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Functional Servicing & Storm Water Management Report

Proposed Building and Servicing at Existing Self-Storage Development 3149 and 3169 Hawthorne Road, Ottawa, Ontario

Prepared for

ACCESS PROPERTY DEVELOPMENT
ACCESS GROUP OF COMPANIES

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November 3rd, 2021

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Executive Summary

- The site is presently operating as a self-storage facility, located at 3169 Hawthorne Road, Ottawa, Ontario. The second address, 3149 Hawthorne Road is presently vacant land, essentially located between the existing storage facility and Hawthorne Road.

  Adjacent properties are industrial and commercial buildings.

- The proposed development is for the construction of a four-story self-storage building, on the vacant land of 3149 Hawthorne, in front of the existing buildings.

- The existing site drains overland, uncontrolled, to a ditch along the south property line and then to the Mather Award Drain at the southwest side of the property.

- Storm drainage for both properties is to be collected and controlled by on-site facilities including sewers and underground storage, discharging to a connection to the culvert under Hawthorne Road. Post-development storm runoff is controlled to 50% impervious pre-development levels or better for the 2- and 5-year events and events greater than 5 years up to and including the 100-year storm are controlled to the 5-year level.

- There is a sanitary connection to the existing office which will be re-used for the new building.

- Proposed fire protection is from the existing connection to the watermain on Hawthorne Road. Existing hydrants on site are maintained. A domestic tap is to be provided to serve the office in the new building.

Existing Conditions

Background and Site Description

The site is comprised of two properties: the portion presently operating as a self-storage facility with eleven storage building s and a small office building, owned by the applicant at 3169 Hawthorne Road, in Ottawa, Ontario and the adjacent 3149 Hawthorne Road, presently vacant and recently acquired by the applicant. Adjacent properties are commercial and industrial facilities.

Topography and Drainage

The combined area of the overall site area is 36,078.2.8m^2 of which approximately 6181.1m^2 is the front property (3149), presently vegetated and drains to ditch inlet catchbasins at the front of the site, Hawthorne Road. The balance of the site (19,897.1m^2, or 3169 Hawthorne) is almost entirely paved or buildings and drains overland, north to south, to a ditch along the south side of the property. Said ditch discharges to the Mather Award Drain, on the northeast side of Hawthorne Road.

Sub-surface Conditions

A geotechnical investigation for the site was completed by exp Services Inc. on November 12th, 2020. Although the investigation was focused on the vacant lands at the front of the property and a portion of the site at the rear to facilitate replacement of some of the existing buildings it is reasonable to infer that the soil conditions are uniform between the two areas where boreholes were obtained.

Site stratigraphy is described in the exp report as generally a layer of fill (and existing pavement structure where applicable) approximately 0.9m to 1.6m thick over clay with sand to clay. Ground water levels were noted as 4.6m to 4.9m from surface on completion and monitored holes showed groundwater 1.1m to 2.7m after 18 days of monitoring.

Recommended pavement structure from the exp report is as follows:

Pavement Layer	Compaction	Light Duty Paving	Heavy Duty Paving
Asphalt Layer (PG58-34)	92-97% MRD	65mm HL/SP 12.5 Cat. B3	40mm HL3/SP12.5 Cat B 50mm HL8/SP12.5 Cat B
OPSS 1010 Granular A	100% SPMDD	150mm	150mm
OPSS 1010 Granular B Sub-Base, Type II	100% SPMDD	450mm	600mm


SITE LOCATION
Walkley Rd
Russell Rd
Trans Canada Hwy
Hawthorne Rd
Hunt Club Rd
Ridge Rd
Ramsayville Rd
Ottawa Business Park
Elizabeth Manley Park
Green's Creek

Proposed Development

The proposed development is for the construction of a four-story self-storage building and the replacement of each of the eleven existing buildings with similar buildings (similar footprints and fabrication). Additionally, the existing site drains poorly, entirely overland, with paved areas graded at less than 0.5% in all areas. To improve this situation and increase usability for tenants, a network of storm sewers is proposed.

For the purposes of this report, the two properties comprising the site will be reviewed as a single site/property.

Servicing and Drainage

Storm Flows

As noted previously, flows from the vacant land and site of the new four-story building are presently collected by two ditch inlet catchbasins along Hawthorne Road. These are to be removed as part of this proposal and replace with catchbasins in the landscaped area at the front of the new building.

The storm sewers draining the roof of the new building and the existing site will discharge to the Mather Award Drain in a similar location to the existing drainage point.

Storm Water Management

Paved and other impervious areas (such as building roofs, sidewalks, etc.) which no longer allow absorption by native soils of storm water runoff from a development site are the primary factor affecting the quantity and rate of storm runoff from the site after development. To mitigate this, roof controls and an orifice pipe are proposed to limit post-development runoff to pre-development levels. Specifically, per the requirements from City of Ottawa staff, post-development storm runoff is controlled to 50% impervious pre-development levels or better for the 2- and 5-year events and events greater than 5 years up to and including the 100-year storm are controlled to the 5-year level.

Existing Drainage Area and Runoff Coefficients

The existing site is 71.6% paved and has a runoff coefficient C of 0.715.

Existing Conditions		
Existing Buildings	4904.1	
Paved Area	13762.0	m^2
Total Impervious Area:	*18666.1*	*m^2*
Landscaped Area:	7412.1	m^2
Total:	**26078.2**	**m^2**

			% of Area	Runoff Coefficient	Weighted Coefficient
Impervious	18666.1	sq.m.	71.58%	0.90	0.644
Landscaped	7412.1	sq.m.	28.42%	0.25	0.071
Total	26078.2	sq.m.	100.00%		0.715

Note: in accordance with City of Ottawa requirements, a pre-development runoff coefficient of C=0.50 was used to determine allowable runoff and storage volumes required.

Proposed Drainage Area and Runoff Coefficient

Proposed (Post-Development)		
Proposed Building:	4483.0	m^2
Paved Area	18765.4	m^2
Total Impervious Area:	*23248.4*	*m^2*
Landscaped Area:	2829.9	m^2
Total:	**26078.2**	**m^2**

The resultant runoff coefficient for the area being developed is as follows:

Proposed:			% of Area	% of Area Excluding Roof	Runoff Coefficient	Weighted Coefficient
Paved	18765.4	sq.m.	71.96%	86.90%	0.90	0.782
Landscaped	2829.9	sq.m.	10.85%	13.10%	0.25	0.033
Subtotal	*21595.2*	*sq.m.*				
Building Roof	4483.0	sq.m.	17.19%	n/a	n/a	n/a
Total	26078.2	sq.m.	100.00%	100.00%		0.815

The above runoff coefficient was adjusted for low frequency events in accordance with MTO guidelines as follows:

Storm Return Period	Adjustment Factor	Adjusted Coefficient
2	1	0.815
5	1	0.815
10	1	0.815
25	1.1	0.896
50	1.2	0.978
100	1.25	1.000

Summarizing the results:

Peak Flows:

Storm Event	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
Q achieved (m3/s)	0.1523	0.1734	0.1857	0.2098	0.2283	0.2469
Q allowable (m3/s)	0.2509	0.3333	0.3333	0.3333	0.3333	0.3333
Δ achieved vs allowable	-0.0986	-0.1599	-0.1476	-0.1235	-0.1050	-0.0864

Storage:

Storm Event	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
Storage Required:	115.10	170.21	207.69	288.24	366.09	419.08
Storage Provided:	116.67	174.22	211.11	290.80	374.40	419.97
Δ achieved vs allowable (m3):	+1.57	+4.01	+3.43	+2.56	+8.31	+0.89
Water Surface Elevation:	*70.88*	*71.08*	*71.20*	*71.47*	*71.70*	*71.95*

The required pre- to post- development flow and storage criteria are met.

Refer to Appendix A for the supporting calculations.

Overland Flow Routing

In the event of clogging of catchbasins or an exceptional storm event, flows in excess of the capacity of the proposed system are conveyed via the driveway and/or the existing swale at the south side of the property to the Mather Award Drain, in the same manner and to the same location as surface runoff would be in the current pre-development condition.

Water Quality

Although the proposed use is not a generator of heavy sediment loading and the site is 36% roof areas, the entire area was considered.

Enhanced stormwater quality control is required [80% removal of Total Suspended Solids (TSS)] and will be addressed by the installation of an Oil and Grit Separator (OGS), in accordance with requirements from the Ministry of Natural Resources and Forestry (MNRF) and the Ministry of the Environment and Climate Change (MOECC). A StormCon SDD3-1800 OGS is proposed to achieve an annual TSS removal efficiency of 90.4%.

Sanitary Servicing

The existing office building is connected to the municipal sanitary sewer on Hawthorne Road. Note that there are few staff and limited facilities in the proposed building. It is proposed to re-use the existing sanitary lateral, with the addition of an inspection manhole at street line.

Potable and Fire Water Supply

There is an existing 150mm water service servicing the existing office and the two private hydrants on the existing portion of the site. There are also two municipal hydrants located on the Hawthorne Road boulevard, in front of the proposed building.

As with sanitary services, because of the minimal staffing at the facility there is limited domestic (potable) water demand for the proposed use. A new meter is to be provided in the new building.

The proposed building is to be sprinklered by a connection to the watermain. One of the site hydrants is to be relocated approximately 12m from its present location to distance it from the proposed loading docks and one of the municipal hydrants is to be relocated to clear the proposed sidewalk on Hawthorne Road. No other changes are proposed for the fire water supply.

Erosion and Sediment Control

During Construction

Erosion and sediment control measures are to be implemented prior to the start of construction and maintained for the duration of the works.

Since the effectiveness of erosion and sediment controls decreases with sediment loading, regular inspection and repair of damaged controls is essential. As indicated on the drawing under Siltation and Erosion Control, the following control measures or better are to be implemented:

- Silt Fences are to be installed adjacent to all property limits subject to drainage from the development area prior to topsoil stripping and in other locations, such as the base of any topsoil stockpiles.
- Discharge from point source discharges (such as dewatering pumps) to be filtered through a rock check dam (OPSD 219.210 or 219.211) and/or silt fence, as appropriate.
- A mud mat is to be provided at the entrance to ensure that mud is not tracked onto adjacent municipal roads. In the event that mud is tracked onto the adjacent roads, it is to be cleaned daily. In the event that the mud mat is deemed not sufficiently effective, truck washing may be required.
- All disturbed areas and stockpiles are to be seeded and stabilized if they are to remain disturbed for thirty days or longer (see drawing notes).
- Care must be taken when removing silt and siltation controls (particularly at catchbasins) to ensure that any accumulated sediment is not dispersed into the storm sewer network.
- Inspections of all of the erosion and sediment controls on the construction site should be undertaken
    - On a weekly basis

- After every rainfall event
- After significant snow melt events
- Prior to forecasted rainfall events

If damaged control measures are identified during inspection, the damaged or ineffective portion should be repaired and/or replaced within 48 hours.

Conclusion

The impact of the proposed development on the total runoff from the area of the site being developed is mitigated to pre-development levels or better.

Fire protection, domestic water, and sanitary services are being provided for the proposed development.

The proposed development is consistent with the existing and adjacent developments and can be constructed in accordance with City of Ottawa criteria.

Respectfully submitted,
EC²E: Edilesse Consulting Civil Engineers Ltd.

per: Mauro Savoldelli, P.Eng.

Appendix A: Quantity Control Calculations

Runoff was calculated using MTO IDF curves for the site.

$i=A(t)^B$ (t in hours)

Parameter	2	5	10	25	50	100
A	19.8	26.3	30.6	36.1	40.1	44.1
B	-0.699	-0.699	-0.699	-0.699	-0.699	-0.699

As stated in report, flows for all storms were controlled to the pre-development runoff from the site based on a runoff coefficient of 0.50.

Results Summary:

Orifice Summary:

Storm	2	5	10	25	50	100
Water Level	70.88	71.08	71.20	71.47	71.70	71.95
C.L. Orifice El.	70.22	70.22	70.22	70.22	70.22	70.22
H (m)	0.66	0.85	0.98	1.25	1.48	1.73
Orifice Diameter (mm)	300	300	300	300	300	300
Radius (mm)	150.0	150.0	150.0	150.0	150.0	150.0
A (sq.m.)	0.0707	0.0707	0.0707	0.0707	0.0707	0.0707
C	0.6	0.6	0.6	0.6	0.6	0.6
Q (c.m./s)	0.1523	0.1734	0.1857	0.2098	0.2283	0.2469
Q allowable (c.m./s.)	0.2509	0.3333	0.3333	0.3333	0.3333	0.3333
Δ, m^3/s (-ve=less than allowable)	-0.0986	-0.1599	-0.1476	-0.1235	-0.1050	-0.0864
Storage Required:	115.10	170.21	207.69	288.24	366.09	419.08
Storage Provided:	116.67	174.22	211.11	290.80	374.40	419.97
Δ, m^3 (+ve=surplus)	-1.5667	-4.0073	-3.4259	-2.5630	-8.3088	-0.8856

Storm Calculations:

Runoff:

i) Pre-Development

(Roof areas included in paved areas, except Proposed Building)

Storm:	**2**	**yr.**
Area =	2.607822	Ha.
i =	69.3	mm/hr (tc=10 min.)
C =	0.50	
Q =	0.2509	c.m./s.

ii) Post-Development

(Roof areas included in paved areas, except Proposed Building)

Controlled Area:			% of Area	Weighted Percent	Runoff Coeff.	Weighted Coeff.
Paved	18765.4	sq.m.	71.96%	86.90%	0.90	0.7821
Landscaped	2829.9	sq.m.	10.85%	13.10%	0.25	0.0328
Subtotal	21595.2	sq.m.				
Roof	4483.0	sq.m.	17.19%	n/a	n/a	n/a
Total	26078.2	sq.m.	100.00%	100.00%		0.8148
				Frequency Adjustment Factor:		100.00%
				Adjusted Coefficient:		0.8148

iii) Runoff volumes:

Storm:	**2**	**Yr**
Area:	21595.22	sq.m.
	2.1595	Ha
C:	0.8148	
Max. Outflow Allowed:	250.92	l./s.
or:	0.2509	c.m./s

Ottawa IDF					*Allowable*		Using Pipe Orifice	
Time (min)	Intensity (mm/hr)	Inflow Site (c.m./s)	Inflow Roof (c.m./s)	Total Inflow	*Predevel. Allowed (c.m./s)*	*Storage Volume (c.m.)*	Outflow Orifice (c.m./s)	Storage Volume (c.m.)
10	69.278	0.3386	0.0055	0.3441	*0.2509*	*55.93*	0.1523	115.10
11	64.813	0.3168	0.0055	0.3223	*0.2509*	*47.11*	0.1523	112.21
12	60.988	0.2981	0.0055	0.3036	*0.2509*	*37.94*	0.1523	108.95
13	57.670	0.2819	0.0055	0.2874	*0.2509*	*28.45*	0.1523	105.38
14	54.758	0.2677	0.0055	0.2732	*0.2509*	*18.68*	0.1523	101.53
15	52.180	0.2550	0.0055	0.2606	*0.2509*	*8.68*	0.1523	97.44
20	42.675	0.2086	0.0055	0.2141	*0.2141*	*0.00*	0.1523	74.17
25	36.512	0.1785	0.0055	0.1840	*0.1840*	*0.00*	0.1523	47.52
30	32.143	0.1571	0.0055	0.1626	*0.1626*	*0.00*	0.1523	18.59
35	28.860	0.1411	0.0055	0.1466	*0.1466*	*0.00*	0.1523	0.00
40	26.288	0.1285	0.0055	0.1340	*0.1340*	*0.00*	0.1340	0.00
45	24.210	0.1183	0.0055	0.1238	*0.1238*	*0.00*	0.1238	0.00
50	22.491	0.1099	0.0055	0.1154	*0.1154*	*0.00*	0.1154	0.00
55	21.042	0.1028	0.0055	0.1084	*0.1084*	*0.00*	0.1084	0.00
60	19.800	0.0968	0.0055	0.1023	*0.1023*	*0.00*	0.1023	0.00
65	18.723	0.0915	0.0055	0.0970	*0.0970*	*0.00*	0.0970	0.00
70	17.777	0.0869	0.0055	0.0924	*0.0924*	*0.00*	0.0924	0.00
75	16.940	0.0828	0.0055	0.0883	*0.0883*	*0.00*	0.0883	0.00
80	16.193	0.0792	0.0055	0.0847	*0.0847*	*0.00*	0.0847	0.00
85	15.521	0.0759	0.0055	0.0814	*0.0814*	*0.00*	0.0814	0.00

Max. Vol. (cu.m.):	**55.93**	**115.10**

Roof, Proposed Building:

Storm: 2 Yr
Area: 4483 sq.m.
0.4483 Ha
C: 0.9

Outflow rate:
based on 23 l/min/in of head
Roof Rise: 4 inches
0.1016 m
Max. Outflow: 0.0055 (c.m./s)
5.51 (l./s.)
or 0.1509 l/s/cm. of head per weir

No. of notches: 9
Max. Volume: 60.65 cu. m.
Depth at weir: 4.06 cm.
(Note: Iterative Solution Used)
(N.A.R. 498.1 sq.m./notch)
(Flow 12.30 l/s/Ha)

Proposed Building Roof:

Ottawa IDF

Time (min)	Intensity (mm/hr)	Inflow Roof (c.m./s)	Outflow (c.m./s)	Storage Volume (c.m.)
10	69.278	0.0776	0.0055	43.28
11	64.813	0.0726	0.0055	44.30
12	60.988	0.0684	0.0055	45.24
13	57.670	0.0646	0.0055	46.11
14	54.758	0.0614	0.0055	46.92
15	52.180	0.0585	0.0055	47.67
20	42.675	0.0478	0.0055	50.78
25	36.512	0.0409	0.0055	53.11
30	32.143	0.0360	0.0055	54.92
35	28.860	0.0323	0.0055	56.35
40	26.288	0.0295	0.0055	57.48
45	24.210	0.0271	0.0055	58.38
50	22.491	0.0252	0.0055	59.08
55	21.042	0.0236	0.0055	59.63
60	19.800	0.0222	0.0055	60.04
65	18.723	0.0210	0.0055	60.33
70	17.777	0.0199	0.0055	60.53
75	16.940	0.0190	0.0055	60.63
80	16.193	0.0181	0.0055	60.65
85	15.521	0.0174	0.0055	60.60

Max. Vol. (cu.m.): 60.65

Runoff:

i) Pre-Development

Storm:	**5**	**yr.**
Area =	2.607822	Ha.
i =	92.0	mm/hr (tc=10 min.)
C =	0.50	
Q =	0.3333	c.m./s.

ii) Post-Development

(Roof areas included in paved areas, except Proposed Building)

Controlled Area:			% of Area	Weighted Percent	Runoff Coeff.	Weighted Coeff.
Paved	18765.4	sq.m.	71.96%	86.90%	0.90	0.7821
Landscaped	2829.9	sq.m.	10.85%	13.10%	0.25	0.0328
Subtotal	21595.2	sq.m.				
Roof	4483.0	sq.m.	17.19%	n/a	n/a	n/a
Total	26078.2	sq.m.	100.00%	100.00%		0.8148
				Frequency Adjustment Factor:		100.00%
				Adjusted Coefficient:		0.8148

iii) Runoff volumes:

Storm:	**5**	**Yr**
Area:	21595.22	sq.m.
	2.1595	Ha
C:	0.8148	
Max. Outflow Allowed:	333.30	l./s.
or:	0.3333	c.m./s

Ottawa IDF					*Allowable*		Using Pipe Orifice	
Time (min)	Intensity (mm/hr)	Inflow Site (c.m./s)	Inflow Roof (c.m./s)	Total Inflow	*Predevel. Allowed (c.m./s)*	*Storage Volume (c.m.)*	Outflow Orifice (c.m./s)	Storage Volume (c.m.)
10	92.020	0.4498	0.0073	0.4571	*0.3333*	*74.29*	0.1734	170.21
11	86.089	0.4208	0.0073	0.4281	*0.3333*	*62.58*	0.1734	168.10
12	81.009	0.3960	0.0073	0.4033	*0.3333*	*50.39*	0.1734	165.51
13	76.601	0.3744	0.0073	0.3817	*0.3333*	*37.79*	0.1734	162.49
14	72.734	0.3555	0.0073	0.3628	*0.3333*	*24.82*	0.1734	159.12
15	69.310	0.3388	0.0073	0.3461	*0.3333*	*11.52*	0.1734	155.42
20	56.684	0.2771	0.0073	0.2844	*0.2844*	*0.00*	0.1734	133.17
25	48.498	0.2371	0.0073	0.2444	*0.2444*	*0.00*	0.1734	106.44
30	42.695	0.2087	0.0073	0.2160	*0.2160*	*0.00*	0.1734	76.67
35	38.334	0.1874	0.0073	0.1947	*0.1947*	*0.00*	0.1734	44.68
40	34.918	0.1707	0.0073	0.1780	*0.1780*	*0.00*	0.1734	10.99
45	32.158	0.1572	0.0073	0.1645	*0.1645*	*0.00*	0.1734	0.00
50	29.875	0.1460	0.0073	0.1533	*0.1533*	*0.00*	0.1533	0.00
55	27.949	0.1366	0.0073	0.1439	*0.1439*	*0.00*	0.1439	0.00
60	26.300	0.1286	0.0073	0.1359	*0.1359*	*0.00*	0.1359	0.00
65	24.869	0.1216	0.0073	0.1289	*0.1289*	*0.00*	0.1289	0.00
70	23.613	0.1154	0.0073	0.1227	*0.1227*	*0.00*	0.1227	0.00
75	22.502	0.1100	0.0073	0.1173	*0.1173*	*0.00*	0.1173	0.00
80	21.509	0.1051	0.0073	0.1125	*0.1125*	*0.00*	0.1125	0.00
85	20.617	0.1008	0.0073	0.1081	*0.1081*	*0.00*	0.1081	0.00

Max. Vol. (cu.m.):	**74.29**	**170.21**

Roof, Proposed Building:

Storm:	**5**	**Yr**
Area:	4483	sq.m.
	0.4483	Ha
C:	0.9	

Outflow rate:

based on 23 l/min/in of head

Roof Rise:	4	inches
	0.1016	m
Max. Outflow:	0.0073	(c.m./s)
	7.32	(l./s.)
or	0.1509	l/s/cm. of head per weir

No. of notches:	9	
Max. Volume:	80.56	cu. m.
Depth at weir:	5.39	cm.

(Note: Iterative Solution Used)

(N.A.R.	498.1	sq.m./notch)
(Flow	16.33	l/s/Ha)

Ottawa IDF

Time (min)	Intensity (mm/hr)	Inflow Roof (c.m./s)	Outflow (c.m./s)	Storage Volume (c.m.)
10	92.020	0.1031	0.0073	57.49
11	86.089	0.0965	0.0073	58.85
12	81.009	0.0908	0.0073	60.10
13	76.601	0.0859	0.0073	61.25
14	72.734	0.0815	0.0073	62.32
15	69.310	0.0777	0.0073	63.32
20	56.684	0.0635	0.0073	67.45
25	48.498	0.0544	0.0073	70.55
30	42.695	0.0479	0.0073	72.95
35	38.334	0.0430	0.0073	74.84
40	34.918	0.0391	0.0073	76.35
45	32.158	0.0360	0.0073	77.54
50	29.875	0.0335	0.0073	78.48
55	27.949	0.0313	0.0073	79.20
60	26.300	0.0295	0.0073	79.75
65	24.869	0.0279	0.0073	80.14
70	23.613	0.0265	0.0073	80.40
75	22.502	0.0252	0.0073	80.53
80	21.509	0.0241	0.0073	80.56
85	20.617	0.0231	0.0073	80.50

Max. Vol. (cu.m.):	**80.56**

Runoff:

i) Pre-Development

Storm:	**5**	**yr.**
Area =	2.607822	Ha.
i =	92.0	mm/hr (tc=10 min.)
C =	0.50	
Q =	0.3333	c.m./s.

ii) Post-Development

(Roof areas included in paved areas, except Proposed Building)

Controlled Area:			% of Area	Weighted Percent	Runoff Coeff.	Weighted Coeff.
Paved	18765.4	sq.m.	71.96%	86.90%	0.90	0.7821
Landscaped	2829.9	sq.m.	10.85%	13.10%	0.25	0.0328
Subtotal	21595.2	sq.m.				
Roof	4483.0	sq.m.	17.19%	n/a	n/a	n/a
Total	26078.2	sq.m.	100.00%	100.00%		0.8148
				Frequency Adjustment Factor:		100.00%
				Adjusted Coefficient:		0.8148

iii) Runoff volumes:

Storm:	**10**	**Yr**
Area:	21595.22	sq.m.
	2.1595	Ha
C:	0.8148	
Max. Outflow Allowed:	333.30	l./s.
or:	0.3333	c.m./s

Ottawa IDF					*Allowable*		Using Pipe Orifice	
Time (min)	Intensity (mm/hr)	Inflow Site (c.m./s)	Inflow Roof (c.m./s)	Total Inflow	*Predevel. Allowed (c.m./s)*	*Storage Volume (c.m.)*	Outflow Orifice (c.m./s)	Storage Volume (c.m.)
10	107.065	0.5233	0.0085	0.5318	*0.3333*	*119.13*	0.1857	207.69
11	100.165	0.4896	0.0085	0.4981	*0.3333*	*108.78*	0.1857	206.20
12	94.254	0.4607	0.0085	0.4692	*0.3333*	*97.87*	0.1857	204.14
13	89.126	0.4356	0.0085	0.4442	*0.3333*	*86.47*	0.1857	201.60
14	84.626	0.4136	0.0085	0.4222	*0.3333*	*74.65*	0.1857	198.63
15	80.642	0.3942	0.0085	0.4027	*0.3333*	*62.45*	0.1857	195.29
20	65.952	0.3224	0.0085	0.3309	*0.3309*	*0.00*	0.1857	174.23
25	56.427	0.2758	0.0085	0.2843	*0.2843*	*0.00*	0.1857	147.95
30	49.675	0.2428	0.0085	0.2513	*0.2513*	*0.00*	0.1857	118.14
35	44.601	0.2180	0.0085	0.2265	*0.2265*	*0.00*	0.1857	85.74
40	40.626	0.1986	0.0085	0.2071	*0.2071*	*0.00*	0.1857	51.36
45	37.416	0.1829	0.0085	0.1914	*0.1914*	*0.00*	0.1857	15.41
50	34.759	0.1699	0.0085	0.1784	*0.1784*	*0.00*	0.1857	0.00
55	32.519	0.1589	0.0085	0.1675	*0.1675*	*0.00*	0.1675	0.00
60	30.600	0.1496	0.0085	0.1581	*0.1581*	*0.00*	0.1581	0.00
65	28.935	0.1414	0.0085	0.1499	*0.1499*	*0.00*	0.1499	0.00
70	27.474	0.1343	0.0085	0.1428	*0.1428*	*0.00*	0.1428	0.00
75	26.181	0.1280	0.0085	0.1365	*0.1365*	*0.00*	0.1365	0.00
80	25.026	0.1223	0.0085	0.1308	*0.1308*	*0.00*	0.1308	0.00
85	23.988	0.1172	0.0085	0.1258	*0.1258*	*0.00*	0.1258	0.00

Max. Vol. (cu.m.):	**119.13**	**207.69**

Roof, Proposed Building:

Storm:	**10**	**Yr**
Area:	4483	sq.m.
	0.4483	Ha
C:	0.9	

Outflow rate:

based on 23 l/min/in of head

Roof Rise:	4	inches
	0.1016	m
Max. Outflow:	0.0085	(c.m./s)
	8.52	(l./s.)
or	0.1509	l/s/cm. of head per weir

No. of notches:	9	
Max. Volume:	93.73	cu. m.
Depth at weir:	6.27	cm.

(Note: Iterative Solution Used)

(N.A.R.	498.1	sq.m./notch)
(Flow	19.00	l/s/Ha)

Proposed Building Roof:

Ottawa IDF

Time (min)	Intensity (mm/hr)	Inflow Roof (c.m./s)	Outflow (c.m./s)	Storage Volume (c.m.)
10	107.065	0.1200	0.0085	66.88
11	100.165	0.1123	0.0085	68.47
12	94.254	0.1056	0.0085	69.92
13	89.126	0.0999	0.0085	71.27
14	84.626	0.0948	0.0085	72.51
15	80.642	0.0904	0.0085	73.67
20	65.952	0.0739	0.0085	78.48
25	56.427	0.0632	0.0085	82.08
30	49.675	0.0557	0.0085	84.88
35	44.601	0.0500	0.0085	87.08
40	40.626	0.0455	0.0085	88.83
45	37.416	0.0419	0.0085	90.22
50	34.759	0.0390	0.0085	91.31
55	32.519	0.0364	0.0085	92.15
60	30.600	0.0343	0.0085	92.79
65	28.935	0.0324	0.0085	93.24
70	27.474	0.0308	0.0085	93.54
75	26.181	0.0293	0.0085	93.70
80	25.026	0.0280	0.0085	93.73
85	23.988	0.0269	0.0085	93.66

Max. Vol. (cu.m.):	**93.73**

Runoff:

i) Pre-Development

Storm:	**5**	**yr.**
Area =	2.607822	Ha.
i =	92.0	mm/hr (tc=10 min.)
C =	0.50	
Q =	0.3333	c.m./s.

ii) Post-Development

(Roof areas included in paved areas, except Proposed Building)

Controlled Area:			% of Area	Weighted Percent	Runoff Coeff.	Weighted Coeff.
Paved	18765.4	sq.m.	71.96%	86.90%	0.90	0.7821
Landscaped	2829.9	sq.m.	10.85%	13.10%	0.25	0.0328
Subtotal	21595.2	sq.m.				
Roof	4483.0	sq.m.	17.19%	n/a	n/a	n/a
Total	26078.2	sq.m.	100.00%	100.00%		0.8148
				Frequency Adjustment Factor:		110.00%
				Adjusted Coefficient:		0.8963

iii) Runoff volumes:

Storm:	**25**	**Yr**
Area:	21595.22	sq.m.
	2.1595	Ha
C:	0.8963	
Max. Outflow Allowed:	333.30	l./s.
or:	0.3333	c.m./s

Ottawa IDF					*Allowable*		Using Pipe Orifice	
Time (min)	Intensity (mm/hr)	Inflow Site (c.m./s)	Inflow Roof (c.m./s)	Total Inflow	*Predevel. Allowed (c.m./s)*	*Storage Volume (c.m.)*	Outflow Orifice (c.m./s)	Storage Volume (c.m.)
10	126.309	0.6791	0.0111	0.6902	*0.3333*	*214.13*	0.2098	288.24
11	118.168	0.6353	0.0111	0.6464	*0.3333*	*206.65*	0.2098	288.17
12	111.196	0.5979	0.0111	0.6089	*0.3333*	*198.45*	0.2098	287.38
13	105.145	0.5653	0.0111	0.5764	*0.3333*	*189.61*	0.2098	285.95
14	99.837	0.5368	0.0111	0.5478	*0.3333*	*180.22*	0.2098	283.98
15	95.136	0.5115	0.0111	0.5226	*0.3333*	*170.35*	0.2098	281.51
20	77.806	0.4183	0.0111	0.4294	*0.3333*	*115.32*	0.2098	263.54
25	66.569	0.3579	0.0111	0.3690	*0.3333*	*53.52*	0.2098	238.80
30	58.604	0.3151	0.0111	0.3261	*0.3261*	*0.00*	0.2098	209.47
35	52.618	0.2829	0.0111	0.2940	*0.2940*	*0.00*	0.2098	176.79
40	47.929	0.2577	0.0111	0.2688	*0.2688*	*0.00*	0.2098	141.53
45	44.141	0.2373	0.0111	0.2484	*0.2484*	*0.00*	0.2098	104.24
50	41.007	0.2205	0.0111	0.2315	*0.2315*	*0.00*	0.2098	65.27
55	38.364	0.2063	0.0111	0.2173	*0.2173*	*0.00*	0.2098	24.90
60	36.100	0.1941	0.0111	0.2052	*0.2052*	*0.00*	0.2098	0.00
65	34.136	0.1835	0.0111	0.1946	*0.1946*	*0.00*	0.1946	0.00
70	32.412	0.1743	0.0111	0.1853	*0.1853*	*0.00*	0.1853	0.00
75	30.886	0.1661	0.0111	0.1771	*0.1771*	*0.00*	0.1771	0.00
80	29.524	0.1587	0.0111	0.1698	*0.1698*	*0.00*	0.1698	0.00
85	28.299	0.1522	0.0111	0.1632	*0.1632*	*0.00*	0.1632	0.00

Max. Vol. (cu.m.):	**214.13**	**288.24**

Roof, Proposed Building:

Storm:	**25**	**Yr**
Area:	4483	sq.m.
	0.4483	Ha
C:	0.990	(adjusted)

Outflow rate:

based on 23 l/min/in of head

Roof Rise:	4	inches
	0.1016	m
Max. Outflow:	0.0111	(c.m./s)
	11.06	(l./s.)
or	0.1509	l/s/cm. of head per weir

No. of notches:	9	
Max. Volume:	121.64	cu. m.
Depth at weir:	8.14	cm.

(Note: Iterative Solution Used)

(N.A.R.	498.1	sq.m./notch)
(Flow	24.66	l/s/Ha)

Ottawa IDF

Time (min)	Intensity (mm/hr)	Inflow Roof (c.m./s)	Outflow (c.m./s)	Storage Volume (c.m.)
15	95.136	0.1173	0.0111	95.61
16	90.940	0.1121	0.0111	97.01
17	87.167	0.1075	0.0111	98.33
18	83.753	0.1033	0.0111	99.57
19	80.647	0.0994	0.0111	100.74
20	77.806	0.0959	0.0111	101.84
25	66.569	0.0821	0.0111	106.52
30	58.604	0.0722	0.0111	110.15
35	52.618	0.0649	0.0111	113.01
40	47.929	0.0591	0.0111	115.27
45	44.141	0.0544	0.0111	117.08
50	41.007	0.0506	0.0111	118.49
55	38.364	0.0473	0.0111	119.59
60	36.100	0.0445	0.0111	120.42
65	34.136	0.0421	0.0111	121.01
70	32.412	0.0400	0.0111	121.39
75	30.886	0.0381	0.0111	121.60
80	29.524	0.0364	0.0111	121.64
85	28.299	0.0349	0.0111	121.54
90	27.191	0.0335	0.0111	121.31

Max. Vol. (cu.m.):	**121.64**

Runoff:

i) Pre-Development

Storm:	**5**	**yr.**
Area =	2.607822	Ha.
i =	92.0	mm/hr (tc=10 min.)
C =	0.50	
Q =	0.3333	c.m./s.

ii) Post-Development

(Roof areas included in paved areas, except Proposed Building)

Controlled Area:			% of Area	Weighted Percent	Runoff Coeff.	Weighted Coeff.
Paved	18765.4	sq.m.	71.96%	86.90%	0.90	0.7821
Landscaped	2829.9	sq.m.	10.85%	13.10%	0.25	0.0328
Subtotal	21595.2	sq.m.				
Roof	4483.0	sq.m.	17.19%	n/a	n/a	n/a
Total	26078.2	sq.m.	100.00%	100.00%		0.8148
					Frequency Adjustment Factor:	120.00%
					Adjusted Coefficient:	0.9778

iii) Runoff volumes:

Storm:	**50**	**Yr**
Area:	21595.22	sq.m.
	2.1595	Ha
C:	0.9778	
Max. Outflow Allowed:	333.30	l./s.
or:	0.3333	c.m./s

Ottawa IDF					*Allowable*		Using Pipe Orifice	
Time (min)	Intensity (mm/hr)	Inflow Site (c.m./s)	Inflow Roof (c.m./s)	Total Inflow	*Predevel. Allowed (c.m./s)*	*Storage Volume (c.m.)*	Outflow Orifice (c.m./s)	Storage Volume (c.m.)
10	140.305	0.8229	0.0123	0.8352	*0.3333*	*301.16*	0.2283	364.16
11	131.262	0.7699	0.0123	0.7822	*0.3333*	*296.27*	0.2283	365.57
12	123.516	0.7245	0.0123	0.7368	*0.3333*	*290.49*	0.2283	366.09
13	116.795	0.6851	0.0123	0.6973	*0.3333*	*283.95*	0.2283	365.85
14	110.899	0.6505	0.0123	0.6628	*0.3333*	*276.74*	0.2283	364.94
15	105.678	0.6198	0.0123	0.6321	*0.3333*	*268.95*	0.2283	363.45
20	86.428	0.5069	0.0123	0.5192	*0.3333*	*223.11*	0.2283	349.10
25	73.946	0.4337	0.0123	0.4460	*0.3333*	*169.06*	0.2283	326.56
30	65.098	0.3818	0.0123	0.3941	*0.3333*	*109.46*	0.2283	298.45
35	58.448	0.3428	0.0123	0.3551	*0.3333*	*45.80*	0.2283	266.29
40	53.239	0.3123	0.0123	0.3246	*0.3246*	*0.00*	0.2283	231.01
45	49.032	0.2876	0.0123	0.2999	*0.2999*	*0.00*	0.2283	193.25
50	45.550	0.2672	0.0123	0.2795	*0.2795*	*0.00*	0.2283	153.46
55	42.615	0.2500	0.0123	0.2622	*0.2622*	*0.00*	0.2283	111.98
60	40.100	0.2352	0.0123	0.2475	*0.2475*	*0.00*	0.2283	69.07
65	37.918	0.2224	0.0123	0.2347	*0.2347*	*0.00*	0.2283	24.91
70	36.004	0.2112	0.0123	0.2235	*0.2235*	*0.00*	0.2283	0.00
75	34.309	0.2012	0.0123	0.2135	*0.2135*	*0.00*	0.2135	0.00
80	32.795	0.1924	0.0123	0.2046	*0.2046*	*0.00*	0.2046	0.00
85	31.435	0.1844	0.0123	0.1967	*0.1967*	*0.00*	0.1967	0.00

Max. Vol. (cu.m.):	**301.16**	**366.09**

Roof, Proposed Building:

Storm:	**50**	**Yr**
Area:	4483	sq.m.
	0.4483	Ha
C:	0.990	(adjusted)

Outflow rate:

based on 23 l/min/in of head

Roof Rise:	4	inches
	0.1016	m
Max. Outflow:	0.0123	(c.m./s)
	12.28	(l./s.)
or	0.1509	l/s/cm. of head per weir

No. of notches:	9	
Max. Volume:	135.12	cu. m.
Depth at weir:	9.04	cm.

(Note: Iterative Solution Used)

(N.A.R.	498.1	sq.m./notch)
(Flow	27.40	l/s/Ha)

Ottawa IDF

Time (min)	Intensity (mm/hr)	Inflow Roof (c.m./s)	Outflow (c.m./s)	Storage Volume (c.m.)
15	105.678	0.1303	0.0123	106.20
16	101.016	0.1245	0.0123	107.76
17	96.825	0.1194	0.0123	109.23
18	93.033	0.1147	0.0123	110.60
19	89.583	0.1104	0.0123	111.90
20	86.428	0.1066	0.0123	113.12
25	73.946	0.0912	0.0123	118.32
30	65.098	0.0803	0.0123	122.35
35	58.448	0.0721	0.0123	125.53
40	53.239	0.0656	0.0123	128.05
45	49.032	0.0604	0.0123	130.05
50	45.550	0.0562	0.0123	131.62
55	42.615	0.0525	0.0123	132.84
60	40.100	0.0494	0.0123	133.76
65	37.918	0.0467	0.0123	134.41
70	36.004	0.0444	0.0123	134.84
75	34.309	0.0423	0.0123	135.07
80	32.795	0.0404	0.0123	135.12
85	31.435	0.0388	0.0123	135.01
90	30.203	0.0372	0.0123	134.75

Max. Vol. (cu.m.):	**135.12**

Runoff:

i) Pre-Development

Storm:	**5**	**yr.**
Area =	2.607822	Ha.
i =	92.0	mm/hr (tc=10 min.)
C =	0.50	
Q =	0.3333	c.m./s.

ii) Post-Development

(Roof areas included in paved areas, except Proposed Building)

Controlled Area:			% of Area	Weighted Percent	Runoff Coeff.	Weighted Coeff.
Paved	18765.4	sq.m.	71.96%	86.90%	0.90	0.7821
Landscaped	2829.9	sq.m.	10.85%	13.10%	0.25	0.0328
Subtotal	21595.2	sq.m.				
Roof	4483.0	sq.m.	17.19%	n/a	n/a	n/a
Total	26078.2	sq.m.	100.00%	100.00%		0.8148
					Frequency Adjustment Factor:	125.00%
					Adjusted Coefficient:	1.0000

iii) Runoff volumes:

Storm:	**100**	**Yr**
Area:	21595.22	sq.m.
	2.1595	Ha
C:	1.0000	
Max. Outflow Allowed:	333.30	l./s.
or:	0.3333	c.m./s

Ottawa IDF					*Allowable*		Using Pipe Orifice	
Time (min)	Intensity (mm/hr)	Inflow Site (c.m./s)	Inflow Roof (c.m./s)	Total Inflow	*Predevel. Allowed (c.m./s)*	*Storage Volume (c.m.)*	Outflow Orifice (c.m./s)	Storage Volume (c.m.)
10	154.300	0.9256	0.0136	0.9392	*0.3333*	*363.57*	0.2469	415.43
11	144.355	0.8659	0.0136	0.8796	*0.3333*	*360.55*	0.2469	417.60
12	135.837	0.8148	0.0136	0.8285	*0.3333*	*356.54*	0.2469	418.77
13	128.446	0.7705	0.0136	0.7841	*0.3333*	*351.66*	0.2469	419.08
14	121.962	0.7316	0.0136	0.7453	*0.3333*	*346.04*	0.2469	418.65
15	116.219	0.6972	0.0136	0.7108	*0.3333*	*339.76*	0.2469	417.55
20	95.049	0.5702	0.0136	0.5838	*0.3333*	*300.62*	0.2469	404.34
25	81.322	0.4878	0.0136	0.5015	*0.3333*	*252.25*	0.2469	381.91
30	71.591	0.4295	0.0136	0.4431	*0.3333*	*197.64*	0.2469	353.22
35	64.278	0.3856	0.0136	0.3992	*0.3333*	*138.45*	0.2469	319.97
40	58.550	0.3512	0.0136	0.3649	*0.3333*	*75.77*	0.2469	283.21
45	53.923	0.3235	0.0136	0.3371	*0.3333*	*10.29*	0.2469	243.67
50	50.094	0.3005	0.0136	0.3141	*0.3141*	*0.00*	0.2469	201.84
55	46.865	0.2811	0.0136	0.2948	*0.2948*	*0.00*	0.2469	158.11
60	44.100	0.2645	0.0136	0.2782	*0.2782*	*0.00*	0.2469	112.77
65	41.700	0.2501	0.0136	0.2638	*0.2638*	*0.00*	0.2469	66.03
70	39.595	0.2375	0.0136	0.2512	*0.2512*	*0.00*	0.2469	18.07
75	37.731	0.2263	0.0136	0.2400	*0.2400*	*0.00*	0.2400	0.00
80	36.067	0.2164	0.0136	0.2300	*0.2300*	*0.00*	0.2300	0.00
85	34.570	0.2074	0.0136	0.2210	*0.2210*	*0.00*	0.2210	0.00

Max. Vol. (cu.m.):	**363.57**	**419.08**

Roof, Proposed Building:

Storm:	**100**	**Yr**
Area:	4483	sq.m.
	0.4483	Ha
C:	1	(adjusted C*1.25)

Outflow rate:

based on 23 l/min/in of head

Roof Rise:	4	inches
	0.1016	m
Max. Outflow:	0.0136	(c.m./s)
	13.64	(l./s.)
or	0.1509	l/s/cm. of head per weir

No. of notches:	9	
Max. Volume:	150.10	cu. m.
Depth at weir:	10.04	cm.

(Note: Iterative Solution Used)

(N.A.R.	498.1	sq.m./notch)
(Flow	30.43	l/s/Ha)

Ottawa IDF

Time (min)	Intensity (mm/hr)	Inflow Roof (c.m./s)	Outflow (c.m./s)	Storage Volume (c.m.)
10	154.300	0.1921	0.0136	107.10
11	144.355	0.1798	0.0136	109.64
12	135.837	0.1692	0.0136	111.97
13	128.446	0.1600	0.0136	114.12
14	121.962	0.1519	0.0136	116.12
15	116.219	0.1447	0.0136	117.97
20	95.049	0.1184	0.0136	125.66
25	81.322	0.1013	0.0136	131.44
30	71.591	0.0892	0.0136	135.91
35	64.278	0.0800	0.0136	139.44
40	58.550	0.0729	0.0136	142.24
45	53.923	0.0671	0.0136	144.47
50	50.094	0.0624	0.0136	146.21
55	46.865	0.0584	0.0136	147.57
60	44.100	0.0549	0.0136	148.59
65	41.700	0.0519	0.0136	149.31
70	39.595	0.0493	0.0136	149.79
75	37.731	0.0470	0.0136	150.04
80	36.067	0.0449	0.0136	150.10
85	34.570	0.0430	0.0136	149.97

Max. Vol. (cu.m.):	**150.10**

Orifice Calculations:

To determine initial orifice size, where $Q = CA\sqrt[2]{2gH}$ and $A = \frac{Q}{C\sqrt[2]{2gH}}$

For 2 year flow:

Outflow Inv.:	70.03	m.
Water Level:	70.88	
C.L. Orifice El.:	70.22	
H =	0.66	m.
Q =	CA*SQRT(2gH)	
A =	Q/C*sqrt(2gH)	
Q allowable =	250.92	l./s.
or	0.2509	c.m./s.
C =	0.6	
A =	0.1164	sq.m.
Radius =	0.1925	m.
Orifice Diameter =	385.0	mm
Use	**300**	**mm pipe**

Storage Calculations:

Storage system capacity stage-storage table on following pages

APD Hawthorne GreenStorm
Stage Storage LW

Project Name	3149 Hawthorne Road									
Location	Ottawa, ON									
Date	November 3, 2021									
Chamber Model		GreenStorm-ST								
Number of Layers		2.0		Top Stone	0.15	m				
Height of Chambers		1.32	m	Bottom Stone	0.15	m				
Chamber Length		74.40		Perimeter Stone	0.15	m				
Chamber Width		4.00		Stone Qty	126.04	m^3				
Storage Void Ratio		0.96		Stone Void Ratio	40.00%					
System Perimeter		157.40								
System Area		321.21	m^2	Liner	Yes					
System Base Elevation		70.40	m							

Height of System		GreenStorm Volume		Stone Volume		Cumulative Storage Volume		Elevation		
mm	in	m^3	ft^3	m^3	ft^3	m^3	ft^3	m	ft	
1620	63.78	0.00	0.00	5.78	204.18	428.96	15,148.70	72.02	236.29	System Top
1575	62.01	0.00	0.00	3.21	113.43	423.18	14,944.51	71.98	236.14	
1550	61.02	0.00	0.00	3.21	113.43	419.97	14,831.08	71.95	236.06	
1525	60.04	0.00	0.00	3.21	113.43	416.76	14,717.65	71.93	235.97	
1500	59.06	0.00	0.00	3.21	113.43	413.55	14,604.21	71.90	235.89	
1475	58.07	14.28	504.46	0.47	16.68	410.33	14,490.78	71.88	235.81	
1425	56.10	7.14	252.23	0.24	8.34	395.58	13,969.64	71.83	235.65	Top of GreenStorm
1400	55.12	7.14	252.23	0.24	8.34	388.20	13,709.07	71.80	235.56	
1375	54.13	7.14	252.23	0.24	8.34	380.82	13,448.50	71.78	235.48	
1350	53.15	7.14	252.23	0.24	8.34	373.44	13,187.93	71.75	235.40	
1325	52.17	7.14	252.23	0.24	8.34	366.06	12,927.36	71.73	235.32	
1300	51.18	7.14	252.23	0.24	8.34	358.68	12,666.79	71.70	235.24	
1275	50.20	7.14	252.23	0.24	8.34	351.31	12,406.22	71.68	235.15	
1250	49.21	7.14	252.23	0.24	8.34	343.93	12,145.65	71.65	235.07	
1225	48.23	7.14	252.23	0.24	8.34	336.55	11,885.08	71.63	234.99	
1200	47.24	7.14	252.23	0.24	8.34	329.17	11,624.51	71.60	234.91	
1175	46.26	7.14	252.23	0.24	8.34	321.79	11,363.95	71.58	234.83	
1150	45.28	7.14	252.23	0.24	8.34	314.41	11,103.38	71.55	234.74	
1125	44.29	7.14	252.23	0.24	8.34	307.03	10,842.81	71.53	234.66	
1100	43.31	7.14	252.23	0.24	8.34	299.66	10,582.24	71.50	234.58	
1075	42.32	7.14	252.23	0.24	8.34	292.28	10,321.67	71.48	234.50	
1050	41.34	7.14	252.23	0.24	8.34	284.90	10,061.10	71.45	234.42	
1025	40.35	7.14	252.23	0.24	8.34	277.52	9,800.53	71.43	234.33	
1000	39.37	7.14	252.23	0.24	8.34	270.14	9,539.96	71.40	234.25	
975	38.39	7.14	252.23	0.24	8.34	262.76	9,279.39	71.38	234.17	
950	37.40	7.14	252.23	0.24	8.34	255.38	9,018.82	71.35	234.09	
925	36.42	7.14	252.23	0.24	8.34	248.01	8,758.25	71.33	234.01	
900	35.43	7.14	252.23	0.24	8.34	240.63	8,497.68	71.30	233.92	
875	34.45	7.14	252.23	0.24	8.34	233.25	8,237.11	71.28	233.84	
850	33.46	7.14	252.23	0.24	8.34	225.87	7,976.54	71.25	233.76	
825	32.48	7.14	252.23	0.24	8.34	218.49	7,715.98	71.23	233.68	
800	31.50	7.14	252.23	0.24	8.34	211.11	7,455.41	71.20	233.60	
775	30.51	7.14	252.23	0.24	8.34	203.74	7,194.84	71.18	233.51	
750	29.53	7.14	252.23	0.24	8.34	196.36	6,934.27	71.15	233.43	
725	28.54	7.14	252.23	0.24	8.34	188.98	6,673.70	71.13	233.35	
700	27.56	7.14	252.23	0.24	8.34	181.60	6,413.13	71.10	233.27	
675	26.57	7.14	252.23	0.24	8.34	174.22	6,152.56	71.08	233.19	
650	25.59	7.14	252.23	0.24	8.34	166.84	5,891.99	71.05	233.10	
625	24.61	7.14	252.23	0.24	8.34	159.46	5,631.42	71.03	233.02	
600	23.62	7.14	252.23	0.24	8.34	152.09	5,370.85	71.00	232.94	
575	22.64	7.14	252.23	0.24	8.34	144.71	5,110.28	70.98	232.86	
550	21.65	7.14	252.23	0.24	8.34	137.33	4,849.71	70.95	232.78	
525	20.67	7.14	252.23	0.24	8.34	129.95	4,589.14	70.93	232.69	
500	19.69	7.14	252.23	0.24	8.34	122.57	4,328.58	70.90	232.61	
475	18.70	7.14	252.23	0.24	8.34	115.19	4,068.01	70.88	232.53	
450	17.72	7.14	252.23	0.24	8.34	107.81	3,807.44	70.85	232.45	
425	16.73	7.14	252.23	0.24	8.34	100.44	3,546.87	70.83	232.37	
400	15.75	7.14	252.23	0.24	8.34	93.06	3,286.30	70.80	232.28	
375	14.76	7.14	252.23	0.24	8.34	85.68	3,025.73	70.78	232.20	
350	13.78	7.14	252.23	0.24	8.34	78.30	2,765.16	70.75	232.12	
325	12.80	7.14	252.23	0.24	8.34	70.92	2,504.59	70.73	232.04	
300	11.81	7.14	252.23	0.24	8.34	63.54	2,244.02	70.70	231.96	

Height of System		GreenStorm Volume		Stone Volume		Cumulative Storage Volume		Elevation		
mm	in	m^3	ft^3	m^3	ft^3	m^3	ft^3	m	ft	
275	10.83	7.14	252.23	0.24	8.34	56.17	1,983.45	70.68	231.87	
250	9.84	7.14	252.23	0.24	8.34	48.79	1,722.88	70.65	231.79	
225	8.86	7.14	252.23	0.24	8.34	41.41	1,462.31	70.63	231.71	
200	7.87	7.14	252.23	0.24	8.34	34.03	1,201.74	70.60	231.63	
175	6.89	7.14	252.23	0.24	8.34	26.65	941.17	70.58	231.55	
150	5.91	0.00	0.00	3.21	113.43	19.27	680.61	70.55	231.46	Bottom of GreenSto
125	4.92	0.00	0.00	3.21	113.43	16.06	567.17	70.53	231.38	
100	3.94	0.00	0.00	3.21	113.43	12.85	453.74	70.50	231.30	
75	2.95	0.00	0.00	3.21	113.43	9.64	340.30	70.48	231.22	
50	1.97	0.00	0.00	3.21	113.43	6.42	226.87	70.45	231.14	
25	0.98	0.00	0.00	3.21	113.43	3.21	113.43	70.43	231.05	
0	0.00	0.00	0.00	3.21	113.43	0.00	0.00	70.40	230.97	System Bottom

Appendix B: Domestic and Fire Flow Calculations

Domestic Flows:

Site Area:	2.608	Ha
Average Day Demand:	35000	l/Ha/day
Average Daily Demand:	91273.77	l/day
Max. Daily Demand	**1.06**	**l/s**
or	16.7	USGPM
Max. Hourly Demand Peaking Factor:	1.5	
Max. Hourly Demand:	**1.58**	**l/s**
or	25.1	USGPM

Fire Flows:

Building Area:

Basement	0.0	sq.m.	
First Floor	4100.0	sq.m.	
Second Floor	4483.0	sq.m.	
Third Floor	4483.0	sq.m.	
Fourth Floor	4483.0	sq.m.	
Total:	17549.0	sq.m.	
Largest Floor	4483	sq.m.	
25% Above Floor	1120.8	sq.m.	(vertical communications 1hr+ rating)
25% Below Floor	1120.8	sq.m.	(vertical communications 1hr+ rating)
Adjusted Floor Area:	**6724.5**	**sq.m.**	

Fire Flow Requirements:

Using *Fire Underwriters Survey*, "Water Supply for Public Fire Protection, 1999" method

Considering Adjusted Floor Area: **6724.5** sq.m.

Required Flow: =220C√A

Construction coefficient, C

wood frame	150%
masonry walls, combustible interiors	100%
non-combustible construction	80%
fire resistive construction	60%

Factor Used: 60%

Adjusted Required Flow: 10824.4 l/min.

Additional Adjustment Factors:

Contents/Occupancy Fire Hazard

non-combustible	75%		
limited combustible	85%		
combustible	100%		
free burning	115%		
rapid burning	125%		
	Factor Used:	100%	

Sprinkler Reduction

complete automatic protection	50%		
NFPA 13 system	70%		
water supply standard for hose & sprinkler	90%		
complete protection *and* very low hazard	90%		
	Factor Used:	70%	(50% maximum)

Proximity to Other Structures

separation 0 to 3m	125%		
3.1 to 10m	120%		
10.1 to 20m	115%		
20.1 to 30m	110%		
30.1 to 45m	105%		
over 45m	100%		
Factor Used, front:	100%		
Factor Used, left (north) side:	100%		
Factor Used, right (south) side:	100%		
Factor Used, rear:	115%		
Summed factor:	115%		
	Factor Used (175% max.):	115%	

	Final Adjusted Required Flow:	**8713.6**	**l/min.**
		145.227	l/s

Appendix C: Wastewater Flow Calculations

Area:	2.608	Ha
Flow	35000	l/Ha/day
or	91274	l/day
or	1.056	l/s
Peaking factor	6.8	(Light Industrial)
Infiltration:	0.28	l/s/Ha
	0.73019	l/s

Total Sanitary Flow:

Q= Eq. Flow*Peaking Factor+Infiltration

Q=	7.91	l/s

Appendix D: Site Servicing and Grading Plans

Provided for convenience and not for construction. Refer to full set of engineering drawings for construction purposes.