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September 6, 2022

Project Number 484-033-22

Functional Servicing Report

Regarding:

Proposed Townhouse Development
422, 424, 426 Yonge Street,
Midland, Ontario

Prepared on behalf of:

Greg and Les Shannon

By:

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

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LIST OF FIGURES & DRAWINGS

1. Introduction

Gerrits Engineering Ltd. (GEL) has been retained by Greg and Les Shannon (Client) to provide engineering services for a new residential development located at 422, 424 & 426 Yonge Street in Midland, Ontario.

This Functional Servicing Report (FSR) has been prepared in support of the Zoning By Law Amendment Application prepared by Innovative Planning Solutions to demonstrate how the proposed development can be serviced by the surrounding existing municipal infrastructure. In particular this FSR will examine the property's conceptual servicing with relation to:

- Water Supply
- Sanitary Sewerage
- Storm Sewerage
- Stormwater Management

1.1. Supporting & Reference Documents

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

- Ministry of the Environment, Guidelines for the Design of Sanitary Sewage Works and Water Works – 2008
- Ministry of the Environment, Stormwater Management Planning and Design Manual, March 2003
- Ministry of the Environment, Design Guidelines for Drinking-Water Systems, 2008
- Ontario Building Code 2012 (O.B.C.)
- Township of Midland Engineering Design Standards
- NVCA, Nottawasaga Valley Conservation Authority, NVCA Stormwater Technical Guide, December 2013

1.2. Subject Property

The proposed residential development is approximately 0.06 Ha in area and generally rectangular in shape. It is legally described as Part of Lot 20, East Side of Queen Street, Registered Plan 169A, Town of Midland, County of Simcoe. The site consists of a 2 storey triplex block with three units (293m^2) that is to remain and be converted into a townhouse block. The site, in its existing state, slopes stormwater away from the triplex building, spilling on to the right of way or rear/side yard swales. The topographical information is based on a survey completed by Dearden & Stanton Ltd., dated July 27, 2022, Simcoe County GIS as well as an aerial map from Google Imagery.

Figure 1 - Subject Property (Red)

1.3. Proposed Land Use

The proponent is seeking to keep the existing triplex in place and sever the lot, which will consist of (3) 2-storey residential townhomes. Each townhome will be serviced with their own sanitary sewage as well as their own domestic water supply provided by the Town of Midland.

2. Servicing

2.1. Overview

Servicing of the Development will involve the connection to the Town's existing water and sanitary distribution and collection system. The Development's internal collection and distribution system will be constructed as per the Town and Ministry of Environment (MOE) design guidelines. The site's internal water distribution system will be designed to account for domestic and fire protection requirements.

2.2. Design Criteria

A summary of the water and wastewater design criteria is as follows:

Serviced Population

- Density (Townhome Dwelling) = 2.5 ppu
- Development residential population – 3 units x 2.5 ppu = 7.5 pers

Wastewater Criteria

- Average Day Flow (ADF) Residential (New Development) = 450 L/c/d
- Extraneous flows (peak per developable ha) = 3460 L/d/ha = 0.23 L/s/ha
- Peak Factor (residential and commercial) Harmon

  $M = 1 + \frac{14}{4+P^{0.5}} = 4.35 = 4.0$ (Maximum)

Water Criteria

- Average Day Demand (ADD) Residential (New Development) = 450 L/c/d
- Max Day Factor (MDD) = 2.0
- Peak Hour factor (PH) = 4.5
- Minimum pressure in system at PH = 275 kPa
- Maximum pressure in system under Static Load = 550 kPa
- Minimum pressure in system at Peak Hour demand = 275 kPa
- Minimum pressure in system at Fire + MDD = 140 kPa

3. Sanitary Servicing

The projected daily average and peak sewage flows from the subject property are summarized in the table below.

Table 1 – Design Wastewater Flows

Average Daily Demand (Design)	3.6	m^3/d
	0.04	L/s
Peak Hour Flow (Design)	15.6	m^3/d
	0.18	L/s

3.1. Proposed Sanitary Connection Point

It is proposed that one sanitary service to each of the dwellings be made by connecting directly to the Municipality's existing 250mm service on Yonge Street. Assuming a slope of 2% from the dwelling to the mainline sewer, a 125mm diameter PVC pipe will be able to convey approximately 7.5 L/s. The anticipated peak flow of 0.06 L/s (per dwelling) is well within the capacity range of the service connection in question. A clean out should be installed for each service line as shown on the attached Lot Grading Plan in Appendix B.

3.2. Internal Sanitary Collection System

It is proposed that the sanitary sewers be constructed in accordance with the Township's Engineering Standards and the MOE guidelines to service the Development. The proposed sewers will consist of PVC DR 35 pipe designed to meet minimum and maximum velocities under full flow conditions.

No Manhole structures are being proposed for this development, however, clean outs should be provided for all service lines. Adequately sized service connections will be provided to each proposed dwelling as specified by Township Standards. See attached Lot Grading Plan in Appendix B for reference.

4. Water Supply and Distribution

4.1. Existing Water System Analysis

The water servicing for this Development has been considered from an internal perspective and the preliminary analysis of the onsite demands has been as per the Town of Midland and the MOE guidelines and includes the above mentioned criteria. The projected daily average, maximum day, and peak hourly flows from the subject property are summarized in the table below:

Table 2 – Design Water Flows

Average Daily Demand (Design)	3.6	m^3/d
	0.04	L/s
Maximum Day Demand (Design)	7.2	m^3/d
	0.08	L/s
Peak Hour Flow (Design)	16.2	m^3/d
	0.19	L/s

4.2. Internal Water Distribution System

To service the subject lands, a 25mm diameter Polyethylene or Copper 'Type K' pipe water service will be provided for each townhome at a minimum depth of 1.7m below finished grade. Each 25mm diameter water service will have a curb stop at the property line. The internal water distribution is to connect into the external watermain system via live tapping. The proposed service connection locations and internal watermain layout is illustrated on the Lot Grading Plan in Appendix B. Given the size of the development, we do not anticipate capacity or pressure issues.

4.3. Fire Flow Requirement

Fire Flow requirements for a development of this size typically are not an issue and will be provided by storage within the potable water supply system. Volume requirements are determined based on population and are outlined in the MOE Guidelines. A new hydrant is not proposed as an existing hydrant is located at the northeast corner of Queen Street and Yonge Street. This hydrant is within 120m from the rear of the proposed development, as specified by the Town of Midland.

5. Storm Drainage and Stormwater Management

A key component of the Development is the need to address environmental and related Stormwater Management (SWM) issues. These are examined in a framework aimed at meeting the Town of Midland and MOE requirements. SWM parameters have evolved from an understanding of the location and sensitivity of the site's natural systems.
It is understood that the objectives of the SWM plan are to:

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

5.1. Existing Drainage Conditions

The subject property is approximately 0.06 Ha in size and is evaluated as having one drainage areas consisting of Grassed areas with a Triplex Dwelling along with Driveways, Walkways and Sheds. Based on our review of the mapping, topography across the development area is relatively flat. Half of the site generally slopes towards the Right-of-Way on Yonge Street while the other half of the site generally slopes towards the rear property line, conveying the water via a swale. No onsite flow attenuation controls exist.

Using the Ministry of Transportation policies and Design Guidelines, the existing site statistics produce the following weighted runoff coefficient:

Grassed	=	168 m^2	R	=	0.10	AR	=	16.8
Interlock	=	21 m^2	R	=	0.70	AR	=	14.7
Asphalt	=	92 m^2	R	=	0.95	AR	=	87.4
Concrete	=	6 m^2	R	=	0.95	AR	=	5.7
Building Roof	=	293 m^2	R	=	0.95	AR	=	278.4
					Total	AR	=	403.0

Site Area = 580 m^2 AR = 403 m^2 Weighted R = 0.70

5.2. Proposed Drainage Conditions

The proposed development will convert the existing Triplex Dwelling into three separate Townhouse Dwellings with an additional driveway being added to the middle Townhouse Dwelling. As per the proposed statistics, the post development weighted runoff is:

Grassed	=	147 m^2	R	=	0.10	AR	=	14.7
Interlock	=	21 m^2	R	=	0.70	AR	=	14.7
Asphalt	=	113 m^2	R	=	0.95	AR	=	107.4
Concrete	=	6 m^2	R	=	0.95	AR	=	5.7
Building Roof	=	293 m^2	R	=	0.95	AR	=	278.4
					Total	AR	=	420.9

Site Area = 580 m^2 AR = 421 m^2 Weighted R = 0.73

Based on the above, the proposed development will have a slight decrease in imperviousness while increasing in perviousness for the entire site.

5.3. Stormwater Quantity Control

As noted above in the comparison between the pre/post development flows, a slight increase in runoff will occur as a result of the proposed development of the site to construct the new driveway.

In order to control post-development runoff rates to pre-development levels, it is proposed to install LID measures such as soak away pits for each developed lot, as well as, enhanced grassed swales and vegetative buffers acting as filter strips that will satisfy quantity control design criteria. These soak away pits have been sized to infiltrate the 25mm event from the roof surface prior to surcharging and flowing overland.

Since the roof stormwater runoff will be controlled on each lot and vegetative strips will be maintained throughout the development area, post-development peak flows will be maintained and reduced to pre-development levels. There will be no increases in runoff directed to adjacent properties and there will be no downstream flood impact concerns associated with this development.

5.4. Stormwater Quality Control

The MOE issued a “Stormwater Management Planning and Design Manual” in March 2003. This manual has been adopted by a variety of agencies including the Town. The objective of our SWM quality control will be to ensure MOE’s Enhanced Protection. To achieve Enhanced Protection, permanent and temporary control of erosion and sediment transport are proposed and are discussed in the following sections.

5.4.1. Stormwater Quality Control During Construction

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

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

5.4.2. Permanent Quality Control

The objective of the permanent SWM quality controls will be to ensure MOE's Enhanced Protection. The proposed development will increase the imperviousness of the site. It is important to quantify this increase to evaluate the potential downstream impacts. As per the site's assumed statistics for the developable area, the post development Total Imperviousness is:

Impermeable Lot	=	433 m^2	(Asphalt - Dwellings Roofs – Concrete – Interlock)
Total Developable	=	580 m^2	

TIMP $= (A_{BLD} + A_{ASP} + A_{CON} + A_{INT}) / A_{TOTAL}$

$= 433\ m^2 / 580\ m^2$

$= 0.746$ (or 75%)

Given the nature of the site, and the favorable on-site soil conditions, it is proposed that a Low Impact Development (LID) method be utilized to provide quality control. On-site controls in the form of soak away pits will be used as the means of addressing quality controls for runoff from the dwelling roof surfaces.

5.4.3. LID Facilities

$A_D = 580\ m^2$

TIMP = 74.7 %

From Table 3.2 Water Quality Storage Requirements based on Receiving Waters (extrapolating for TIMP = 74.7%)

$V_{Req'd} = 36.6\ m^3/ha$

$= 36.6\ m^3/ha \times 0.0580\ ha$

$\mathbf{= 2.1\ m^3}$

Therefore, the combined volume of the LID facilities must provide about **2.1 m^3** of volume for infiltration to meet MOE Enhanced removal requirements.

It is proposed to use individual soak away pits located within the residential lots in order to provide quality control. These infiltration galleries will capture storm flows from roofs, with the use of a 100mm diameter perforated pipe, and have capabilities of being installed in a variety of ways including beneath decks, lawns and patios. These have been preliminarily sized as having a width of about 1.5m, maximum depth of 0.58m, and length of 2.0m per gallery. This will result in approximately 0.71m^3 of infiltration volume being provided per lot giving a total volume of **2.1m^3**. The galleries have been sized to meet the required footprint of 24-48 hour detention time, given the assumed percolation rates of 60mm/hr (24mm/hr with a safety factor of 2.5). Calculations of the infiltration galleries have been provided within Appendix A.

5.5. Water Balance

The proposed development will increase the impervious cover of the site, which decreases the infiltration of groundwater. This decrease in infiltration reduces groundwater recharge and soil moisture replenishment. Therefore, it is important to maintain this natural hydrologic cycle as much as possible.

Referencing Section 3.2 of the MOE "Stormwater Management Planning and Design Manual, (March 2003), and the historical rainfall distribution for the area, the following review of the water balance has been completed. The project site is approximately 3.2 Ha in area, and referencing the Simcoe County Soil Maps, we know the soil is typically characterized as a Sandy Loam. Referencing Table 3.1 Hydrologic Cycle Component Values of the MOE manual, a lawn ground cover comprised of a Sandy Loam, has an average annual evapotranspiration of 525mm. Using this information, combined with the calculated infiltration factor determined for the subject property and the water balance spreadsheet we calculate about $56m^3$ of infiltration per year.

Calculating the anticipated uncontrolled post-development infiltration, it is anticipated that about $49m^3$ surface runoff will infiltrate per year. Therefore, additional onsite methods will be required to maintain the water balance. It is proposed that a minimum of 25mm of each rainfall event be infiltrated from the rooftop and pavement surfaces through the use of soak away pit infiltration trench methods. These methods, in addition to the pervious infiltration across the site, result in a volume of $358m^3$ to be infiltrated per year, which exceeds the current regime of the site. The following table details the various infiltrations with detailed calculations of these methods included in Appendix A.

Table 3 – Infiltration Results

	Total Infiltration (m^3/yr)
Pre-Development	56
Uncontrolled Post Development	49
Controlled Post Development	358

5.6. Erosion and Sediment Control

To ensure Stormwater runoff quality is controlled during construction, an erosion and sediment control strategy will be implemented to mitigate transportation of silt off-site to the existing roads and sewers. It is imperative that effective controls be put in place and maintained until all areas are stabilized with surface cover. All erosion and sediment control Best Management Practices (BMP) shall be designed, constructed and maintained in accordance with the Township of Essa's erosion control requirements.

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

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

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

- Temporary sediment control fencing should be erected around the perimeter of the grading activities.
- Temporary sediment fabric and stone filters should be installed on existing and proposed catch basins until surface cover and vegetation has been stabilized.

- A temporary construction access mud mat should be implemented to reduce the amount of materials that may be transported off site.
- Construction during drier months should be monitored for wind-borne transport of sediments. At the direction of the engineer, the contractor may be directed to water down exposed earth areas with an aqueous solution of calcium chloride.
- All disturbed areas not under immediate construction for 30 days, or not intended for building activities within a 3-month time period, should be stabilized with seeding.
- Built up sediment should be removed and disposed off-site at least once a month, or more frequently as directed by the engineer.

6. Conclusions

Implementation of the designs outlined in this report will ensure that the stormwater drainage from the site complies with the requirements of the reviewing authorities, is of acceptable quality both during and after construction, and further, in the event of a major storm, that proper facilities are in place to protect the buildings and adjacent properties. The preliminary analysis and conceptual design outlined in this report demonstrates that the servicing of this proposed Development is feasible and, if based on sound engineering principles, the development will become a cohesive part of the Community for the Town of Midland.

All of which is respectfully submitted,
Gerrits Engineering Ltd.

Noam Itzkovsky, P.Eng.
Civil Intermediate Engineer

Jeff McCuaig, P.Eng.
Director , Civil Engineer

Appendix A
Design Calculations

RESIDENTIAL DEVELOPMENT

SANITARY FLOW CALCULATIONS

CLIENT: GREG AND LES SHANNON | **Date:** 19-Aug-22

PROJECT: Proposed Residential Townhome Building | **Design** Noam Itzkovsky

FILE: 484-033

n = 0.013
M = 1 + (14 / (4 + (P / 1000) ^ 0.5)) 2 <= "M" <= 4
Qp = P * Q * M / 86400 Q = 450 L/cap/day

Qtot = Qp + Qi

ASSUMPTIONS

DESCRIPTION	DENSITY	FLOW RATE
Single Family	3.00 people/unit	450 L/cap/d
Townhomes	2.50 people/unit	450 L/cap/d
Condominium Building	2.00 people/unit	450 L/cap/d

PEAK RATE FACTOR: M

Extraneous Flow 0.23 L/s/ha

	SINGLE UNITS	DEVELOPMENT AREA (Ha)	TOTAL UNITS	POPULATION (P)	POPULATION (ACC.)	EXTRANEOUS FLOW	PEAKING FACTOR (M)	AVERAGE FLOW (L/s)	PEAK FLOW (L/s)
Townhomes	3	0.058	3	7.5	8	0.01	4.00	0.04	0.18
TOTAL UNITS	**3**	**0.058**	**3**	**7.5**	**8**	**0.01**	**4.00**	0.04	**0.18**

INFILTRATION 0.058 ha

0.04 **0.18**

RESIDENTIAL DEVELOPMENT

WATER FLOW CALCULATIONS

CLIENT: GREG AND LES SHANNON

Date: 19-Aug-22

PROJECT: Proposed Residential Townhome Building

Design Noam Itzkovsky

FILE: 484-033

ASSUMPTIONS

DESCRIPTION	DENSITY	FLOW RATE	PEAKING FACTORS*	
			MAX DAY FACTOR	2.00
Single Family	3.00 people/unit	450 L/cap/d	PEAK RATE FACTOR	4.50
Townhomes	2.50 people/unit	450 L/cap/d		
Condominium Building	2.00 people/unit	450 L/cap/d		

*From MOE Manual Table 3-3 - Population of Fewer than 500

PHASE	SINGLE UNITS		TOTAL UNITS	POPULATION (P)	COMMERCIAL AREA (ha)	COMMERCIAL EQUIVALENT POPULATION	EQUIVALENT POPULATION	AVERAGE FLOW (L/s)	MAX DAY FLOW (L/s)	PEAK FLOW (L/s)
Townhome Building	3		3	8			8	0.04	0.08	0.19
TOTAL UNITS	**3**		**3**	**8**			**8**	**0.04**	**0.08**	**0.19**

Calculation of Weighted Runoff Coefficient

Pre/Post Development Areas and Sub-Areas

Area ID	Total Area	Grassed 0.10	Asphalt Drive 0.95	Building Roof 0.95	Inter-locking Pavers 0.70	Concrete 0.95		Weighted Rational Coefficient
Pre-Development	580	168	92	293	21	6		0.70
X-1	580	168	92	293	21	6		0.70
Post-Development	580	147	113	293	21	6		0.73
P-1	580	147	113	293	21	6		0.73

Pre-Development Runoff Calculation

West Nipissing OPP

Area	0.06	ha		
Runoff Coefficient	0.70			
Time of Concentration	10	min		
	Interpolated			
Return Rate	2	year		
Coefficient	1			
Rainfall Intesity	78.3	mm/hr		
Allowable Release Rate	0.01	m^3/s	8.77	L/s
Return Rate	5	year		
Coefficient	1			
Rainfall Intesity	102.3	mm/hr		
Allowable Release Rate	0.01	m^3/s	11.46	L/s
Return Rate	10	year		
Coefficient	1			
Rainfall Intesity	118.4	mm/hr		
Allowable Release Rate	0.01	m^3/s	13.26	L/s
Return Rate	25	year		
Coefficient	1.1			
Rainfall Intesity	138.4	mm/hr		
Allowable Release Rate	0.02	m^3/s	17.06	L/s
Return Rate	50	year		
Coefficient	1.2			
Rainfall Intesity	153.2	mm/hr		
Allowable Release Rate	0.02	m^3/s	20.60	L/s
Return Rate	100	year		
Coefficient	1.25			
Rainfall Intesity	168.4	mm/hr		
Allowable Release Rate	0.02	m^3/s	23.59	L/s

Storm (yrs)	Coeff A	Coeff B	Coeff C
2	**807.44**	**6.75**	**0.828**
5	**1135.4**	**7.5**	**0.841**
10	**1387**	**7.97**	**0.852**
25	**1676.2**	**8.3**	**0.858**
50	**1973.1**	**9**	**0.868**
100	**2193.1**	**9.04**	**0.871**

Modified Rational Method

$$Q = C_i CIA / 360$$

Where:

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

Gerrits
Engineering Limited

Post Development Runoff Calculation

West Nipissing OPP

Area	0.06	ha		
Runoff Coefficient	0.73			
Time of Concentration	10	min		
	Interpolated			
Return Rate	2	year		
Coefficient	1			
Rainfall Intesity	78.3	mm/hr		
Allowable Release Rate	0.01	m^3/s	9.15	L/s
Return Rate	5	year		
Coefficient	1			
Rainfall Intesity	102.3	mm/hr		
Allowable Release Rate	0.01	m^3/s	11.96	L/s
Return Rate	10	year		
Coefficient	1			
Rainfall Intesity	118.4	mm/hr		
Allowable Release Rate	0.01	m^3/s	13.84	L/s
Return Rate	25	year		
Coefficient	1.1			
Rainfall Intesity	138.4	mm/hr		
Allowable Release Rate	0.02	m^3/s	17.81	L/s
Return Rate	50	year		
Coefficient	1.2			
Rainfall Intesity	153.2	mm/hr		
Allowable Release Rate	0.02	m^3/s	21.50	L/s
Return Rate	100	year		
Coefficient	1.25			
Rainfall Intesity	168.4	mm/hr		
Allowable Release Rate	0.02	m^3/s	24.63	L/s

Storm (yrs)	Coeff A	Coeff B	Coeff C
2	**807.44**	**6.75**	**0.828**
5	**1135.4**	**7.5**	**0.841**
10	**1387**	**7.97**	**0.852**
25	**1676.2**	**8.3**	**0.858**
50	**1973.1**	**9**	**0.868**
100	**2193.1**	**9.04**	**0.871**

Modified Rational Method

$$Q = C_i CIA / 360$$

Where:

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

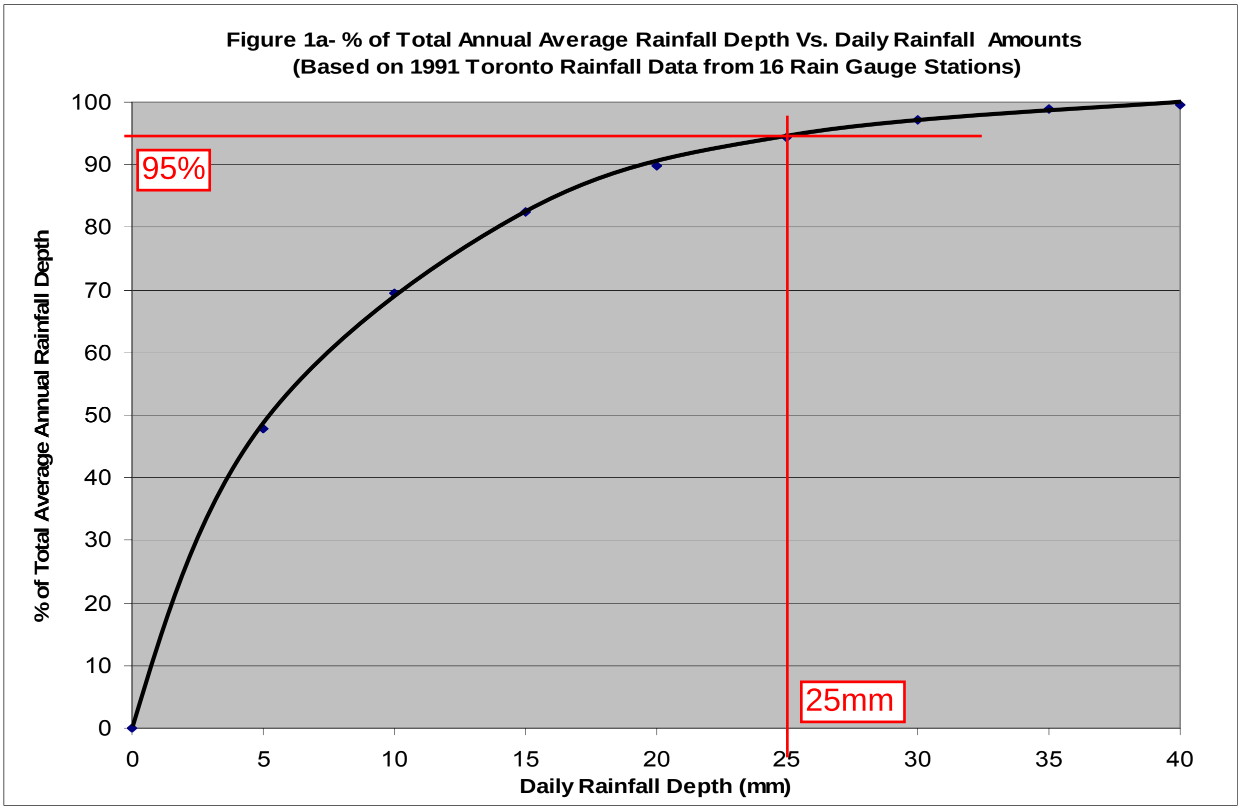
Figure 1a- % of Total Annual Average Rainfall Depth Vs. Daily Rainfall Amounts
(Based on 1991 Toronto Rainfall Data from 16 Rain Gauge Stations)
% of Total Average Annual Rainfall Depth
Daily Rainfall Depth (mm)
95%
25mm
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
30
35
40

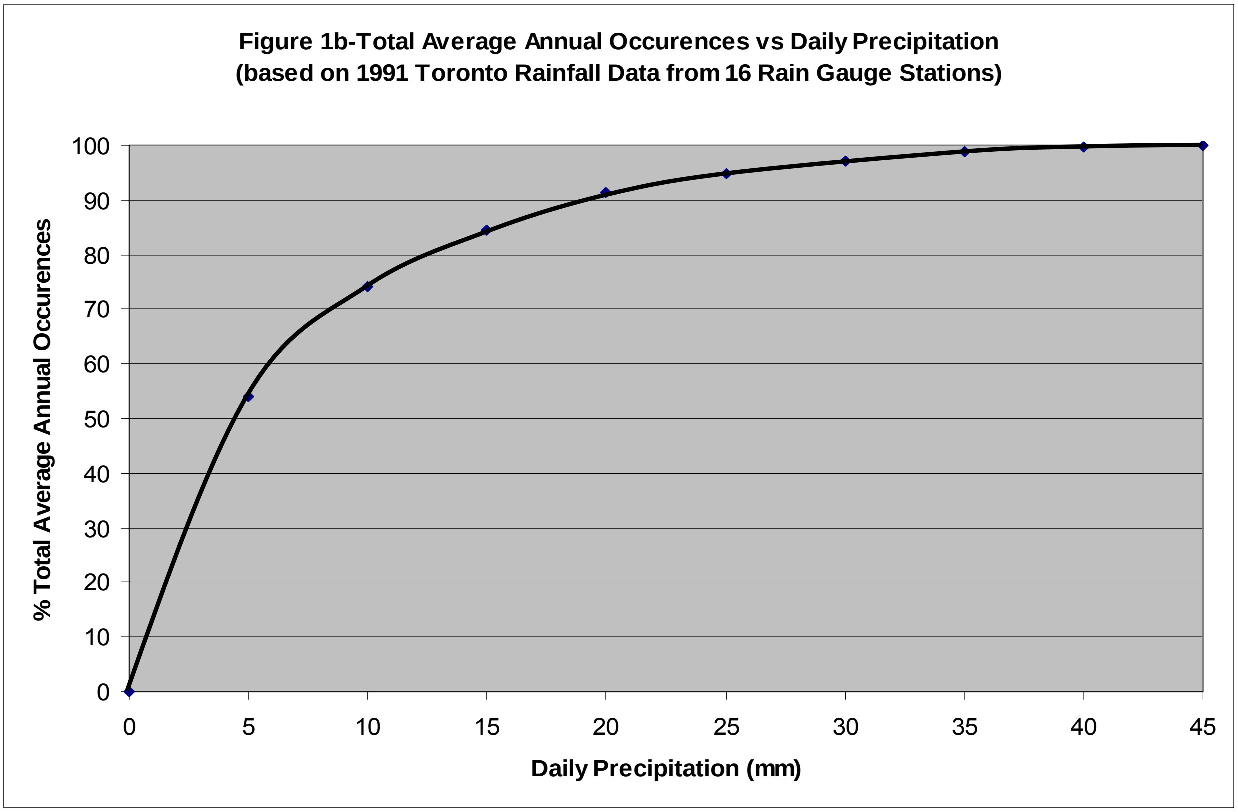
Figure 1b-Total Average Annual Occurences vs Daily Precipitation
(based on 1991 Toronto Rainfall Data from 16 Rain Gauge Stations)
% Total Average Annual Occurences
Daily Precipitation (mm)
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
30
35
40
45

Table 3.2 Water Quality Storage Requirements based on Receiving Waters[1, 2]

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	**55%**	**70%**	**85%**
Enhanced 80% long-term S.S. removal	Infiltration	25	30	35	40
	Wetlands	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
Normal 70% long-term S.S. removal	Infiltration	20	20	25	30
	Wetlands	60	70	80	90
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
Basic 60% long-term S.S. removal	Infiltration	20	20	20	20
	Wetlands	60	60	60	60
	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

Site Area:	580 m^2
Site Impervious Area:	433 m^2
Impervious Level of Site:	74.7%
Volume Req'd for Quality Control:	36.6 m^3/ha
Volume Required:	2.1 m^3

Perforated Pipe Design

Width of Retention Area =	1.50 m		Dia. Of Pipe =	100 mm		
Height of Trench =	0.58 m					
Trench Area (A_T)=	0.87 sq.m.		Pipe Area (A_P)=	0.007854 sq.m.		
Trench SurfaceArea (A_T)=	3 sq.m.					
Stone Area (A_{ST}) = A_T - A_P =	0.86					
Length of Trench (L_T) =	2 m		Pipe Volume (V_P) =		A_P x L_P =	0.02 m^3
Length of Pipe (L_P) =	2 m		Stone Volume (V_{ST}) =		A_{ST} x L_T x n =	0.69 m^3
			Total Volume (V_P) =	0.705 m^3		

Determine Minimum Sizing of Infiltration Gallery

Table 4.4: Minimum Soil Percolation Rates

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

Soil Type
loam

Volume Required:	0.705 m^3
Assumed Porosity:	0.4
Percolation Rate:	60 mm/h
Percolation Rate with Factor of Safety (2.5):	24 mm/h
Area Req'd (24hr):	3.1 m^2
Area Req'd (48hr):	1.5 m^2
Maximum Depth:	0.576 m

Equation 4.3: Infiltration Trench Bottom Area

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

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

Equation 4.2: Maximum Allowable Soakaway Pit Depth

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

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

484-033 Water Balance

PRE-DEVELOPMENT	Site			
Catchment Designation	Grass/Open Space	Paved	Building	TOTALS
Area (m^2)	168	119	293	580
Pervious Area (m^2)	168	119	0	287
Impervious Area (m^2)	0	0	293	293
MOE Infiltration Factors				
Topography Infiltration Factor	0.30	0.30	0.30	
Soil Infiltration Factor	0.40	0.10	0.40	
Land Cover Infiltration Factor	0.10	0.10	0.10	
MOE Total Infiltration Factor	0.80	0	0	
Runoff Coefficient	0.20	1	1	
Runoff from Impervious Surfaces	0	0.8	0.8	
Inputs (per Unit Area)				
Precipitation (mm/yr)	940	940	940	940
TOTAL INPUTS (mm/yr)	940	940	940	940
Outputs (per Unit Area)				
Precipitation Surplus (mm/yr)	415.0	752	752	
Evapotranspiration (mm/yr)	525	188	188	
Infiltration (mm/yr)	332	0	0	
Rooftop Infiltration (mm/yr)	0	0	0	
Total Infiltration (mm/yr)	332	0	0	
Runoff Pervious Areas (mm/yr)	83	0	0	
Runoff Impervious Areas (mm/yr)	0	752	752	
Total Runoff (mm/yr)	83	752	752	
TOTAL OUTPUTS (mm/yr)	940	940	940	940
Difference (INPUTS-OUTPUTS)	0	0	0	0
Inputs (Volumes)				
Precipitation (m^3/yr)	158	112	275	545
TOTAL INPUTS (m^3/yr)	158	112	275	545
Outputs (Volumes)				
Precipitation Surplus (m^3/yr)	70	89	220	380
Evapotranspiration (m^3/yr)	88	22	55	166
Infiltration (m^3/yr)	56	0	0	56
Rooftop Infiltration (m^3/yr)	0	0	0	0
Total Infiltration (m^3/yr)	56	0	0	56
Runoff Pervious Areas (m^3/yr)	14	0	0	14
Runoff Impervious Areas (m^3/yr)	0	89	220	310
Total Runoff (m^3/yr)	14	89	220	324
TOTAL OUTPUTS (m^3/yr)	158	112	275	545
Difference (INPUTS-OUTPUTS)	0	0	0	0

POST-DEVELOPMENT	Site			
Catchment Designation	Grass/Open Space	Paved	Building	TOTALS
Area (m^2)	147	140	293	580
Pervious Area (m^2)	147	0	0	147
Impervious Area (m^2)	0	140	293	433
MOE Infiltration Factors				
Topography Infiltration Factor	0.30	0.30	0.30	
Soil Infiltration Factor	0.40	0.40	0.40	
Land Cover Infiltration Factor	0.10	0.10	0.10	
MOE Total Infiltration Factor	0.80	0	0	
Runoff Coefficient	0.20	1	1	
Runoff from Impervious Surfaces	0	0.8	0.8	
Inputs (per Unit Area)				
Precipitation (mm/yr)	940	940	940	940
TOTAL INPUTS (mm/yr)	940	940	940	940
Outputs (per Unit Area)				
Precipitation Surplus (mm/yr)	415	752	752	
Evapotranspiration (mm/yr)	525	188	188	
Infiltration (mm/yr)	332	0	0	
Rooftop Infiltration (mm/yr)	0	0	0	
Total Infiltration (mm/yr)	332	0	0	
Runoff Pervious Areas (mm/yr)	83	0	0	
Runoff Impervious Areas (mm/yr)	0	752	752	
Total Runoff (mm/yr)	83	752	752	
TOTAL OUTPUTS (mm/yr)	940	940	940	
Difference (INPUTS-OUTPUTS)	0	0	0	
Inputs (Volumes)				
Precipitation (m^3/yr)	138	132	275	545
TOTAL INPUTS (m^3/yr)	138	132	275	545
Outputs (Volumes)				
Precipitation Surplus (m^3/yr)	61	105	220	387
Evapotranspiration (m^3/yr)	77	26	55	159
Infiltration (m^3/yr)	49	0	0	49
Rooftop Infiltration (m^3/yr)	0	0	0	0
Total Infiltration (m^3/yr)	49	0	0	49
Runoff Pervious Areas (m^3/yr)	12	0	0	12
Runoff Impervious Areas (m^3/yr)	0	105	220	326
Total Runoff (m^3/yr)	12	105	220	338
TOTAL OUTPUTS (m^3/yr)	138	132	275	545
Difference (INPUTS-OUTPUTS)	0	0	0	0

POST-DEVELOPMENT with MITIGATION	Site			
Catchment Designation	Grass/Open Space	Paved	New Roof	TOTALS
Area (m^2)	147	140	293	580
Pervious Area (m^2)	147	0	0	147
Impervious Area (m^2)	0	140	293	433
MOE Infiltration Factors				
Topography Infiltration Factor	0.30	0.30	0.30	
Soil Infiltration Factor	0.40	0.40	0.40	
Land Cover Infiltration Factor	0.10	0.10	0.10	
MOE Total Infiltration Factor	0.8	0	0	
Runoff Coefficient	0.2	1	1	
Runoff from Impervious Surfaces	0	0.8	0.8	
Inputs (per Unit Area)				
Precipitation (mm/yr)	940	940	940	940
TOTAL INPUTS (mm/yr)	940	940	940	940
Outputs (per Unit Area)				
Precipitation Surplus (mm/yr)	415	752	752	
Evapotranspiration (mm/yr)	525	188	188	
Infiltration (mm/yr)	332	0	0	
Impervious Infiltration (mm/yr)	0	714	714	
Total Infiltration (mm/yr)	332	714	714	
Runoff Pervious Areas (mm/yr)	83	0	752	
Runoff Impervious Areas (mm/yr)	0	752	0	
Total Runoff (mm/yr)	83	752	752	
TOTAL OUTPUTS (mm/yr)	940	940	940	
Difference (INPUTS-OUTPUTS)	0	0	0	
Inputs (Volumes)				
Precipitation (m^3/yr)	138	132	275	545
TOTAL INPUTS (m^3/yr)	138	132	275	545
Outputs (Volumes)				
Precipitation Surplus (m^3/yr)	61	105	220	387
Evapotranspiration (m^3/yr)	77	26	55	159
Infiltration (m^3/yr)	49	0	0	49
Impervious Infiltration (m^3/yr)	0	100	209	309
Total Infiltration (m^3/yr)	49	100	209	358
Runoff Pervious Areas (m^3/yr)	12	0	0	12
Runoff Impervious Areas (m^3/yr)	0	105	0	105
Total Runoff (m^3/yr)	12	105	0	117
TOTAL OUTPUTS (m^3/yr)	138	132	275	545
Difference (INPUTS-OUTPUTS)	0	0	0	0

Appendix B

Figures & Drawings