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March 19, 2021

Project Number 109-258-19

STORMWATER MANAGEMENT REPORT

Regarding:

1 Reid Dr.
Barrie, Ontario

Prepared on behalf of:

Maplereid Properties Inc.

By:

GERRITS ENGINEERING LIMITED
222 Mapleview Dr. W., Suite 300
Barrie, ON L4N 9E7

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1. Introduction

Gerrits Engineering Ltd. (GEL) has been retained by Maplereid Properties Inc. (Client) to prepare a Stormwater Management Brief for the proposed industrial facility located at 1 Reid Dr., in the City of Barrie (City), County of Simcoe. This report will be submitted to the City and other required agencies in support of a Site Plan Application for the subject land.

The subject land is approximately 2.13 ha in area, and it is proposed to construct a 3,982 sq.m. industrial building with a future addition of 2,967 sq.m. footprint on the site. This report will address the detailed design and stormwater management controls implemented to provide enhanced level of treatment for quality control, mitigate the runoff to existing development conditions, maintain or enhance the infiltration of stormwater to improve the watershed water balance, and provide phosphorous reduction efforts.

1.1. Supporting & Reference Documents

The following documents have been referenced in the preparation of this report:

- Ministry of the Environment, Stormwater Management Planning and Design Manual, March 2003
- Ontario Building Code 2012 (O.B.C.)
- City of Barrie, Storm Drainage and Stormwater Management Policies and Design Guidelines, October 2020
- NVCA Stormwater Technical Guide, December 2013

1.2. Subject Property

The Subject Lands are about 2.13 Ha in area and is rectangular in shape. It is legally described as Part 5 of Plan 51R-35959, west of Veterans Drive, in the City of Barrie. The site is vacant in its existing condition and consists mostly of open area. The topographical information is based on survey completed by Rudy Mak Surveying Ltd.

Figure 1 - Subject Property

2. Storm Drainage and Stormwater Management

A key component of the Development is the need to address environmental and related Stormwater Management (SWM) issues. These are examined in a framework aimed at meeting the City of Barrie, Nottawasaga Valley Conservation Authority (NVCA), and MECP requirements. SWM parameters have evolved from an understanding of the location and sensitivity of the site's natural systems.

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

- Protect life and property from flooding and erosion.
- Maintain water quality for ecological integrity, recreational opportunities etc.
- Protect and maintain groundwater flow regime(s).
- Protect aquatic and fishery communities and habitats.
- Maintain and protect significant natural features.
- Protect and provide diverse recreational opportunities that are in harmony with the environment.

2.1. Existing Drainage Conditions

Based on the Storm Drainage Plan provided by the City of Barrie, the property is shown as being a part of two (2) sub-catchment areas. One area drains overland in a westward direction towards Reid Dr., while the other area drains in an eastern direction towards a large drainage channel along the east side of the property. Both drainage areas ultimately discharge to a municipal stormwater management pond located southwest of the subject property. The subject property has been allocated a runoff coefficient of 0.75 as per the City of Barrie Storm Drainage map STM-2 of Contract 2003-19. Further, discussions with City Staff have indicated that if the proposed site meets the runoff coefficients as detailed on the aforementioned plan, the required quantity and quality controls have already been accounted for in the downstream systems and sized accordingly.

Given the size of the site, the Modified Rational Method will be used to determine the allowable release rates:

Catchment Area = 1.06 ha (west)
= 1.06 ha (east)
Runoff Coefficient = 0.75
Time of Concentration (t_c) = 10 minutes
Rainfall Intensity = City of Barrie WPCC IDF Curve Parameters
Peaking Factor (C_i) = 1.00 (2-10 year design periods)
= 1.10 (25 year design period)
= 1.20 (50 year design period)
= 1.25 (100 year design period)
Peak Runoff Rate (Q_r) = $C \times I \times A \times 360^{-1}$

Applying the above results in the following release rates:

Table 1: Subject Site Allowable Release Rate

	2 year (m^3/s)	5 year (m^3/s)	10 year (m^3/s)	25 year (m^3/s)	50 year (m^3/s)	100 year (m^3/s)
Drainage to the East	0.18	0.24	0.28	0.36	0.44	0.50
Drainage to Reid Dr.	0.18	0.24	0.28	0.36	0.44	0.50

2.2. Proposed Drainage Conditions

Based on a review of Simcoe County Soils Mapping the subject site is underlain Dundonald sandy loam. This soil falls into the hydrologic soil group “AB”. The proposed Development will increase the imperviousness of the site and it is important to quantify this change to determine quantity control requirements. The typical runoff coefficients as detailed in the City of Barrie Stormwater Management Policies were referenced to determine the post-development weighted runoff coefficient, including external drainage areas.

2.2.1. Drainage to the East

Asphalt Area	=	4,824 m^2	R	=	0.95	AR	=	4,582.8
Grass Area	=	2,071 m^2	R	=	0.10	AR	=	207.1
					Total	AR	=	4,789.9

Site Area = 6,895 m^2 AR = 4,790 m^2 Weighted R = 0.69

The anticipated post-development runoff coefficient of 0.69 is reasonable for a development of this type. The Modified Rational Method will be used to determine the proposed release rates.

2.2.1. Drainage to Reid Dr.

Asphalt Area	=	5,449 m^2	R	=	0.95	AR	=	5,176.6
Building Area	=	6,933 m^2	R	=	0.95	AR	=	6,586.4
Concrete Area	=	143 m^2	R	=	0.95	AR	=	135.9
Grass Area	=	1,842 m^2	R	=	0.10	AR	=	184.2
					Total	AR	=	12,083.1

Site Area = 14,367 m^2 AR = 12,083 m^2 Weighted R = 0.84

The anticipated post-development runoff coefficient of 0.84 is reasonable for a development of this type. The Modified Rational Method will be used to determine the proposed release rates.

Catchment Area = 1.44 ha (west)
= 0.69 ha (east)
Runoff Coefficient = 0.84 (west)
= 0.69 (east)
Time of Concentration (t_c) = 10 minutes
Rainfall Intensity = City of Barrie WPCC IDF Curve Parameters
Peaking Factor (C_i) = 1.00 (2-10 year design periods)
= 1.10 (25 year design period)
= 1.20 (50 year design period)
= 1.25 (100 year design period)
Peak Runoff Rate (Q_r) = $C \times I \times A \times 360^{-1}$

Applying the above results in the following release rates:

Table 2: Post Development Uncontrolled Release Rate

	2 year (m^3/s)	5 year (m^3/s)	10 year (m^3/s)	25 year (m^3/s)	50 year (m^3/s)	100 year (m^3/s)
Drainage to the East	0.09	0.11	0.13	0.17	0.21	0.24
Drainage to Reid Dr.	0.30	0.40	0.46	0.59	0.72	0.82

In reviewing the above, it is noted that the anticipated release rates for the Drainage to the East, is less than the allowable release rates. Therefore, no additional quantity controls are required for this area. When reviewing the Drainage to Reid Drive, it is noted that the anticipated release rates, exceed the allowable release rates. Therefore, additional quantity controls are required for the Drainage to Reid Dr. area.

2.3. Quantity Control

The development of this Site increases the existing stormwater runoff rate above that of the allowable release rate. Therefore, site quantity controls have been designed to closely approximate the allowable release rates to Reid Dr. Stormwater quantity control will be provided through surface storage ponding at the front and rear of the building, in addition to rooftop storage. Release from the subject site will be controlled by an outlet pipe sized using the following equation:

$Q = cA\sqrt{2gh}$

Q = allowable release rate
A = orifice area = 0.110 m^2 (375mm dia)
c = orifice coefficient = 0.80
g = gravitational constant = 9.81m/s^2
h = high water level over center of orifice

Applying the above equation, we find that a 375mm orifice pipe will restrict the flows such that the controlled and uncontrolled stormwater flow from the site is at a rate of less than the allowable release rates for all storm events. The Pre- and Post Development calculated release rates for the proposed development are detailed in Table 6 below. Calculations have been included within Appendix A.

Table 3: Site Release Rates

	Design Storm Event Release Rate (m^3/s)					
	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
Allowable Release Rate to Reid Drive	0.18	0.24	0.28	0.36	0.44	0.50
Post Development Controlled Release Rate to Reid Drive	0.14	0.18	0.23	0.28	0.34	0.38
Storage Volume Required (m^3)	90	118	139	182	222	256

Quantity storage requirements are calculated to be approximately 256 m^3. The proposed storage areas have been sized with a total available quantity control volume of 322 m^3, which exceeds storage requirements. Detailed calculations have been provided in Appendix A.

2.4. Stormwater Quality Control During Construction

To ensure stormwater quality control during construction, it is imperative that effective environmental and sedimentation controls be in place throughout the entire area subject to construction activities. With the requirement of earth grading, there will be a potential of soil erosion. It is therefore recommended that the following be implemented to assist in achieving acceptable stormwater runoff quality:

- Restoration of exposed surfaces with vegetation and non-vegetative material as soon as construction schedules permit;
- Installation of temporary sediment ponds, filter strips, silt fences and rock check dams or other similar facilities throughout the site, and specifically during all construction activities;
- Reduce stormwater drainage velocities where possible;
- Ensure that disturbed areas that are left inactive for more than 30 days shall be vegetated and stabilized as instructed by the Engineer;
- Minimize the amount of existing vegetation removed.

2.5. Permanent Quality Control

The objective of the permanent SWM quality controls will be to ensure MOE’s Enhanced Protection. The municipal stormwater management pond downstream of the subject site provides Enhanced or Level 1 protection to a run-off coefficient of 0.75. The proposed development will increase the imperviousness of the site and exceeds the specified runoff coefficient. Therefore, additional quality controls should be implemented.

Given the nature and use of the site, Low Impact Development (LID) methods are not recommended. Therefore, it is proposed to install on-site controls in the form of an Oil-Grit Separator that will be sized to treat the respective drainage area. This, in conjunction with the downstream municipal SWM facility, will provide a treatment train approach to the stormwater runoff.

2.5.1. Oil/Grit Separator

A CDS or equivalent treatment unit is proposed to treat the stormwater released from this site to the MECP’s Enhanced or Level 1 Protection standard. This MECP standard stipulates a Total Suspended Solids (TSS) removal of at least 80%. The PMSU2025_5 model will treat the post development flows to the required MOE quality standard, with a TSS removal rate of approximately 80.3%. The design criteria and background information on how the CDS unit is sized is provided within Appendix B.

2.6. Proposed Storm System Design

It is proposed that the subject site be designed to integrate minor and major storm systems in order to convey minor storm flows underground and major storm flows overland.

2.6.1. Minor Storm System

The subject site will be graded to contain the stormwater and direct it towards the internal catchbasins and catchbasin manholes located throughout the site. The catchbasins are connected to a system of storm sewers, which have been designed to convey the 5-year design storm flows.

2.6.2. Major Storm System

In the event of a major storm, defined as storms larger than the 5-year event and up to the 100-year event, the minor storm system may surcharge, forcing stormwater to the site's surface. In events larger than the 100-year return storm, the site has been graded to include an overland flow route within the asphalt laneway. In the event the storm chamber's capacity is reached (storm larger than the 100-year), the system is designed to surcharge and flows be conveyed overland to the east into the designated drainage corridor and west into the Municipal Right-of-Way.

2.7. Water Balance

The proposed development will increase the impervious cover of the site, which decreases the infiltration of groundwater. This decrease in infiltration reduces groundwater recharge and soil moisture replenishment. Therefore, it is important to understand this natural hydrologic cycle as much as possible. Section 6.0 of the NVCA Stormwater Technical Guide provides references to various limitations on a site that would not make suitable for groundwater recharge. Referencing Section 3.2 of the MOE "Stormwater Management Planning and Design Manual (March 2003)", the following water balance has been completed. Referencing Table 3.1 of the MOE manual the existing site has an average annual evapotranspiration of 515 mm for open areas. Using this information, we calculate about 7,113 m^3 infiltration for the pre-development condition. For the post-development condition, we are proposing to infiltration the 25mm event which equates to 95% of the annual rainfall events, from the roof area only. Calculations with respect to the infiltration gallery are included in Appendix A. The following chart details the total infiltration with detailed calculations of these methods included in Appendix A.

	Total Infiltration (m^3/yr)
Pre-Development	7,113
Uncontrolled Post Development	1,312
Controlled Post Development	5,369

2.8. Phosphorus Budget

The existing site generates approximately 0.13 kg of phosphorous annually and the proposed lands will generate approximately 3.88 kg of phosphorous annually. The following chart details the anticipated phosphorous loadings for the pre- and uncontrolled post-development conditions.

	Total P (kg/yr)
Pre-Development	0.135
Uncontrolled Post Development	3.88

As per the Phosphorous Budget Tool documentation as provided by the MECP, the removal efficiency of 60% was selected for the area draining towards the infiltration gallery. In addition, the removal efficiency for the site draining to the Municipal Wet Pond was selected as having a removal efficiency of 63%. The following chart details the anticipated phosphorous loading for the post-development treated condition. Phosphorous budget calculations have been included in Appendix A.

	Total P (kg/yr)
Controlled Post-Development	1.15

Based on the post development phosphorus release without the presence of BMP's of 3.88 kg annually, and post development release of 1.15 kg annually with the presence of BMP's, the subject site is able to achieve about 70% in total phosphorus reduction.

2.9. Erosion and Sediment Control

To ensure Stormwater runoff quality is controlled during construction, an erosion and sediment control strategy will be implemented to mitigate transportation of silt off-site to the existing roads and sewers. It is imperative that effective controls be put in place and maintained until all areas are stabilized with surface cover.

All erosion and sediment control Best Management Practices (BMP) shall be designed, constructed and maintained in accordance with the NVCA's erosion control requirements.

Items that will be addressed for both temporary and permanent erosion and sediment controls are based on the following:

- Site location description and area;
- Existing and proposed land use;
- Vegetative cover;
- Existing drainage routes;
- Proposed site works;
- Proposed outlets;
- Permits required;
- Sediment filters and barriers - silt fences;
- Construction entrance location;
- Protection to catch basins and ditch inlets;

To prevent construction generated sediments from entering the storm sewers or leaving the site by overland flow, the following measures should be implemented during the construction phase:

- Temporary sediment control fencing should be erected around the perimeter of the grading activities.
- Temporary sediment fabric and stone filters should be installed on existing and proposed catch basins until surface cover has been stabilized.
- A temporary construction access mud mat should be implemented to reduce the amount of materials that may be transported off site.
- Construction during drier months should be monitored for wind-borne transport of sediments. At the direction of the engineer, the contractor may be directed to water down exposed earth areas with an aqueous solution of calcium chloride.
- All disturbed areas not under immediate construction for 30 days, or not intended for building activities within a 3-month time period, should be stabilized with seeding.

Built up sediment should be removed and disposed off-site at least once a month, or more frequently as directed by the engineer. Details have been provided on drawing ESC-1 and can be found in Appendix C.

3. Maintenance and Operation

3.1. CDS Unit

It is recommended that the CDS Hydrodynamic Separator be inspected on a quarterly basis to help and ensure that the unit is cleaned out at the appropriate time. Where site conditions may cause a rapid accumulation of pollutants, more frequent inspections should be carried out. The CDS unit should be cleaned when the sediment depth has accumulated to about 650mm. Maintenance should be performed using a vacuum truck, and preferably during dry weather. The material removed from the unit is anticipated to be able to be disposed of in a similar manner to other stormwater management facilities sediment, and is not anticipated to be hazardous. Any oil should be removed from the unit immediately upon discovery. This should be completed using a small portable pump and/or adsorbent pads, and then remaining water within the unit to be decanted, upon approval from the operating authority, to the municipal sanitary mains. Any sludge or sediment in the bottom of the unit is then required to be removed and disposed of appropriately. If maintenance is not performed as recommended, sediment may accumulate outside the grit chamber. If this happens, it will be necessary to pump out all chambers. The regular maintenance of the oil/grit separator will ensure satisfactory and long-term treatment.

4. Conclusions

Implementation of the designs outlined in this report will ensure that the stormwater drainage from the site complies with the requirements of the reviewing authorities, is of acceptable quality both during and after construction, and further, in the event of a major storm, that proper facilities are in place to protect the buildings and adjacent properties.

All of which is respectfully submitted,

Gerrits Engineering Ltd.

Edward Sanchez, EIT

Jeff McCuaig, P.Eng.
Director , Civil Engineer

Appendix A
Design Calculations

Q= 0.0028*C*I*A (cms)
C=RUNOFF COEFFICIENT
I-RAINFALL INTENSITY= 853.608/(Time+4.699)^0.766
A=AREA (ha)

CITY OF BARRIE

STORM SEWER DESIGN - 1

DATE: 11-Mar-21
FILE: 109-258-19
CONTRACT/PROJECT: Canpar

Areas	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME		I	TOTAL	S	D	Q	V
								(min)			Q			FULL	FULL
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)
P - 1	CB #1	STM MH #4	48.4	0.70	0.18	0.12	0.12	20.00	0.94	73.19	0.03	0.50	250	0.04	0.86
	STM MH #4	CBMH #2	40.9	0.00	0.00	0.00	0.12	20.94	0.70	71.12	0.02	0.50	300	0.07	0.97
P - 2	CBMH #2	CBMH #3	50.6	0.95	0.09	0.08	0.21	21.65	0.87	69.66	0.04	0.50	300	0.07	0.97
P - 3	CBMH #3	Outfall	11.5	0.91	0.16	0.15	0.35	22.52	0.17	67.95	0.07	0.50	375	0.12	1.12
P - 8	STM SERVICE	STM MH #2	19.1	0.95	0.69	0.66	0.66	20.00	0.29	73.19	0.13	0.65	300	0.08	1.10
								Roof Release controlled to			0.07				
	STM #3	CBMH #4	4.4	0.00	0.00	0.00	0.66	20.29	0.06	72.54	0.07	0.50	450	0.20	1.27
P - 4	CBMH #4	CBMH #5	56.9	0.95	0.24	0.23	0.89	20.35	0.75	72.42	0.11	0.50	450	0.20	1.27
P - 7	CB #2	STM MH #1	41.3	0.74	0.19	0.14	0.14	20.00	0.80	73.19	0.03	0.50	250	0.04	0.86
	STM MH #1	CBMH #6	30.4	0.00	0.00	0.00	0.14	20.80	0.52	71.42	0.03	0.50	300	0.07	0.97
P - 6	CBMH #6	CBMH #5	57.3	0.45	0.07	0.03	0.17	21.33	0.99	70.32	0.03	0.50	300	0.07	0.97
P - 5	CBMH #5	CDS2025	16.1	0.90	0.28	0.25	1.31	22.31	0.17	68.34	0.19	0.75	450	0.25	1.55
-	CDS2025	Ex, STM MH	5.0	0.00	0.00	0.00	1.31	22.49	0.05	68.01	0.19	0.75	450	0.25	1.55

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Calculation of Weighted Runoff Coefficient

Post Development Areas and Sub-Areas

		0.10	0.95	0.95	0.28	0.50	0.95	
Area ID	Total Area	Grass	Asphalt	Building	Pasture	Gravel	Conc.	Weighted Rational Coefficient
Pre-Development	21279							
X-2	21279	21279	0	0	0	0	0	0.10
Post Total	21279	3907	10253	6949	0	0	170	0.79
P-1	1780	488	1292	0	0	0	0	0.72
P-2	860	44	816	0	0	0	0	0.91
P-3	1660	0	1640	0	0	0	20	0.95
P-4	2380	0	2380	0	0	0	0	0.95
P-5	2830	268	2562	0	0	0	0	0.87
P-6	700	412	263	0	0	0	25	0.45
P-7	1880	455	1300	0	0	0	125	0.74
P-8	6949	0	0	6949	0	0	0	0.95
P-9	240	240	0	0	0	0	0	0.10

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Pre-Development Runoff Calculation

	Pre-Development	
Area	1.06	ha
Runoff Coefficient	0.75	
Time of Concentration	10	min
	Interpolated	
Return Rate	2	year
Coefficient	1	
Rainfall Intesity	83.1	mm/hr
Allowable Release Rate	0.18	m^3/s
Return Rate	5	year
Coefficient	1	
Rainfall Intesity	108.9	mm/hr
Allowable Release Rate	0.24	m^3/s
Return Rate	10	year
Coefficient	1	
Rainfall Intesity	126.5	mm/hr
Allowable Release Rate	0.28	m^3/s
Return Rate	25	year
Coefficient	1.1	
Rainfall Intesity	148.2	mm/hr
Allowable Release Rate	0.36	m^3/s
Return Rate	50	year
Coefficient	1.2	
Rainfall Intesity	164.2	mm/hr
Allowable Release Rate	0.44	m^3/s
Return Rate	100	year
Coefficient	1.25	
Rainfall Intesity	180.2	mm/hr
Allowable Release Rate	0.50	m^3/s

Storm (yrs)	Coeff A	Coeff B	Coeff C
2	**678.085**	**4.699**	**0.781**
5	**853.608**	**4.699**	**0.766**
10	**975.865**	**4.699**	**0.76**
25	**1146.275**	**4.922**	**0.757**
50	**1236.152**	**4.699**	**0.751**
100	**1426.408**	**5.273**	**0.759**

Modified Rational Method

$$Q = C_iCIA / 360$$

Where:

Q - Flow Rate (m3/s)
Ci - Peaking Coefficient
C - Rational Method Runoff Coefficient
I - Storm Intensity (mm/hr)
A - Area (ha.)

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Post Development Runoff Calculation

	Reid Drive		Channel Flow	
Area	1.55	ha	0.58	ha
Runoff Coefficient	0.85		0.65	
Time of Concentration	10	min	10	min
	Interpolated		Interpolated	
Return Rate	2	year	2	year
Coefficient	1		1	
Rainfall Intesity	83.1	mm/hr	83.1	mm/hr
Allowable Release Rate	0.30	m^3/s	0.09	m^3/s
Return Rate	5	year	5	year
Coefficient	1		1	
Rainfall Intesity	108.9	mm/hr	108.9	mm/hr
Allowable Release Rate	0.40	m^3/s	0.11	m^3/s
Return Rate	10	year	10	year
Coefficient	1		1	
Rainfall Intesity	126.5	mm/hr	126.5	mm/hr
Allowable Release Rate	0.46	m^3/s	0.13	m^3/s
Return Rate	25	year	25	year
Coefficient	1.1		1.1	
Rainfall Intesity	148.2	mm/hr	148.2	mm/hr
Allowable Release Rate	0.59	m^3/s	0.17	m^3/s
Return Rate	50	year	50	year
Coefficient	1.2		1.2	
Rainfall Intesity	164.2	mm/hr	164.2	mm/hr
Allowable Release Rate	0.72	m^3/s	0.21	m^3/s
Return Rate	100	year	100	year
Coefficient	1.25		1.25	
Rainfall Intesity	180.2	mm/hr	180.2	mm/hr
Allowable Release Rate	0.82	m^3/s	0.24	m^3/s

Storm (yrs)	Coeff A	Coeff B	Coeff C
2	678.085	4.699	0.781
5	853.608	4.699	0.766
10	975.865	4.699	0.76
25	1146.275	4.922	0.757
50	1236.152	4.699	0.751
100	1426.408	5.273	0.759

Modified Rational Method

$$Q = C_iCIA / 360$$

Where:

Q -	Flow Rate (m3/s)
Ci -	Peaking Coefficient
C -	Rational Method Runoff Coefficient
I -	Storm Intensity (mm/hr)
A -	Area (ha.)

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Post Development Runoff Calculation

	Discharge to Reid Dr.			
	Controlled Release			Uncontrolled
	P-5,6,7	Rooftop P9	P-8	P-9,10
Area	0.59 ha	0.69 ha	0.19 ha	0.07 ha
Runoff Coefficient	0.85	0.95	0.74	0.10
	Interpolated	Interpolated	Interpolated	Interpolated
Return Rate	2 year	2 year	2 year	2 year
Coefficient	1	1	1	1
Time of Concentration	10	10	10	10
Rainfall Intesity	83.1 mm/hr	83.1 mm/hr	83.1 mm/hr	83.1 mm/hr
Allowable Release Rate	0.12 m^3/s	0.15 m^3/s	0.03 m^3/s	0.00 m^3/s
Return Rate	5 year	5 year	5 year	5 year
Coefficient	1	1	1	1
Time of Concentration	10	10	10	10
Rainfall Intesity	108.9 mm/hr	108.9 mm/hr	108.9 mm/hr	108.9 mm/hr
Allowable Release Rate	0.15 m^3/s	0.20 m^3/s	0.04 m^3/s	0.00 m^3/s
Return Rate	10 year	10 year	10 year	10 year
Coefficient	1	1	1	1
Time of Concentration	10	10	10	10
Rainfall Intesity	126.5 mm/hr	126.5 mm/hr	126.5 mm/hr	126.5 mm/hr
Allowable Release Rate	0.18 m^3/s	0.23 m^3/s	0.05 m^3/s	0.00 m^3/s
Return Rate	25 year	25 year	25 year	25 year
Coefficient	1.1	1.1	1.1	1.1
Time of Concentration	10	10	10	10
Rainfall Intesity	148.2 mm/hr	148.2 mm/hr	148.2 mm/hr	148.2 mm/hr
Allowable Release Rate	0.23 m^3/s	0.30 m^3/s	0.06 m^3/s	0.00 m^3/s
Return Rate	50 year	50 year	50 year	50 year
Coefficient	1.2	1.2	1.2	1.2
Time of Concentration	10	10	10	10
Rainfall Intesity	164.2 mm/hr	164.2 mm/hr	164.2 mm/hr	164.2 mm/hr
Allowable Release Rate	0.28 m^3/s	0.36 m^3/s	0.08 m^3/s	0.00 m^3/s
Return Rate	100 year	100 year	100 year	100 year
Coefficient	1.25	1.25	1.25	1.25
Time of Concentration	10	10	10	10
Rainfall Intesity	180.2 mm/hr	180.2 mm/hr	180.2 mm/hr	180.2 mm/hr
Allowable Release Rate	0.32 m^3/s	0.41 m^3/s	0.09 m^3/s	0.00 m^3/s

Storm (yrs)	Coeff A	Coeff B	Coeff C
2	**678.085**	**4.699**	**0.781**
5	**853.608**	**4.699**	**0.766**
10	**975.865**	**4.699**	**0.76**
25	**1146.275**	**4.922**	**0.757**
50	**1236.152**	**4.699**	**0.751**
100	**1426.408**	**5.273**	**0.759**

Modified Rational Method

$$Q = C_iCIA / 360$$

Where:

Q -	Flow Rate (m3/s)
Ci -	Peaking Coefficient
C -	Rational Method Runoff Coefficient
I -	Storm Intensity (mm/hr)
A -	Area (ha.)

Project Number #109-258
1 Reid Drive
City of Barrie

TOTAL COMBINED ROOFTOP STORAGE @ 10 mins(m^3)	169.6
TOTAL COMBINED ROOFTOP STORAGE MAXIMUM	214.4

SUMMARY

Building	**A**	**B**
Rooftop Area (m^2)	3981.6	2967.2
Number of Drains	8	6
Total Number of Weirs	24	18
Discharge/Weir/Drain (L/m)	93	93
Total Roof Discharge (L/s)	37.20	27.90
Maximum Design Depth (mm)	100	100
Roof Storage at 10 minutes (m^3)	97.2	72.4
Maximum Roof Storage (m^3)	123.0	91.4
Maximum Storage Depth (mm)	98	97

BUILDING A

Time	Intensity	Q_{total}	$Q_{discharge}$	$Q_{storage}$	Volume to Store
(min)	(mm/hr)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3)
10	180.2	0.199	0.0372	0.162	97.2
20	122.9	0.136	0.0372	0.099	118.5
30	95.4	0.106	0.0372	0.068	123.0
40	79.0	0.087	0.0372	0.050	120.3
50	67.9	0.075	0.0372	0.038	113.6

Area per Drain	497.70	m^2
Equivalent Radius	12.59	m
Original Slope	0.46	%
New Radius	12.27	m
Ponding Depth	98	mm

BUILDING B

Time	Intensity	Q_{total}	$Q_{discharge}$	$Q_{storage}$	Volume to Store
(min)	(mm/hr)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3)
10	180.2	0.148	0.0279	0.121	72.4
20	122.9	0.101	0.0279	0.073	88.1
30	95.4	0.079	0.0279	0.051	91.4
40	79.0	0.065	0.0279	0.037	89.3
50	67.9	0.056	0.0279	0.028	84.1

Area per Drain	494.53	m^2
Equivalent Radius	12.55	m
Original Slope	0.46	%
New Radius	12.22	m
Ponding Depth	97	mm

Depth of Ponding	Pipe	Length	Diameter	Area	D. Inv.	U. Inv.	Depth 1	Depth 2	% Avg. Depth	% Area	V (pipe)
306.2	1	56.9	0.45	0.16	306.18	306.46	0.02	0	0.02	4%	0.36
	2	57.3	0.375	0.11	306.18	306.47	0.02	0	0.03	4%	0.25
	3	30.4	0.3	0.07	306.47	306.62	0	0	0.00	0%	0.00
	CBMH 5		1.2	1.13	306.18			0.02			0.02
	CBMH 4		1.2	1.13	306.46			0			0.00
	CBMH 6		1.2	1.13	306.47			0			0.00
	STM 1		1.2	1.13	306.62			0			0.00

Depth of Ponding	Pipe	Length	Diameter	Area	D. Inv.	U. Inv.	Depth 1	Depth 2	% Avg. Depth	% Area	V (pipe)
306.5	1	56.9	0.45	0.16	306.18	306.46	0.32	0.04	0.40	38%	3.44
	2	57.3	0.375	0.11	306.18	306.47	0.32	0.03	0.47	38%	2.40
	3	30.4	0.3	0.07	306.47	306.62	0.03	0	0.05	4%	0.09
	CBMH 5		1.2	1.13	306.18			0.32			0.36
	CBMH 4		1.2	1.13	306.46			0.04			0.05
	CBMH 6		1.2	1.13	306.47			0.03			0.03
	STM 1		1.2	1.13	306.62			0			0.00

Depth of Ponding	Pipe	Length	Diameter	Area	D. Inv.	U. Inv.	Depth 1	Depth 2	% Avg. Depth	% Area	V (pipe)
306.8	1	56.9	0.45	0.16	306.18	306.46	0.45	0.34	0.88	90%	8.14
	2	57.3	0.375	0.11	306.18	306.47	0.375	0.33	0.94	90%	5.70
	3	30.4	0.3	0.07	306.47	306.62	0.3	0.18	0.80	58%	1.25
	CBMH 5		1.2	1.13	306.18			0.62			0.70
	CBMH 4		1.2	1.13	306.46			0.34			0.38
	CBMH 6		1.2	1.13	306.47			0.33			0.37
	STM 1		1.2	1.13	306.62			0.18			0.20

Depth of Ponding	Pipe	Length	Diameter	Area	D. Inv.	U. Inv.	Depth 1	Depth 2	% Avg. Depth	% Area	V (pipe)
307.1	1	56.9	0.45	0.16	306.18	306.46	0.45	0.45	1.00	100%	9.05
	2	57.3	0.375	0.11	306.18	306.47	0.375	0.375	1.00	100%	6.33
	3	30.4	0.3	0.07	306.47	306.62	0.3	0.3	1.00	100%	2.15
	CBMH 5		1.2	1.13	306.18			0.92			1.04
	CBMH 4		1.2	1.13	306.46			0.64			0.72
	CBMH 6		1.2	1.13	306.47			0.63			0.71
	STM 1		1.2	1.13	306.62			0.48			0.54

STAGE - STORAGE - DISCHARGE - CB2

Elevation	Area	Cum. Volume	Storage Vol.	Depth 1	Flow 1		Major Storm Control Weir			Total Flow
(m)	(m^2)	(m^3)	(m^3)	(m)	(m^3/s)	Depth 3 (m)	Overflow (x)	Rectangular 'C'	Flow (m^3/s)	(m^3/s)
308.85	0	0	0	0	0	0	0	0	0	0
308.86	1	0	0	1.84	0.0212	0.00	0.00	0.00	0.0000	0.0212
308.87	5	0	0	1.85	0.0213	0.00	0.00	0.00	0.0000	0.0213
308.88	11	0	0	1.86	0.0214	0.00	0.00	0.00	0.0000	0.0214
308.89	19	0	0	1.87	0.0214	0.00	0.00	0.00	0.0000	0.0214
308.90	29	0	1	1.88	0.0215	0.00	0.00	0.00	0.0000	0.0215
308.91	41	0	1	1.89	0.0215	0.00	0.00	0.00	0.0000	0.0215
308.92	56	0	1	1.90	0.0216	0.00	0.00	0.00	0.0000	0.0216
308.93	73	1	2	1.91	0.0216	0.00	0.00	0.00	0.0000	0.0216
308.94	91	1	3	1.92	0.0217	0.00	0.00	0.00	0.0000	0.0217
308.95	112	1	4	1.93	0.0218	0.00	0.00	0.00	0.0000	0.0218
308.96	133	1	5	1.94	0.0218	0.00	0.00	0.00	0.0000	0.0218
308.97	154	1	6	1.95	0.0219	0.00	0.00	0.00	0.0000	0.0219
308.98	176	2	8	1.96	0.0219	0.00	0.00	0.00	0.0000	0.0219
308.99	199	2	10	1.97	0.0220	0.00	0.00	0.00	0.0000	0.0220
309.00	221	2	12	1.98	0.0220	0.00	0.00	0.00	0.0000	0.0220
309.01	246	2	14	1.99	0.0221	0.00	0.00	0.00	0.0000	0.0221
309.02	270	3	17	2.00	0.0222	0.00	0.00	0.00	0.0000	0.0222
309.03	294	3	20	2.01	0.0222	0.00	0.00	0.00	0.0000	0.0222
309.04	320	3	23	2.02	0.0223	0.00	0.00	0.00	0.0000	0.0223
309.05	345	3	26	2.03	0.0223	0.00	0.00	0.00	0.0000	0.0223
309.06	372	4	30	2.04	0.0224	0.00	0.00	0.00	0.0000	0.0224
309.07	399	4	34	2.05	0.0224	0.00	0.00	0.00	0.0000	0.0224
309.08	426	4	38	2.06	0.0225	0.00	0.00	0.00	0.0000	0.0225
309.09	453	4	42	2.07	0.0225	0.00	0.00	0.00	0.0000	0.0225
309.10	483	5	47	2.08	0.0226	0.00	0.00	0.00	0.0000	0.0226
309.11	512	5	52	2.09	0.0226	0.00	0.00	0.00	0.0000	0.0226
309.12	542	5	57	2.10	0.0227	0.00	0.00	0.00	0.0000	0.0227
309.13	573	6	63	2.11	0.0228	0.00	0.00	0.00	0.0000	0.0228
309.14	604	6	69	2.12	0.0228	0.00	0.00	0.00	0.0000	0.0228
309.15	635	6	75	2.13	0.0229	0.00	0.00	0.00	0.0000	0.0229

Orifice 1	
Diameter	75 mm
Elevation	306.98 m
Orifice Constant	0.8
Orifice Centroid	307.02 m

Over Flow Weir	
Width	1.00 m
Side Slopes	3 :1
Bottom Elevation	309.15 m
Length of Weir	1.00 m

STAGE - STORAGE - DISCHARGE - CBMH5

Elevation	Area	Cum. Volume	Sub surface	Storage Vol.	Depth 1	Flow 1		Major Storm Control Weir			Total Flow
(m)	(m^2)	(m^3)		(m^3)	(m)	(m^3/s)	Depth 3 (m)	Overflow (x)	Rectangular 'C'	Flow (m^3/s)	(m^3/s)
306.60					0	0	0	0	0	0	0
306.20			0.6	0.6	0.00	0.0000	0.00	0.00	0.00	0.0000	0.0000
306.50			6.4	6.4	0.13	0.1425	0.00	0.00	0.00	0.0000	0.1425
306.80			16.7	16.7	0.43	0.2574	0.00	0.00	0.00	0.0000	0.2574
307.10			20.5	20.5	0.73	0.3350	0.00	0.00	0.00	0.0000	0.3350
307.76	0	0		21	0	0	0	0	0	0	0
307.77	3	0		21	1.40	0.4635	0.00	0.00	0.00	0.0000	0.4635
307.78	9	0		21	1.41	0.4651	0.00	0.00	0.00	0.0000	0.4651
307.79	16	0		21	1.42	0.4668	0.00	0.00	0.00	0.0000	0.4668
307.80	24	0		21	1.43	0.4684	0.00	0.00	0.00	0.0000	0.4684
307.81	34	0		21	1.44	0.4701	0.00	0.00	0.00	0.0000	0.4701
307.82	45	0		22	1.45	0.4717	0.00	0.00	0.00	0.0000	0.4717
307.83	56	1		22	1.46	0.4733	0.00	0.00	0.00	0.0000	0.4733
307.84	68	1		23	1.47	0.4749	0.00	0.00	0.00	0.0000	0.4749
307.85	82	1		24	1.48	0.4765	0.00	0.00	0.00	0.0000	0.4765
307.86	97	1		24	1.49	0.4781	0.01	0.01	1.12	0.0089	0.4871
307.87	113	1		25	1.50	0.4797	0.02	0.02	1.36	0.0308	0.5106
307.88	130	1		27	1.51	0.4813	0.03	0.03	1.45	0.0601	0.5414
307.89	149	1		28	1.52	0.4829	0.04	0.04	1.49	0.0953	0.5782
307.90	169	2		30	1.53	0.4845	0.05	0.05	1.51	0.1355	0.6200
307.91	190	2		31	1.54	0.4861	0.06	0.06	1.53	0.1802	0.6663
307.92	214	2		33	1.55	0.4876	0.07	0.07	1.55	0.2291	0.7168

Orifice 1	
Diameter	375 mm
Elevation	306.18 m
Orifice Constant	0.8
Orifice Centroid	306.37 m

Over Flow Weir	
Width	8.00 m
Side Slopes	3 :1
Bottom Elevation	307.85 m
Length of Weir	1.00 m

CHECKING STORAGE RELEASE CHARACTERISTICS OF STAGE STORAGE GALLERIES
- CITY OF BARRIE IDF EQUATIONS -

P8

100 Year Post Development Flow	0.088	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
308.85	0.00	0.00	0
308.90	0.02	0.00	1
308.95	0.02	0.00	4
309.00	0.02	0.00	12
309.05	0.02	0.00	26
309.10	0.02	0.00	47
309.15	0.02	0.01	75

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.01	0.000	1	1
	2	0.02	0.021	0	0
	3	0.03	0.012	1	1
	4	0.04	0.022	1	2
	5	0.04	0.022	1	3
	6	0.05	0.022	2	5
	7	0.06	0.022	2	7
	8	0.07	0.022	3	10
	9	0.08	0.022	3	14
Peak	10	0.09	0.022	4	18
	11	0.08	0.022	3	21
	12	0.07	0.022	3	24
	13	0.06	0.022	2	26
	14	0.05	0.022	2	28
	15	0.04	0.022	1	29
	16	0.04	0.022	1	30
	17	0.03	0.022	0	30
	18	0.02	0.022	0	30
	19	0.01	0.022	-1	29
	20	0.00	0.022	-1	28
	21	0.00	0.022	-1	27
	22	0.00	0.022	-1	25
	23	0.00	0.022	-1	24
	24	0.00	0.022	-1	23
	25	0.00	0.022	-1	21
	26	0.00	0.022	-1	20
	27	0.00	0.022	-1	19
	28	0.00	0.022	-1	17
	29	0.00	0.022	-1	16
	30	0.00	0.022	-1	15
	31	0.00	0.022	-1	13
	32	0.00	0.022	-1	12
	33	0.00	0.022	-1	11
	34	0.00	0.022	-1	9
	35	0.00	0.022	-1	8
	36	0.00	0.022	-1	7
	37	0.00	0.022	-1	5
	38	0.00	0.022	-1	4
	39	0.00	0.022	-1	3
	40	0.00	0.022	-1	1
	41	0.00	0.022	-1	0
	42	0.00	0.008	0	0
	43	0.00	0.000	0	0
	44	0.00	0.000	0	0
	45	0.00	0.000	0	0
	46	0.00	0.000	0	0
	47	0.00	0.000	0	0
	48	0.00	0.000	0	0
	49	0.00	0.000	0	0
	50	0.00	0.000	0	0
	51	0.00	0.000	0	0
	52	0.00	0.000	0	0
	53	0.00	0.000	0	0
	54	0.00	0.000	0	0
	55	0.00	0.000	0	0
	56	0.00	0.000	0	0
	57	0.00	0.000	0	0
	58	0.00	0.000	0	0
	59	0.00	0.000	0	0
	60	0.00	0.000	0	0

Rooftop - P9

100 Year Post Development Flow	0.413	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
100.00	0.02	0.00	0.00
100.03	0.02	0.01	53.50
100.05	0.03	0.01	107.00
100.08	0.05	0.02	160.50
100.10	0.07	0.02	214.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.04	0.000	2	2
	2	0.08	0.000	5	0
	3	0.12	0.000	7	8
	4	0.17	-0.001	10	18
	5	0.21	-0.002	13	30
	6	0.25	-0.003	15	45
	7	0.29	-0.005	18	63
	8	0.33	0.019	19	82
	9	0.37	0.025	21	102
Peak	10	0.41	0.031	23	125
	11	0.37	0.038	20	145
	12	0.33	0.044	17	162
	13	0.29	0.049	14	177
	14	0.25	0.054	12	188
	15	0.21	0.057	9	197
	16	0.17	0.060	6	204
	17	0.12	0.062	4	207
	18	0.08	0.063	1	209
	19	0.04	0.063	-1	207
	20	0.00	0.063	-4	203
	21	0.00	0.062	-4	200
	22	0.00	0.061	-4	196
	23	0.00	0.060	-4	193
	24	0.00	0.059	-4	189
	25	0.00	0.058	-3	186
	26	0.00	0.056	-3	182
	27	0.00	0.055	-3	179
	28	0.00	0.054	-3	176
	29	0.00	0.053	-3	172
	30	0.00	0.052	-3	169
	31	0.00	0.051	-3	166
	32	0.00	0.051	-3	163
	33	0.00	0.050	-3	160
	34	0.00	0.049	-3	157
	35	0.00	0.048	-3	154
	36	0.00	0.047	-3	152
	37	0.00	0.046	-3	149
	38	0.00	0.045	-3	146
	39	0.00	0.044	-3	143
	40	0.00	0.044	-3	141
	41	0.00	0.043	-3	138
	42	0.00	0.042	-3	136
	43	0.00	0.041	-2	133
	44	0.00	0.041	-2	131
	45	0.00	0.040	-2	128
	46	0.00	0.039	-2	126
	47	0.00	0.038	-2	124
	48	0.00	0.038	-2	121
	49	0.00	0.037	-2	119
	50	0.00	0.036	-2	117
	51	0.00	0.036	-2	115
	52	0.00	0.035	-2	113
	53	0.00	0.034	-2	111
	54	0.00	0.034	-2	109
	55	0.00	0.033	-2	107
	56	0.00	0.032	-2	105
	57	0.00	0.032	-2	103
	58	0.00	0.031	-2	101
	59	0.00	0.031	-2	99
	60	0.00	0.030	-2	97

P5,6,7

100 Year Post Development Flow	0.315	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
306.18	0.00	0.00	0.00
306.20	0.00	0.00	0.64
307.77	0.46	0.00	20.56
307.85	0.48	0.00	23.51
307.86	0.49	0.00	24.40
307.89	0.58	0.00	28.06
307.92	0.72	0.00	33.47

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.03	0.000	2	2
	2	0.08	0.029	3	0
	3	0.11	0.000	6	7
	4	0.15	0.140	0	7
	5	0.18	0.150	2	9
	6	0.21	0.190	1	10
	7	0.24	0.219	1	11
	8	0.29	0.252	2	14
	9	0.33	0.309	1	15
Peak	10	0.37	0.339	2	17
	11	0.34	0.380	-2	15
	12	0.32	0.329	-1	14
	13	0.29	0.314	-1	13
	14	0.27	0.284	-1	12
	15	0.24	0.258	-1	10
	16	0.21	0.229	-1	9
	17	0.18	0.200	-1	8
	18	0.15	0.170	-1	7
	19	0.12	0.140	-1	5
	20	0.09	0.108	-1	4
	21	0.08	0.076	0	4
	22	0.08	0.087	0	4
	23	0.08	0.081	0	4
	24	0.08	0.082	0	4
	25	0.08	0.080	0	4
	26	0.08	0.080	0	4
	27	0.08	0.078	0	4
	28	0.08	0.077	0	4
	29	0.08	0.076	0	4
	30	0.07	0.075	0	4
	31	0.07	0.074	0	4
	32	0.07	0.073	0	4
	33	0.07	0.072	0	4
	34	0.07	0.071	0	4
	35	0.07	0.070	0	4
	36	0.07	0.070	0	4
	37	0.07	0.069	0	4
	38	0.07	0.068	0	4
	39	0.07	0.067	0	3
	40	0.07	0.066	0	3
	41	0.06	0.065	0	3
	42	0.05	0.064	-1	3
	43	0.04	0.044	0	2
	44	0.04	0.040	0	2
	45	0.04	0.041	0	2
	46	0.04	0.039	0	2
	47	0.04	0.039	0	2
	48	0.04	0.038	0	2
	49	0.04	0.037	0	2
	50	0.04	0.037	0	2
	51	0.04	0.036	0	2
	52	0.03	0.035	0	2
	53	0.03	0.035	0	2
	54	0.03	0.034	0	2
	55	0.03	0.034	0	2
	56	0.03	0.033	0	2
	57	0.03	0.032	0	2
	58	0.03	0.032	0	2
	59	0.03	0.031	0	2
	60	0.03	0.031	0	2

Uncontrolled P10,11

100 Year Post Development Flow	0.005	m3/sec
Storm Duration	20	min

Pond Rating Curve

Hydrograph Data

	Minute	In Flow	Out Flow
		(m3/sec)	(m3/sec)
	(1)	(2)	(4)
	0	0.00	0.000
	1	0.00	0.000
	2	0.00	0.030
	3	0.00	0.001
	4	0.00	0.142
	5	0.00	0.153
	6	0.00	0.193
	7	0.00	0.222
	8	0.00	0.255
	9	0.00	0.314
Peak	10	0.00	0.343
	11	0.00	0.384
	12	0.00	0.333
	13	0.00	0.317
	14	0.00	0.286
	15	0.00	0.260
	16	0.00	0.231
	17	0.00	0.202
	18	0.00	0.171
	19	0.00	0.140
	20	0.00	0.108
	21	0.00	0.076
	22	0.00	0.087
	23	0.00	0.081
	24	0.00	0.082
	25	0.00	0.080
	26	0.00	0.080
	27	0.00	0.078
	28	0.00	0.077
	29	0.00	0.076
	30	0.00	0.075
	31	0.00	0.074
	32	0.00	0.073
	33	0.00	0.072
	34	0.00	0.071
	35	0.00	0.070
	36	0.00	0.070
	37	0.00	0.069
	38	0.00	0.068
	39	0.00	0.067
	40	0.00	0.066
	41	0.00	0.065
	42	0.00	0.064
	43	0.00	0.044
	44	0.00	0.040
	45	0.00	0.041
	46	0.00	0.039
	47	0.00	0.039
	48	0.00	0.038
	49	0.00	0.037
	50	0.00	0.037
	51	0.00	0.036
	52	0.00	0.035
	53	0.00	0.035
	54	0.00	0.034
	55	0.00	0.034
	56	0.00	0.033
	57	0.00	0.032
	58	0.00	0.032
	59	0.00	0.031
	60	0.00	0.031

CHECKING STORAGE RELEASE CHARACTERISTICS OF STAGE STORAGE GALLERIES
- CITY OF BARRIE IDF EQUATIONS -

P8

50 Year Post Development Flow	0.077	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
308.85	0.00	0.00	0
308.90	0.02	0.00	1
308.95	0.02	0.00	4
309.00	0.02	0.00	12
309.05	0.02	0.00	26
309.10	0.02	0.00	47
309.15	0.02	0.01	75

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.01	0.000	0	0
	2	0.02	0.020	0	0
	3	0.02	0.012	1	1
	4	0.03	0.022	1	1
	5	0.04	0.022	1	2
	6	0.05	0.022	1	4
	7	0.05	0.022	2	6
	8	0.06	0.022	2	8
	9	0.07	0.022	3	11
Peak	10	0.08	0.022	3	14
	11	0.07	0.022	3	17
	12	0.06	0.022	2	19
	13	0.05	0.022	2	21
	14	0.05	0.022	1	23
	15	0.04	0.022	1	24
	16	0.03	0.022	1	24
	17	0.02	0.022	0	24
	18	0.02	0.022	0	24
	19	0.01	0.022	-1	23
	20	0.00	0.022	-1	22
	21	0.00	0.022	-1	20
	22	0.00	0.022	-1	19
	23	0.00	0.022	-1	18
	24	0.00	0.022	-1	16
	25	0.00	0.022	-1	15
	26	0.00	0.022	-1	14
	27	0.00	0.022	-1	12
	28	0.00	0.022	-1	11
	29	0.00	0.022	-1	10
	30	0.00	0.022	-1	8
	31	0.00	0.022	-1	7
	32	0.00	0.022	-1	6
	33	0.00	0.022	-1	4
	34	0.00	0.022	-1	3
	35	0.00	0.022	-1	2
	36	0.00	0.022	-1	1
	37	0.00	0.021	-1	0
	38	0.00	0.000	0	0
	39	0.00	0.000	0	0
	40	0.00	0.000	0	0
	41	0.00	0.000	0	0
	42	0.00	0.000	0	0
	43	0.00	0.000	0	0
	44	0.00	0.000	0	0
	45	0.00	0.000	0	0
	46	0.00	0.000	0	0
	47	0.00	0.000	0	0
	48	0.00	0.000	0	0
	49	0.00	0.000	0	0
	50	0.00	0.000	0	0
	51	0.00	0.000	0	0
	52	0.00	0.000	0	0
	53	0.00	0.000	0	0
	54	0.00	0.000	0	0
	55	0.00	0.000	0	0
	56	0.00	0.000	0	0
	57	0.00	0.000	0	0
	58	0.00	0.000	0	0
	59	0.00	0.000	0	0
	60	0.00	0.000	0	0

Rooftop - P9

50 Year Post Development Flow	0.361	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
100.00	0.02	0.00	0.00
100.03	0.02	0.01	53.50
100.05	0.03	0.01	107.00
100.08	0.05	0.02	160.50
100.10	0.07	0.02	214.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.04	0.000	2	2
	2	0.07	0.000	4	0
	3	0.11	0.000	7	7
	4	0.14	-0.001	9	16
	5	0.18	-0.002	11	26
	6	0.22	-0.003	13	40
	7	0.25	-0.004	15	55
	8	0.29	0.017	16	71
	9	0.33	0.022	18	90
Peak	10	0.36	0.027	20	110
	11	0.33	0.033	18	127
	12	0.29	0.039	15	142
	13	0.25	0.043	13	155
	14	0.22	0.047	10	165
	15	0.18	0.050	8	173
	16	0.14	0.053	6	178
	17	0.11	0.054	3	182
	18	0.07	0.055	1	183
	19	0.04	0.056	-1	181
	20	0.00	0.055	-3	178
	21	0.00	0.054	-3	175
	22	0.00	0.053	-3	172
	23	0.00	0.052	-3	169
	24	0.00	0.051	-3	165
	25	0.00	0.050	-3	162
	26	0.00	0.049	-3	159
	27	0.00	0.049	-3	157
	28	0.00	0.048	-3	154
	29	0.00	0.047	-3	151
	30	0.00	0.046	-3	148
	31	0.00	0.045	-3	145
	32	0.00	0.044	-3	143
	33	0.00	0.043	-3	140
	34	0.00	0.043	-3	138
	35	0.00	0.042	-3	135
	36	0.00	0.041	-2	133
	37	0.00	0.040	-2	130
	38	0.00	0.040	-2	128
	39	0.00	0.039	-2	126
	40	0.00	0.038	-2	123
	41	0.00	0.037	-2	121
	42	0.00	0.037	-2	119
	43	0.00	0.036	-2	117
	44	0.00	0.035	-2	114
	45	0.00	0.035	-2	112
	46	0.00	0.034	-2	110
	47	0.00	0.034	-2	108
	48	0.00	0.033	-2	106
	49	0.00	0.032	-2	104
	50	0.00	0.032	-2	102
	51	0.00	0.031	-2	101
	52	0.00	0.031	-2	99
	53	0.00	0.030	-2	97
	54	0.00	0.029	-2	95
	55	0.00	0.029	-2	93
	56	0.00	0.028	-2	92
	57	0.00	0.028	-2	90
	58	0.00	0.027	-2	88
	59	0.00	0.027	-2	87
	60	0.00	0.026	-2	85

P5,6,7

50 Year Post Development Flow	0.276	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
306.18	0.00	0.00	0.00
306.20	0.00	0.00	0.64
307.77	0.46	0.00	20.56
307.85	0.48	0.00	23.51
307.86	0.49	0.00	24.40
307.89	0.58	0.00	28.06
307.92	0.72	0.00	33.47

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.03	0.000	2	2
	2	0.07	0.024	3	0
	3	0.09	0.000	6	6
	4	0.13	0.124	0	6
	5	0.16	0.135	1	8
	6	0.19	0.169	1	9
	7	0.21	0.194	1	10
	8	0.26	0.223	2	12
	9	0.29	0.273	1	13
Peak	10	0.32	0.299	2	15
	11	0.30	0.335	-2	13
	12	0.28	0.291	-1	13
	13	0.26	0.278	-1	11
	14	0.23	0.251	-1	10
	15	0.21	0.228	-1	9
	16	0.19	0.203	-1	8
	17	0.16	0.178	-1	7
	18	0.13	0.152	-1	6
	19	0.11	0.125	-1	5
	20	0.08	0.098	-1	4
	21	0.08	0.069	0	4
	22	0.08	0.079	0	4
	23	0.07	0.074	0	4
	24	0.07	0.075	0	4
	25	0.07	0.073	0	4
	26	0.07	0.072	0	4
	27	0.07	0.071	0	4
	28	0.07	0.070	0	4
	29	0.07	0.069	0	4
	30	0.07	0.069	0	4
	31	0.07	0.068	0	4
	32	0.07	0.067	0	3
	33	0.07	0.066	0	3
	34	0.06	0.065	0	3
	35	0.06	0.064	0	3
	36	0.06	0.063	0	3
	37	0.06	0.062	0	3
	38	0.04	0.062	-1	2
	39	0.04	0.031	0	2
	40	0.04	0.042	0	2
	41	0.04	0.037	0	2
	42	0.04	0.038	0	2
	43	0.04	0.036	0	2
	44	0.04	0.036	0	2
	45	0.03	0.035	0	2
	46	0.03	0.035	0	2
	47	0.03	0.034	0	2
	48	0.03	0.033	0	2
	49	0.03	0.033	0	2
	50	0.03	0.032	0	2
	51	0.03	0.032	0	2
	52	0.03	0.031	0	2
	53	0.03	0.030	0	2
	54	0.03	0.030	0	2
	55	0.03	0.029	0	2
	56	0.03	0.029	0	2
	57	0.03	0.028	0	2
	58	0.03	0.028	0	2
	59	0.03	0.027	0	2
	60	0.03	0.027	0	2

Uncontrolled P10,11

50 Year Post Development Flow	0.004	m3/sec
Storm Duration	20	min

Pond Rating Curve

Hydrograph Data

	Minute	In Flow	Out Flow
		(m3/sec)	(m3/sec)
	(1)	(2)	(4)
	0	0.00	0.000
	1	0.00	0.000
	2	0.00	0.024
	3	0.00	0.001
	4	0.00	0.125
	5	0.00	0.137
	6	0.00	0.171
	7	0.00	0.197
	8	0.00	0.226
	9	0.00	0.277
Peak	10	0.00	0.303
	11	0.00	0.339
	12	0.00	0.294
	13	0.00	0.280
	14	0.00	0.253
	15	0.00	0.230
	16	0.00	0.205
	17	0.00	0.179
	18	0.00	0.153
	19	0.00	0.125
	20	0.00	0.098
	21	0.00	0.069
	22	0.00	0.079
	23	0.00	0.074
	24	0.00	0.075
	25	0.00	0.073
	26	0.00	0.072
	27	0.00	0.071
	28	0.00	0.070
	29	0.00	0.069
	30	0.00	0.069
	31	0.00	0.068
	32	0.00	0.067
	33	0.00	0.066
	34	0.00	0.065
	35	0.00	0.064
	36	0.00	0.063
	37	0.00	0.062
	38	0.00	0.062
	39	0.00	0.031
	40	0.00	0.042
	41	0.00	0.037
	42	0.00	0.038
	43	0.00	0.036
	44	0.00	0.036
	45	0.00	0.035
	46	0.00	0.035
	47	0.00	0.034
	48	0.00	0.033
	49	0.00	0.033
	50	0.00	0.032
	51	0.00	0.032
	52	0.00	0.031
	53	0.00	0.030
	54	0.00	0.030
	55	0.00	0.029
	56	0.00	0.029
	57	0.00	0.028
	58	0.00	0.028
	59	0.00	0.027
	60	0.00	0.027

CHECKING STORAGE RELEASE CHARACTERISTICS OF STAGE STORAGE GALLERIES
- CITY OF BARRIE IDF EQUATIONS -

P8

25 Year Post Development Flow	0.063	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
308.85	0.00	0.00	0
308.90	0.02	0.00	1
308.95	0.02	0.00	4
309.00	0.02	0.00	12
309.05	0.02	0.00	26
309.10	0.02	0.00	47
309.15	0.02	0.01	75

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.01	0.000	0	0
	2	0.01	0.016	0	0
	3	0.02	0.012	0	1
	4	0.03	0.021	0	1
	5	0.03	0.022	1	2
	6	0.04	0.022	1	3
	7	0.04	0.022	1	4
	8	0.05	0.022	2	6
	9	0.06	0.022	2	8
Peak	10	0.06	0.022	2	10
	11	0.06	0.022	2	12
	12	0.05	0.022	2	14
	13	0.04	0.022	1	15
	14	0.04	0.022	1	16
	15	0.03	0.022	1	17
	16	0.03	0.022	0	17
	17	0.02	0.022	0	17
	18	0.01	0.022	-1	16
	19	0.01	0.022	-1	15
	20	0.00	0.022	-1	14
	21	0.00	0.022	-1	13
	22	0.00	0.022	-1	11
	23	0.00	0.022	-1	10
	24	0.00	0.022	-1	9
	25	0.00	0.022	-1	7
	26	0.00	0.022	-1	6
	27	0.00	0.022	-1	5
	28	0.00	0.022	-1	4
	29	0.00	0.022	-1	2
	30	0.00	0.022	-1	1
	31	0.00	0.022	-1	0
	32	0.00	0.000	0	0
	33	0.00	0.000	0	0
	34	0.00	0.000	0	0
	35	0.00	0.000	0	0
	36	0.00	0.000	0	0
	37	0.00	0.000	0	0
	38	0.00	0.000	0	0
	39	0.00	0.000	0	0
	40	0.00	0.000	0	0
	41	0.00	0.000	0	0
	42	0.00	0.000	0	0
	43	0.00	0.000	0	0
	44	0.00	0.000	0	0
	45	0.00	0.000	0	0
	46	0.00	0.000	0	0
	47	0.00	0.000	0	0
	48	0.00	0.000	0	0
	49	0.00	0.000	0	0
	50	0.00	0.000	0	0
	51	0.00	0.000	0	0
	52	0.00	0.000	0	0
	53	0.00	0.000	0	0
	54	0.00	0.000	0	0
	55	0.00	0.000	0	0
	56	0.00	0.000	0	0
	57	0.00	0.000	0	0
	58	0.00	0.000	0	0
	59	0.00	0.000	0	0
	60	0.00	0.000	0	0

Rooftop - P9

25 Year Post Development Flow	0.299	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
100.00	0.02	0.00	0.00
100.03	0.02	0.01	53.50
100.05	0.03	0.01	107.00
100.08	0.05	0.02	160.50
100.10	0.07	0.02	214.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.03	0.000	2	2
	2	0.06	0.000	4	0
	3	0.09	0.000	5	6
	4	0.12	-0.001	7	13
	5	0.15	-0.001	9	22
	6	0.18	-0.002	11	33
	7	0.21	-0.003	13	46
	8	0.24	-0.005	15	60
	9	0.27	0.018	15	75
Peak	10	0.30	0.023	17	92
	11	0.27	0.028	14	106
	12	0.24	0.032	12	119
	13	0.21	0.036	10	129
	14	0.18	0.039	8	137
	15	0.15	0.042	6	144
	16	0.12	0.044	5	148
	17	0.09	0.045	3	151
	18	0.06	0.046	1	152
	19	0.03	0.046	-1	151
	20	0.00	0.046	-3	148
	21	0.00	0.045	-3	146
	22	0.00	0.044	-3	143
	23	0.00	0.043	-3	140
	24	0.00	0.043	-3	138
	25	0.00	0.042	-3	135
	26	0.00	0.041	-2	133
	27	0.00	0.040	-2	130
	28	0.00	0.040	-2	128
	29	0.00	0.039	-2	126
	30	0.00	0.038	-2	123
	31	0.00	0.038	-2	121
	32	0.00	0.037	-2	119
	33	0.00	0.036	-2	117
	34	0.00	0.035	-2	115
	35	0.00	0.035	-2	112
	36	0.00	0.034	-2	110
	37	0.00	0.034	-2	108
	38	0.00	0.033	-2	106
	39	0.00	0.032	-2	104
	40	0.00	0.032	-2	103
	41	0.00	0.031	-2	101
	42	0.00	0.031	-2	99
	43	0.00	0.030	-2	97
	44	0.00	0.030	-2	95
	45	0.00	0.029	-2	94
	46	0.00	0.028	-2	92
	47	0.00	0.028	-2	90
	48	0.00	0.027	-2	88
	49	0.00	0.027	-2	87
	50	0.00	0.026	-2	85
	51	0.00	0.026	-2	84
	52	0.00	0.025	-2	82
	53	0.00	0.025	-2	81
	54	0.00	0.025	-1	79
	55	0.00	0.024	-1	78
	56	0.00	0.024	-1	76
	57	0.00	0.023	-1	75
	58	0.00	0.023	-1	74
	59	0.00	0.022	-1	72
	60	0.00	0.022	-1	71

P5,6,7

25 Year Post Development Flow	0.228	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
306.18	0.00	0.00	0.00
306.20	0.00	0.00	0.64
307.77	0.46	0.00	20.56
307.85	0.48	0.00	23.51
307.86	0.49	0.00	24.40
307.89	0.58	0.00	28.06
307.92	0.72	0.00	33.47

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.02	0.000	1	1
	2	0.06	0.017	3	0
	3	0.08	0.000	5	5
	4	0.11	0.104	1	6
	5	0.14	0.116	1	7
	6	0.16	0.143	1	8
	7	0.18	0.164	1	9
	8	0.20	0.188	1	10
	9	0.25	0.211	2	12
Peak	10	0.27	0.259	1	13
	11	0.26	0.278	-1	11
	12	0.24	0.246	-1	11
	13	0.22	0.233	-1	10
	14	0.20	0.212	-1	9
	15	0.18	0.193	-1	8
	16	0.16	0.172	-1	7
	17	0.14	0.151	-1	6
	18	0.11	0.130	-1	5
	19	0.09	0.107	-1	4
	20	0.07	0.085	-1	3
	21	0.07	0.061	0	4
	22	0.07	0.069	0	3
	23	0.07	0.065	0	3
	24	0.06	0.066	0	3
	25	0.06	0.064	0	3
	26	0.06	0.064	0	3
	27	0.06	0.063	0	3
	28	0.06	0.062	0	3
	29	0.06	0.061	0	3
	30	0.06	0.060	0	3
	31	0.06	0.060	0	3
	32	0.04	0.059	-1	2
	33	0.04	0.028	0	2
	34	0.04	0.039	0	2
	35	0.03	0.034	0	2
	36	0.03	0.035	0	2
	37	0.03	0.034	0	2
	38	0.03	0.033	0	2
	39	0.03	0.033	0	2
	40	0.03	0.032	0	2
	41	0.03	0.032	0	2
	42	0.03	0.031	0	2
	43	0.03	0.030	0	2
	44	0.03	0.030	0	2
	45	0.03	0.029	0	2
	46	0.03	0.029	0	2
	47	0.03	0.028	0	2
	48	0.03	0.028	0	2
	49	0.03	0.027	0	2
	50	0.03	0.027	0	2
	51	0.03	0.026	0	2
	52	0.03	0.026	0	2
	53	0.03	0.025	0	2
	54	0.02	0.025	0	2
	55	0.02	0.024	0	2
	56	0.02	0.024	0	2
	57	0.02	0.024	0	2
	58	0.02	0.023	0	2
	59	0.02	0.023	0	2
	60	0.02	0.022	0	2

Uncontrolled P10,11

25 Year Post Development Flow	0.003	m3/sec
Storm Duration	20	min

Pond Rating Curve

Hydrograph Data

	Minute	In Flow	Out Flow
		(m3/sec)	(m3/sec)
	(1)	(2)	(4)
	0	0.00	0.000
	1	0.00	0.000
	2	0.00	0.018
	3	0.00	0.001
	4	0.00	0.105
	5	0.00	0.118
	6	0.00	0.145
	7	0.00	0.167
	8	0.00	0.191
	9	0.00	0.214
Peak	10	0.00	0.262
	11	0.00	0.281
	12	0.00	0.249
	13	0.00	0.235
	14	0.00	0.214
	15	0.00	0.194
	16	0.00	0.173
	17	0.00	0.152
	18	0.00	0.130
	19	0.00	0.108
	20	0.00	0.085
	21	0.00	0.061
	22	0.00	0.069
	23	0.00	0.065
	24	0.00	0.066
	25	0.00	0.064
	26	0.00	0.064
	27	0.00	0.063
	28	0.00	0.062
	29	0.00	0.061
	30	0.00	0.060
	31	0.00	0.060
	32	0.00	0.059
	33	0.00	0.028
	34	0.00	0.039
	35	0.00	0.034
	36	0.00	0.035
	37	0.00	0.034
	38	0.00	0.033
	39	0.00	0.033
	40	0.00	0.032
	41	0.00	0.032
	42	0.00	0.031
	43	0.00	0.030
	44	0.00	0.030
	45	0.00	0.029
	46	0.00	0.029
	47	0.00	0.028
	48	0.00	0.028
	49	0.00	0.027
	50	0.00	0.027
	51	0.00	0.026
	52	0.00	0.026
	53	0.00	0.025
	54	0.00	0.025
	55	0.00	0.024
	56	0.00	0.024
	57	0.00	0.024
	58	0.00	0.023
	59	0.00	0.023
	60	0.00	0.022

CHECKING STORAGE RELEASE CHARACTERISTICS OF STAGE STORAGE GALLERIES
- CITY OF BARRIE IDF EQUATIONS -

P8

10 Year Post Development Flow	0.049	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
308.85	0.00	0.00	0
308.90	0.02	0.00	1
308.95	0.02	0.00	4
309.00	0.02	0.00	12
309.05	0.02	0.00	26
309.10	0.02	0.00	47
309.15	0.02	0.01	75

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.00	0.000	0	0
	2	0.01	0.013	0	0
	3	0.01	0.012	0	0
	4	0.02	0.019	0	0
	5	0.02	0.020	0	1
	6	0.03	0.021	0	1
	7	0.03	0.022	1	2
	8	0.04	0.022	1	3
	9	0.04	0.022	1	4
Peak	10	0.05	0.022	2	6
	11	0.04	0.022	1	7
	12	0.04	0.022	1	8
	13	0.03	0.022	1	9
	14	0.03	0.022	0	10
	15	0.02	0.022	0	10
	16	0.02	0.022	0	10
	17	0.01	0.022	0	9
	18	0.01	0.022	-1	9
	19	0.00	0.022	-1	7
	20	0.00	0.022	-1	6
	21	0.00	0.022	-1	5
	22	0.00	0.022	-1	4
	23	0.00	0.022	-1	2
	24	0.00	0.022	-1	1
	25	0.00	0.022	-1	0
	26	0.00	0.000	0	0
	27	0.00	0.000	0	0
	28	0.00	0.000	0	0
	29	0.00	0.000	0	0
	30	0.00	0.000	0	0
	31	0.00	0.000	0	0
	32	0.00	0.000	0	0
	33	0.00	0.000	0	0
	34	0.00	0.000	0	0
	35	0.00	0.000	0	0
	36	0.00	0.000	0	0
	37	0.00	0.000	0	0
	38	0.00	0.000	0	0
	39	0.00	0.000	0	0
	40	0.00	0.000	0	0
	41	0.00	0.000	0	0
	42	0.00	0.000	0	0
	43	0.00	0.000	0	0
	44	0.00	0.000	0	0
	45	0.00	0.000	0	0
	46	0.00	0.000	0	0
	47	0.00	0.000	0	0
	48	0.00	0.000	0	0
	49	0.00	0.000	0	0
	50	0.00	0.000	0	0
	51	0.00	0.000	0	0
	52	0.00	0.000	0	0
	53	0.00	0.000	0	0
	54	0.00	0.000	0	0
	55	0.00	0.000	0	0
	56	0.00	0.000	0	0
	57	0.00	0.000	0	0
	58	0.00	0.000	0	0
	59	0.00	0.000	0	0
	60	0.00	0.000	0	0

Rooftop - P9

10 Year Post Development Flow	0.232	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
100.00	0.02	0.00	0.00
100.03	0.02	0.01	53.50
100.05	0.03	0.01	107.00
100.08	0.05	0.02	160.50
100.10	0.07	0.02	214.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.02	0.000	1	1
	2	0.05	0.000	3	0
	3	0.07	0.000	4	4
	4	0.09	0.000	6	10
	5	0.12	-0.001	7	17
	6	0.14	-0.002	8	26
	7	0.16	-0.003	10	35
	8	0.19	-0.004	11	47
	9	0.21	-0.005	13	60
Peak	10	0.23	0.018	13	72
	11	0.21	0.022	11	84
	12	0.19	0.025	10	93
	13	0.16	0.028	8	101
	14	0.14	0.031	7	108
	15	0.12	0.033	5	113
	16	0.09	0.034	4	116
	17	0.07	0.035	2	118
	18	0.05	0.036	1	119
	19	0.02	0.036	-1	118
	20	0.00	0.036	-2	116
	21	0.00	0.035	-2	114
	22	0.00	0.035	-2	112
	23	0.00	0.034	-2	110
	24	0.00	0.033	-2	108
	25	0.00	0.033	-2	106
	26	0.00	0.032	-2	104
	27	0.00	0.032	-2	102
	28	0.00	0.031	-2	100
	29	0.00	0.030	-2	98
	30	0.00	0.030	-2	97
	31	0.00	0.029	-2	95
	32	0.00	0.029	-2	93
	33	0.00	0.028	-2	91
	34	0.00	0.028	-2	90
	35	0.00	0.027	-2	88
	36	0.00	0.027	-2	86
	37	0.00	0.026	-2	85
	38	0.00	0.026	-2	83
	39	0.00	0.025	-2	82
	40	0.00	0.025	-1	80
	41	0.00	0.024	-1	79
	42	0.00	0.024	-1	77
	43	0.00	0.024	-1	76
	44	0.00	0.023	-1	75
	45	0.00	0.023	-1	73
	46	0.00	0.022	-1	72
	47	0.00	0.022	-1	71
	48	0.00	0.021	-1	69
	49	0.00	0.021	-1	68
	50	0.00	0.021	-1	67
	51	0.00	0.020	-1	66
	52	0.00	0.020	-1	64
	53	0.00	0.020	-1	63
	54	0.00	0.019	-1	62
	55	0.00	0.019	-1	61
	56	0.00	0.019	-1	60
	57	0.00	0.018	-1	59
	58	0.00	0.018	-1	58
	59	0.00	0.018	-1	57
	60	0.00	0.017	-1	56

P5,6,7

10 Year Post Development Flow	0.177	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
306.18	0.00	0.00	0.00
306.20	0.00	0.00	0.64
307.77	0.46	0.00	20.56
307.85	0.48	0.00	23.51
307.86	0.49	0.00	24.40
307.89	0.58	0.00	28.06
307.92	0.72	0.00	33.47

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.02	0.000	1	1
	2	0.05	0.010	2	0
	3	0.07	0.000	4	4
	4	0.09	0.082	0	5
	5	0.11	0.093	1	6
	6	0.13	0.115	1	6
	7	0.15	0.133	1	7
	8	0.16	0.151	1	8
	9	0.18	0.168	1	9
Peak	10	0.22	0.186	2	10
	11	0.20	0.229	-2	9
	12	0.19	0.193	0	9
	13	0.17	0.187	-1	8
	14	0.16	0.169	-1	7
	15	0.14	0.155	-1	7
	16	0.13	0.139	-1	6
	17	0.11	0.123	-1	5
	18	0.09	0.106	-1	4
	19	0.08	0.088	-1	4
	20	0.06	0.071	-1	3
	21	0.06	0.053	0	3
	22	0.06	0.059	0	3
	23	0.06	0.056	0	3
	24	0.06	0.056	0	3
	25	0.05	0.055	0	3
	26	0.03	0.054	-1	2
	27	0.03	0.024	0	2
	28	0.03	0.035	0	2
	29	0.03	0.030	0	2
	30	0.03	0.031	0	2
	31	0.03	0.030	0	2
	32	0.03	0.029	0	2
	33	0.03	0.029	0	2
	34	0.03	0.028	0	2
	35	0.03	0.028	0	2
	36	0.03	0.027	0	2
	37	0.03	0.027	0	2
	38	0.03	0.026	0	2
	39	0.03	0.026	0	2
	40	0.02	0.025	0	2
	41	0.02	0.025	0	2
	42	0.02	0.024	0	2
	43	0.02	0.024	0	2
	44	0.02	0.023	0	2
	45	0.02	0.023	0	2
	46	0.02	0.023	0	2
	47	0.02	0.022	0	2
	48	0.02	0.022	0	2
	49	0.02	0.021	0	2
	50	0.02	0.021	0	2
	51	0.02	0.021	0	2
	52	0.02	0.020	0	1
	53	0.02	0.020	0	1
	54	0.02	0.019	0	1
	55	0.02	0.019	0	1
	56	0.02	0.019	0	1
	57	0.02	0.018	0	1
	58	0.02	0.018	0	1
	59	0.02	0.018	0	1
	60	0.02	0.017	0	1

Uncontrolled P10,11

10 Year Post Development Flow	0.003	m3/sec
Storm Duration	20	min

Pond Rating Curve

Hydrograph Data

	Minute	In Flow	Out Flow
		(m3/sec)	(m3/sec)
	(1)	(2)	(4)
	0	0.00	0.000
	1	0.00	0.000
	2	0.00	0.010
	3	0.00	0.001
	4	0.00	0.083
	5	0.00	0.094
	6	0.00	0.117
	7	0.00	0.134
	8	0.00	0.153
	9	0.00	0.171
Peak	10	0.00	0.189
	11	0.00	0.231
	12	0.00	0.195
	13	0.00	0.189
	14	0.00	0.171
	15	0.00	0.156
	16	0.00	0.140
	17	0.00	0.123
	18	0.00	0.106
	19	0.00	0.089
	20	0.00	0.071
	21	0.00	0.053
	22	0.00	0.059
	23	0.00	0.056
	24	0.00	0.056
	25	0.00	0.055
	26	0.00	0.054
	27	0.00	0.024
	28	0.00	0.035
	29	0.00	0.030
	30	0.00	0.031
	31	0.00	0.030
	32	0.00	0.029
	33	0.00	0.029
	34	0.00	0.028
	35	0.00	0.028
	36	0.00	0.027
	37	0.00	0.027
	38	0.00	0.026
	39	0.00	0.026
	40	0.00	0.025
	41	0.00	0.025
	42	0.00	0.024
	43	0.00	0.024
	44	0.00	0.023
	45	0.00	0.023
	46	0.00	0.023
	47	0.00	0.022
	48	0.00	0.022
	49	0.00	0.021
	50	0.00	0.021
	51	0.00	0.021
	52	0.00	0.020
	53	0.00	0.020
	54	0.00	0.019
	55	0.00	0.019
	56	0.00	0.019
	57	0.00	0.018
	58	0.00	0.018
	59	0.00	0.018
	60	0.00	0.017

CHECKING STORAGE RELEASE CHARACTERISTICS OF STAGE STORAGE GALLERIES
- CITY OF BARRIE IDF EQUATIONS -

P8

5 Year Post Development Flow 0.042 m3/sec

Storm Duration 20 min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
308.85	0.00	0.00	0
308.90	0.02	0.00	1
308.95	0.02	0.00	4
309.00	0.02	0.00	12
309.05	0.02	0.00	26
309.10	0.02	0.00	47
309.15	0.02	0.01	75

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.00	0.000	0	0
	2	0.01	0.011	0	0
	3	0.01	0.012	0	0
	4	0.02	0.014	0	1
	5	0.02	0.021	0	0
	6	0.03	0.021	0	1
	7	0.03	0.022	0	1
	8	0.03	0.022	1	2
	9	0.04	0.022	1	3
Peak	10	0.04	0.022	1	4
	11	0.04	0.022	1	5
	12	0.03	0.022	1	6
	13	0.03	0.022	0	6
	14	0.03	0.022	0	7
	15	0.02	0.022	0	7
	16	0.02	0.022	0	6
	17	0.01	0.022	-1	6
	18	0.01	0.022	-1	5
	19	0.00	0.022	-1	4
	20	0.00	0.022	-1	3
	21	0.00	0.022	-1	1
	22	0.00	0.022	-1	0
	23	0.00	0.000	0	0
	24	0.00	0.000	0	0
	25	0.00	0.000	0	0
	26	0.00	0.000	0	0
	27	0.00	0.000	0	0
	28	0.00	0.000	0	0
	29	0.00	0.000	0	0
	30	0.00	0.000	0	0
	31	0.00	0.000	0	0
	32	0.00	0.000	0	0
	33	0.00	0.000	0	0
	34	0.00	0.000	0	0
	35	0.00	0.000	0	0
	36	0.00	0.000	0	0
	37	0.00	0.000	0	0
	38	0.00	0.000	0	0
	39	0.00	0.000	0	0
	40	0.00	0.000	0	0
	41	0.00	0.000	0	0
	42	0.00	0.000	0	0
	43	0.00	0.000	0	0
	44	0.00	0.000	0	0
	45	0.00	0.000	0	0
	46	0.00	0.000	0	0
	47	0.00	0.000	0	0
	48	0.00	0.000	0	0
	49	0.00	0.000	0	0
	50	0.00	0.000	0	0
	51	0.00	0.000	0	0
	52	0.00	0.000	0	0
	53	0.00	0.000	0	0
	54	0.00	0.000	0	0
	55	0.00	0.000	0	0
	56	0.00	0.000	0	0
	57	0.00	0.000	0	0
	58	0.00	0.000	0	0
	59	0.00	0.000	0	0
	60	0.00	0.000	0	0

Rooftop - P9

5 Year Post Development Flow 0.200 m3/sec

Storm Duration 20 min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
100.00	0.02	0.00	0.00
100.03	0.02	0.01	53.50
100.05	0.03	0.01	107.00
100.08	0.05	0.02	160.50
100.10	0.07	0.02	214.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.02	0.000	1	1
	2	0.04	0.000	2	0
	3	0.06	0.000	4	4
	4	0.08	0.000	5	9
	5	0.10	-0.001	6	15
	6	0.12	-0.002	7	22
	7	0.14	-0.002	9	31
	8	0.16	-0.003	10	40
	9	0.18	-0.004	11	51
Peak	10	0.20	-0.005	12	64
	11	0.18	0.019	10	73
	12	0.16	0.022	8	82
	13	0.14	0.025	7	88
	14	0.12	0.027	6	94
	15	0.10	0.029	4	98
	16	0.08	0.030	3	101
	17	0.06	0.031	2	103
	18	0.04	0.031	1	104
	19	0.02	0.032	-1	103
	20	0.00	0.031	-2	101
	21	0.00	0.031	-2	99
	22	0.00	0.030	-2	97
	23	0.00	0.030	-2	96
	24	0.00	0.029	-2	94
	25	0.00	0.029	-2	92
	26	0.00	0.028	-2	90
	27	0.00	0.028	-2	89
	28	0.00	0.027	-2	87
	29	0.00	0.027	-2	86
	30	0.00	0.026	-2	84
	31	0.00	0.026	-2	82
	32	0.00	0.025	-2	81
	33	0.00	0.025	-1	79
	34	0.00	0.024	-1	78
	35	0.00	0.024	-1	77
	36	0.00	0.023	-1	75
	37	0.00	0.023	-1	74
	38	0.00	0.022	-1	72
	39	0.00	0.022	-1	71
	40	0.00	0.022	-1	70
	41	0.00	0.021	-1	69
	42	0.00	0.021	-1	67
	43	0.00	0.020	-1	66
	44	0.00	0.020	-1	65
	45	0.00	0.020	-1	64
	46	0.00	0.019	-1	63
	47	0.00	0.019	-1	61
	48	0.00	0.019	-1	60
	49	0.00	0.018	-1	59
	50	0.00	0.018	-1	58
	51	0.00	0.018	-1	57
	52	0.00	0.017	-1	56
	53	0.00	0.017	-1	55
	54	0.00	0.017	-1	54
	55	0.00	0.016	-1	53
	56	0.00	-0.006	0	53
	57	0.00	-0.006	0	54
	58	0.00	0.016	-1	53
	59	0.00	-0.006	0	53
	60	0.00	-0.006	0	53

P5,6,7

5 Year Post Development Flow 0.152 m3/sec

Storm Duration 20 min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
306.18	0.00	0.00	0.00
306.20	0.00	0.00	0.64
307.77	0.46	0.00	20.56
307.85	0.48	0.00	23.51
307.86	0.49	0.00	24.40
307.89	0.58	0.00	28.06
307.92	0.72	0.00	33.47

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.02	0.000	1	1
	2	0.04	0.006	2	0
	3	0.06	0.000	3	4
	4	0.07	0.072	0	4
	5	0.10	0.076	1	5
	6	0.11	0.106	0	6
	7	0.13	0.115	1	6
	8	0.14	0.134	1	7
	9	0.16	0.147	1	8
Peak	10	0.17	0.163	1	8
	11	0.18	0.178	0	8
	12	0.17	0.178	-1	8
	13	0.15	0.161	0	7
	14	0.14	0.150	-1	6
	15	0.13	0.136	-1	6
	16	0.11	0.123	-1	5
	17	0.10	0.109	-1	5
	18	0.08	0.094	-1	4
	19	0.07	0.079	-1	3
	20	0.05	0.064	-1	3
	21	0.05	0.049	0	3
	22	0.05	0.054	0	3
	23	0.03	0.051	-1	2
	24	0.03	0.021	0	2
	25	0.03	0.032	0	2
	26	0.03	0.027	0	2
	27	0.03	0.028	0	2
	28	0.03	0.027	0	2
	29	0.03	0.027	0	2
	30	0.03	0.026	0	2
	31	0.03	0.026	0	2
	32	0.03	0.025	0	2
	33	0.02	0.025	0	2
	34	0.02	0.025	0	2
	35	0.02	0.024	0	2
	36	0.02	0.024	0	2
	37	0.02	0.023	0	2
	38	0.02	0.023	0	2
	39	0.02	0.022	0	2
	40	0.02	0.022	0	2
	41	0.02	0.022	0	2
	42	0.02	0.021	0	2
	43	0.02	0.021	0	2
	44	0.02	0.020	0	1
	45	0.02	0.020	0	1
	46	0.02	0.020	0	1
	47	0.02	0.019	0	1
	48	0.02	0.019	0	1
	49	0.02	0.019	0	1
	50	0.02	0.018	0	1
	51	0.02	0.018	0	1
	52	0.02	0.018	0	1
	53	0.02	0.017	0	1
	54	0.02	0.017	0	1
	55	0.02	0.017	0	1
	56	0.00	0.016	-1	0
	57	0.00	0.000	0	0
	58	0.02	0.000	1	1
	59	0.00	0.016	-1	0
	60	0.00	0.000	0	0

Uncontrolled P10,11

5 Year Post Development Flow 0.002 m3/sec

Storm Duration 20 min

Pond Rating Curve

Hydrograph Data

	Minute	In Flow	Out Flow
		(m3/sec)	(m3/sec)
	(1)	(2)	(4)
	0	0.00	0.000
	1	0.00	0.000
	2	0.00	0.007
	3	0.00	0.001
	4	0.00	0.073
	5	0.00	0.077
	6	0.00	0.108
	7	0.00	0.116
	8	0.00	0.135
	9	0.00	0.149
Peak	10	0.00	0.165
	11	0.00	0.180
	12	0.00	0.180
	13	0.00	0.163
	14	0.00	0.152
	15	0.00	0.137
	16	0.00	0.124
	17	0.00	0.109
	18	0.00	0.095
	19	0.00	0.080
	20	0.00	0.064
	21	0.00	0.049
	22	0.00	0.054
	23	0.00	0.051
	24	0.00	0.021
	25	0.00	0.032
	26	0.00	0.027
	27	0.00	0.028
	28	0.00	0.027
	29	0.00	0.027
	30	0.00	0.026
	31	0.00	0.026
	32	0.00	0.025
	33	0.00	0.025
	34	0.00	0.025
	35	0.00	0.024
	36	0.00	0.024
	37	0.00	0.023
	38	0.00	0.023
	39	0.00	0.022
	40	0.00	0.022
	41	0.00	0.022
	42	0.00	0.021
	43	0.00	0.021
	44	0.00	0.020
	45	0.00	0.020
	46	0.00	0.020
	47	0.00	0.019
	48	0.00	0.019
	49	0.00	0.019
	50	0.00	0.018
	51	0.00	0.018
	52	0.00	0.018
	53	0.00	0.017
	54	0.00	0.017
	55	0.00	0.017
	56	0.00	0.016
	57	0.00	0.000
	58	0.00	0.000
	59	0.00	0.016
	60	0.00	0.000

CHECKING STORAGE RELEASE CHARACTERISTICS OF STAGE STORAGE GALLERIES
- CITY OF BARRIE IDF EQUATIONS -

P8

2Year Post Development Flow	0.032	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
308.85	0.00	0.00	0
308.90	0.02	0.00	1
308.95	0.02	0.00	4
309.00	0.02	0.00	12
309.05	0.02	0.00	26
309.10	0.02	0.00	47
309.15	0.02	0.01	75

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.00	0.000	0	0
	2	0.01	0.008	0	0
	3	0.01	0.012	0	0
	4	0.01	0.006	0	1
	5	0.02	0.021	0	0
	6	0.02	0.010	1	1
	7	0.02	0.022	0	1
	8	0.03	0.022	0	1
	9	0.03	0.022	0	2
Peak	10	0.03	0.022	1	2
	11	0.03	0.022	0	3
	12	0.03	0.022	0	3
	13	0.02	0.022	0	3
	14	0.02	0.022	0	3
	15	0.02	0.022	0	3
	16	0.01	0.022	-1	2
	17	0.01	0.022	-1	1
	18	0.01	0.022	-1	0
	19	0.00	0.016	-1	0
	20	0.00	0.000	0	0
	21	0.00	0.000	0	0
	22	0.00	0.000	0	0
	23	0.00	0.000	0	0
	24	0.00	0.000	0	0
	25	0.00	0.000	0	0
	26	0.00	0.000	0	0
	27	0.00	0.000	0	0
	28	0.00	0.000	0	0
	29	0.00	0.000	0	0
	30	0.00	0.000	0	0
	31	0.00	0.000	0	0
	32	0.00	0.000	0	0
	33	0.00	0.000	0	0
	34	0.00	0.000	0	0
	35	0.00	0.000	0	0
	36	0.00	0.000	0	0
	37	0.00	0.000	0	0
	38	0.00	0.000	0	0
	39	0.00	0.000	0	0
	40	0.00	0.000	0	0
	41	0.00	0.000	0	0
	42	0.00	0.000	0	0
	43	0.00	0.000	0	0
	44	0.00	0.000	0	0
	45	0.00	0.000	0	0
	46	0.00	0.000	0	0
	47	0.00	0.000	0	0
	48	0.00	0.000	0	0
	49	0.00	0.000	0	0
	50	0.00	0.000	0	0
	51	0.00	0.000	0	0
	52	0.00	0.000	0	0
	53	0.00	0.000	0	0
	54	0.00	0.000	0	0
	55	0.00	0.000	0	0
	56	0.00	0.000	0	0
	57	0.00	0.000	0	0
	58	0.00	0.000	0	0
	59	0.00	0.000	0	0
	60	0.00	0.000	0	0

Rooftop - P9

2Year Post Development Flow	0.152	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
100.00	0.02	0.00	0.00
100.03	0.02	0.01	53.50
100.05	0.03	0.01	107.00
100.08	0.05	0.02	160.50
100.10	0.07	0.02	214.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.02	0.000	1	1
	2	0.03	0.000	2	0
	3	0.05	0.000	3	3
	4	0.06	0.000	4	7
	5	0.08	-0.001	5	11
	6	0.09	-0.001	6	17
	7	0.11	-0.002	7	23
	8	0.12	-0.002	7	31
	9	0.14	-0.003	8	39
Peak	10	0.15	-0.004	9	49
	11	0.14	-0.005	9	57
	12	0.12	0.017	6	63
	13	0.11	0.019	5	69
	14	0.09	0.021	4	73
	15	0.08	0.022	3	76
	16	0.06	0.023	2	78
	17	0.05	0.024	1	80
	18	0.03	0.024	0	80
	19	0.02	0.024	-1	80
	20	0.00	0.024	-1	78
	21	0.00	0.024	-1	77
	22	0.00	0.023	-1	75
	23	0.00	0.023	-1	74
	24	0.00	0.022	-1	73
	25	0.00	0.022	-1	71
	26	0.00	0.022	-1	70
	27	0.00	0.021	-1	69
	28	0.00	0.021	-1	67
	29	0.00	0.021	-1	66
	30	0.00	0.020	-1	65
	31	0.00	0.020	-1	64
	32	0.00	0.019	-1	63
	33	0.00	0.019	-1	61
	34	0.00	0.019	-1	60
	35	0.00	0.018	-1	59
	36	0.00	0.018	-1	58
	37	0.00	0.018	-1	57
	38	0.00	0.017	-1	56
	39	0.00	0.017	-1	55
	40	0.00	0.017	-1	54
	41	0.00	0.016	-1	53
	42	0.00	-0.006	0	53
	43	0.00	-0.006	0	54
	44	0.00	0.016	-1	53
	45	0.00	-0.006	0	53
	46	0.00	-0.006	0	53
	47	0.00	-0.006	0	54
	48	0.00	0.016	-1	53
	49	0.00	-0.006	0	53
	50	0.00	-0.006	0	53
	51	0.00	-0.006	0	54
	52	0.00	0.016	-1	53
	53	0.00	-0.006	0	53
	54	0.00	-0.006	0	53
	55	0.00	-0.006	0	54
	56	0.00	0.016	-1	53
	57	0.00	-0.006	0	53
	58	0.00	-0.006	0	54
	59	0.00	0.016	-1	53
	60	0.00	-0.006	0	53

P5,6,7

2Year Post Development Flow	0.116	m3/sec
Storm Duration	20	min

Pond Rating Curve

Elevation (m)	Outflow (m3/sec)	Storage (ha - m)	0.8 (m3)
306.18	0.00	0.00	0.00
306.20	0.00	0.00	0.64
307.77	0.46	0.00	20.56
307.85	0.48	0.00	23.51
307.86	0.49	0.00	24.40
307.89	0.58	0.00	28.06
307.92	0.72	0.00	33.47

Hydrograph Data

	Minute	In Flow	Out Flow	Del_Storage	Cumulative Storage
		(m3/sec)	(m3/sec)	(m3)	(m3)
	(1)	(2)	(4)	(5)	(6)
	0	0.00	0.000	0	0
	1	0.01	0.000	1	1
	2	0.03	0.001	2	0
	3	0.05	0.000	3	3
	4	0.05	0.057	0	3
	5	0.08	0.051	2	5
	6	0.08	0.091	-1	4
	7	0.10	0.075	2	6
	8	0.11	0.114	0	6
	9	0.13	0.115	1	6
Peak	10	0.14	0.131	0	7
	11	0.13	0.141	-1	6
	12	0.13	0.121	1	7
	13	0.12	0.137	-1	6
	14	0.11	0.117	0	5
	15	0.10	0.111	-1	5
	16	0.09	0.099	0	4
	17	0.08	0.088	0	4
	18	0.07	0.077	0	3
	19	0.05	0.066	-1	3
	20	0.02	0.046	-1	1
	21	0.02	0.016	0	2
	22	0.02	0.027	0	2
	23	0.02	0.022	0	2
	24	0.02	0.023	0	2
	25	0.02	0.022	0	2
	26	0.02	0.022	0	2
	27	0.02	0.022	0	2
	28	0.02	0.021	0	2
	29	0.02	0.021	0	2
	30	0.02	0.020	0	1
	31	0.02	0.020	0	1
	32	0.02	0.020	0	1
	33	0.02	0.019	0	1
	34	0.02	0.019	0	1
	35	0.02	0.019	0	1
	36	0.02	0.018	0	1
	37	0.02	0.018	0	1
	38	0.02	0.018	0	1
	39	0.02	0.017	0	1
	40	0.02	0.017	0	1
	41	0.02	0.017	0	1
	42	0.00	0.016	-1	0
	43	0.00	0.000	0	0
	44	0.02	0.000	1	1
	45	0.00	0.016	-1	0
	46	0.00	0.000	0	0
	47	0.00	0.000	0	0
	48	0.02	0.000	1	1
	49	0.00	0.016	-1	0
	50	0.00	0.000	0	0
	51	0.00	0.000	0	0
	52	0.02	0.000	1	1
	53	0.00	0.016	-1	0
	54	0.00	0.000	0	0
	55	0.00	0.000	0	0
	56	0.02	0.000	1	1
	57	0.00	0.016	-1	0
	58	0.00	0.000	0	0
	59	0.02	0.000	1	1
	60	0.00	0.016	-1	0

Uncontrolled P10,11

2Year Post Development Flow	0.002	m3/sec
Storm Duration	20	min

Pond Rating Curve

Hydrograph Data

	Minute	In Flow	Out Flow
		(m3/sec)	(m3/sec)
	(1)	(2)	(4)
	0	0.00	0.000
	1	0.00	0.000
	2	0.00	0.002
	3	0.00	0.001
	4	0.00	0.058
	5	0.00	0.052
	6	0.00	0.092
	7	0.00	0.076
	8	0.00	0.115
	9	0.00	0.116
Peak	10	0.00	0.132
	11	0.00	0.142
	12	0.00	0.122
	13	0.00	0.138
	14	0.00	0.118
	15	0.00	0.111
	16	0.00	0.099
	17	0.00	0.089
	18	0.00	0.077
	19	0.00	0.066
	20	0.00	0.046
	21	0.00	0.016
	22	0.00	0.027
	23	0.00	0.022
	24	0.00	0.023
	25	0.00	0.022
	26	0.00	0.022
	27	0.00	0.022
	28	0.00	0.021
	29	0.00	0.021
	30	0.00	0.020
	31	0.00	0.020
	32	0.00	0.020
	33	0.00	0.019
	34	0.00	0.019
	35	0.00	0.019
	36	0.00	0.018
	37	0.00	0.018
	38	0.00	0.018
	39	0.00	0.017
	40	0.00	0.017
	41	0.00	0.017
	42	0.00	0.016
	43	0.00	0.000
	44	0.00	0.000
	45	0.00	0.016
	46	0.00	0.000
	47	0.00	0.000
	48	0.00	0.000
	49	0.00	0.016
	50	0.00	0.000
	51	0.00	0.000
	52	0.00	0.000
	53	0.00	0.016
	54	0.00	0.000
	55	0.00	0.000
	56	0.00	0.000
	57	0.00	0.016
	58	0.00	0.000
	59	0.00	0.000
	60	0.00	0.016

Table 3.1: Hydrologic Cycle Component Values

	Water Holding Capacity mm	Hydrologic Soil Group	Precipitation mm	Evapo-transpiration mm	Runoff mm	Infiltration* mm
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)						
Fine Sand	50	A	940	515	149	276
Fine Sandy Loam	75	B	940	525	187	228
Silt Loam	125	C	940	536	222	182
Clay Loam	100	CD	940	531	245	164
Clay	75	D	940	525	270	145
Moderately Rooted Crops (corn and cereal grains)						
Fine Sand	75	A	940	525	125	291
Fine Sandy Loam	150	B	940	539	160	241
Silt Loam	200	C	940	543	199	199
Clay Loam	200	CD	940	543	218	179
Clay	150	D	940	539	241	160
Pasture and Shrubs						
Fine Sand	100	A	940	531	102	307
Fine Sandy Loam	150	B	940	539	140	261
Silt Loam	250	C	940	546	177	217
Clay Loam	250	CD	940	546	197	197
Clay	200	D	940	543	218	179
Mature Forests						
Fine Sand	250	A	940	546	79	315
Fine Sandy Loam	300	B	940	548	118	274
Silt Loam	400	C	940	550	156	234
Clay Loam	400	CD	940	550	176	215
Clay	350	D	940	549	196	196

Notes: Hydrologic Soil Group A represents soils with low runoff potential and Soil Group D represents soils with high runoff potential. The evapotranspiration values are for mature vegetation. Streamflow is composed of baseflow and runoff.

* *This is the total infiltration of which some discharges back to the stream as base flow. The infiltration factor is determined by summing a factor for topography, soils and cover.*

Topography	Flat Land, average slope < 0.6 m/km	0.3
	Rolling Land, average slope 2.8 m to 3.8 m/km	0.2
	Hilly Land, average slope 28 m to 47 m/km	0.1
Soils	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
Cover	Cultivated Land	0.1
	Woodland	0.2

Figure 1a- % of Total Annual Average Rainfall Depth Vs. Daily Rainfall Amounts (Based on 1991 Toronto Rainfall Data from 16 Rain Gauge Stations)

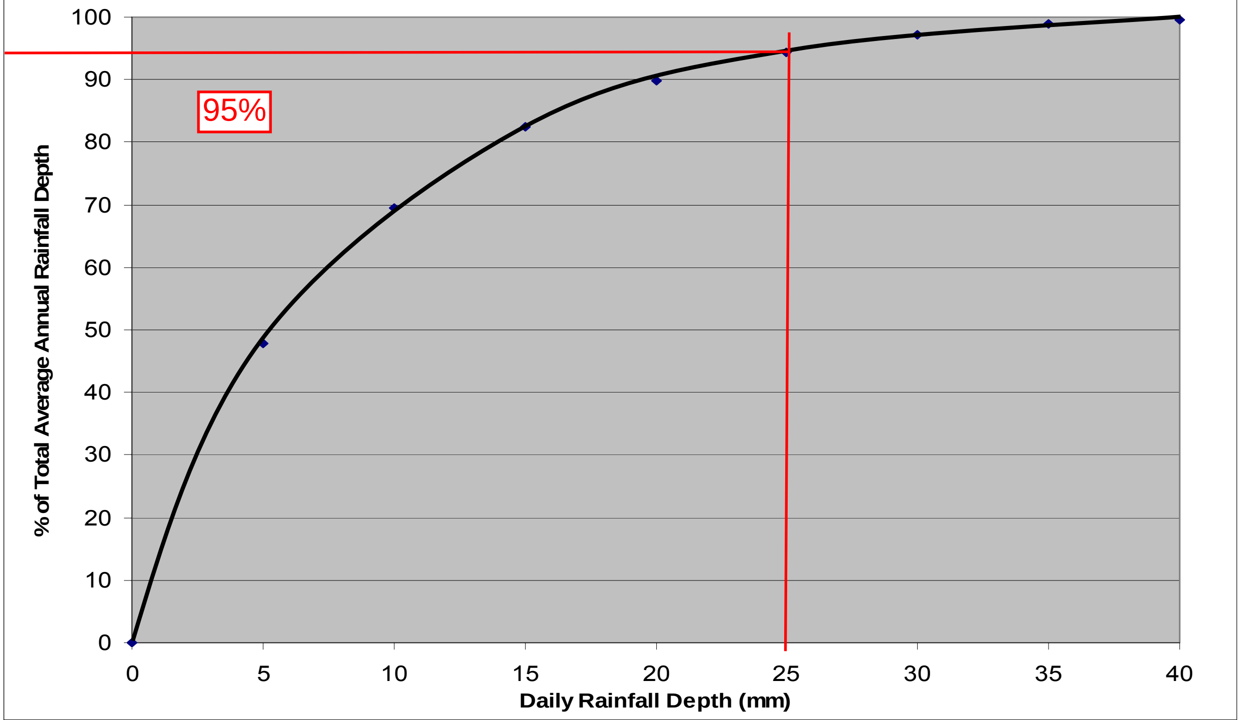
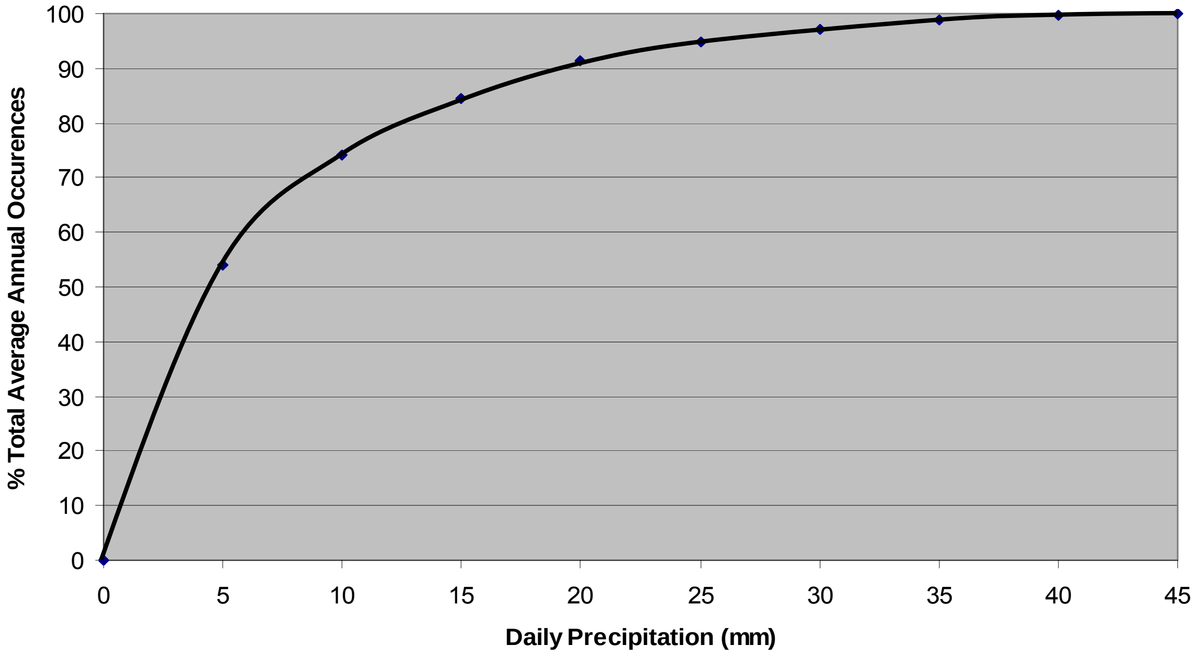


Figure 1b-Total Average Annual Occurences vs Daily Precipitation (based on 1991 Toronto Rainfall Data from 16 Rain Gauge Stations)



PRE-DEVELOPMENT	Site	
Catchment Designation	Caplan	TOTALS
Area (m^2)	21,272	21,272
Pervious Area (m^2)	21,272	21,272
Impervious Area (m^2)	0	0
MOE Infiltration Factors		
Topography Infiltration Factor	0.30	
Soil Infiltration Factor	0.40	
Land Cover Infiltration Factor	0.10	
MOE Total Infiltration Factor	0.80	
Runoff Coefficient	0.2	
Runoff from Impervious Surfaces	0	
Inputs (per Unit Area)		
Precipitation (mm/yr)	933	933
TOTAL INPUTS (mm/yr)	933	933
Outputs (per Unit Area)		
Precipitation Surplus (mm/yr)	418	
Evapotranspiration (mm/yr)	515	
Infiltration (mm/yr)	334	
Rooftop Infiltration (mm/yr)	0	
Total Infiltration (mm/yr)	334	
Runoff Pervious Areas (mm/yr)	84	
Runoff Impervious Areas (mm/yr)	0	
Total Runoff (mm/yr)	84	
TOTAL OUTPUTS (mm/yr)	933	933
Difference (INPUTS-OUTPUTS)	0	0
Inputs (Volumes)		
Precipitation (m^3/yr)	19,847	19,847
TOTAL INPUTS (m^3/yr)	19,847	19,847
Outputs (Volumes)		
Precipitation Surplus (m^3/yr)	8,892	
Evapotranspiration (m^3/yr)	10,955	
Infiltration (m^3/yr)	7,113	
Rooftop Infiltration (m^3/yr)	0	
Total Infiltration (m^3/yr)	7,113	
Runoff Pervious Areas (m^3/yr)	1,778	
Runoff Impervious Areas (m^3/yr)	0	
Total Runoff (m^3/yr)	1,778	
TOTAL OUTPUTS (m^3/yr)	19,847	19,847
Difference (INPUTS-OUTPUTS)	0	0

POST-DEVELOPMENT	Site			
Catchment Designation	Grass/Open Space	Paved	Building	TOTALS
Area (m^2)	3,923	10,416	6,933	21,272
Pervious Area (m^2)	3,923	0	0	3,923
Impervious Area (m^2)	0	10,416	6,933	17,349
MOE Infiltration Factors				
Topography Infiltration Factor	0.30	0.10	0.10	
Soil Infiltration Factor	0.40	0.10	0.10	
Land Cover Infiltration Factor	0.10	0.00	0.00	
MOE Total Infiltration Factor	0.8	0	0	
Runoff Coefficient	0.2	1	1	
Runoff from Impervious Surfaces	0	0.8	0.8	
Inputs (per Unit Area)				
Precipitation (mm/yr)	933	933	933	933
TOTAL INPUTS (mm/yr)	933	933	933	933
Outputs (per Unit Area)				
Precipitation Surplus (mm/yr)	418	746	746	
Evapotranspiration (mm/yr)	515	163	163	
Infiltration (mm/yr)	334	0	0	
Rooftop Infiltration (mm/yr)	0	0	0	
Total Infiltration (mm/yr)	334	0	0	
Runoff Pervious Areas (mm/yr)	84	0	0	
Runoff Impervious Areas (mm/yr)	0	746	746	
Total Runoff (mm/yr)	84	746	746	
TOTAL OUTPUTS (mm/yr)	933	909	909	
Difference (INPUTS-OUTPUTS)	0	24	24	
Inputs (Volumes)				
Precipitation (m^3/yr)	3,660	9,718	6,468	19,847
TOTAL INPUTS (m^3/yr)	3,660	9,718	6,468	19,847
Outputs (Volumes)				
Precipitation Surplus (m^3/yr)	1,640	7,775	5,175	14,589
Evapotranspiration (m^3/yr)	2,020	1,698	1,130	4,848
Infiltration (m^3/yr)	1,312	0	0	1,312
Rooftop Infiltration (m^3/yr)	0	0	0	0
Total Infiltration (m^3/yr)	1,312	0	0	1,312
Runoff Pervious Areas (m^3/yr)	328	0	0	328
Runoff Impervious Areas (m^3/yr)	0	7,775	5,175	12,949
Total Runoff (m^3/yr)	328	7,775	5,175	13,277
TOTAL OUTPUTS (m^3/yr)	3,660	9,472	6,305	19,437
Difference (INPUTS-OUTPUTS)	0	0	0	409

POST-DEVELOPMENT with MITIGATION	Site			
Catchment Designation	Grass/Open Spac	Paved	Building	TOTALS
Area (m^2)	3,923	10,416	6,933	21,272
Pervious Area (m^2)	3,923	0	0	3,923
Impervious Area (m^2)	0	10,416	6,933	17,349
MOE Infiltration Factors				
Topography Infiltration Factor	0.30	0.30	0.30	
Soil Infiltration Factor	0.40	0.40	0.40	
Land Cover Infiltration Factor	0.10	0.10	0.10	
MOE Total Infiltration Factor	0.8	0.8	0.8	
Runoff Coefficient	0.2	0.2	0.2	
Runoff from Impervious Surfaces	0	0	0	
Inputs (per Unit Area)				
Precipitation (mm/yr)	933	933	933	933
TOTAL INPUTS (mm/yr)	933	933	933	933
Outputs (per Unit Area)				
Precipitation Surplus (mm/yr)	418	770	770	
Evapotranspiration (mm/yr)	515	163	163	
Infiltration (mm/yr)	334	616	616	
Impervious Infiltration (mm/yr)	0	0	585	
Total Infiltration (mm/yr)	334	616	1201	
Runoff Pervious Areas (mm/yr)	84	154	154	
Runoff Impervious Areas (mm/yr)	418	770	770	
Total Runoff (mm/yr)	502	924	924	
TOTAL OUTPUTS (mm/yr)	933	933	933	
Difference (INPUTS-OUTPUTS)	0	0	0	
Inputs (Volumes)				
Precipitation (m^3/yr)	3,660	9,718	6,468	19,847
TOTAL INPUTS (m^3/yr)	3,660	9,718	6,468	19,847
Outputs (Volumes)				
Precipitation Surplus (m^3/yr)	1,640	8,020	5,338	14,999
Evapotranspiration (m^3/yr)	2,020	1,698	1,130	4,848
Infiltration (m^3/yr)	1,312	0	0	1,312
Impervious Infiltration (m^3/yr)	0	0	4,057	4,057
Total Infiltration (m^3/yr)	1,312	0	4,057	5,369
Runoff Pervious Areas (m^3/yr)	328	0	0	328
Runoff Impervious Areas (m^3/yr)	0	8,020	5,338	13,359
Total Runoff (m^3/yr)	328	8,020	5,338	13,687
TOTAL OUTPUTS (m^3/yr)	3,660	9,718	6,468	19,847
Difference (INPUTS-OUTPUTS)	0	0	0	0

Phosphorous Concentrations by Land Use

	High Intensity		**Transition**		**Forest / slope**		
Average Total P (kg/ha/year)	1.82		0.06		0.06		

Pre-Development Condition

Total Annual Rainfall Percipitation 933.0 mm

	Low Intensity	**Transition**	**Forest/slope**
Area (ha):	2.13	0.00	0
Total P (kg/yr) :	0.13	0.00	0.00

Total Pre-Development P (kg) : 0.13

Post Development Condition - Untreated

	High Intensity	**Transition**	**Forest/slope**
Area (ha):	2.13	0.00	0
Total P (kg/yr) :	3.88	0.00	0.00

Total Post Development P (kg/yr) : 3.88

Post Development Condition - Treated

	SWM Facility	**High Intensity**	**Transition**	**Forest/slope**
Area (ha):	0.69	1.43	0.00	0
Total P (kg/yr) :	1.26	2.61	0.00	0.00

Without Treatment

Total Post Development P (kg/yr) : 3.87

With Treatment

Rooftop Infiltration Efficiency :	60	0	0	0
P Removed (kg/yr) :	0.76	0.00	0.00	0.00
Wet Pond Removal Efficiency	63	63	0	0
P Removed (kg/yr) :	0.32	1.64	0.00	0.00

Total Post Development P (kg/yr) : 1.15

Determine Minimum Sizing of Infiltration Gallery

Table 4.4: Minimum Soil Percolation Rates

Soil Type	Percolation Rate (mm/h)
sand	210
loamy sand	60
sandy loam	25
loam	15

$$A = \frac{1{,}000V}{Pn\triangle t}$$

Equation 4.3: Infiltration Trench Bottom Area

where A = bottom area of the trench (m^2)
V = runoff volume to be infiltrated (Table 3.2)
P = percolation rate of surrounding native soil (mm/h)
n = porosity of the storage media (0.4 for clear stone)
$\triangle t$ = retention time (24 to 48 hours)

$$d = \frac{PT}{1{,}000}$$

Equation 4.2: Maximum Allowable Soakaway Pit Depth

where d = maximum allowable depth of the soakaway pit (m)
P = percolation rate (Table 4.1) (mm/h)
T = drawdown time (24 - 48 h) (h)

Soil Type
Alliston Sandy Loam/Dundonald Sandy Load

Volume Required: 200.0 m^3
Assumed Porosity: 0.95
Percolation Rate: 60 mm/h
Percolation Rate (F.S. 2.5): 24 mm/h
Area Req'd (24hr): 365.5 m^2
Area Req'd (48hr): 182.7 m^2

Provided Area: 272.0 m^2

Therefore: As the provided infiltration area is greater than area required for a 48hr drawdown sufficient area has bene provided. The anticipated drawdown time is about 36hrs.

Appendix B

CDS UNIT SIZING

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD BASED ON A FINE PARTICLE SIZE DISTRIBUTION

Project Name: 149 Caplan Ave
Location: Barrie, ON
OGS #: 1 - Revision 1

Engineer: **Gerrits Engineering Limited**
Contact: Jeff McCuaig, P.Eng.
Report Date: 18-Dec-20

Area 1.440 ha
Weighted C 0.75
CDS Model 2025

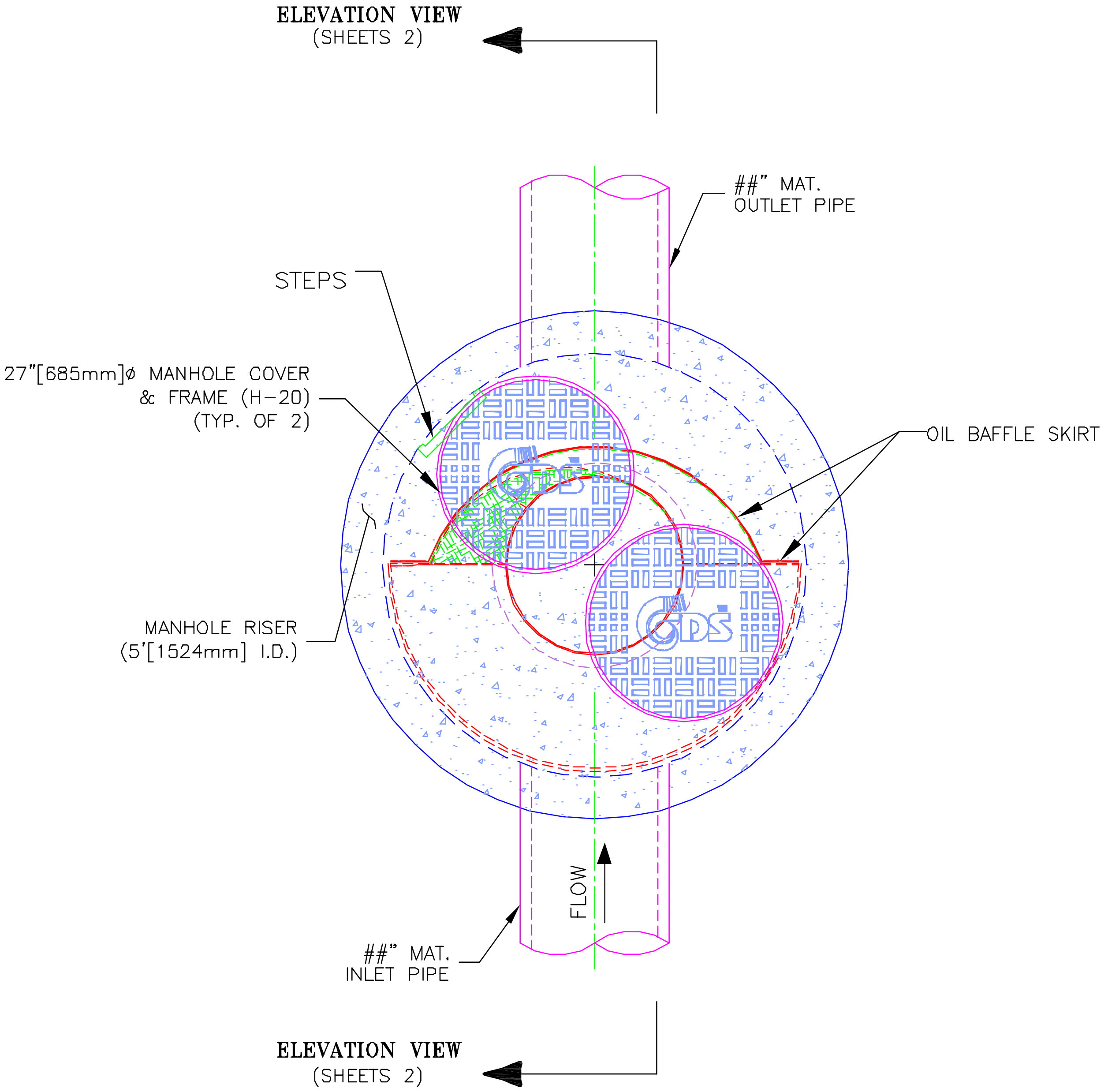
Rainfall Station # 203
Particle Size Distribution FINE
CDS Treatment Capacity 45 l/s

Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
1.0	10.8%	19.6%	3.0	3.0	6.6	97.0	10.5
1.5	9.5%	29.0%	4.5	4.5	9.9	96.0	9.1
2.0	8.4%	37.4%	6.0	6.0	13.3	95.1	8.0
2.5	6.8%	44.2%	7.5	7.5	16.6	94.1	6.4
3.0	5.6%	49.8%	9.0	9.0	19.9	93.2	5.2
3.5	5.1%	54.9%	10.5	10.5	23.2	92.2	4.7
4.0	4.9%	59.8%	12.0	12.0	26.5	91.3	4.5
4.5	4.1%	63.9%	13.5	13.5	29.8	90.3	3.7
5.0	3.5%	67.4%	15.0	15.0	33.1	89.4	3.1
6.0	4.9%	72.3%	18.0	18.0	39.8	87.5	4.3
7.0	4.0%	76.3%	21.0	21.0	46.4	85.6	3.4
8.0	3.2%	79.5%	24.0	24.0	53.0	83.7	2.7
9.0	2.2%	81.7%	27.0	27.0	59.6	81.8	1.8
10.0	2.0%	83.7%	30.0	30.0	66.3	79.9	1.6
15.0	8.2%	91.9%	45.0	45.0	99.4	70.4	5.7
20.0	3.4%	95.2%	60.0	45.3	100.0	53.0	1.8
25.0	2.5%	97.7%	75.1	45.3	100.0	42.4	1.1
30.0	1.4%	99.1%	90.1	45.3	100.0	35.3	0.5
35.0	0.3%	99.4%	105.1	45.3	100.0	30.3	0.1
40.0	0.6%	100.0%	120.1	45.3	100.0	26.5	0.2
45.0	0.0%	100.0%	135.1	45.3	100.0	23.5	0.0
50.0	0.0%	100.0%	150.1	45.3	100.0	21.2	0.0
							86.8

Removal Efficiency Adjustment[2] = 6.5%
Predicted Net Annual Load Removal Efficiency = 80.3%
Predicted Annual Rainfall Treated = 96.6%

1 - Based on 27 years of hourly rainfall data from Canadian Station 6110557, Barrie ON
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.
3 - CDS Efficiency based on testing conducted at the University of Central Florida
4 - CDS design flowrate and scaling based on standard manufacturer model & product specifications

PLAN VIEW



CDS MODEL PMSU20_25m, 1.7 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT

PROJECT NAME

CITY, STATE

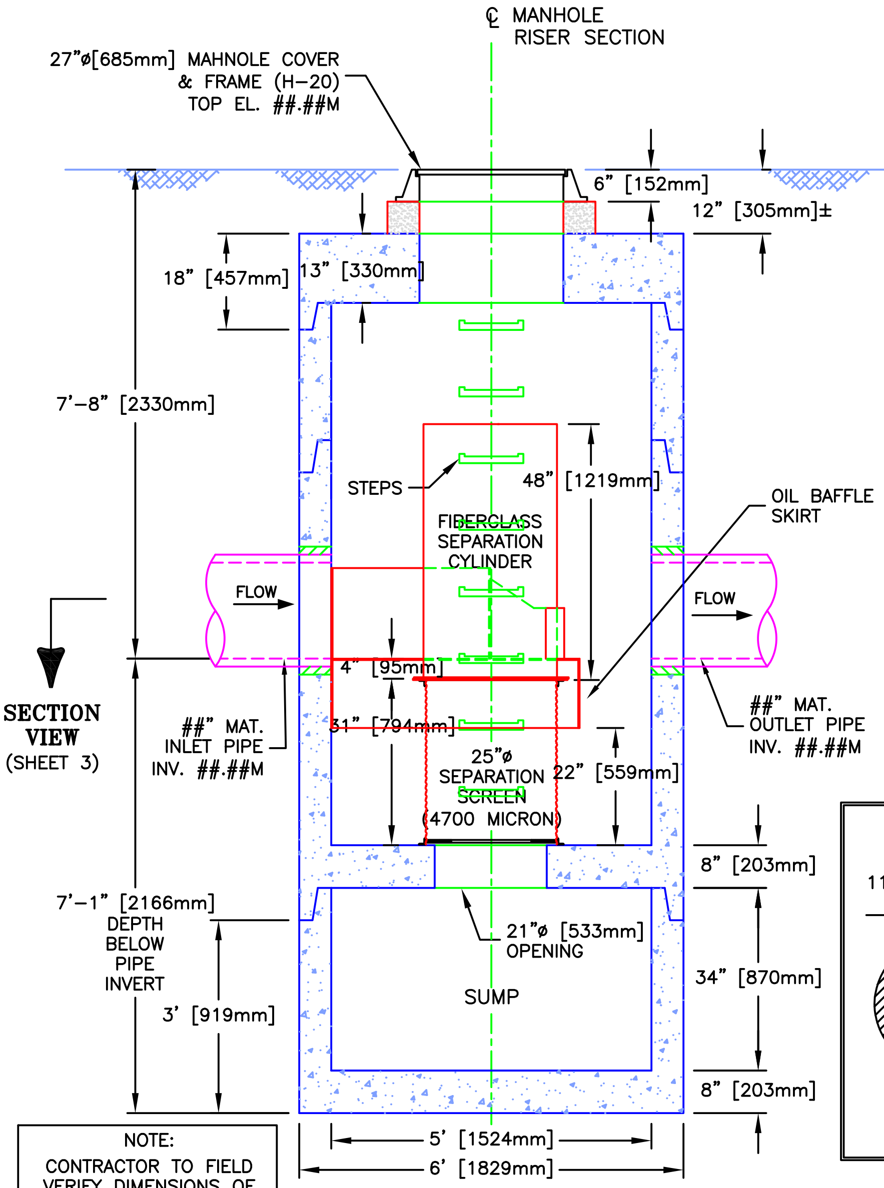
JOB# XX-##-###
DATE ##/##/##
DRAWN INITIALS
APPROV.

SCALE
1" = 2'

SHEET
1

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

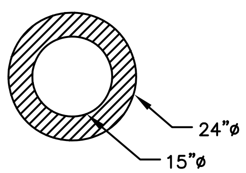
ELEVATION VIEW



NOTE:
CONTRACTOR TO FIELD
VERIFY DIMENSIONS OF
OR CONCRETE SECTIONS

INSERT

11 GA. STAINLESS STEEL
SEPARATION PLATE



PLAN VIEW

CDS MODEL PMSU20_25m, 1.7 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT

PROJECT NAME
CITY, STATE

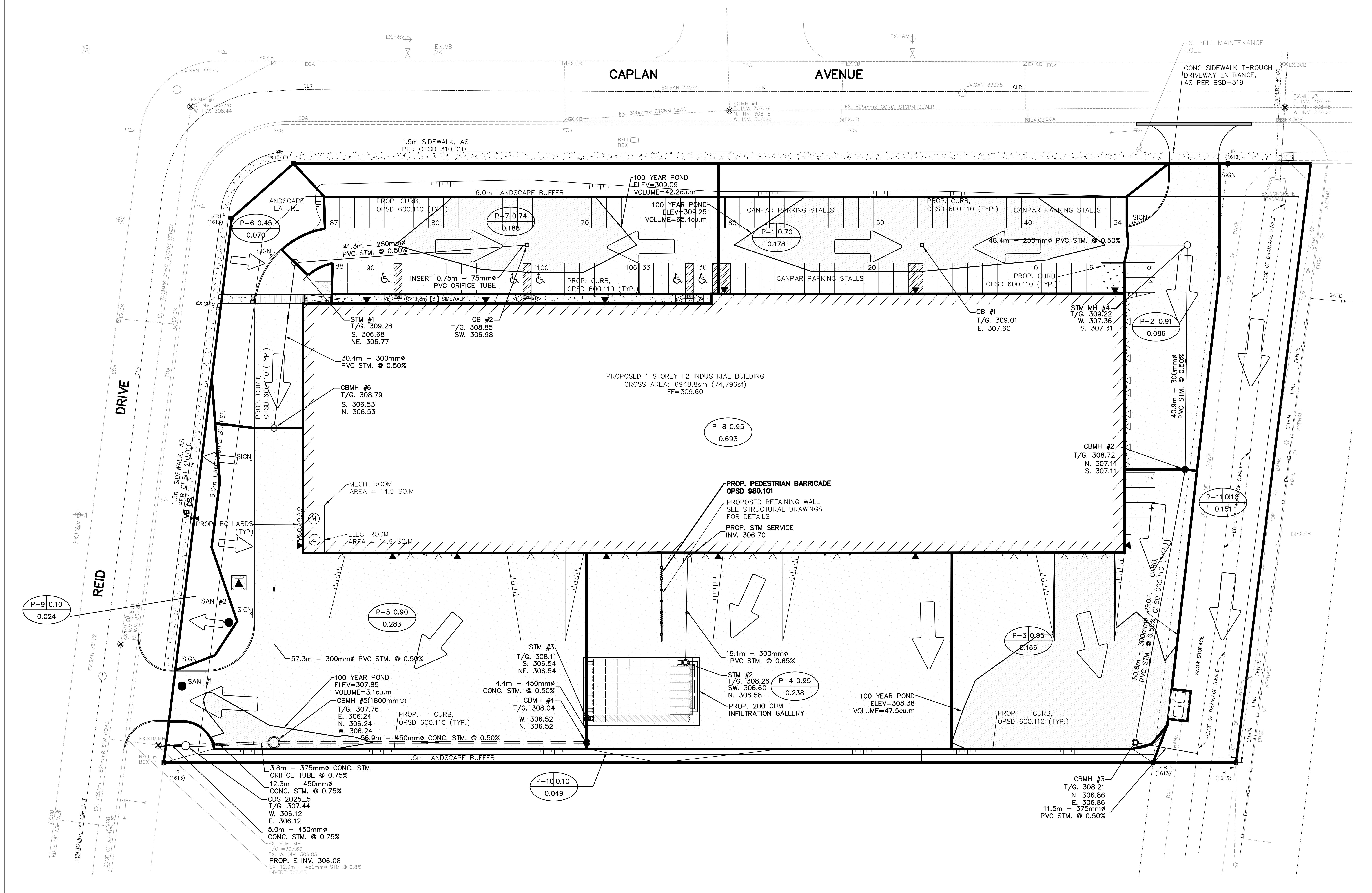
JOB# XX-##-###
DATE ##/##/##
DRAWN INITIALS
APPROV.

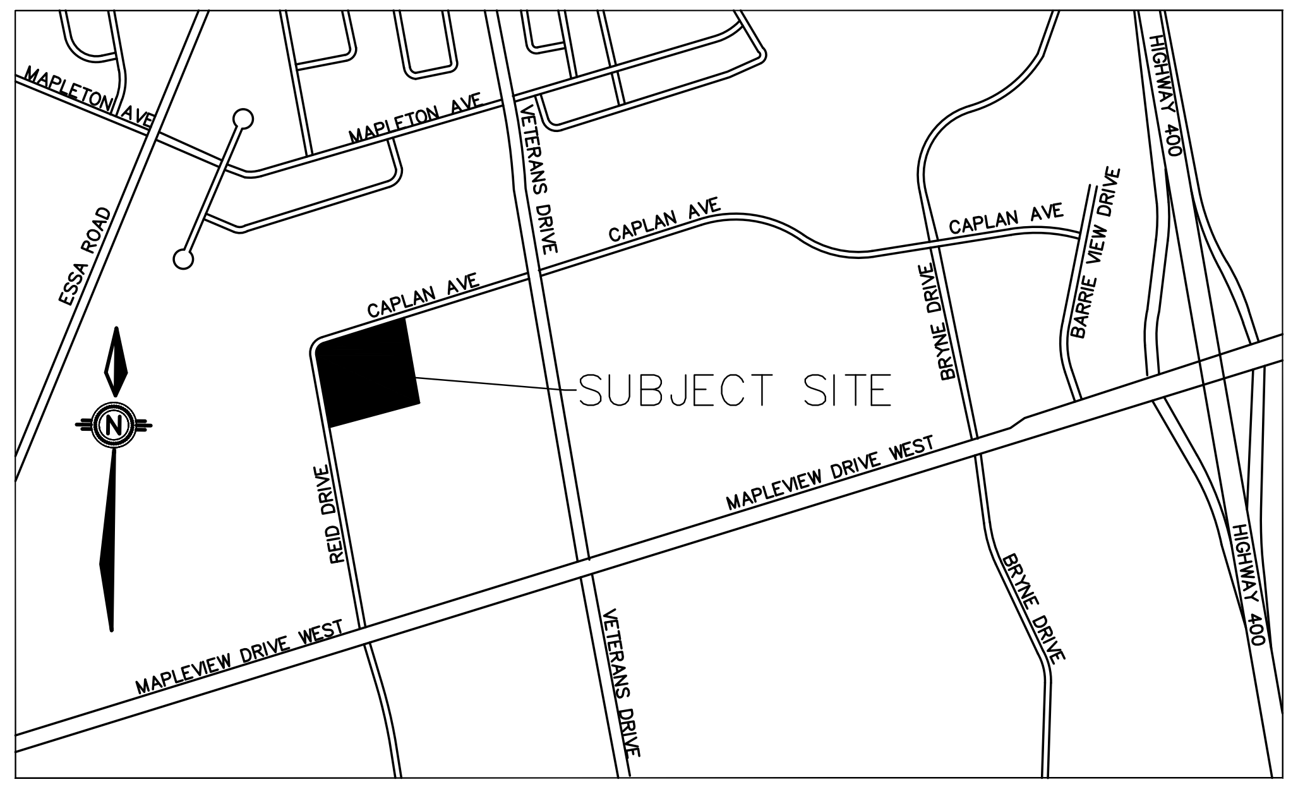
SCALE
1" = 3'

SHEET
2

Appendix C

Figures & Drawings





LEGEND

- ○ EXISTING SANITARY MAINTENANCE HOLE
- ● PROPOSED SANITARY MAINTENANCE HOLE
- ☒ EXISTING CATCH BASIN
- ☐ PROPOSED CATCH BASIN
- EXISTING CATCH BASIN MAINTENANCE HOLE
- PROPOSED CATCH BASIN MAINTENANCE HOLE
- ⊗ EXISTING STORM MAINTENANCE HOLE
- ◎ PROPOSED STORM MAINTENANCE HOLE
- 324.00 PROPOSED ELEVATION
- ×324.00 EXISTING ELEVATION
- 1.6% PROPOSED GRADE
- EXISTING HYDRO TRANSFORMER
- SERVICE CAP
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT
- EX.VB EXISTING WATER VALVE
- VB PROPOSED WATER VALVE
- EX.CS EXISTING CURB STOP
- CS PROPOSED CURB STOP
- PROPOSED SIGN
- EXISTING LIGHT POLE
- ▶ MANDOOR
- ▷ OVERHEAD DOOR
- FIRE DEPT CONNECTION
- Ⓔ ELECTRICAL ROOM
- Ⓜ WATER METER LOCATION
- PROPOSED TRANSFORMER
- LANDSCAPE AREA
- LIGHT–DUTY ASPHALT AREA
- CONCRETE AREA
- HEAVY–DUTY ASPHALT AREA
- ⇩ OVERLAND FLOW

ID P–2 0.75 RUNOFF COEFFICIENT
5.55 AREA (ha)

Gerrits
ENGINEERING

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0 5 10 20 30 40 50mm
0" 1/4" 1/2" 1" 1 1/2" 2"

No.	Issuance Description	YY/MM/DD
1.	ISSUED FOR QUOTATION	20/08/06
2.	SITE PLAN APPROVAL	20/12/30
3.	SPA - 2ND SUBMISSION	21/03/12

HORIZONTAL CONTROL:
ID# 03120040035
R.I.B. W/ BRASS CAP PROTECTED BY A WATER VALVE COVER. LOCATED JUST BEHIND THE SOUTH CURB LINE OF MAPLEVIEW DRIVE WEST, EAST OF VETERAN'S DRIVE.
NORTHING–N4909639.121m, EASTING–E603897.740m

ID# 03120040027
R.I.B. W/ BRASS CAP PROTECTED BY A WATER VALVE COVER. LOCATED ON NW. CORNER OF MAPLEVIEW AND BARRIE VIEW DR AT BACK OF SIDEWALK
NORTHING–N4909901.795m, EASTING–E604588.426m

VERTICAL CONTROL:
ID# 03120060018
BRASS TABLET. LOCATED ON CULVERT HEADWALL NE. CORNER OF MAPLEVIEW AND VETERANS DR. SET FLUSH ON E. FACE OF HEADWALL, 110mm BELOW TOP OF WALL AND 110mm N. OF THE SOUTH INSIDE CORNER OF THE WALL.
ELEVATION–306.589m

ID# 03120030031
BRASS TABLET. LOCATED ON CULVERT HEADWALL SW. CORNER OF MAPLEVIEW AND BARRIE VIEW DR. SET FLUSH ON W. FACE OF HEADWALL, 290mm BELOW TOP OF WALL AND 180mm NORTH OF THE S. END OF WALL.
ELEVATION–301.195m

BENCHMARK: TOP OF TOP OF SPINDLE OF FIRE HYDRANT ELEVATION OF 311.23

Issued For:
SITE PLAN APPROVAL

Client
Aerarium DEVELOPMENT CORPORATION

Project
1 REID DRIVE
149 CAPLAN AVE, BARRIE, ONTARIO

Drawing:
POST–DEVELOPMENT STORM WATER MANAGEMENT

Project No. 109-258-19	Designed by: AC / SAS	Checked by: KF	
Scale: 1:?00	Drawn by: AC / SAS	Approved by: JDM	

Orientation

Stamp

Drawing No.
STM-2

NOTES FOR SEDIMENT & EROSION CONTROL

1. DISTURBED AREAS THAT HAVE FAILED TO HAVE STABLE GROUND COVER ESTABLISHED BY OCTOBER 30TH SHALL BE PROTECTED WITH A SILTATION CONTROL FENCE OR STRAW MULCH ETC. AND MAINTAINED BY THE CONTRACTOR UNTIL VEGETATION BECOMES ESTABLISHED IN THE SUBSEQUENT GROWING SEASON.
2. ANY DEWATERING WASTE SHALL BE DISCHARGED TO A VEGETATED AREA AT LEAST 30 M FROM ANY WATERCOURSE AND FILTERED. FILTERING METHODS MUST BE APPROVED BY THE SITE ADMINISTRATOR.
3. SILT FENCE SHALL BE PUT IN PLACE PRIOR TO AND MAINTAINED DURING ALL GRADING. SILT FENCE TO BE INSPECTED PRIOR TO COMMENCEMENT OF EARTH GRADING ACTIVITIES. SILT FENCE TO BE INSPECTED AND REPAIRED OR REPLACED IF DAMAGED AS DIRECTED BY THE SITE ADMINISTRATOR. SILT CONTROLS TO BE INSPECTED ON A REGULAR BASIS AND AFTER EVERY RAIN EVENT. INSTALLATION SHALL BE TO THE MANUFACTURER'S SUGGESTED SPECIFICATIONS.
4. THE CONTRACTOR SHALL BE PREPARED FOR UNEXPECTED CONDITIONS AND ACCORDINGLY HAVE STOCKPILED MATERIALS ON SITE FOR NECESSARY REPAIRS AS A RESULT OF FAILED OR INADEQUATE CONTROL MEASURES. ALL SEDIMENT AND EROSION CONTROL MEASURES SHALL BE INSPECTED AT LEAST ONCE A WEEK, AND AFTER EVERY RAINFALL EVENT.
5. MUD MATS AT SOUTH ENTRANCE WHERE CONSTRUCTION TRAFFIC ENTERS OR LEAVES THE SITE SHALL BE USED. MUD MATS TO CONSIST OF 300mm min. 100mm TO 200mm CLEAR STONE HAVING DIMENSIONS 6.0m WIDE X 30.0m LONG (AS PER BSD 23D).
6. CONTRACTOR SHALL OBTAIN A CURRENT COPY AND BECOME FAMILIAR WITH OPSS 577, CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES AS WELL AS ALL APPLICABLE MUNICIPAL STANDARDS.
7. THE CONTRACTOR MAY CONSIDER ALTERNATIVE SEDIMENT AND EROSION CONTROL MEASURES. SUCH MEASURES SHOULD BE PRESENTED IN WRITING FOR APPROVAL OF THE SITE ADMINISTRATOR AND MUST BE APPROVED IN WRITING BY THE CONSERVATION AUTHORITY.
8. THE TOPS OF ALL FILTER FABRIC MUST BE A MINIMUM OF 1.0 METRES ABOVE THE GROUND LEVEL AND ATTACHED TO THE FENCE WITH A CONTINUOUS STEEL WIRE. ALTERNATIVELY, THE FILTER FABRIC MUST BE FOLDED OVER THE TOP OF THE FENCE AND ATTACHED TO THE FENCE WITH WIRE LOOPED THROUGH THE FABRIC ON BOTH SIDES OF THE FENCE. FILTER FABRIC IS TO BE TERRAFIX 270R OR EQUIVALENT.
9. ALL DISTURBED GROUND LEFT INACTIVE SHALL BE STABILIZED BY SEEDING, SODDING, MULCHING, OR COVERING OR OTHER EQUIVALENT CONTROL MEASURES. THIS PERIOD OF INACTIVITY SHALL BE AT THE DISCRETION OF THE DIRECTOR OF INFRASTRUCTURE BUT SHALL NOT EXCEED THIRTY DAYS OR SUCH LONGER PERIOD DEEMED ADVISABLE BY DIRECTOR OF INFRASTRUCTURE.
10. CONTRACTOR SHALL INSTALL AND MAINTAIN CATCHBASIN SEDIMENT BARRIERS THROUGHOUT THE SITE DURING ALL CONSTRUCTION ACTIVITIES IN ORDER TO TRAP SEDIMENT.

SEQUENCE OF CONSTRUCTION

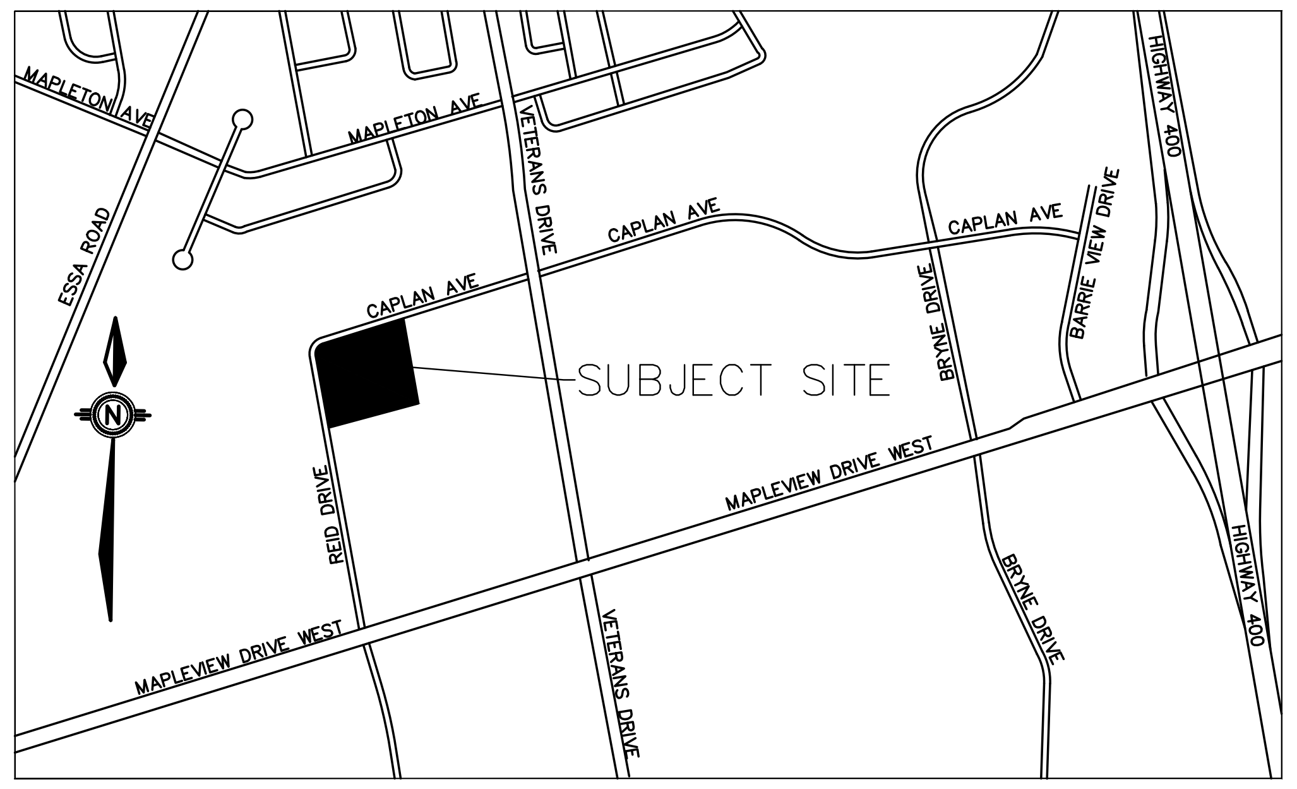
1. ENGINEER TO BE NOTIFIED PRIOR TO INITIATION OF ANY ON SITE WORKS.
2. SILT FENCE AND CONSTRUCTION ACCESS MATS TO BE INSTALLED PRIOR TO THE COMMENCEMENT OF ANY WORKS ONSITE.
3. VEGETATION REMOVAL MAY COMMENCE AFTER ALL SILT FENCE IS INSTALLED AND APPROVED BY THE ENGINEER.
4. COMMENCE WITH EARTH EXCAVATION AND SITE SERVICING (TO BE REMOVED FROM SITE – NO STOCKPILE).
5. EROSION CONTROL MEASURES TO BE MAINTAINED AS DIRECTED BY THE ENGINEER DURING THE CONSTRUCTION PERIOD. ADDITIONAL CONTROL MEASURES MAY BE REQUIRED AT THE DISCRETION OF THE ENGINEER.
6. ALL DISTURBED GROUND LEFT INACTIVE FOR MORE THAN 30 DAYS SHALL BE STABILIZED WITH SEED, SOD, MULCH OR OTHER ADEQUATE COVERING, AS INSTRUCTED BY THE ENGINEER.

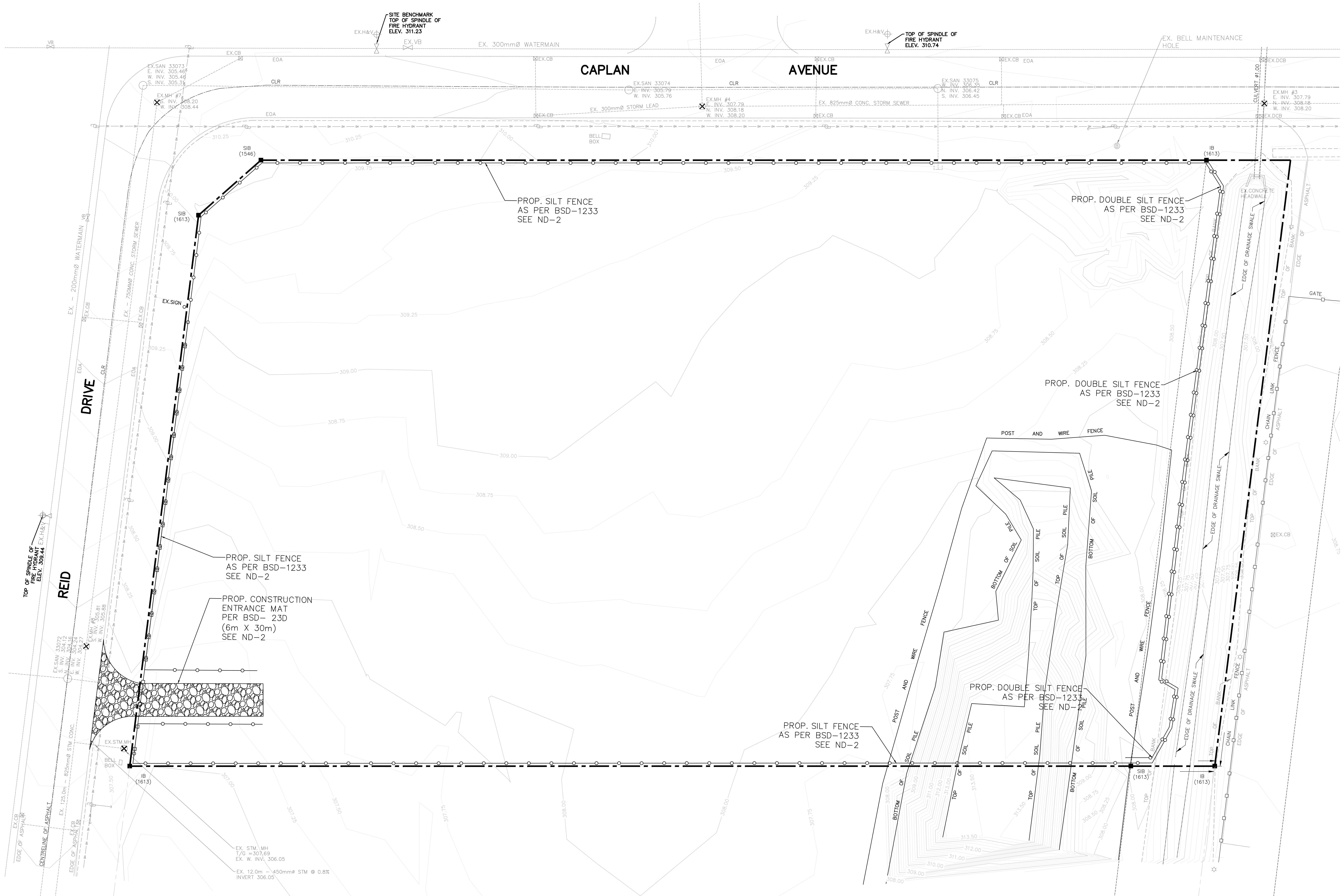
Site Area	21272 sq.m.
Area of Alteration	21272 sq.m.
Existing Land Use	Industrial (EM–1)
Adjoining Property Land Use	Industrial/Institutional
Soil Type	Dundonald (Ds)

NO FUEL TO BE STORED ON SITE. IN CASE OF A SPILL PLEASE CONTACT:
MOECC SPILLS ACTION CENTER
1–800–268–6060

THE ON–CALL CITY OF BARRIE ENVIRONMENTAL OFFICER SHALL ALSO BE NOTIFIED VIA PAGER (705) 720–5056 IN THE EVENT THE SPILL REACHES PUBLIC PROPERTY.

THE SEDIMENT CONTROLS ARE TO REMAIN IN PLACE UNTIL WRITTEN DIRECTION IS RECEIVED FROM THE ENGINEER REGARDING THEIR REMOVAL.





LEGEND

- ○ EXISTING SANITARY MAINTENANCE HOLE
- ● PROPOSED SANITARY MAINTENANCE HOLE
- ⊠ EXISTING CATCH BASIN
- □ PROPOSED CATCH BASIN
- ⊗ EXISTING CATCH BASIN MAINTENANCE HOLE
- ◉ PROPOSED CATCH BASIN MAINTENANCE HOLE
- ⊗ EXISTING STORM MAINTENANCE HOLE
- ◎ PROPOSED STORM MAINTENANCE HOLE
- 324.00 PROPOSED ELEVATION
- 324.00 EXISTING ELEVATION
- 1.6% PROPOSED GRADE
- ▣ EXISTING HYDRO TRANSFORMER
- ⊓ SERVICE CAP
- ✧ EXISTING FIRE HYDRANT
- ✦ PROPOSED FIRE HYDRANT
- EX.VB ⋈ EXISTING WATER VALVE
- VB ⋈ PROPOSED WATER VALVE
- EX.CS EXISTING CURB STOP
- CS PROPOSED CURB STOP
- PROPOSED SIGN
- ☆ EXISTING LIGHT POLE
- ▶ MANDOOR
- ▷ OVERHEAD DOOR
- FIRE DEPT CONNECTION
- Ⓔ ELECTRICAL ROOM
- Ⓜ WATER METER LOCATION
- △ PROPOSED TRANSFORMER
- ▨ LANDSCAPE AREA
- ▨ LIGHT–DUTY ASPHALT AREA
- ▨ CONCRETE AREA
- ▨ HEAVY–DUTY ASPHALT AREA
- —o— PROPOSED SILT FENCE

Gerrits ENGINEERING

222 Mapleview Drive West, Suite 300
Barrie, ON L4N 9E7 Canada
Tel.:705.737.3303
Fax.: F.705.737.1772
www.gerreng.com

0 5 10 20 30 40 50mm
0" 1/4" 1/2" 1" 1 1/2" 2"

No.	Issuance Description	YY/MM/DD
1.	ISSUED FOR QUOTATION	20/08/06
2.	SITE PLAN APPROVAL	20/12/30
3.	SPA - 2ND SUBMISSION	21/03/12

HORIZONTAL CONTROL:

ID# 03120040035
R.I.B. W/ BRASS CAP PROTECTED BY A WATER VALVE COVER. LOCATED JUST BEHIND THE SOUTH CURB LINE OF MAPLEVIEW DRIVE WEST, EAST OF VETERAN'S DRIVE.
NORTHING–N4909639.121m, EASTING–E603897.740m

ID# 03120040027
R.I.B. W/ BRASS CAP PROTECTED BY A WATER VALVE COVER. LOCATED ON NW. CORNER OF MAPLEVIEW AND BARRIE VIEW DR AT BACK OF SIDEWALK
NORTHING–N4909901.795m, EASTING–E604588.426m

VERTICAL CONTROL:

ID# 03120060018
BRASS TABLET. LOCATED ON CULVERT HEADWALL NE. CORNER OF MAPLEVIEW AND VETERANS DR. SET FLUSH ON E. FACE OF HEADWALL, 110mm BELOW TOP OF WALL AND 110mm N. OF THE SOUTH INSIDE CORNER OF THE WALL.
ELEVATION–306.589m

ID# 03120030031
BRASS TABLET. LOCATED ON CULVERT HEADWALL SW. CORNER OF MAPLEVIEW AND BARRIE VIEW DR. SET FLUSH ON W. FACE OF HEADWALL, 290mm BELOW TOP OF WALL AND 180mm NORTH OF THE S. END OF WALL.
ELEVATION–301.195m

BENCHMARK: TOP OF TOP OF SPINDLE OF FIRE HYDRANT ELEVATION OF 311.23

Issued For:
SITE PLAN APPROVAL

Client
Aerarium DEVELOPMENT CORPORATION

Project
1 REID DRIVE
149 CAPLAN AVE, BARRIE, ONTARIO

Drawing:
EROSION & SEDIMENT CONTROL PLAN

Project No.	109-258-19	Designed by: AC / SAS	Checked by: KF
Scale:	1:400	Drawn by: AC / SAS	Approved by: JDM

Orientation

Stamp

Drawing No.
ESC-1

Appendix D

Geotechnical Investigation Report – Central Earth Engineering

April 21, 2020

647 Welham Road, Unit 14
Barrie, Ontario, L4N 0B7
P: (705) 719-7994
F: (888) 558-9424
www.centralearth.ca

GEOTECHNICAL REPORT

Proposed Industrial Building
1 Reid Drive
Barrie, Ontario

Prepared For: CAPREID INC.
Type of Document: Final Report
Reference Number: 20-1067A
Prepared By: Russell Wiginton, P.Eng.
Reviewed By: Alexander Winkelmann, P.Eng.
Date Issued: April 21, 2020

Table of Contents

Figures

Appendices

1 Introduction

Central Earth Engineering Inc. (CEE) was retained by CAPREID INC. to complete a geotechnical investigation and report for 1 Reid Drive in Barrie, Ontario. A site location plan is provided as Figure 1. The site measures approximately 180 metres east to west by 100 metres north to south and is undeveloped. It is vegetated with grasses and slopes gradually from near Elev. 310 metres in the north to Elev. 308 metres in the south based on Simcoe County online mapping with contours. An aerial image of the site is shown on Figure 2.

CEE was provided with a preliminary site plan for review in preparation of this report. It is understood that the proposed development includes the construction of an approximately 70,000 sq. ft. industrial building that will be divided into at least 2 separate spaces (warehouse and office space) with associated driveways, parking areas, truck delivery areas, sidewalks, and landscaping.

The purpose of the subsurface investigation was to assess the subsurface soil conditions at the site by advancing five (5) boreholes across the site. The results of the boreholes are summarized within this report, and were used to provide geotechnical engineering recommendations in support of the proposed development including design recommendations for foundations, pavements, and slabs-on-grade, seismic site classification, earth pressures, and site servicing, as well as considerations for constructability such as soil excavation, compaction, and temporary groundwater control. Monitoring well installations and groundwater level measurements were also completed.

2 Procedures and Methodology

Prior to the commencement of drilling activities, the locations of underground utilities including natural gas, electrical, telephone, water, etc. were marked out by public and private utility locating companies. The fieldwork for the drilling program was carried out on March 31, 2020. A total of five (5) boreholes (Boreholes 1 to 5) were advanced on site by Drilltech Drilling using an M-5 track-mounted drill rig. To advance the boreholes, continuous flight solid stem augers and standard soil sampling equipment was utilized. All samples were collected as per ASTM D1586 to assess the strength characteristics of the substrate.

The boreholes were advanced to depths of 5.0 to 9.6 metres below existing grade (Elev. 303.9 to 298.8 metres). The horizontal locations were laid out in the field by Central Earth Engineering prior to the drilling operations. Ground surface elevations of the boreholes were measured using survey equipment in relation to a geodetic benchmark (well casing from a nearby property), with a known geodetic elevation. GPS coordinates were measured with a handheld GPS unit and referenced to the NAD 83 geodetic datum.

The CEE field staff examined and classified characteristics of the soils encountered in the boreholes, including the presence of fill materials, made groundwater observations during and upon completion of the drilling, recorded observations of borehole construction, and processed the recovered samples. Soil sampling was conducted at regular intervals for the full depth of the borehole. All recovered soil samples were logged in the field, carefully packaged and transported to the laboratory for more detailed examination and classification. In the laboratory, the samples were classified as to their visual and textural characteristics and geotechnical laboratory testing for grain size was carried out with the results provided in Appendix B.

A 50 mm diameter monitoring well was installed in Borehole 3 by CEE. Two existing monitoring wells were located on site and were measured by CEE to be 50 mm in diameter and extend to depths of 6.0 and 7.7 metres below grade. It is unknown who installed these monitoring wells and for what purpose. Boreholes 1 and 2 were advanced adjacent to the existing wells and extended below the bottom depth of the wells to determine the stratigraphy captured by the existing well screens. Monitoring well construction is shown on the borehole logs in Appendix A.

3 Subsurface Conditions

3.1 General Overview

The detailed soil profiles encountered in the boreholes are indicated on the attached borehole logs in Appendix A, and the geotechnical laboratory results are included in Appendix B. Borehole locations are shown on Figure 2 and a subsurface profile is provided as Figure 3. It should be noted that the conditions indicated on the borehole logs are for specific locations only and can vary between and beyond the locations. It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones and should not be interpreted as exact planes of geological change.

In addition, the descriptions provided in the borehole logs are inferred from a variety of factors, including: visual observations of the soil samples retrieved, laboratory testing, measurements prior to and after drilling, and the drilling process itself (speed of drilling, shaking/grinding of the augers, etc.). The passage of time also may result in changes in conditions interpreted to exist at locations where sampling was conducted.

3.2 Stratigraphy

All boreholes (Boreholes 1 to 5) encountered a glacial till deposit at the ground surface with a cohesionless matrix consisting of sandy silt with some gravel and some clay. The upper 0.8 metres of the glacial till in Boreholes 1, 2, and 5 was weathered/disturbed. The glacial till extended to depths of 3.1 to 7.6 metres below grade (Elev. 305.6 to 301.7 metres) in Boreholes 1 to 3 and 5, and Borehole 4 terminated in the glacial till at a depth of 5.0 metres below grade (Elev. 303.9 metres). The glacial till is moist and brown, turning grey and wet with depth in Borehole 3. Standard Penetration Test (SPT) results ("N" Values) measured in the glacial till ranged from 8 to more than 100 blows per 300 mm of penetration, indicating a loose to very dense (but generally compact to dense) relative density.

In Boreholes 1 to 3 and 5, the glacial till was underlain by a cohesive deposit of clay and silt that was grey and moist. Frequent silt partings were encountered in some zones of the deposit. The clay and silt was encountered at depths of 3.1 to 7.6 metres below grade (Elev. 305.6 to 301.7 metres), extended to depths of 4.6 to 9.1 metres (Elev. 303.6 to 300.2 metres) in Boreholes 1 to 3, and extended beyond the vertical depth of investigation in Borehole 5 at a depth of 5.0 metres below grade (Elev. 303.6 metres). The SPT "N" Values measured in the clay and silt ranged from 9 to 42 blows per 300 mm of penetration, indicating a stiff to hard consistency. The disturbed soil samples recovered from the split-spoon sampler were also tested using a pocket penetrometer to obtain a general sense of the undrained shear strength of the clay and silt, which ranged from approximately 175 to greater than 225 kPa.

In Boreholes 1 to 3, the clay and silt was underlain by a cohesionless deposit of fine sand with trace to some silt. The brown and moist to wet sand was encountered at depths of 4.6 to 9.1 metres below grade (Elev. 303.6 to 300.2 metres) and extended beyond the vertical depth of investigation at 8.1 to 9.6 metres below grade (Elev. 300.1 to 298.8 metres). SPT "N" Values measured in the sand ranged from 21 to 80 blows per 300 mm of penetration, indicating a compact to very dense relative density.

3.3 Groundwater

Unstabilized ground water level measurements and cave measurements were taken upon completion of drilling of each borehole. These measurements provide a rough estimate of the possible excavation and temporary groundwater control constructability considerations that may arise. Boreholes 3 and 5 remained dry upon completion and unstabilized water was encountered at depths of 3.6 to 6.1 metres below grade in Boreholes 1, 2, and 4. The boreholes remained open or caved up to a depth of 4.1 metres.

A 50 mm diameter monitoring well was installed in Borehole 3 by CEE. Two existing monitoring wells were located on site and were measured by CEE to be 50 m in diameter and extend to depths of 6.0 and 7.7 metres below grade. It is unknown who installed these monitoring wells and for what purpose. Boreholes 1 and 2 were advanced adjacent to the existing wells and extended below the bottom depth of the wells to determine the stratigraphy captured by the existing well screens. Monitoring well construction and groundwater measurements are shown on the borehole logs in Appendix A, and the results are summarized in the table below.

Monitoring Well	**Well Screen Location**		**Strata Screened**	**Depth / Elevation (m) of Groundwater Table**	
	Depth (m)	**Elevation (m)**		**March 31, 2020**	**April 4, 2020**
BH 1	6.1 to 7.6	302.3 to 300.8	Clay & Silt	5.82 / 302.58	5.81 / 302.59
BH 2	4.5 to 6.0	303.6 to 302.1	Fine Sand	5.87 / 302.30	5.86 / 302.31
BH 3	7.9 to 9.4	301.4 to 299.9	Clay & Silt; Fine Sand	6.25 / 303.09	6.28 / 303.06

Based on the results of the water levels and the moisture contents of the soil within the boreholes, the prevailing groundwater table is expected to be near a depth of 5.8 metres (Elev. 302.5 metres) in the southern and eastern parts of the site, and near a depth of 6.3 metres (Elev. 303 metres) in the northwestern part of the site.

Groundwater levels are expected to show seasonal fluctuations and vary in response to prevailing climate conditions.

4 Engineering Design Parameters & Analysis

CEE was provided with a preliminary site plan for review in preparation of this report. It is understood that the proposed development includes the construction of an approximately 70,000 sq. ft. industrial building that will be divided into at least 2 separate spaces (warehouse and office space) with associated driveways, parking areas, truck delivery areas, sidewalks, and landscaping.

4.1 Foundation Design

Foundations at this site may be constructed as conventional spread and strip footing foundations that bear on undisturbed glacial till. Glacial till was encountered at the ground surface in the boreholes, but the upper 0.8-metre-thick weathered / disturbed zone of the glacial till encountered in Boreholes 1, 2, and 5 is not suitable for the support of foundations.

Foundations set a minimum of 0.3 metres into the undisturbed glacial till encountered at Elev. 309.3 to 307.4 metres may be designed using a geotechnical reaction at SLS of 150 kPa, for an estimated settlement of 25 mm or less. The maximum factored geotechnical resistance at ULS is 225 kPa.

The minimum strip and spread footing widths to be used shall be dictated as per the Ontario Building Code, regardless of loading considerations. Footings stepped from one level to another must be at a slope not exceeding 7 vertical to 10 horizontal. This concept should also be applied to excavations for new foundations in relation to existing footings or underground services unless rigid shoring is provided. All footings and pile caps exposed to ambient air temperature throughout the year must be provided with a minimum of 1.2 metres of earth cover or equivalent insulation for frost protection.

The foundation design parameters provided above are predicated on the assumption that the foundation subgrade surface is undisturbed, and that all deleterious, softened, disturbed, organic, and caved material is removed. The foundation excavation must be done in such a way that groundwater is controlled to prevent any disturbance to the foundation base.

The foundation subgrade must be reviewed by the geotechnical engineer prior to concrete placement to ensure the foundation design parameters provided above are applicable, and to provide remedial recommendations if necessary. If the foundation excavation will be open for a prolonged period of time, the foundation subgrade should be protected with a skim coat of lean mix concrete (after inspection by the geotechnical engineer), to ensure that no deterioration will occur due to weather effects.

4.2 Seismic Site Classification

Section 4.1.8.4 of the Ontario Building Code (2012) provides values of the acceleration and velocity-based site coefficients (F_a and F_v) for various time periods, associated with specific Site Classes. These Site Classes are based on the energy-corrected Average Standard Penetration Resistance values and undrained shear strength within the upper 30 metres of soil underlying the grade beams or foundations of the proposed structure. As the boreholes were advanced less than this depth at the site, the site classification recommendation provided below assumes that the soil conditions are similar below the drilled depth.

The native soils below the site are typically cohesionless deposits that range from compact to very dense. Based on these subsurface conditions, the Site Classification for Seismic Site Response is “D”.

4.3 Earth Pressures

Underground levels, basements, retaining walls, cantilevered shoring walls and shoring walls with a single level of earth anchors all must be designed to resist unbalanced lateral earth pressures imparted from the weight of adjacent soils. Lateral earth pressures are calculated using the following equation:

$$P = K[\gamma h + q]$$

where,
P = the horizontal pressure at depth, **h** (m)
K = the earth pressure coefficient (dimensionless)
h = depth below surface in metres
γ = the bulk unit weight of soil, (kN/m^3)
q = surcharge loading (kPa)

The above equation assumes that a drainage system is present which prevents the build up of any hydrostatic pressure behind the structure subjected to the unbalanced lateral earth pressures. If this is not the case, the equation must be revised to also incorporate the submerged unit weight of the soil multiplied by the earth pressure coefficient, in addition to the water pressure itself.

The values for use in the design of structures subjected to unbalanced lateral earth pressures at this site are as follows:

Soil Type	γ - Bulk Unit Weight (kN/m^3)	φ - Friction Angle (degrees)	Earth Pressure Coefficient (dimensionless)		
			K_a - Active	K_o – At-Rest	K_p - Passive
Granular 'B' (OPSS 1010)	21.0	32	0.31	0.47	3.25
Glacial Till	20.0	33	0.29	0.46	3.39
Clay and Silt	18.0	29	0.35	0.52	2.88

The calculation of the earth pressure coefficients is based on Rankine theory, which provides a conservative estimate as no friction between the soil and the structure is accounted for. The earth pressure coefficients provided above are only applicable for flat ground surfaces beyond the structure and must be increased for sloping ground surfaces.

The earth pressure coefficients referenced within the above table are a function of the friction angle of the adjacent soil, and both the degree and direction of movement of the structure subjected to unbalanced lateral earth pressures. For structures that are restrained at the top (such as basement walls), the at-rest earth pressure coefficient will apply. For structures that allow for 0.1 to 1% of movement away from the soil (such as unrestrained retaining walls), the full active earth pressure coefficient will apply. For structures that allow for 1 to 10% of movement into the soil, the full passive earth pressure coefficient will apply. The percentage movement is based on the height of the structure.

Other types of structures such as shoring walls with multiple rows of tiebacks and soil nail walls are subject to different loading conditions and must be analyzed separately.

4.4 Slab-on-Grade Design

Any topsoil, vegetation, or native soil with a high organic content must be stripped prior to placement of the building. Undisturbed glacial till or inspected and proof-rolled weathered / disturbed glacial till are suitable for the support of a lightly supported unreinforced concrete slab on-grade. The subgrade for the slab on grade must be assessed by the geotechnical engineer, prior to the placement of an aggregate base. If any soft or weak subgrade areas are identified, or if there are areas containing excessive amounts of deleterious/organic material, they must be locally sub-excavated and backfilled with approved clean earth fill or imported granular material and compacted to a minimum of 98% SPMDD. The modulus of subgrade reaction appropriate for design of a slab-on-grade on the undisturbed glacial till or proof-rolled weathered / disturbed glacial till is 30,000 kPa/m.

It is necessary that the floor slabs be provided with a capillary moisture barrier and drainage layer. This is made by placing the slab on a minimum 200 mm layer of clear stone compacted by vibration to a dense state. The upper 50 mm of clear stone can be replaced with 19 mm crusher run limestone for a working surface.

Perimeter and under-slab drainage at the foundation level is not required, provided that the underside of concrete slab is at least 200 mm above the prevailing grade of the site and the surrounding surfaces slope away from the building at a gradient of at least 2% to promote surface water run-off and to reduce groundwater infiltration adjacent to foundations. For the portions of the building below prevailing grade, and for any pits or chambers made below grade level, perimeter drainage or waterproofing is required. To minimize infiltration of surface water, the upper 150 mm of backfill could comprise relatively impervious compacted soil material.

4.5 Site Servicing

4.5.1 Bedding

The type of material and depth of granular bedding below the pipe will, to some extent, depend on the method of construction used by the contractor. Pipe bedding for flexible pipes should follow the requirements in Ontario Provincial Standard Drawing 802.010 or 802.013 or applicable municipal standards. Pipe bedding for rigid pipes should follow the requirements in Ontario Provincial Standard Drawings 802.030 to 802.033 or applicable municipal standards.

A subgrade made within the native soils will provide adequate support for pipes with the bedding requirements as laid out in the above referenced OPS drawings. Where disturbance of the trench base has occurred from groundwater seepage, construction traffic, etc., the disturbed soils should be sub-excavated and replaced with suitably compacted granular fill. If weak zones are encountered, additional bedding materials and differing construction practices may be required and should be determined during construction.

Regardless of whether flexible or rigid pipes are implemented, granular bedding and cover material should consist of a well graded, free draining material, such as Granular “A” (OPSS.MUNI 1010). All granular bedding must be compacted to a minimum of 95% SPMDD.

4.5.2 Backfill

The native soils excavated on site can be re-used as backfill provided the moisture content is within 2% of optimum moisture content. Soil compaction specifications are provided in Section 5.2. The backfill should be compacted to a minimum of 95% SPMDD. In confined areas the layer thickness will have to be reduced to utilize smaller compaction equipment efficiently or by using granular material instead of locally sourced fill. Any backfill that is frozen, contains a high percentage of organic material (topsoil, peat, etc.), or has otherwise unsuitable deleterious inclusions should not be used as backfill. The maximum cobble or boulder size should not exceed half of the loose lift thickness (i.e. all particles with a diameter greater than 100 mm should be removed).

Where trenches are within the traveled portions of a driveway or parking lot, backfill within the frost penetration depth of 1.2 metres should consist of non-organic, excavated material consistent with the soils surrounding the trench. If this technique is not undertaken, then frequently problems arise with yearly differential frost heave movements between the trench backfill and the adjacent native soil. Alternatively, if different soil is used as the backfill due to issues with achieving compaction, a frost taper of 5H:1V can be implemented to help mitigate the potential for differential settlement and frost heave.

4.6 Pavement Design

4.6.1 Subgrade Preparation

A review of the borehole data suggests that the subgrade for any parking/drive areas will consist of undisturbed glacial till or weathered / disturbed glacial till. These soils are an adequate subgrade for the support of a pavement structure, provided the subgrade is proof-rolled and approved by a geotechnical engineer at the time of construction and does not contain excessive amounts of topsoil, organics or deleterious materials, or soft / weak zones.

A proof-roll is recommended to facilitate the subgrade inspection by the geotechnical engineer. Any organic, loose, soft, wet, or unstable areas should be sub-excavated, and backfilled with clean earth fill compacted to a minimum of 98% SPMDD. It is anticipated that the subgrade bearing modulus will be 30,000 kPa/m on undisturbed glacial till or weathered / disturbed glacial till that is proof-rolled.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures must be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as possible when fill is placed, and the natural subgrade is not disturbed or weakened after it is exposed.

4.6.2 Drainage

Control of surface water is an important factor in achieving a good pavement life. The need for adequate subgrade drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (at a minimum grade of 3 percent) to provide effective drainage toward subgrade drains. Grading adjacent to pavement areas should be designed to ensure that water is not allowed to pond adjacent to the outside edges of the pavement.

Continuous pavement subdrains should be provided along both sides of the parking and driving areas and drained into respective catchbasins to facilitate drainage of the subgrade and the granular materials. The subdrain invert should be maintained at least 0.3 metres below subgrade level. To minimize the problems of differential movement between the pavement and catchbasins/manhole due to frost action, the backfill around the structures should consist of free-draining granulars. Typical pavement drainage details are provided in Appendix C.

4.6.3 Pavement Structure

The industry pavement design methods are based on a design life of 15 to 20 years for typical weather conditions depending on actual traffic volumes. A light duty pavement structure is recommended for parking and driving areas for cars and other light traffic. A heavy duty pavement structure is recommended for fire truck routes, truck driving and turning areas, etc. The following pavement thickness design is provided on the above noted considerations and subgrade basis for an asphaltic concrete pavement structure:

Pavement Layer	**Compaction Requirements**	**Minimum Component Thickness**	
		Light Duty	**Heavy Duty**
Surface Course Asphaltic Concrete: HL- 3 with PG 58-28 Asphalt Cement	OPSS 310	40 mm	40 mm
Binder Course Asphaltic Concrete: HL-8 with PG 58-28 Asphalt Cement		50 mm	80 mm
Base Course: Granular ‘A’	100% SPMDD (ASTM-D698)	150 mm	150 mm
Subbase Course: Granular ‘B’ Type I or II		300 mm	450 mm

The granular and asphalt pavement materials and their placement should conform to OPSS 310, 501, 1010 and 1150. The granular materials should be placed in lifts 200 mm thick or less and must be compacted to a minimum of 100% SPMDD for both granular base and granular subbase. Asphalt materials should be rolled and compacted as per OPSS 310.

If the pavement construction occurs in wet, winter or inclement weather, it may be necessary to provide additional subgrade support for heavy construction traffic by increasing the thickness of the granular subbase, base or both. Further, traffic areas for construction equipment may experience unstable subgrade conditions. These areas may be stabilized utilizing additional thickness of granular materials.

It should be noted that in addition to adherence of the above pavement design recommendations, a close control on the pavement construction process will also be required in order to obtain the desired pavement life. Therefore, it is recommended that regular inspection and testing should be conducted during the pavement construction to confirm material quality, thickness, and to ensure adequate compaction.

5 Constructability Considerations

5.1 Excavations

Excavations must be carried out in accordance with the Occupational Health and Safety Act, Ontario Regulation 213/91 (as amended), Construction Projects, Part III - Excavations, Section 222 through 242. Where workers must enter a trench or excavation the soil must be suitably sloped and/or braced in accordance with the OHSA. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety. It is expected that all excavations made at the site will extend into the cohesionless glacial till deposit, which is considered a Type 3 soil and requires trench sidewalls to be constructed no steeper than 1 horizontal to 1 vertical from the base of the excavation.

Minimum support system requirements for steeper excavations are stipulated in Sections 235 through 238 and 241 of the OHSA and include provisions for timbering, shoring and moveable trench boxes. To reduce the potential for instability of the trench excavations, materials excavated from the service trenches and/or other fill materials or heavy equipment should not be placed near the crest of the trench excavations.

As excavations are expected to be above the prevailing ground water table, there should be limited groundwater control issues present. During times of high precipitation, some water may collect at the base of the excavation. Local sumps placed at the base of the excavation can typically control groundwater seepage in this scenario.

It is important to note that soils encountered in the construction excavations may vary significantly across the site. Our preliminary soil classifications are based solely on the materials encountered in the four boreholes advanced on site. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, we recommend that CEE be contacted immediately to evaluate the conditions encountered. Cobbles and boulders may be encountered embedded in the glacial till deposit during construction excavations.

5.2 Compaction Specifications

Standard Proctor Maximum Dry Density (SPMDD) is the level to which a soil or aggregate is compacted. To achieve the specified SPMDD as indicated in the subsequent sections of this report, all soils or aggregates must be placed in lift thicknesses no greater than 200 mm. If this is not the case, only the upper portion of the lift will be adequately compacted, and the lower portion of the lift has a high probability of not meeting compaction specifications. In addition, industry standard equipment used to determine the degree of compaction consists of nuclear densometers. These devices have an inherent limitation in that they cannot test beyond 300 mm in depth, and so the degree of compaction beyond this depth cannot be quantitatively determined.

Along with lift thickness, ensuring that the soil or aggregate is within 2% of its optimum moisture content ensures that the specified compaction can be reached. If the soil or aggregate is too dry/wet, it is either very difficult or impossible to reach the specified compaction. This is especially true for when higher compaction specifications such as 98% and 100% SPMDD are required. Based on our review of the soil types encountered in the boreholes with associated moisture contents, the soils at this site are as follows:

- One-half of in-situ soil is estimated to be at or near optimum moisture content.
- One-quarter of in-situ soil is estimated to be dry of optimum moisture content.
- One-quarter of in-situ soil is estimated to be wet of optimum moisture content.

Moisture can be increased by adding water and mixing the soil prior to re-use, or by importing soil to the site that is at optimum and can be readily compacted. Moisture can be reduced by tilling or spreading out the soil to dry or blending it with drier material.

In addition to the above compaction specifications, any loose, soft, wet or unstable areas should be sub-excavated, and backfilled with clean earth fill or Granular 'B' (OPSS.MUNI 1010) compacted to a minimum of 98% SPMDD prior to placing new earth fill. This recommendation applies to site servicing, slab-on-grade and pavement subgrades.

5.3 Quality Verification Services

On-site quality verification services are an integral part of the geotechnical design function, and for foundations and retaining walls, are required under the Ontario Building Code. Quality verification services are used to confirm that construction is being conducted in general conformance with the requirements as outlined in the drawings, reports and specifications prepared for the proposed development.

Central Earth Engineering can provide all the on-site quality verification services outlined below:

- The subgrade for shallow foundations must be field reviewed by the geotechnical engineer as required by Section 4.2.2.2 of the Ontario Building Code.
- Installation of retaining structures and related backfilling operations must be field reviewed on a continuous basis by the geotechnical engineer as required by Section 4.2.2.2 of the Ontario Building Code.
- Part-time monitoring of the subgrade support capabilities, material quality, lift thickness, moisture content, degree of compaction, etc. is recommended for the following areas to ensure the recommendations within this report are followed and they perform adequately in the long-term:
    - Slabs-on-grade;
    - Pavement structure (granular layers and asphalt); and
    - Bedding/backfilling of site servicing.
- Testing of the concrete (compressive strength, slump, air content, etc.) and testing of the asphalt (asphalt content and gradation) are recommended to ensure that the quality of the materials being brought to site meet the requirements of the project.

5.4 Site Work

The soils found at this site may become weakened when subjected to traffic, particularly when wet. If there is site work carried out during periods of wet weather, then it can be expected that the subgrade will be disturbed unless an adequate granular working surface is provided to protect the integrity of the subgrade soils from construction traffic. Subgrade preparation works cannot be adequately accomplished during wet weather and the project must be scheduled accordingly. The disturbance caused by the traffic can result in the removal of disturbed soil and use of granular fill material for site restoration or underfloor fill that is not intrinsic to the project requirements.

The most severe loading conditions on the subgrade may occur during construction. Consequently, special provisions such as end dumping and forward spreading of earth and aggregate fills, restricted construction lanes, and half-loads during paving and other work may be required, especially if construction is carried out during unfavourable weather.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the founding subgrade and concrete must be provided. The soil at this site is susceptible to frost damage. Consideration must be given to frost effects, such as heave or softening, on exposed soil surfaces in the context of this particular project development.

6 Limitations and Conclusion

6.1 Limitations

The recommendations and comments provided are necessarily on-going as new information of underground conditions becomes available. More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, conditions not observed during this investigation may become apparent. Should this occur, Central Earth Engineering Inc. should be contacted to assess the situation and additional testing and reporting may be required.

Central Earth Engineering Inc. should be retained for a general review of the final design drawings and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, Central Earth Engineering Inc. will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of the design engineers. The number of boreholes required to determine the localized underground conditions between the boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This report was prepared by Central Earth Engineering Inc. for the account of CAPREID INC. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Central Earth Engineering Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

6.2 Conclusion

It is recognized that municipal/regional governing bodies, in their capacity as the planning and building authority under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both as are expressed and implied.

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to contact our office.

Yours Truly,

Central Earth Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
A.WINKELMANN
100150146
April 21, 2020
PROVINCE OF ONTARIO

Alexander Winkelmann, P.Eng.
President, Geotechnical Engineer

R. Wiginton

LICENSED PROFESSIONAL ENGINEER
R. M. WIGINTON
100193069
Apr. 21, 2020
PROVINCE OF ONTARIO

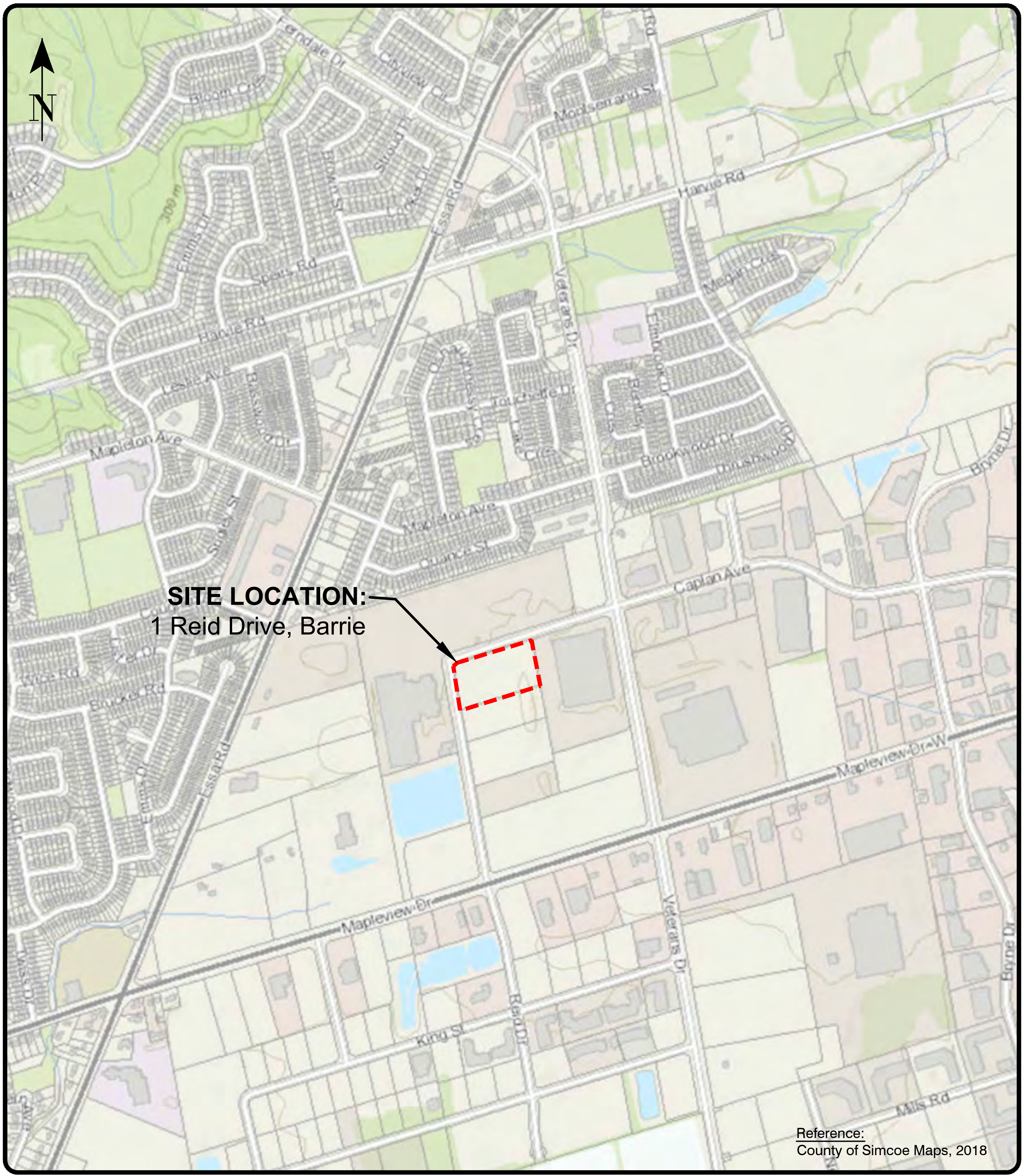
Russell Wiginton, P.Eng.
Geotechnical Engineer

Figures –

SITE LOCATION PLAN

BOREHOLE LOCATION PLAN

SUBSURFACE PROFILE



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Geotechnical Engineering and Construction
Materials Testing & Inspection

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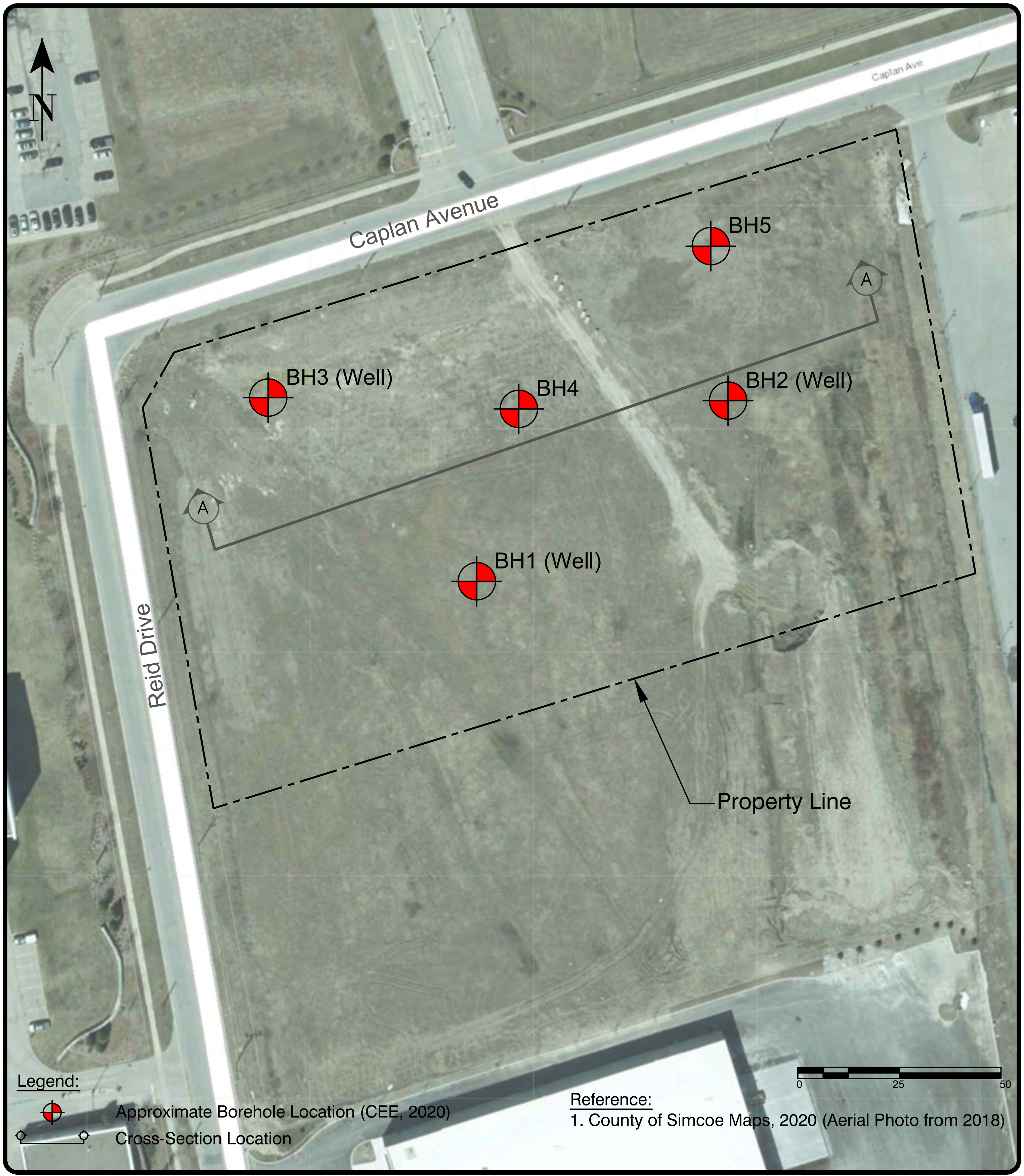
Project: 1 Reid Drive, Barrie

Title: SITE LOCATION PLAN

Approved by:	A.W.	Date:	April 2020	Project No.:	20-1067A
Drawn by:	B.H.	Scale:	N.T.S.	Figure No.:	1



Legend:

⊕ Approximate Borehole Location (CEE, 2020)

Cross-Section Location

Reference:

1. County of Simcoe Maps, 2020 (Aerial Photo from 2018)

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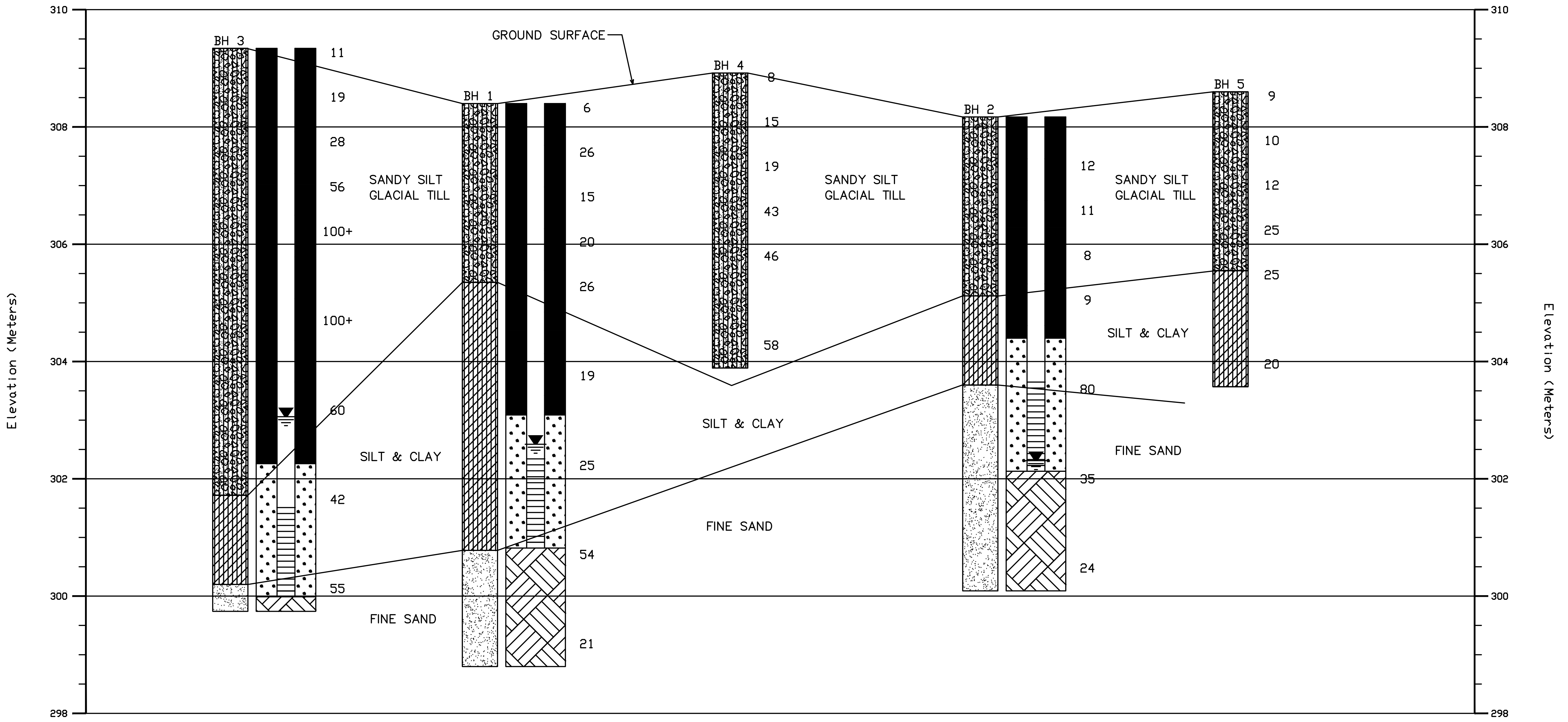
Project:	1 Reid Drive, Barrie				
Title:	BOREHOLE LOCATION PLAN				
Approved by:	A.W.	Date:	April 2020	Project No.:	20-1067A
Drawn by:	R.W.	Scale:	1 : 1,250	Figure No.:	2



Legend:

▼ Water Level in Monitoring Well

▩ Sandy Silt Glacial Till

▨ Clay & Silt

░ Fine Sand

Notes:
1. Numbers shown next to boreholes are SPT "N" Values.
2. Subsurface conditions known only at borehole locations.
3. Horizontal distance between boreholes is not to scale.
4. Water levels measured on April 4, 2020.

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Project: 1 Reid Drive, Barrie, ON

Title: SUBSURFACE PROFILE A-A'

Approved by: A.W.	Date: April 2020	Project No.: 20-1067A
Drawn by: R.W.	Scale: Vertical: 1:75 Horizontal: N.T.S.	Figure No.: 3

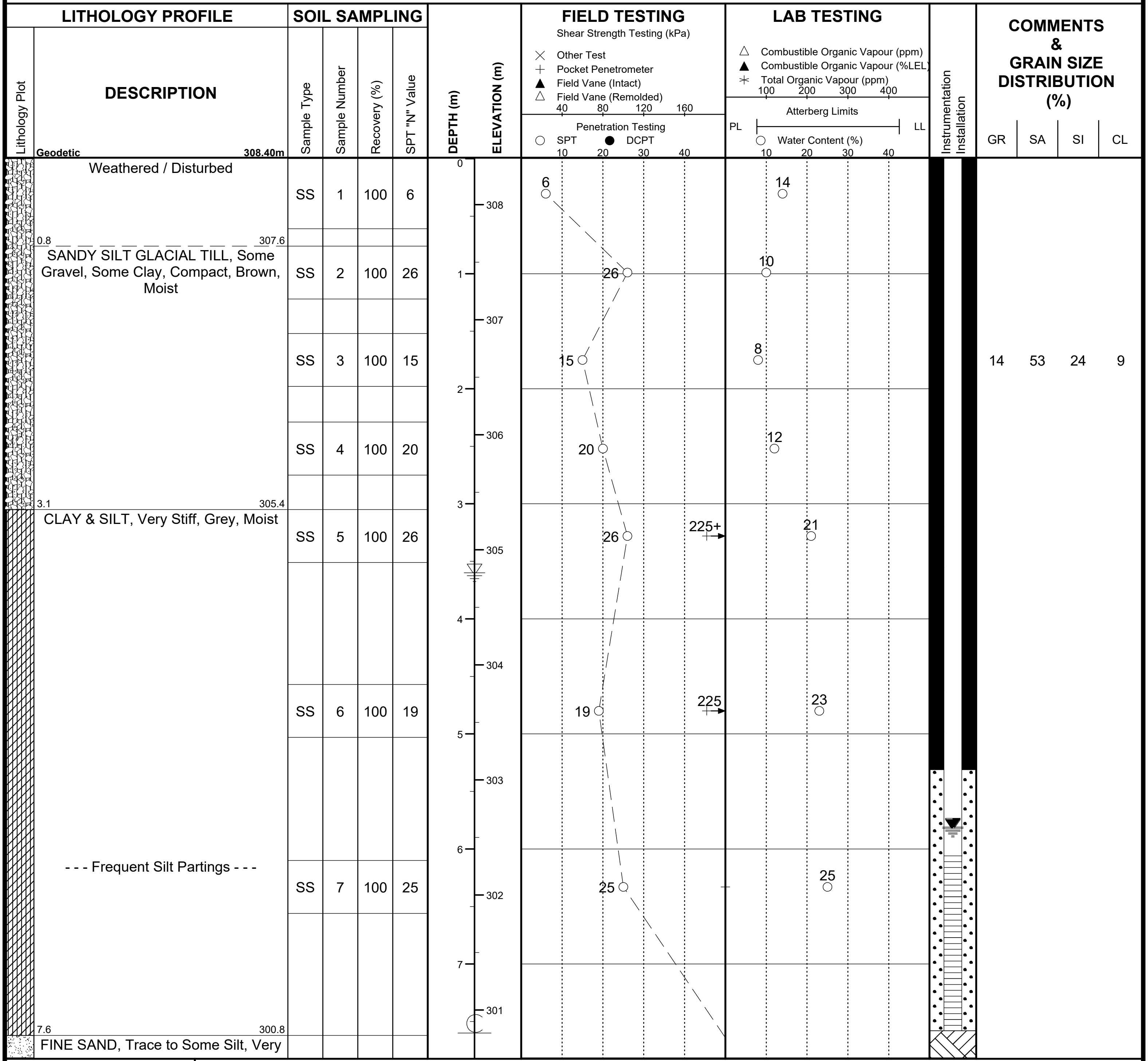
Appendix A –

BOREHOLE LOGS

RECORD OF BOREHOLE No. 1

Project Number: **21-1067A**
Project Client: **CAPREID INC.**
Project Name: **1 Reid Drive, Barrie**
Project Location: **Barrie, Ontario**
Drilling Location: **Southwest of the Site**

Drilling Method: **Solid Stem Augers**
Drilling Machine: **M-5, Track Mount**
Logged By: **BH**
Reviewed By: **AW**
Northing: **4909930**
Easting: **603325**
Date Started: **Mar.31/20**
Date Completed: **Mar.31/20**



DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Water Content (%)	Shear Strength (kPa)	GR	SA	SI	CL
Geodetic 308.40m										
Weathered / Disturbed	SS	1	100	6	14					
0.8 307.6 SANDY SILT GLACIAL TILL, Some Gravel, Some Clay, Compact, Brown, Moist	SS	2	100	26	10					
	SS	3	100	15	8		14	53	24	9
	SS	4	100	20	12					
3.1 305.4 CLAY & SILT, Very Stiff, Grey, Moist	SS	5	100	26	21	225+				
	SS	6	100	19	23	225				
- - - Frequent Silt Partings - - -	SS	7	100	25	25					
7.6 300.8 FINE SAND, Trace to Some Silt, Very										

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

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Groundwater depth encountered on completion of drilling: **3.6m**

Cave depth after auger removal: **7.6m**

Groundwater depth observed on **Mar. 31/20** at a depth of: **5.82m**

Observed on **Apr. 4/20** at a depth of: **5.81m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

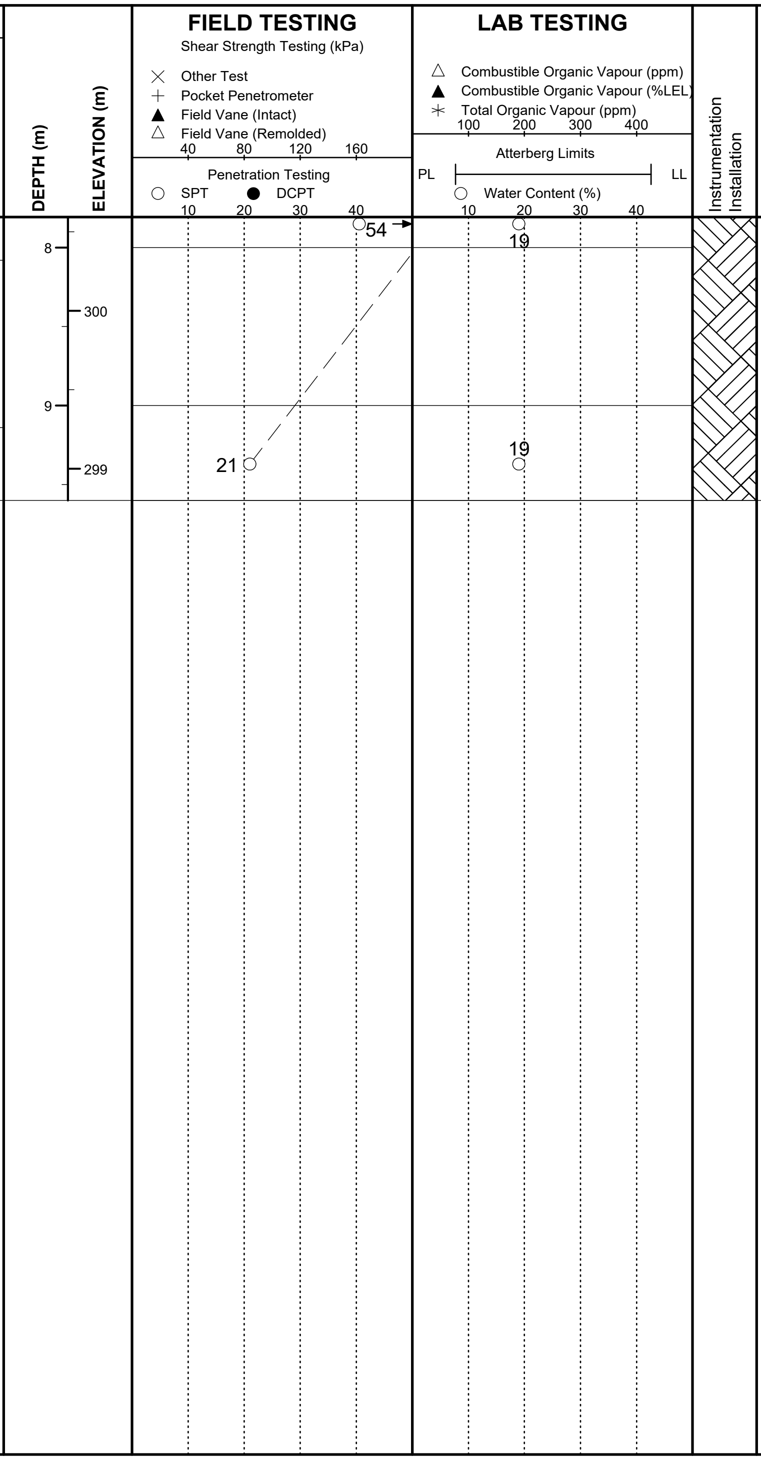
Scale: **1 :50**

RECORD OF BOREHOLE No. 1

Project Number: **21-1067A**
Project Client: **CAPREID INC.**
Project Name: **1 Reid Drive, Barrie**
Project Location: **Barrie, Ontario**
Drilling Location: **Southwest of the Site**

Drilling Method: **Solid Stem Augers**
Drilling Machine: **M-5, Track Mount**
Logged By: **BH**
Northing: **4909930**
Date Started: **Mar.31/20**
Reviewed By: **AW**
Easting: **603325**
Date Completed: **Mar.31/20**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	Penetration Testing: SPT / DCPT	Water Content (%)	Instrumentation Installation	GR	SA	SI	CL
▨	Dense, Brown, Wet	SS	8	100	54	8	300	54	19					
▨	- - - Compact - - -	SS	9	100	21	9	299	21	19					
	9.6 298.8													
	End of Borehole @ 9.6m													



Groundwater depth encountered on completion of drilling: **3.6m**

Cave depth after auger removal: **7.6m**

Groundwater depth observed on **Mar. 31/20** at a depth of: **5.82m**

Observed on **Apr. 4/20** at a depth of: **5.81m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

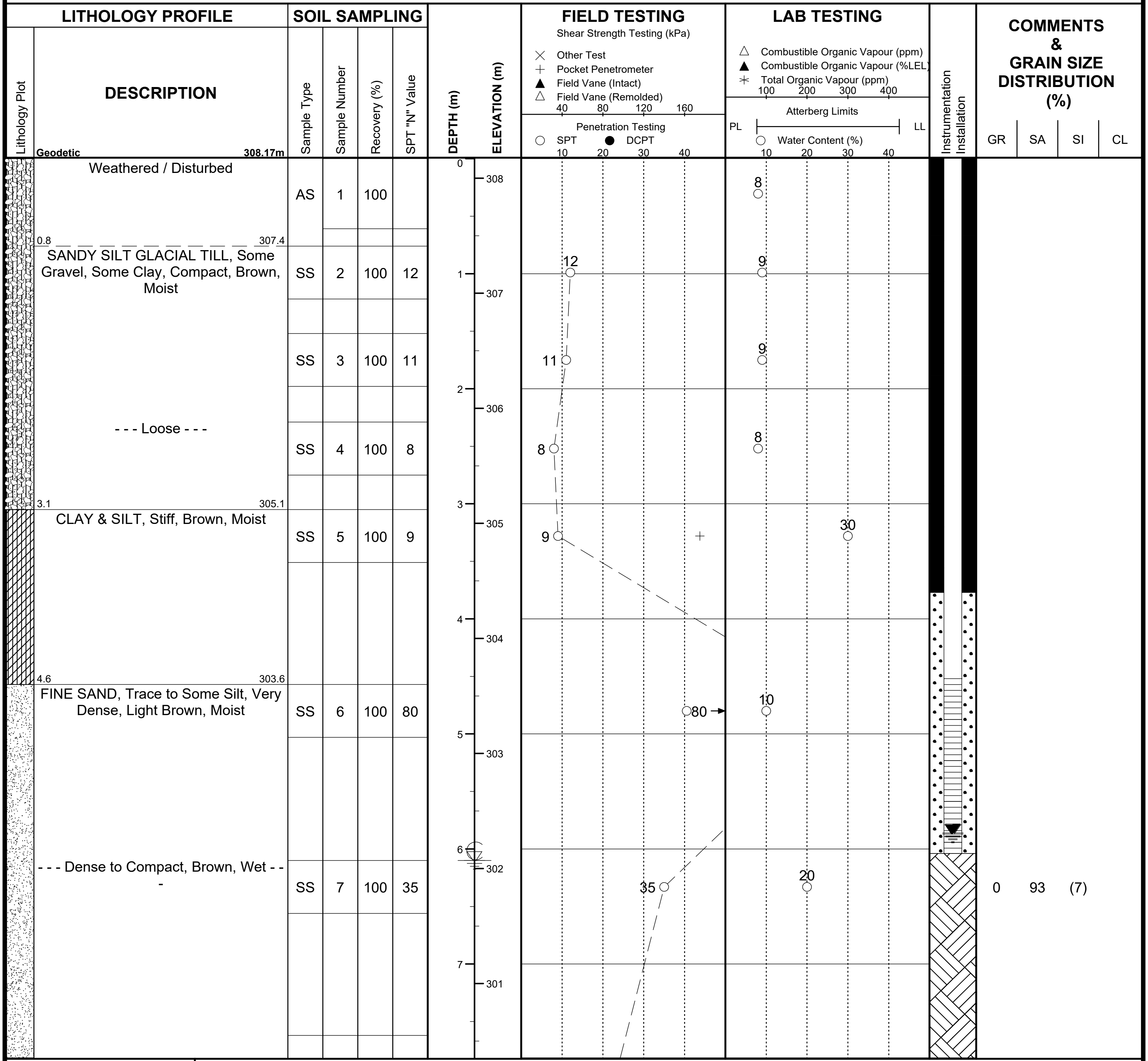
Scale: **1 :50**

RECORD OF BOREHOLE No. 2

Central Earth ENGINEERING

Project Number: **21-1067A**
Project Client: **CAPREID INC.**
Project Name: **1 Reid Drive, Barrie**
Project Location: **Barrie, Ontario**
Drilling Location: **Southeast of the Site**

Drilling Method: **Solid Stem Augers**
Drilling Machine: **M-5, Track Mount**
Logged By: **BH**
Northing: **4909976**
Date Started: **Mar.31/20**
Reviewed By: **AW**
Easting: **603386**
Date Completed: **Mar.31/20**



DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Water Content (%)	GR	SA	SI	CL
Weathered / Disturbed	AS	1	100		8				
0.8 — 307.4 SANDY SILT GLACIAL TILL, Some Gravel, Some Clay, Compact, Brown, Moist	SS	2	100	12	9				
	SS	3	100	11	9				
- - - Loose - - -	SS	4	100	8	8				
3.1 — 305.1 CLAY & SILT, Stiff, Brown, Moist	SS	5	100	9	30				
4.6 — 303.6 FINE SAND, Trace to Some Silt, Very Dense, Light Brown, Moist	SS	6	100	80	10				
- - - Dense to Compact, Brown, Wet - - -	SS	7	100	35	20	0	93	(7)	

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Groundwater depth encountered on completion of drilling: **6.1m**

Cave depth after auger removal: **6.1m**

Groundwater depth observed on **Mar. 31/20** at a depth of: **5.87m**

Observed on **Apr. 4/20** at a depth of: **5.86m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :50**

RECORD OF BOREHOLE No. 2

Project Number: **21-1067A**
Project Client: **CAPREID INC.**
Project Name: **1 Reid Drive, Barrie**
Project Location: **Barrie, Ontario**
Drilling Location: **Southeast of the Site**

Drilling Method: **Solid Stem Augers**
Drilling Machine: **M-5, Track Mount**
Logged By: **BH**
Northing: **4909976**
Date Started: **Mar.31/20**
Reviewed By: **AW**
Easting: **603386**
Date Completed: **Mar.31/20**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	Shear Strength Testing (kPa) ✕ Other Test + Pocket Penetrometer ▲ Field Vane (Intact) △ Field Vane (Remolded) 40 80 120 160 Penetration Testing ○ SPT ● DCPT 10 20 30 40	△ Combustible Organic Vapour (ppm) ▲ Combustible Organic Vapour (%LEL) ✳ Total Organic Vapour (ppm) 100 200 300 400 Atterberg Limits PL LL ○ Water Content (%) 10 20 30 40	Instrumentation Installation	GR	SA	SI	CL
	8.1 300.1	SS	8	100	24	8		24 ○	○ 21					
	End of Borehole @ 8.1m													

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Groundwater depth encountered on completion of drilling: **6.1m**

Cave depth after auger removal: **6.1m**

Groundwater depth observed on **Mar. 31/20** at a depth of: **5.87m**

Observed on **Apr. 4/20** at a depth of: **5.86m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :50**

RECORD OF BOREHOLE No. 3

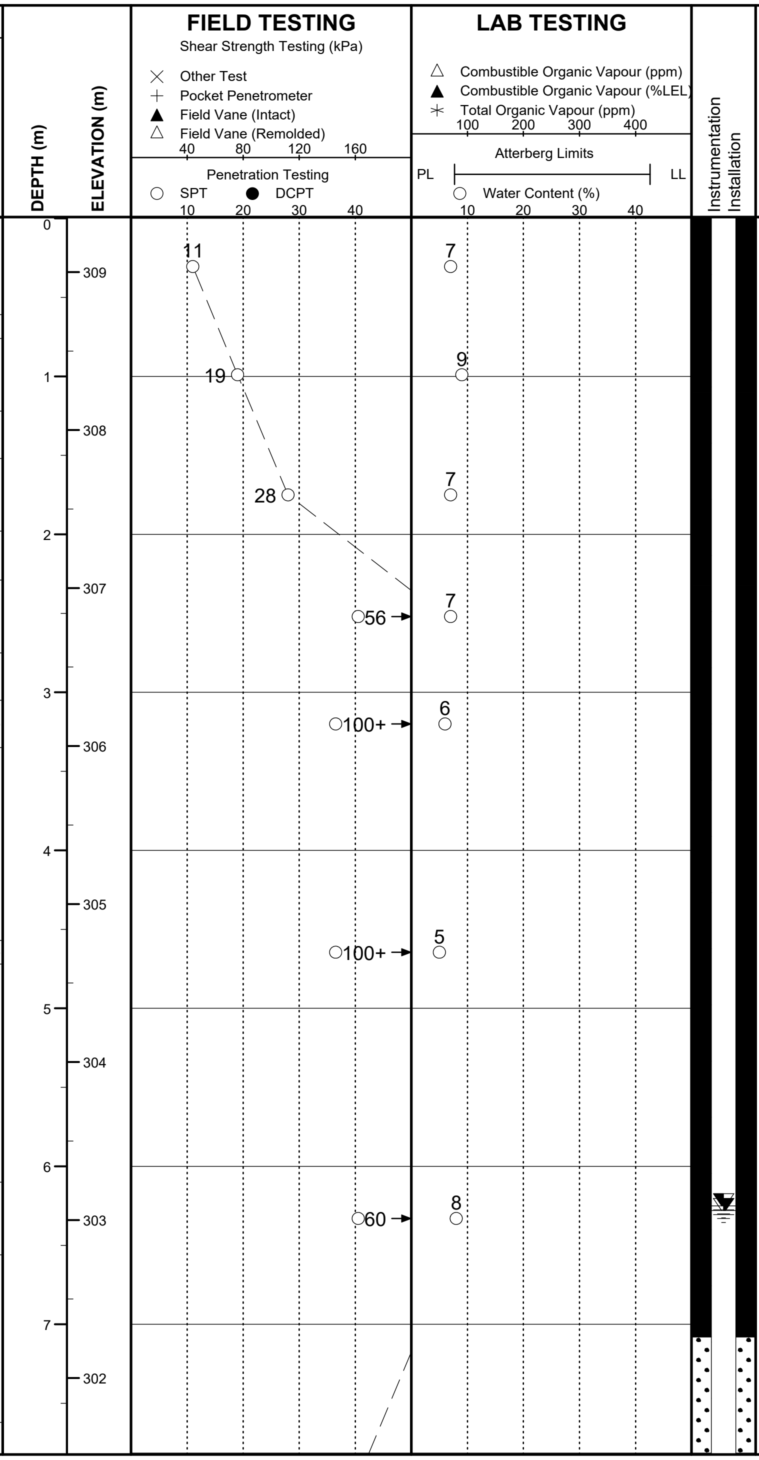
Central Earth ENGINEERING

Project Number:	**21-1067A**				
Project Client:	**CAPREID INC.**				
Project Name:	**1 Reid Drive, Barrie**	Drilling Method:	**Solid Stem Augers**	Drilling Machine:	**M-5, Track Mount**
Project Location:	**Barrie, Ontario**	Logged By:	**BH**	Northing:	**4909974**
Drilling Location:	**Northwest of the Site**	Reviewed By:	**AW**	Easting:	**603273**

Date Started: **Mar.31/20**

Date Completed: **Mar.31/20**

LITHOLOGY PROFILE		SOIL SAMPLING			
DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT "N" Value
Geodetic	309.34m				
SANDY SILT GLACIAL TILL, Some Gravel, Some Clay, Compact, Brown, Moist		SS	1	100	11
		SS	2	100	19
		SS	3	100	28
- - - Very Dense - - -		SS	4	100	56
		SS	5	67	100+
- - - Grey - - -		SS	6	33	100+
		SS	7	100	60
7.6	301.7				
CLAY & SILT, Frequent Silt Partings,					



COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

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Groundwater depth encountered on completion of drilling: **Dry**

Cave depth after auger removal: **Open**

Groundwater depth observed on **Mar. 31/20** at a depth of: **6.25m**

Observed on **Apr. 4/20** at a depth of: **6.28m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :50**

RECORD OF BOREHOLE No. 3

Project Number: **21-1067A**
Project Client: **CAPREID INC.**
Project Name: **1 Reid Drive, Barrie**
Project Location: **Barrie, Ontario**
Drilling Location: **Northwest of the Site**

Drilling Method: **Solid Stem Augers**
Drilling Machine: **M-5, Track Mount**
Logged By: **BH**
Northing: **4909974**
Date Started: **Mar.31/20**
Reviewed By: **AW**
Easting: **603273**
Date Completed: **Mar.31/20**

FIELD TESTING: Shear Strength Testing (kPa): × Other Test; + Pocket Penetrometer; ▲ Field Vane (Intact); △ Field Vane (Remolded); 40 80 120 160. Penetration Testing: ○ SPT ● DCPT; 10 20 30 40

LAB TESTING: △ Combustible Organic Vapour (ppm); ▲ Combustible Organic Vapour (%LEL); ✳ Total Organic Vapour (ppm); 100 200 300 400. Atterberg Limits: PL ├──┤ LL; ○ Water Content (%); 10 20 30 40

LITHOLOGY PROFILE		SOIL SAMPLING									COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	Instrumentation Installation	GR	SA	SI	CL
▨	Hard, Grey, Moist	SS	8	100	42	8	301	42 225+	22		0	0	46	54
	9.1 300.2					9								
▒	FINE SAND, Trace to Some Silt, Very Dense, Grey, Wet	SS	9	100	55		300	55	20					
	9.6 299.7													
	End of Borehole @ 9.6m													

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Groundwater depth encountered on completion of drilling: **Dry**

Cave depth after auger removal: **Open**

Groundwater depth observed on **Mar. 31/20** at a depth of: **6.25m**

Observed on **Apr. 4/20** at a depth of: **6.28m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

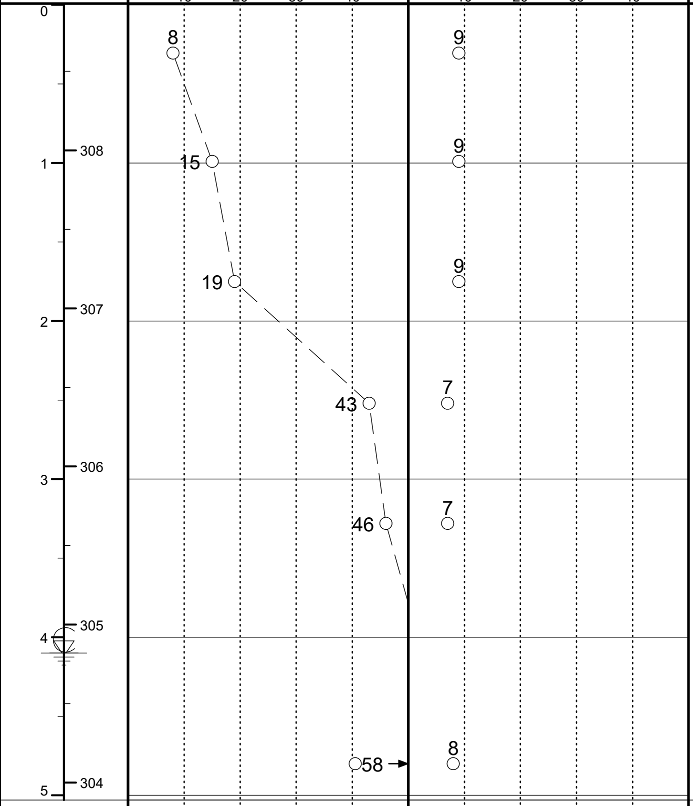
Scale: **1 :50**

RECORD OF BOREHOLE No. 4

Project Number: **21-1067A**
Project Client: **CAPREID INC.**
Project Name: **1 Reid Drive, Barrie**
Project Location: **Barrie, Ontario**
Drilling Location: **Center of the Site**

Drilling Method: **Solid Stem Augers**
Drilling Machine: **M-5, Track Mount**
Logged By: **BH**
Northing: **4909973**
Date Started: **Mar.31/20**
Reviewed By: **AW**
Easting: **603334**
Date Completed: **Mar.31/20**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)
DESCRIPTION Geodetic 308.92m	Elevation / Depth	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	Penetration Testing SPT	Water Content (%)	Instrumentation Installation	GR / SA / SI / CL
SANDY SILT GLACIAL TILL, Some Gravel, Some Clay, Loose, Brown, Moist		SS	1	100	8	0		8	9		
- - - Compact - - -		SS	2	100	15	1	308	15	9		
		SS	3	100	19			19	9		
- - - Dense - - -		SS	4	100	43	2	307	43	7		
		SS	5	100	46	3	306	46	7		
						4	305				
- - - Very Dense - - -		SS	6	100	58			58 →	8		
	5.0 / 303.9					5	304				
End of Borehole @ 5.0m											



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Groundwater depth encountered on completion of drilling: **4.1m**

Cave depth after auger removal: **4.1m**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :50**

RECORD OF BOREHOLE No. 5

Project Number: **21-1067A**
Project Client: **CAPREID INC.**
Project Name: **1 Reid Drive, Barrie**
Project Location: **Barrie, Ontario**
Drilling Location: **Northeast of the Site**

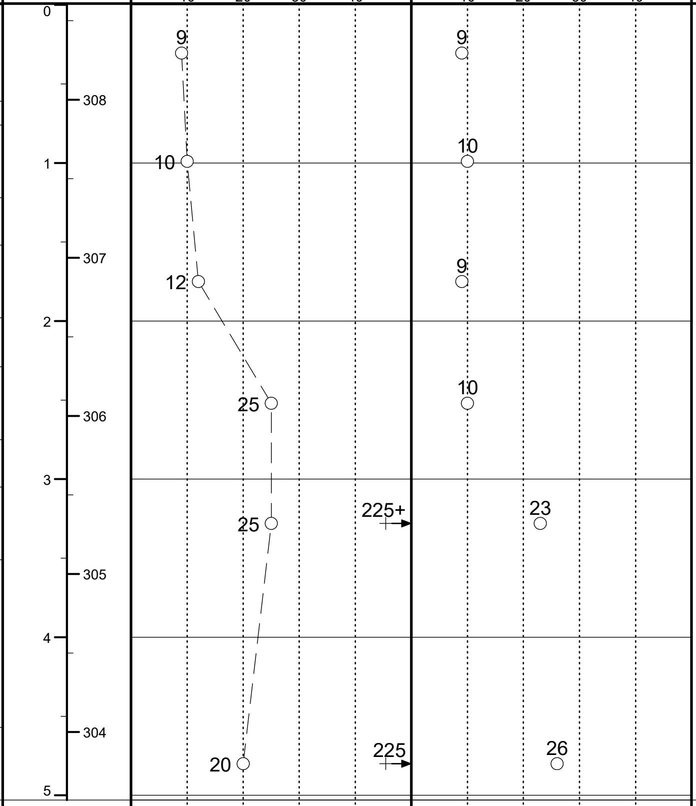
Drilling Method: **Solid Stem Augers**
Drilling Machine: **M-5, Track Mount**
Logged By: **BH**
Northing: **4910013**
Date Started: **Mar.31/20**
Reviewed By: **AW**
Easting: **603381**
Date Completed: **Mar.31/20**

LITHOLOGY PROFILE		SOIL SAMPLING				COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Depth / Elevation	DESCRIPTION (Geodetic 308.60m)	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	GR	SA	SI	CL
	Weathered / Disturbed	AS	1	0	9				
0.8 / 307.8	SANDY SILT GLACIAL TILL, Some Gravel, Some Clay, Compact, Brown, Moist	SS	2	100	10				
		SS	3	100	12				
	- - - Dark Brown - - -	SS	4	11	25				
3.1 / 305.6	CLAY & SILT, Very Stiff, Grey, Moist	SS	5	100	25				
		SS	6	100	20				
5.0 / 303.6	End of Borehole @ 5.0m								

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
✳ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL LL
○ Water Content (%)
10 20 30 40

Instrumentation Installation



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Barrie, Ontario L4N 0B8
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E: info.com
W: centralearth.com

Groundwater depth encountered on completion of drilling: **Dry**

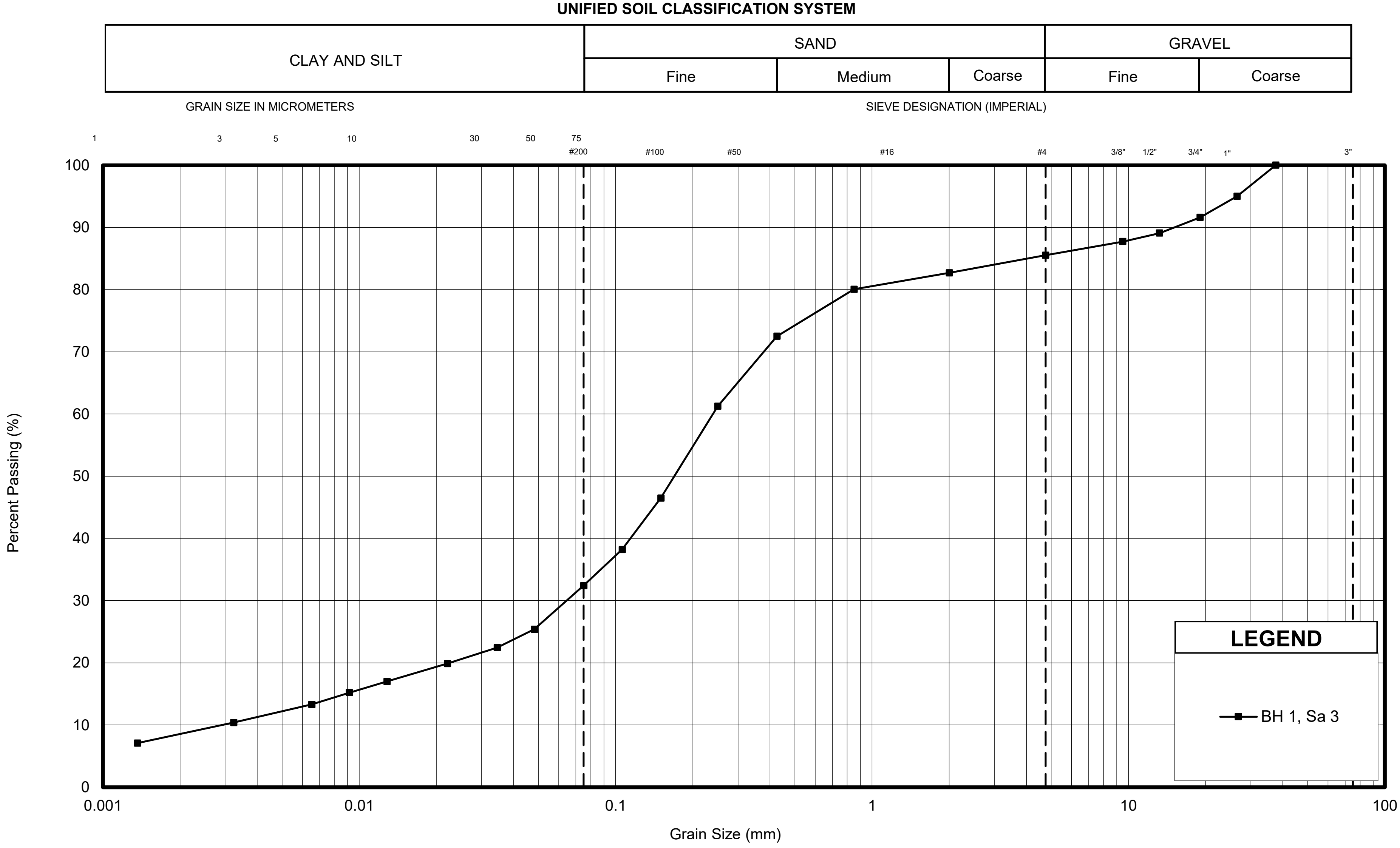
Cave depth after auger removal: **Open**

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :50**

Appendix B –

GEOTECHNICAL LABORATORY DATA



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH 1, Sa 3	SILTY SAND GLACIAL TILL, some gravel, some clay	14	53	24	9	0.003	0.064	0.240	82.0	6.0

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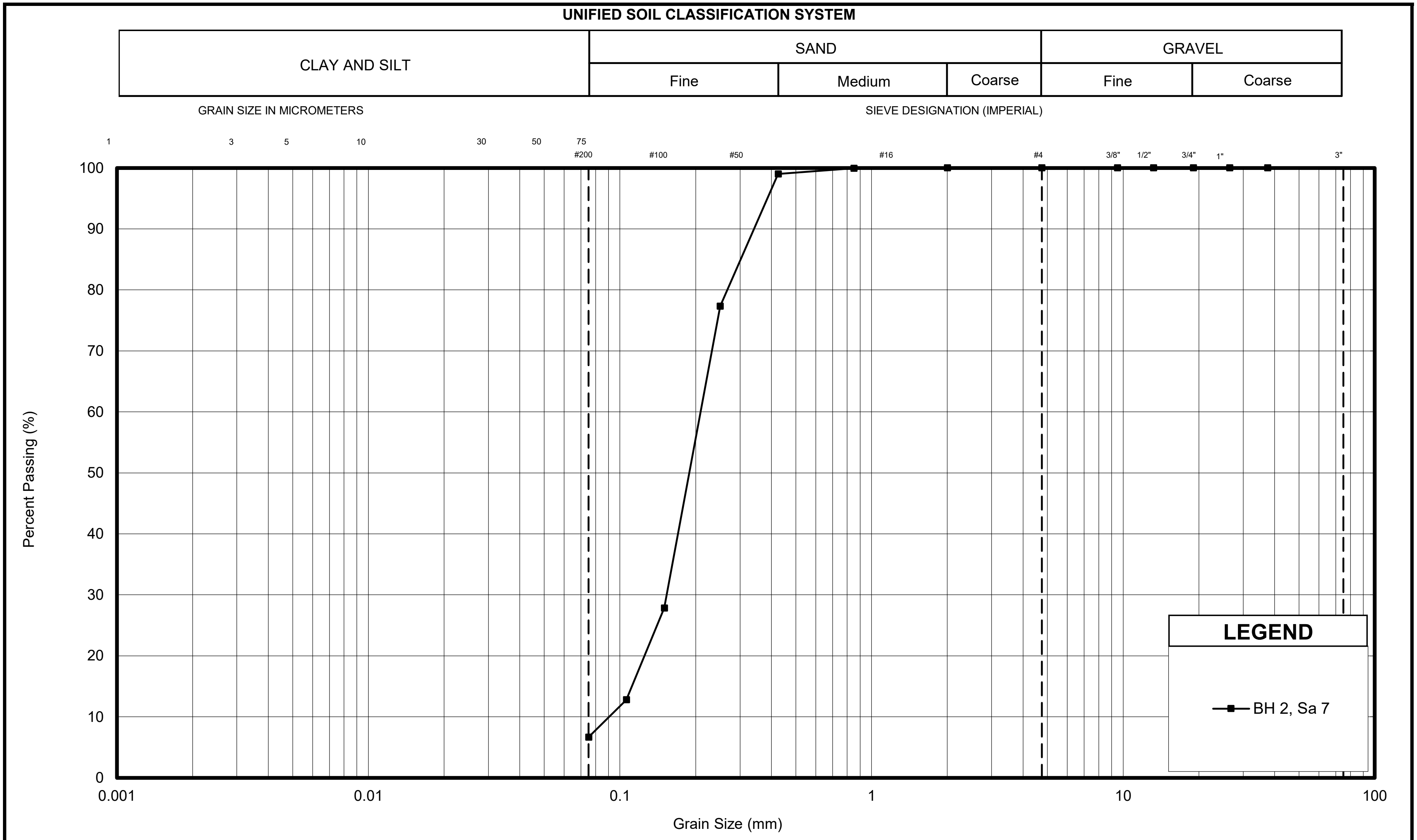
GRAIN SIZE DISTRIBUTION - 1 Reid Drive, Barrie

SILTY SAND GLACIAL TILL

FIGURE No.	B1
REF. No.	20-1067A
DATE	April 2020

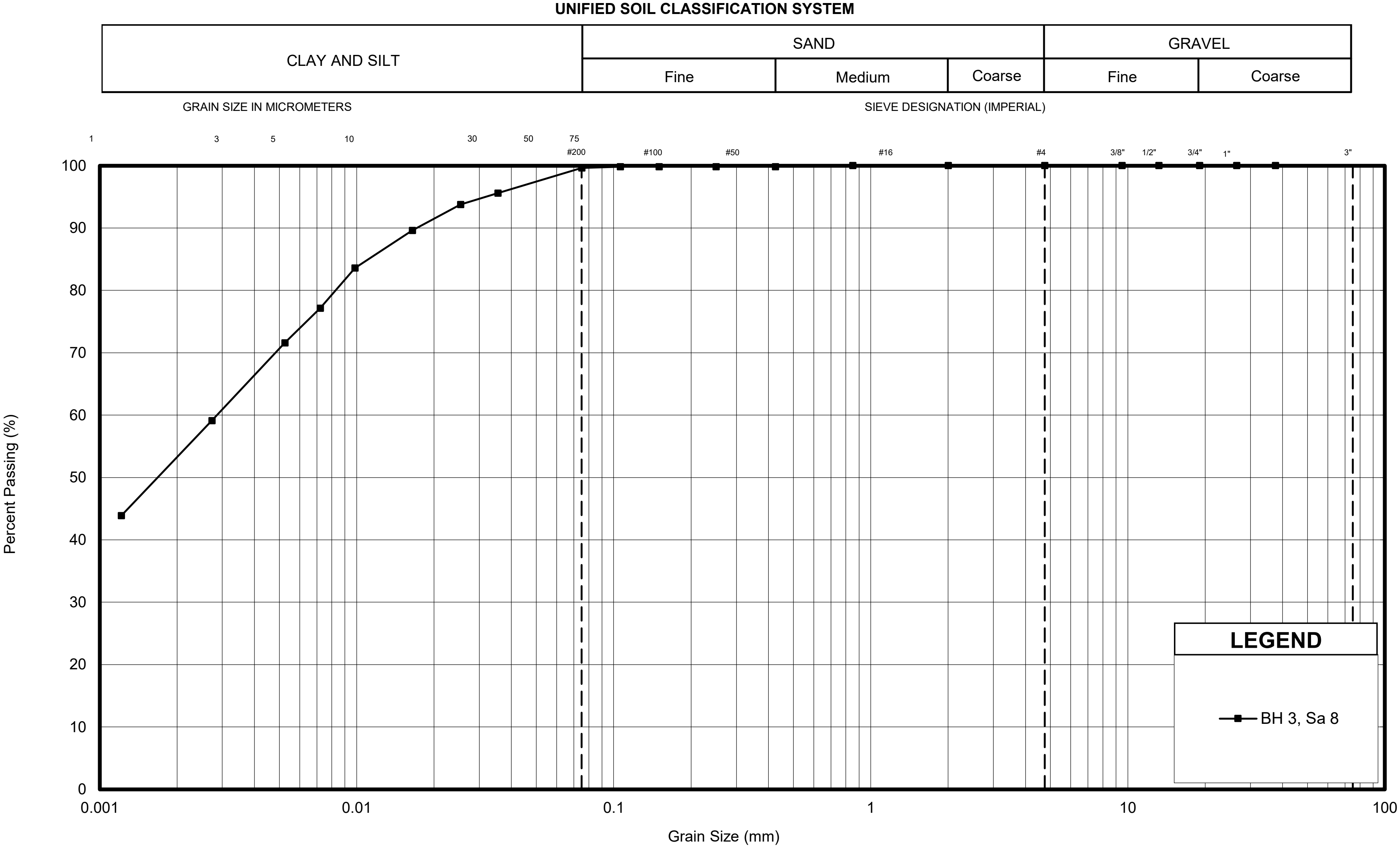


Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH 2, Sa 7	FINE SAND, trace fines	0	93	7		0.091	0.15	0.21	2.3	1.2

GRAIN SIZE DISTRIBUTION - 1 Reid Drive, Barrie

FINE SAND

FIGURE No.	B2
REF. No.	20-1067A
DATE	April 2020



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH 3, Sa 8	CLAY AND SILT	0	0	46	54	-	-	0.003	-	-

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GRAIN SIZE DISTRIBUTION - 1 Reid Drive, Barrie

CLAY & SILT

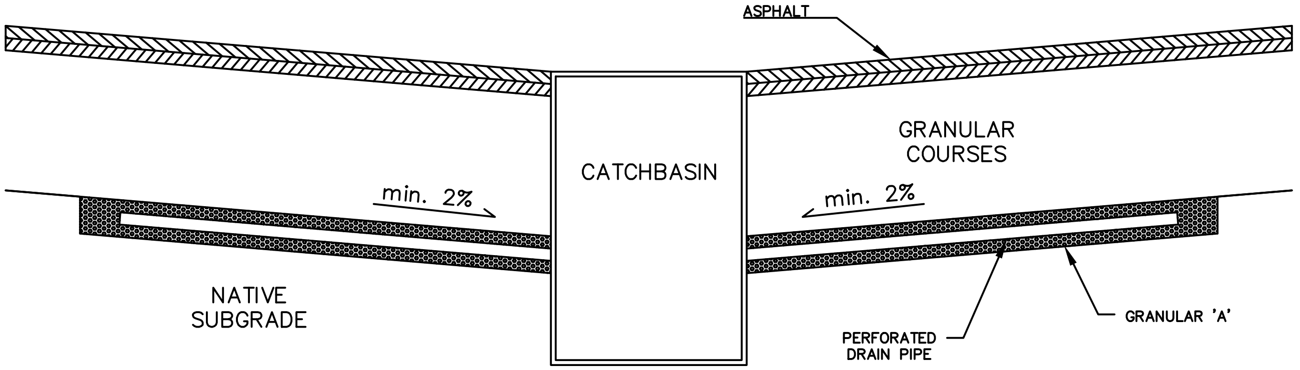
FIGURE No. B3

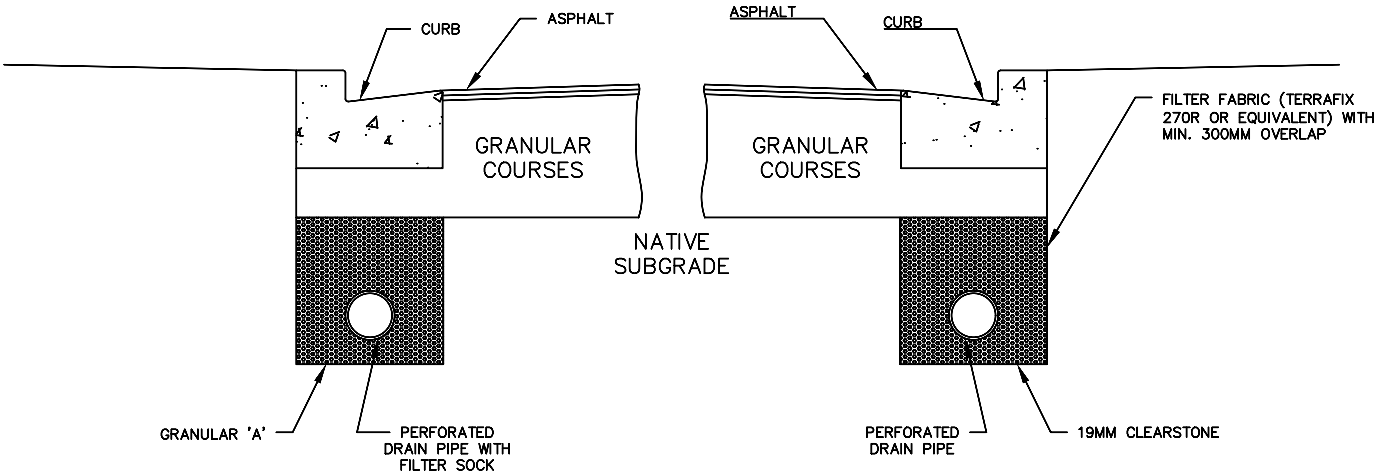
REF. No. 20-1067A

DATE April 2020

Appendix C –

TYPICAL DETAILS

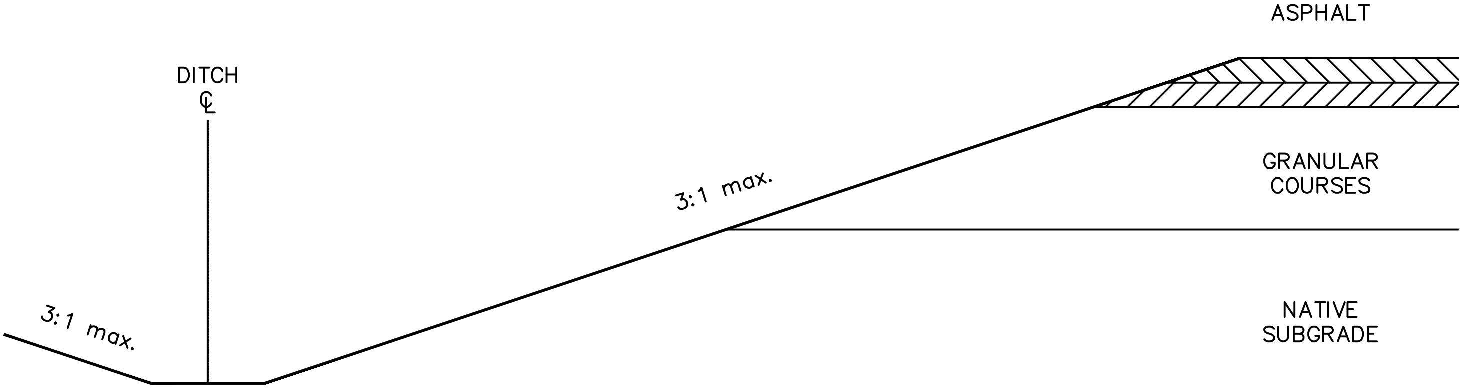




Unwrapped Trench

Wrapped Trench

Urban Cross Sections



Rural Cross Section

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PAVEMENT DRAINAGE ALTERNATIVES
TYPICAL DETAILS