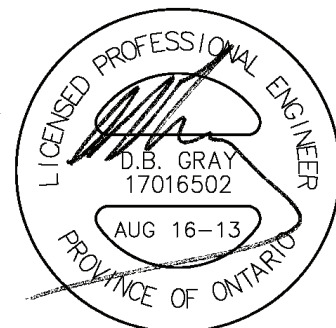


STORMWATER MANAGEMENT REPORT

Ladouceur Street & Merton Street
Townhouses
Ottawa, Ontario

Report No. 13029-SWM

August 16, 2013



NOT VALID UNLESS
SIGNED & DATED

D. B. GRAY ENGINEERING INC.

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STORMWATER MANAGEMENT REPORT

Ladouceur Street & Merton Street Townhouses Ottawa, Ontario

This report addresses the stormwater management requirements of an 8 unit townhouse residential development located on 698 sq.m. of land at the intersection of Ladouceur Street & Merton Street in Ottawa.

This report forms part of the stormwater management design for the proposed development. Also refer to drawing SG-1, SG-2 & SG-3 prepared by D. B. Gray Engineering Inc.

WATER QUALITY:

During construction, an erosion and sediment control plan has been developed (see notes 2.1 to 2.5 on drawing SG-3). 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 and all new catch basins as they are installed.

WATER QUANTITY:

As requested by the staff of City of Ottawa Infrastructure Approvals: The desired stormwater quantity control measures are 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 0.50 and a 20 minute time of concentration.

However the above criteria cannot be achieved without the roof drains discharging into expensive underground storage. Such an arrangement would increase the risk of flooding inside the houses. To alleviate the risk of flooding the rainwater leaders would need to be vented. If left unvented an air lock could develop and the water column in the rainwater leader could cause the cleanouts at the base of the leader to fail and cause flooding inside the building.

The above arrangement is not desired; as such the stormwater quantity control measures detailed in this report are based on the criteria that the release rate for post-development storm events is equal to or less than the flow produced by the existing development. It is calculated that the pre-development conditions reflect a 5-year runoff coefficient of 0.58.

As recommended in City of Ottawa Technical Bulletin ISDTB-2012-1, the drainage system has been "stress tested" using design storms calculated on the basis of a 20% increase of the City's 1:100 year IDF curve rainfall values. The purpose of the stress test is to identify potential flooding of properties and, if necessary, to modify the proposed drainage system to prevent the flooding.

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 roofs of the proposed buildings and underground in a catch basin, manhole and sewer pipes.

The runoff from between the proposed building and the sidewalk and driveway entrance (Drainage Area I – 257 sq.m.) will be allowed to flow uncontrolled off the site. The flow from these areas is calculated at the five year event at 10 minutes concentration.

Each of 14 roof drains will be flow control type installed with one parabolic shaped slotted weir (0.0124 l/s per mm per slot - 5 USgpm per inch per slot) causing the storm water to pond on the roofs (Drainage Areas II to VII – 379 sq.m.).

An inlet control device (ICD) located at the outlet pipe of MH-2 will also control the release of stormwater off the site. The ICD will restrict the flow and force the stormwater to back up into the upstream sewer pipe, catch basin and manhole.

Stormwater released through the flow control roof drains on the roofs of Units 1 to 6 will be conveyed off the site via a six 100mm storm sewer connections into a 300mm storm sewer on Ladouceur Street.

Stormwater released through the flow control roof drains on the roofs of Units 7 and 8 and the ICD will be conveyed off the site via a 250mm storm sewer connecting to a 375mm storm sewer on Merton Street.

The ICD shall be a Hydrovex "VHV Vertical Vortex Flow Regulator" and shall be sized by the manufacturer for a discharge rate of 0.89 l/s at 0.43 m head. It is calculated that an orifice area of 1963 sq.mm. (± 50 mm diameter) and a discharge coefficient of 0.155 will restrict the outflow rate to 0.89 l/s at a head of 0.43 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 0.43 l/s at 0.10 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 roofs (Drainage Area II to VII) will increase to the maximum depth at the roof drain and overflow out the scuppers.

The depth of the water in the underground storage (catch basin, manhole and sewer pipes - Drainage Area VII) increases from 0.43 m to 0.74 m.

The maximum flowrate off the site will increase by about 19% from 18.79 to 22.27 l/s.

The maximum volume of on-site storage will increase by about 25% from 6.25 to 7.84 cu.m.

There are no potential flooding issues and therefore the proposed drainage system does not need to be modified.

Since the stormwater management facility is located on more than one property it is expected that a Ministry of Environment Environmental Compliance Approval (ECA) will be required.

ONE HUNDRED-YEAR PRE-DEVELOPMENT RUNOFF RATE:

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

Area (A):	628 sq.m.
Time of Concentration (T):	20 minutes
Rainfall Intensity (Five Year Event) (i):	70 mm/hr
Runoff Coefficient (C):	0.71
Maximum Allowable Release Rate:	24.59 l/s

FIVE-YEAR PRE-DEVELOPMENT RUNOFF RATE:

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

Area (A):	628 sq.m.
Time of Concentration (T):	20 minutes
Rainfall Intensity (Five Year Event) (i):	70 mm/hr
Runoff Coefficient (C):	0.58
Maximum Allowable Release Rate:	11.69 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 pre-development runoff rate for the one hundred-year storm event for the site is 24.59 l/s. The maximum post-development release rate for the 100-year storm event is calculated to be 18.79 l/s. Therefore the maximum post development release rate for the 100-year storm event is 24% less than the pre-development runoff rate. A maximum stored volume of 6.25 cu.m. is required to achieve the post development release rate.

Five Year Storm Event:

The pre-development runoff rate for the five-year storm event for the site is 11.69 l/s. The maximum post-development release rate for the 5-year storm event is calculated to be 11.69 l/s. Therefore the maximum post-development release rate for the 5-year storm event is less than the pre-development flow rate. A maximum stored volume of 2.18 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	Pre-development Runoff l/s	Maximum Volume Stored cu.m.	Maximum Volume Required cu.m.
AREA I (Uncontrolled flow off site)	6.80	-	-	-
AREA II 1 Terrace Roof) (Unit	0.85	-	0.71	0.71
AREA III 1 Lower Roof) (Unit	0.70	-	0.15	0.15
AREA IV 2 to 6 Terrace Roof) (Unit	3.55	-	1.44	1.44
AREA V 2 to 6 Lower Roof) (Unit	4.25	-	1.00	1.00
AREA VI 7 Roof) (Unit	0.86	-	0.73	0.73
AREA VII 8 Roof) (Unit	0.88	-	0.82	0.82
AREA VIII	0.89	-	1.39	1.39
TOTAL	18.79	24.59	6.25	6.25

Summary Tables

FIVE YEAR EVENT				
Drainage Area	Maximum Release Rate l/s	Pre-development Runoff l/s	Maximum Volume Stored cu.m.	Maximum Volume Required cu.m.
AREA I (Uncontrolled flow off site)	3.46	-	-	-
AREA II 1 Terrace Roof) (Unit	0.62	-	0.27	0.27
AREA III 1 Lower Roof) (Unit	0.48	-	0.05	0.05
AREA IV 2 to 6 Terrace Roof) (Unit	2.52	-	0.52	0.52
AREA V 2 to 6 Lower Roof) (Unit	2.91	-	0.32	0.32
AREA VI 7 Roof) (Unit	0.63	-	0.28	0.28
AREA VII 8 Roof) (Unit	0.64	-	0.32	0.32
AREA VIII	0.43	-	0.42	0.42
TOTAL	11.68	11.69	2.18	2.18

Summary Tables

STRESS TEST - 20% INCREASE TO ONE HUNDRED YEAR EVENT RAINFALL				
Drainage Area	Maximum Release Rate l/s	Pre-development Runoff l/s	Maximum Volume Stored cu.m.	Maximum Volume Required cu.m.
AREA I (Uncontrolled flow off site)	8.16	-	-	-
AREA II 1 Terrace Roof) (Unit	0.93	-	0.92	0.92
AREA III 1 Lower Roof) (Unit	0.86	-	0.18	0.18
AREA IV 2 to 6 Terrace Roof) (Unit	4.39	-	1.65	1.65
AREA V 2 to 6 Lower Roof) (Unit	4.74	-	1.31	1.31
AREA VI 7 Roof) (Unit	0.98	-	0.92	0.92
AREA VII 8 Roof) (Unit	1.06	-	0.98	0.98
AREA VIII	1.16	-	1.87	1.87
TOTAL	22.27	29.50	7.84	7.84

STORMWATER MANAGEMENT CALCULATIONS

The orifice calculations are based on the following formula:

$$Q = C_d \times A_o \sqrt{2gh} \times 1000$$

where:

Q = flowrate in litres per second

C_d = coefficient of discharge

A_o = orifice area in sq.m.

g = 9.81 m/s²

h = head above orifice in meters

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

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

where:

Q = flowrate in litres 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

Calculations for sub-surface storage (manholes and sewer pipes) are based on the following formula for volume of a cylinder:

$$V = L \times \text{Pi} \times (d/2)^2$$

where:

V = volume in cu.m.

L = depth of water in manhole or length of pipe in meters

d = diameter of manhole (1.22 m) or pipe in meters

Ladouceur St & Merton St
Townhouses
Ottawa, Ontario

STORM WATER MANAGEMENT CALCULATIONS
Rational Method

ONE HUNDRED YEAR EVENT

Desired Maximum Release Rate

Area (A):	698	sq.m.
Time of Concentration:	20	min.
Rainfall Intensity (i):	70	mm/hr (5 year event)
Runoff Coefficient (C):	0.50	
Maximum Release Rate:	6.82	l/s

Pre-development Runoff

Roof Area:	71	sq.m.	1.000
Asphalt/Concrete Area:	3	sq.m.	1.000
Gravel:	225	sq.m.	0.875
Sparse Grass & Weeds / Steep Slope:	<u>399</u>	<u>sq.m.</u>	<u>0.563</u>
Total Catchment Area	698	sq.m.	0.71

Area (A):	698	sq.m.
Time of Concentration:	10	min.
Rainfall Intensity (i):	179	mm/hr (100 year event)
Runoff Coefficient (C):	0.71	
Pre-development Flow:	24.59	l/s

DRAINAGE AREA I:
(Uncontrolled Flow Off Site - Sheet Flow)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	97	sq.m.	1.00
Landscaped:	<u>160</u>	<u>sq.m.</u>	<u>0.25</u>
Total Catchment Area	257	sq.m.	0.53
Area (A):	257	sq.m.	
Time of Concentration:	10	min.	
Rainfall Intensity (i):	179	mm/hr (100 year event)	
Runoff Coefficient (C):	0.53		
Flow Rate (2.78AiC):	6.80	l/s	

DRAINAGE AREA II (Unit 1 Terrace Roof):

(ONE HUNDRED YEAR EVENT)

				C
Roof Area:	41	sq.m.	1.00	
Paved Area:	0	sq.m.	1.00	
Landscaped Areas:	<u>0</u>	sq.m.	<u>0.25</u>	
Total Catchment Area	41	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:	69	mm		
Maximum Release Rate	0.85	l/s	Pond Area:	31 sq.m.
			Achieved Vol:	0.71 cu.m.
			Max. Vol. Required:	0.71 cu.m.

Time	i	2.78AiC	Release	Stored	Stored
min.	mm/hr	l/s	Rate	Rate	Volume
			l/s	l/s	cu.m.
5	243	2.77	0.85	1.92	0.57
10	179	2.04	0.85	1.18	0.71
15	143	1.63	0.85	0.78	0.70
20	120	1.37	0.85	0.52	0.62
25	104	1.18	0.85	0.33	0.50
30	92	1.05	0.85	0.20	0.35
35	83	0.94	0.85	0.09	0.19
40	75	0.86	0.85	0.01	0.01
45	69	0.79	0.79	0.00	0.00
50	64	0.73	0.73	0.00	0.00
55	60	0.68	0.68	0.00	0.00
60	56	0.64	0.64	0.00	0.00
65	53	0.60	0.60	0.00	0.00
70	50	0.57	0.57	0.00	0.00
75	47	0.54	0.54	0.00	0.00
80	45	0.51	0.51	0.00	0.00
85	43	0.49	0.49	0.00	0.00
90	41	0.47	0.47	0.00	0.00
95	39	0.45	0.45	0.00	0.00
100	38	0.43	0.43	0.00	0.00
105	36	0.42	0.42	0.00	0.00
110	35	0.40	0.40	0.00	0.00
115	34	0.39	0.39	0.00	0.00
120	33	0.37	0.37	0.00	0.00
125	32	0.36	0.36	0.00	0.00
130	31	0.35	0.35	0.00	0.00
135	30	0.34	0.34	0.00	0.00
140	29	0.33	0.33	0.00	0.00
145	28	0.32	0.32	0.00	0.00
150	28	0.31	0.31	0.00	0.00
180	24	0.27	0.27	0.00	0.00
210	21	0.24	0.24	0.00	0.00
240	19	0.22	0.22	0.00	0.00
270	17	0.20	0.20	0.00	0.00
300	16	0.18	0.18	0.00	0.00

DRAINAGE AREA III (Unit 1 Lower Roof):

(ONE HUNDRED YEAR EVENT)

				C
Roof Area:	18	sq.m.	1.00	
Paved Area:	0	sq.m.	1.00	
Landscaped Areas:	0	sq.m.	<u>0.25</u>	
Total Catchment Area	18	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:	57	mm		
Maximum Release Rate	0.70	l/s	Pond Area:	8 sq.m.
			Achieved Vol:	0.15 cu.m.
			Max. Vol. Required:	0.15 cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	243	1.21	0.70	0.51	0.15
10	179	0.89	0.70	0.19	0.11
15	143	0.72	0.70	0.01	0.01
20	120	0.60	0.60	0.00	0.00
25	104	0.52	0.52	0.00	0.00
30	92	0.46	0.46	0.00	0.00
35	83	0.41	0.41	0.00	0.00
40	75	0.38	0.38	0.00	0.00
45	69	0.35	0.35	0.00	0.00
50	64	0.32	0.32	0.00	0.00
55	60	0.30	0.30	0.00	0.00
60	56	0.28	0.28	0.00	0.00
65	53	0.26	0.26	0.00	0.00
70	50	0.25	0.25	0.00	0.00
75	47	0.24	0.24	0.00	0.00
80	45	0.23	0.23	0.00	0.00
85	43	0.21	0.21	0.00	0.00
90	41	0.21	0.21	0.00	0.00
95	39	0.20	0.20	0.00	0.00
100	38	0.19	0.19	0.00	0.00
105	36	0.18	0.18	0.00	0.00
110	35	0.18	0.18	0.00	0.00
115	34	0.17	0.17	0.00	0.00
120	33	0.16	0.16	0.00	0.00
125	32	0.16	0.16	0.00	0.00
130	31	0.15	0.15	0.00	0.00
135	30	0.15	0.15	0.00	0.00
140	29	0.15	0.15	0.00	0.00
145	28	0.14	0.14	0.00	0.00
150	28	0.14	0.14	0.00	0.00
180	24	0.12	0.12	0.00	0.00
210	21	0.11	0.11	0.00	0.00
240	19	0.10	0.10	0.00	0.00
270	17	0.09	0.09	0.00	0.00
300	16	0.08	0.08	0.00	0.00

DRAINAGE AREA IV (Units 2 to 6 Terrace Roof):

(ONE HUNDRED YEAR EVENT)

				C
Roof Area:	120	sq.m.	1.00	
Paved Area:	0	sq.m.	1.00	
Landscaped Areas:	<u>0</u>	<u>sq.m.</u>	<u>0.25</u>	
Total Catchment Area	120	Ave. C	1.00	
No. of Roof Drains:	5			
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)		
Depth at Roof Drain:	57	mm		
Maximum Release Rate	3.55	l/s	Pond Area:	75 sq.m.
			Achieved Vol:	1.44 cu.m.
			Max. Vol. Required:	1.44 cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	243	8.10	3.55	4.54	1.36
10	179	5.96	3.55	2.40	1.44
15	143	4.77	3.55	1.21	1.09
20	120	4.00	3.55	0.45	0.54
25	104	3.46	3.46	0.00	0.00
30	92	3.06	3.06	0.00	0.00
35	83	2.75	2.75	0.00	0.00
40	75	2.51	2.51	0.00	0.00
45	69	2.30	2.30	0.00	0.00
50	64	2.13	2.13	0.00	0.00
55	60	1.99	1.99	0.00	0.00
60	56	1.86	1.86	0.00	0.00
65	53	1.76	1.76	0.00	0.00
70	50	1.66	1.66	0.00	0.00
75	47	1.58	1.58	0.00	0.00
80	45	1.50	1.50	0.00	0.00
85	43	1.43	1.43	0.00	0.00
90	41	1.37	1.37	0.00	0.00
95	39	1.32	1.32	0.00	0.00
100	38	1.26	1.26	0.00	0.00
105	36	1.22	1.22	0.00	0.00
110	35	1.17	1.17	0.00	0.00
115	34	1.13	1.13	0.00	0.00
120	33	1.10	1.10	0.00	0.00
125	32	1.06	1.06	0.00	0.00
130	31	1.03	1.03	0.00	0.00
135	30	1.00	1.00	0.00	0.00
140	29	0.97	0.97	0.00	0.00
145	28	0.95	0.95	0.00	0.00
150	28	0.92	0.92	0.00	0.00
180	24	0.80	0.80	0.00	0.00
210	21	0.71	0.71	0.00	0.00
240	19	0.63	0.63	0.00	0.00
270	17	0.58	0.58	0.00	0.00
300	16	0.53	0.53	0.00	0.00

DRAINAGE AREA V (Units 2 to 6 Lower Roof):

(ONE HUNDRED YEAR EVENT)

							C
Roof Area:	113	sq.m.					1.00
Paved Area:	0	sq.m.					1.00
Landscaped Areas:	<u>0</u>	<u>sq.m.</u>					<u>0.25</u>
Total Catchment Area	113	Ave. C					1.00
No. of Roof Drains:	5						
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)					
Depth at Roof Drain:	69	mm					
Maximum Release Rate	4.25	l/s			Pond Area:	44	sq.m.
					Achieved Vol:	1.00	cu.m.
					Max. Vol. Required:	1.00	cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	243	7.59	4.25	3.34	1.00
10	179	5.58	4.25	1.33	0.80
15	143	4.47	4.25	0.22	0.20
20	120	3.75	3.75	0.00	0.00
25	104	3.25	3.25	0.00	0.00
30	92	2.87	2.87	0.00	0.00
35	83	2.58	2.58	0.00	0.00
40	75	2.35	2.35	0.00	0.00
45	69	2.16	2.16	0.00	0.00
50	64	2.00	2.00	0.00	0.00
55	60	1.86	1.86	0.00	0.00
60	56	1.75	1.75	0.00	0.00
65	53	1.65	1.65	0.00	0.00
70	50	1.56	1.56	0.00	0.00
75	47	1.48	1.48	0.00	0.00
80	45	1.41	1.41	0.00	0.00
85	43	1.34	1.34	0.00	0.00
90	41	1.29	1.29	0.00	0.00
95	39	1.23	1.23	0.00	0.00
100	38	1.19	1.19	0.00	0.00
105	36	1.14	1.14	0.00	0.00
110	35	1.10	1.10	0.00	0.00
115	34	1.06	1.06	0.00	0.00
120	33	1.03	1.03	0.00	0.00
125	32	1.00	1.00	0.00	0.00
130	31	0.97	0.97	0.00	0.00
135	30	0.94	0.94	0.00	0.00
140	29	0.91	0.91	0.00	0.00
145	28	0.89	0.89	0.00	0.00
150	28	0.86	0.86	0.00	0.00
180	24	0.75	0.75	0.00	0.00
210	21	0.66	0.66	0.00	0.00
240	19	0.59	0.59	0.00	0.00
270	17	0.54	0.54	0.00	0.00
300	16	0.50	0.50	0.00	0.00

DRAINAGE AREA VI (Unit 7 Roof):

(ONE HUNDRED YEAR EVENT)

					C	
Roof Area:	42	sq.m.			1.00	
Paved Area:	0	sq.m.			1.00	
Landscaped Areas:	0	sq.m.			<u>0.25</u>	
Total Catchment Area	42		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:	70	mm				
Maximum Release Rate	0.86	l/s		Pond Area:	32	sq.m.
				Achieved Vol:	0.73	cu.m.
				Max. Vol. Required:	0.73	cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	243	2.83	0.86	1.97	0.59
10	179	2.08	0.86	1.22	0.73
15	143	1.67	0.86	0.81	0.73
20	120	1.40	0.86	0.54	0.65
25	104	1.21	0.86	0.35	0.53
30	92	1.07	0.86	0.21	0.38
35	83	0.96	0.86	0.10	0.22
40	75	0.88	0.86	0.02	0.04
45	69	0.81	0.81	0.00	0.00
50	64	0.75	0.75	0.00	0.00
55	60	0.70	0.70	0.00	0.00
60	56	0.65	0.65	0.00	0.00
65	53	0.61	0.61	0.00	0.00
70	50	0.58	0.58	0.00	0.00
75	47	0.55	0.55	0.00	0.00
80	45	0.53	0.53	0.00	0.00
85	43	0.50	0.50	0.00	0.00
90	41	0.48	0.48	0.00	0.00
95	39	0.46	0.46	0.00	0.00
100	38	0.44	0.44	0.00	0.00
105	36	0.43	0.43	0.00	0.00
110	35	0.41	0.41	0.00	0.00
115	34	0.40	0.40	0.00	0.00
120	33	0.38	0.38	0.00	0.00
125	32	0.37	0.37	0.00	0.00
130	31	0.36	0.36	0.00	0.00
135	30	0.35	0.35	0.00	0.00
140	29	0.34	0.34	0.00	0.00
145	28	0.33	0.33	0.00	0.00
150	28	0.32	0.32	0.00	0.00
180	24	0.28	0.28	0.00	0.00
210	21	0.25	0.25	0.00	0.00
240	19	0.22	0.22	0.00	0.00
270	17	0.20	0.20	0.00	0.00
300	16	0.19	0.19	0.00	0.00

DRAINAGE AREA VII (Unit 8 Roof):

(ONE HUNDRED YEAR EVENT)

				C	
Roof Area:	45	sq.m.		1.00	
Paved Area:	0	sq.m.		1.00	
Landscaped Areas:	0	sq.m.	<u> </u>	<u>0.25</u>	
Total Catchment Area	45	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:	71	mm			
Maximum Release Rate	0.88	l/s		Pond Area:	35 sq.m.
				Achieved Vol:	0.82 cu.m.
				Max. Vol. Required:	0.82 cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	243	3.04	0.88	2.16	0.65
10	179	2.23	0.88	1.36	0.81
15	143	1.79	0.88	0.91	0.82
20	120	1.50	0.88	0.62	0.75
25	104	1.30	0.88	0.42	0.63
30	92	1.15	0.88	0.27	0.49
35	83	1.03	0.88	0.16	0.33
40	75	0.94	0.88	0.06	0.15
45	69	0.86	0.86	0.00	0.00
50	64	0.80	0.80	0.00	0.00
55	60	0.75	0.75	0.00	0.00
60	56	0.70	0.70	0.00	0.00
65	53	0.66	0.66	0.00	0.00
70	50	0.62	0.62	0.00	0.00
75	47	0.59	0.59	0.00	0.00
80	45	0.56	0.56	0.00	0.00
85	43	0.54	0.54	0.00	0.00
90	41	0.51	0.51	0.00	0.00
95	39	0.49	0.49	0.00	0.00
100	38	0.47	0.47	0.00	0.00
105	36	0.46	0.46	0.00	0.00
110	35	0.44	0.44	0.00	0.00
115	34	0.43	0.43	0.00	0.00
120	33	0.41	0.41	0.00	0.00
125	32	0.40	0.40	0.00	0.00
130	31	0.39	0.39	0.00	0.00
135	30	0.38	0.38	0.00	0.00
140	29	0.36	0.36	0.00	0.00
145	28	0.35	0.35	0.00	0.00
150	28	0.35	0.35	0.00	0.00
180	24	0.30	0.30	0.00	0.00
210	21	0.26	0.26	0.00	0.00
240	19	0.24	0.24	0.00	0.00
270	17	0.22	0.22	0.00	0.00
300	16	0.20	0.20	0.00	0.00

DRAINAGE AREA VIII

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	61	sq.m.	1.00
Landscaped:	<u>1</u>	<u>sq.m.</u>	<u>0.25</u>
Total Catchment Area	62	sq.m.	0.99

Water Elevation: 59.29 m

ICD Invert:	58.85	m	Storage in MH's & CB's			
(Outlet Pipe OF MH-2)			Invert	Depth		
			m	m		
Head:	0.43	m	MH-2	58.85	0.43	0.49 cu.m.
			CB-3	58.92	0.36	0.13 cu.m.

Orifice Diameter 50 mm

Orifice Area:	1963	sq.mm.	Storage in Sewer Pipes			
			Diam.	Length		
			mm	m		
Coefficient of Discharge:	0.155		250	16.7	0.77	cu.m.

Max. Release Rate: 0.89 l/s Achieved Vol: 1.39 cu.m.

Max. Vol. Required: 1.39 cu.m.

Time	i	2.78AiC	Release	Stored	Stored
min.	mm/hr	l/s	l/s	l/s	cu.m.
5	243	4.13	0.89	3.24	0.97
10	179	3.04	0.89	2.15	1.29
15	143	2.43	0.89	1.54	1.39
20	120	2.04	0.89	1.15	1.38
25	104	1.77	0.89	0.88	1.32
30	92	1.56	0.89	0.68	1.22
35	83	1.41	0.89	0.52	1.09
40	75	1.28	0.89	0.39	0.94
45	69	1.18	0.89	0.29	0.77
50	64	1.09	0.89	0.20	0.60
55	60	1.02	0.89	0.13	0.42
60	56	0.95	0.89	0.06	0.23
65	53	0.90	0.89	0.01	0.03
70	50	0.85	0.85	0.00	0.00
75	47	0.80	0.80	0.00	0.00
80	45	0.77	0.77	0.00	0.00
85	43	0.73	0.73	0.00	0.00
90	41	0.70	0.70	0.00	0.00
95	39	0.67	0.67	0.00	0.00
100	38	0.65	0.65	0.00	0.00
105	36	0.62	0.62	0.00	0.00
110	35	0.60	0.60	0.00	0.00
115	34	0.58	0.58	0.00	0.00
120	33	0.56	0.56	0.00	0.00
125	32	0.54	0.54	0.00	0.00
130	31	0.53	0.53	0.00	0.00
135	30	0.51	0.51	0.00	0.00
140	29	0.50	0.50	0.00	0.00
145	28	0.48	0.48	0.00	0.00
150	28	0.47	0.47	0.00	0.00
180	24	0.41	0.41	0.00	0.00
210	21	0.36	0.36	0.00	0.00
240	19	0.32	0.32	0.00	0.00
270	17	0.29	0.29	0.00	0.00
300	16	0.27	0.27	0.00	0.00

FIVE YEAR EVENT

Desired Maximum Release Rate

Area (A):	698	sq.m.
Time of Concentration:	20	min.
Rainfall Intensity (i):	70	mm/hr (5 year event)
Runoff Coefficient (C):	0.50	
Maximum Release Rate:	6.82	l/s

Pre-development Runoff

Roof Area:	71	sq.m.	0.90
Asphalt/Concrete Area:	3	sq.m.	0.90
Gravel:	225	sq.m.	0.70
Sparse Grass & Weeds:	<u>399</u>	<u>sq.m.</u>	<u>0.45</u>
Total Catchment Area	698	sq.m.	0.58

Area (A):	698	sq.m.
Time of Concentration:	10	min.
Rainfall Intensity (i):	104	mm/hr (5 year event)
Runoff Coefficient (C):	0.58	
Pre-development Flow:	11.69	l/s

DRAINAGE AREA I:

(Uncontrolled Flow Off Site - Sheet Flow)

			C
Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	97	sq.m.	0.90
Landscaped:	<u>160</u>	<u>sq.m.</u>	<u>0.20</u>
Total Catchment Area	257	sq.m.	0.46

Area (A):	257	sq.m.
Time of Concentration:	10	min.
Rainfall Intensity (i):	104	mm/hr (5 year event)
Runoff Coefficient (C):	0.46	
Flow Rate (2.78AiC):	3.46	l/s

DRAINAGE AREA II (Unit 1 Terrace Roof):

(FIVE YEAR EVENT)

				C
Roof Area:	41	sq.m.	0.90	
Paved Area:	0	sq.m.	0.90	
Landscaped Areas:	<u>0</u>	<u>sq.m.</u>	<u>0.20</u>	
Total Catchment Area	41	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:	50	mm		
Maximum Release Rate	0.62	l/s	Pond Area:	16 sq.m.
			Achieved Vol:	0.27 cu.m.
			Max. Vol. Required:	0.27 cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	141	1.45	0.62	0.83	0.25
10	104	1.07	0.62	0.45	0.27
15	84	0.86	0.62	0.24	0.22
20	70	0.72	0.62	0.10	0.12
25	61	0.62	0.62	0.01	0.01
30	54	0.55	0.55	0.00	0.00
35	49	0.50	0.50	0.00	0.00
40	44	0.45	0.45	0.00	0.00
45	41	0.42	0.42	0.00	0.00
50	38	0.39	0.39	0.00	0.00
55	35	0.36	0.36	0.00	0.00
60	33	0.34	0.34	0.00	0.00
65	31	0.32	0.32	0.00	0.00
70	29	0.30	0.30	0.00	0.00
75	28	0.29	0.29	0.00	0.00
80	27	0.27	0.27	0.00	0.00
85	25	0.26	0.26	0.00	0.00
90	24	0.25	0.25	0.00	0.00
95	23	0.24	0.24	0.00	0.00
100	22	0.23	0.23	0.00	0.00
105	22	0.22	0.22	0.00	0.00
110	21	0.21	0.21	0.00	0.00
115	20	0.21	0.21	0.00	0.00
120	19	0.20	0.20	0.00	0.00
125	19	0.19	0.19	0.00	0.00
130	18	0.19	0.19	0.00	0.00
135	18	0.18	0.18	0.00	0.00
140	17	0.18	0.18	0.00	0.00
145	17	0.17	0.17	0.00	0.00
150	16	0.17	0.17	0.00	0.00
180	14	0.15	0.15	0.00	0.00
210	13	0.13	0.13	0.00	0.00
240	11	0.12	0.12	0.00	0.00
270	10	0.11	0.11	0.00	0.00
300	9	0.10	0.10	0.00	0.00

DRAINAGE AREA III (Unit 1 Lower Roof):

(FIVE YEAR EVENT)

							C
Roof Area:	18	sq.m.	0.90				
Paved Area:	0	sq.m.	0.90				
Landscaped Areas:	<u>0</u>	sq.m.	<u>0.20</u>				
Total Catchment Area	18	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:	39	mm					
Maximum Release Rate	0.48	l/s		Pond Area:	4	sq.m.	
				Achieved Vol:	0.05	cu.m.	
				Max. Vol. Required:	0.05	cu.m.	

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	141	0.64	0.48	0.16	0.05
10	104	0.47	0.47	0.00	0.00
15	84	0.38	0.38	0.00	0.00
20	70	0.32	0.32	0.00	0.00
25	61	0.27	0.27	0.00	0.00
30	54	0.24	0.24	0.00	0.00
35	49	0.22	0.22	0.00	0.00
40	44	0.20	0.20	0.00	0.00
45	41	0.18	0.18	0.00	0.00
50	38	0.17	0.17	0.00	0.00
55	35	0.16	0.16	0.00	0.00
60	33	0.15	0.15	0.00	0.00
65	31	0.14	0.14	0.00	0.00
70	29	0.13	0.13	0.00	0.00
75	28	0.13	0.13	0.00	0.00
80	27	0.12	0.12	0.00	0.00
85	25	0.11	0.11	0.00	0.00
90	24	0.11	0.11	0.00	0.00
95	23	0.10	0.10	0.00	0.00
100	22	0.10	0.10	0.00	0.00
105	22	0.10	0.10	0.00	0.00
110	21	0.09	0.09	0.00	0.00
115	20	0.09	0.09	0.00	0.00
120	19	0.09	0.09	0.00	0.00
125	19	0.08	0.08	0.00	0.00
130	18	0.08	0.08	0.00	0.00
135	18	0.08	0.08	0.00	0.00
140	17	0.08	0.08	0.00	0.00
145	17	0.08	0.08	0.00	0.00
150	16	0.07	0.07	0.00	0.00
180	14	0.06	0.06	0.00	0.00
210	13	0.06	0.06	0.00	0.00
240	11	0.05	0.05	0.00	0.00
270	10	0.05	0.05	0.00	0.00
300	9	0.04	0.04	0.00	0.00

DRAINAGE AREA IV (Units 2 to 6 Terrace Roof):

(FIVE YEAR EVENT)

				C		
Roof Area:	120	sq.m.		0.90		
Paved Area:	0	sq.m.		0.90		
Landscaped Areas:	0	sq.m.		0.20		
 Total Catchment Area	 120	 Ave. C		 0.90		
 No. of Roof Drains:	 5					
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)				
 Depth at Roof Drain:	 41	 mm				
 Maximum Release Rate	 2.52	 l/s		 Pond Area:	 38	 sq.m.
				Achieved Vol:	0.52	cu.m.
				Max. Vol. Required:	0.52	cu.m.

Time	i	2.78AiC	Release	Stored	Stored
min.	mm/hr	l/s	l/s	l/s	cu.m.
5	141	4.24	2.52	1.72	0.52
10	104	3.13	2.52	0.61	0.36
15	84	2.51	2.51	0.00	0.00
20	70	2.11	2.11	0.00	0.00
25	61	1.83	1.83	0.00	0.00
30	54	1.62	1.62	0.00	0.00
35	49	1.46	1.46	0.00	0.00
40	44	1.33	1.33	0.00	0.00
45	41	1.22	1.22	0.00	0.00
50	38	1.13	1.13	0.00	0.00
55	35	1.05	1.05	0.00	0.00
60	33	0.99	0.99	0.00	0.00
65	31	0.93	0.93	0.00	0.00
70	29	0.88	0.88	0.00	0.00
75	28	0.84	0.84	0.00	0.00
80	27	0.80	0.80	0.00	0.00
85	25	0.76	0.76	0.00	0.00
90	24	0.73	0.73	0.00	0.00
95	23	0.70	0.70	0.00	0.00
100	22	0.67	0.67	0.00	0.00
105	22	0.65	0.65	0.00	0.00
110	21	0.63	0.63	0.00	0.00
115	20	0.60	0.60	0.00	0.00
120	19	0.58	0.58	0.00	0.00
125	19	0.57	0.57	0.00	0.00
130	18	0.55	0.55	0.00	0.00
135	18	0.53	0.53	0.00	0.00
140	17	0.52	0.52	0.00	0.00
145	17	0.50	0.50	0.00	0.00
150	16	0.49	0.49	0.00	0.00
180	14	0.43	0.43	0.00	0.00
210	13	0.38	0.38	0.00	0.00
240	11	0.34	0.34	0.00	0.00
270	10	0.31	0.31	0.00	0.00
300	9	0.28	0.28	0.00	0.00

DRAINAGE AREA V (Units 2 to 6 Lower Roof):

(FIVE YEAR EVENT)

				C	
Roof Area:	113	sq.m.		0.90	
Paved Area:	0	sq.m.		0.90	
Landscaped Areas:	0	sq.m.		0.20	
Total Catchment Area	113	Ave. C		0.90	
No. of Roof Drains:	5				
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)			
Depth at Roof Drain:	47	mm			
Maximum Release Rate	2.91	l/s		Pond Area:	21 sq.m.
				Achieved Vol:	0.32 cu.m.
				Max. Vol. Required:	0.32 cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	141	3.97	2.91	1.07	0.32
10	104	2.93	2.91	0.03	0.02
15	84	2.35	2.35	0.00	0.00
20	70	1.98	1.98	0.00	0.00
25	61	1.71	1.71	0.00	0.00
30	54	1.52	1.52	0.00	0.00
35	49	1.37	1.37	0.00	0.00
40	44	1.24	1.24	0.00	0.00
45	41	1.14	1.14	0.00	0.00
50	38	1.06	1.06	0.00	0.00
55	35	0.99	0.99	0.00	0.00
60	33	0.93	0.93	0.00	0.00
65	31	0.87	0.87	0.00	0.00
70	29	0.83	0.83	0.00	0.00
75	28	0.78	0.78	0.00	0.00
80	27	0.75	0.75	0.00	0.00
85	25	0.71	0.71	0.00	0.00
90	24	0.68	0.68	0.00	0.00
95	23	0.66	0.66	0.00	0.00
100	22	0.63	0.63	0.00	0.00
105	22	0.61	0.61	0.00	0.00
110	21	0.59	0.59	0.00	0.00
115	20	0.57	0.57	0.00	0.00
120	19	0.55	0.55	0.00	0.00
125	19	0.53	0.53	0.00	0.00
130	18	0.51	0.51	0.00	0.00
135	18	0.50	0.50	0.00	0.00
140	17	0.49	0.49	0.00	0.00
145	17	0.47	0.47	0.00	0.00
150	16	0.46	0.46	0.00	0.00
180	14	0.40	0.40	0.00	0.00
210	13	0.35	0.35	0.00	0.00
240	11	0.32	0.32	0.00	0.00
270	10	0.29	0.29	0.00	0.00
300	9	0.27	0.27	0.00	0.00

DRAINAGE AREA VI (Unit 7 Roof):

(FIVE YEAR EVENT)

Roof Area:	42	sq.m.	C	0.90
Paved Area:	0	sq.m.		0.90
Landscaped Areas:	<u>0</u>	<u>sq.m.</u>		<u>0.20</u>
Total Catchment Area	42	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:	51	mm		
Maximum Release Rate	0.63	l/s	Pond Area:	17 sq.m.
			Achieved Vol:	0.28 cu.m.
			Max. Vol. Required:	0.28 cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	141	1.48	0.63	0.86	0.26
10	104	1.09	0.63	0.47	0.28
15	84	0.88	0.63	0.25	0.23
20	70	0.74	0.63	0.11	0.13
25	61	0.64	0.63	0.01	0.02
30	54	0.57	0.57	0.00	0.00
35	49	0.51	0.51	0.00	0.00
40	44	0.46	0.46	0.00	0.00
45	41	0.43	0.43	0.00	0.00
50	38	0.40	0.40	0.00	0.00
55	35	0.37	0.37	0.00	0.00
60	33	0.35	0.35	0.00	0.00
65	31	0.33	0.33	0.00	0.00
70	29	0.31	0.31	0.00	0.00
75	28	0.29	0.29	0.00	0.00
80	27	0.28	0.28	0.00	0.00
85	25	0.27	0.27	0.00	0.00
90	24	0.26	0.26	0.00	0.00
95	23	0.24	0.24	0.00	0.00
100	22	0.24	0.24	0.00	0.00
105	22	0.23	0.23	0.00	0.00
110	21	0.22	0.22	0.00	0.00
115	20	0.21	0.21	0.00	0.00
120	19	0.20	0.20	0.00	0.00
125	19	0.20	0.20	0.00	0.00
130	18	0.19	0.19	0.00	0.00
135	18	0.19	0.19	0.00	0.00
140	17	0.18	0.18	0.00	0.00
145	17	0.18	0.18	0.00	0.00
150	16	0.17	0.17	0.00	0.00
180	14	0.15	0.15	0.00	0.00
210	13	0.13	0.13	0.00	0.00
240	11	0.12	0.12	0.00	0.00
270	10	0.11	0.11	0.00	0.00
300	9	0.10	0.10	0.00	0.00

DRAINAGE AREA VII (Unit 8 Roof):

(FIVE YEAR EVENT)

									C
	Roof Area:	45	sq.m.						0.90
	Paved Area:	0	sq.m.						0.90
	Landscaped Areas:	0	sq.m.						<u>0.20</u>
	Total Catchment Area	45		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:	52	mm						
	Maximum Release Rate	0.64	l/s			Pond Area:	19	sq.m.	
						Achieved Vol:	0.32	cu.m.	
						Max. Vol. Required:	0.32	cu.m.	

Time	i	2.78AiC	Release	Stored	Stored
min.	mm/hr	l/s	Rate	Rate	Volume
			l/s	l/s	cu.m.
5	141	1.59	0.64	0.95	0.28
10	104	1.17	0.64	0.53	0.32
15	84	0.94	0.64	0.30	0.27
20	70	0.79	0.64	0.15	0.18
25	61	0.69	0.64	0.04	0.07
30	54	0.61	0.61	0.00	0.00
35	49	0.55	0.55	0.00	0.00
40	44	0.50	0.50	0.00	0.00
45	41	0.46	0.46	0.00	0.00
50	38	0.42	0.42	0.00	0.00
55	35	0.40	0.40	0.00	0.00
60	33	0.37	0.37	0.00	0.00
65	31	0.35	0.35	0.00	0.00
70	29	0.33	0.33	0.00	0.00
75	28	0.31	0.31	0.00	0.00
80	27	0.30	0.30	0.00	0.00
85	25	0.29	0.29	0.00	0.00
90	24	0.27	0.27	0.00	0.00
95	23	0.26	0.26	0.00	0.00
100	22	0.25	0.25	0.00	0.00
105	22	0.24	0.24	0.00	0.00
110	21	0.23	0.23	0.00	0.00
115	20	0.23	0.23	0.00	0.00
120	19	0.22	0.22	0.00	0.00
125	19	0.21	0.21	0.00	0.00
130	18	0.21	0.21	0.00	0.00
135	18	0.20	0.20	0.00	0.00
140	17	0.19	0.19	0.00	0.00
145	17	0.19	0.19	0.00	0.00
150	16	0.18	0.18	0.00	0.00
180	14	0.16	0.16	0.00	0.00
210	13	0.14	0.14	0.00	0.00
240	11	0.13	0.13	0.00	0.00
270	10	0.12	0.12	0.00	0.00
300	9	0.11	0.11	0.00	0.00

DRAINAGE AREA VIII

(FIVE YEAR EVENT)

			C
Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	61	sq.m.	0.90
Landscaped:	<u>1</u>	<u>sq.m.</u>	<u>0.20</u>
Total Catchment Area	62	sq.m.	0.89

Water Elevation: 58.95 m

ICD Invert:	58.85	m	Storage in MH's & CB's			
(Outlet Pipe OF MH-2)			Invert	Depth		
			m	m		
Head:	0.10	m	MH-2	58.85	0.10	0.12 cu.m.
			CB-3	58.92	0.03	0.01 cu.m.

Orifice Diameter 50 mm

Orifice Area:	1963	sq.mm.	Storage in Sewer Pipes			
			Diam.	Length		
			mm	m		
Coefficient of Discharge:	0.155		250	16.7	0.30	cu.m.

Max. Release Rate: 0.43 l/s Achieved Vol: 0.42 cu.m.

Max. Vol. Required: 0.42 cu.m.

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	141	2.16	0.89	1.27	0.38
10	104	1.60	0.89	0.71	0.42
15	84	1.28	0.89	0.39	0.35
20	70	1.08	0.89	0.19	0.22
25	61	0.93	0.89	0.04	0.07
30	54	0.83	0.83	0.00	0.00
35	49	0.74	0.74	0.00	0.00
40	44	0.68	0.68	0.00	0.00
45	41	0.62	0.62	0.00	0.00
50	38	0.58	0.58	0.00	0.00
55	35	0.54	0.54	0.00	0.00
60	33	0.50	0.50	0.00	0.00
65	31	0.48	0.48	0.00	0.00
70	29	0.45	0.45	0.00	0.00
75	28	0.43	0.43	0.00	0.00
80	27	0.41	0.41	0.00	0.00
85	25	0.39	0.39	0.00	0.00
90	24	0.37	0.37	0.00	0.00
95	23	0.36	0.36	0.00	0.00
100	22	0.34	0.34	0.00	0.00
105	22	0.33	0.33	0.00	0.00
110	21	0.32	0.32	0.00	0.00
115	20	0.31	0.31	0.00	0.00
120	19	0.30	0.30	0.00	0.00
125	19	0.29	0.29	0.00	0.00
130	18	0.28	0.28	0.00	0.00
135	18	0.27	0.27	0.00	0.00
140	17	0.26	0.26	0.00	0.00
145	17	0.26	0.26	0.00	0.00
150	16	0.25	0.25	0.00	0.00
180	14	0.22	0.22	0.00	0.00
210	13	0.19	0.19	0.00	0.00
240	11	0.17	0.17	0.00	0.00
270	10	0.16	0.16	0.00	0.00
300	9	0.14	0.14	0.00	0.00

STRESS TEST - 20% INCREASE TO ONE HUNDRED YEAR EVENT RAINFALL

Pre-development Runoff

Roof Area:	71	sq.m.	1.000
Asphalt/Concrete Area:	3	sq.m.	1.000
Gravel	225	sq.m.	0.875
Landscaped:	<u>399</u>	<u>sq.m.</u>	<u>0.563</u>
Total Catchment Area	698	sq.m.	0.71

Area (A):	698	sq.m.
Time of Concentration:	10	min.
Rainfall Intensity (i):	214	mm/hr (120% of 100 year event)
Runoff Coefficient (C):	0.71	

Pre-development Flow: 29.50 l/s

DRAINAGE AREA I:

(Uncontrolled Flow Off Site - Sheet Flow)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	97	sq.m.	1.00
Landscaped:	<u>160</u>	<u>sq.m.</u>	<u>0.25</u>
Total Catchment Area	257	sq.m.	0.53

Area (A):	257	sq.m.
Time of Concentration:	10	min.
Rainfall Intensity (i):	214	mm/hr (120% of 100 year event)
Runoff Coefficient (C):	0.53	

Flow Rate (2.78AiC): 8.16 l/s

DRAINAGE AREA II (Unit 1 Terrace Roof):

(STRESS TEST)

			C	
Roof Area:	41	sq.m.	1.00	
Paved Area:	0	sq.m.	1.00	
Landscaped Areas:	<u>0</u>	<u>sq.m.</u>	<u>0.25</u>	
 Total Catchment Area	 41	 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:	 75	 mm		
 Maximum Release Rate	 0.93	 l/s	 Pond Area:	 37
			sq.m.	
			Achieved Vol:	0.92
			cu.m.	
			Max. Vol. Required:	0.92
			cu.m.	

Time min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	291	3.32	0.93	2.39	0.72
10	214	2.44	0.93	1.51	0.91
15	171	1.95	0.93	1.03	0.92
20	144	1.64	0.93	0.71	0.85
25	125	1.42	0.93	0.49	0.74
30	110	1.26	0.93	0.33	0.59
35	99	1.13	0.93	0.20	0.42
40	90	1.03	0.93	0.10	0.24
45	83	0.94	0.93	0.02	0.04
50	77	0.87	0.87	0.00	0.00
55	72	0.82	0.82	0.00	0.00
60	67	0.76	0.76	0.00	0.00
65	63	0.72	0.72	0.00	0.00
70	60	0.68	0.68	0.00	0.00
75	57	0.65	0.65	0.00	0.00
80	54	0.62	0.62	0.00	0.00
85	52	0.59	0.59	0.00	0.00
90	49	0.56	0.56	0.00	0.00
95	47	0.54	0.54	0.00	0.00
100	45	0.52	0.52	0.00	0.00
105	44	0.50	0.50	0.00	0.00
110	42	0.48	0.48	0.00	0.00
115	41	0.47	0.47	0.00	0.00
120	39	0.45	0.45	0.00	0.00
125	38	0.44	0.44	0.00	0.00
130	37	0.42	0.42	0.00	0.00
135	36	0.41	0.41	0.00	0.00
140	35	0.40	0.40	0.00	0.00
145	34	0.39	0.39	0.00	0.00
150	33	0.38	0.38	0.00	0.00
180	29	0.33	0.33	0.00	0.00
210	25	0.29	0.29	0.00	0.00
240	23	0.26	0.26	0.00	0.00
270	21	0.24	0.24	0.00	0.00
300	19	0.22	0.22	0.00	0.00

DRAINAGE AREA III (Unit 1 Lower Roof):

(STRESS TEST)

			C
Roof Area:	18	sq.m.	1.00
Paved Area:	0	sq.m.	1.00
Landscaped Areas:	<u>0</u>	sq.m.	<u>0.25</u>

Total Catchment Area 18 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: 60 mm

Maximum RD Release Rate:	0.74	l/s	Pond Area:	9	sq.m.
Maximum Scupper Release Rate:	<u>0.11</u>	l/s	Achieved Vol:	0.18	cu.m.
Total Maximum Release Rate:	0.86	l/s	Max. Vol. Required:	0.18	cu.m.

Time min.	i mm/hr	2.78AiC l/s	RD Release Rate l/s	Scupper Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	291	1.46	0.74	0.11	0.60	0.18
10	214	1.07	0.74	0.03	0.30	0.18
15	171	0.86	0.74	0.00	0.11	0.10
20	144	0.72	0.72	0.00	0.00	0.00
25	125	0.62	0.62	0.00	0.00	0.00
30	110	0.55	0.55	0.00	0.00	0.00
35	99	0.50	0.50	0.00	0.00	0.00
40	90	0.45	0.45	0.00	0.00	0.00
45	83	0.41	0.41	0.00	0.00	0.00
50	77	0.38	0.38	0.00	0.00	0.00
55	72	0.36	0.36	0.00	0.00	0.00
60	67	0.34	0.34	0.00	0.00	0.00
65	63	0.32	0.32	0.00	0.00	0.00
70	60	0.30	0.30	0.00	0.00	0.00
75	57	0.28	0.28	0.00	0.00	0.00
80	54	0.27	0.27	0.00	0.00	0.00
85	52	0.26	0.26	0.00	0.00	0.00
90	49	0.25	0.25	0.00	0.00	0.00
95	47	0.24	0.24	0.00	0.00	0.00
100	45	0.23	0.23	0.00	0.00	0.00
105	44	0.22	0.22	0.00	0.00	0.00
110	42	0.21	0.21	0.00	0.00	0.00
115	41	0.20	0.20	0.00	0.00	0.00
120	39	0.20	0.20	0.00	0.00	0.00
125	38	0.19	0.19	0.00	0.00	0.00
130	37	0.19	0.19	0.00	0.00	0.00
135	36	0.18	0.18	0.00	0.00	0.00
140	35	0.18	0.18	0.00	0.00	0.00
145	34	0.17	0.17	0.00	0.00	0.00
150	33	0.17	0.17	0.00	0.00	0.00
180	29	0.14	0.14	0.00	0.00	0.00
210	25	0.13	0.13	0.00	0.00	0.00
240	23	0.11	0.11	0.00	0.00	0.00
270	21	0.10	0.10	0.00	0.00	0.00
300	19	0.10	0.10	0.00	0.00	0.00

DRAINAGE AREA IV (Units 2 to 6 Terrace Roof):

(STRESS TEST)

Roof Area:	120	sq.m.	C	1.00
Paved Area:	0	sq.m.		1.00
Landscaped Areas:	<u>0</u>	sq.m.		<u>0.25</u>

Total Catchment Area 120 Ave. C 1.00

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

Depth at Roof Drain: 60 mm

Maximum Release Rate	3.72	l/s	Pond Area:	83	sq.m.
Maximum Scupper Release Rate:	<u>0.67</u>	l/s	Achieved Vol:	1.65	cu.m.
Total Maximum Release Rate:	4.39	l/s	Max. Vol. Required:	1.65	cu.m.

Time	i	2.78AiC	RD Release Rate	Scupper Release Rate	Stored Rate	Stored Volume
min.	mm/hr	l/s	l/s	l/s	l/s	cu.m.
5	291	9.72	3.72	0.48	5.52	1.65
10	214	7.15	3.72	0.67	2.76	1.65
15	171	5.72	3.72	0.16	1.84	1.65
20	144	4.80	3.72	0.00	1.08	1.30
25	125	4.16	3.72	0.00	0.44	0.66
30	110	3.68	3.68	0.00	0.00	0.00
35	99	3.31	3.31	0.00	0.00	0.00
40	90	3.01	3.01	0.00	0.00	0.00
45	83	2.76	2.76	0.00	0.00	0.00
50	77	2.56	2.56	0.00	0.00	0.00
55	72	2.39	2.39	0.00	0.00	0.00
60	67	2.24	2.24	0.00	0.00	0.00
65	63	2.11	2.11	0.00	0.00	0.00
70	60	1.99	1.99	0.00	0.00	0.00
75	57	1.89	1.89	0.00	0.00	0.00
80	54	1.80	1.80	0.00	0.00	0.00
85	52	1.72	1.72	0.00	0.00	0.00
90	49	1.65	1.65	0.00	0.00	0.00
95	47	1.58	1.58	0.00	0.00	0.00
100	45	1.52	1.52	0.00	0.00	0.00
105	44	1.46	1.46	0.00	0.00	0.00
110	42	1.41	1.41	0.00	0.00	0.00
115	41	1.36	1.36	0.00	0.00	0.00
120	39	1.32	1.32	0.00	0.00	0.00
125	38	1.28	1.28	0.00	0.00	0.00
130	37	1.24	1.24	0.00	0.00	0.00
135	36	1.20	1.20	0.00	0.00	0.00
140	35	1.17	1.17	0.00	0.00	0.00
145	34	1.14	1.14	0.00	0.00	0.00
150	33	1.11	1.11	0.00	0.00	0.00
180	29	0.96	0.96	0.00	0.00	0.00
210	25	0.85	0.85	0.00	0.00	0.00
240	23	0.76	0.76	0.00	0.00	0.00
270	21	0.69	0.69	0.00	0.00	0.00
300	19	0.64	0.64	0.00	0.00	0.00

DRAINAGE AREA V (Units 2 to 6 Lower Roof):

(STRESS TEST)

Roof Area:	113	sq.m.	C	1.00
Paved Area:	0	sq.m.		1.00
Landscaped Areas:	0	sq.m.		<u>0.25</u>

Total Catchment Area 113 Ave. C 1.00

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

Depth at Roof Drain: 75 mm

Maximum Release Rate	4.65	l/s	Pond Area:	52	sq.m.
Maximum Scupper Release Rate:	<u>0.09</u>	l/s	Achieved Vol:	1.31	cu.m.
Total Maximum Release Rate:	4.74	l/s	Max. Vol. Required:	1.31	cu.m.

Time min.	i mm/hr	2.78AiC l/s	RD Release Rate l/s	Scupper Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	291	9.11	4.65	0.09	4.37	1.31
10	214	6.70	4.65	0.00	2.05	1.23
15	171	5.36	4.65	0.00	0.71	0.64
20	144	4.50	4.50	0.00	0.00	0.00
25	125	3.90	3.90	0.00	0.00	0.00
30	110	3.45	3.45	0.00	0.00	0.00
35	99	3.10	3.10	0.00	0.00	0.00
40	90	2.82	2.82	0.00	0.00	0.00
45	83	2.59	2.59	0.00	0.00	0.00
50	77	2.40	2.40	0.00	0.00	0.00
55	72	2.24	2.24	0.00	0.00	0.00
60	67	2.10	2.10	0.00	0.00	0.00
65	63	1.98	1.98	0.00	0.00	0.00
70	60	1.87	1.87	0.00	0.00	0.00
75	57	1.77	1.77	0.00	0.00	0.00
80	54	1.69	1.69	0.00	0.00	0.00
85	52	1.61	1.61	0.00	0.00	0.00
90	49	1.54	1.54	0.00	0.00	0.00
95	47	1.48	1.48	0.00	0.00	0.00
100	45	1.42	1.42	0.00	0.00	0.00
105	44	1.37	1.37	0.00	0.00	0.00
110	42	1.32	1.32	0.00	0.00	0.00
115	41	1.28	1.28	0.00	0.00	0.00
120	39	1.23	1.23	0.00	0.00	0.00
125	38	1.20	1.20	0.00	0.00	0.00
130	37	1.16	1.16	0.00	0.00	0.00
135	36	1.13	1.13	0.00	0.00	0.00
140	35	1.09	1.09	0.00	0.00	0.00
145	34	1.06	1.06	0.00	0.00	0.00
150	33	1.04	1.04	0.00	0.00	0.00
180	29	0.90	0.90	0.00	0.00	0.00
210	25	0.79	0.79	0.00	0.00	0.00
240	23	0.71	0.71	0.00	0.00	0.00
270	21	0.65	0.65	0.00	0.00	0.00
300	19	0.60	0.60	0.00	0.00	0.00

DRAINAGE AREA VI (Unit 7 Roof):

(STRESS TEST)

Roof Area:	42	sq.m.	C	1.00
Paved Area:	0	sq.m.		1.00
Landscaped Areas:	0	sq.m.		<u>0.25</u>

Total Catchment Area 42 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: 75 mm

Maximum Release Rate	0.93	l/s	Pond Area:	37	sq.m.
Maximum Scupper Release Rate:	<u>0.05</u>	l/s	Achieved Vol:	0.92	cu.m.
Total Maximum Release Rate:	0.98	l/s			

Max. Vol. Required: 0.92 cu.m.

Time	i	2.78AiC	RD Release Rate	Scupper Release Rate	Stored Rate	Stored Volume
min.	mm/hr	l/s	l/s	l/s	l/s	cu.m.
5	291	3.40	0.93	0.00	2.47	0.74
10	214	2.50	0.93	0.04	1.54	0.92
15	171	2.00	0.93	0.05	1.02	0.92
20	144	1.68	0.93	0.00	0.75	0.90
25	125	1.46	0.93	0.00	0.53	0.79
30	110	1.29	0.93	0.00	0.36	0.64
35	99	1.16	0.93	0.00	0.23	0.48
40	90	1.05	0.93	0.00	0.12	0.29
45	83	0.97	0.93	0.00	0.04	0.10
50	77	0.90	0.90	0.00	0.00	0.00
55	72	0.84	0.84	0.00	0.00	0.00
60	67	0.78	0.78	0.00	0.00	0.00
65	63	0.74	0.74	0.00	0.00	0.00
70	60	0.70	0.70	0.00	0.00	0.00
75	57	0.66	0.66	0.00	0.00	0.00
80	54	0.63	0.63	0.00	0.00	0.00
85	52	0.60	0.60	0.00	0.00	0.00
90	49	0.58	0.58	0.00	0.00	0.00
95	47	0.55	0.55	0.00	0.00	0.00
100	45	0.53	0.53	0.00	0.00	0.00
105	44	0.51	0.51	0.00	0.00	0.00
110	42	0.49	0.49	0.00	0.00	0.00
115	41	0.48	0.48	0.00	0.00	0.00
120	39	0.46	0.46	0.00	0.00	0.00
125	38	0.45	0.45	0.00	0.00	0.00
130	37	0.43	0.43	0.00	0.00	0.00
135	36	0.42	0.42	0.00	0.00	0.00
140	35	0.41	0.41	0.00	0.00	0.00
145	34	0.40	0.40	0.00	0.00	0.00
150	33	0.39	0.39	0.00	0.00	0.00
180	29	0.33	0.33	0.00	0.00	0.00
210	25	0.30	0.30	0.00	0.00	0.00
240	23	0.27	0.27	0.00	0.00	0.00
270	21	0.24	0.24	0.00	0.00	0.00
300	19	0.22	0.22	0.00	0.00	0.00

DRAINAGE AREA VII (Unit 8 Roof):

(STRESS TEST)

Roof Area:	45	sq.m.	C	1.00
Paved Area:	0	sq.m.		1.00
Landscaped Areas:	0	sq.m.		<u>0.25</u>

Total Catchment Area 45 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: 75 mm

Maximum Release Rate	0.93	l/s	Pond Area:	39	sq.m.
Maximum Scupper Release Rate:	<u>0.13</u>	l/s	Achieved Vol:	0.98	cu.m.
Total Maximum Release Rate:	1.06	l/s	Max. Vol. Required:	0.98	cu.m.

Time min.	i mm/hr	2.78AiC l/s	RD Release Rate l/s	Scupper Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
5	291	3.64	0.93	0.00	2.71	0.81
10	214	2.68	0.93	0.12	1.63	0.98
15	171	2.15	0.93	0.13	1.09	0.98
20	144	1.80	0.93	0.06	0.81	0.98
25	125	1.56	0.93	0.00	0.63	0.94
30	110	1.38	0.93	0.00	0.45	0.81
35	99	1.24	0.93	0.00	0.31	0.65
40	90	1.13	0.93	0.00	0.20	0.48
45	83	1.04	0.93	0.00	0.11	0.29
50	77	0.96	0.93	0.00	0.03	0.09
55	72	0.90	0.90	0.00	0.00	0.00
60	67	0.84	0.84	0.00	0.00	0.00
65	63	0.79	0.79	0.00	0.00	0.00
70	60	0.75	0.75	0.00	0.00	0.00
75	57	0.71	0.71	0.00	0.00	0.00
80	54	0.68	0.68	0.00	0.00	0.00
85	52	0.64	0.64	0.00	0.00	0.00
90	49	0.62	0.62	0.00	0.00	0.00
95	47	0.59	0.59	0.00	0.00	0.00
100	45	0.57	0.57	0.00	0.00	0.00
105	44	0.55	0.55	0.00	0.00	0.00
110	42	0.53	0.53	0.00	0.00	0.00
115	41	0.51	0.51	0.00	0.00	0.00
120	39	0.49	0.49	0.00	0.00	0.00
125	38	0.48	0.48	0.00	0.00	0.00
130	37	0.46	0.46	0.00	0.00	0.00
135	36	0.45	0.45	0.00	0.00	0.00
140	35	0.44	0.44	0.00	0.00	0.00
145	34	0.43	0.43	0.00	0.00	0.00
150	33	0.41	0.41	0.00	0.00	0.00
180	29	0.36	0.36	0.00	0.00	0.00
210	25	0.32	0.32	0.00	0.00	0.00
240	23	0.29	0.29	0.00	0.00	0.00
270	21	0.26	0.26	0.00	0.00	0.00
300	19	0.24	0.24	0.00	0.00	0.00

DRAINAGE AREA VIII

(STRESS TEST)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	61	sq.m.	1.00
Landscaped:	<u>1</u>	<u>sq.m.</u>	<u>0.25</u>
Total Catchment Area	62	sq.m.	0.99

Water Elevation: 59.59 m

ICD Invert:	58.85	m	Storage in MH's & CB's			
(Outlet Pipe OF MH-2)			Invert	Depth		
			m	m		
Head:	0.74	m	MH-2	58.85	0.74	0.84 cu.m.
			CB-3	58.92	0.67	0.24 cu.m.

Orifice Diameter 50 mm

Orifice Area:	1963	sq.mm.	Storage in Sewer Pipes			
			Diam.	Length		
			mm	m		
Coefficient of Discharge:	0.155		250	16.7	0.79	cu.m.

Max. Release Rate: 1.16 l/s Achieved Vol: 1.87 cu.m.

Max. Vol. Required: 1.87 cu.m.

Time	i	2.78AiC	Release	Stored	Stored
min.	mm/hr	l/s	Rate	Rate	Volume
			l/s	l/s	cu.m.
5	291	4.96	0.89	4.07	1.22
10	214	3.65	0.89	2.76	1.66
15	171	2.92	0.89	2.03	1.83
20	144	2.45	0.89	1.56	1.87
25	125	2.12	0.89	1.23	1.85
30	110	1.88	0.89	0.99	1.78
35	99	1.69	0.89	0.80	1.68
40	90	1.54	0.89	0.65	1.55
45	83	1.41	0.89	0.52	1.41
50	77	1.31	0.89	0.42	1.25
55	72	1.22	0.89	0.33	1.09
60	67	1.14	0.89	0.25	0.91
65	63	1.08	0.89	0.19	0.73
70	60	1.02	0.89	0.13	0.54
75	57	0.97	0.89	0.08	0.34
80	54	0.92	0.89	0.03	0.14
85	52	0.88	0.88	0.00	0.00
90	49	0.84	0.84	0.00	0.00
95	47	0.81	0.81	0.00	0.00
100	45	0.77	0.77	0.00	0.00
105	44	0.75	0.75	0.00	0.00
110	42	0.72	0.72	0.00	0.00
115	41	0.69	0.69	0.00	0.00
120	39	0.67	0.67	0.00	0.00
125	38	0.65	0.65	0.00	0.00
130	37	0.63	0.63	0.00	0.00
135	36	0.61	0.61	0.00	0.00
140	35	0.60	0.60	0.00	0.00
145	34	0.58	0.58	0.00	0.00
150	33	0.56	0.56	0.00	0.00
180	29	0.49	0.49	0.00	0.00
210	25	0.43	0.43	0.00	0.00
240	23	0.39	0.39	0.00	0.00
270	21	0.35	0.35	0.00	0.00
300	19 ₃₂	0.32	0.32	0.00	0.00