TOWNSHIP OF SOUTH FRONTENAC

BY-LAW NUMBER 2016-43

BEING A BY-LAW TO AUTHORIZE THE MAYOR AND THE CLERK TO EXECUTE A SITE PLAN AGREEMENT BETWEEN THE CORPORATION OF THE TOWNSHIP OF SOUTH FRONTENAC AND DARRYL SILVER AND SHIRLEY SILVER.

WHEREAS a Site Plan Agreement has been prepared to the satisfaction of the Township of South Frontenac and the proponent;

AND WHEREAS the Owners have signed the site plan agreement;

NOW THEREFORE THE CORPORATION OF THE TOWNSHIP OF SOUTH FRONTENAC BY ITS COUNCI, HEREBY ENACTS AS FOLLOWS:

1. **THAT** the Mayor and the Clerk are hereby authorized to execute a Site Plan Agreement between the Corporation of the Township of South Frontenac and Darryl Silver and Shirley Silver, a copy of which is attached hereto forming part of this by-law.

2. **THAT** this By-law and Agreement shall be registered on title of the properties described as Part Lot 2, Concession IV, Loughborough District, Township of South Frontenac.

3. THIS BY-LAW shall come into force and effect in accordance with section 41 of the Planning Act 1990, either upon the date of passage or as otherwise provided by the said section 41.

Dated at the Township of South Frontenac this fifth day of July, 2016.

Read a first and second time this fifth day of July, 2016.

Read a third time and finally passed this fifth day of July, 2016.

THE CORPORATION OF THE TOWNSHIP OF SOUTH FRONTENAC

Ron Vandewal, Mayor

Wayne Orr, Clerk-Administrator

THIS SITE PLAN AGREEMENT made this day of , 2016.

BETWEEN:

DARRYL SILVER AND SHIRLEY SILVER

hereinafter called the "Owner"

OF THE FIRST PART

- and -

THE CORPORATION OF THE TOWNSHIP OF SOUTH FRONTENAC

hereinafter called the "Municipality"

OF THE SECOND PART

WHEREAS the Owner is the registered owner in fee simple of certain lands described in Schedule "A", attached hereto, located in the Township of South Frontenac (the "Owners' Land");

AND WHEREAS the Municipality is authorized to enter into this agreement and register it against the title to the Lands pursuant to section 41 of the Planning Act and section 6.17 of the Township of South Frontenac Official Plan;

AND WHEREAS the Municipality has passed by-law No. 2003-75 to designate all of the Township of South Frontenac as a "Site Plan Control Area";

NOW THEREFORE, THIS AGREEMENT WITNESSETH that in consideration of the mutual covenants and agreements contained herein, the parties agree each with the other as follows:

In this Agreement:

a) *"Owner" includes a mortgagee in possession, a tenant in possession pursuant to a leasehold interest, and encumbancer in possession and may mean more than one Owner specified in the Certificate of ownership.*

1. The Owner covenants that the Owner is the Owner in fee simple of the Owner's land.

2. The obligations imposed by this Agreement affect the land described in Schedule "A" hereto and any restrictive covenants expressed herein run with the land and bind successors in title to the said property as well as the successors and assigns of the Owner.

3. The encumbrancer agrees to satisfy all the obligations imposed pursuant to this document if it should enter into possession of the said land.

4. The following schedules are attached to and form part of this agreement and no new building, structure or other facility shall be erected, altered or placed on the said land except in accordance with the attached schedules which consist of:

   A. Legal Description of Lands
   B. Site Plan
   C. Sydenham Medical Centre Stormwater Management Report

5. The Owner shall perform all the work and provide all the materials necessary for the construction of the new facilities and access ways and any required fencing andlandscaping as specified on the Site Plan, included as Schedule "B" to this Agreement.

6. The Owner shall construct a 311 metre^2 single storey commercial building and a 297 metre^2 paved manoeuvring/access area located as shown on Schedule "B" and as further specified on Schedule "C" and as described on Drawings dated September 15, 2015 prepared by Pelow Engineering. This work shall include areas specified for garbage collection, lighting, loading, landscaping and signage.

7. The Owner shall carry out the placement of a landscaped area and treed area as identified on Schedule "B" and to include landscaping treatment between the road allowance of Rutledge Road and the paved area.

8. All work on the subject land shall be carried out in accordance with the "Sydenham Medical Centre Stormwater Management Report", dated October 2015, prepared by Forefront Engineering Inc.

9. Site development shall include access and manoeuvring areas as shown and signage is to be attached to the north-facing side of the building. Lighting is to be placed on the building as indicated on "Schedule B".

10. The access onto Rutledge Road is to be constructed to Township specifications. The required access and manoeuvring areas shown on Schedule "B" are to be paved with asphalt. The parking, access aisles and manoeuvring areas shall be paved with asphalt within two (2) years of the date of this agreement.

11. The Owner shall prevent damage being caused to existing public highways, other public works or municipal property in the course of development of the lands.

12. The Owner agrees to contribute to improvements to Rutledge Road to facilitate access to the development to the satisfaction of the Township.

13. In the event of a sale of the improved lands, the new Owner will assume full and complete responsibility for the continuing obligations under this Agreement. The enforcement of this Agreement is the responsibility of the Municipality.

14. The Agreement shall be registered against the title of the Lands and the Municipality shall be entitled to enforce its provisions against the Owner and any and all subsequent owners of the Lands.

15. In the event that the Owner fails to install or maintain the facilities covered by this Agreement, then, upon the Chief Building Official or designate, giving seven days written notice by pre-paid registered mail to the Owners, the municipality, through it's employees, agents or contractors, may, without further notice, enter upon the lands and proceed to supply all materials and to do all the necessary inspections and works in connection with the facilities including the repair or reconstruction of faulty work and the replacement of materials which are not in accordance with plans or specifications and to charge the cost thereof, together with the cost of engineering and any other expenses incurred by the municipality, against the Owner. Such entry and work shall not be deemed as acceptance or assumption of said facilities nor an assumption by the Municipality of any liability. It is expressly agreed that the Owners or any person in possession shall not question the cost incurred by the Municipality for labour, materials or any other costs incidental to do the said work and this provision shall be deemed to operate as an effective estoppel in judicial proceedings if such costs are challenged or placed in question. The Owners agree to permit the Chief Building Official, or agent, to enter onto the Lands at any time to inspect the work. The Municipality may perform any of the required services and collect the cost for the enforcement of this Agreement against the said Lands from any security received.

16. The Owner covenants and agrees that the lands and premises more particularly described in Schedule "A" annexed hereto may only be used for those purposes specified by Zoning Amendment By-law No. 2010-58.

WITNESS the corporate seals of the respective corporate parties hereto, duly affixed under the hands of their respective signing officers, duly authorized in that behalf.

SIGNED, SEALED AND DELIVERED
In the presence of

_____

THE CORPORATION OF THE TOWNSHIP OF SOUTH FRONTENAC

_____
Mayor

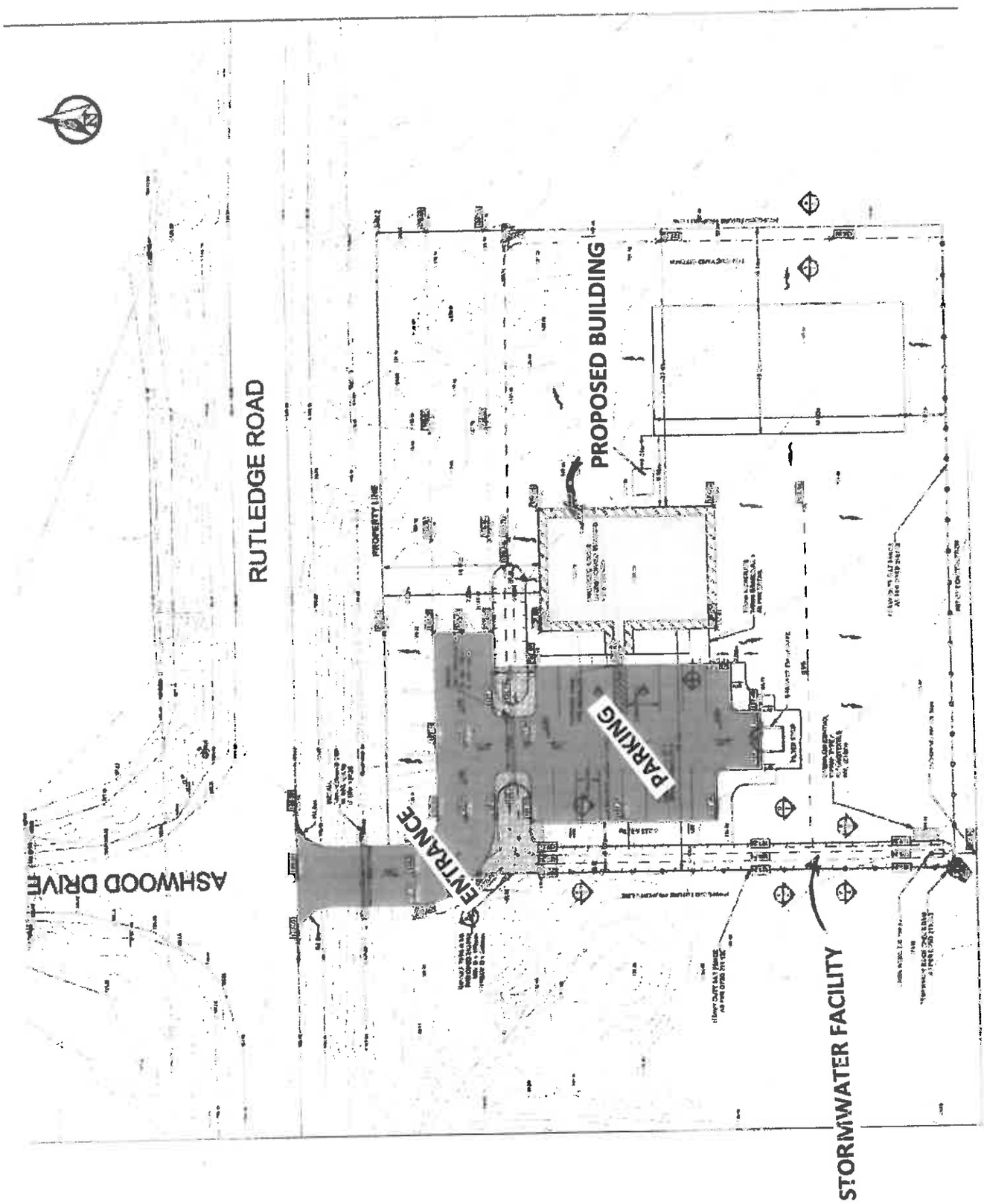
_____
Clerk

SCHEDULE "A"

LEGAL DESCRIPTION OF LANDS

Part of Lot 2, Concession IV, Loughborough District, Township of South Frontenac

ATTACHMENT #2



Forefront Engineering Inc

SCHEDULE "C"

SYDENHAM MEDICAL CENTRE
STORMWATER MANAGEMENT REPORT
Prepared by Forefront Engineering Inc.
October, 2015

PELOW ENGINEERING

Sydenham Medical Centre
Stormwater Management Report

Prepared by:

FOREFRONT Engineering Inc.
1329 Gardiners Road, Suite 210
Kingston, ON, Canada K7P 0L8

613.634.9009 tel
888.884.9392 fax

Date: October 2015

Statement of Qualifications and Limitations

The attached Report has been prepared by Forefront Engineering Inc. (Consultant) for the benefit of the Client in accordance with their Agreement.

The information, data, recommendations and conclusions contained in the Report:

1. is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report;
2. represents Consultant's judgement in light of the limitations and industry standards for the preparation of similar reports;
3. may be based on information provided to Consultant which has not been independently verified;
4. has not been updated since the date of issuance of the Report and its accuracy is limited to the time and circumstances in which it was prepared; and
5. must be read as a whole and sections should not be read out of context.

Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared.

Any estimates or opinions regarding expected construction costs or construction schedule provided by Consultant represent Consultant's judgement in light of its experience and the knowledge and information available to it at the time of preparation. Consultant does not make any representations, with respect to such estimates or opinions, and accepts no responsibility for any loss or damage arising from them. Persons relying on such estimates or opinions do so at their own risk.

Except as agreed to in writing by Consultant and Client; as required by-law; or to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals, the Report and the Information may be used and relied upon only by Client.

Consultant accepts no responsibility, to parties other than Client who may obtain access to the Report or the information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report, except to the extent those parties have obtained the prior written consent of Consultant to use and rely upon the Report and the information. Any injury, loss or damages arising from improper use of the Report shall be borne by the party making such use.

Forefront Engineering Inc

1329 Gardiners Road, Suite 210
Kingston, ON, Canada K7P 0L8

613 634 9009 tel
888.884.9392 fax

October 23, 2015

Mr. John Pelow
Pelow Engineering
1089 Dunham Street
Kingston, Ontario K7P 2K2

Dear Mr. Pelow

Regarding: **Sydenham Medical Centre**
Stormwater Management Report

The enclosed report details the infrastructure upgrades required for this development and recommendations for the proposed development.

Stormwater runoff from the Sydenham Medical Centre parking lot building to be directed to the filter strip and proposed stormwater management facility (SWMF). The remainder of the proposed Sydenham Medical Centre development should be directed to the proposed side yard swales to be constructed along the property line.

The Report demonstrates that adequate stormwater management controls are available for the proposed development.

If you have any enquiries or wish to discuss further, please contact this office.

Sincerely,
FOREFRONT Engineering Inc.

Kyle Nielissen, P.Eng.
Project Manager
Kyle.Nielissen@Forefronteng.ca
KN:kn

FOREFRONT Signatures

Report Prepared By:

Brandon Travers, CET

Report Reviewed By:

Kyle Nielissen, P. Eng

Table of Contents

Statement of Qualifications and Limitations
Letter of Transmittal

Appendices

Appendix A.

- Figure 2: Pre and Post Development Catchment Areas
- Site Plan and Grading Plan
- Details

Appendix B.

- Modified Rational Method Analysis – 5 Year Event
- Modified Rational Method Analysis – 100 Year Event
- Bio-retention Sizing Calculation

1. Introduction

Forefront has assembled relevant supporting information for the proposed commercial development known as the Sydenham Medical Centre, located in Sydenham Ontario. The legal description of the land is Concession 4, Lot 2, Sydenham, Ontario. The property is located on the south side of Rutledge Road, and south of Ashwood Drive. Refer to Figure 1: Location Plan for the site location.

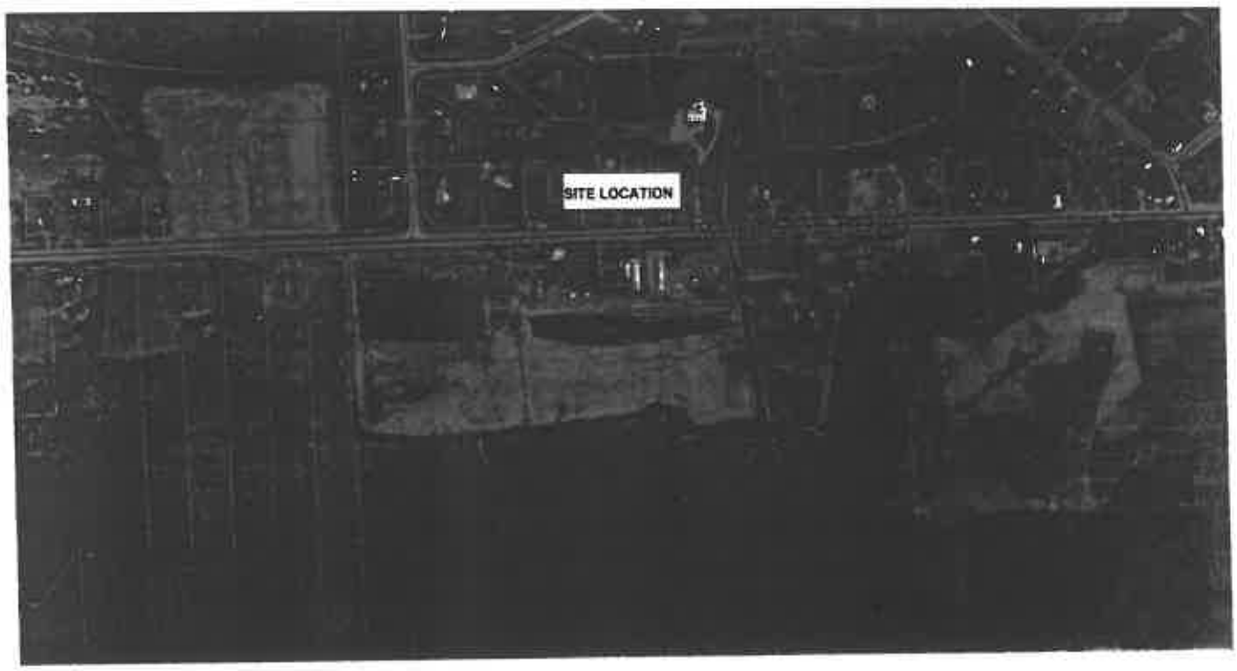


Figure 1: Location Plan (Image Courtesy of)

The subject area is currently zoned RC 12 classified as special rural commercial. The property has a number of structures and uses. The subject site construction limit is approximately 0.51 hectares in area.

The proposed development will consist of a 311m^2 single storey building, and 297 m^2 of paved area.

Refer to **Appendix A**: Site Plan & Grading Plan

2. Existing Conditions

The Soil Survey of Frontenac County identifies the soil cover in the northern area as Lyons Loam. Lyons Loam consists of calcareous glacial till that contains thin fragments of limestone; and is a poorly-drained soil. The southern part of the site identifies as Muck. Muck consists of fairly well decomposed plant material; and is a very poorly-drained soil.

Existing drainage at the subject development generally sheet flows to the south west, directing runoff to a low lying field that flows south of the site. The flows are directed to the downstream Millhaven Creek south of the site.

Refer to **Figure 2: Pre and Post Development Catchment Areas** in Appendix A for the pre development catchment areas for Sydenham Medical Center.

3. Proposed Development

The proposed development will consist of a new building, and asphalt parking lot. To provide water quality and quantity stormwater management controls onsite, a filter strip for pre-treatment and bioretention swale is proposed.

3.1 Water Quantity

Urbanization leads to an increase in impermeable surfaces (roof tops and parking areas). The resultant increased peak flows increase the risk to life, environment and property damage. Water quantity control is generally required when there will be downstream quantity impacts.

Consistent with general Stormwater Management practices, both stormwater quality and quantity control is proposed for the majority of the site. Post development flows will be maintained to pre development levels for all storm events up to and including the 100 year design event.

3.2 Drainage Plan

It is recommended that Sydenham Medical Centre development drainage be directed southerly to the Millhaven Creek through side yard swales and the proposed Stormwater Management Facility.

Major and minor flow paths will be directed to the proposed SWMF and side yard swales. Concentrated outlet locations will be enhanced with rip-rap and geotextile.

Refer to **Figure 2: Pre and Post Development Catchment Areas** in Appendix A for the post development catchment areas for Sydenham Medical Center.

3.3 Analysis

The Rational Method and Modified Rational Method will be utilized to design the proposed SWMF.

3.3.1 Modified Rational Method

The Rational Method calculates the peak flow rate in a catchment due to the runoff contributed from the entire upstream catchment area at a specific location. The Rational Method is represented by then following equation:

$$Q = 0.0028\ C\ I\ A$$

Where:

C = Runoff coefficient
I = Rainfall intensity (mm/hr)
A = Drainage area (ha)

When developing the rational method the runoff volume was not considered, and the Rational Method alone was not meant for detention basin design. However, the modified Rational Method, actually an extension of the conventional Rational method, has been used in the past for sizing of detention basins. This method should generally be restricted to drainage areas less than 20 acres, and this method is expected to be appropriate for the subject site. The Modified Rational method uses the peak flow calculations paired with assumptions about the inflow and outflow

hydrographs to compute an approximation of storage volumes for simple detention calculations. This approach assumes the stormwater runoff hydrograph (detention basin inflow hydrograph) for the design storm is trapezoidal in shape. The peak runoff rate is calculated using the Rational Formula and it is assumed that the peak of the outflow hydrograph falls on the recession limb of the inflow hydrograph and the rising limb of the outflow hydrograph can be approximated by a straight line. The storage volume is approximated with the following equation;

$$S_d = Q_p t_d - Q_d((t_d + t_c)/2)$$

*Storage Formula (Aron and Kibler, 1990)

Where:

	td = Duration of Storm
Q=Peak runoff rate (m3/s)	(min)
C=Composite runoff coefficient	Qp = Peak Flow (m3/s)
I=Rainfall Intensity (mm/hr)	Qd = Discharge Rate (m3/s)
A=Drainage area (ha)	Sd = Required Storage
tc= Time of Concentration (min)	Volume (m3)

The design storm duration is that duration that maximizes the detention storage volume, S_d, for a given return period. An allowable target outflow is set based on predevelopment conditions. The storm duration is td, and is varied until the storage volume is maximized. The t_c (time of concentration) will be calculated with The Bransby Williams and Kirpich Method and the shorter duration will be selected, this will provide a conservative flow estimate. Typically the Bransby Williams method is utilized for catchment areas with a C factor greater than 0.4 and the Kirpich method is utilized for catchments with a C factor less than 0.4. A minimum time of concentration of 15 min is required.

3.3.2 *Design Storm Events*

Quality Event

The Ministry of Environment Stormwater Management Manual refers to a 12.5mm to 25mm 4 hour Chicago storm event for sizing quality treatment facilities in Ontario that are not included in table 3.2 of the manual.

The following formula has been developed for a 25mm- 4 hr Chicago Design storm for this area:

$$I_{25mm} = \frac{498}{(t_c+9.7)^{0.825}}$$

Minor and Major Event

The minor and major design storm events were based on IDF rainfall statistics that describe the frequency of rainfall depths over a specified duration. Rainfall intensities with various durations and return periods for the site were obtained from the MTO Drainage Manual. A minimum t_c (time of concentration) of 15 minutes is to be used.

3.3.3 *Hydrology*

Runoff Coefficients

The runoff coefficient (C) is a dimensionless coefficient relating the amount of runoff to the amount of precipitation received. It is a larger value for areas with low infiltration and high runoff (pavement, steep gradient), and lower for

permeable, well vegetated areas (forest, flat land). Coefficients were assigned based on surface cover and soil conditions as follows;

Urban			
Land Use & Topography	**Runoff Coefficients**		
Asphalt, concrete, roof areas	0.9		
Grassed area, parkland	0.25		
Commercial	0.8		
Industrial	0.7		
Residential			
Single family (<400 m²)	0.4		
Single family (>400 m²)	0.5		
Semi-detached	0.5		
Townhouses	0.6		
Apartments	0.6		
Institutions	0.55		
Rural			
	Soil Texture		
Land Use & Topography	**Open Sand Loam**	**Loam or Silt Loam**	**Clay Loam or Clay**
Cultivated			
Flat 0-5% Slopes	0.22	0.35	0.55
Rolling 5-10% Slopes	0.3	0.45	0.6
Hilly 10-30% Slopes	0.4	0.65	0.7
Pasture			
Flat 0-5% Slopes	0.1	0.28	0.4
Rolling 5-10% Slopes	0.15	0.35	0.45
Hilly 10-30% Slopes	0.22	0.4	0.55
Woodlands and Cutover			
Flat 0-5% Slopes	0.08	0.25	0.35
Rolling 5-10% Slopes	0.12	0.3	0.42
Hilly 10-30% Slopes	0.18	0.35	0.52
	Coverage		
Bare Rock	30%	50%	70%
Flat 0-5% Slopes	0.4	0.55	0.75
Rolling 5-10% Slopes	0.5	0.65	0.8
Hilly 10-30% Slopes	0.55	0.7	0.85
Lakes and Wetlands	0.05		
Note: Values are a combination of the City of Kingston Subdivision Guidelines and Ministry of Transportation Design Chart 1.07			

In order to reflect the unique hydrologic properties within each sub-catchment, a variety of surface cover types were defined.

Due to the drainage characteristics of the soil at this site there is minimal opportunity for infiltration. Based on the existing site conditions a runoff coefficient of 0.3 is recommended.

3.3.4 Pre Development Flows

Runoff coefficients, and catchment characteristics were assigned for the existing catchments and are summarized in Table 3-1 below.

Table 3-1 Existing Conditions

Sydenham Medical Center- Overland Flow Time of Concentration Calculations								
Hydrologic Units - Existing Conditions								
Hydrologic Unit	Est'd C	Area (ha)	Length (m)	Average Width (m)	Grade(%)	Tc (Bransby Williams) (when C = >0.4)	Tc (Kirpich Method) (C<0.4)	Tc (Airport Method) (C<0.4)
EX1	0.30	0.51	102	68.04	1.67	5.62	3.27	22.25

A minimum time of concentration of 15 min is proposed.

3.3 5 Post Development Flows

The development of this site will increase the imperviousness of the site and hence the runoff. Runoff coefficients and catchment characteristics were assigned for the proposed catchments and are detailed in Table 3-2.

Table 3-2 Proposed Conditions

Sydenham Medical Center- Overland Flow Time of Concentration Calculations								
Hydrologic Units - Proposed Conditions								
Hydrologic Unit	Est'd C	Area (ha)	Length (m)	Average Width (m)	Grade(%)	Tc (Bransby Williams) (when C = >0.4)	Tc (Kirpich Method) (C<0.4)	Tc (Airport Method) (C<0.4)
Catchment 1	0.30	0.04	184.00	7.16	0.50	16.62	8.19	44.47
Catchment 2	0.30	0.16	84.00	15.72	1.00	5.75	3.43	23.90
Catchment 3	0.90	0.14	285.00	14.25	0.25	26.09	14.97	17.39
Catchment 4	0.30	0.17	270.00	21.80	2.35	15.49	6.06	32.32
Total	0.46	0.51						

A minimum time of concentration of 15 min is proposed.

Results shown in Table 3-3 quantify the peak rate of surface runoff calculated with the rational method and assigned catchment characteristics, both the pre-development and uncontrolled post development flow rates are calculated.

Table 3-3 Uncontrolled Peak Flows in Pre & Post Development Conditions

Description	25mm- 4 hr Design Storm	5 yr Design Storm	100 yr Design Storm
	Peak Flow Q (LPS)	Peak Flow Q (LPS))	Peak Flow Q (LPS)
Pre-development	15	27	47
Post Development	23	39	72

Note: The MTO District 8 West of Kingston was utilized for the intensity calculations

Conveyance controls and a storage system is proposed to limit post developments flows shown in Table 3-3 to pre development levels.

Conveyance controls and a storage system is proposed to limit post developments flows to pre-development levels.

A bio-retention filter facility is proposed for quality and quantity control. The quality outlet will include a subdrain with an overflow structure and the quantity control will be controlled with a rip-rap weir.

Quantity control volumes required for bio-retention filter facility are based on the 5 year and 100 year design storm and are 13.9 m^3 and 23.8 m^3, detailed modified rational calculations are included in Appendix B. Quantity control volumes proposed are in excess of the required volumes.

Refer to the Modified Rational Method Calculations for the 5 Year and 100 Year events in Appendix B for the peak flow, outlet and storage calculations.

3.4 Water Quality

The Stormwater Management Planning and Design Manual by the MOE describes various levels of protection of water quality, based on a general relationship between the end-of-pipe stormwater management facilities long-term suspended solids removal and the lethal and chronic effects of suspended solids on aquatic life.

Based on the characteristics of the receiving watercourse, Enhanced Protection (corresponding to the end-of-pipe storage volumes required for the long-term removal of 80% of suspended solids) is proposed. The proposed development shall utilize a treatment train approach with pre-treatment being provided by a filter strip and end of pipe controls with a bioretention filter type facility. The filter strip will provide between 20% and 60% removal of total suspended solids and the bioretention filter facility will provide a minimum of 80% removal of suspended solids. The combined removal efficiency is expected to be between 80% and 99% removal of total suspended solids in excess of the 80% required.

3.4.1 Quality Control

Quality Event
The Ministry of Environment (MOE) Stormwater Management Manual utilized continuous event modeling for storm events of 12.5 mm to 25 mm to develop table 3.2 in the manual. An additional approach is to utilize the 25mm 4 hour Chicago water quality storm.

It is proposed to utilize the 25mm storm water quality volume to size the facility.

Water Quality Volume= (WQV= V x C x A)
C= % Impervious
A= Impervious Area (m^2)
V= Storm Volume (m)
V= 0.025 m for 25 mm event

Below is a summary of the impervious areas and associated water quality volume (WQV) calculations based on the 25mm 4 hour Chicago Storm event:

Land Description	Area (m2)	% Impervious	Treatment	WQV (m^3)
Building	311	0.9	Filter Strip and Bio-Retention Filter	7.0
Parking Lot	297	0.9	Filter Strip and Bio-Retention Filter	6.7
Landscaped Area	4492	0.3	Bio-Retention Filter	33.7
Total	5,100	0.46		58.6

Water quality is not a concern for rooftops and area with direct rainfall on pervious landscaped areas of the site.

3.4.2 Filter Strip (Pre-Treatment)

Filter strips discharge in the form of sheet flow and are most effective when utilized as pre-treatment features. The purpose of a filter strip is to slow runoff velocity and filter out suspended solids. Native grass vegetation is proposed with an incorporated pea gravel diaphragm to be used as a level spreader to maintain sheet flow. The ideal slope is between 1 and 5%.

According to the "*Low Impact Development Stormwater Management Planning and Design Guide*" (2010) by the Toronto and Credit Valley Conservation Authority, filter strip water quality treatment is moderate but highly variable and as such filter strips should be used in a series. Removal efficiencies of Total Suspended Solids (TSS), Total Nitrogen, Total Phosphorous and Total Heavy Metal are between 20 to 80%. The minimum width of the filter strip should be 2 metres in length. In addition to quality control the typical volumetric runoff reduction for a 2.0 metre filter strip is approximately 20%. As is the case, filter strips are best utilized for areas less than 2 hectares.

The following criteria was utilized in the filter strip design:

- 2.0m wide filter strip
- 1%-4% side slope
- Pea gravel diaphragm
- 300 mm of Topsoil
- Native grass plantings

3.4.3 Bioretention Filter

A bioretention filter and vegetated filter strip are to be utilized for the proposed development.
The total site area is 0.51 ha, quality control will be provided for the entire site. For a 25 mm design storm the required control volume is 58.65 m^3

See **Appendix B: Bioretention Sizing Calculation**, and **Appendix A: Details** for details.

The following criteria was utilized in the design:

- 1.3 m deep
- 1.0 m filter media (75mm mulch, 1.0 mm Engineered soil, 0.3m Gravel Storage Layer)
- 0.3 m gravel storage layer (50mm clean stone)
- 100 mm underdrain
- Overflow structure
- The interior side slopes are 3:1
- Native Plantings

3.4.4 Drainage

Side yard swales shall be incorporated along the north, south, and east property lines and an entrance culvert shall be incorporated to allow minor and major flow conveyance onsite.

The parking area shall be graded to discharge runoff to the filter strip and bioretention filter.

3.5 Maintenance

Maintenance access to the bioretention filter and filter strip is provided via the asphalt parking area. Periodic maintenance inspection of the facilities should be undertaken. The inspection should provide a summary of the following items:

- Observations resulting from the inspection of the facility over the course of the year. These observations should include comments on the:
- hydraulic operation of the facilities (detention time, evidence or occurrence of overflows)
- condition of vegetation in and around facility
- occurrence of obstructions at the inlet and outlet
- evidence of spills and oil/grease contamination
- frequency of trash build-up
- Measured sediment depths in the facilities;
- Maintenance and operational control undertaken during the year;
- Recommendations for inspection and maintenance program for the coming year.

The bioretention filter and filter strip will require routine periodic maintenance including weed control, and trash removal will be required several times per year. Removal of accumulated sediment, replacement of mulch and replacement of plantings should be evaluated annually with a recommended replacement period every 5 years.

4. Quality Control (Short Term)

Silt fencing is to be provided at all side slopes and down gradient locations to ensure sediment and erosion control during construction. Other control devices such as rock flow check dams will also be provided where drainage is concentrated. Sediment and erosion management measures also serve to provide a limit to the grading operations.

The stormwater facility and components are to be constructed concurrently with initial phases of development. The timeframe for land to remain exposed before it is stabilized with sod, mulch, or hydroseeding is to be minimized. Topsoil is to be stockpiled away from watercourses and wetlands.

Inspection of the sediment control works should be undertaken before and after all rainfall (and snowmelt) events. Maintenance is to be undertaken as required to ensure the proper operation of all sediment and erosion controls.

5. Conclusions

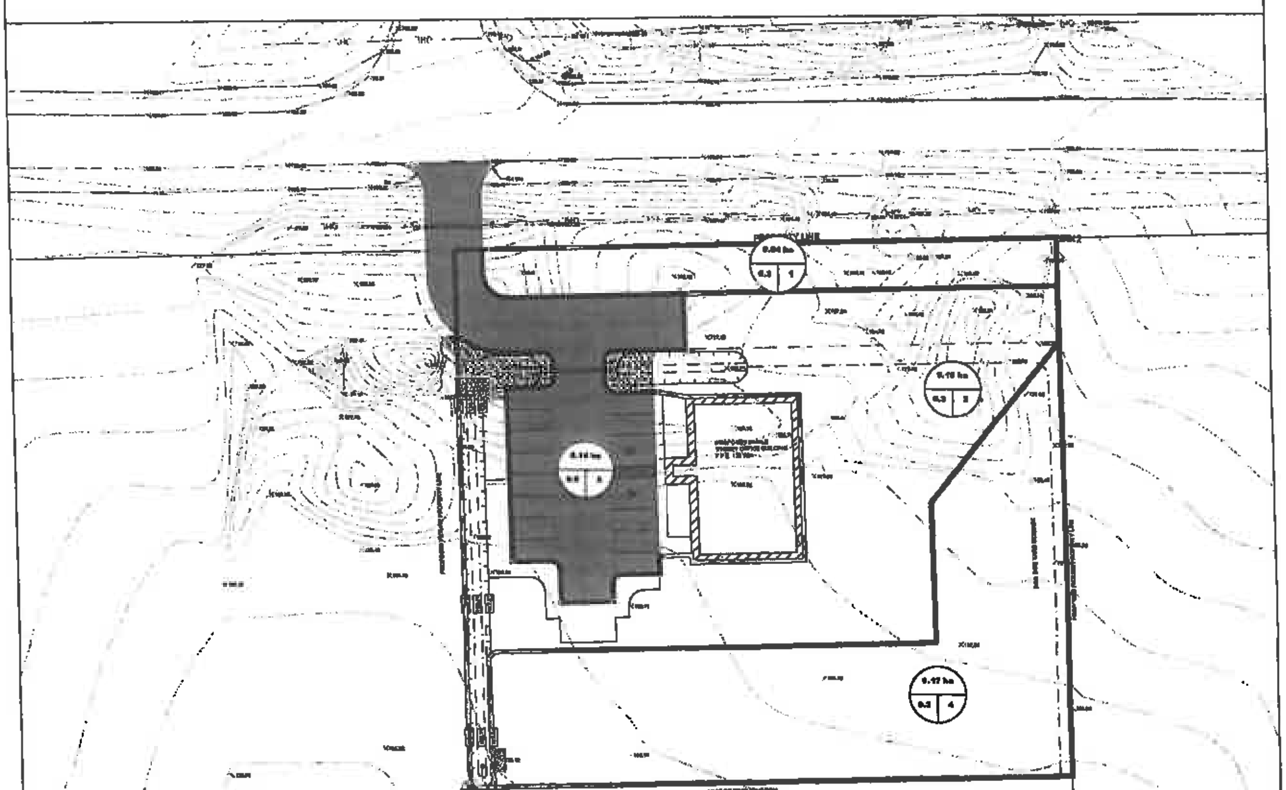
Preliminary calculations find that the proposed infrastructure is capable of and will effectively service the proposed demand created by this development. A 2.0 m wide filter strip and bioretention filter shall be utilized for on-site stormwater quality and quantity control.

Forefront Engineering Inc

Appendix A

Figure 2: Pre and Post Development Catchment Areas
Servicing Plan & Grading Plan
Details

EXISTING STORMWATER CATCHMENT AREAS



PROPOSED STORMWATER CATCHMENT AREAS

Forefront Engineering Inc

PELOW ENGINEERING

SYDENHAM MEDICAL CENTER

PRE AND POST DEVELOPMENT CATCHMENT AREAS

FIG.2

GENERAL

1. All works to be installed in accordance with current Township of South Frontenac Site Plan Control Guidelines, Utilities Kingston Standards, Ontario building codes and, Ontario Provincial Standard Specifications and Drawings unless specified otherwise.
2. The Contractor shall acquire all permits as required for all works within the Municipal Right of Way
3. Refer to Architectural Drawings, Landscape Drawings and coordinate.
4. Prior to construction, Contractor to verify all dimensions, sewer inverts and utility locates and identify possible conflicts
5. In the event that human remains are encountered during construction, the Contractor shall immediately contact the Ministry of Tourism Culture and Sport, the Registrar of the Cemeteries Regulation Unit from the Ministry of Consumer Services, at (416) 326-8393 and City Police.
6. Septic system to be designed by others as per O.B.C.
7. Well to be installed onsite, separation from septic bed shall be a minimum of 15m.

GRADING

1. Finished surfaces shall be at a minimum grade of 2% unless otherwise noted.
2. Slopes in landscaped areas shall not exceed 3:1.
3. All existing elevations and grades are to be verified by the contractor prior to grading
4. Utilities are to be located prior to construction
5. All ground surfaces shall be graded to prevent ponding and without low areas except where approved swale or catchbasin outlets are provided.
6. Maximum hard surface grades are to be 5.0%
7. Staked straw bale filters and flow checks to be installed as per OPSD 219.180 and OPSD 219.180 around catchbasins and sewer inlets.
8. Conflicts between the architectural drawings and grading shall be brought to the attention of the contract administrator
9. The contractor is responsible for reviewing proposed grades with conflicts regarding the proposed structures
10. Sub-drain and outlet elevations are to be confirmed prior to construction any structures.
11. Sub-grade shall be graded at a minimum of 2%, until a lower ditch is constructed or the existing surface drains away from the sloped sub-grade.
12. Gravel areas include all rounding required to maintain the proposed gravel pad edges.

SITE WORKS

1. Road cuts to be reinstated with Asphalt, Granular A, Granular B to existing depths or a minimum of 40mm HL3, 40mm HDB 150mm granular A, 300mm Granular B.
2. Where in earth subgrade granular depths to be 150 mm Granular A and 300mm Granular B. Provide 2% crossfall on subgrade.
3. Existing pavement thickness to be matched on Rutledge Road.
4. Hot mix, hot laid asphalt concrete as per OPSS 1150.
5. Mix designs shall contain a minimum of 5.4% asphalt cement with a performance grade of PG58-28 and 3.5% air voids. Parking lot Hot mix asphalt shall be:
   50mm HL4
6. Concrete curb, type OPSD 600.040
7. Concrete shall be Class C2, 32 Mpa 28 day strength, 19mm coarse aggregate nominal maximum size, 5.0% to 8.0% air content
8. Concrete materials and production as per OPSS 350, 351, 352, 353, 1301, 1302 and 1350.
9. Boulevards slope shall be a minimum of 2% and a maximum of 8% within ROW
10. Boulevards and landscape areas to be finished with 100mm of topsoil and nursery sod or seed.
11. All ground surface grades shall be graded to prevent ponding and without low areas.
12. Subgrade to be reviewed by Geotechnical Engineer prior to installing granular materials.

SEDIMENT AND EROSION CONTROL NOTES

1. All erosion and sediment controls shall be installed prior to construction and monitored and maintained by the Contractor throughout the construction process, until all disturbed areas have been revegetated then the temporary sediment and erosion control measures must be removed once the site has been stabilized/completed of site works.
2. All erosion and sediment control measures shall be inspected after each rainfall to the satisfaction of CRCA.
3. Any disturbed areas not scheduled for further construction within forty-five (45) days will be provided with a suitable temporary mulch and seed cover within seven (7) days of completion.
4. Regardless of site specific items detailed on the plans, the Contractor shall install erosion control measures to suit the proposed work methods to control sediment from running off the site prior to any disturbance.
5. Following construction, disturbed areas, as well as proposed grassed and vegetated surfaces shall be reinstated as soon as practical.
6. All roads used to access the site shall be kept clean to the satisfaction of the Director of Public Works.

ENVIRONMENTAL

While undertaking clearing, demolition, excavation or construction the owner and their contractors shall be vigilant for the potential presence of underground fuel tanks, contaminated soil or groundwater, buried wastes or abandoned water wells. If any of the above are encountered or suspected, the owner shall ensure that:

1. The Owner and Consultant are notified;
2. Any soil or groundwater contamination encountered is remediated to applicable standards as defined within o.reg. 153/04 or as revised;
3. Any wastes generated by site clean-ups are managed in accordance with applicable laws and standards;
4. Any abandoned fuel tanks encountered are decommissioned in accordance with applicable laws and standards;
5. Any unused water wells (drilled or dug) are properly abandoned in accordance with ontario regulation 903 - wells or as revised;
6. If it appears likely that contamination extends beyond the boundaries of the subject property, the owner notifies the local office of the ministry of the environment and the city of kingston's environment department;
7. Construction wastes are not to be buried within the property that is the subject of this agreement, and
8. That the owner and their contractors report all spills to the ministry of the environment's spills action centre (1-800-268-6060) and to the municipality (546-4291 ext. 1348) forthwith.

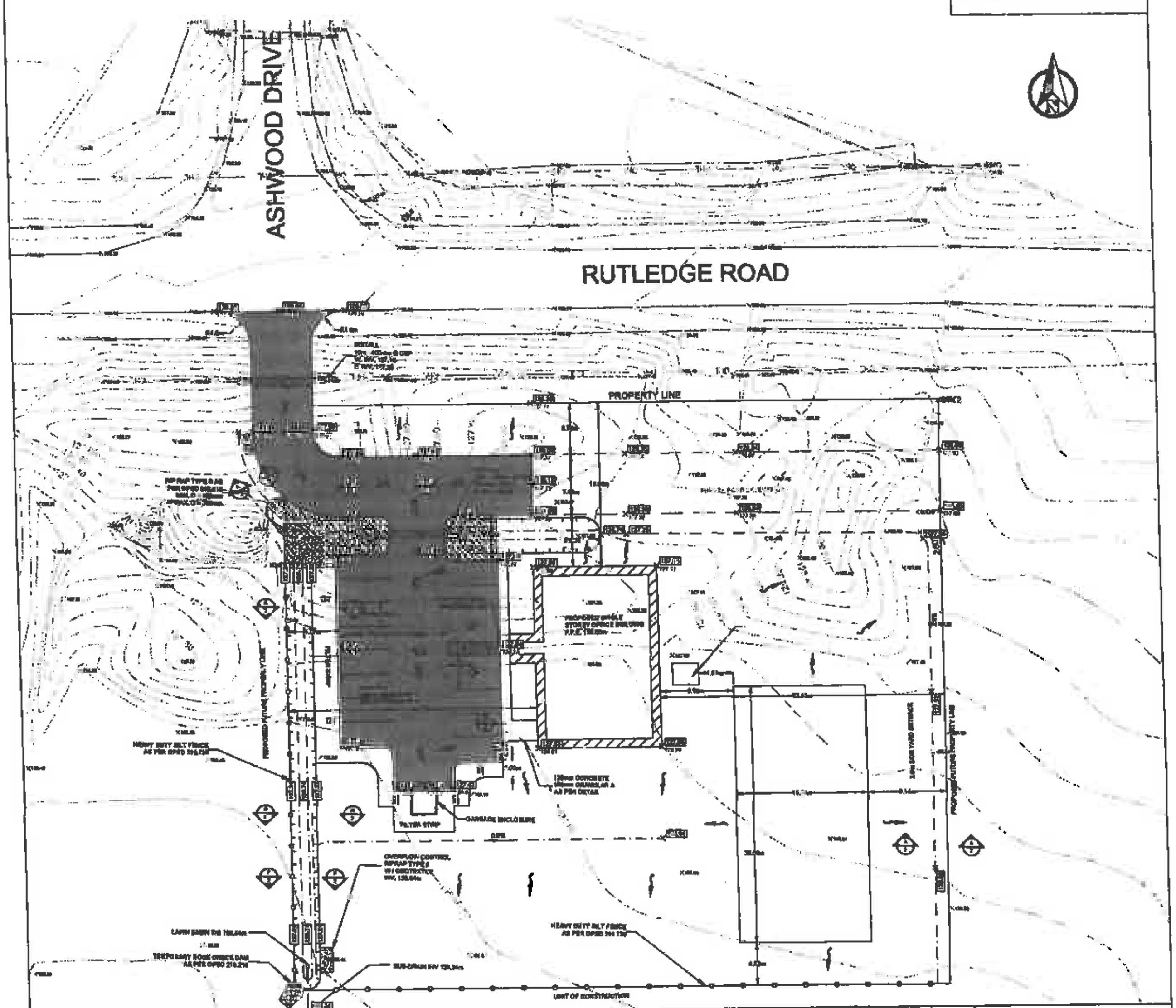
LEGEND

- LIGHT STANDARD
- STOP SIGN
- STREET SIGN
- OVERLAND FLOW PATH
- FLOW PATH
- EXISTING VEGETATION
- VEGETATION REMOVAL
- PROPOSED TREE
- PROPOSED SILT FENCE
- PROPOSED CHAINLINK FENCE
- PROPOSED SWALE CENTRELINE
- BENCHMARK
- ASPHALT SURFACE
- RIP RAP

BENCHMARK

BENCHMARK 1: STANDARD IRON BAR ON NORTH SIDE OF RUTLEDGE ROAD CIVIC# 2572 ELEVATION = 132.300

BENCHMARK 2: STANDARD IRON BAR ON SOUTH SIDE OF RUTLEDGE ROAD CIVIC# 3063 ELEVATION = 128.785



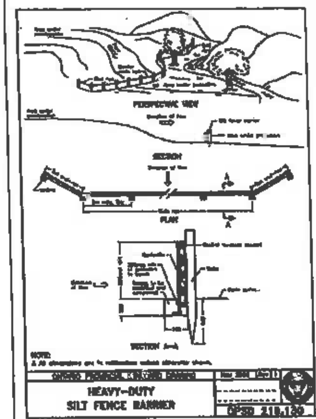
Forefront Engineering Inc

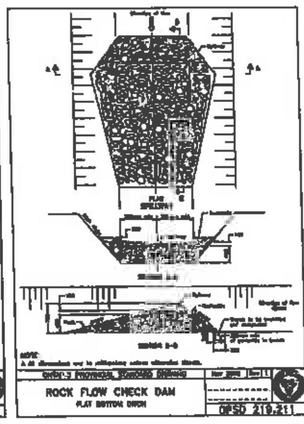
Project: SYDENHAM MEDICAL CENTER

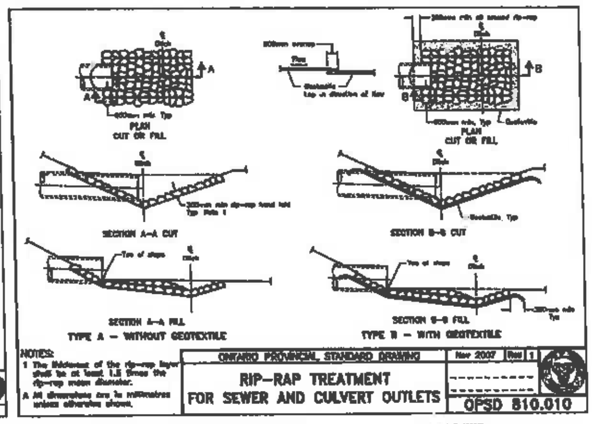
Drawing: SITE PLAN & GRADING PLAN

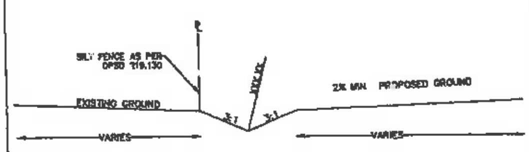
Client: PELOW ENGINEERING

Drawing No. 1

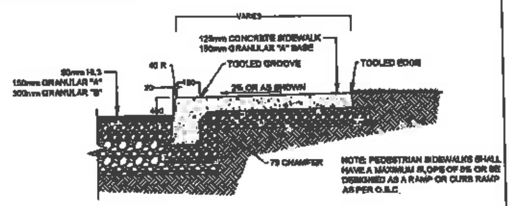




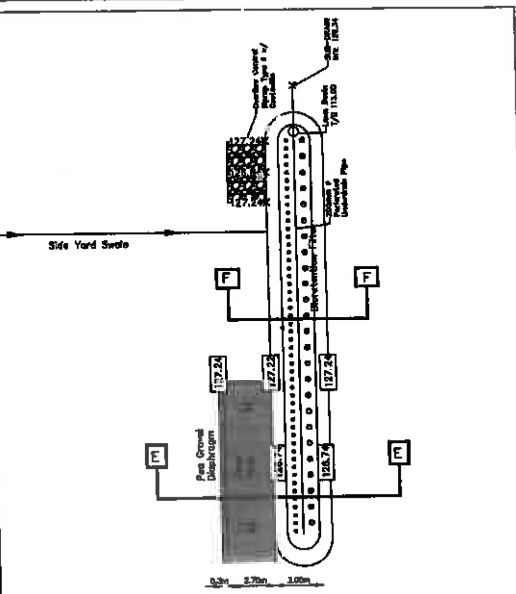




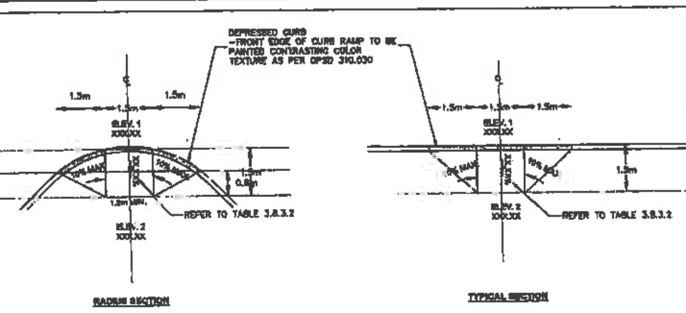
A-A / 2 **SIDEYARD SWALE DETAIL**
NTS



B / 2 **TYPICAL CURB FACE CONCRETE SIDEWALK DETAIL**
NTS



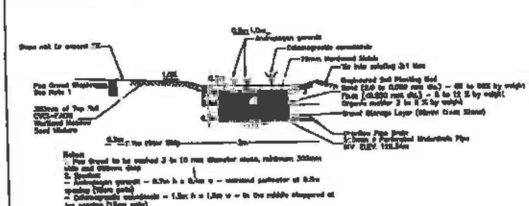
D / 2 **PLAN: STORMWATER MANAGEMENT FACILITY**
NTS



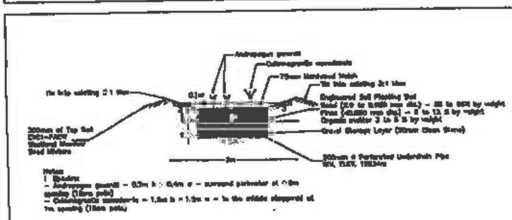
C / 2 **TYPICAL CURB RAMP DETAILS**
NTS

NOTE: WHERE A DIFFERENCE IN ELEVATION IS LESS THAN 200mm, THE ABOVE DETAILS MAY BE USED WHERE THE SLOPE EXCEEDS 5% AND A RAMP AS PER O.B.C. IS NOT SPECIFIED.

O.B.C. TABLE 3.8.3.2 RAMP RISE AND SLOPE	
VERTICAL RISE BETWEEN SURFACES, mm	SLOPE
75 TO 200	1:10 TO 1:12
LESS THAN 75	1:8 TO 1:10



E-E / 2 **STORMWATER MANAGEMENT FACILITY**
NTS



F-F / 2 **STORMWATER MANAGEMENT FACILITY**
NTS

Forefront Engineering Inc

PELOW ENGINEERING

Project: SYDENHAM MEDICAL CENTER

Drawing: DETAILS

Scale: NTS

Drawing No. 2

Forefront Engineering Inc

Appendix B

Modified Rational Method Analysis - 5 year Event
Modified Rational Method Analysis - 100 year Event
Bio-retention Sizing Calculations

MODIFIED RATIONAL METHOD CACULATIONS &
STORAGE VOLUMES FOR SMALL SITES

Project: Sydenham Medical Center
Date: October 2015

5 Year Return Period

Pre-development Runoff	
C	0.3
t_c (min)	15
Area (ha)	0.51
Intensity (mm/hr	63.50
Q (m^3/s)	0.027

Post-development Characteristics			
Description	C	Area (ha)	CxA
Proposed PH2	0.46	0.51	0.23
Total	0.46	0.51	0.23

Post-development Peak Flow	
C	0.43
t_c (min)	15
Area (ha)	0.51
Intensity (mm/hr)	63.50
Q_{Peak} (m^3/s)	0.039

Formulas:

$$I = \frac{1778}{(t_c+13)}$$

$$Q = 0.0028 * C * I * A$$

$$S_d = Q_p t_d - Q_d((t_d+t_c)/2)$$

*Storage Formula (Aron and Kibler, 1990)

Where:

Q=Peak runoff rate (m^3/s)
C=Composite runoff coefficient
I=Rainfall intensity (mm/hr)
A=Drainage area (ha)
tc= Time of Concentration (min)
td = Duration of Storm (min)
Qp = Peak Flow (m^3/s)
Q_d = Discharge Rate (m^3/s)
Sd = Required Storage Volume (m^3)

Orifice Equation

$Q = 0.65 A (2gH)^{1/2}$

where A = orifice area; g = gravity; and H=head above centre of orifice (m)

Weir Equation

$Q = 1.837(L-.06H)xH^{1.5}$

H= Upstream- Downstream elevation

Storage							
Duration td (min)	Intensity (mm/hr)	CxA	Q_p-Uncontrolled Runoff Rate (m^3/s)	Q_d-Allowable Outflow (m^3/s)	Peak Storage Rate (m^3/s)	Storage Volume Total (m^3)	Comments
10	79.21	0.23	0.052	0.027	0.025	11.0	
15	63.50	0.23	0.042	0.027	0.015	13.2	
20	53.66	0.23	0.035	0.027	0.008	13.9	Storage Required
25	46.63	0.23	0.031	0.027	0.004	13.5	
30	41.41	0.23	0.027	0.027	0.000	12.5	
40	34.13	0.23	0.022	0.027	-0.005	9.2	

Weir Width (m)	Water Surface Elevation (m)	Invert of Weir (m)	Head (m)	Release Rate (m^3/s)	Required Release (m^3/s)	Velocity m/s	Comments
0.3	126.950	126.840	0.110	0.020	0.027	0.61	
0.3	126.950	126.840	0.110	0.020	0.027	0.61	Proposed
0.3	126.950	126.840	0.110	0.020	0.027	0.61	

MODIFIED RATIONAL METHOD CACULATIONS &
STORAGE VOLUMES FOR SMALL SITES

Project: Sydenham Medical Center
Date: October 2015

100 Year Return Period

Pre-development Runoff	
C	0.3
t_c (min)	15
Area (ha)	0.51
Intensity (mm/hr	110.24
Q (m^3/s)	0.047

Post-development Characteristics			
Description	C	Area (ha)	CxA
Proposed PH2	0.46	0.51	0.23
Total			

Post-development Peak Flow	
C	0.46
t_c (min)	15
Area (ha)	0.51
Intensity (mm/hr)	110 24
Q_{Peak} (m^3/s)	0.072

Storage

Duration td (min)	Intensity (mm/hr)	CxA	Q_o- Uncontrolled kunoff Rate (m^3/s)	Q_d-Allowable Outflow (m^3/s)	Peak Storage Rate (m^3/s)	Storage Volume Total (m^3)	Comments
5	190.79	0.23	0.125	0.047	0.078	9 5	
10	138.41	0.23	0.091	0.047	0.044	19.1	
15	110.24	0.23	0.072	0.047	0.026	23.0	
20	92.70	0.23	0.061	0.047	0.014	23.8	Storage Required
25	80.21	0.23	0.053	0.047	0.006	22.8	
30	70.98	0.23	0 047	0.047	0.000	20.6	
35	63.85	0.23	0.042	0.047	-0.005	17.7	
40	58.16	0.23	0.038	0.047	-0.009	14.3	

Weir Width (m)	Water Surface Elevation (m)	Invert of Weir (m)	Head (m)	Release Rate (m^3/s)	Required Release (m^3/s)	Velocity m/s	Comments
0.3	127.020	126 840	0.180	0.042	0.047	0.78	
0.3	127.020	126.840	0.180	0.042	0.047	0.78	Proposed
0.3	127 020	126.840	0.180	0.042	0.047	0.78	

Formulas:

I= Mto District 8 West IDF Curve

$Q = 0.0028 * C * I * A$

$S_d = Q_p t_d - Q_d((t_d * t_d)/2)$

*Storage Formula (Aron and Kibler, 1990)

Where:

Q=Peak runoff rate (m^3/s)
C=Composite runoff coefficient
I=Rainfall intensity (mm/hr)
A=Drainage area (ha)
tc= Time of Concentration (min)
td = Duration of Storm (min)
Qp = Peak Flow (m^3/s)
Q_d = Discharge Rate (m^3/s)
Sd = Required Storage Volume (m^3)

Orifice Equation

$Q = 0.85\ A\ (2gH)^{1/2}$

where A = orifice area, g = gravity; and H=head above centre of orifice (m)

Weir Equation

Q= 1.837(L-.08H)xH^1.5

S = Upstream- Downstream elevation

Bioretenion Sizing

WQV= V x C x A

C= % Impervious
A= Impervious Area (m^2)
V= Storm Volume (m)
V= 0.025 m for 25 mm event

A=	5100 m^2
C=	0.46
V=	0.025 m
WQV=	58.65 m^3

$d_r = i * t_s / V_r$ Maximum depth of stone reservoir below the underdrain pipe

$d_{c\,max} = i * (t_s - d_p / i) / V_r$ Maximum allowable depth of the cell (filter bed and gravel storage layer)

i=	Infiltration rate for native soils (mm/hr)
ts=	Time to drain (design for 48 hour time to drain is recommended)
Vr=	Void space ratio for filter bed and gravel storage layer (assume 0.4)
d_p=	Maximum surface ponding depth (mm)

i=	15 mm/hr
ts=	48 hrs
Vr=	0.4
d_p=	100 mm

d_r=	1800 mm
$d_{c\,max}$=	1550 mm
$d_{c\,proposed}$=	900 mm

$A_f = WQV / d_p + (dc * Vr)$

A_f = Footprint surface area (m^2)
WQV = Water quality volume (m^3)
d_c = Bioretention cell depth (m)
Vr = Void space ratio for filter bed and gravel storage layer (assume 0.4)
d_p=Maximum surface ponding depth (mm)

A_f= 151.3 m^2 Including 100 year storage requirement

190 m^2 is provided