		ACTUAL STORAGE VOLUME (m3/s)		ATT POND INVERT LEVEL (m)	T.W.L. 1 in 5 (m)	T.W.L. 1 in 25 (m)	CREST LEVEL ATT POND (m)	OUTLET PIPE DIA I.d. (m)	CREST LEVEL 1 in 25 WEIR	POST-DEV PEAK RUN-OFF (ATTENUATED) (m3/s)		FREEBOARD 1 in 25 TWL & CREST OF POND (mm)	MAX STORAGE TO CREST OF POND (m3)
	1 in 5	1 in 25	1 in 5	1 in 25		1 in 5	1 in 25	1 in 5	1 in 25										
	19.110	1.032	2.074	3.799		4.652	RES0001	3404	4753							4320	5760		

TOTAL POST DEVELOPMENT PEAK FLOW m3/s 1.025 1.656

TOTAL PRE DEVELOPMENT PEAK FLOW m3/s 1.032 2.074

ADDITIONAL PEAK FLOW -0.007 -0.418

ATTENUATION REQUIREMENTS SATISFIED

NOTE - ANALYSIS UNDERTAKEN FOR STORM DURATIONS FROM 5 MINUTES TO 80 MINUTES DURATION

ANALYSIS REPORTED FOR STORM DURATION YIELDING GREATEST PEAK FLOW.

4. ANALYSIS PARAMETERS

CROSSROADS MALL

ANALYSIS PARAMETERS

ITEM	VALUE	COMMENTS
MAP (mm)	711	
CATCHMENT AREA	19.11 ha	
CATCHMENT SLOPE	0.0167	
OVERLAND FLOW LENGTH	380 m	
% IMPERVIOUS AREAS		
POST DEVELOPMENT	90%	Shopping Mall - high impervious area
PRE - DEVELOPMENT	1%	Pre-development site
OVERLAND MANNINGS 'n'		
POST - DEVELOPMENT		
PERVIOUS	0.2	Landscaped areas
IMPERVIOUS	0.018	Parking, roads and roof / slab areas
PRE - DEVELOPMENT		
PERVIOUS	0.2	Veld grass
IMPERVIOUS	0.018	Sundry

5. ANALYSIS

**5.1.1 Pre-development Site
Catchment details**

Rainfall Type: Triangular

Areal Reduction: Unspecif

Mean Annual Percipitation: 711 (mm)

I.D.F Type: HRU/78

Time To Peak: 0.30

Rainfall Region: Inland

Total Area(ha): 0.000

Project No/Name: 329620/1

CROSSROADS MALL PREDEV

KAT0001	<END>	19.110	0.0156	1	383.00	45	5	0.200	0.020	3.0	1.0	
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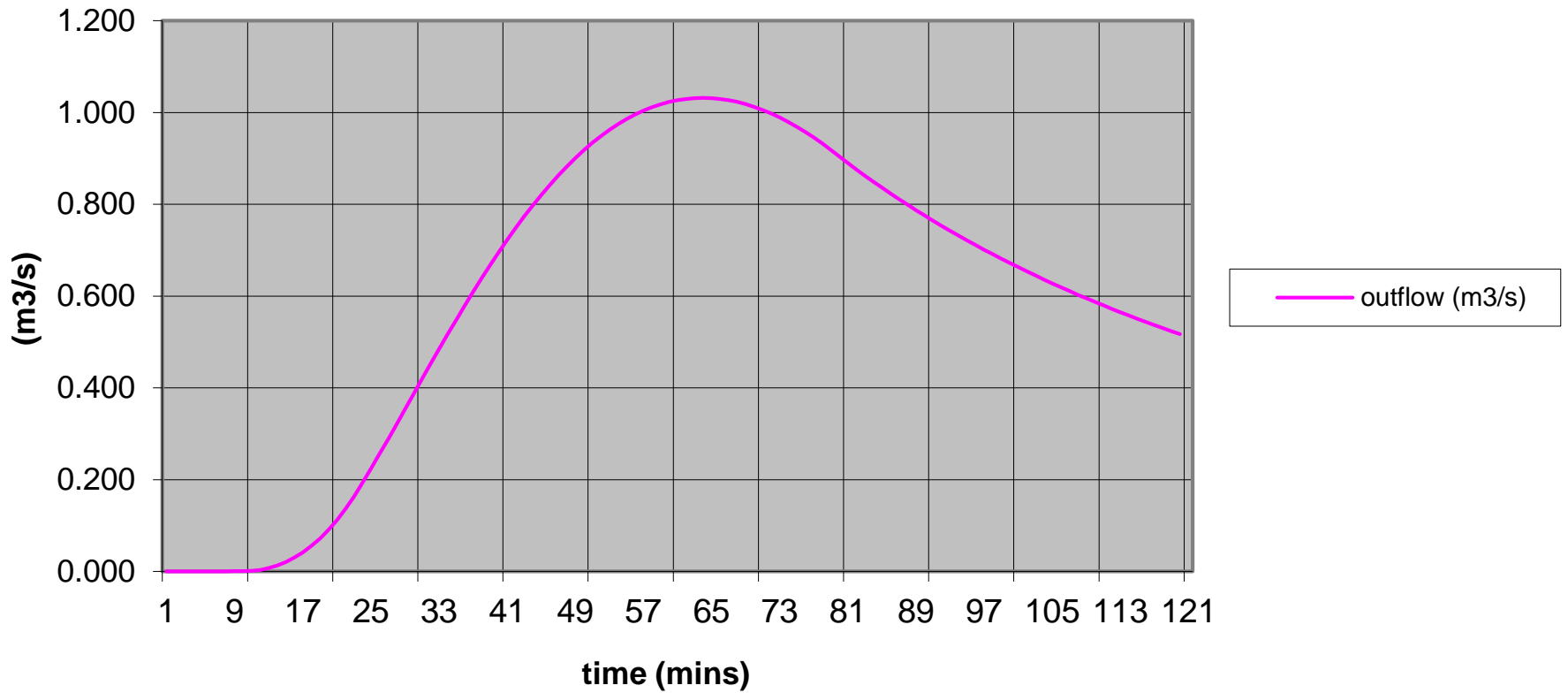
**5.1.2 Pre-development Site
1 in 5 R.I. hydrograph
Catchment KAT0001**

**CROSSROADS MALL
CATCHMENT KAT0001
PRE-DEVELOPMENT SITE
1in5 R.I. HYDROGRAPH**

NODE	R.I.	DURATION	TIME	INFLOW	OUTFLOW
		(mins)	(mins)	(m3/s)	(m3/s)
KAT0001	5	80	1	0.000	0.000
KAT0001	5	80	2	0.000	0.000
KAT0001	5	80	4	0.000	0.000
KAT0001	5	80	6	0.000	0.000
KAT0001	5	80	8	0.000	0.000
KAT0001	5	80	10	0.000	0.001
KAT0001	5	80	12	0.000	0.003
KAT0001	5	80	14	0.000	0.013
KAT0001	5	80	16	0.000	0.030
KAT0001	5	80	18	0.000	0.056
KAT0001	5	80	19	0.000	0.072
KAT0001	5	80	20	0.000	0.091
KAT0001	5	80	22	0.000	0.136
KAT0001	5	80	24	0.000	0.193
KAT0001	5	80	26	0.000	0.256
KAT0001	5	80	28	0.000	0.321
KAT0001	5	80	30	0.000	0.387
KAT0001	5	80	32	0.000	0.452
KAT0001	5	80	34	0.000	0.517
KAT0001	5	80	35	0.000	0.548
KAT0001	5	80	36	0.000	0.579
KAT0001	5	80	38	0.000	0.639
KAT0001	5	80	40	0.000	0.696
KAT0001	5	80	42	0.000	0.749
KAT0001	5	80	44	0.000	0.798
KAT0001	5	80	46	0.000	0.842
KAT0001	5	80	48	0.000	0.882
KAT0001	5	80	50	0.000	0.918
KAT0001	5	80	52	0.000	0.949
KAT0001	5	80	54	0.000	0.974
KAT0001	5	80	56	0.000	0.995
KAT0001	5	80	58	0.000	1.012
KAT0001	5	80	60	0.000	1.023
KAT0001	5	80	62	0.000	1.030
KAT0001	5	80	64	0.000	1.032
KAT0001	5	80	66	0.000	1.030
KAT0001	5	80	68	0.000	1.023
KAT0001	5	80	70	0.000	1.013
KAT0001	5	80	72	0.000	0.998
KAT0001	5	80	74	0.000	0.980
KAT0001	5	80	76	0.000	0.958
KAT0001	5	80	78	0.000	0.933
KAT0001	5	80	80	0.000	0.904
KAT0001	5	80	82	0.000	0.876
KAT0001	5	80	84	0.000	0.849
KAT0001	5	80	86	0.000	0.824
KAT0001	5	80	88	0.000	0.799
KAT0001	5	80	90	0.000	0.776
KAT0001	5	80	92	0.000	0.753
KAT0001	5	80	94	0.000	0.732
KAT0001	5	80	96	0.000	0.711
KAT0001	5	80	98	0.000	0.691
KAT0001	5	80	100	0.000	0.672
KAT0001	5	80	102	0.000	0.654
KAT0001	5	80	104	0.000	0.636
KAT0001	5	80	106	0.000	0.620
KAT0001	5	80	108	0.000	0.603
KAT0001	5	80	110	0.000	0.588
KAT0001	5	80	112	0.000	0.572
KAT0001	5	80	114	0.000	0.558
KAT0001	5	80	116	0.000	0.544
KAT0001	5	80	118	0.000	0.530
KAT0001	5	80	120	0.000	0.517

PEAK FLOW

**1 in 5 R.I hydrograph
Pre-development Site
Catchment KAT0001**



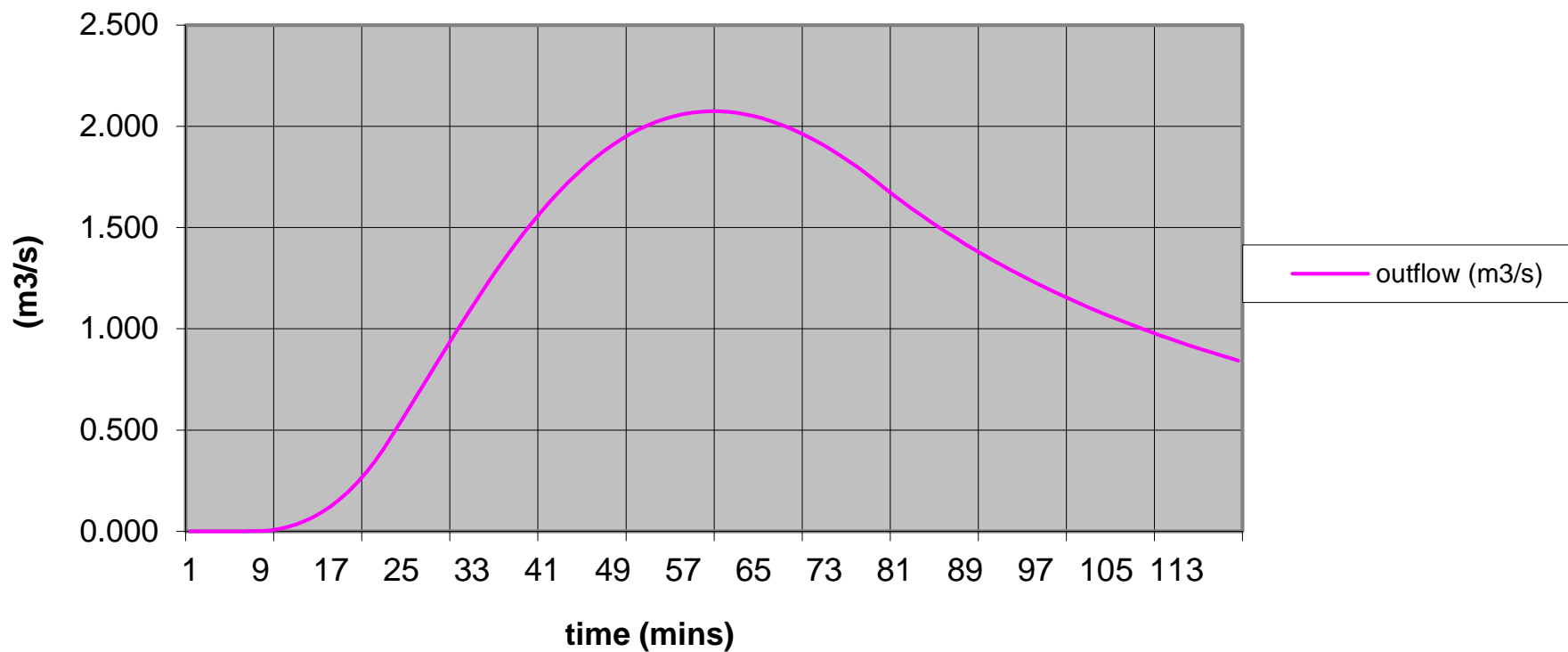
**5.1.3 Pre-development Site
1 in 25 R.I. hydrograph
Catchment KAT0001**

**CROSSROADS MALL
CATCHMENT KAT0001
PRE-DEVELOPMENT SITE
1in25 R.I. HYDROGRAPH**

NODE	R.I.	DURATION	TIME	INFLOW	OUTFLOW
		(mins)	(mins)	(m3/s)	(m3/s)
KAT0001	25	80	1	0.000	0.000
KAT0001	25	80	2	0.000	0.000
KAT0001	25	80	4	0.000	0.000
KAT0001	25	80	6	0.000	0.000
KAT0001	25	80	8	0.000	0.001
KAT0001	25	80	10	0.000	0.005
KAT0001	25	80	12	0.000	0.021
KAT0001	25	80	14	0.000	0.050
KAT0001	25	80	16	0.000	0.095
KAT0001	25	80	18	0.000	0.158
KAT0001	25	80	19	0.000	0.197
KAT0001	25	80	20	0.000	0.242
KAT0001	25	80	22	0.000	0.347
KAT0001	25	80	24	0.000	0.477
KAT0001	25	80	26	0.000	0.616
KAT0001	25	80	28	0.000	0.759
KAT0001	25	80	30	0.000	0.901
KAT0001	25	80	32	0.000	1.040
KAT0001	25	80	34	0.000	1.174
KAT0001	25	80	35	0.000	1.239
KAT0001	25	80	36	0.000	1.302
KAT0001	25	80	38	0.000	1.422
KAT0001	25	80	40	0.000	1.533
KAT0001	25	80	42	0.000	1.635
KAT0001	25	80	44	0.000	1.726
KAT0001	25	80	46	0.000	1.807
KAT0001	25	80	48	0.000	1.878
KAT0001	25	80	50	0.000	1.937
KAT0001	25	80	52	0.000	1.986
KAT0001	25	80	54	0.000	2.023
KAT0001	25	80	56	0.000	2.050
KAT0001	25	80	58	0.000	2.067
KAT0001	25	80	60	0.000	2.074
KAT0001	25	80	62	0.000	2.071
KAT0001	25	80	64	0.000	2.060
KAT0001	25	80	66	0.000	2.039
KAT0001	25	80	68	0.000	2.010
KAT0001	25	80	70	0.000	1.973
KAT0001	25	80	72	0.000	1.929
KAT0001	25	80	74	0.000	1.879
KAT0001	25	80	76	0.000	1.822
KAT0001	25	80	78	0.000	1.759
KAT0001	25	80	80	0.000	1.691
KAT0001	25	80	82	0.000	1.624
KAT0001	25	80	84	0.000	1.561
KAT0001	25	80	86	0.000	1.502
KAT0001	25	80	88	0.000	1.446
KAT0001	25	80	90	0.000	1.393
KAT0001	25	80	92	0.000	1.342
KAT0001	25	80	94	0.000	1.295
KAT0001	25	80	96	0.000	1.249
KAT0001	25	80	98	0.000	1.206
KAT0001	25	80	100	0.000	1.165
KAT0001	25	80	102	0.000	1.125
KAT0001	25	80	104	0.000	1.088
KAT0001	25	80	106	0.000	1.052
KAT0001	25	80	108	0.000	1.018
KAT0001	25	80	110	0.000	0.986
KAT0001	25	80	112	0.000	0.955
KAT0001	25	80	114	0.000	0.925
KAT0001	25	80	116	0.000	0.897
KAT0001	25	80	118	0.000	0.870
KAT0001	25	80	120	0.000	0.844

PEAK FLOW

**1 in 25 R.I hydrograph
Pre-development Site
Catchment KAT0001**



5.2.1 Post-development Site

Catchment Details

Pipe Details

Channel Details

Reservoir Details

Rainfall Type: Triangular

Areal Reduction: Unspecif

Mean Annual Percipitation: 711 (mm)

I.D.F Type: HRU/78

Time To Peak: 0.30

Rainfall Region: Inland

Total Area(ha): 0.000

Project No/Name: 329620/2

CROSSROADS MALL POSTDEV

KAT0001	PIP0003	0.948	0.0114	90	115.00	45	5	0.200	0.018	3.0	1.0	
KAT0002	PIP0003	0.449	0.0070	90	133.00	45	5	0.200	0.018	3.0	1.0	
KAT0003	PIP0003	0.581	0.0070	90	160.00	45	5	0.200	0.018	3.0	1.0	
KAT0004	PIP0004	1.747	0.0190	90	164.00	45	5	0.200	0.018	3.0	1.0	
KAT0005	PIP0004	0.462	0.0185	90	148.00	45	5	0.200	0.018	3.0	1.0	
KAT0006	PIP0004	0.727	0.0070	90	209.00	45	5	0.200	0.018	3.0	1.0	
KAT0007	PIP0002	7.571	0.0175	90	330.00	45	5	0.200	0.018	3.0	1.0	
KAT0008	PIP0001	2.912	0.0144	90	193.00	45	5	0.200	0.018	3.0	1.0	
KAT0009	PIP0001	0.603	0.0169	90	113.00	45	5	0.200	0.018	3.0	1.0	
KAT0010	PIP0001	2.111	0.0145	90	193.00	45	5	0.200	0.018	3.0	1.0	
KAT0011	PIP0001	0.522	0.0151	90	159.00	45	5	0.200	0.018	3.0	1.0	
KAT0012	PIP0005	0.477	0.0070	90	112.00	45	5	0.200	0.018	3.0	1.0	

Rainfall Type: Triangular

Areal Reduction: Equation

Mean Annual Precipitation: 711 (mm)

I.D.F Type: HRU/78

Time To Peak: 0.30

Rainfall Region: Inland

Total Area(ha): 19.110

Pipes Project No/Name: 329620/2					Topographical		Kerb Inlet	
Node ID	Drain To	Spill To	Dia (m)	'n'	Slope(m/m)	Length (m)	Eff (%)	Max Flow Cap(m3/s)
PIP0001	PIP0005	CHA0001	0.869	0.015	0.00700	107.00	100	1.286
PIP0002	PIP0005	CHA0001	0.869	0.015	0.01500	49.00	100	1.883
PIP0003	PIP0004	CHA0002	0.514	0.015	0.00700	231.00	100	0.317
PIP0004	PIP0005	CHA0002	0.869	0.015	0.00700	201.00	100	1.286
PIP0005	RES0001	CHA0003	1.157	0.015	0.01400	103.00	100	3.902

Rainfall Type: Triangular

Areal Reduction: Equation

Mean Annual Precipitation: 711 (mm)

I.D.F Type: HRU/78

Time To Peak: 0.30

Rainfall Region: Inland

Total Area(ha): 19.110

CHA0001	CHA0003	<NONE>	0.10	40.0000	1.0000	0.15	0.016	Ovf	500.00	0.00700	100	0.445
CHA0002	CHA0003	<NONE>	0.10	40.0000	1.0000	0.15	0.016	Ovf	300.00	0.00700	100	0.445
CHA0003	RES0001	<NONE>	0.10	40.0000	1.0000	0.15	0.016	Ovf	100.00	0.01500	100	0.651

Rainfall Type: Triangular Areal Red: Unspecif M.A.F 711 (mm) I.D.F Type: HRU/78 Time To Peak: 0.30

Project No/Name: 329620/2
 Total Area(ha): 19.110

CROSSROADS MALL POSTDEV

Reservoir Attenuation: 26.980
 Reservoir Lag Time: 0

			Outlet Works (Pipes)			Outlet Works (Culverts)				Outlet Works (Spillways)			
Node ID	Drain To	Elev Points	No	Diameter	Invert Lev	No	Width	Height	Invert Lev	No	Coef	Width	Invert Lev
RES0001	<END>	0	1	0.710	0.00	0	0.000	0.00	0.00	1	1.600	6.00	1.20
Reservoir Storage Contour:									No	Elevation	Storage Volume (m3)		
									1	0.0000	0.000		
									2	0.1000	360.000		
									3	0.2000	720.000		
									4	0.3000	1,080.000		
									5	0.4000	1,440.000		
									6	0.5000	1,800.000		
									7	0.6000	2,160.000		
									8	0.7000	2,520.000		
									9	0.8000	2,880.000		
									10	0.9000	3,240.000		
									11	1.0000	3,600.000		
									12	1.1000	3,960.000		
									13	1.2000	4,320.000		
									14	1.3000	4,680.000		
									15	1.4000	5,040.000		
									16	1.5000	5,400.000		
									17	1.6000	5,760.000		

**5.2.2 Post-development Site
1 in 5 Year R.I.
Hydrograph Res0001**

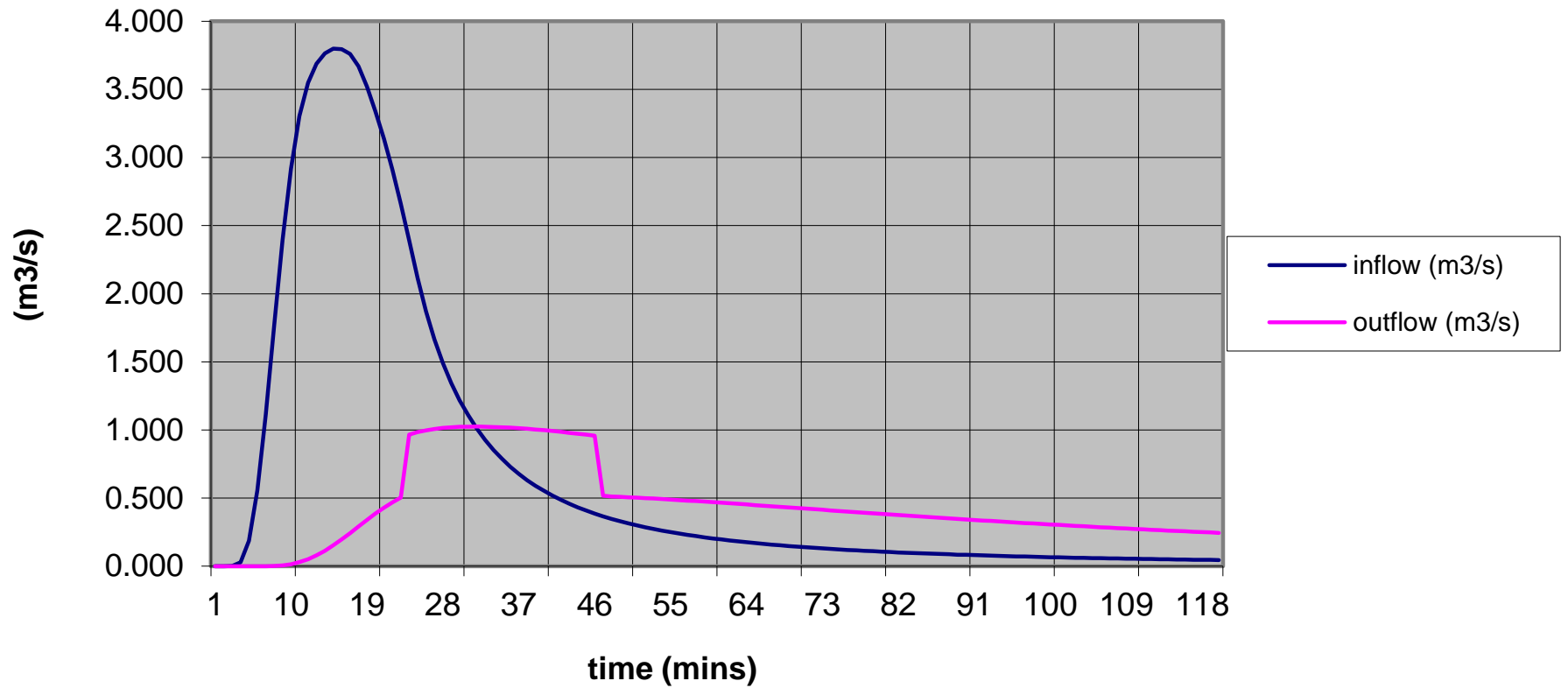
**CROSSROADS MALL
POST DEVELOPMENT SITE
1 in 5 R.I. HYDROGRAPH
RESERVOIR RES0001**

NODE	R.I.	DURATION	TIME	INFLOW	OUTFLOW	DEPTH
		(mins)	(mins)	(m3/s)	(m3/s)	(m)
RES0001	5	25	1	0.000	0.000	0.000
RES0001	5	25	2	0.000	0.000	0.000
RES0001	5	25	4	0.028	0.000	0.000
RES0001	5	25	6	0.556	0.000	0.008
RES0001	5	25	7	1.111	0.000	0.022
RES0001	5	25	8	1.766	0.002	0.046
RES0001	5	25	9	2.395	0.006	0.081
RES0001	5	25	10	2.916	0.015	0.125
RES0001	5	25	12	3.549	0.052	0.233
RES0001	5	25	13	3.687	0.080	0.293
RES0001	5	25	14	3.765	0.114	0.354
RES0001	5	25	15	3.799	0.153	0.415
RES0001	5	25	16	3.796	0.197	0.476
RES0001	5	25	17	3.760	0.243	0.537
RES0001	5	25	18	3.669	0.291	0.595
RES0001	5	25	20	3.340	0.386	0.702
RES0001	5	25	22	2.912	0.469	0.794
RES0001	5	25	24	2.391	0.965	0.867
RES0001	5	25	25	2.115	0.985	0.892
RES0001	5	25	26	1.872	0.998	0.909
RES0001	5	25	28	1.492	1.015	0.931
RES0001	5	25	30	1.217	1.023	0.943
RES0001	5	25	32	1.012	1.025	0.946
RES0001	5	25	34	0.854	1.023	0.942
RES0001	5	25	35	0.789	1.020	0.939
RES0001	5	25	36	0.730	1.017	0.935
RES0001	5	25	38	0.632	1.009	0.923
RES0001	5	25	40	0.552	0.998	0.910
RES0001	5	25	42	0.487	0.986	0.894
RES0001	5	25	44	0.432	0.972	0.876
RES0001	5	25	46	0.387	0.958	0.857
RES0001	5	25	48	0.348	0.511	0.841
RES0001	5	25	50	0.315	0.506	0.835
RES0001	5	25	52	0.286	0.500	0.828
RES0001	5	25	54	0.262	0.493	0.821
RES0001	5	25	56	0.240	0.486	0.813
RES0001	5	25	58	0.221	0.478	0.804
RES0001	5	25	60	0.204	0.470	0.795
RES0001	5	25	62	0.189	0.462	0.786
RES0001	5	25	64	0.176	0.453	0.777
RES0001	5	25	66	0.164	0.445	0.767
RES0001	5	25	68	0.154	0.436	0.758
RES0001	5	25	70	0.144	0.427	0.748
RES0001	5	25	72	0.135	0.419	0.739
RES0001	5	25	74	0.127	0.410	0.729
RES0001	5	25	76	0.120	0.401	0.720
RES0001	5	25	78	0.113	0.393	0.710
RES0001	5	25	80	0.107	0.384	0.701
RES0001	5	25	82	0.102	0.376	0.691
RES0001	5	25	84	0.096	0.368	0.682
RES0001	5	25	86	0.092	0.360	0.673
RES0001	5	25	88	0.087	0.352	0.664
RES0001	5	25	90	0.083	0.344	0.655
RES0001	5	25	92	0.079	0.336	0.646
RES0001	5	25	94	0.076	0.328	0.638
RES0001	5	25	96	0.073	0.321	0.629
RES0001	5	25	98	0.069	0.314	0.621
RES0001	5	25	100	0.067	0.307	0.613
RES0001	5	25	102	0.064	0.300	0.605
RES0001	5	25	104	0.061	0.293	0.597
RES0001	5	25	106	0.059	0.287	0.589
RES0001	5	25	108	0.057	0.280	0.581
RES0001	5	25	110	0.055	0.274	0.574
RES0001	5	25	112	0.053	0.268	0.567
RES0001	5	25	114	0.051	0.262	0.559
RES0001	5	25	116	0.049	0.256	0.552
RES0001	5	25	118	0.047	0.250	0.545
RES0001	5	25	120	0.046	0.245	0.539

PEAK INFLOW

PEAK OUTFLOW

**1 in 5 R.I hydrograph
Post-development Site
Res0001**



**5.2.3 Post-development Site
1 in 25 Year R.I.
Hydrograph Res0001**

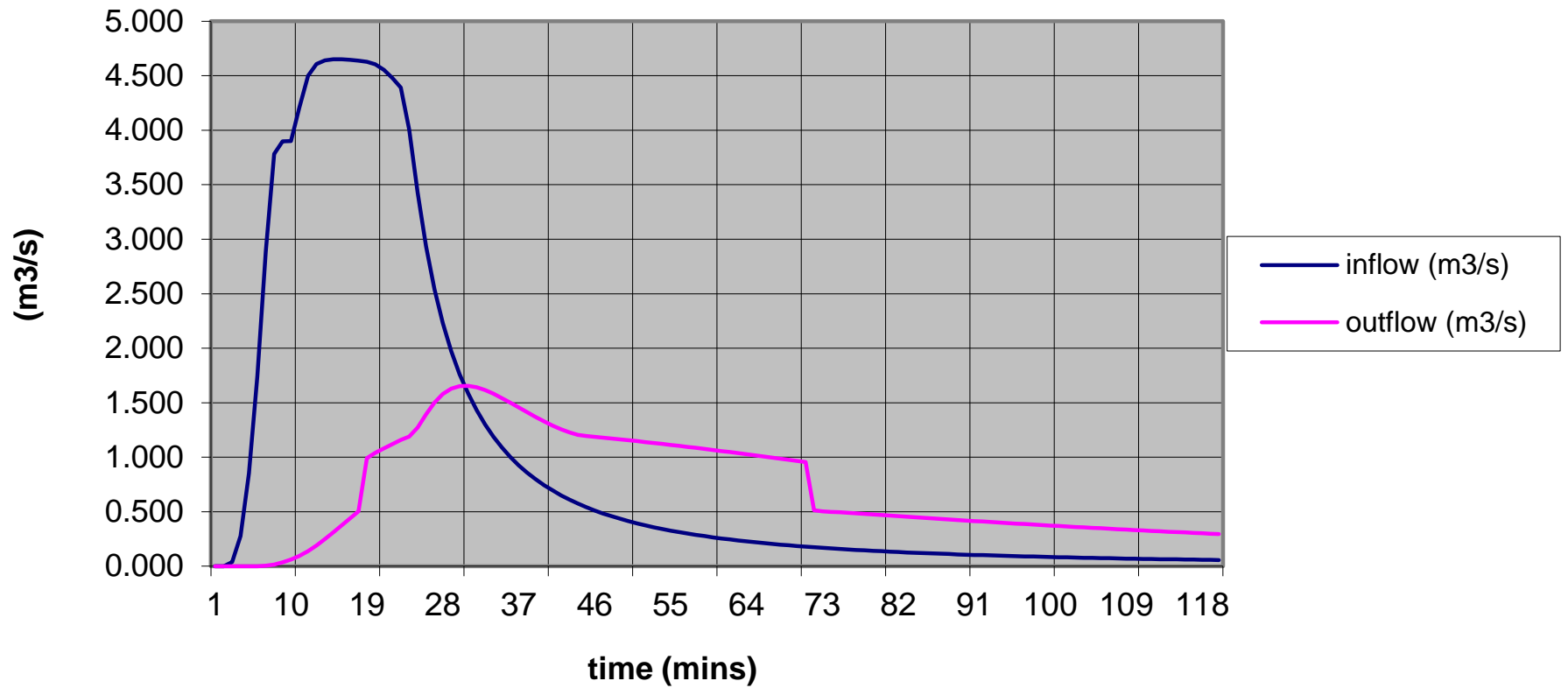
**CROSSROADS MALL
POST DEVELOPMENT SITE
1 in 25 R.I. HYDROGRAPH
RESERVOIR RES0001**

NODE	R.I.	DURATION	TIME	INFLOW	OUTFLOW	DEPTH
		(mins)	(mins)	(m3/s)	(m3/s)	(m)
RES0001	25	25	1	0.000	0.000	0.000
RES0001	25	25	2	0.000	0.000	0.000
RES0001	25	25	4	0.277	0.000	0.003
RES0001	25	25	6	1.745	0.001	0.034
RES0001	25	25	7	2.885	0.005	0.073
RES0001	25	25	8	3.783	0.016	0.128
RES0001	25	25	9	3.898	0.035	0.192
RES0001	25	25	10	3.902	0.062	0.257
RES0001	25	25	12	4.499	0.139	0.395
RES0001	25	25	13	4.606	0.191	0.468
RES0001	25	25	14	4.642	0.248	0.543
RES0001	25	25	15	4.652	0.310	0.617
RES0001	25	25	16	4.651	0.374	0.689
RES0001	25	25	17	4.646	0.439	0.761
RES0001	25	25	18	4.637	0.503	0.832
RES0001	25	25	20	4.604	1.040	0.966
RES0001	25	25	22	4.479	1.121	1.083
RES0001	25	25	24	4.006	1.191	1.189
RES0001	25	25	25	3.430	1.271	1.232
RES0001	25	25	26	2.937	1.393	1.264
RES0001	25	25	28	2.230	1.579	1.303
RES0001	25	25	30	1.761	1.653	1.317
RES0001	25	25	31	1.583	1.656	1.318
RES0001	25	25	32	1.431	1.642	1.315
RES0001	25	25	34	1.188	1.583	1.304
RES0001	25	25	35	1.089	1.543	1.296
RES0001	25	25	36	1.003	1.500	1.288
RES0001	25	25	38	0.858	1.412	1.269
RES0001	25	25	40	0.744	1.329	1.248
RES0001	25	25	42	0.651	1.257	1.227
RES0001	25	25	44	0.575	1.205	1.205
RES0001	25	25	46	0.512	1.187	1.183
RES0001	25	25	48	0.459	1.172	1.160
RES0001	25	25	50	0.414	1.156	1.135
RES0001	25	25	52	0.375	1.139	1.110
RES0001	25	25	54	0.342	1.122	1.084
RES0001	25	25	56	0.313	1.104	1.057
RES0001	25	25	58	0.288	1.086	1.031
RES0001	25	25	60	0.266	1.067	1.004
RES0001	25	25	62	0.246	1.048	0.977
RES0001	25	25	64	0.228	1.028	0.950
RES0001	25	25	66	0.213	1.008	0.923
RES0001	25	25	68	0.199	0.988	0.896
RES0001	25	25	70	0.186	0.967	0.869
RES0001	25	25	72	0.174	0.513	0.843
RES0001	25	25	74	0.164	0.500	0.828
RES0001	25	25	76	0.154	0.489	0.817
RES0001	25	25	78	0.146	0.479	0.805
RES0001	25	25	80	0.138	0.469	0.794
RES0001	25	25	82	0.131	0.459	0.783
RES0001	25	25	84	0.124	0.449	0.772
RES0001	25	25	86	0.118	0.439	0.761
RES0001	25	25	88	0.112	0.429	0.750
RES0001	25	25	90	0.106	0.419	0.740
RES0001	25	25	92	0.101	0.410	0.729
RES0001	25	25	94	0.097	0.401	0.719
RES0001	25	25	96	0.093	0.391	0.708
RES0001	25	25	98	0.089	0.382	0.698
RES0001	25	25	100	0.085	0.373	0.689
RES0001	25	25	102	0.081	0.365	0.679
RES0001	25	25	104	0.078	0.356	0.669
RES0001	25	25	106	0.075	0.348	0.660
RES0001	25	25	108	0.072	0.340	0.651
RES0001	25	25	110	0.069	0.332	0.642
RES0001	25	25	112	0.067	0.324	0.633
RES0001	25	25	114	0.064	0.317	0.624
RES0001	25	25	116	0.062	0.310	0.616
RES0001	25	25	118	0.060	0.302	0.608
RES0001	25	25	120	0.057	0.296	0.600

PEAK INFLOW

PEAK OUTFLOW

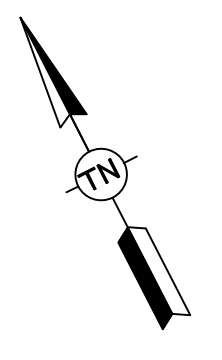
**1 in 25 R.I hydrograph
Post-development Site
Res0001**



C001 LOCATION PLAN

C002 AERIAL PHOTOGRAPH

**C003 POST DEVELOPMENT CATCHMENT
AND STORMWATER DRAINAGE PLAN**



STORMWATER CHANNEL INFORMATION					
(NOTE : ROAD CARRIAGEWAYS MODELLED AS CHANNELS)					
CHANNEL	DEPTH (m)	LEFT SLOPE (m/m)	RIGHT SLOPE (m/m)	LENGTH (m)	GRADIENT (m/m)
CHA0001	0.15	0.025	1	500	0.007
CHA0002	0.15	0.025	1	300	0.007
CHA0003	0.15	0.025	1	100	0.015

STORMWATER PIPE INFORMATION			
PIPE	BEGIN - END	LENGTH (m)	GRADIENT (m/m)
PIP0001	NODE 1 - NODE 2	107	0.007
PIP0002	NODE 3 - NODE 2	49	0.015
PIP0003	NODE 6 - NODE 5	231	0.007
PIP0004	NODE 5 - NODE 2	201	0.007
PIP0005	NODE 2 - NODE 4	103	0.014

RESERVOIR INFORMATION		
RESERVOIR	DEPTH (m)	VOLUME (m3)
RES0001	1.6	5760

STORMWATER CATCHMENT INFORMATION			
CATCHMENT	AREA (m ²)	O.F.L. (m)	GRADIENT (m/m)
KAT0001	9481	114	0.0114
KAT0002	4488	133	0.007
KAT0003	5809	168	0.007
KAT0004	17467	164	0.019
KAT0005	4614	148	0.0185
KAT0006	7269	209	0.007
KAT0007	75709	330	0.0175
KAT0008	29119	252	0.0144
KAT0009	6027	113	0.0169
KAT0010	21112	193	0.0145
KAT0011	5223	159	0.0151
KAT0012	4768	112	0.007



REV	DATE	DRAWN	CHECKED	DESCRIPTION
A	05/11/13	PY	RB	ISSUED FOR INFORMATION

CONSULTANT

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 Johannesburg, 2000
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 Fax: 27 11 566 9600
 email: admin@pdna.co.za

CLIENT
BOOGERTMAN + PARTNERS

CLIENT

DIJALO
 PROPERTY DEVELOPMENT #101110

PROJECT
**CROSSROADS MALL
 KWA - THEMA**

DRAWING
**POST DEVELOPMENT
 CATCHMENT AND STORMWATER
 DRAINAGE PLAN**

FOR INFORMATION

SIGNATURE	DATE
DESIGNED PY	05/11/13
DRAWN PY	05/11/13
CHECKED RB	05/11/13
APPROVED RB	05/11/13

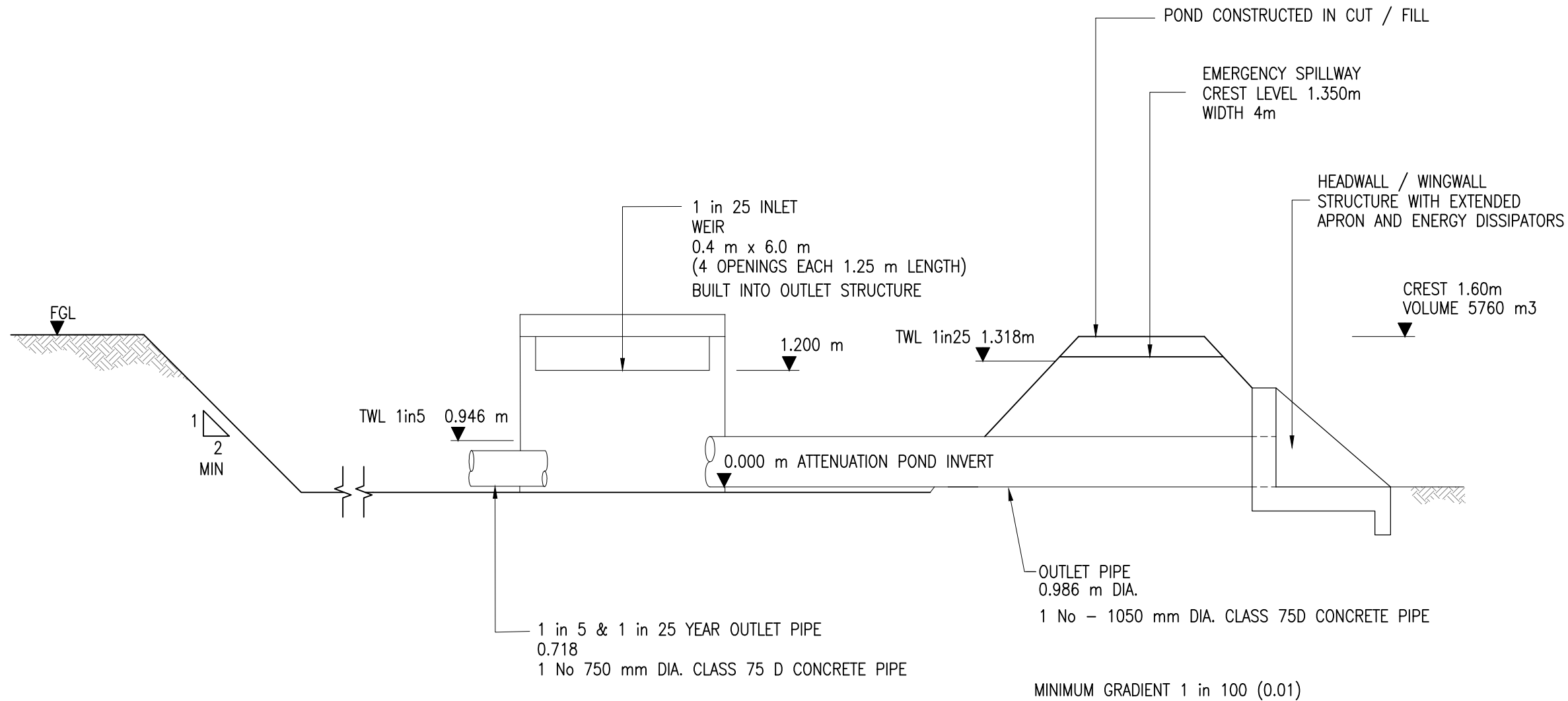
PROJECT No.	DISCIPL.	DRG. NUMBER	STAGE	SHEET SIZE	REVISION
329620	C	003	C	A1	A

CLIENT DRAWING No. FILE NAME AND LOCATION No. (AUTOCAD 2007)
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C004 RESERVOIR SCHEMATICS

RES0001

	1 in 5	1 in 25
PEAK INFLOW TO ATTENUATION POND	3.799 m ³ /s	4.652 m ³ /s
PEAK OUTFLOW FROM ATTENUATION POND	1.025 m ³ /s	1.656 m ³ /s



REV	DATE	DRAWN	CHECKED	DESCRIPTION
A	05/11/13	PY	RB	FOR INFORMATION


Mott MacDonald
PDNA
Mott MacDonald PDNA House, South Block 25 Scott Street, Waverley, 2060 P.O. Box 7707, Johannesburg, 2000
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CLIENT

DIJALO
PROPERTY DEVELOPMENT PTY LTD

ARCHITECT
BOOGERTMAN + PARTNERS

PROJECT
CROSSROADS MALL
KWA - THEMA

DRAWING
RESERVOIR SCHEMATICS
RES0001

FOR INFORMATION

SIGNATURE	DATE
DESIGNED P. YENKETSAMY	05/11/13
DRAWN P. YENKETSAMY	05/11/13
CHECKED R. BRYANT	05/11/13
APPROVED R. BRYANT	05/11/13
SCALE	NTS

PROJECT No.	DISCIPL.	DRG. NUMBER	STAGE	SHEET SIZE	REVISION
329620	C	004	A	A3	A
CLIENT DRAWING No.		FILE NAME AND LOCATION No. (AUTOCAD 2002)			

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