SITE SERVICING
AND
STORMWATER MANAGEMENT REPORT

Proposed Travel Stop Development

AT
NE Corner of Hurontario Street & King Street
Town of Caledon

Prepared for
Glen Schnarr & Associates Inc.

Nov 26, 2019	Issued for 1st SPA Submission

REVISIONS

FLORA DESIGNS INC.
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1.0 INTRODUCTION

Flora Designs Inc. has been retained by Glen Schnarr & Associates Inc. (the "Consultant") to prepare a Site Servicing and Stormwater Management Report for a proposed Travel Stop development, located at NE Corner of Hurontario Street & King Street, Town of Caledon, Ontario (**Appendix "A"**), in accordance with the Engineering Design Standards provided by the Town of Caledon, Region of Peel, and MOE Stormwater Management Planning and Design Manual 2003 (SWMPD).

This report is prepared in support of a Site Plan Application (SPA) by Glen Schnarr & Associates Inc. acting on behalf of the Owner. The purpose of this report is to provide site-specific information for the Town and Region's review with respect to the infrastructure required to support the proposed development regarding storm drainage, sanitary drainage and water supply.

An inventory of the existing infrastructure in the area of proposed development was carried out. This report discusses the existing services together with the servicing requirements for the proposed development.

2.0 SITE DESCRIPTION

The proposed development site is located at NE Corner of Hurontario Street & King Street, Town of Caledon, Ontario (**Appendix "A"**). The site is bounded as follows:

- An existing residential development East,
- King Street to the South,
- Hurontario Street to the West, and
- Undeveloped agricultural lands to the North.

The subject site is approximately 32,125 m^2 (3.21 hectares) in size. Currently the property is vacant.

3.0 SITE PROPOSAL

The Site Plan Application proposes Card Lock Fuelling Stations, Retail Gas Fuelling Stations, Convenient Store, Three standalone restaurants and associated parking lot. A reduced version of the architectural site plan is included in **Appendix "A"**. Please refer to the building and site statistics provided by Antrix Architects Inc.

In the post-development development condition, the stormwater runoff from the building roofs and site area will be conveyed to the on-site stormwater dry pond facility through the on-site private sewer network. The entire major and minor system flows from the site will be discharged to an existing municipal culvert located across King Street in compliance with the pre-development drainage pattern.

An on-site subsurface disposal facility will be provided for sanitary drainage system. Please refer to the design documents prepared by WSP Canada Inc. for MECP Sewage Treatment and Disposal System Design.

The water supply requirements for this development will be fulfilled by an existing 300 mm dia watermain located with the municipal allowance of King Street through an existing 300 mm dia fire and domestic combined service provided by the Region to serve future development on this land.

4.0 STORMWATER MANAGEMENT AND DRAINAGE

4.1 Design Criteria

The proposed development will meet the Province of Ontario standards as set out in the MOE Stormwater Management Planning and Design Manual 2003 (SWMPD), Region of Peel Design Guidelines and local engineering standards provided by the Town of Caledon in the Development Standards, Policies & Guidelines Manual. A brief summary of the design criteria are as follows;

- For new developments, return frequency values for design shall be 5-year for Minor System and 100-year for Major System.
- Town of Caledon Rainfall Intensity Curves provided in the Standards No.104 are to be used for analysis **(Appendix "B")**.
- The post-development peak flows for all events from the site up to and including 100-year rainfall event should be controlled to the peak flow resulting from the target pre-development conditions during respective rainfall events.
- The on-site storm sewer network is sized to convey minor system flows.
- Overland flow route shall be provided to direct runoff in excess of the 100-year storm event to a safe outlet.
- Maximum detention depth in parking areas during the 100-year storm event is not to exceed 300mm.
- Stormwater should be treated to Enhanced Protection level as defined in the MOE SWM Planning & Design Manual (2003).

4.2 Existing Conditions

Currently the property is vacant. Based on review of the topographic survey and a site visit, we have concluded that, the site area drains towards the South property limits through overland sheet flow, which subsequently generates uncontrolled discharge to an existing municipal culvert and an unnamed municipal stream. In addition to this property, a small portion of upstream external lands to the North drains through this property that generates uncontrolled discharge to the same municipal culvert. The pre-development surface condition and drainage area for this site has been illustrated in **Appendix "B"**.

For calculating the pre-development discharge rates and runoff for the 5-Year and 100-Year storm events, Inlet time of Concentration (Tc) is based on the minimum Tc provided by the Town of Caledon. The value for the pre-development weighted runoff coefficient C=0.26 is calculated based on actual surface conditions for this site. Input parameters used to model the target pre-development condition are

provided in **Table-1** below and detailed calculations have been illustrated in **Appendix "B"**.

Table-1 Pre-development Input Parameters

Drainage System	Catchment #	Drainage Area (ha)	Runoff Coefficient (C)	Time of Concentration (Tc)
Uncontrolled	CA-1-Pre	3.21	0.26	10
TOTAL		**3.21**	**0.26**	**10**

The pre-development peak flow was simulated using the Town of Caledon Rainfall Intensity Curves using the Rational Method. The results of the pre-development peak flow calculations are provided in **Table-2** below, and detailed calculations have been illustrated in **Appendix "B".**

Table-2 Pre-development Peak Flows

Catchment #	Peak Flow (m^3/s)	
	5-year	**100-year**
CA-1-Pre	0.254	0.456

4.3 Stormwater Management

In the post-development condition, the site grading is designed to restrict stormwater flow from the upstream lands from entering to this site. Therefore, only the lands occupied by this site is considered for the stormwater management design for this development proposal. There are uncontrolled site areas contributing to the total storm discharge from the site. Therefore, the site is divided into two primary drainage systems; “Controlled” (CA-1-Post) and “Uncontrolled” (CA-2-Post). The post-development drainage areas have been illustrated in **Appendix "B"**.

For calculating the post-development discharge rates and runoff for 5-Year and 100-Year storm events, Inlet time of Concentration (Tc) and weighted runoff coefficient (C) is calculated similar to the pre-development calculations. Input parameters used to model the target pre-development condition are provided in **Table-3** below and detailed calculations have been illustrated in **Appendix "B"**.

Table-3 Post-development Input Parameters

Drainage System	Catchment #	Drainage Area (ha)	Runoff Coefficient (C)	Time of Concentration (Tc)
Controlled	CA-1-Post	2.91	0.65	10
Uncontrolled	CA-2-Post	0.30	0.26	10
TOTAL		**3.21**	**0.62**	**10**

Results of the post-development peak flow calculations by considering minimum Tc and IDF data similar to the pre-development flow calculations are provided in

Table-4 below, and detailed post-development flow calculations have been illustrated in **Appendix "B".**

Table-4 Post-development Peak Flows

Catchment #	Peak Flow (m^3/s)	
	5-year	**100-year**
CA-1-Post	0.577	1.033
CA-3-Post	0.024	0.043

The post-development peak flow targets will be achieved using a combination of surface storage, detention storage in the storm sewer system and an on-site End-of-Pipe Dry Storage facility (SU-1). Site grading for the controlled portion of the site area (CA-1-Post) has been designed to capture runoff from the site using a series of on-site catch basins. When the incoming flow is greater than the allowable peak discharge rate through an orifice plate and a weir installed at the dry pond Outlet-1, the storm sewer system will surcharge and the excess runoff volume will be stored within the storm sewer pipes and dry storage facility (SU-1). A summary of the stage and storage volumes available on site are provided in **Table-5** below and detailed calculations have been illustrated in **Appendix "B".**

Table-5 Available Stage Storage Summary

Stage Elevation	Stage Storage Volume (m^3)				
	CB-MH	**Pipe**	**Surface**	**SU-1**	**Total**
286.75	1.54	24.05	0.00	592.88	**618.47**
287.50	11.43	66.45	0.00	1410.73	**1488.61**
287.60	12.92	67.20	12.67	1541.58	**1634.37**

The post-development Stormwater Management will be justified by discussing the following stormwater controls:

4.3.1 Quantity Control

Stormwater quantity control is typically implemented to minimise the potential for downstream flooding, stream bank erosion and overflow of infrastructure. As per minimum standards provided by the Town of Caledon, the post-development peak flows for all events from the site should be controlled in line with the respective peak flow resulting from the target pre-development condition during 5-year to 100-year storm events.

The site grading is designed such that, no external areas from the adjoining properties shall affect the stormwater flow from this site.

Modified Rational Method calculations were undertaken to determine the peak flows and required storage volume from the proposed site during 5-Year and 100-Year storm events. This method calculates the storage volume using the composite runoff coefficient and the allowable release

rate based on rainfall intensities over a three-hour storm event. A summary of the post-development quantity control analysis is provided in **Table-6** below and detailed calculations have been illustrated in **Appendix "B".**

Table-6 Post-development Peak Flow and Quantity Control Analysis

Storm Event	Allowable Release Rate (m^3/s)	Runoff from Controlled Area (m^3/s)	Runoff from Uncont. Area (m^3/s)	Total Peak Runoff (m^3/s)	Available Storage Volume (m^3)	Storage Volume Used (m^3)	Water Surface Elevation (m)
5-year	0.254	0.042	0.024	0.066	1488.61	564.63	286.69
100-year	0.456	0.057	0.043	0.100	1634.37	1172.96	287.25

The post-development peak flow targets will be achieved by controlling discharge from the site area using a combination of 150mm dia orifice plate and 400mm(w) X 350mm(d) rectangle weir installed in the perforated CSP outlet structure (Outlet-1). Detailed calculations for orifice-weir ratings and stage storage in the dry storage facility have been illustrated in **Appendix "B".**

4.3.2 Quality Control

In accordance with the MOE SWM Planning & Design Manual, various levels of treatment are defined with a goal of maintain or enhance existing aquatic habitat based on the total suspended solids (TSS) removal efficiency. For this development, based on the Town standards, enhanced (Level 1) quality protection is typically implemented to treat the runoff.

The quality control for the site is provided by a multiple component treatment train consisting of a dry, end-of-pipe, detention storage facility and CDS oil and grit separator unit. In the post-development condition, the site area occupied by CA-2-Post are mainly consists of grassed area which generates uncontrolled discharge to the municipal culvert and unnamed municipal stream. Considering, this portion of the site area does not have any vehicular traffic, it is excluded from the quality control modelling. Therefore, only 2.91 ha site area occupied by CA-1-Post having 61.99 % imperviousness that contributes to the proposed quality control unit are accounted in the quality control modelling.

CDS model PMSU 20-20 oil grit separator unit is proposed at downstream of the Outlet-1 structure. The CDS unit will receive controlled release through the orifice / weir installed at the Outlet-1 and hence it will not operate in a surcharged condition.

Please refer to **Appendix "B"** for the design summary of CDS model PMSU 20-20 oil grit separator unit provided by Echelon Environmental. Proposed water quality unit will treat 99.4% of average annual rainfall volume and

remove 83.3% of TSS prior to discharging from the site. This is concluded by considering the controlled portion of the site area that discharges to the dry pond facilities and contributing to the proposed quality control unit. The option for upstream attenuation and storage-discharge relationship for dry pond facility SU-1 is used to access TSS removal by the CDS system.

An ongoing maintenance program, consisting of periodic inspection and cleaning of the CDS and on-site catch basins are recommended (minimum once per year).

4.4 Downstream Capacity

The site area occupied by this development is contributing to the existing municipal culvert and an unnamed stream located at the south property limits in the pre-development condition. Since, the post-development peak flows from this site are controlled in line with the respective peak flow resulting from the target pre-development condition during 5-year to 100-year storm events, the total release from the site will be less then the pre-development condition. Hence, there will be no need to map downstream capacity of existing municipal conveyance system.

5.0 EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

Construction activity, especially operations involving the handling of earthen material, dramatically increases the availability of particulate matter for erosion and transport by surface drainage. In order to mitigate the adverse environmental impacts caused by the release of silt--laden stormwater runoff into receiving watercourses, measures for erosion and sediment control are required for construction sites.

The impact of construction on the environment is recognized by the Greater Golden Horseshoe Area Conservation Authorities. “Erosion & Sediment Control Guidelines for Urban Construction” released by Authority in December 2006, provides guidance for the preparation of effective erosion and sediment control plans. Control measures must be selected in light of the erosion potential of the site. It is important to have implementations and modifications on a staged basis to reflect the site's activities. Furthermore, the effectiveness of control measures decreases with sediment loading as a result inspection and maintenance is recommended. The selection, implementation, inspection, and maintenance of the control features are summarized as follows:

5.1 Control Measures

On relatively small sites, measures for erosion and sediment control typically include the use of silt fencing, mud mats and sediment traps. The description of the sediment controls to be implemented on the subject site is as follows.

- Installation of ***Silt Fences*** adjacent to all property limits subject to drainage from the development area prior to topsoil stripping and in other locations, such as at the bases of topsoil stockpiles.

- Installation of ***Mud Mats*** at all construction entrances prior to commencing earthworks to minimize the tracking of mud onto municipal roads.
- Installation of ***Sediment Traps*** at all catch basins and area drain locations once the storm sewer system has been constructed to prevent silt-laden runoff from entering the municipal storm sewer system.

5.2 Construction Sequencing

The schedule of construction activities with respect to sediment controls is as follows:

- Installation of the silt fences prior to any other activities on the site.
- Construction of temporary mud mats at all construction access.
- Installation of site servicing and underground utilities.
- Construction of building foundations and disposal of all the surplus excavated materials off site.
- Construction of building, parking lot and driveways.
- Restoration / re-vegetation of disturbed areas either with temporary measures such as mulch or seeding or with final landscape and paving.
- Removal of the sediment controls following stabilization of disturbed areas.

5.3 Inspection & Maintenance

In order to ensure that the erosion and sediment control measures operate effectively, regular monitoring together with periodic cleaning (e.g. removal of accumulated silt), maintenance and/or re-construction is strongly recommended. Inspections of all the erosion and sediment controls on the construction site should be undertaken with the following frequency:

- On a weekly basis
- After every rainfall event
- After significant snow melt events
- Prior to forecasted rainfall events

If damaged control measures are found, they should be repaired and/or replaced within 48 hours. Site inspection staff and construction managers should refer to the Erosion and Sediment Control Inspection Guide (2008) prepared by the Greater Golden Horseshoe Area Conservation Authorities. This Inspection Guide provides information related to the inspection reporting, problem response and proper installation techniques. Infiltration Gallery shall be kept offline until the site has been stabilised.

6.0 SANITARY DRAINAGE SYSTEM

The Owner has retained WSP Canada Inc. to prepare design documents for private on-site sub-surface disposal facility in accordance with the MECP design guidelines.

Currently WSP is working with MECP regional office to finalise terms of reference and design flow for the proposed Sewage Treatment and Disposal System.

Please refer to the design documents prepared by WSP Canada Inc. for MECP Sewage Treatment and Disposal System Design.

7.0 WATER SUPPLY SYSTEM

Currently the property Vacant. An existing 300mm dia watermain located within the municipal allowance of King Street is available to serve the future development on this site. The region of Peel has provided a 300 mm dia fire and domestic combined service to serve future development on this land.

7.1 Proposed Water Supply Requirements

The post-development water supply requirement is calculated in accordance with the Watermain Linear Design Manual provided by the Region of Peel. This manual provides peaking factors to calculate peak hour and maximum day based on Ministry of Environment Guidelines.

The estimated water consumption of approximately 0.78 L/s with a peak hourly demand of 1.68 L/s will be required to service proposed development with domestic water based on population density calculated for this site and proposed land use. Detailed calculations have been illustrated in **Appendix "C"**.

The Town of Caledon and Region of Peel requires the fire flow calculations based on the Water Supply for Public Fire Protection Guidelines provided by the Fire Underwriters Survey (FUS). The fire flow required for the proposed Travel Stop development is estimated at 100.00 L/s for 4 hours, delivered with a residual pressure of not less then 140 kilopascals. Detailed calculations have been illustrated in **Appendix "C"**.

A flow and pressure test will be performed on the nearest hydrant to the site prior to the building permit application to determine compliance for minimum suppression outlined in the FUS and Town's guidelines.

7.2 Proposed Water Service

This development application proposes to make use of the existing 300mm dia fire and domestic combines service provided by the Region of Peel from the existing 300mm dia municipal watermain located within road allowance of King Street. The proposed combined service will split at the property line into fire and domestic services. An internal network of 150 mm dia fire main and 100 mm dia domestic watermain are proposed in accordance with the Region of Peel Standard Drawing 1-8-5A to serve future development.

8.0 CONCLUSIONS AND RECOMMENDATIONS

This report is to be read in conjunction with the submission materials for the project proposal known as proposed Travel Stop development, located at NE Corner of Hurontario Street & King Street, Town of Caledon, Ontario.

8.1 STORM

1. The site is divided into two primary drainage systems; “Controlled” (CA-1-Post) and “Uncontrolled” (CA-2-Post).
2. The post-development peak flow targets will be achieved using detention storage within an on-site End-of-Pipe Dry Storage facility (SU-1).
3. The post-development peak flow targets will be achieved by controlling discharge from the site area using a combination of 150mm dia orifice plate and 400mm(w) X 350mm(d) rectangle weir installed in the perforated CSP outlet structure (Outlet-1).
4. Total 1,172.96 m^3 of storage is used out of 1,634.37 m^3 storage volume provided during 100-year storm event.
5. The quality control for the site is provided by a multiple component treatment train consisting of a dry, end-of-pipe, detention storage facility and CDS oil and grit separator unit.
6. Proposed water quality unit will treat 99.4% of average annual rainfall volume and remove 83.3% of TSS prior to discharging from the site.
7. An ongoing maintenance program consists of periodic inspection and cleaning of the Stormceptor and Catch basins are recommended (minimum once per year).
8. Erosion and Sediment controls are to be implemented during construction to prevent silt-laden runoff from leaving the site in accordance with the "Erosion & Sediment Control Guidelines for Urban Construction".

8.2 SANITARY

1. Currently WSP Canada Inc. is working with MECP regional office to finalise terms of reference and design flow for the proposed Sewage Treatment and Disposal System.
2. Please refer to the design documents prepared by WSP Canada Inc. for MECP Sewage Treatment and Disposal System Design.

8.3 WATER

1. The estimated water consumption of approximately 0.78 L/s with a peak hourly demand of 1.68 L/s will be required to service the proposed development with domestic water.
2. The fire flow required for proposed development is estimated at 100.00 L/s for 4 hours, delivered with a residual pressure of not less then 140 kilopascals.
3. This development application proposes to make use of the existing 300mm dia fire and domestic combines service provided by the Region of Peel from the existing 300mm dia municipal watermain located within road allowance of King Street.
4. The proposed combined service will split at the property line into fire and domestic services.
5. A flow and pressure test will be performed on the nearest hydrant to the site prior to the building permit application to determine compliance for minimum suppression outlined in the FUS and Town’s guidelines.

We trust that this report satisfies the requirements of the Town of Caledon and Region of Peel with respect to the subject development. Should you have any questions, please feel free to contact the undersigned.

Yours truly,
FLORA DESIGNS INC.

Chirag C. Patel, P.Eng, PMP
Senior Project Manager

Appendix "A" Plans

- Location Map
- Site Survey Drawing
- Architectural Site Plan

LOCATION MAP (NTS)

SITE SURVEY DRAWING (NTS)

ARCHITECTURAL SITE PLAN (NTS)

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- Perforated CSP Pipe Calculations (Outlet-1)
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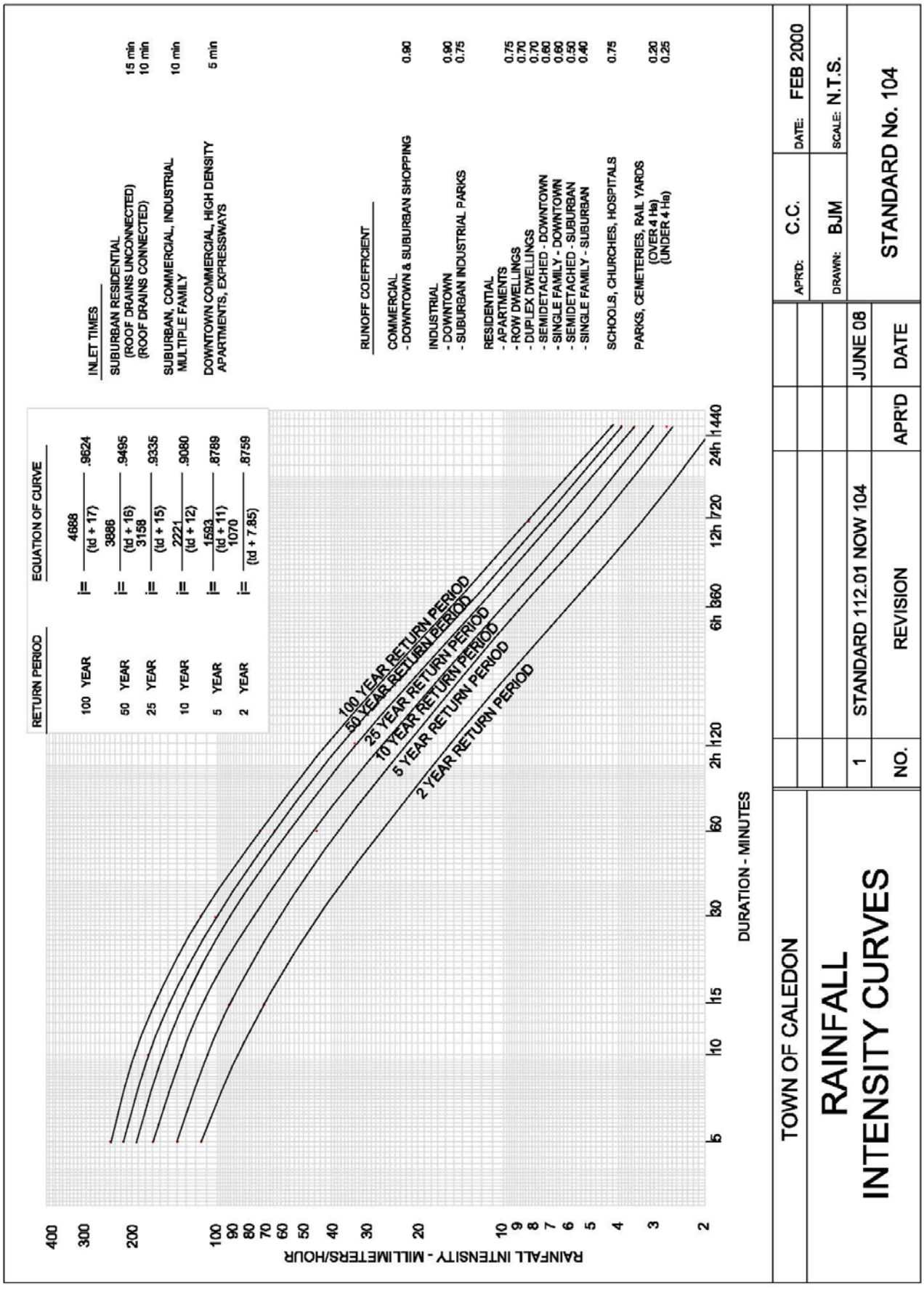
- CDS Model 2020 – Typical Drawing

IDF CURVE - TOWN OF CALEDON

(Standard No. 104)



RUNOFF COEFFICIENT CALCULATIONS

In Accordance with STD No.104, Development Standards, Policies & Guidelines Manual

Character of Surface	Runoff Coeff. "C"
Parks (Under 4 Ha)	0.25
Asphalt, Concrete, Roof Areas	0.90

Pre-Development Drainage Area

Catchment Type	Catchment #	Area (m^2)		Area (ha)		% Impervious	Runoff Coeff. "C"
		Impervious	Total	Impervious	Total		
Uncontrolled	**CA-1-Pre**	509.55	32125.68	0.05	3.21	1.59	0.26
Total Site		**509.55**	**32125.68**	**0.05**	**3.21**	**1.59**	**0.26**

Post-Development Drainage Area

Catchment Type	Catchment #	Area (m^2)		Area (ha)		% Impervious	Runoff Coeff. "C"
		Impervious	Total	Impervious	Total		
Controlled	**CA-1-Post**	18045.72	29108.54	1.80	2.91	61.99	0.65
Uncontrolled	**CA-2-Post**	42.43	3017.14	0.00	0.30	1.41	0.26
Total Site		**18088.15**	**32125.68**	**1.81**	**3.21**	**56.30**	**0.62**

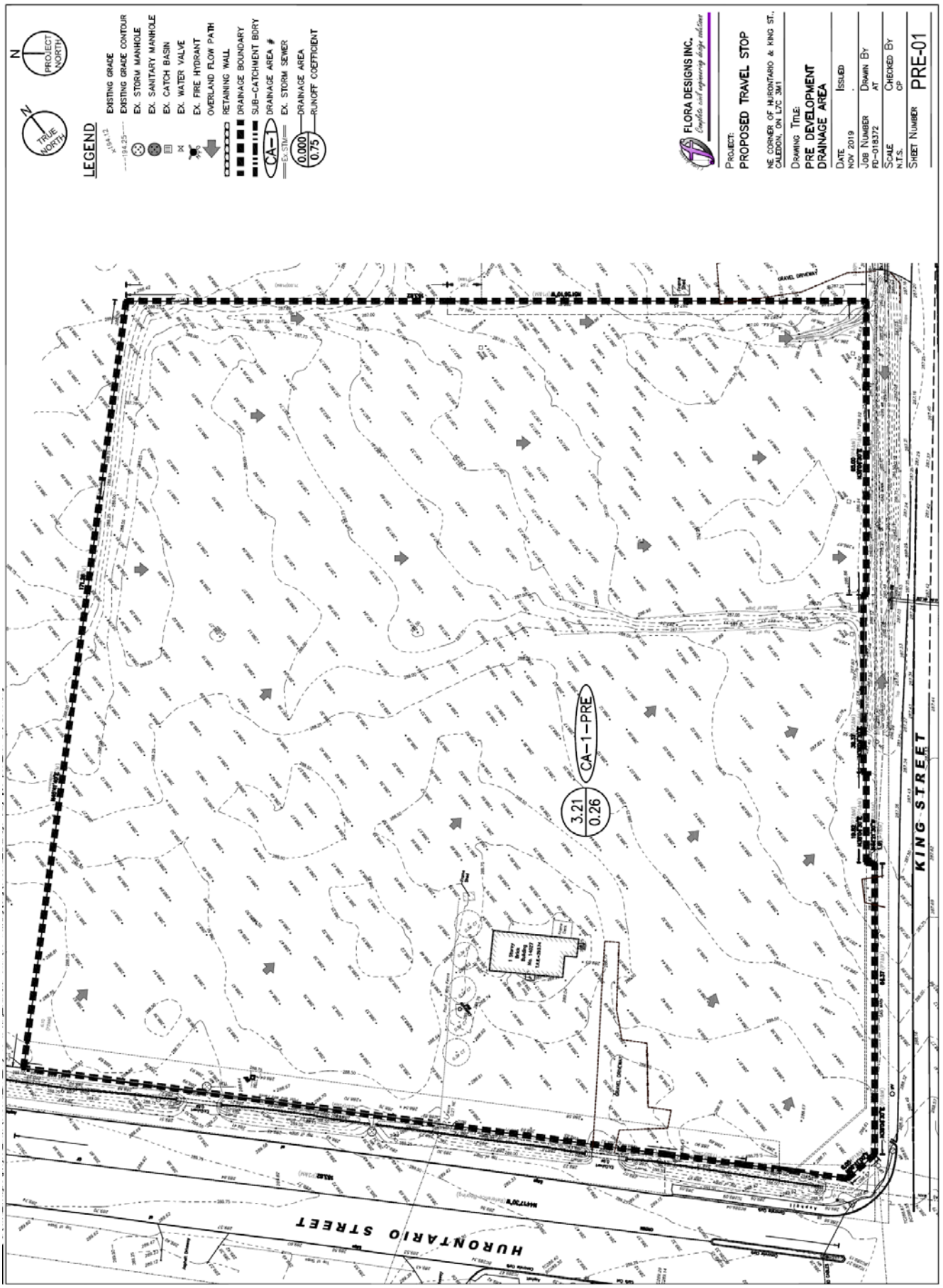
Runoff Coefficient (C)

C = 0.9 i + 0.25 (1 - i), Where i = Imperviousness Ratio

Sub-Catchment Area of CA-1-Post

Catchment Type	Inlet Location	Area (m^2)		Area (ha)		% Impervious	Runoff Coeff. "C"
		Impervious	Total	Impervious	Total		
Controlled	**CB-1**	499.77	532.23	0.05	0.05	93.90	0.86
	CB-2	1167.89	1386.52	0.12	0.14	84.23	0.80
	Canopy	216.87	216.87	0.02	0.02	100.00	0.90
	DCB-3	3100.57	4153.37	0.31	0.42	74.65	0.74
	DCB-4	1794.02	2085.76	0.18	0.21	86.01	0.81
	CB-5	1521.17	1521.17	0.15	0.15	100.00	0.90
	DCB-6	1469.17	1991.56	0.15	0.20	73.77	0.73
	CB-7	963.31	1210.53	0.10	0.12	79.58	0.77
	BLDG-A	548.75	548.75	0.05	0.05	100.00	0.90
	BLDG-B	298.00	298.00	0.03	0.03	100.00	0.90
	CBMH-4	229.75	366.98	0.02	0.04	62.61	0.66
	BLDG-C	335.02	335.02	0.03	0.03	100.00	0.90
	BLDG-D	335.02	335.02	0.03	0.03	100.00	0.90
	CBMH-6	550.02	550.02	0.06	0.06	100.00	0.90
	CBMH-7	1472.83	1957.25	0.15	0.20	75.25	0.74
	Canopy	188.47	188.47	0.02	0.02	100.00	0.90
	CBMH-8	1504.72	1632.16	0.15	0.16	92.19	0.85
	CB-8	302.60	415.07	0.03	0.04	72.90	0.72
	CBMH-9	0.00	1580.59	0.00	0.16	0.00	0.25
	CBMH-10	1547.77	1593.58	0.15	0.16	97.13	0.88
	POND	0.00	6209.62	0.00	0.62	0.00	0.25
Sub Total - Controlled		**18045.72**	**29108.54**	**1.80**	**2.91**	**61.99**	**0.65**

EXISTING STORM DRAINAGE PLAN (NTS)



PRE-DEVELOPMENT PEAK FLOW CALCULATIONS

Catchment #	Drainage Area	Runoff Coefficient	Time of Concentration
	"A" in Hector	"C"	"Tc" in Minute
CA-1-Pre	3.21	0.26	10

Where: Q = Runoff Quantity (Flow) in litre/sec
A = Drainage Area in Hectors
C = Runoff Coefficient
I = Average Rainfall Intensity - mm/h

Event 5 yr

*(I) = a * (Tc + b)^c*

IDF Data Set, Town of Caledon

Coefficient, a =	1593.00
Coefficient, b =	11.00
Exponent, c =	-0.879

Catchment #	A (ha)	I (mm/h)	C	Q (L/s)	Q (m^3/s)
CA-1-Pre	3.21	109.68	0.26	254.47	0.254

Event 100 yr

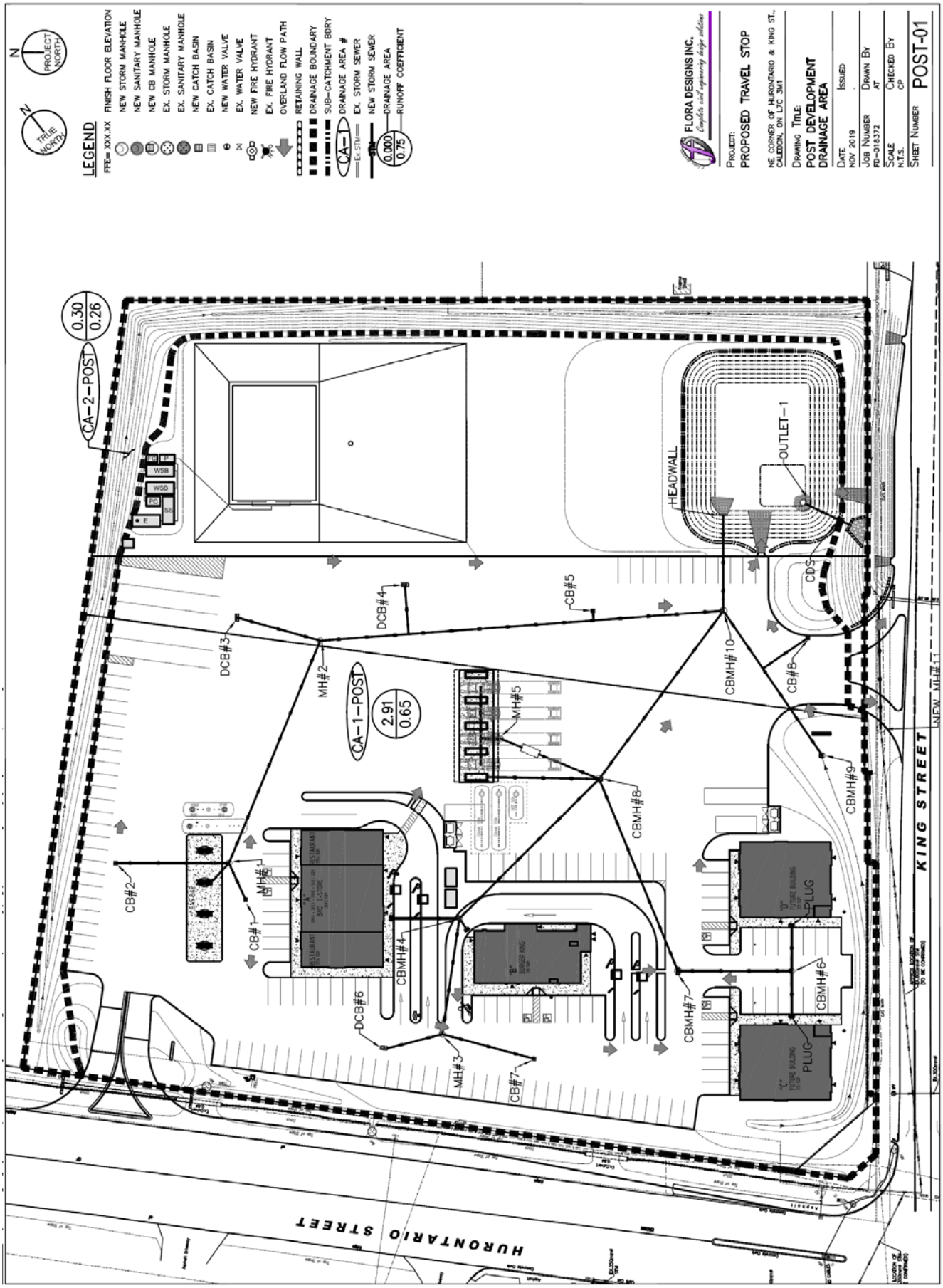
*(I) = a * (Tc + b)^c*

IDF Data Set, Town of Caledon

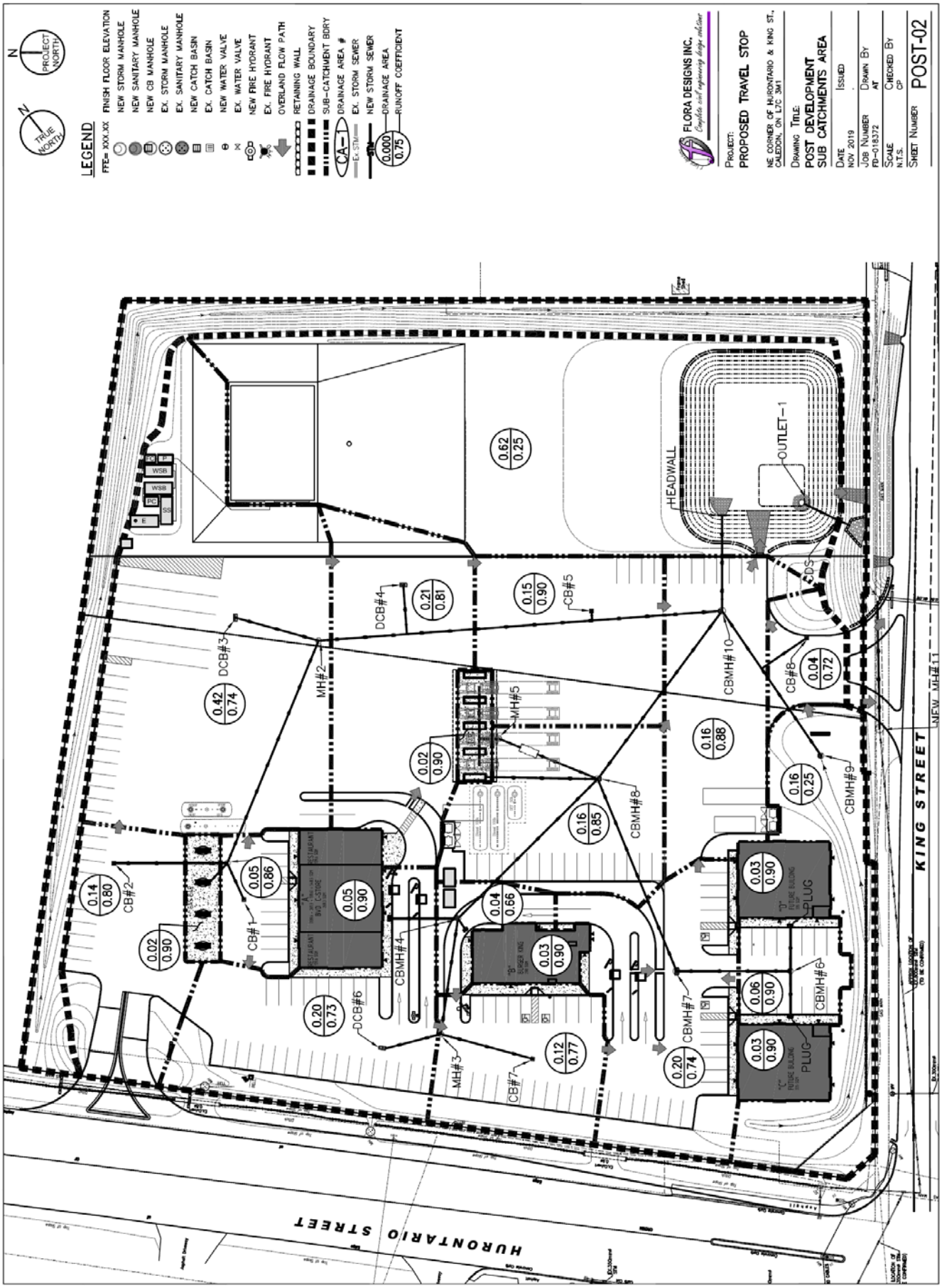
Coefficient, a =	4688.00
Coefficient, b =	17.00
Exponent, c =	-0.962

Catchment #	A (ha)	I (mm/h)	C	Q (L/s)	Q (m^3/s)
CA-1-Pre	3.21	196.54	0.26	456.00	0.456

PROPOSED STORM DRAINAGE PLAN (NTS)



PROPOSED SUB-CATCHMENT AREA PLAN (NTS)



POST-DEVELOPMENT PEAK FLOW CALCULATIONS

Catchment #	Drainage Area	Runoff Coefficient	Time of Concentration
	"A" in Hector	"C"	"Tc" in Minute
CA-1-Post	2.91	0.65	10
CA-2-Post	0.30	0.26	10

Where: Q = Runoff Quantity (Flow) in litre/sec
A = Drainage Area in Hectors
C = Runoff Coefficient
I = Average Rainfall Intensity - mm/h

Event 5 yr

*(I) = a * (Tc + b)^c*

IDF Data Set, Town of Caledon

Coefficient, a =	1593.00
Coefficient, b =	11.00
Exponent, c =	-0.879

Catchment #	A (ha)	I (mm/h)	C	Q (L/s)	Q (m^3/s)
CA-1-Post	2.91	109.68	0.65	576.72	0.577
CA-2-Post	0.30	109.68	0.26	23.78	0.024

Event 100 yr

*(I) = a * (Tc + b)^c*

IDF Data Set, Town of Caledon

Coefficient, a =	4688.00
Coefficient, b =	17.00
Exponent, c =	-0.962

Catchment #	A (ha)	I (mm/h)	C	Q (L/s)	Q (m^3/s)
CA-1-Post	2.91	196.54	0.65	1033.46	1.033
CA-2-Post	0.30	196.54	0.26	42.62	0.043

STAGE STORAGE CALCULATIONS – POND SU-1

Bottom Elevation, Base = 285.90 m

Stage-Storage Information:

POND STORAGE (SU-1)					Incremental Storage Volume (SITE)	Cumulative Storage Volume
	Elevation (m)	Stage (m)	Surface Area (m2)	Incremental Storage Volume (POND) V=[(A1+A2)/2]d (m3)	(m3)	(m3)
Base	285.90	0.00	90.52	--	--	0
	286.00	0.10	590.47	34.05	0.00	34.05
	286.25	0.35	690.23	160.09	8.53	202.67
	286.50	0.60	795.91	185.77	8.53	396.97
	286.75	0.85	907.87	212.97	8.53	618.47
	287.00	1.10	1026.12	241.75	17.43	877.65
	287.25	1.35	1150.64	272.10	17.43	1167.17
	287.50	1.60	1281.45	304.01	17.43	1488.61
Top	287.60	1.70	1335.54	130.85	14.91	1634.37

STAGE STORAGE CALCULATIONS – SITE AREA

Orifice Invert = 285.90
Stage = 286.75
Storage Depth = 0.85 m

CB & MH Storage:

ID	RIM Elevation (m)	INV Elevation (m)	Stage Elevation (m)	Water Depth (m)	Nominal MH Dia (mm)	MH Diameter (m)	Area (m^2)	Storage Volume (m^3)
CB-1	288.70	287.33	286.75	0.00	CB	N/A	0.36	0.00
CB-2	288.45	287.42	286.75	0.00	CB	N/A	0.36	0.00
DCB-3	287.90	286.99	286.75	0.00	DCB	N/A	0.72	0.00
DCB-4	287.90	286.80	286.75	0.00	DCB	N/A	0.72	0.00
CB-5	287.70	286.59	286.75	0.16	CB	N/A	0.36	0.06
DCB-6	288.25	287.22	286.75	0.00	DCB	N/A	0.72	0.00
CB-7	288.10	287.31	286.75	0.00	CB	N/A	0.36	0.00
CB-8	287.50	286.70	286.75	0.05	CB	N/A	0.36	0.02
MH-1	288.81	287.24	286.75	0.00	1200	1.22	1.17	0.00
MH-2	288.31	286.74	286.75	0.01	1200	1.22	1.17	0.01
MH-3	288.42	287.07	286.75	0.00	1200	1.22	1.17	0.00
CBMH-4	288.20	286.89	286.75	0.00	1200	1.22	1.17	0.00
MH-5	288.32	287.00	286.75	0.00	1200	1.22	1.17	0.00
CBMH-6	288.05	287.11	286.75	0.00	1200	1.22	1.17	0.00
CBMH-7	287.95	286.90	286.75	0.00	1500	1.52	1.81	0.00
CBMH-8	287.85	286.52	286.75	0.23	1500	1.52	1.81	0.42
CBMH-9	287.55	286.70	286.75	0.05	1200	1.22	1.17	0.06
CBMH-10	287.50	286.21	286.75	0.54	1500	1.52	1.81	0.98
Total CB & MH Storage Volume								**1.54**

Pipe Storage:

Pipe Dia. (m)	Pipe Length (m)	From				To				Storage Volume (m^3)
		ID	Invert Elevation (m)	Water Depth (m)	Area (m^2)	ID	Invert Elevation (m)	Water Depth (m)	Area (m^2)	
0.250	8.81	CB-1	287.33	0.00	0.00	MH-1	287.29	0.00	0.00	0.00
0.200	5.73	Canopy	287.45	0.00	0.00	MH-1	287.34	0.00	0.00	0.00
0.250	25.00	CB-2	287.42	0.00	0.00	MH-1	287.29	0.00	0.00	0.00
0.300	53.16	MH-1	287.24	0.00	0.00	MH-2	286.97	0.00	0.00	0.00
0.375	19.05	DCB-3	286.99	0.00	0.00	MH-2	286.89	0.00	0.00	0.00
0.300	10.90	DCB-4	286.80	0.00	0.00	Lead	286.75	0.00	0.00	0.00
0.250	2.15	CB-5	286.59	0.16	0.03	Lead	286.57	0.18	0.04	0.08
0.525	89.20	MH-2	286.74	0.01	0.00	CBMH-10	286.29	0.46	0.20	8.92
0.300	13.25	DCB-6	287.22	0.00	0.00	MH-3	287.15	0.00	0.00	0.00
0.250	21.00	CB-7	287.31	0.00	0.00	MH-3	287.20	0.00	0.00	0.00
0.375	25.84	MH-3	287.07	0.00	0.00	CBMH-4	286.94	0.00	0.00	0.00
0.250	15.35	BLDG-A	287.17	0.00	0.00	CBMH-4	287.02	0.00	0.00	0.00
0.250	3.18	BLDG-B	287.05	0.00	0.00	CBMH-4	287.02	0.00	0.00	0.00
0.375	43.60	CBMH-4	286.89	0.00	0.00	CBMH-8	286.67	0.08	0.02	0.44
0.200	24.69	Canopy	287.10	0.00	0.00	CBMH-8	286.85	0.00	0.00	0.00
0.200	19.55	MH-5	287.00	0.00	0.00	CBMH-8	286.85	0.00	0.00	0.00
0.250	10.24	BLDG-C	287.23	0.00	0.00	CBMH-6	287.16	0.00	0.00	0.00
0.250	10.26	BLDG-D	287.23	0.00	0.00	CBMH-6	287.16	0.00	0.00	0.00
0.300	25.08	CBMH-6	287.11	0.00	0.00	CBMH-7	286.98	0.00	0.00	0.00
0.375	45.92	CBMH-7	286.90	0.00	0.00	CBMH-8	286.67	0.08	0.02	0.46
0.525	46.19	CBMH-8	286.52	0.23	0.09	CBMH-10	286.29	0.46	0.20	6.70
0.250	12.10	CB-8	286.70	0.05	0.01	Lead	286.62	0.13	0.03	0.24
0.300	38.73	CBMH-9	286.70	0.05	0.01	CBMH-10	286.51	0.24	0.06	1.36
0.600	21.32	CBMH-10	286.21	0.54	0.27	Pond	286.00	0.60	0.28	5.86
Total Pipe Storage Volume										**24.05**

Surface Storage:

ID	RIM Elevation (m)	HWL (m)	Surface Area @ HWL (m^2)	Stage Elevation (m)	Ponding Depth (m)	Storage Volume (m^3)
CB-8	287.50	287.60	85.00	286.75	0.00	0.00
CBMH-9	287.55	287.60	105.50	286.75	0.00	0.00
CBMH-10	287.50	287.60	115.73	286.75	0.00	0.00
Total Surface Storage Volume						**0.00**

TOTAL STAGE STORAGE AT ELEVATION	**286.75**	**=**	**25.59**	**m^3**

Orifice Invert = 285.90
Stage = 287.50
Storage Depth = 1.60 m

CB & MH Storage:

ID	RIM Elevation (m)	INV Elevation (m)	Stage Elevation (m)	Water Depth (m)	Nominal MH Dia (mm)	MH Diameter (m)	Area (m^2)	Storage Volume (m^3)
CB-1	288.70	287.33	287.50	0.17	CB	N/A	0.36	0.06
CB-2	288.45	287.42	287.50	0.08	CB	N/A	0.36	0.03
DCB-3	287.90	286.99	287.50	0.51	DCB	N/A	0.72	0.37
DCB-4	287.90	286.80	287.50	0.70	DCB	N/A	0.72	0.50
CB-5	287.70	286.59	287.50	0.91	CB	N/A	0.36	0.33
DCB-6	288.25	287.22	287.50	0.28	DCB	N/A	0.72	0.20
CB-7	288.10	287.31	287.50	0.19	CB	N/A	0.36	0.07
CB-8	287.50	286.70	287.50	0.80	CB	N/A	0.36	0.29
MH-1	288.81	287.24	287.50	0.26	1200	1.22	1.17	0.30
MH-2	288.31	286.74	287.50	0.76	1200	1.22	1.17	0.89
MH-3	288.42	287.07	287.50	0.43	1200	1.22	1.17	0.50
CBMH-4	288.20	286.89	287.50	0.61	1200	1.22	1.17	0.71
MH-5	288.32	287.00	287.50	0.50	1200	1.22	1.17	0.58
CBMH-6	288.05	287.11	287.50	0.39	1200	1.22	1.17	0.46
CBMH-7	287.95	286.90	287.50	0.60	1500	1.52	1.81	1.09
CBMH-8	287.85	286.52	287.50	0.98	1500	1.52	1.81	1.78
CBMH-9	287.55	286.70	287.50	0.80	1200	1.22	1.17	0.93
CBMH-10	287.50	286.21	287.50	1.29	1500	1.52	1.81	2.34
Total CB & MH Storage Volume								**11.43**

Pipe Storage:

Pipe Dia. (m)	Pipe Length (m)	From				To				Storage Volume (m^3)
		ID	Invert Elevation (m)	Water Depth (m)	Area (m^2)	ID	Invert Elevation (m)	Water Depth (m)	Area (m^2)	
0.250	8.81	CB-1	287.33	0.17	0.04	MH-1	287.29	0.21	0.04	0.35
0.200	5.73	Canopy	287.45	0.05	0.01	MH-1	287.34	0.16	0.03	0.11
0.250	25.00	CB-2	287.42	0.08	0.01	MH-1	287.29	0.21	0.04	0.63
0.300	53.16	MH-1	287.24	0.26	0.07	MH-2	286.97	0.30	0.07	3.72
0.375	19.05	DCB-3	286.99	0.38	0.11	MH-2	286.89	0.38	0.11	2.10
0.300	10.90	DCB-4	286.80	0.30	0.07	Lead	286.75	0.30	0.07	0.76
0.250	2.15	CB-5	286.59	0.25	0.05	Lead	286.57	0.25	0.05	0.11
0.525	89.20	MH-2	286.74	0.53	0.22	CBMH-10	286.29	0.53	0.22	19.62
0.300	13.25	DCB-6	287.22	0.28	0.07	MH-3	287.15	0.30	0.07	0.93
0.250	21.00	CB-7	287.31	0.19	0.04	MH-3	287.20	0.25	0.05	0.95
0.375	25.84	MH-3	287.07	0.38	0.11	CBMH-4	286.94	0.38	0.11	2.84
0.250	15.35	BLDG-A	287.17	0.25	0.05	CBMH-4	287.02	0.25	0.05	0.77
0.250	3.18	BLDG-B	287.05	0.25	0.05	CBMH-4	287.02	0.25	0.05	0.16
0.375	43.60	CBMH-4	286.89	0.38	0.11	CBMH-8	286.67	0.38	0.11	4.80
0.200	24.69	Canopy	287.10	0.20	0.03	CBMH-8	286.85	0.20	0.03	0.74
0.200	19.55	MH-5	287.00	0.20	0.03	CBMH-8	286.85	0.20	0.03	0.59
0.250	10.24	BLDG-C	287.23	0.25	0.05	CBMH-6	287.16	0.25	0.05	0.51
0.250	10.26	BLDG-D	287.23	0.25	0.05	CBMH-6	287.16	0.25	0.05	0.51
0.300	25.08	CBMH-6	287.11	0.30	0.07	CBMH-7	286.98	0.30	0.07	1.76
0.375	45.92	CBMH-7	286.90	0.38	0.11	CBMH-8	286.67	0.38	0.11	5.05
0.525	46.19	CBMH-8	286.52	0.53	0.22	CBMH-10	286.29	0.53	0.22	10.16
0.250	12.10	CB-8	286.70	0.25	0.05	Lead	286.62	0.25	0.05	0.61
0.300	38.73	CBMH-9	286.70	0.30	0.07	CBMH-10	286.51	0.30	0.07	2.71
0.600	21.32	CBMH-10	286.21	0.60	0.28	Pond	286.00	0.60	0.28	5.97
Total Pipe Storage Volume										**66.45**

Surface Storage:

ID	RIM Elevation (m)	HWL (m)	Surface Area @ HWL (m^2)	Stage Elevation (m)	Ponding Depth (m)	Storage Volume (m^3)
CB-8	287.50	287.60	85.00	287.50	0.00	0.00
CBMH-9	287.55	287.60	105.50	287.50	0.00	0.00
CBMH-10	287.50	287.60	115.73	287.50	0.00	0.00
Total Surface Storage Volume						**0.00**

TOTAL STAGE STORAGE AT ELEVATION	**287.50**	**=**	**77.88**	**m^3**

Orifice Invert = 285.90
Stage = 287.60
Storage Depth = 1.70 m

CB & MH Storage:

ID	RIM Elevation (m)	INV Elevation (m)	Stage Elevation (m)	Water Depth (m)	Nominal MH Dia (mm)	MH Diameter (m)	Area (m^2)	Storage Volume (m^3)
CB-1	288.70	287.33	287.60	0.27	CB	N/A	0.36	0.10
CB-2	288.45	287.42	287.60	0.18	CB	N/A	0.36	0.06
DCB-3	287.90	286.99	287.60	0.61	DCB	N/A	0.72	0.44
DCB-4	287.90	286.80	287.60	0.80	DCB	N/A	0.72	0.58
CB-5	287.70	286.59	287.60	1.01	CB	N/A	0.36	0.36
DCB-6	288.25	287.22	287.60	0.38	DCB	N/A	0.72	0.27
CB-7	288.10	287.31	287.60	0.29	CB	N/A	0.36	0.10
CB-8	287.50	286.70	287.50	0.80	CB	N/A	0.36	0.29
MH-1	288.81	287.24	287.60	0.36	1200	1.22	1.17	0.42
MH-2	288.31	286.74	287.60	0.86	1200	1.22	1.17	1.00
MH-3	288.42	287.07	287.60	0.53	1200	1.22	1.17	0.62
CBMH-4	288.20	286.89	287.60	0.71	1200	1.22	1.17	0.83
MH-5	288.32	287.00	287.60	0.60	1200	1.22	1.17	0.70
CBMH-6	288.05	287.11	287.60	0.49	1200	1.22	1.17	0.57
CBMH-7	287.95	286.90	287.60	0.70	1500	1.52	1.81	1.27
CBMH-8	287.85	286.52	287.60	1.08	1500	1.52	1.81	1.96
CBMH-9	287.55	286.70	287.55	0.85	1200	1.22	1.17	0.99
CBMH-10	287.50	286.21	287.50	1.29	1500	1.52	1.81	2.34
Total CB & MH Storage Volume								**12.92**

Pipe Storage:

Pipe Dia. (m)	Pipe Length (m)	From				To				Storage Volume (m^3)
		ID	Invert Elevation (m)	Water Depth (m)	Area (m^2)	ID	Invert Elevation (m)	Water Depth (m)	Area (m^2)	
0.250	8.81	CB-1	287.33	0.25	0.05	MH-1	287.29	0.25	0.05	0.44
0.200	5.73	Canopy	287.45	0.15	0.03	MH-1	287.34	0.20	0.03	0.17
0.250	25.00	CB-2	287.42	0.18	0.04	MH-1	287.29	0.25	0.05	1.13
0.300	53.16	MH-1	287.24	0.30	0.07	MH-2	286.97	0.30	0.07	3.72
0.375	19.05	DCB-3	286.99	0.38	0.11	MH-2	286.89	0.38	0.11	2.10
0.300	10.90	DCB-4	286.80	0.30	0.07	Lead	286.75	0.30	0.07	0.76
0.250	2.15	CB-5	286.59	0.25	0.05	Lead	286.57	0.25	0.05	0.11
0.525	89.20	MH-2	286.74	0.53	0.22	CBMH-10	286.29	0.53	0.22	19.62
0.300	13.25	DCB-6	287.22	0.30	0.07	MH-3	287.15	0.30	0.07	0.93
0.250	21.00	CB-7	287.31	0.25	0.05	MH-3	287.20	0.25	0.05	1.05
0.375	25.84	MH-3	287.07	0.38	0.11	CBMH-4	286.94	0.38	0.11	2.84
0.250	15.35	BLDG-A	287.17	0.25	0.05	CBMH-4	287.02	0.25	0.05	0.77
0.250	3.18	BLDG-B	287.05	0.25	0.05	CBMH-4	287.02	0.25	0.05	0.16
0.375	43.60	CBMH-4	286.89	0.38	0.11	CBMH-8	286.67	0.38	0.11	4.80
0.200	24.69	Canopy	287.10	0.20	0.03	CBMH-8	286.85	0.20	0.03	0.74
0.200	19.55	MH-5	287.00	0.20	0.03	CBMH-8	286.85	0.20	0.03	0.59
0.250	10.24	BLDG-C	287.23	0.25	0.05	CBMH-6	287.16	0.25	0.05	0.51
0.250	10.26	BLDG-D	287.23	0.25	0.05	CBMH-6	287.16	0.25	0.05	0.51
0.300	25.08	CBMH-6	287.11	0.30	0.07	CBMH-7	286.98	0.30	0.07	1.76
0.375	45.92	CBMH-7	286.90	0.38	0.11	CBMH-8	286.67	0.38	0.11	5.05
0.525	46.19	CBMH-8	286.52	0.53	0.22	CBMH-10	286.29	0.53	0.22	10.16
0.250	12.10	CB-8	286.70	0.25	0.05	Lead	286.62	0.25	0.05	0.61
0.300	38.73	CBMH-9	286.70	0.30	0.07	CBMH-10	286.51	0.30	0.07	2.71
0.600	21.32	CBMH-10	286.21	0.60	0.28	Pond	286.00	0.60	0.28	5.97
Total Pipe Storage Volume										**67.20**

Surface Storage:

ID	RIM Elevation (m)	HWL (m)	Surface Area @ HWL (m^2)	Stage Elevation (m)	Ponding Depth (m)	Storage Volume (m^3)
CB-8	287.50	287.60	85.00	287.60	0.10	4.25
CBMH-9	287.55	287.60	105.50	287.60	0.05	2.64
CBMH-10	287.50	287.60	115.73	287.60	0.10	5.79
Total Surface Storage Volume						**12.67**

TOTAL STAGE STORAGE AT ELEVATION	287.60	=	92.79	m^3

Stage Storage Summary

Stage Elevation	Stage Storage Volume (m^3)			
	CB-MH	Pipe	Surface	Total
286.75	1.54	24.05	0.00	**25.59**
287.50	11.43	66.45	0.00	**77.88**
287.60	12.92	67.20	12.67	**92.79**

POST-DEVELOPMENT SITE FLOW AND STORAGE USED SUMMARY - 5-YEAR STORM

Actual Release Rate (RR)				0.042	m^3/s
Actual Release Volume per 5-min. Interval				12.45	m^3
5-year Design Storm				**Catchment #**	**CA-1-Post**
a =	1593.00			Area (ha) =	2.91
b =	11.00			C =	0.65
c =	-0.879			Tc (min.)=	10
i =	a * (Tc + b)^c				
1	2	3	4	5	6
Time (min.)	**Rainfall Intensity (mm/hr)**	**Storm Runoff (m^3/s)**	**Storm Runoff Volume (m^3)**	**Released Volume (m^3)**	**Storage Volume (m^3)**
	(2)=a*((1))^b	(3)=[(2)*A*C]/360	(4)=(3)*(1)*60	(5)=(RR)*(1)*60	(6)=(4)-(5)
10	109.68	0.576	345.76	24.90	320.86
15	90.91	0.478	429.87	37.35	392.52
20	77.89	0.409	491.07	49.80	441.27
25	68.29	0.359	538.24	62.25	475.99
30	60.92	0.320	576.12	74.70	501.42
35	55.06	0.289	607.49	87.15	520.34
40	50.28	0.264	634.08	99.60	534.48
45	46.32	0.243	657.05	112.05	545.00
50	42.96	0.226	677.20	124.50	552.70
55	40.09	0.211	695.08	136.95	558.13
60	37.60	0.198	711.13	149.40	561.73
65	35.41	0.186	725.67	161.85	563.82
70	33.48	0.176	738.93	174.30	**564.63**
75	31.77	0.167	751.11	186.75	564.36
80	30.23	0.159	762.36	199.20	563.16
85	28.84	0.152	772.81	211.65	561.16
90	27.58	0.145	782.56	224.10	558.46
95	26.43	0.139	791.69	236.55	555.14
100	25.39	0.133	800.27	249.00	551.27
105	24.42	0.128	808.37	261.45	546.92
110	23.53	0.124	816.03	273.90	542.13
115	22.71	0.119	823.29	286.35	536.94
120	21.95	0.115	830.20	298.80	531.40
125	21.23	0.112	836.78	311.25	525.53
130	20.57	0.108	843.07	323.70	519.37
135	19.95	0.105	849.09	336.15	512.94
140	19.37	0.102	854.86	348.60	506.26
145	18.82	0.099	860.40	361.05	499.35
150	18.31	0.096	865.73	373.50	492.23
155	17.82	0.094	870.86	385.95	484.91
160	17.36	0.091	875.81	398.40	477.41
165	16.93	0.089	880.59	410.85	469.74
170	16.52	0.087	885.21	423.30	461.91
175	16.13	0.085	889.68	435.75	453.93
180	15.75	0.083	894.01	448.20	445.81

POST-DEVELOPMENT SITE FLOW AND STORAGE USED SUMMARY - 100-YEAR STORM

Actual Release Rate (RR)				0.057	m^3/s
Actual Release Volume per 5-min. Interval				17.21	m^3
100-year Design Storm				**Catchment #**	**CA-1-Post**
a =	4688.00			Area (ha) =	2.91
b =	17.00			C =	0.65
c =	-0.962			Tc (min.)=	10
i =	a * (Tc + b)^c				
1	2	3	4	5	6
Time (min.)	**Rainfall Intensity (mm/hr)**	**Storm Runoff (m^3/s)**	**Storm Runoff Volume (m^3)**	**Released Volume (m^3)**	**Storage Volume (m^3)**
	(2)=a*((1))^b	(3)=[(2)*A*C]/360	(4)=(3)*(1)*60	(5)=(RR)*(1)*60	(6)=(4)-(5)
10	196.54	1.033	619.58	34.42	585.17
15	166.89	0.877	789.18	51.62	737.56
20	145.13	0.763	915.03	68.83	846.20
25	128.46	0.675	1012.44	86.04	926.40
30	115.28	0.606	1090.28	103.25	987.03
35	104.59	0.550	1154.06	120.46	1033.61
40	95.75	0.503	1207.39	137.66	1069.73
45	88.31	0.464	1252.73	154.87	1097.86
50	81.95	0.431	1291.81	172.08	1119.73
55	76.47	0.402	1325.89	189.29	1136.61
60	71.69	0.377	1355.92	206.50	1149.43
65	67.47	0.355	1382.62	223.70	1158.91
70	63.74	0.335	1406.52	240.91	1165.61
75	60.40	0.317	1428.09	258.12	1169.97
80	57.40	0.302	1447.65	275.33	1172.32
85	54.69	0.287	1465.50	292.54	**1172.96**
90	52.23	0.274	1481.86	309.74	1172.11
95	49.98	0.263	1496.92	326.95	1169.97
100	47.93	0.252	1510.85	344.16	1166.69
105	46.03	0.242	1523.77	361.37	1162.40
110	44.29	0.233	1535.80	378.58	1157.22
115	42.67	0.224	1547.04	395.78	1151.25
120	41.17	0.216	1557.56	412.99	1144.57
125	39.78	0.209	1567.44	430.20	1137.24
130	38.47	0.202	1576.74	447.41	1129.33
135	37.25	0.196	1585.51	464.62	1120.90
140	36.11	0.190	1593.81	481.82	1111.99
145	35.04	0.184	1601.67	499.03	1102.64
150	34.03	0.179	1609.13	516.24	1092.89
155	33.08	0.174	1616.22	533.45	1082.78
160	32.18	0.169	1622.98	550.66	1072.32
165	31.33	0.165	1629.42	567.86	1061.56
170	30.52	0.160	1635.58	585.07	1050.51
175	29.75	0.156	1641.47	602.28	1039.19
180	29.03	0.153	1647.10	619.49	1027.62

ORIFICE-WEIR RATING CALCULATIONS

Active Storage Stage-Orifice Flow Relationship: **(Dry Pond Outlet-1)**

	Elevation (m)	Stage (m)	Cumulative Storage Volume (m^3)	Flow Orifice-1 (m^3/s)	Flow Weir-1 (m^3/s)	Total Flow (m^3/s)
Base	285.90	0.00	0.00	0.000	0.000	0.000
	286.00	0.10	34.05	0.008	0.000	0.008
	286.25	0.35	202.67	0.026	0.000	0.026
	286.50	0.60	396.97	0.036	0.000	0.036
	286.75	0.85	618.47	0.043	0.000	0.043
	287.00	1.10	877.65	0.050	0.000	0.050
	287.25	1.35	1167.17	0.056	0.000	0.056
	287.50	1.60	1488.61	0.061	0.092	0.153
Top	287.60	1.70	1634.37	0.063	0.152	0.215

Orifice-1

Orifice Invert = 285.90 m

Orifice Characteristics:

$Q_P = CA_O(2gh_{CL})^{0.5}$

where,

Orifice Coefficient, C =	0.63	
Orifice Plate Diameter, D_O =	150	mm
Orifice sectional area, A_O =	0.01766	m^2
Elev at Centre of Orifice =	285.98	m
Acceleration - gravity, g =	9.81	m/s^2
Elev at Centre of Orifice =	0.14	m

Weir-1 (Sharp Crested Rectangular)

Weir Invert = 287.25 m

Weir Characteristics:

$Q_P = C_w * b * (h)^{3/2}$

where,

Weir Coefficient, C_w =	1.837	
Head on the Weir, h =	Per Stage	m
Downstream Headwater, h_s =	Nan	m
Width of the Weir, b =	0.40	m
Max. Depth of the Weir, d =	0.35	m

STORM SEWER DESIGN SHEET

FLORA DESIGNS INC.
Complete civil engineering design solutions

MUNICIPALITY:	Town of Caledon					**STORM SEWER DESIGN SHEET**											DESIGNER:	Flora Designs Inc.		
PROJECT NAME:	Proposed Travel Stop																PROJECT No:	18372		
RAINFALL PARAMETERS:		A =	1593.00			Pipe Capacity Q : $1/n * A * R^{2/3} * S^{1/2}$											Pipe Roughness ("n" Value):	0.013	Plastic	
Event:	5 Year Rainfall	B =	11.00			Pipe Velocity V : Q / A												0.013	Concrete	
IDF Data:	Town of Caledon	C =	-0.8789			Time of Flow: $(L/V_{act})/60$												0.024	CSP	

LOCATION			STORMWATER ANALYSIS								STORM SEWER DESIGN									
DESCRIPTION	From MH	To MH	Contri. Area A (ha)	Runoff Coeff. C	A x C	Accum. A x C	Time of Conc. Tc (min)	Rainfall Intensity I (mm/hr)	Total Peak Flow Q_{act} (L/s)	Actual Flow Velocity V_{act} (m/s)	Length (m)	Diameter (mm)	Slope (%)	Pipe Material	"n" Value	Full Flow Capacity Q_{cap} (L/s)	Full Flow Velocity V_{cap} (m/s)	Percent Full Q_{act}/Q_{cap}	Travel Time (min)	Total Time of Flow (min)
	CB-1	MH-1	0.05	0.86	0.04	0.04	10.0	109.68	13.11	0.76	8.81	250	0.50%	PVC	0.013	41.99	0.86	31.22%	0.2	10.2
	CB-2	MH-1	0.14	0.80	0.11	0.11	10.0	109.68	34.15	0.95	25.00	250	0.50%	PVC	0.013	41.99	0.86	81.33%	0.4	10.4
	Canopy	MH-1	0.02	0.90	0.02	0.02	10.0	109.68	5.49	1.01	5.73	200	2.00%	PVC	0.013	46.31	1.47	11.85%	0.1	10.1
	MH-1	MH-2			0.00	0.17	10.4	107.87	51.88	1.06	53.16	300	0.50%	PVC	0.013	68.28	0.97	75.98%	0.8	11.2
	DCB-3	MH-2	0.42	0.74	0.31	0.31	10.0	109.68	94.76	1.23	19.05	375	0.50%	PVC	0.013	123.82	1.12	76.54%	0.3	10.3
	DCB-4	Lead	0.21	0.81	0.17	0.17	10.0	109.68	51.86	1.06	10.90	300	0.50%	PVC	0.013	68.28	0.97	75.95%	0.2	10.2
	CB-5	Lead	0.15	0.90	0.14	0.14	10.0	109.68	41.16	1.30	2.15	250	1.00%	PVC	0.013	59.38	1.21	69.32%	0.0	10.0
	MH-2	CBMH-10			0.00	0.79	11.2	104.45	229.07	1.53	89.20	525	0.50%	CONC	0.013	303.74	1.40	75.42%	1.0	12.2
	DCB-6	MH-3	0.20	0.73	0.15	0.15	10.0	109.68	44.52	1.02	13.25	300	0.50%	PVC	0.013	68.28	0.97	65.19%	0.2	10.2
	CB-7	MH-3	0.12	0.77	0.09	0.09	10.0	109.68	28.17	0.91	21.00	250	0.50%	PVC	0.013	41.99	0.86	67.10%	0.4	10.4
	MH-3	CBMH-4			0.00	0.24	10.4	107.87	71.49	1.16	25.84	375	0.50%	PVC	0.013	123.82	1.12	57.74%	0.4	10.8
	BLDG-A	CBMH-4	0.05	0.90	0.05	0.05	10.0	109.68	13.72	0.98	15.35	250	1.00%	PVC	0.013	59.38	1.21	23.11%	0.3	10.3
	BLDG-B	CBMH-4	0.03	0.90	0.03	0.03	10.0	109.68	8.23	0.82	3.18	250	1.00%	PVC	0.013	59.38	1.21	13.86%	0.1	10.1
	CBMH-4	CBMH-8	0.04	0.66	0.03	0.34	10.8	106.13	99.37	1.24	43.60	375	0.50%	PVC	0.013	123.82	1.12	80.26%	0.6	11.4
	BLDG-C	CBMH-6	0.03	0.90	0.03	0.03	10.0	109.68	8.23	0.76	10.24	250	0.70%	PVC	0.013	49.68	1.01	16.57%	0.2	10.2
	BLDG-D	CBMH-6	0.03	0.90	0.03	0.03	10.0	109.68	8.23	0.76	10.26	250	0.70%	PVC	0.013	49.68	1.01	16.57%	0.2	10.2
	CBMH-6	CBMH-7	0.06	0.90	0.05	0.11	10.2	108.77	32.66	0.95	25.08	300	0.50%	PVC	0.013	68.28	0.97	47.82%	0.4	10.6
	CBMH-7	CBMH-8	0.20	0.74	0.15	0.26	10.6	107.00	76.15	1.17	45.92	375	0.50%	PVC	0.013	123.82	1.12	61.50%	0.7	11.3
	Canopy	CBMH-8	0.02	0.90	0.02	0.02	10.0	109.68	5.49	0.81	24.69	200	1.00%	PVC	0.013	32.75	1.04	16.76%	0.5	10.5
	CBMH-8	CBMH-10	0.16	0.85	0.14	0.75	11.4	103.63	215.15	1.52	46.19	525	0.50%	CONC	0.013	303.74	1.40	70.83%	0.5	11.9
	CB-8	Lead	0.04	0.72	0.03	0.03	10.0	109.68	8.78	0.76	12.10	250	0.70%	PVC	0.013	49.68	1.01	17.67%	0.3	10.3
	CBMH-9	CBMH-10	0.16	0.25	0.04	0.07	10.3	108.32	20.72	0.85	38.73	300	0.50%	PVC	0.013	68.28	0.97	30.34%	0.8	11.1
	CBMH-10	Pond	0.16	0.88	0.14	1.75	12.2	100.48	487.53	2.40	21.32	600	1.00%	CONC	0.013	613.31	2.17	79.49%	0.1	12.3
	Outlet-1	CDS	100-Year Max Flow from **Outlet-1**						57.36	1.40	8.00	450	1.00%	CONC	0.013	284.75	1.79	20.14%	0.1	0.1
	CDS	Head Wall	100-Year Max Flow from **Outlet-1**						57.36	1.40	3.00	450	1.00%	CONC	0.013	284.75	1.79	20.14%	0.0	0.0

PERFORATED CSP PIPE CALCULATIONS (OUTLET-1)

Perforated Outlet Pipe Characteristics:

Pipe Diameter =	1500	mm	Perforation Diameter =	50	mm
Perforated Pipe Length =	1.70	m	Perforation Spacing =	125	mm (center to center)
Pipe Circumference =	4.710	m	Perforation Area =	0.00196	m^2

# of Perforations per Row (Pipe Circumference) =	37	
# of Rows per Perforated Pipe Length =	12	
Total # of Perforations in Pipe =	444	
Total Perforated Area of Pipe =	0.871	m^2

NOTE:

The perforated portion of the outlet pipe is designed to provide sufficient flow to the downstream orifice plate even under a 75% blockage condition of the perforated pipe.
The perforated area of the outlet pipe provides a minimum opening area that is four (4) times greater than the cross-sectional area of the proposed orifice plate located downstream.

Orifice / Weir Characteristics:

	Orifice-1		Weir-1		
Size	150	mm	400	350	mm
Area	0.018	m^2	0.140		m^2

4 x Orifice/Weir Area =	0.631	m^2

Total Perforated Area of Pipe > 4 x Orifice/Weir Area .....O.K.

CDS DESIGN SUMMARY

CDS Average Annual Efficiency For TSS Removal & Total Annual Volume Treated

Area = 2.91 ha
Impervious: 62 %
CDS Model: PMSU2020_5
Flowrate: 31 l/s
IDF Data: Toronto Airport
PSD: FINE

Upstream Storage:
Storage 1634 m^3

Engineer: Flora Designs
Contact: Chirag Patel. P.Eng, P.M.P
Date: 21-Nov-19

Project: Highway 10 & King Street
Location: Caledon, ON
OGS ID: PMSU

Return	Period	Peak Flow	TSS Percentage Captured	Treated Flow Volume	Total Flow Volume	Annual Exceedance Probability	System Flow	CDS Flow	By-Pass Flow	Volume Percentage Treated
month / yr	Yr	l/s	%	litres	litres	%	l/s	l/s	l/s	%
1-M	0.08	8.05	92.93	77165	77165	**100.00**	8.05	8.05	0.00	100.00
2-M	0.17	11.73	90.15	112752	112752	**99.75**	11.73	11.73	0.00	100.00
3-M	0.25	14.69	87.88	141921	141921	**98.17**	14.69	14.69	0.00	100.00
4-M	0.33	17.31	85.85	168059	168059	**95.04**	17.31	17.31	0.00	100.00
5-M	0.42	19.25	84.32	187894	187894	**90.91**	19.25	19.25	0.00	100.00
6-M	0.50	21.19	82.78	207728	207728	**86.47**	21.19	21.19	0.00	100.00
7-M	0.58	22.57	81.67	222203	222203	**82.01**	22.57	22.57	0.00	100.00
8-M	0.67	23.95	80.56	236678	236678	**77.67**	23.95	23.95	0.00	100.00
9-M	0.75	25.34	79.44	251152	251152	**73.64**	25.34	25.34	0.00	100.00
10-M	0.83	26.37	78.59	262239	262239	**69.90**	26.37	26.37	0.00	100.00
11-M	0.92	27.40	77.74	273326	273326	**66.40**	27.40	27.40	0.00	100.00
1-Yr	1	28.43	76.90	284413	284413	**63.21**	28.43	28.43	0.00	100.00
2-Yr	2	36.19	68.46	353345	371271	**39.35**	36.19	31.15	5.04	95.17
5-Yr	5	42.01	59.97	374169	440134	**18.13**	42.01	31.15	10.86	85.01
10-Yr	10	45.29	55.12	375813	480502	**9.52**	45.29	31.15	14.14	78.21
25-Yr	25	48.32	51.16	376716	518758	**3.92**	48.32	31.15	17.17	72.62
50-Yr	50	52.15	46.78	377718	568643	**1.98**	52.15	31.15	21.00	66.42
100-Yr	100	57.11	42.05	378892	634414	**1.00**	57.11	31.15	25.96	59.72
Average Annual TSS Removal Efficiency [%]:					**83.3**	Ave. Ann. T. Volume [%]:				**99.4**

Notes:
1) CDS Efficiency based on testing conducted at the University of Central Florida
2) CDS design flowrate and scaling based on standard manufacturer model & product specificiations

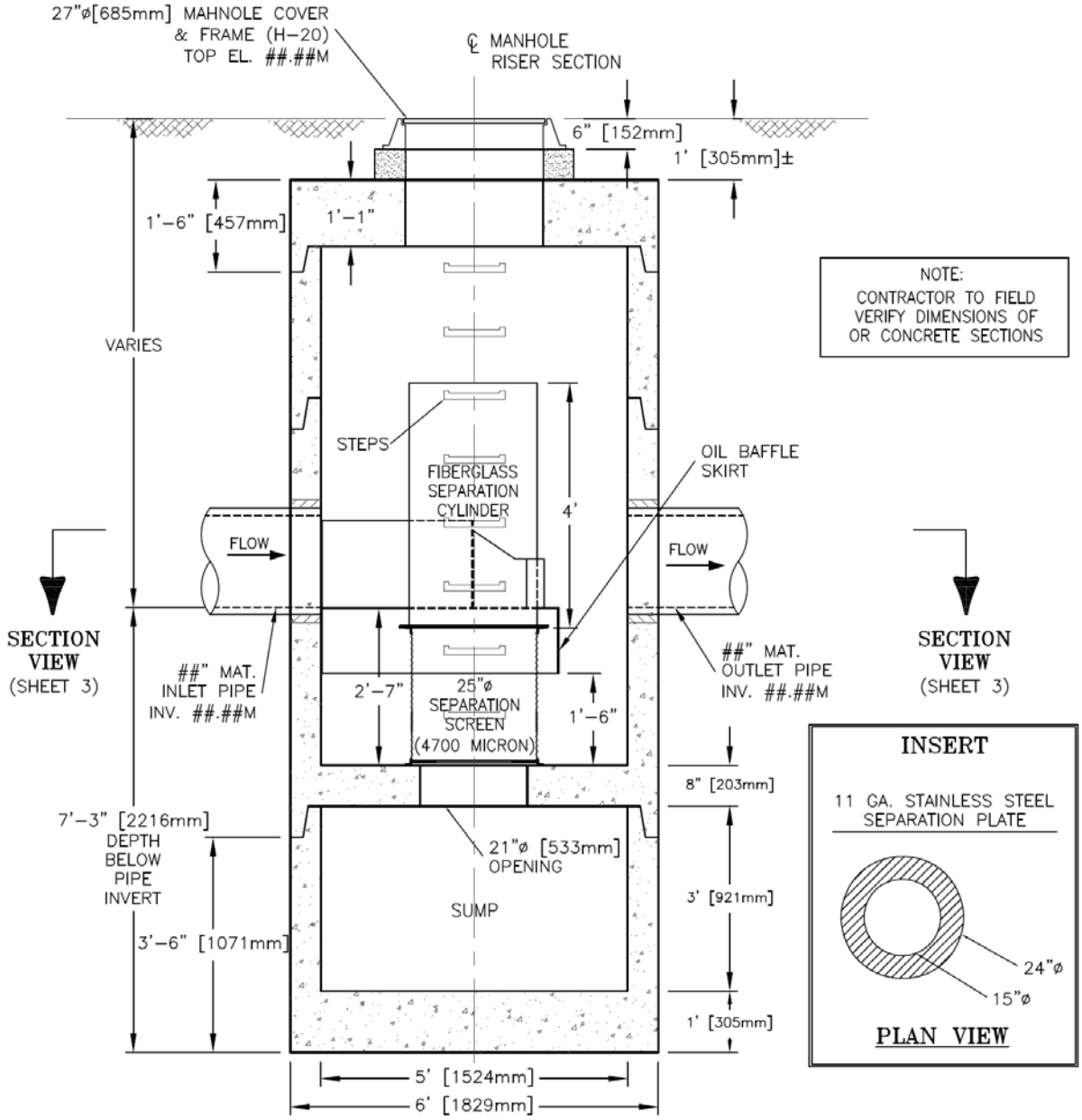
ECHELON ENVIRONMENTAL

CDS TECHNOLOGIES

FLORA DESIGNS INC. Complete civil engineering design solutions

CDS MODEL 2020 - TYPICAL DRAWING (NTS)

ELEVATION VIEW



CDS MODEL PMSU20_20m, 31 L/s TREATMENT CAPACITY STORM WATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS	NE CORNER OF KING STREET & HURONTARIO STREET TOWN OF CALEDON, ONTARIO	JOB# XX-##-###	SCALE N.T.S.
		DATE ##/##/##	SHEET 2
		DRAWN INITIALS	
		APPROV.	

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

Appendix "C" Water Supply System

- Post-development Population Density Calculations
- Post-development Water Supply Requirement Calculations
- Post-development Fire Flow Requirement Calculations

POST-DEVELOPMENT POPULATION DENSITY CALCULATIONS

(According to the Sanitary Sewer Design Criteria, Region of Peel)

Development Type	**Equivalent Population Density** (Persons/ha)	**Area of Site** (ha)	**Population** (Persons)
Commercial	50	3.21	161

POST-DEVELOPMENT WATER SUPPLY REQUIREMENT CALCULATIONS

Typical Water Demand Criteria (According to the Watermain Design Criteria, Region of Peel)

Population Type	Unit	Average Consumption Rate	Max Day Factor	Peak Hour Factor
ICI	L / Employee . D	300	1.4	3.0

Post-development Water Supply Requirements

Development Type	Commercial
Eq. Population Density	161

No.	Demand Type	Demand	Units
1	Average day flow	0.56	L/Sec
2	Maximum day flow	0.78	L/Sec
3	Peak hour flow	1.68	L/Sec
4	Fire flow	100.00	L/Sec
Analysis			
5	Maximum day plus fire flow	100.78	L/Sec
6	Peak hour flow	1.68	L/Sec
7	**Maximum demand flow**	**100.78**	L/Sec

POST-DEVELOPMENT FIRE FLOW REQUIREMENT CALCULATIONS

The Fire Underwriters Survey requires that a minimum water supply source "F" be provided at 140 kPa.

1 Estimate of Required Fire Flow

F =	220 * C * (A)^0.5

Where => F = Required Fire Flow (L/min)
C = Coefficient related to construction
A = Total Area (m^2)

Determining "C"

C =	0.8	For non-combustible construction

Determining "A"

A =	Total floor area of all storeys in the building	For non-combustible construction

Largest Floor Area =	548.50	m^2	Building-A
1st adjoining Floor Area =	0.00	m^2	
2nd adjoining Floor Area =	0.00	m^2	
A =	548.50	m^2	

So that,

F =	**4,000.00**	**L/min.**

(Rounded per FUS Guide Page # 20)

2 Addition / Reduction for occupancy type

Increased by	25%	For the occupancies having high contents of fire hazard

So that,

F =	**5,000.00**	**L/min.**

3 Reduction for sprinkler system

No Charge	0%	No sprinkler system

4 Addition for structures exposed within distance of fire area

Side	Distance (m)	% Addition
North	17.40	15%
South	20.12	10%
East	None	0%
West	None	0%
Total		**25%**

Shall not exceed 75%

Net Reduction / Addition for step 3 & 4

Reduced by	25%

So that,

F =	**6000.00**	**L/min.**

(Rounded per FUS Guide Page # 20)

N.B. - As per FUS requirements fire flow shall not exceed **45000 L/min** nor be less than **2000 L/min**.

Therefore, the fire flow required is =	**6000.00**	L/min.
	100.00	L/sec
	1585.03	USGPM
	1320.86	Imp. GPM

REGION OF PEEL DEMAND TABLE

Project : Proposed Travel Stop
Project Address : NW Corner of Hurontario Street & King Street
SPA No. : xx-xx

WATER CONNECTION

Connection Point :	Approximate 38.0m west of centerline of Hurontario Street from the existing 300mm dia watermain located within road allowance of King Street		
Pressure zone of connection point			
Total equivalent population to be serviced [1)]			161
Total lands to be serviced			3.21 ha
Hydrant Flow Test:	To be performed		
Hydrant flow test location			
Hydrant residual test location			
		Pitot Pressure (kPa)	Time
Minimum water pressure			
Maximum water pressure			

WATER DEMANDS

No.	Demand Type	Demand	Units
1	Average day flow	0.56	L/Sec
2	Maximum day flow	0.78	L/Sec
3	Peak hour flow	1.68	L/Sec
4	Fire flow [2)]	100.00	L/Sec
Analysis			
5	Maximum day plus fire flow	100.78	L/Sec

WASTEWATER CONNECTION

Connection Point [3)]**:**	Private on-site sub-surface disposal facility		
Total equivalent population to be serviced [1)]			161
Total lands to be serviced			3.21 ha
6	Wastewater sewer effluent	N.A.	L/Sec

1) The calculations should be based on the development estimated population (employment or residential).
2) Please reference the Fire Underwriters Survey Document
3) Please specify the connection point ID
4) Please specify the connection point (wastewater line of manhole ID)
Also, the ``total equivalent population to be serviced`` and the ``total lands to be serviced should reference the connection point (The FSR should contain one copy of Site Servicing Plan)

Appendix "D" Statement of Limiting Conditions and Assumptions

Statement of Limiting Conditions and Assumptions

1. This Report/Study (the "Work") has been prepared at the request of, and for the exclusive use of, the Owner, and its affiliates (the "Intended Users"). No one other then the intended users have the right to use and rely on the work without first obtaining the written authorization of FLORA DESIGNS INC. and its Owners. All concerned governing authorities and reviewing agencies are permitted to use all engineering design documents prepared for this project.
2. The comments, recommendations and material in this report reflect Flora Designs best judgement in light of the information available to it at the time of preparation of this report. It is not qualified to and is not providing legal or planning advice in this work.
3. Flora Designs expressly excludes liability to any third party except the Intended Users for any use of, and/or reliance upon, the work.
4. Flora Designs notes that the following assumptions were made in completing the work
   a) The land use description(s) supplied to Flora Designs are correct
   b) The surveys and other data supplied to Flora Designs by the Owner are accurate
   c) Market timing, approval delivery and secondary information is within the control of parties other then Flora Designs
   d) There are no encroachments, leases, covenants, binding agreements, restrictions, pledges, charges, liens or special assessments outstanding, or encumbrances, which would significantly affect the use or servicing

   Investigations have not carried out to verify these assumptions. Flora Designs deems the sources of data and statistical information contained herein to be reliable, but we extend no guarantee of accuracy in these respects.
5. All the plans, photographs, and sketches prepared and presented in this report/study are included solely to aid the visualizing the location of the property, the boundaries of the site, and the relative position of the improvements on the said lands are based on information provided by Owner
6. Flora Designs accepts no responsibility for legal interpretations, questions of survey, opinion of title, hidden or inconspicuous conditions of the property, toxic wastes or contaminated materials, soil or sub soil conditions, environmental, engineering or other factual and technical matters disclosed by the owner, the clients, or any public agency, which by their nature, may change the outcome of the work.
7. In the preparation of this report, Flora Designs have made investigations from secondary sources as documented in the work, but did not checked compliance with by-laws, codes, agency and government regulations, etc., unless specifically noted in the work.
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