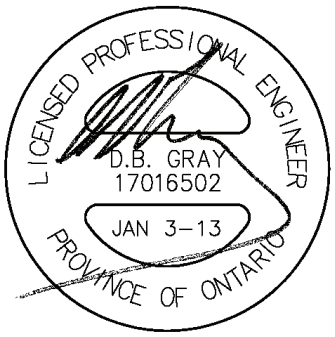
STORMWATER MANAGEMENT REPORT

406-408 Bank Street
Ottawa, Ontario

Report No. 10015-SWM

December 13, 2011
Revised January 3, 2013



NOT VALID UNLESS
SIGNED & DATED

D. B. G R A Y E N G I N E E R I N G I N C.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

1052 Karsh Drive,
Ottawa, Ontario.
K1G 4N1

Tel: (613) 249-8044
Fax: (613) 249-9815
email: dbgray@rogers.com

STORMWATER MANAGEMENT REPORT

406-408 Bank Street
Ottawa, Ontario

This report addresses the stormwater management requirements of a proposed five-storey residential building with ground floor commercial development located on 303 sq.m. of land 406-408 Bank Street at the corner of Florence Street in Ottawa.

This report forms part of the stormwater management design for the proposed development. Also refer to drawing SG-1 (Revision 8: Jan 3-13), prepared by D. B. Gray Engineering Inc.

WATER QUALITY:

The roof of the proposed development will occupy 99% of the site. Typically runoff from the roofs is considered clean. As such no permanent water quality measures are proposed.

During construction, an erosion and sediment control plan has been developed (see notes 2.1 to 2.3 on drawing SG-1). In summary: to filter out construction sediment geotextile fabric will be placed between the grate and frame of all existing catch basins adjacent to the site.

WATER QUANTITY:

In February 2010 consultation with Bruce Coombe and Eric Tousignant advised that the stormwater quantity control measures for this property are to be based on the criteria that the release rate for post-development storm events is equal to or less than the flow produced by a five year storm using a runoff coefficient of 0.40 and a 20 minute time of concentration. However we are able to meet the following criteria that are typical when connecting to a combined sewer: The release rate for post-development storm events is equal to or less than the flow produced by a two year storm using a runoff coefficient of 0.40 and a 20 minute time of concentration.

Calculations are based on the rational method. The runoff coefficients for the 100 year event were increased by 25% to maximum 1.00.

Stormwater will be stored within the development on the main roof of the proposed building and in a cistern located in the basement.

The one roof drain on the main roof will be flow control type installed with a parabolic shaped slotted weir (1 slot per weir drain at 5 USgpm per inch per slot - 0.0124 l/s per mm per slot) causing the storm water to pond on the roof. All roof drains, including this flow control roof drain and the roof drains on the terrace roof, will drain to a cistern in the basement.

An inlet control device (ICD) located in the outlet pipe of the cistern will control the release of stormwater off the site. The ICD shall a Hydrovex "VHV Vertical Vortex Flow Regulator" and shall be sized by the manufacturer for a discharge rate of 1.60 l/s at 1.51 m head. It is

calculated that an orifice area of 1963 sq.mm. (50 mm diameter) and a discharge coefficient of 0.15 will restrict the outflow rate to 1.60 l/s at a head of 1.51 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 1.18 l/s at 0.81 m. Based on this orifice the maximum outflow rate for the "stress test" storm event is calculated to be 1.75 l/s at 1.80 m.

Stress Test:
In the event that the 1:100 year IDF rainfall values are increased by 20%, the depth of the water stored on the roof will increase from 140mm depth at the roof drains to the maximum of 150mm depth. Above this level, stormwater will overflow out the scuppers and onto the lower terrace roof. The cistern has adequate capacity to store the extra volume. In such an event the maximum flowrate off the site will increase by about 10% from 1.75 to 1.93 l/s. There are no potential flooding issues and therefore the proposed drainage system does not need to be modified.

Since the stormwater management facility discharges to a combined sewer it is expected that a Ministry of Environment Certificate of Approval will be required.

MAXIMUM PERMITTED FLOW:

The maximum permitted flow for the subject site is calculated as follows:

Area (A):	303 sq.m.
Time of Concentration (T):	20 minutes
Rainfall Intensity (Five Year Event) (i):	70 mm/hr
Runoff Coefficient (C):	0.40
Five-Year Release Rate (2.78 AiC)	2.37 l/s

The two-year event flow for the subject site:

Area (A):	303 sq.m.
Time of Concentration (T):	20 minutes
Rainfall Intensity (Five Year Event) (i):	52 mm/hr
Runoff Coefficient (C):	0.40
Two-Year Release Rate (2.78 AiC)	1.75 l/s

CONCLUSIONS:

WATER QUALITY:

An erosion and sediment control plan as been developed to be implemented during construction

WATER QUANTITY:

One Hundred-Year Storm Event:
The maximum allowable release rate for the one hundred-year storm event for the site is 2.37 l/s. The release rate for the one hundred year storm event being controlled to a two-year storm is 1.75 l/s. The post-development release rate for the 100-year storm event is calculated to be 1.75 l/s. Therefore the maximum post development release rate for the 100-year storm event is less than the maximum permitted release rate and equals the two-year storm release rate. A maximum stored volume of 13.31 cu.m. is required to achieve the post development release rate.

Five Year-Storm Event:
The maximum allowable release rate for the five-year storm event for the site is 2.37 l/s. The release rate for the five-year storm event being controlled to a two-year storm is 1.75 l/s. The post-development release rate for the 5-year storm event is calculated to be 1.25 l/s. Therefore the maximum post development release rate for the 5-year storm event is less than the maximum permitted release rate and the two-year storm release rate. A maximum stored volume of 6.41 cu.m. is required to achieve the post development release rate.

Stress Test:
Increasing the 1:100 year IDF rainfall values by 20% does not identify any potential flooding issues and therefore the proposed drainage system does not need to be modified.

Summary Tables

ONE HUNDRED YEAR EVENT

Drainage Area	Maximum Release Rate l/s	Allowable Release Rate l/s	Maximum Volume Stored cu.m.	Maximum Volume Required cu.m.
AREA I (Uncontrolled Flow)	0.15	-	-	-
AREA II (Main Roof - Discharges to Cistern)	1.73	-	7.79	7.79
AREA III (Cistern)	1.60	-	5.52	5.52
TOTAL	1.75	1.75	13.31	13.31

FIVE YEAR EVENT

Drainage Area	Maximum Release Rate l/s	Allowable Release Rate l/s	Maximum Volume Stored cu.m.	Maximum Volume Required cu.m.
AREA I (Uncontrolled Flow)	0.08	-	-	-
AREA II (Main Roof - Discharges to Cistern)	1.32	-	3.44	3.44
AREA III (Cistern)	1.18	-	2.97	2.97
TOTAL	1.25	1.75	6.41	6.41

STRESS TEST 20% INCREASE TO ONE HUNDRED YEAR EVENT

Drainage Area	Maximum Release Rate l/s	Allowable Release Rate l/s	Maximum Volume Stored cu.m.	Maximum Volume Required cu.m.
AREA I (Uncontrolled Flow)	0.18	-	-	-
AREA II (Main Roof - Discharges to Cistern)	1.86	-	9.65	9.65
AREA III (Cistern)	1.75	-	6.60	6.60
TOTAL	1.93	-	16.24	16.24

STORMWATER MANAGEMENT CALCULATIONS

Flow control roof drain calculations are based on the following formula:

$$Q = N \times S \times d \times F$$

where:

- Q = flowrate in ltires per second
- N = number of roof drains
- S = slots per weir
- d = pond depth at roof drain in mm
- F = flowrate through each slot
  0.0124 litres per second per mm pond depth (5 USgpm per inch)

Storage calculations on the roof are based on the following formula for volume of a cone:

$$V = (A \times d)/3$$

where:

- V = volume in cu.m.
- A = ponding area in sq.m.
- d = ponding depth in meters

13-Dec-11

REVISED 03-Jan-13

406-408 Bank Street, Ottawa

Ottawa, Ontario

STORM WATER MANAGEMENT CALCULATIONS

Rational Method

ONE HUNDRED YEAR EVENT

Maximum Allowable Release Rate

Area (A):	303	sq.m.
Time of Concentration:	20	min.
Rainfall Intensity (i):	52	mm/hr (2 year event)
Runoff Coefficient (C):	0.40	
Maximum Allowable Release Rate:	1.75	l/s

DRAINAGE AREA I (Uncontrolled Flow Off Site):

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	3	sq.m.	1.00
Landscaped:	0	sq.m.	0.25
Total Catchment Area	3	sq.m.	1.00

Area (A):	3	sq.m.
Time of Concentration:	10	min.
Rainfall Intensity (i):	179	mm/hr (100 year event)
Runoff Coeficient (C):	1.00	
Flow Rate (2.78AiC):	0.15	l/s

DRAINAGE AREA II (Main Roof):

(One Hundred-Year Event)

			C
Roof Area:	237	sq.m.	1.00
Paved Area:	0	sq.m.	1.00
Landscaped Areas:	0	sq.m.	0.25
Total Catchment Area	237	Ave. C	1.00

No. of Roof Drains: 1

Slots per Wier: 1 0.0124 l/s/mm/slot (5 USgpm/in/slot)

Depth at Roof Drain: 140 mm

Maximum Release Rate 1.73 l/s

Pond Area: 167 sq.m.

Achieved Vol: 7.79 cu.m.

Max. Vol. Required: 7.79 cu.m.

Time	i	2.78AiC	Release Rate	Stored Rate	Stored Volume
min.	mm/hr	l/s	l/s	l/s	cu.m.
5	243	15.99	1.73	14.26	4.28
10	179	11.76	1.73	10.03	6.02
15	143	9.41	1.73	7.68	6.91
20	120	7.90	1.73	6.17	7.41
25	104	6.84	1.73	5.11	7.67
30	92	6.05	1.73	4.32	7.78
35	83	5.44	1.73	3.71	7.79
40	75	4.95	1.73	3.22	7.73
45	69	4.55	1.73	2.82	7.61
50	64	4.21	1.73	2.48	7.44
55	60	3.93	1.73	2.20	7.25
60	56	3.68	1.73	1.95	7.02
65	53	3.47	1.73	1.74	6.77
70	50	3.28	1.73	1.55	6.50
75	47	3.11	1.73	1.38	6.22
80	45	2.96	1.73	1.23	5.91
85	43	2.83	1.73	1.10	5.60
90	41	2.71	1.73	0.98	5.27
95	39	2.60	1.73	0.87	4.94
100	38	2.50	1.73	0.77	4.59
105	36	2.40	1.73	0.67	4.24
110	35	2.32	1.73	0.59	3.88
115	34	2.24	1.73	0.51	3.51
120	33	2.17	1.73	0.44	3.13
125	32	2.10	1.73	0.37	2.75
130	31	2.04	1.73	0.30	2.37
135	30	1.98	1.73	0.24	1.98
140	29	1.92	1.73	0.19	1.58
145	28	1.87	1.73	0.14	1.19
150	28	1.82	1.73	0.09	0.78
180	24	1.57	1.57	0.00	0.00
210	21	1.39	1.39	0.00	0.00
240	19	1.25	1.25	0.00	0.00
270	17	1.14	1.14	0.00	0.00
300	16	1.05	1.05	0.00	0.00

DRAINAGE AREA III

(One Hundred-Year Event)

			C
Roof Area (Terrace Roof):	63	sq.m.	1.00
Asphalt/Concrete Area:	0	sq.m.	1.00
Landscaped:	0	sq.m.	0.25
Total Catchment Area	63	sq.m.	1.00

Water Elevation:	69.35	m	Storage in 450 PVC Pipe Shaft		
			Water Depth		
Outlet Pipe Invert:	67.84	m	m		
			1.51	0.24	cu.m.
Head:	1.51	m			
(water elevation - outlet pipe invert)			Cistern		
			Water Depth		
Orifice Diameter	50	mm	m		
			1.51	5.28	cu.m.
Orifice Area:	1963	sq.mm.			
Coefficient of Discharge:	0.150		Achieved Vol:	5.52	cu.m.
Max. Release Rate:	1.60	l/s	Max. Vol. Required:	5.52	cu.m.

Time	i	2.78AiC	Released from Upper Roof	Total Inflow	Release Rate	Stored Rate	Stored Volume
min.	mm/hr	l/s	l/s	l/s	l/s	l/s	cu.m.
5	243	4.25	1.73	5.98	1.60	4.38	1.31
10	179	3.13	1.73	4.86	1.60	3.26	1.95
15	143	2.50	1.73	4.23	1.60	2.63	2.37
20	120	2.10	1.73	3.83	1.60	2.23	2.68
25	104	1.82	1.73	3.55	1.60	1.95	2.92
30	92	1.61	1.73	3.34	1.60	1.74	3.13
35	83	1.45	1.73	3.18	1.60	1.58	3.31
40	75	1.32	1.73	3.05	1.60	1.45	3.47
45	69	1.21	1.73	2.94	1.60	1.34	3.62
50	64	1.12	1.73	2.85	1.60	1.25	3.75
55	60	1.04	1.73	2.78	1.60	1.17	3.87
60	56	0.98	1.73	2.71	1.60	1.11	3.99
65	53	0.92	1.73	2.65	1.60	1.05	4.10
70	50	0.87	1.73	2.60	1.60	1.00	4.21
75	47	0.83	1.73	2.56	1.60	0.96	4.31
80	45	0.79	1.73	2.52	1.60	0.92	4.40
85	43	0.75	1.73	2.48	1.60	0.88	4.50
90	41	0.72	1.73	2.45	1.60	0.85	4.59
95	39	0.69	1.73	2.42	1.60	0.82	4.68
100	38	0.66	1.73	2.40	1.60	0.79	4.76
105	36	0.64	1.73	2.37	1.60	0.77	4.84
110	35	0.62	1.73	2.35	1.60	0.75	4.93
115	34	0.60	1.73	2.33	1.60	0.73	5.00
120	33	0.58	1.73	2.31	1.60	0.71	5.08
125	32	0.56	1.73	2.29	1.60	0.69	5.16
130	31	0.54	1.73	2.27	1.60	0.67	5.23
135	30	0.53	1.73	2.26	1.60	0.66	5.31
140	29	0.51	1.73	2.24	1.60	0.64	5.38
145	28	0.50	1.73	2.23	1.60	0.63	5.45
150	28	0.48	1.73	2.22	1.60	0.61	5.52
180	24	0.42	1.57	1.99	1.60	0.39	4.22
210	21	0.37	1.39	1.76	1.60	0.16	2.03
240	19	0.33	1.25	1.59	1.59	0.00	0.00
270	17	0.30	1.14	1.44	1.44	0.00	0.00
300	16	0.28	1.05	1.33	1.33	0.00	0.00

FIVE YEAR EVENT

Maximum Allowable Release Rate

Area (A):	303	sq.m.
Time of Concentration:	20	min.
Rainfall Intensity (i):	52	mm/hr (2 year event)
Runoff Coefficient (C):	0.40	
Maximum Allowable Release Rate:	1.75	l/s

DRAINAGE AREA I (Uncontrolled Flow Off Site):

			C
Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	3	sq.m.	0.90
Landscaped:	0	sq.m.	0.20
Total Catchment Area	3	sq.m.	0.90

Area (A):	3	sq.m.
Time of Concentration:	10	min.
Rainfall Intensity (i):	104	mm/hr (5 year event)
Runoff Coeficient (C):	0.90	
Flow Rate (2.78AiC):	0.08	l/s

DRAINAGE AREA II (Main Roof):

(Five-Year Event)

			C
Roof Area:	237	sq.m.	0.90
Paved Area:	0	sq.m.	0.90
Landscaped Areas:	0	sq.m.	0.20
Total Catchment Area	237	Ave. C	0.90

No. of Roof Drains: 1

Slots per Wier: 1 0.0124 l/s/mm/slot (5 USgpm/in/slot)

Depth at Roof Drain: 106 mm

Maximum Release Rate 1.32 l/s

Pond Area: 97 sq.m.

Achieved Vol: 3.44 cu.m.

Max. Vol. Required: 3.44 cu.m.

Time	i	2.78AiC	Release Rate	Stored Rate	Stored Volume
min.	mm/hr	l/s	l/s	l/s	cu.m.
5	141	8.37	1.32	7.05	2.12
10	104	6.18	1.32	4.86	2.92
15	84	4.95	1.32	3.64	3.27
20	70	4.17	1.32	2.85	3.42
25	61	3.61	1.32	2.29	3.44
30	54	3.20	1.32	1.88	3.38
35	49	2.88	1.32	1.56	3.27
40	44	2.62	1.32	1.30	3.12
45	41	2.41	1.32	1.09	2.94
50	38	2.23	1.32	0.91	2.74
55	35	2.08	1.32	0.76	2.52
60	33	1.95	1.32	0.63	2.28
65	31	1.84	1.32	0.52	2.04
70	29	1.74	1.32	0.42	1.78
75	28	1.65	1.32	0.33	1.51
80	27	1.58	1.32	0.26	1.23
85	25	1.50	1.32	0.19	0.95
90	24	1.44	1.32	0.12	0.66
95	23	1.38	1.32	0.06	0.36
100	22	1.33	1.32	0.01	0.06
105	22	1.28	1.28	0.00	0.00
110	21	1.23	1.23	0.00	0.00
115	20	1.19	1.19	0.00	0.00
120	19	1.15	1.15	0.00	0.00
125	19	1.12	1.12	0.00	0.00
130	18	1.08	1.08	0.00	0.00
135	18	1.05	1.05	0.00	0.00
140	17	1.02	1.02	0.00	0.00
145	17	1.00	1.00	0.00	0.00
150	16	0.97	0.97	0.00	0.00
180	14	0.84	0.84	0.00	0.00
210	13	0.74	0.74	0.00	0.00
240	11	0.67	0.67	0.00	0.00
270	10	0.61	0.61	0.00	0.00
300	9	0.56	0.56	0.00	0.00

DRAINAGE AREA III

(Five-Year Event)

			C
Roof Area (Terrace Roof):	63	sq.m.	0.90
Asphalt/Concrete Area:	0	sq.m.	0.90
Landscaped:	0	sq.m.	0.20
Total Catchment Area	63	sq.m.	0.90

Water Elevation:	68.65	m	Storage in 450 PVC Pipe Shaft		
			Water Depth		
Outlet Pipe Invert:	67.84	m	m		
			0.81	0.13	cu.m.
Head:	0.81	m			
(water elevation - outlet pipe invert)			Cistern		
			Water Depth		
Orifice Diameter	50	mm	m		
			0.81	2.85	cu.m.
Orifice Area:	1963	sq.mm.			
Coefficient of Discharge:	0.150		Achieved Vol:	2.97	cu.m.
Max. Release Rate:	1.18	l/s	Max. Vol. Required:	2.97	cu.m.

Time	i	2.78AiC	Released from Upper Roof	Total Inflow	Release Rate	Stored Rate	Stored Volume
min.	mm/hr	l/s	l/s	l/s	l/s	l/s	cu.m.
5	141	2.23	1.32	3.54	1.18	2.37	0.71
10	104	1.64	1.32	2.96	1.18	1.78	1.07
15	84	1.32	1.32	2.64	1.18	1.46	1.31
20	70	1.11	1.32	2.43	1.18	1.25	1.50
25	61	0.96	1.32	2.28	1.18	1.10	1.65
30	54	0.85	1.32	2.17	1.18	0.99	1.79
35	49	0.76	1.32	2.08	1.18	0.91	1.91
40	44	0.70	1.32	2.02	1.18	0.84	2.01
45	41	0.64	1.32	1.96	1.18	0.78	2.11
50	38	0.59	1.32	1.91	1.18	0.74	2.21
55	35	0.55	1.32	1.87	1.18	0.70	2.30
60	33	0.52	1.32	1.84	1.18	0.66	2.38
65	31	0.49	1.32	1.81	1.18	0.63	2.46
70	29	0.46	1.32	1.78	1.18	0.61	2.54
75	28	0.44	1.32	1.76	1.18	0.58	2.62
80	27	0.42	1.32	1.74	1.18	0.56	2.69
85	25	0.40	1.32	1.72	1.18	0.54	2.77
90	24	0.38	1.32	1.70	1.18	0.53	2.84
95	23	0.37	1.32	1.69	1.18	0.51	2.91
100	22	0.35	1.32	1.67	1.18	0.50	2.97
105	22	0.34	1.28	1.62	1.18	0.44	2.80
110	21	0.33	1.23	1.56	1.18	0.39	2.55
115	20	0.32	1.19	1.51	1.18	0.33	2.30
120	19	0.31	1.15	1.46	1.18	0.28	2.05
125	19	0.30	1.12	1.42	1.18	0.24	1.80
130	18	0.29	1.08	1.37	1.18	0.20	1.54
135	18	0.28	1.05	1.33	1.18	0.16	1.27
140	17	0.27	1.02	1.30	1.18	0.12	1.01
145	17	0.26	1.00	1.26	1.18	0.08	0.74
150	16	0.26	0.97	1.23	1.18	0.05	0.47
180	14	0.22	0.84	1.06	1.06	0.00	0.00
210	13	0.20	0.74	0.94	0.94	0.00	0.00
240	11	0.18	0.67	0.85	0.85	0.00	0.00
270	10	0.16	0.61	0.77	0.77	0.00	0.00
300	9	0.15	0.56	0.71	0.71	0.00	0.00

STRESS TEST
20% INCREASE TO ONE HUNDRED YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site):

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	3	sq.m.	1.00
Landscaped:	0	sq.m.	0.25
Total Catchment Area	3	sq.m.	1.00
Area (A):	3	sq.m.	
Time of Concentration:	10	min.	
Rainfall Intensity (i):	214	mm/hr (100 year event)	
Runoff Coeficient (C):	1.00		
Flow Rate (2.78AiC):	0.18	l/s	

DRAINAGE AREA II (Main Roof):

(Stress Test)

			C
Roof Area:	237	sq.m.	1.00
Paved Area:	0	sq.m.	1.00
Landscaped Areas:	0	sq.m.	0.25
Total Catchment Area	237	Ave. C	1.00

No. of Roof Drains: 1
Slots per Wier: 1 0.0124 l/s/mm/slot (5 USgpm/in/slot)

Depth at Roof Drain: 150 mm

Maximum Roof Drain Release Rate:	1.86	l/s	Pond Area:	193	sq.m.
Maximum Scupper Release Rate:	0.08	l/s			
Maximum Release Rate:	1.94	l/s	Achieved Vol:	9.65	cu.m.
			Max. Vol. Required:	9.65	cu.m.

Time	i	2.78AiC	Roof Drain Release Rate	Scupper Release Rate	TOTAL Release Rate	Stored Rate	Stored Volume
min.	mm/hr	l/s	l/s	l/s	l/s	l/s	cu.m.
5	291	19.19	1.86	0.00	1.86	17.33	5.20
10	214	14.12	1.86	0.00	1.86	12.26	7.35
15	171	11.30	1.86	0.00	1.86	9.44	8.49
20	144	9.48	1.86	0.00	1.86	7.62	9.15
25	125	8.21	1.86	0.00	1.86	6.35	9.53
30	110	7.26	1.86	0.05	1.91	5.36	9.65
35	99	6.53	1.86	0.08	1.94	4.59	9.65
40	90	5.94	1.86	0.06	1.92	4.02	9.65
45	83	5.46	1.86	0.03	1.89	3.57	9.65
50	77	5.06	1.86	0.00	1.86	3.20	9.59
55	72	4.71	1.86	0.00	1.86	2.85	9.42
60	67	4.42	1.86	0.00	1.86	2.56	9.21
65	63	4.16	1.86	0.00	1.86	2.30	8.98
70	60	3.94	1.86	0.00	1.86	2.08	8.72
75	57	3.74	1.86	0.00	1.86	1.88	8.44
80	54	3.56	1.86	0.00	1.86	1.70	8.15
85	52	3.40	1.86	0.00	1.86	1.54	7.83
90	49	3.25	1.86	0.00	1.86	1.39	7.51
95	47	3.12	1.86	0.00	1.86	1.26	7.17
100	45	3.00	1.86	0.00	1.86	1.14	6.82
105	44	2.89	1.86	0.00	1.86	1.03	6.46
110	42	2.78	1.86	0.00	1.86	0.92	6.09
115	41	2.69	1.86	0.00	1.86	0.83	5.72
120	39	2.60	1.86	0.00	1.86	0.74	5.33
125	38	2.52	1.86	0.00	1.86	0.66	4.94
130	37	2.44	1.86	0.00	1.86	0.58	4.55
135	36	2.37	1.86	0.00	1.86	0.51	4.14
140	35	2.30	1.86	0.00	1.86	0.44	3.74
145	34	2.24	1.86	0.00	1.86	0.38	3.32
150	33	2.18	1.86	0.00	1.86	0.32	2.91
180	29	1.89	1.86	0.00	1.86	0.03	0.32
210	25	1.67	1.67	0.00	1.67	0.00	0.00
240	23	1.50	1.50	0.00	1.50	0.00	0.00
270	21	1.37	1.37	0.00	1.37	0.00	0.00
300	19	1.26	1.26	0.00	1.26	0.00	0.00

DRAINAGE AREA III

(Stress Test)

			C
Roof Area (Terrace Roof):	63	sq.m.	1.00
Asphalt/Concrete Area:	0	sq.m.	1.00
Landscaped:	0	sq.m.	0.25
Total Catchment Area	63	sq.m.	1.00

Water Elevation:	69.64	m	Storage in 450 PVC Pipe Shaft		
			Water Depth		
Outlet Pipe Invert:	67.84	m	m		
			1.80	0.29	cu.m.
Head:	1.80	m			
(water elevation - outlet pipe invert)			Cistern		
			Water Depth		
Orifice Diameter	50	mm	m		
			1.80	6.31	cu.m.
Orifice Area:	1963	sq.mm.			
Coefficient of Discharge:	0.150		Achieved Vol:	6.60	cu.m.
Max. Release Rate:	1.75	l/s	Max. Vol. Required:	6.60	cu.m.

Time	i	2.78AiC	Released from Upper Roof	Total Inflow	Release Rate	Stored Rate	Stored Volume
min.	mm/hr	l/s	l/s	l/s	l/s	l/s	cu.m.
5	291	5.10	1.86	6.96	1.75	5.21	1.56
10	214	3.75	1.86	5.61	1.75	3.86	2.32
15	171	3.00	1.86	4.86	1.75	3.11	2.80
20	144	2.52	1.86	4.38	1.75	2.63	3.16
25	125	2.18	1.86	4.04	1.75	2.29	3.44
30	110	1.93	1.91	3.84	1.75	2.08	3.75
35	99	1.74	1.94	3.67	1.75	1.92	4.03
40	90	1.58	1.92	3.50	1.75	1.75	4.20
45	83	1.45	1.89	3.34	1.75	1.59	4.28
50	77	1.34	1.86	3.20	1.75	1.45	4.36
55	72	1.25	1.86	3.11	1.75	1.36	4.49
60	67	1.17	1.86	3.03	1.75	1.28	4.62
65	63	1.11	1.86	2.97	1.75	1.21	4.74
70	60	1.05	1.86	2.91	1.75	1.15	4.85
75	57	0.99	1.86	2.85	1.75	1.10	4.96
80	54	0.95	1.86	2.81	1.75	1.05	5.06
85	52	0.90	1.86	2.76	1.75	1.01	5.16
90	49	0.86	1.86	2.72	1.75	0.97	5.25
95	47	0.83	1.86	2.69	1.75	0.94	5.34
100	45	0.80	1.86	2.66	1.75	0.91	5.43
105	44	0.77	1.86	2.63	1.75	0.88	5.52
110	42	0.74	1.86	2.60	1.75	0.85	5.60
115	41	0.71	1.86	2.57	1.75	0.82	5.68
120	39	0.69	1.86	2.55	1.75	0.80	5.76
125	38	0.67	1.86	2.53	1.75	0.78	5.84
130	37	0.65	1.86	2.51	1.75	0.76	5.91
135	36	0.63	1.86	2.49	1.75	0.74	5.98
140	35	0.61	1.86	2.47	1.75	0.72	6.06
145	34	0.60	1.86	2.46	1.75	0.70	6.13
150	33	0.58	1.86	2.44	1.75	0.69	6.20
180	29	0.50	1.86	2.36	1.75	0.61	6.60
210	25	0.44	1.67	2.12	1.75	0.36	4.59
240	23	0.40	1.50	1.90	1.75	0.15	2.17
270	21	0.36	1.37	1.73	1.73	0.00	0.00
300	19	0.33	1.26	1.59	1.59	0.00	0.00