PROPOSED INDUSTRIAL DEVELOPMENT
Lot 28 ANDERSON BLVD,
UXBRIDGE, ONTARIO, L9P 0C7

STROMWATER MANAGEMENT REPROT

REV 0 – September 2024

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1. INTRODUCTION

Luban Engineering Ltd. has been retained by Architalcan Design Inc. (Project Manager) to prepare a Stormwater Management (SWM) Report for the proposed industrial facility at Lot 28 Anderson Boulevard in the Township of Uxbridge.

The property, located within the Uxbridge Industrial Park Subdivision, is approximately 0.83 hectares in size and faces Anderson Blvd to the west. Currently vacant, the site is intended for the construction of a single-storey industrial building, which will feature a parking lot and four loading spaces at the rear.

2. REFERENCED DOCUMENTS

The design of the SWM Facilities for this site has been conducted in accordance with:

- The Ministry of the Environment Stormwater Management Planning and Design Manual, March 2003
- Township of Uxbridge Design Criteria and Standard Details Drawings, 2013
- Toronto and Region Conservation Authority, Stormwater Management Criteria, 2012
- Uxbridge Industrial Park Revised SWM Analysis, by R.V. Anderson Associates Limited, June 29, 2004.
- Stormwater Management Report For Uxbridge Industrial, Phase 2, by Weslake Inc., October 2005.

3. DESIGN CRITERIA

It is understood the objectives of the SWM plan are to:

- Prevent any increases in flood risk potential;
- Maintain runoff volume, frequency, and duration from frequent storm events;
- Protect water quality;
- Preserve groundwater and baseflow characteristics;
- Prevent undesirable geomorphic changes in watercourses; and,
- Maintain an appropriate diversity of terrestrial and aquatic life and opportunities for human uses.

The following design criteria are applied to this project:

- Water Quality treatment is to be provided per MOE Guidelines.
- Erosion control is to be provided through the extended detention of the runoff from a 25mm rainfall for 24 to 48 hours,
- Control post-development peak flows to pre-development levels for all storms up to and including the 100 year storm (i.e., 2, 5, 10, 25, 50, and 100 year storms)
- The water balance should ensure that rainfall events of 10mm or less are infiltrated on-site. (Weslake Inc SWM report 2005)

4. STORMWATER MANAGEMENT

4.1. Existing Drainage Conditions

The existing project site is currently vacant. It primarily drains towards Anderson Boulevard via overland flow with an average grade ranging from 1% to 3%. Anderson Boulevard drains into an existing stormwater management (SWM) pond located southwest of the project site. This pond, designed by R.V. Anderson in 2003 for the industrial subdivision, provides quality and quantity control for the site with a maximum runoff coefficient of 0.67.

According to Shaheen & Peaker Limited's Geological Investigation dated March 9, 2001, the site consists of disturbed earth over sandy silt with traces of clay and gravel, all underlain by sandy silt till. Borehole 01-1, located on the subject lot, indicates a groundwater depth of 15 meters. Please refer to Appendix C for the Geotechnical Report.

Given the site's size, the Rational Method will be used to determine the allowable peak flows. The maximum allowable runoff coefficient for the site is 0.67, as specified in R.V. Anderson's SWM report (2004) for the SWM Pond. IDF curve parameters were obtained from the Town of Caledon Standards to determine storm intensity values. The allowable peak flow to the Uxbridge Industrial Subdivision SWM Pond for the site is detailed in Table 1 below.

Table 1

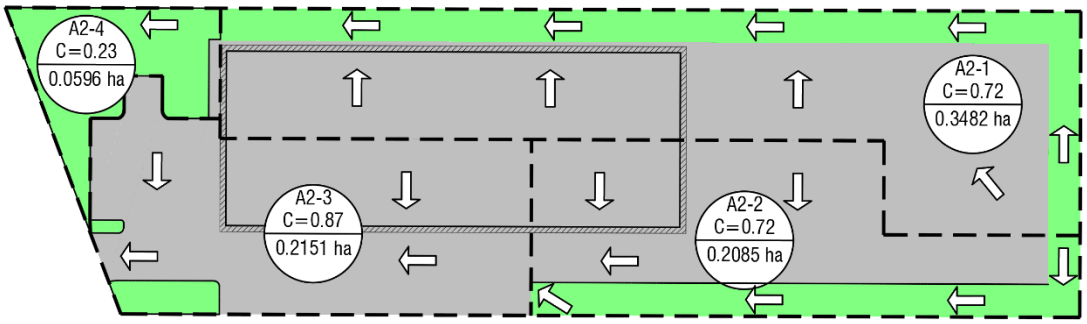
Pre-Development	2 year storm	5 year storm	10 year storm	25 year storm	50 year storm	100 year storm
Allowable Flow Rate (m^3/s)	0.111	0.145	0.170	0.199	0.221	0.241

4.2. Proposed Drainage Conditions

The post-development storm drainage for the project will generally maintain pre-development conditions. The paved areas to the north, east, and south of the proposed building will direct runoff overland to the storm sewer system, which is sized for a 5-year storm event. The landscaped areas to the west, north, and east of the building will be directed via a proposed swale towards Anderson Boulevard. Both the storm sewer and Anderson Boulevard will discharge into the existing SWM Pond designed for the Uxbridge Industrial Site, Phase 2.

In the event of a storm exceeding the 5-year event, runoff from the parking lot and building will overflow into rain gardens located to the west and east. These rain gardens are sized for quantity control of a 100-year storm event, as well as water balance functions. The east rain garden will drain into the parking lot, while the west rain garden will outlet to a side swale. Please refer to Appendix A for the Site Servicing Plan, Appendix B for the Site Grading Plan, and Figure 1 for the post-development drainage plan below.

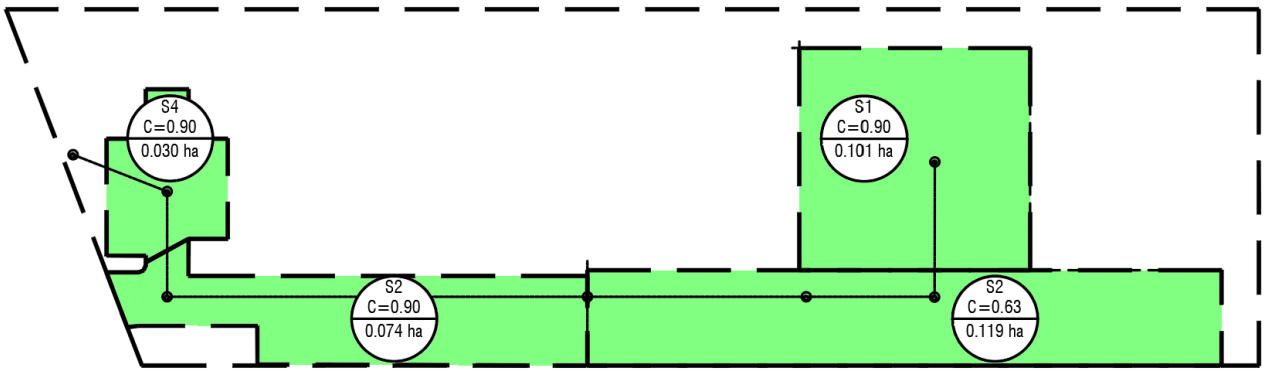
Figure 1 – Post development drainage area



4.3. Minor storm system

The site storm sewer system is designed to handle a 5-year storm event. An orifice will be installed at the control manhole STMH6 outlet to regulate the release rate, limiting it to the pre-development 5-year flow rate of 0.146 m³/s. The storm sewer drainage area is shown in Figure 2 below, and the storm sewer design details are provided in Appendix D.

Figure 2 - Storm Sewer Drainage Area



4.4. Quantity Control

The proposed development will increase the imperviousness of the site, resulting in higher post-development peak flows. It is essential to quantify this increase in stormwater runoff rates and implement measures to attenuate these increases. The calculated post-development runoff coefficient is 0.72, which exceeds the allowable runoff coefficient of 0.67.

To address the runoff coefficient exceeding 0.67, additional onsite quantity control measures, such as rain gardens, are proposed. These will work in conjunction with the existing SWM Pond located southwest of the site to manage the quantity control for the proposed development.

As shown in Figure 1, there is a small uncontrolled drainage area, A2-4. The release rate for this area is detailed in Table 2.

Table 2

Post-Development (un-controlled)	2 year storm	5 year storm	10 year storm	25 year storm	50 year storm	100 year storm
Release Rate (m^3/s)	0.003	0.004	0.004	0.005	0.005	0.006

The controlled drainage areas include A2-1, A2-2, and A2-3. Rain gardens are provided for areas A2-1 and A2-2. During a 5-year storm event, roof leaders and parking lot runoff will be directed to these rain gardens for storage and infiltration. An underground infiltration gallery is designed for A2-3 to serve the same purpose. The total required stormwater management quantity control storage volume is detailed in Appendix D, with a required volume of 56.7 m³. The combined capacity of the rain gardens and the underground infiltration gallery is 83.1 m³. The release rate for the controlled drainage areas is shown in Table 3, and the total site release rate is shown in Table 4.

Table 3

Post-Development (controlled)	2 year storm	5 year storm	10 year storm	25 year storm	50 year storm	100 year storm
Release Rate (m^3/s)	0.013	0.033	0.052	0.092	0.141	0.179

Table 4

Post-Development	2 year storm	5 year storm	10 year storm	25 year storm	50 year storm	100 year storm
Total Release Rate (m^3/s)	0.016	0.036	0.056	0.097	0.146	0.185

With the on-site storage facility, the final site release rate (Table 4) is lower than the pre-development site release rate (Table 1).

4.5. Stormwater Quality Control

According to the MECP "Stormwater Management Planning and Design Manual, March 2003," the development's stormwater quality control objective is to provide Enhanced Protection quality control.

The driveways and impervious surfaces of the development pose a risk to stormwater quality due to the accumulation of grit, salt, sand, and oils. The quality control objective for the site is to treat stormwater to meet the MECP's Enhanced Protection standard, which requires a Total Suspended Solids (TSS) removal rate of at least 80%.

In the post-development condition, the site's impervious level is 75%. According to the MOE Manual, Table 3.2, the required storage volume for this impervious level is 40 m³/ha. Therefore, the site will require 40 x 0.75 = 30 m³. The rain gardens and underground infiltration gallery provide 83.1 m³ of storage, which, in addition to the clear stone filter and the industrial subdivision SWM pond, meets the MECP's Enhanced Protection Standard of at least 80% sediment removal.

4.6. Water Balance

Since the post-development condition will increase the site's imperviousness, considerations were given to groundwater recharge. According to the Weslake Inc. SWM report (2005), the water balance should ensure that rainfall events of 10 mm or less are infiltrated on-site.

- For drainage area A2-1, 10 mm x 0.35 ha = 3.5 m³ of storage is required for infiltration.
- For drainage area A2-2, 10 mm x 0.21 ha = 2.1 m³ of storage is required for infiltration.
- For drainage area A2-3, 10 mm x 0.27 ha = 2.7 m³ of storage is required for infiltration.

The site will require a total of 8.3 m³ of storage for infiltration. The proposed rain gardens and underground infiltration gallery provide 83.1 m³, which exceeds the required amount.

4.7. On-site stormwater management facility

The total site area is 0.83 ha. In the post-development condition, the runoff coefficient is 0.72, and the impervious surface level is 75%. The site incorporates the following stormwater management facilities, as summarized in Table 5.

- In drainage area A2-1, a rain garden with dimensions of 130 m x 2.0 m x 0.15 m (depth) provides 35 m³ of storage.
- In drainage area A2-2, a rain garden with dimensions of 70 m x 2.0 m x 0.15 m (depth) provides 21 m³ of storage.
- In drainage area A2-3, an underground infiltration gallery with dimensions of 14.5 m x 3.5 m x 1.35 m (depth) provides 27.4 m³ of storage.

Table 5

	Required		Provided	
Quantity Control	100yr vs 100yr	56.7 m3	Rain Gardens & Infiltration Gallery	87.4 m3
Quality Control	Enhanced 80% removal of total suspended solids.	33.3 m3		
Water Balance	runoff from a 10mm storm is detained for 24 hours	83.1 m3		

According to the Hydrogeological Report by King EPCM dated June 30 2024, Appendix G, the soil percolation rate of 42.6 mm/. The infiltration gallery's drainage time is calculated as follows:

$$\text{Drainage time} = 1.35\ \text{m} \times 1000\ \text{mm/m} \times 42.6\ \text{min/cm} = 32\ \text{hr.}$$

The infiltration gallery's invert is 2.4 m below grade. According to Groundwater Impact Assessment by Jagger Hims Limited dated March 2001 (Appendix H) and Geotechnical Investigation Report by King EPCM dated June 21, 2024, (Appendix I) , the groundwater level is recorded at 15 m below grade, meaning the infiltration gallery is 12.6 m above the groundwater table, which meets the required conditions.

4.8. Inspection and Maintenance

4.8.1. Rain Garden

Maintenance of disconnected downspouts and rain garden for stormwater management will generally be no different than maintenance of lawns or landscaped areas. A maintenance agreement with property owners or managers may be required to ensure that downspouts remain disconnected, and the pervious area remains pervious. For long-term efficacy, the pervious area should be protected from compaction. One method is to plant shrubs or trees along the perimeter of the pervious area to prevent traffic. On commercial sites, the pervious area should not be an area with high foot traffic. If ponding water for longer than 24 hours occurs, the pervious area should be dethatched and aerated. If ponding persists, regrading or tilling to reverse compaction and/or addition of compost to improve soil moisture retention may be required.

4.8.2. Infiltration Gallery

As with all infiltration practices, these facilities require regular inspection to ensure they continue to function. Maintenance typically consists of cleaning out leaves, debris and accumulated sediment caught in pretreatment devices, inlets and outlets annually or as needed. Inspection via an monitoring well should be performed to ensure the facility drains within the maximum acceptable length of time (typically 72 hours) at least annually and following every major storm event (>25 mm). If the time required to fully drain exceeds 72 hours, drain via pumping and clean out the perforated pipe underdrain, if present. If slow drainage persists, the system may need removal and replacement of granular material and/or geotextile fabric (PDEP, 2006). The expected lifespan of infiltration practices is not well understood; however, it can be expected that it will vary depending on pretreatment practice maintenance frequency, and the sediment texture and load coming from the catchment.

4.9. Sediment & Erosion Control

During construction, earth grading and excavation will create the potential for soil erosion and sedimentation. It is imperative that effective environmental and sedimentation controls are in place and maintained throughout the duration of construction activities to ensure the stormwater runoff's quality. The Erosion Protection Plan can be seen in Appendix C.

Therefore, the following recommendations shall be implemented and maintained during construction to achieve acceptable stormwater runoff quality:

- Installation of silt fence along the entire perimeter of the site to reduce sediment migration onto surrounding properties;
- Installation of a construction entrance mat to minimize transportation of sediment onto roadways;
- Restoration of exposed surfaces with vegetative and non-vegetative material as soon as construction schedules permit. The duration in which surfaces are disturbed/exposed shall not exceed 30 days;

- Reduce stormwater drainage velocities where possible; and
- Minimize the amount of existing vegetation removed.

5. CONCLUSIONS

The site's runoff coefficient of 0.72 exceeds the allowable value of 0.67, as specified in R.V. Anderson Associates Limited's stormwater management report. However, the on-site stormwater management facility provides 83.1 m³ of storage, which is sufficient for quantity control, quality control, and water balance management.

Yours truly,

Feng Shi, P.Eng.
Principal Engineer

APPENDIX

A. Site Servicing Plan
B. Grading Plan
C. Sediment & Erosion Control Plan
D. Storm Sewer Design Sheet
E. Stormwater Quantity control required storage calculations
F. Orifice calculation
G. Hydrogeological Report
H. Groundwater Impact Assessment
I. Geotechnical Investigation Report

A. Site Servicing Plan

B. Grading Plan

C. Sediment & Erosion Control Plan

D. Storm Sewer Design Sheet

SITE STORM SEWER DESIGN (5-YEAR)

PROJECT NAME: POPOSED INDUSTRIAL BUILDING, 26 ANDERSON BLVD, UXBRIDGE, ON L9P 0C7

SHEET No.:
JOB No.: 2023-S308
DATE: 2024-09-01
CONSULTANT: LUBAN LTD
AMANDA NUMBER:

Design Return Period = 5 Years, n = 0.013

Rainfall Intensity "I" = A/ $(t+B)^{c}$
A = 681
B = 3.8
C = 0.754
Starting "t" = 10 min

Location			Runoff			Rainfall Intensity	Tc	Cumm Flow	Pipe Data			Full Capacity	Full Velocity	Qact/Qcap	Time (Entry 10 min.)	
Drainage Area	Manhole No.		Area (A)	(R)	(A x R)	I			Length	Diameter	Slope				Sect.	Accum
	From	To	(ha)			(mm/hr)	(min)	(m^3/s)	(m)	(mm)	(%)	(m^3/s)	(m/s)		(min.)	(min.)
S1	CB1	STMH1	0.101	0.90	0.091	94	10	0.024	19.0	250	2.00%	0.08	1.71	28%	0.18	10.18
	STMH1	STMH2				93	10.18	0.024	17.9	300	1.00%	0.10	1.37	24%	0.22	10.40
	STMH2	CBMH3				92	10.40	0.024	30.7	300	1.00%	0.10	1.37	24%	0.37	10.78
S2	CBMH3	CBMH4	0.119	0.63	0.075	90	10.78	0.043	59.0	300	2.00%	0.14	1.93	31%	0.51	11.29
S3	CBMH4	CBMH5	0.074	0.90	0.067	88	11.29	0.059	14.8	300	2.00%	0.14	1.93	43%	0.13	11.41
S4	CBMH5	STMH6	0.030	0.90	0.027	87	11.41	0.065	14.2	300	2.00%	0.14	1.93	48%	0.12	11.54

E. Stormwater Quantity control required storage calculations

--> BE SURE TO CHECK PRINT PREVIEW AND UPDATE HEADER AND FOOTER AS REQUIRED

	TIME minutes	2 Year INTENSITY mm/hr	Q 2 Year m^3/s	Control Q (pre) m^3/s	Q Stored m^3/s	STORAGE m^3
Tc =>	5.0	102.6	0.167	0.013	0.154	46.2
	10.0	72.0	0.117	0.013	0.104	62.5
	15.0	56.6	0.092	0.013	0.079	71.1
	20.0	47.1	0.077	0.013	0.064	76.2
	25.0	40.6	0.066	0.013	0.053	79.4
	30.0	35.9	0.059	0.013	0.045	81.4
	35.0	32.3	0.053	0.013	0.039	82.6
	40.0	29.4	0.048	0.013	0.035	83.1
	45.0	27.0	0.044	0.013	0.031	**83.1**
	50.0	25.1	0.041	0.013	0.028	82.7
	55.0	23.4	0.038	0.013	0.025	82.1
	60.0	22.0	0.036	0.013	0.023	81.2
	65.0	20.8	0.034	0.013	0.021	80.0

Pre-development
Return Period 2 Year
Intensity
i = a / (b + T)^b (mm/hr)
where,
a = 531
b = 3.5
c = 0.767
Q = 0.103

Post-Development
Return Period 2 Year
Intensity
i = a / (b + T)^b (mm/hr)
where,
a = 531
b = 3.5
c = 0.767
Q = 0.117

5 Hillcourt Ave, East Unit
Site - Controlled

Area (ha) 0.772

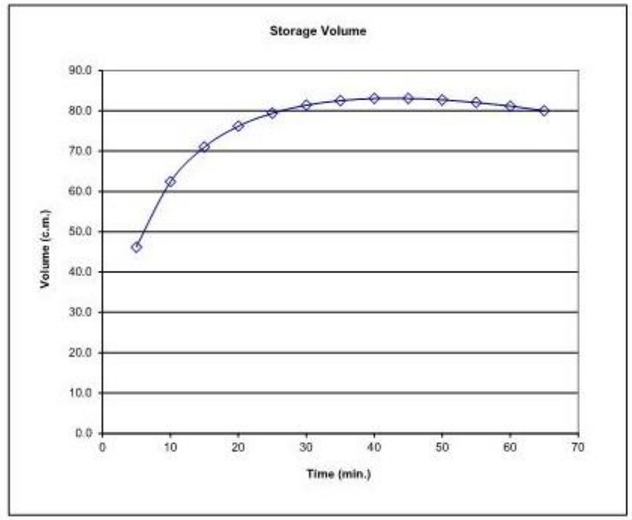
Pre-Development

Area (ha)	0.772
$C_{composite}$	0.67
Tc (min)	10.00
Intensity mm/hr	72.0
Qp (m^3/s)	0.103
Qc	0.013

Post-Development

C	0.76
Time Incr.	5.0

DO NOT ERASE
Max.Storage
83.1



--> BE SURE TO CHECK PRINT PREVIEW AND UPDATE HEADER AND FOOTER AS REQUIRED

	TIME minutes	5 Year INTENSITY mm/hr	Q 5 Year m^3/s	Control Q (pre) m^3/s	Q Stored m^3/s	STORAGE m^3
Tc =>	5.0	131.9	0.215	0.033	0.182	54.7
	10.0	94.0	0.153	0.033	0.121	72.4
	15.0	74.5	0.121	0.033	0.089	79.9
	20.0	62.4	0.102	0.033	0.069	82.8
	25.0	54.0	0.088	0.033	0.055	**83.1**
	30.0	47.9	0.078	0.033	0.045	81.7
	35.0	43.1	0.070	0.033	0.038	79.1
	40.0	39.4	0.064	0.033	0.032	75.7
	45.0	36.3	0.059	0.033	0.027	71.6
	50.0	33.7	0.055	0.033	0.022	67.0
	55.0	31.5	0.051	0.033	0.019	61.9
	60.0	29.7	0.048	0.033	0.016	56.5
	65.0	28.0	0.046	0.033	0.013	50.8

Pre-development
Return Period 5 Year
Intensity
i = a / (b + T)^b (mm/hr)
where,
a = 681
b = 3.8
c = 0.754
Q = 0.135

Post-Development
Return Period 5 Year
Intensity
i = a / (b + T)^b (mm/hr)
where,
a = 681
b = 4
c = 1
Q = 0.153

5 Hillcourt Ave, East Unit
Site - Controlled

Area (ha) 0.772

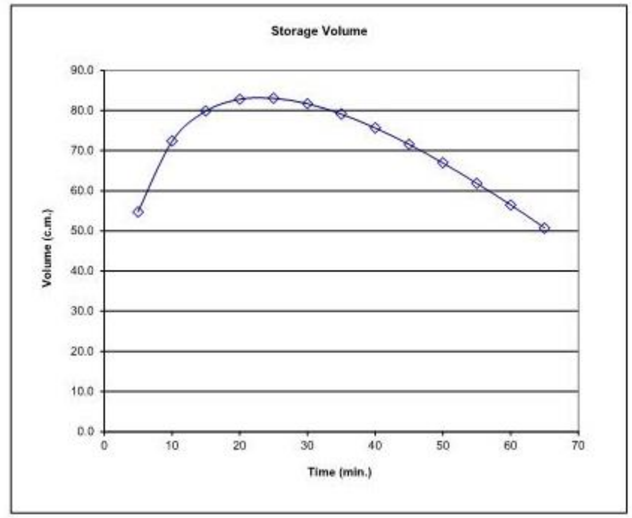
Pre-Development

Area (ha)	0.772
$C_{composite}$	0.67
Tc (min)	10.00
Intensity mm/hr	94.0
Qp (m^3/s)	0.135
Qc	0.033

Post-Development

C	0.76
Time Incr.	5.0

DO NOT ERASE
Max.Storage
83.1



--> BE SURE TO CHECK PRINT PREVIEW AND UPDATE HEADER AND FOOTER AS REQUIRED

	TIME minutes	10 Year INTENSITY mm/hr	Q 10 Year m^3/s	Control Q (pre) m^3/s	Q Stored m^3/s	STORAGE m^3
Tc =>	5.0	150.5	0.245	0.052	0.193	58.0
	10.0	110.1	0.180	0.052	0.128	76.5
	15.0	88.3	0.144	0.052	0.092	82.7
	20.0	74.4	0.121	0.052	0.069	**83.1**
	25.0	64.6	0.105	0.052	0.053	80.1
	30.0	57.4	0.094	0.052	0.042	74.9
	35.0	51.8	0.085	0.052	0.033	68.3
	40.0	47.3	0.077	0.052	0.025	60.5
	45.0	43.7	0.071	0.052	0.019	51.8
	50.0	40.6	0.066	0.052	0.014	42.5
	55.0	38.0	0.062	0.052	0.010	32.7
	60.0	35.7	0.058	0.052	0.006	22.4
	65.0	33.7	0.055	0.052	0.003	11.7

5 Hillcourt Ave, East Unit

Site - Controlled

Area (ha)	0.772

Pre-Development

Area (ha)	0.772
$C_{composite}$	0.67
Tc (min)	10.00
Intensity mm/hr	110.1
Qp (m^3/s)	0.158
Qc	0.052

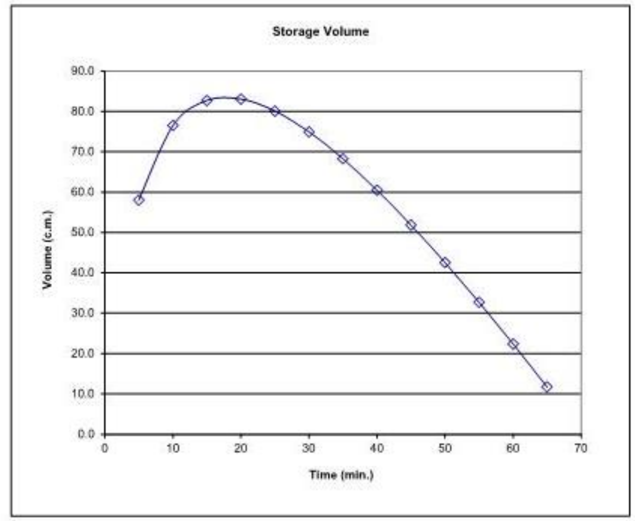
Post-Development

C	0.76
Time Incr.	5.0

DO NOT ERASE
Max.Storage
83.1

Pre-development
Return Period 10 Year
Intensity
i = a / (b + T)^b (mm/hr)
where,
a = 877
b = 5.0
c = 0.767
Q = 0.158

Post-Development
Return Period 10 Year
Intensity
i = a / (b + T)^b (mm/hr)
where,
a = 877
b = 5.0
c = 0.767
Q = 0.180



--> BE SURE TO CHECK PRINT PREVIEW AND UPDATE HEADER AND FOOTER AS REQUIRED

	TIME minutes	25 Year INTENSITY mm/hr	Q 25 Year m^3/s	Control Q (pre) m^3/s	Q Stored m^3/s	STORAGE m^3
Tc =>	5.0	174.9	0.314	0.092	0.221	66.4
	10.0	128.3	0.230	0.092	0.138	82.7
	15.0	103.0	0.185	0.092	0.092	**83.1**
	20.0	86.8	0.156	0.092	0.063	76.1
	25.0	75.5	0.135	0.092	0.043	64.7
	30.0	67.1	0.120	0.092	0.028	50.5
	35.0	60.6	0.109	0.092	0.016	34.4
	40.0	55.4	0.099	0.092	0.007	16.9
	45.0	51.1	0.092	0.092	-0.001	-1.8
	50.0	47.5	0.085	0.092	-0.007	-21.3
	55.0	44.5	0.080	0.092	-0.013	-41.5
	60.0	41.8	0.075	0.092	-0.017	-62.4
	65.0	39.5	0.071	0.092	-0.021	-83.7

Pre-development
Return Period 25 Year
Intensity
i = a / (b + T)^b (mm/hr)
where,
a = 1016
b = 5.0
c = 0.764
Q = 0.184

Post-Development
Return Period 25 Year
Intensity
i = a / (b + T)^b (mm/hr)
where,
a = 1016
b = 5.0
c = 0.764
Q = 0.209

5 Hillcourt Ave, East Unit
Site - Controlled

Area (ha) 0.772

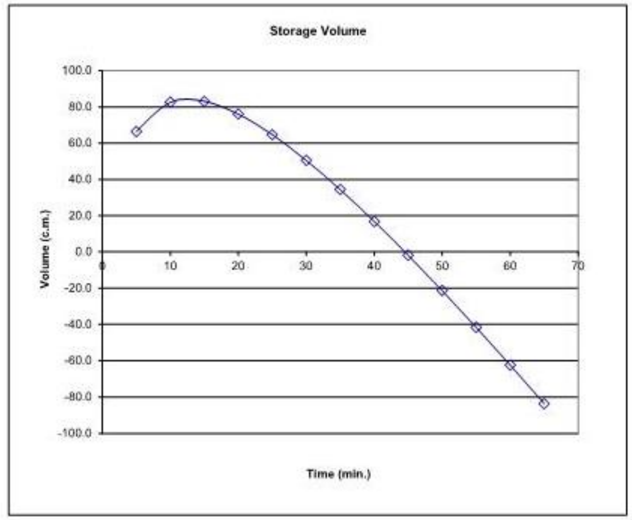
Pre-Development

Area (ha)	0.772
$C_{composite}$	0.67
Tc (min)	10.00
Intensity mm/hr	128.3
Qp (m^3/s)	0.184
Qc	0.092

Post-Development

C	0.76
Time Incr.	5.0

DO NOT ERASE
Max.Storage
83.1



--> BE SURE TO CHECK PRINT PREVIEW AND UPDATE HEADER AND FOOTER AS REQUIRED

	TIME minutes	50 Year INTENSITY mm/hr	Q 50 Year m^3/s	Control Q (pre) m^3/s	Q Stored m^3/s	STORAGE m^3
Tc =>	5.0	195.0	0.381	0.141	0.241	72.2
	10.0	142.7	0.279	0.141	0.139	**83.1**
	15.0	114.4	0.224	0.141	0.083	74.8
	20.0	96.4	0.189	0.141	0.048	57.4
	25.0	83.8	0.164	0.141	0.023	34.8
	30.0	74.4	0.146	0.141	0.005	8.8
	35.0	67.2	0.131	0.141	-0.009	-19.6
	40.0	61.3	0.120	0.141	-0.021	-49.6
	45.0	56.6	0.111	0.141	-0.030	-81.0
	50.0	52.6	0.103	0.141	-0.038	-113.5
	55.0	49.2	0.096	0.141	-0.044	-146.8
	60.0	46.3	0.091	0.141	-0.050	-180.8
	65.0	43.7	0.086	0.141	-0.055	-215.4

5 Hillcourt Ave, East Unit
Site - Controlled

Area (ha) 0.772

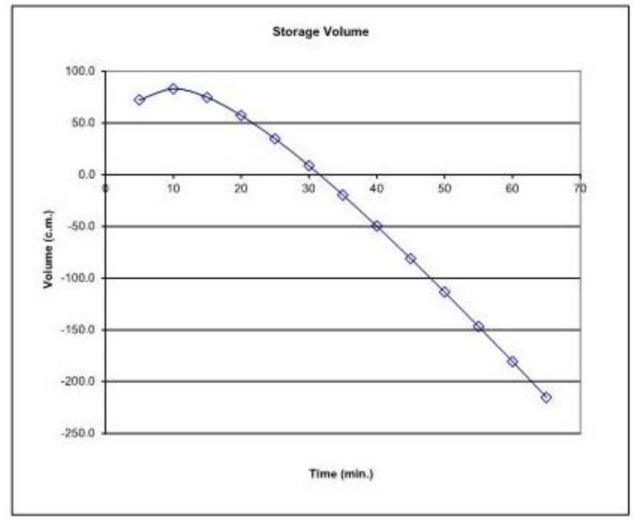
Pre-Development

Area (ha)	0.772
$C_{composite}$	0.67
Tc (min)	10.00
Intensity mm/hr	142.7
Qp (m^3/s)	0.205
Qc	0.141

Post-Development

C	0.76
Time Incr.	5.0

DO NOT ERASE
Max.Storage
83.1



Pre-development
Return Period 50 Year
Intensity
i = a / (b + T)^b (mm/hr)
where,
a = 1137
b = 5.0
c = 0.767
Q = 0.205

Post-Development
Return Period 50 Year
Intensity
i = a / (b + T)^b (mm/hr)
where,
a = 1137
b = 5.0
c = 0.767
Q = 0.233

--> BE SURE TO CHECK PRINT PREVIEW AND UPDATE HEADER AND FOOTER AS REQUIRED

	TIME minutes	100 Year INTENSITY mm/hr	Q 100 Year m^3/s	Control Q (pre) m^3/s	Q Stored m^3/s	STORAGE m^3
Tc =>	5.0	208.1	0.424	0.179	0.245	73.5
	10.0	155.8	0.318	0.179	0.139	**83.1**
	15.0	126.3	0.257	0.179	0.078	70.5
	20.0	107.1	0.218	0.179	0.039	47.1
	25.0	93.5	0.191	0.179	0.012	17.3
	30.0	83.3	0.170	0.179	-0.009	-16.7
	35.0	75.4	0.154	0.179	-0.025	-53.5
	40.0	69.0	0.141	0.179	-0.039	-92.5
	45.0	63.7	0.130	0.179	-0.049	-133.2
	50.0	59.2	0.121	0.179	-0.058	-175.1
	55.0	55.5	0.113	0.179	-0.066	-218.0
	60.0	52.2	0.106	0.179	-0.073	-261.9
	65.0	49.3	0.101	0.179	-0.079	-306.4

5 Hillcourt Ave, East Unit
Site - Controlled

Area (ha) 0.772

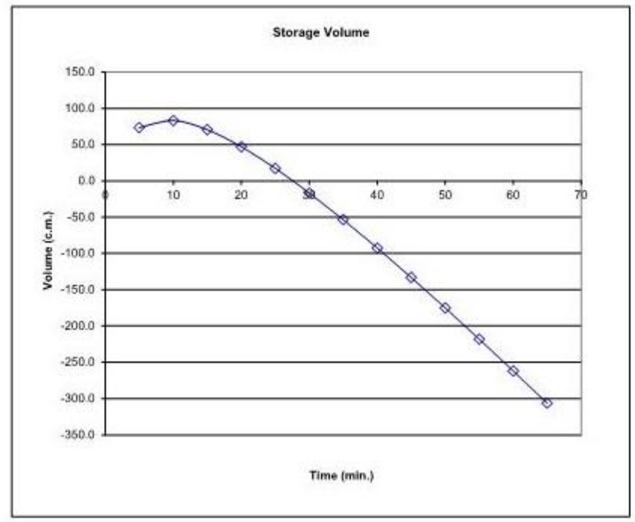
Pre-Development

Area (ha)	0.772
$C_{composite}$	0.67
Tc (min)	10.00
Intensity mm/hr	155.8
Qp (m³/s)	0.224
Qc	0.179

Post-Development

C	0.76
Time Incr.	5.0

DO NOT ERASE
Max.Storage
83.1



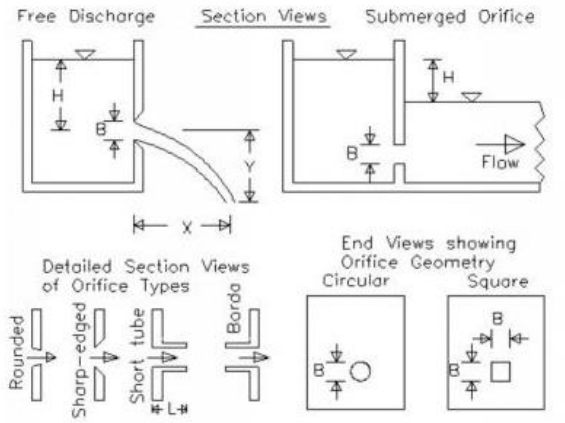
Pre-development
Return Period 100 Year
Intensity
i = a / (b + T)^b (mm/hr)
where,
a = 1325
b = 6.0
c = 0.772
Q = 0.224

Post-Development
Return Period 100 Year
Intensity
i = a / (b + T)^b (mm/hr)
where,
a = 1325
b = 6.0
c = 0.772
Q = 0.254

F. Orifice calculation

Orifice Calculation

Control Flow	0.145	m^3/s
Orifice Size (Diameter)	0.180	m
Orifice area	0.025	m^2
Orifice Discharge Coefficient	0.6	
H	4.510	m
Discharge Flow	0.144	m^3/s



Either the free discharge orifice or the submerged orifice can be modeled. The equations are the same for both cases. A drop-down menu allows you to select circular or square orifice geometry. For a circular orifice, B is orifice diameter. For a square orifice, B is orifice width and height. A drop-down menu allows you to select an orifice type. Discharge coefficients for the four orifice types are built into the calculation. User-defined discharge coefficients are permitted but be sure that $C_o = C_c C_v$. The calculation only checks to see if inputs are positive; we do not check to see if $C_o = C_c C_v$.

Built-in values for orifice discharge coefficients

	Rounded	Sharp-edged	Short tube	Borda
C_c	1.0	0.62	1.0	0.52
C_v	0.98	0.98	0.8	0.98

The short tube C values are valid for L ~ 2.5 B.
The Borda type is also known as a re-entrant since it juts into the tank.
C values were obtained from Dally et al. (1993) for circular orifices. However, similar values for square orifices are given in Davis (1942), so our calculation uses the Dally values for both circular and square orifices.

Equations. From Dally et al. (1993) and Streeter et al. (1985)
The tank discharge equations are valid for: H > 1.25 m (4.17 ft) and B > 2.54 cm (1 inch). Values will be computed even if H or B is too small, but a warning message will appear.

$$V = C_v\sqrt{2gH} \quad and \quad V = X\sqrt{\frac{g}{2Y}} \quad and \quad A = \frac{\pi}{4}B^2 \ or \ A = B^2$$

$$Q = C_c AV \quad and \quad Q = C_o A\sqrt{2gH}$$

where: A = orifice area, B = orifice diameter or width and height, C_c = contraction coefficient, C_v = velocity coefficient, C_o = orifice coefficient = $C_c C_v$, g = acceleration due to gravity = 32.174 ft/s^2 or 9.8066 m/s^2, H = head defined in diagrams above, Q = flow rate (discharge), V = horizontal velocity through orifice, X = horizontal trajectory, Y = vertical trajectory.

G. Hydrogeological Report

H. Groundwater Impact Assessment

I. Geotechnical Investigation Report