

STORMWATER MANAGEMENT REPORT

Ladouceur Street & Merton Street
Townhouses
Ottawa, Ontario

Report No. 13029-SWM

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NOT VALID UNLESS
SIGNED & DATED

D. B. GRAY ENGINEERING INC.

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

700 Long Point Circle
Ottawa, Ontario K1T 4E9

613-425-8044
dbgray@rogers.com

STORMWATER MANAGEMENT REPORT

Ladouceur Street & Merton Street Townhouses Ottawa, Ontario

This report addresses the stormwater management requirements of a 6 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:

The Rideau Valley Conservation Authority (RVCA) provided the following comments: *“Based on our GID mapping of the municipal storm sewer system, the sewers fronting this development proposal on Merton and Ladouceur travels approximately 775m to a direct outlet in to the Ottawa River. The Ottawa River requires 80% TSS removal for stormwater. If the development is expected to have the equivalent of 10 or more surface parking spaces (including drive aisles), we would recommend that stormwater quality treatment be implemented on-site to meet the enhanced quality threshold. I expect, without a site plan to evaluate, that this development proposal is on the threshold, and would therefore suggest that opportunities to implement on-site BMP’s be explored. For example, grading the parking area and travelled surface so that stormwater is directed through a grass swale prior to entering a catch basin would be desirable.”*

We have recently sent a site plan to RVCA. We also indicated that since the proposed grassed area on the site is lower than the road elevation and about 1 m lower than the parking area there is no opportunity to drain across a grassed area prior to entering a catch basin. We are waiting for further comments.

During construction, an erosion and sediment control plan has been developed (see notes 2.1 to 2.4 on drawing SG-2). In summary: To filter out construction sediment sediment capture filter sock inserts will be installed in 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 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 10 minute time of concentration. The maximum allowable release rate for the site is calculated to be 10.11 l/s.

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 – 278 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 12 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. Unit 1 roof drains (Drainage Areas II – 41 sq.m. and III – 18 sq.m.) discharge to a storm sewer connection downstream of the inlet control devices (ICDs). Unit 2 to 4 roof drains (Drainage Areas IV – 72 sq.m. and V – 68 sq.m.) discharge to a storm sewer connection upstream of the ICD in manhole MH-ST.5. The discharge from the Unit 2 to 4 roof drains is added to the flow into Drainage Area VI. Unit 5 & 6 roof drains (Drainage Areas VII – 48 sq.m. and V – 45 sq.m.) discharge to a storm sewer connection upstream of the ICD in manhole CB/MH-ST.3. The discharge from the Unit 5 & 6 roof drains is added to the flow into Drainage Area IX.

In addition to the Unit 1 roof drains (Drainage Areas II & III), two ICDs located at the outlet pipe of manholes CB/MH-ST.3 and MH-ST.5 will also control the release of stormwater off the site.

The ICD in MH-ST.5 will restrict the flow and force the stormwater to back up into the upstream sewer pipe and manholes. The ICD shall be a Hydrovex "SVHV Vertical Vortex Flow Regulator" and shall be sized by the manufacturer for a discharge rate of 0.86 l/s at 1.67 m head. It is calculated that an orifice area of 804 sq.mm. (32 mm diameter) and a discharge coefficient of 0.188 will restrict the outflow rate to 0.86 l/s at a head of 1.67 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 0.51 l/s at 0.58 m.

The ICD in CB/MH-ST.3 will restrict the flow and force the stormwater to back up into the upstream sewer pipe and manholes and onto the surface above the catch basins. The ICD shall be a Hydrovex "SVHV Vertical Vortex Flow Regulator" and shall be sized by the manufacturer for a discharge rate of 0.48 l/s at 2.09 m head. It is calculated that an orifice area of 491 sq.mm. (25 mm diameter) and a discharge coefficient of 0.152

will restrict the outflow rate to 0.48 l/s at a head of 2.09 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 0.47 l/s at 1.99 m.

Stormwater released through the ICDs will be conveyed off the site via a 250mm storm sewer connecting to a 375mm storm sewer on Merton Street.

MINISTRY OF ENVIRONMENT ENVIRONMENTAL COMPLIANCE APPROVAL:

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

CONCLUSIONS:

WATER QUALITY:

Further comments and recommendations concerning the stormwater quality criteria for this site are required from the RVCA to determine if permanent on-site quality control measures required.

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 site is 10.11 l/s. The maximum post-development release rate for the 100-year storm event is calculated to be 10.11 l/s. Therefore the maximum post development release rate for the 100-year storm event is equal to the maximum allowable release rate. A maximum stored volume of 19.30 cu.m. is required to achieve the post development release rate.

Five Year Storm Event:

The maximum allowable release rate for the site is 10.11 l/s. The maximum post-development release rate for the 5-year storm event is calculated to be 5.74 l/s. Therefore the maximum post-development release rate for the 5-year storm event is less than the maximum allowable release rate. A maximum stored volume of 8.50 cu.m. is required to achieve the post-development release rate.

MINISTRY OF ENVIRONMENT ENVIRONMENTAL COMPLIANCE APPROVAL:

A MOE ECA is expected to be required.

Summary Tables

ONE HUNDRED YEAR EVENT			
Drainage Area	Maximum Release Rate l/s	Maximum Allowable Release Rate l/s	Maximum Volume Stored cu.m.
AREA I (Uncontrolled flow off site)	7.21	-	-
AREA II (Unit 1 Terrace Roof)	0.85	-	0.71
AREA III (Unit 1 Lower Roof)	0.70	-	0.15
AREA IV 2 to 4 Terrace Roof - Drains to Area VI) (Unit	2.13	-	0.87
AREA V 2 to 4 Lower Roof - Drains to Area VI) (Unit	2.55	-	0.60
AREA VI	0.86		4.92
AREA VII 5 & 6 Terrace Roof - Drains to Area IX) (Unit	1.42	-	0.58
AREA VIII 5 & 6 Lower Roof - Drains to Area IX) (Unit	1.70	-	0.40
AREA IX	0.48	-	11.07
TOTAL FLOWRATE (Areas I + II + III + VI + IX)	10.11	10.11	-
TOTAL VOLUME	-	-	19.30

Summary Tables

FIVE YEAR EVENT			
Drainage Area	Maximum Release Rate l/s	Maximum Allowable Release Rate l/s	Maximum Volume Stored cu.m.
AREA I (Uncontrolled flow off site)	3.66	-	-
AREA II (Unit 1 Terrace Roof)	0.62	-	0.27
AREA III (Unit 1 Lower Roof)	0.48	-	0.05
AREA IV 2 to 4 Terrace Roof - Drains to Area VI) (Unit	1.52	-	0.31
AREA V 2 to 4 Lower Roof - Drains to Area VI) (Unit	1.75	-	0.19
AREA VI	0.51	-	2.48
AREA VII 5 & 6 Terrace Roof - Drains to Area IX) (Unit	1.01	-	0.21
AREA VIII 5 & 6 Lower Roof - Drains to Area IX) (Unit	1.17	-	0.13
AREA IX	0.47	-	4.86
TOTAL FLOWRATE (Areas I + II + III + VI + IX)	5.74	10.11	-
TOTAL VOLUME	-	-	8.50

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 and above the catch basins 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

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STORM WATER MANAGEMENT CALCULATIONS
 Rational Method

ONE HUNDRED YEAR EVENT

Maximum Release Rate

Area (A):	698	sq.m.
Time of Concentration:	10	min.
Rainfall Intensity (i):	104	mm/hr (5 year event)
Runoff Coefficient (C):	0.50	
Maximum Release Rate:	10.11	l/s

DRAINAGE AREA I:
 (Uncontrolled Flow Off Site)

			C
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	101	sq.m.	1.00
Landscaped:	177	sq.m.	0.25
Total Catchment Area	278	sq.m.	0.52
Area (A):	278	sq.m.	
Time of Concentration:	10	min.	
Rainfall Intensity (i):	179	mm/hr (100 year event)	
Runoff Coefficient (C):	0.52		
Flow Rate (2.78AiC):	7.21	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:	0	sq.m.	0.25	
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 min.	i mm/hr	2.78AiC l/s	Release Rate l/s	Stored Rate l/s	Stored Volume 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.	0.25	
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 4 Terrace Roof):

(ONE HUNDRED YEAR EVENT)

			C	
Roof Area:	72	sq.m.	1.00	
Paved Area:	0	sq.m.	1.00	
Landscaped Areas:	0	sq.m.	0.25	
 Total Catchment Area	 72	 Ave. C	 1.00	
 No. of Roof Drains:	 3			
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)		
 Depth at Roof Drain:	 57	 mm		
 Maximum Release Rate	 2.13	 l/s		
			Pond Area:	45 sq.m.
			Achieved Vol:	0.87 cu.m.
			Max. Vol. Required:	0.87 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	4.86	2.13	2.73	0.82
10	179	3.57	2.13	1.44	0.87
15	143	2.86	2.13	0.73	0.66
20	120	2.40	2.13	0.27	0.32
25	104	2.08	2.08	0.00	0.00
30	92	1.84	1.84	0.00	0.00
35	83	1.65	1.65	0.00	0.00
40	75	1.50	1.50	0.00	0.00
45	69	1.38	1.38	0.00	0.00
50	64	1.28	1.28	0.00	0.00
55	60	1.19	1.19	0.00	0.00
60	56	1.12	1.12	0.00	0.00
65	53	1.05	1.05	0.00	0.00
70	50	1.00	1.00	0.00	0.00
75	47	0.95	0.95	0.00	0.00
80	45	0.90	0.90	0.00	0.00
85	43	0.86	0.86	0.00	0.00
90	41	0.82	0.82	0.00	0.00
95	39	0.79	0.79	0.00	0.00
100	38	0.76	0.76	0.00	0.00
105	36	0.73	0.73	0.00	0.00
110	35	0.70	0.70	0.00	0.00
115	34	0.68	0.68	0.00	0.00
120	33	0.66	0.66	0.00	0.00
125	32	0.64	0.64	0.00	0.00
130	31	0.62	0.62	0.00	0.00
135	30	0.60	0.60	0.00	0.00
140	29	0.58	0.58	0.00	0.00
145	28	0.57	0.57	0.00	0.00
150	28	0.55	0.55	0.00	0.00
180	24	0.48	0.48	0.00	0.00
210	21	0.42	0.42	0.00	0.00
240	19	0.38	0.38	0.00	0.00
270	17	0.35	0.35	0.00	0.00
300	16	0.32	0.32	0.00	0.00

DRAINAGE AREA V (Unit 2 to 4 Lower Roof):

(ONE HUNDRED YEAR EVENT)

				C
Roof Area:	68	sq.m.	1.00	
Paved Area:	0	sq.m.	1.00	
Landscaped Areas:	0	sq.m.	0.25	
Total Catchment Area	68	Ave. C	1.00	
No. of Roof Drains:	3			
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)		
Depth at Roof Drain:	69	mm		
Maximum Release Rate	2.55	l/s	Pond Area:	26 sq.m.
			Achieved Vol:	0.60 cu.m.
			Max. Vol. Required:	0.60 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	4.55	2.55	2.00	0.60
10	179	3.35	2.55	0.80	0.48
15	143	2.68	2.55	0.13	0.12
20	120	2.25	2.25	0.00	0.00
25	104	1.95	1.95	0.00	0.00
30	92	1.72	1.72	0.00	0.00
35	83	1.55	1.55	0.00	0.00
40	75	1.41	1.41	0.00	0.00
45	69	1.30	1.30	0.00	0.00
50	64	1.20	1.20	0.00	0.00
55	60	1.12	1.12	0.00	0.00
60	56	1.05	1.05	0.00	0.00
65	53	0.99	0.99	0.00	0.00
70	50	0.93	0.93	0.00	0.00
75	47	0.89	0.89	0.00	0.00
80	45	0.84	0.84	0.00	0.00
85	43	0.81	0.81	0.00	0.00
90	41	0.77	0.77	0.00	0.00
95	39	0.74	0.74	0.00	0.00
100	38	0.71	0.71	0.00	0.00
105	36	0.68	0.68	0.00	0.00
110	35	0.66	0.66	0.00	0.00
115	34	0.64	0.64	0.00	0.00
120	33	0.62	0.62	0.00	0.00
125	32	0.60	0.60	0.00	0.00
130	31	0.58	0.58	0.00	0.00
135	30	0.56	0.56	0.00	0.00
140	29	0.55	0.55	0.00	0.00
145	28	0.53	0.53	0.00	0.00
150	28	0.52	0.52	0.00	0.00
180	24	0.45	0.45	0.00	0.00
210	21	0.40	0.40	0.00	0.00
240	19	0.36	0.36	0.00	0.00
270	17	0.32	0.32	0.00	0.00
300	16	0.30	0.30	0.00	0.00

DRAINAGE AREA VI

(ONE HUNDRED YEAR EVENT)

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

Water Elevation:	60.51	m	Storage in MH's & CB's			
			Invert	Depth		
ICD Invert:	58.84	m	m	m		
(Outlet Pipe OF MH-ST.5)			MH-ST.5	58.84	1.67	1.88 cu.m.
			MH-ST.7	58.86	1.65	1.86 cu.m.
Head:	1.67	m				
Orifice Diameter	32	mm	Storage in Sewer Pipes			
			Diam.	Length		
Orifice Area:	804	sq.mm.	mm	m		
			450	8.6		1.18 cu.m.
Coefficient of Discharge:	0.188					
Max. Release Rate:	0.86	l/s		Achieved Vol:	4.92	cu.m.
				Max. Vol. Required:	4.92	cu.m.

Time min.	i mm/hr	2.78AiC l/s	Inflow from		Total Inflow l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
			Roofs (Units 2 to 4) l/s					
5	243	0.00	4.68		4.68	0.86	3.82	1.15
10	179	0.00	4.68		4.68	0.86	3.82	2.29
15	143	0.00	4.68		4.68	0.86	3.82	3.44
20	120	0.00	4.38		4.38	0.86	3.52	4.22
25	104	0.00	4.03		4.03	0.86	3.16	4.74
30	92	0.00	3.56		3.56	0.86	2.70	4.86
35	83	0.00	3.20		3.20	0.86	2.34	4.91
40	75	0.00	2.91		2.91	0.86	2.05	4.92
45	69	0.00	2.68		2.68	0.86	1.81	4.90
50	64	0.00	2.48		2.48	0.86	1.62	4.85
55	60	0.00	2.31		2.31	0.86	1.45	4.78
60	56	0.00	2.17		2.17	0.86	1.30	4.69
65	53	0.00	2.04		2.04	0.86	1.18	4.59
70	50	0.00	1.93		1.93	0.86	1.07	4.48
75	47	0.00	1.83		1.83	0.86	0.97	4.36
80	45	0.00	1.74		1.74	0.86	0.88	4.23
85	43	0.00	1.67		1.67	0.86	0.80	4.09
90	41	0.00	1.59		1.59	0.86	0.73	3.94
95	39	0.00	1.53		1.53	0.86	0.67	3.79
100	38	0.00	1.47		1.47	0.86	0.61	3.63
105	36	0.00	1.42		1.42	0.86	0.55	3.47
110	35	0.00	1.37		1.37	0.86	0.50	3.31
115	34	0.00	1.32		1.32	0.86	0.45	3.14
120	33	0.00	1.28		1.28	0.86	0.41	2.96
125	32	0.00	1.24		1.24	0.86	0.37	2.79
130	31	0.00	1.20		1.20	0.86	0.33	2.61
135	30	0.00	1.16		1.16	0.86	0.30	2.42
140	29	0.00	1.13		1.13	0.86	0.27	2.24
145	28	0.00	1.10		1.10	0.86	0.24	2.05
150	28	0.00	1.07		1.07	0.86	0.21	1.86
180	24	0.00	0.93		0.93	0.86	0.06	0.68
210	21	0.00	0.82		0.82	0.82	0.00	0.00
240	19	0.00	0.74		0.74	0.74	0.00	0.00
270	17	0.00	0.67		0.67	0.67	0.00	0.00
300	16	0.00	0.62		0.62	0.62	0.00	0.00

DRAINAGE AREA VII (Units 5 & 6 Terrace Roof):

(ONE HUNDRED YEAR EVENT)

			C	
Roof Area:	48	sq.m.	1.00	
Paved Area:	0	sq.m.	1.00	
Landscaped Areas:	0	sq.m.	0.25	
 Total Catchment Area	 48	 Ave. C	 1.00	
 No. of Roof Drains:	 2			
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)		
 Depth at Roof Drain:	 57	 mm		
 Maximum Release Rate	 1.42	 l/s		 Pond Area: 30 sq.m.
				Achieved Vol: 0.58 cu.m.
				Max. Vol. Required: 0.58 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	3.24	1.42	1.82	0.55
10	179	2.38	1.42	0.96	0.58
15	143	1.91	1.42	0.49	0.44
20	120	1.60	1.42	0.18	0.22
25	104	1.39	1.39	0.00	0.00
30	92	1.23	1.23	0.00	0.00
35	83	1.10	1.10	0.00	0.00
40	75	1.00	1.00	0.00	0.00
45	69	0.92	0.92	0.00	0.00
50	64	0.85	0.85	0.00	0.00
55	60	0.80	0.80	0.00	0.00
60	56	0.75	0.75	0.00	0.00
65	53	0.70	0.70	0.00	0.00
70	50	0.66	0.66	0.00	0.00
75	47	0.63	0.63	0.00	0.00
80	45	0.60	0.60	0.00	0.00
85	43	0.57	0.57	0.00	0.00
90	41	0.55	0.55	0.00	0.00
95	39	0.53	0.53	0.00	0.00
100	38	0.51	0.51	0.00	0.00
105	36	0.49	0.49	0.00	0.00
110	35	0.47	0.47	0.00	0.00
115	34	0.45	0.45	0.00	0.00
120	33	0.44	0.44	0.00	0.00
125	32	0.43	0.43	0.00	0.00
130	31	0.41	0.41	0.00	0.00
135	30	0.40	0.40	0.00	0.00
140	29	0.39	0.39	0.00	0.00
145	28	0.38	0.38	0.00	0.00
150	28	0.37	0.37	0.00	0.00
180	24	0.32	0.32	0.00	0.00
210	21	0.28	0.28	0.00	0.00
240	19	0.25	0.25	0.00	0.00
270	17	0.23	0.23	0.00	0.00
300	16	0.21	0.21	0.00	0.00

DRAINAGE AREA VIII (Units 5 & 6 Lower 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.	0.25	
Total Catchment Area	45	Ave. C	1.00	
No. of Roof Drains:	2			
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)		
Depth at Roof Drain:	69	mm		
Maximum Release Rate	1.70	l/s		
			Pond Area:	18 sq.m.
			Achieved Vol:	0.40 cu.m.
			Max. Vol. Required:	0.40 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	1.70	1.34	0.40
10	179	2.23	1.70	0.53	0.32
15	143	1.79	1.70	0.09	0.08
20	120	1.50	1.50	0.00	0.00
25	104	1.30	1.30	0.00	0.00
30	92	1.15	1.15	0.00	0.00
35	83	1.03	1.03	0.00	0.00
40	75	0.94	0.94	0.00	0.00
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 IX

(ONE HUNDRED YEAR EVENT)

	C		
Roof Area:	0	sq.m.	1.00
Asphalt/Concrete Area:	127	sq.m.	1.00
Landscaped:	1	sq.m.	0.25

Total Catchment Area 128 sq.m. 0.99

Water Elevation:	60.99	m		Storage in MH's & CB's			
				Invert	Depth		
				m	m		
ICD Invert:	58.90	m	CB/MH-ST.3	58.90	1.94	2.19	cu.m.
(Outlet Pipe OF CB/MH-ST.3)			CB/MH-ST.4	58.92	1.92	2.17	cu.m.

Head:	2.09	m		Storage in Sewer Pipes			
				Diam.	Length		
				mm	m		
Orifice Diameter	25	mm		250	5.4	0.21	cu.m.

				Storage above CB-2			
				Top	Ave.		
				Area	Depth		
				sq.m.	m		
Coefficient of Discharge:	0.152			130.0	0.15	6.50	cu.m.

Max. Release Rate: 0.48 l/s Achieved Vol: 11.07 cu.m.

Max. Vol. Required: 11.07 cu.m.

Time	i	2.78AiC	Inflow from Roofs (Units	Total	Release	Stored	Stored
min.	mm/hr	l/s	5 & 6)	Inflow	Rate	Rate	Volume
			l/s	l/s	l/s	l/s	cu.m.
5	243	8.59	3.12	11.71	0.48	11.23	3.37
10	179	6.32	3.12	9.44	0.48	8.96	5.38
15	143	5.05	3.12	8.18	0.48	7.70	6.93
20	120	4.24	2.92	7.17	0.48	6.69	8.02
25	104	3.67	2.68	6.36	0.48	5.88	8.82
30	92	3.25	2.38	5.63	0.48	5.15	9.27
35	83	2.92	2.13	5.06	0.48	4.58	9.61
40	75	2.66	1.94	4.60	0.48	4.12	9.90
45	69	2.44	1.79	4.23	0.48	3.75	10.13
50	64	2.26	1.65	3.92	0.48	3.44	10.31
55	60	2.11	1.54	3.65	0.48	3.17	10.47
60	56	1.98	1.45	3.42	0.48	2.94	10.60
65	53	1.86	1.36	3.22	0.48	2.75	10.71
70	50	1.76	1.29	3.05	0.48	2.57	10.80
75	47	1.67	1.22	2.89	0.48	2.42	10.87
80	45	1.59	1.16	2.75	0.48	2.28	10.93
85	43	1.52	1.11	2.63	0.48	2.15	10.98
90	41	1.45	1.06	2.52	0.48	2.04	11.01
95	39	1.40	1.02	2.41	0.48	1.94	11.04
100	38	1.34	0.98	2.32	0.48	1.84	11.06
105	36	1.29	0.94	2.23	0.48	1.76	11.07
110	35	1.25	0.91	2.16	0.48	1.68	11.07
115	34	1.20	0.88	2.08	0.48	1.60	11.07
120	33	1.16	0.85	2.01	0.48	1.54	11.06
125	32	1.13	0.82	1.95	0.48	1.47	11.05
130	31	1.09	0.80	1.89	0.48	1.41	11.03
135	30	1.06	0.78	1.84	0.48	1.36	11.01
140	29	1.03	0.75	1.78	0.48	1.31	10.98
145	28	1.00	0.73	1.74	0.48	1.26	10.95
150	28	0.98	0.71	1.69	0.48	1.21	10.92
180	24	0.85	0.62	1.46	0.48	0.99	10.65
210	21	0.75	0.55	1.29	0.48	0.82	10.29
240	19	0.67	0.49	1.16	0.48	0.69	9.88
270	17	0.61	0.45	1.06	0.48	0.58	9.41
300	16	0.56	0.41	0.97	0.48	0.50	8.91

FIVE YEAR EVENT

Maximum Release Rate

Area (A):	698	sq.m.
Time of Concentration:	10	min.
Rainfall Intensity (i):	104	mm/hr (5 year event)
Runoff Coefficient (C):	0.50	
Maximum Release Rate:	10.11	l/s

DRAINAGE AREA I: (Uncontrolled Flow Off Site)

			C
Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	101	sq.m.	0.90
Landscaped:	177	sq.m.	0.20
Total Catchment Area	278	sq.m.	0.45
Area (A):	278	sq.m.	
Time of Concentration:	10	min.	
Rainfall Intensity (i):	104	mm/hr (5 year event)	
Runoff Coefficient (C):	0.45		
Flow Rate (2.78AiC):	3.66	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:	0	sq.m.	0.20	
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	0.21
20	70	0.72	0.62	0.10	0.12
25	61	0.62	0.62	0.00	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:	0	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	0.15	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 4 Terrace Roof): (FIVE YEAR EVENT)

			C	
Roof Area:	72	sq.m.	0.90	
Paved Area:	0	sq.m.	0.90	
Landscaped Areas:	0	sq.m.	0.20	
 Total Catchment Area	 72	 Ave. C	 0.90	
 No. of Roof Drains:	 3			
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)		
 Depth at Roof Drain:	 41	 mm		
 Maximum Release Rate	 1.52	 l/s		 Pond Area: 23 sq.m.
				Achieved Vol: 0.31 cu.m.
				Max. Vol. Required: 0.31 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	2.54	1.52	1.03	0.31
10	104	1.88	1.52	0.36	0.22
15	84	1.51	1.51	0.00	0.00
20	70	1.27	1.27	0.00	0.00
25	61	1.10	1.10	0.00	0.00
30	54	0.97	0.97	0.00	0.00
35	49	0.87	0.87	0.00	0.00
40	44	0.80	0.80	0.00	0.00
45	41	0.73	0.73	0.00	0.00
50	38	0.68	0.68	0.00	0.00
55	35	0.63	0.63	0.00	0.00
60	33	0.59	0.59	0.00	0.00
65	31	0.56	0.56	0.00	0.00
70	29	0.53	0.53	0.00	0.00
75	28	0.50	0.50	0.00	0.00
80	27	0.48	0.48	0.00	0.00
85	25	0.46	0.46	0.00	0.00
90	24	0.44	0.44	0.00	0.00
95	23	0.42	0.42	0.00	0.00
100	22	0.40	0.40	0.00	0.00
105	22	0.39	0.39	0.00	0.00
110	21	0.38	0.38	0.00	0.00
115	20	0.36	0.36	0.00	0.00
120	19	0.35	0.35	0.00	0.00
125	19	0.34	0.34	0.00	0.00
130	18	0.33	0.33	0.00	0.00
135	18	0.32	0.32	0.00	0.00
140	17	0.31	0.31	0.00	0.00
145	17	0.30	0.30	0.00	0.00
150	16	0.29	0.29	0.00	0.00
180	14	0.26	0.26	0.00	0.00
210	13	0.23	0.23	0.00	0.00
240	11	0.20	0.20	0.00	0.00
270	10	0.19	0.19	0.00	0.00
300	9	0.17	0.17	0.00	0.00

DRAINAGE AREA V (Unit 2 to 4 Lower Roof):

(FIVE YEAR EVENT)

			C	
Roof Area:	68	sq.m.	0.90	
Paved Area:	0	sq.m.	0.90	
Landscaped Areas:	0	sq.m.	0.20	
 Total Catchment Area	 68	 Ave. C	 0.90	
 No. of Roof Drains:	 3			
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)		
 Depth at Roof Drain:	 47	 mm		
 Maximum Release Rate	 1.75	 l/s	 Pond Area:	 12 sq.m.
			Achieved Vol:	0.19 cu.m.
			Max. Vol. Required:	0.19 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	2.38	1.75	0.64	0.19
10	104	1.76	1.75	0.01	0.01
15	84	1.41	1.41	0.00	0.00
20	70	1.19	1.19	0.00	0.00
25	61	1.03	1.03	0.00	0.00
30	54	0.91	0.91	0.00	0.00
35	49	0.82	0.82	0.00	0.00
40	44	0.75	0.75	0.00	0.00
45	41	0.69	0.69	0.00	0.00
50	38	0.64	0.64	0.00	0.00
55	35	0.59	0.59	0.00	0.00
60	33	0.56	0.56	0.00	0.00
65	31	0.52	0.52	0.00	0.00
70	29	0.50	0.50	0.00	0.00
75	28	0.47	0.47	0.00	0.00
80	27	0.45	0.45	0.00	0.00
85	25	0.43	0.43	0.00	0.00
90	24	0.41	0.41	0.00	0.00
95	23	0.39	0.39	0.00	0.00
100	22	0.38	0.38	0.00	0.00
105	22	0.36	0.36	0.00	0.00
110	21	0.35	0.35	0.00	0.00
115	20	0.34	0.34	0.00	0.00
120	19	0.33	0.33	0.00	0.00
125	19	0.32	0.32	0.00	0.00
130	18	0.31	0.31	0.00	0.00
135	18	0.30	0.30	0.00	0.00
140	17	0.29	0.29	0.00	0.00
145	17	0.28	0.28	0.00	0.00
150	16	0.28	0.28	0.00	0.00
180	14	0.24	0.24	0.00	0.00
210	13	0.21	0.21	0.00	0.00
240	11	0.19	0.19	0.00	0.00
270	10	0.17	0.17	0.00	0.00
300	9	0.16	0.16	0.00	0.00

DRAINAGE AREA VI

(FIVE YEAR EVENT)

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

Water Elevation:	59.43	m	Storage in MH's & CB's			
			Invert	Depth		
ICD Invert:	58.84	m	m	m		
(Outlet Pipe OF CB/MH-ST.5)			MH-ST.5	58.84	0.58	0.66 cu.m.
			MH-ST.7	58.86	0.56	0.64 cu.m.
Head:	0.58	m				
Orifice Diameter	32	mm	Storage in Sewer Pipes			
			Diam.	Length		
Orifice Area:	804	sq.mm.	mm	m		
			450	8.6		1.18 cu.m.
Coefficient of Discharge:	0.188					
Max. Release Rate:	0.51	l/s			Achieved Vol:	2.48 cu.m.
					Max. Vol. Required:	2.48 cu.m.

Time min.	i mm/hr	2.78AiC l/s	Inflow from		Total Inflow l/s	Release Rate l/s	Stored Rate l/s	Stored Volume cu.m.
			Roofs (Units 2 to 4) l/s					
5	141	0.00	3.27		3.27	0.51	2.75	0.83
10	104	0.00	3.27		3.27	0.51	2.75	1.65
15	84	0.00	2.92		2.92	0.51	2.40	2.16
20	70	0.00	2.45		2.45	0.51	1.94	2.33
25	61	0.00	2.13		2.13	0.51	1.61	2.42
30	54	0.00	1.88		1.88	0.51	1.37	2.47
35	49	0.00	1.69		1.69	0.51	1.18	2.48
40	44	0.00	1.54		1.54	0.51	1.03	2.47
45	41	0.00	1.42		1.42	0.51	0.91	2.45
50	38	0.00	1.31		1.31	0.51	0.80	2.41
55	35	0.00	1.23		1.23	0.51	0.71	2.36
60	33	0.00	1.15		1.15	0.51	0.64	2.30
65	31	0.00	1.08		1.08	0.51	0.57	2.23
70	29	0.00	1.03		1.03	0.51	0.51	2.15
75	28	0.00	0.97		0.97	0.51	0.46	2.08
80	27	0.00	0.93		0.93	0.51	0.41	1.99
85	25	0.00	0.89		0.89	0.51	0.37	1.90
90	24	0.00	0.85		0.85	0.51	0.34	1.81
95	23	0.00	0.81		0.81	0.51	0.30	1.72
100	22	0.00	0.78		0.78	0.51	0.27	1.62
105	22	0.00	0.75		0.75	0.51	0.24	1.52
110	21	0.00	0.73		0.73	0.51	0.21	1.42
115	20	0.00	0.70		0.70	0.51	0.19	1.31
120	19	0.00	0.68		0.68	0.51	0.17	1.20
125	19	0.00	0.66		0.66	0.51	0.15	1.10
130	18	0.00	0.64		0.64	0.51	0.13	0.99
135	18	0.00	0.62		0.62	0.51	0.11	0.87
140	17	0.00	0.60		0.60	0.51	0.09	0.76
145	17	0.00	0.59		0.59	0.51	0.07	0.65
150	16	0.00	0.57		0.57	0.51	0.06	0.53
180	14	0.00	0.49		0.49	0.49	0.00	0.00
210	13	0.00	0.44		0.44	0.44	0.00	0.00
240	11	0.00	0.39		0.39	0.39	0.00	0.00
270	10	0.00	0.36		0.36	0.36	0.00	0.00
300	9	0.00	0.33		0.33	0.33	0.00	0.00

DRAINAGE AREA VII (Units 5 & 6 Terrace Roof):

(FIVE YEAR EVENT)

			C	
Roof Area:	48	sq.m.	0.90	
Paved Area:	0	sq.m.	0.90	
Landscaped Areas:	0	sq.m.	0.20	
 Total Catchment Area	 48	 Ave. C	 0.90	
 No. of Roof Drains:	 2			
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)		
 Depth at Roof Drain:	 41	 mm		
 Maximum Release Rate	 1.01	 l/s		
			Pond Area:	15 sq.m.
			Achieved Vol:	0.21 cu.m.
			Max. Vol. Required:	0.21 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	1.70	1.01	0.68	0.21
10	104	1.25	1.01	0.24	0.14
15	84	1.00	1.00	0.00	0.00
20	70	0.84	0.84	0.00	0.00
25	61	0.73	0.73	0.00	0.00
30	54	0.65	0.65	0.00	0.00
35	49	0.58	0.58	0.00	0.00
40	44	0.53	0.53	0.00	0.00
45	41	0.49	0.49	0.00	0.00
50	38	0.45	0.45	0.00	0.00
55	35	0.42	0.42	0.00	0.00
60	33	0.40	0.40	0.00	0.00
65	31	0.37	0.37	0.00	0.00
70	29	0.35	0.35	0.00	0.00
75	28	0.33	0.33	0.00	0.00
80	27	0.32	0.32	0.00	0.00
85	25	0.30	0.30	0.00	0.00
90	24	0.29	0.29	0.00	0.00
95	23	0.28	0.28	0.00	0.00
100	22	0.27	0.27	0.00	0.00
105	22	0.26	0.26	0.00	0.00
110	21	0.25	0.25	0.00	0.00
115	20	0.24	0.24	0.00	0.00
120	19	0.23	0.23	0.00	0.00
125	19	0.23	0.23	0.00	0.00
130	18	0.22	0.22	0.00	0.00
135	18	0.21	0.21	0.00	0.00
140	17	0.21	0.21	0.00	0.00
145	17	0.20	0.20	0.00	0.00
150	16	0.20	0.20	0.00	0.00
180	14	0.17	0.17	0.00	0.00
210	13	0.15	0.15	0.00	0.00
240	11	0.14	0.14	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 (Units 5 & 6 Lower Roof): (FIVE YEAR EVENT)

			C	
Roof Area:	45	sq.m.	0.90	
Paved Area:	0	sq.m.	0.90	
Landscaped Areas:	0	sq.m.	0.20	
 Total Catchment Area	 45	 Ave. C	 0.90	
 No. of Roof Drains:	 2			
Slots per Wier:	1	0.0124 l/s/mm/slot (5 USgpm/in/slot)		
 Depth at Roof Drain:	 47	 mm		
 Maximum Release Rate	 1.17	 l/s	 Pond Area:	 8 sq.m.
			Achieved Vol:	0.13 cu.m.
			Max. Vol. Required:	0.13 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	1.59	1.17	0.42	0.13
10	104	1.17	1.17	0.01	0.00
15	84	0.94	0.94	0.00	0.00
20	70	0.79	0.79	0.00	0.00
25	61	0.69	0.69	0.00	0.00
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 IX

(FIVE YEAR EVENT)

			C
Roof Area:	0	sq.m.	0.90
Asphalt/Concrete Area:	127	sq.m.	0.90
Landscaped:	1	sq.m.	0.20

Total Catchment Area 128 sq.m. 0.89

Water Elevation:	60.89	m	Storage in MH's & CB's			
			Invert	Depth		
			m	m		
ICD Invert:	58.90	m	CB/MH-ST.3	58.90	1.94	2.19 cu.m.
(Outlet Pipe OF CB/MH-ST.3)			CB/MH-ST.4	58.92	1.92	2.17 cu.m.

Head:	1.99	m	Storage in Sewer Pipes			
			Diam.	Length		
			mm	m		
Orifice Diameter	25	mm	250	5.4	0.21	cu.m.

Orifice Area:	491	sq.mm.	Storage above CB-2			
			Top	Ave.		
			Area	Depth		
			sq.m.	m		
Coefficient of Discharge:	0.152		16.1	0.05	0.28	cu.m.

Max. Release Rate: 0.47 l/s Achieved Vol: 4.86 cu.m.

Max. Vol. Required: 4.86 cu.m.

Time	i	2.78AiC	Inflow from Roofs (Units 5 & 6)	Total Inflow	Release	Stored	Stored
min.	mm/hr	l/s	l/s	l/s	l/s	l/s	Volume cu.m.
5	141	4.49	2.18	6.67	0.47	6.20	1.86
10	104	3.32	2.18	5.49	0.47	5.03	3.02
15	84	2.66	1.94	4.60	0.47	4.14	3.72
20	70	2.24	1.63	3.87	0.47	3.40	4.09
25	61	1.94	1.42	3.36	0.47	2.89	4.33
30	54	1.72	1.25	2.97	0.47	2.50	4.51
35	49	1.54	1.13	2.67	0.47	2.21	4.63
40	44	1.41	1.03	2.43	0.47	1.97	4.72
45	41	1.29	0.95	2.24	0.47	1.77	4.78
50	38	1.20	0.88	2.07	0.47	1.61	4.82
55	35	1.12	0.82	1.94	0.47	1.47	4.85
60	33	1.05	0.77	1.82	0.47	1.35	4.86
65	31	0.99	0.72	1.71	0.47	1.24	4.85
70	29	0.93	0.68	1.62	0.47	1.15	4.84
75	28	0.89	0.65	1.54	0.47	1.07	4.82
80	27	0.85	0.62	1.46	0.47	1.00	4.79
85	25	0.81	0.59	1.40	0.47	0.93	4.75
90	24	0.77	0.57	1.34	0.47	0.87	4.71
95	23	0.74	0.54	1.28	0.47	0.82	4.66
100	22	0.71	0.52	1.23	0.47	0.77	4.61
105	22	0.69	0.50	1.19	0.47	0.72	4.55
110	21	0.66	0.48	1.15	0.47	0.68	4.49
115	20	0.64	0.47	1.11	0.47	0.64	4.43
120	19	0.62	0.45	1.07	0.47	0.61	4.36
125	19	0.60	0.44	1.04	0.47	0.57	4.30
130	18	0.58	0.43	1.01	0.47	0.54	4.22
135	18	0.57	0.41	0.98	0.47	0.51	4.15
140	17	0.55	0.40	0.95	0.47	0.48	4.07
145	17	0.53	0.39	0.93	0.47	0.46	4.00
150	16	0.52	0.38	0.90	0.47	0.43	3.91
180	14	0.45	0.33	0.78	0.47	0.31	3.40
210	13	0.40	0.29	0.69	0.47	0.23	2.84
240	11	0.36	0.26	0.62	0.47	0.16	2.24
270	10	0.33	0.24	0.57	0.47	0.10	1.62
300	9	0.30	0.22	0.52	0.47	0.05	0.98

From: DOUGLAS GRAY <dbgray@rogers.com>
To: Jocelyn Chandler <jocelyn.chandler@rvca.ca>
Sent: Thursday, April 30, 2015 10:44 AM
Subject: Re: 37 Ladouceur St & 53 Merton St

Hi Jocelyn

The proposed 6-unit development has 6 surface parking spaces.

A site plan is attached.

Regards, Doug

D. B. GRAY ENGINEERING INC.

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

700 Long Point Circle
Ottawa, Ontario K1T 4E9

Tel: 613-425-8044
dbgray@rogers.com

From: Jocelyn Chandler <jocelyn.chandler@rvca.ca>
To: DOUGLAS GRAY <dbgray@rogers.com>
Sent: Monday, April 27, 2015 10:08 AM
Subject: RE: 37 Ladouceur St & 53 Merton St

Hello Doug,

Based on our GID mapping of the municipal storm sewer system, the sewers fronting this development proposal on Merton and Ladouceur travels approximately 775m to a direct outlet in to the Ottawa River. The Ottawa River requires 80% TSS removal for stormwater. If the development is expected to have the equivalent of 10 or more surface parking spaces (including drive aisles), we would recommend that stormwater quality treatment be implemented on-site to meet the enhanced quality threshold. I expect, without a site plan to evaluate, that this development proposal is on the threshold, and would therefore suggest that opportunities to implement on-site BMP's be explored. For example, grading the parking area and travelled surface so that stormwater is directed through a grass swale prior to entering a catch basin would be desirable.

If you could send along a general site plan with your inquiry, it would help me provide more definitive recommendations. Thank you for contacting me, Jocelyn

Jocelyn Chandler M.P.I. MCIP, RPP
Planner, RVCA

t) 613-692-3571 x1137

f) 613-692-0831

jocelyn.chandler@rvca.ca

www.rvca.ca

mail: Box 599 3889 Rideau Valley Dr., Manotick, ON K4M 1A5

courier: 3889 Rideau Valley Dr., Nepean, ON K2C 3H1

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From: DOUGLAS GRAY [mailto:dbgray@rogers.com]
Sent: Monday, April 27, 2015 9:18 AM
To: Jocelyn Chandler
Subject: 37 Ladouceur St & 53 Merton St

Hi Jocelyn

I am working on a proposed 6 unit townhouse residential development located on 698 sq.m. of land at the intersection of Ladouceur Street & Merton Street in Ottawa.

Attached are location maps.

Please comment concerning the stormwater management for this site.

Regards, Doug

D. B. GRAY ENGINEERING INC.

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

700 Long Point Circle
Ottawa, Ontario K1T 4E9

Tel: 613-425-8044
dbgray@rogers.com

POST DEVELOPMENT DRAINAGE AREAS

