STORMWATER MANAGEMENT PLAN

THE VILLAGE OF EAST FONTHILL

TOWN OF PELHAM

Prepared for:

The Allen Group 4211 Yonge Street, Suite 230 Toronto, ON M2P 2A9

And

The Corporation of the Town of Pelham 20 Pelham Town Square Fonthill ON LOS 1E0

Prepared by:

Upper Canada Consultants 261 Martindale Road, Unit 1 St. Catharines, Ontario L2W 1A1

June 2015

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References

- 1. Stormwater Management Planning and Design Manual Ontario Ministry of the Environment (March 2003)
- Environmental Planning Report for the East Fonthill Secondary Plan Area LCA Environmental Consulting Upper Canada Consultants Trow Associates Inc.(November 2011)
- 3. Stormwater Management Guidelines Niagara Peninsula Conservation Authority AECOM (March 2010)
- 4. Town of Pelham Official Plan (1974)/ Consolidated version- November 2003
- 5. Geotechnical Investigation & Hydrogeological Evaluation, Proposed Development Site, Merrit Road and Regional Road #20, West of Rice Road, Pelham, Ontario Trow Associates Inc. (2007)
- 6. Part 654 Stream Restoration Design National Engineering Handbook Chapter 11- Rosgen Geomorphic Channel Design United States Department of Agriculture (August 2007)

STORMWATER MANAGEMENT PLAN

THE VILLAGE OF EAST FONTHILL

TOWN OF PELHAM

1.0 INTRODUCTION

1.1 Study Area

This stormwater management report addresses the northern development portion of the East Fonthill Secondary Plan Area within the Town of Pelham. The study area encompasses two major development lands, being developed through two Draft Plan of Subdivision applications to the Town of Pelham.

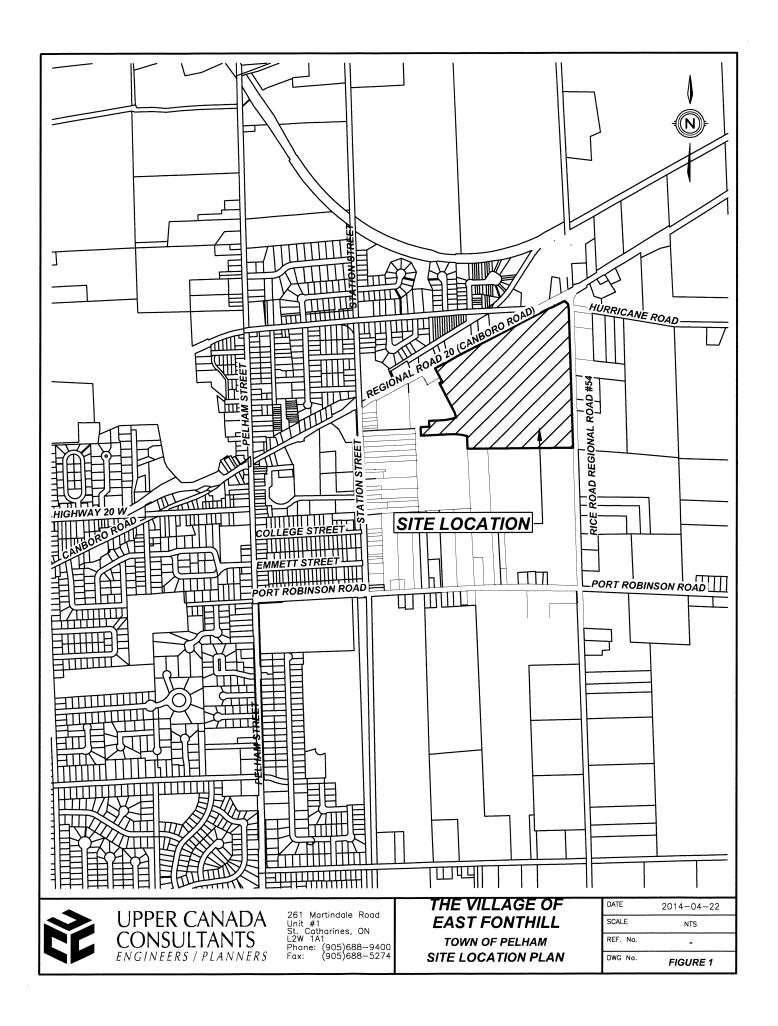
This stormwater management report has been prepared in support of the Draft Plan of Subdivision application for *The Village of East Fonthill*.

These projects are; lands under development by River Realty along Rice Road and known within this report as "Rice Road Development" and the lands previously known as the "Allen Property/Town Lands" identified as the "The Village of East Fonthill".

As shown in the Site Location Plan (Figure 1), the study area is located directly west of Rice Road, north of Port Robinson Road, east of Station Street, and generally south of Regional Road 20.

For the purpose of this stormwater management plan, the study area includes the proposed developments, existing residential/commercial lands to the west, the existing Regional Road 20 and 54 to the North and the proposed reconstruction of Port Robinson Road to the south. The development of the adjacent River Realty lands are identified as part of the "Ultimate" Stormwater conditions.

The stormwater outlets for the study area are both Twelve Mile Creek (Lake Ontario) and the Singer's Drain. This area has been previously addressed for overall stormwater management as part of the East Fonthill Secondary Plan process (Upper Canada Consultants, 2011). Existing conditions and recommendations are obtained from that report and are generally followed herein; and have been previously identified as outlets A & B.



1.2 Objectives

The objectives of this study are as follows:

- Establish criteria for the management of stormwater from this site.
- Determine the impact of development on the peak flow of stormwater from this site.
- Investigate alternatives for controlling the quality of stormwater from this site.
- Confirm the extent of lands necessary for stormwater management as identified in the approved Draft Plan of Subdivision.

1.3 Existing and Future Conditions

Existing Conditions

The proposed *The Village of East Fonthill* residential development is located in the East Fonthill area of the Town of Pelham. The site is located directly west of Rice Road (Regional Road 54), north of Port Robinson Road and *The River Realty* development lands, east of Station Street, and south of Regional Road 20.

The study area covers approximately 74.7 hectares of existing active agricultural land, with an impervious level of approximately 5.6%. This subcatchment includes *The Village of East Fonthill* and the adjacent *Rice Road (River Realty)* development site as well as adjacent future development lands to the west. External lands (Area '102') include a higher concentration of existing single family residences, as well as commercial lands located along Regional Road 20, and have a corresponding imperviousness of 49.3%.

The existing topography of the study area is undulating, with slopes ranging from 2.5 to 16.5%, and a general west to east tendency. A break point located midway through the development site delineates flows between the north Twelve Mile Creek watershed (Outlet A) and the east Singers Drain watershed (Outlet B).

Soils within the study area are characterized by the Geotechnical Investigation & Hydrogeological Evaluation as being of moderate to low imperviousness, as "the site is underlain mostly by clayey silt" (Trow, 2007). An SCS curve number of 74 was assumed to be representative of the soil conditions present within the study area, based upon land usage and soil characteristics.

Future Conditions

External lands within the drainage shed are based upon the respective Draft Plan of Subdivision applications of the adjacent land owners (where available), or the Secondary Plan. These generally follow the watershed boundary established for the post-development future storm drainage conditions.

The proposed *The Village of East Fonthill* development site will consist of approximately 18.75 hectares of development area, a channel block and two stormwater management facility blocks. The proposed stormwater management blocks will convey stormwater flows to the respective stormwater outlets, Outlets A and B.

Drainage areas to the stormwater management facilities (SWMF) will include flows from the development site, Regional Road 20 and future development lands to the west.

Stormwater flows from the existing Regional Road 20 redevelopment are required to be contained within the Outlet 'A' stormwater management facility located at the northern limit of the site. External flows from adjacent lands to the west of Station Street shall continue to outlet through the study area, and are to be channelized to a watercourse block running through the development site generally within the proposed alignment.

Stormwater within this watercourse will combine with flows from the Outlet 'B1' stormwater management facility and the future 'B2' stormwater management facility associated with the adjacent River Realty (Rice Road) development project, and flow south-east to Singer's Drain (Outlet B as identified in the Secondary Plan Document).

Flows from part of the existing lands west of the development site and south of Regional Road 20 shall be diverted along Station Street south to the drainage channel and ultimately to Outlet D. As required by the Secondary Plan Document, this flow diversion shall reduce the overall flows required to be conveyed internally to Outlet B. A corresponding level of overcontrol will be required within the watershed confluencing to Singer's Drain in order that the post-development peak flow remain consistent with the pre-development flows.

Lands internal to the study area are to be serviced with a conventional stormwater management system, including both a minor and major system. The stormwater system shall include concrete curb and gutter, asphalt pavement, grassed swales, concrete catch basins, and storm sewers. Major stormwater flows, beyond the design capacity of the storm sewers, shall be conveyed overland within the paved portion of the road, and convey stormwater flows to the stormwater outlet. The realigned and constructed drainage channels shall be designed to accommodate major flows to the stormwater outlet.

2.0 STORMWATER MANAGEMENT CRITERIA

All new developments within the province of Ontario are required to provide stormwater management according to provincial and municipal policies including:

- Stormwater Quality Guidelines for New Development (MOEE/MNR, May 1991).
- Stormwater Management Planning and Design Manual (MOE, March 2003)

Based on the comments and outstanding policies from the various agencies (Town of Pelham, Region of Niagara, Niagara Peninsula Conservation Authority (NPCA), and the Ministry of Environment (MOE), and others) the following site specific considerations were identified within the Fonthill East Secondary Plan report and have been confirmed herein:

- The northern (Outlet A) receiving waters (Twelve Mile Creek) are considered Type 1 (Critical) fish habitat. Based on this fish habitat and corresponding NPCA criteria, the MOE level of protection for new developments within this watershed shall be Enhanced (Level 1).
- The northern (Outlet A) receiving waters (Twelve Mile Creek) are considered a Cold Water Fishery. Based on this fish habitat, stormwater thermal mitigation measures are required to minimize the increase in temperature associated with any stormwater management controls.
- The Municipal Class Environmental Assessment (EA) and associated Part II Order for Regional Road 20 requires that flows from the previously reconstructed road be provided with stormwater quantity controls within the adjacent stormwater management facility. Stormwater quality controls for Regional Road 20 are provided by existing oil/grit separators and based on this stormwater quality protection is not required for these flows.
- The eastern outlets (Outlet B-C) receiving waters (Singers Drain) are considered Type 2 (Important) fish habitat. Based on this fish habitat and corresponding NPCA criteria, the MOE level of protection for new developments within this watershed shall be Normal (Level 2).
- The downstream outlets (Singer's Drain and Twelve Mile Creek) contain natural elements and, therefore, downstream erosion controls are considered necessary in compliance with the 25mm MOE erosion guidelines.
- The downstream outlets (Singer's Drain and Twelve Mile Creek) contain lands that would be negatively impacted by increased flooding levels, and, therefore, stormwater quantity control is considered necessary to maintain the downstream peak water elevations.

Based on the above policies and site specific considerations, the following stormwater management criteria have been established for this site:

- Stormwater quality controls are to be provided for the internal storm system conveying stormwater flows to Twenty Mile Creek to provide Enhanced (Level 1) Protection according to MOE guidelines.
- Stormwater quality controls are to be provided for the internal storm system conveying stormwater flows to Singer's Drain to provide Normal (Level 2) Protection according to MOE guidelines.
- Stormwater thermal improvements are to be provided for stormwater flows to Twelve Mile Creek.
- Stormwater erosion controls are to be provided to detain and release the 25mm storm event volume for a minimum of 24 hours.
- Quantity controls are to be provided for the outlet to limit the future post-development peak flows from the 25mm, 5 and 100 year storm events to pre-development peak flow levels.

3.0 STORMWATER ANALYSIS

Stormwater for the existing and proposed conditions was estimated using the MIDUSS computer modelling program. This program was selected because it is applicable to both urban and rural drainage areas like the study area. It is relatively easy to use and modify for the future drainage conditions and control facilities. It readily allows for design storm hyetographs for the various return periods being investigated.

A hydrologic modelling schematic for existing and future conditions are shown below in Figure 3.

MIDUSS output files for existing and future conditions can be found in Appendices B-D.

3.1 Design Storms

Design storm hyetographs for the storm system design uses a Chicago distribution based on the City of Welland Intensity-Duration-Frequency (IDF) curves that are used within the Town of Pelham. Hyetographs for the 25mm, 5 and 100 year events were developed using a 4-hour Chicago distribution.

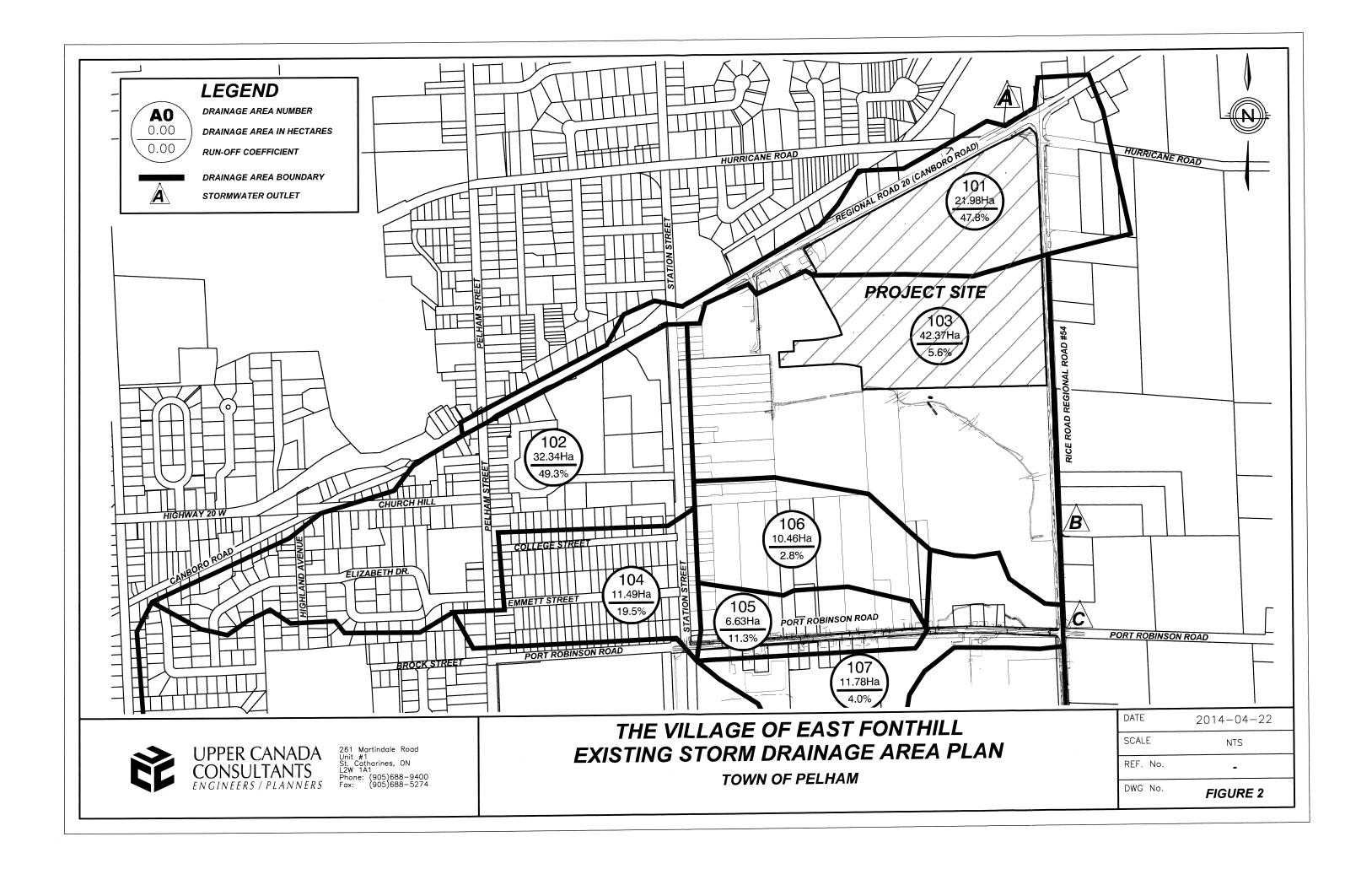
Table 1 summarizes the rainfall data applied in the stormwater modelling. The 4-hour storm event was used due to the large drainage areas and extended flow lengths.

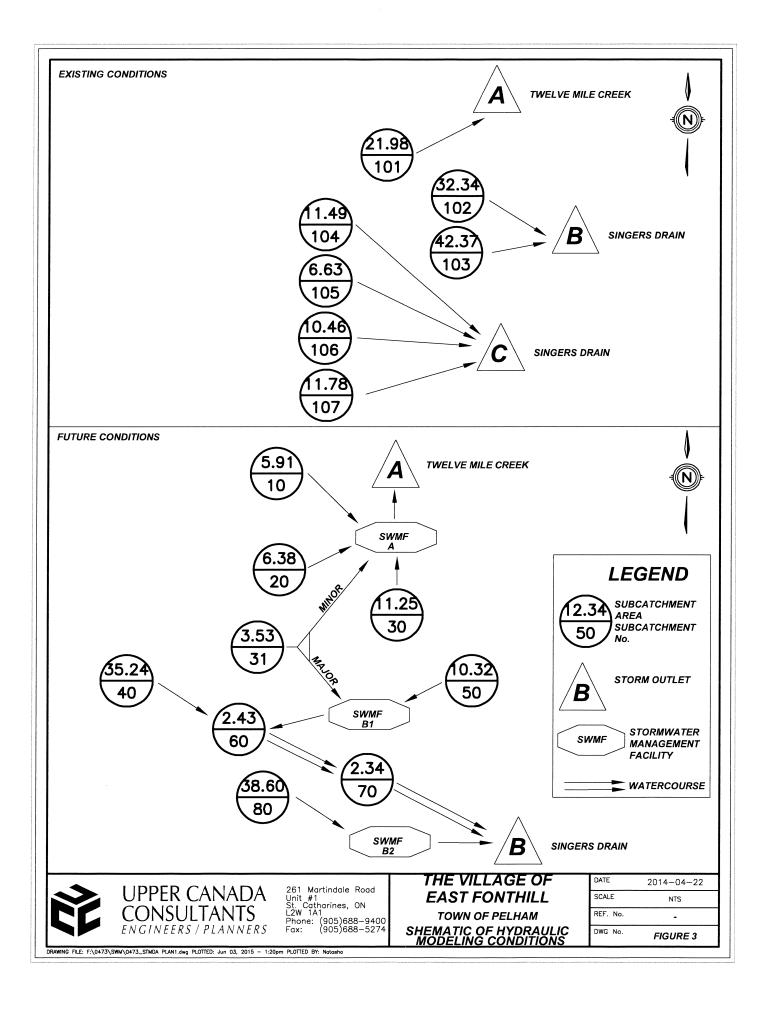
Table 1. Rainfall Data							
Design Storm	Chicago I	Distribution	Parameters	Duration			
(Return Period)	a	b	c	(minutes)			
25mm	500.00	8.100	0.810	240			
5- Year	5- Year 830.00 7.300 0.777 240						
100- Year 1,020.00 4.700 0.731 240							
	Intensity ($\left(\frac{mm}{hr}\right) = \frac{1}{(t_0)^n}$	a ; + b) ^c				

3.2 Existing Conditions

The study area, existing subcatchment areas, and existing storm outlets are shown below in Figure 2. Input parameters for the computer modeling of existing conditions are shown in Table 2. Detailed computational inputs for existing conditions are attached in Appendix B.

Table 2. Hydrologic Parameters for Existing Conditions								
Area No.	Area	Length	Slope	Man	ning 'n'	Soil	SCS	Percent
Area No.	(ha)	(m)	(%)	Perv	Imperv	type	CN	Impervious
101	21.98	385	3.33	0.25	0.015	C	74	47.8%
102	32.34	465	16.46	0.25	0.015	C	74	49.3%
103	42.37	530	2.45	0.25	0.015	C	74	5.6%
104	11.49	275	4.43	0.25	0.015	C	74	19.5%
105	6.63	210	2.63	0.25	0.015	C	74	11.3%
106	10.46	265	2.00	0.25	0.015	C	74	2.8%
107	11.78	280	2.78	0.25	0.015	C	74	4.0%
Total area	137.05							





3.3 Future Conditions

The post-development future storm drainage conditions are shown in Figure . It is proposed to control the post-development stormwater flows to both Outlet A and B to pre-development levels with two (2) stormwater management facilities within the subject lands of *The Village of East Fonthill*.

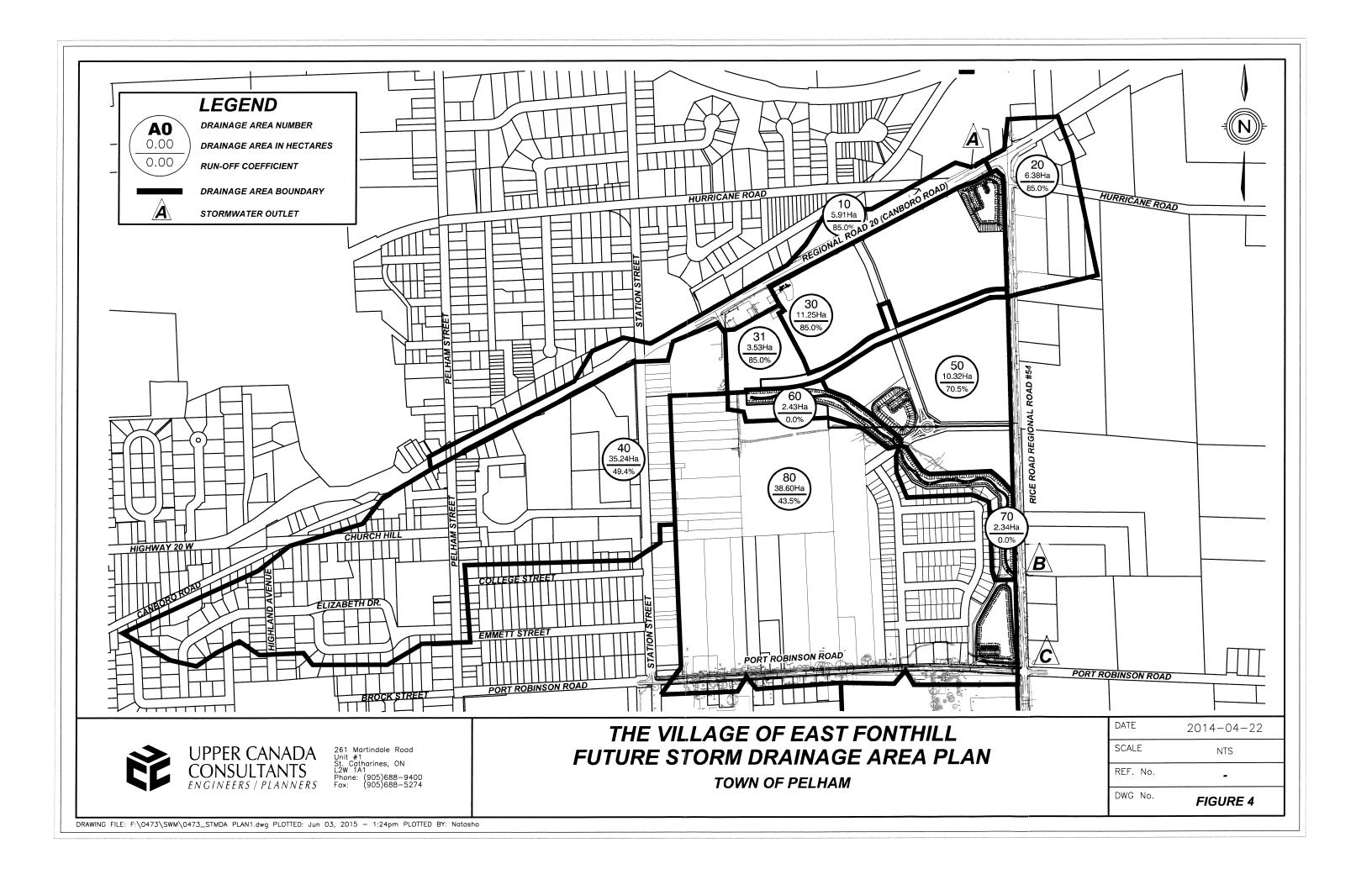
A proposed future external stormwater management facility is included within the modelling and is located downstream of the site, and conveys adjacent development flows from the *River Realty (Rice Road)* lands to the realigned naturalized channel prior to stormwater flows exiting the *Fonthill East Secondary Plan* area and Outlet B.

Sizing for this facility is based upon the sizing found within the Fonthill East Secondary Plan and has been refined in concert with that development proposal in preparation for their submission for Draft Plan of Subdivision Approvals.

Imperviousness for each subcatchment was determined based on the proposed land use and external land future area use computational parameters obtained from the Environmental Planning Report for the East Fonthill Secondary Plan Area. Subcatchment Area '31' (Street 'C') shall have the minor system (sewers) convey stormwater flows to the north SWM Facility (Outlet 'A'); while major flows shall be directed south to the south SWM Facility and Outlet 'B'.

Input parameters for the computer modeling of future conditions are shown below in Table 3. Detailed computational inputs are attached in Appendix C for future conditions without SWM, and Appendix D for future conditions with SWM.

Table 3. Hydrologic Parameters for Future Conditions								
Area No.	Area	Length	Slope	Man	ning 'n'	Soil	SCS	Percent
Area No.	(ha)	(m)	(%)	Perv	Imperv	type	CN	Impervious
10	5.91	200	2.0	0.25	0.015	C	74	85.0%
20	6.38	205	2.0	0.25	0.015	C	74	85.0%
30	11.25	260	2.0	0.25	0.015	C	74	85.0%
31	3.53	155	2.0	0.25	0.015	C	74	85.0%
40	35.24	485	15.48	0.25	0.015	C	74	49.4%
50	10.32	260	2.0	0.25	0.015	С	74	70.5%
60	2.43	125	2.0	0.25	0.015	С	74	0%
70	2.34	120	2.0	0.25	0.015	С	74	0%
80	38.60	510	2.0	0.25	0.015	С	74	43.5%
Total area (ha)	116.0116		750000 VIII		entralistic en entralis	· · · · · · · · · · · · · · · · · · ·	gran , spaten	and the state of t



4.0 STORMWATER MANAGEMENT ALTERNATIVES

4.1 Screening of Stormwater Management Alternatives

A variety of stormwater management alternatives are available to control the quantity and quality of stormwater runoff. Most of these are described in the Stormwater Management Planning and Design Manual (MOE, March 2003). Alternatives for this site were considered in the following broad categories: lot level, vegetative, infiltration, and surface storage controls. General comments on each category are provided below. Individual alternatives for the proposed development are listed in Table 4 with comments on their effectiveness and applicability to this site.

a. Lot Level Controls

Lot level controls are not usually suitable as the primary control facility for quality control. They are generally used to enhance stormwater quality levels in conjunction with other types of control facilities

b. <u>Vegetative Alternatives</u>

Vegetative stormwater management practices are generally not suitable as the primary control facility for quantity or quality controls. They are generally used to reduce the rate of runoff and to enhance stormwater quality in conjunction with other types of control facilities.

c. Infiltration Alternatives

Where soils are suitable, infiltration alternatives can be very effective in providing both quality and quantity controls. However, infiltration rates generally limit the use of these techniques. Soils on this site are predominantly clay with infiltration rates of less than 12 mm/hr. Infiltration alternatives may provide some quality benefits. Due to the low infiltration rates and large development site, infiltration alternatives are not considered feasible as primary control facilities for this site.

d. Surface Storage

Surface storage techniques can be very effective in providing both quality and quantity control. Wetlands are generally the most efficient for water quality control, however require more maintenance than a wet pond and are more subject to negative public perception. Both the onsite and additional offsite lands will generate sufficient stormwater to maintain a permanent pool. Therefore, two wet ponds are recommended as stormwater management facilities to provide quality protection for the two stormwater Outlets A and B.

e. Thermal Controls

Surface storage techniques can be very effective in providing both quality and quantity controls, however solar radiation results in increased water temperatures that can have negative impacts upon the downstream habitat, specifically the Cold Water Fishery designation of Twelve Mile Creek. Vegetative cover can mitigate some of these effects, and proper landscape design including shade trees is important. More aggressive measure includes directing low flow through underground clear stone filter beds to cool the outflow water through thermal transfer.

4.2 Selection of Stormwater Management Alternatives

The stormwater management alternatives recommended within the Secondary Plan document were screened based on technical effectiveness, physical suitability for this site, and their ability to meet the stormwater management criteria established for the proposed future development areas. The following stormwater management alternatives are recommended for implementation on the proposed development:

- a) Lot grading to be kept as flat as practical in order to slow down runoff and encourage infiltration.
- b) Roof water leaders to be discharged to the ground surface in order to slow down runoff and encourage infiltration.
- c) **Grassed swales** to be used to collect and convey rear lot drainage. These tend to filter sediments, and slow down the rate of runoff.
- d) That a stormwater management **wet pond** facility be constructed to provide an Enhanced level of stormwater quality protection for frequent storms and provide quantity control to **Outlet A** Twelve Mile Creek.
- e) That an **underground thermal contact bed** be constructed to accommodate the 10mm storm event for stormwater flows conveyed to **Outlet A** Twelve Mile Creek.
- f) That a stormwater management **wet pond** facility be constructed to provide a Normal level of stormwater quality protection for frequent storms and provide quantity control to **Outlet B** Singer's Drain.

		Ta	Table 4. Evaluation of Stormwater Management Practices	f Stormwater Man	agement I	ractices		
The Village of	Cr	iteria for Implementati	Criteria for Implementation of Stormwater Management Practices (SWMP)	ement Practices (SWMP)				
Fonthill East	Topography	Soils	Bedrock	Groundwater	Area	Technical	Recommend	
Site Conditions	Variable I to 2%	Clay <12mm/hr	At Considerable Depth	At Considerable Depth	±90.4ha	high)	Application Yes/No	Comments
Lot Level Controls	S							
Lot Grading	<5%	nlc	nlc	nlc	nlc	2	Yes	Quality/quantity benefits
Roof Leaders to Surface	nlc	nlc	nlc	nlc	nlc	2	Yes	Quality/quantity benefits
Roof Ldrs.to Soakaway Pits	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 0.5 ha	9	No	Unsuitable site soil conditions
Sump Pump Fdtn. Drains	nlc	nlc	nlc	nlc	nlc	2	No	Unsuitable site soil conditions
Vegetative								
Grassed Swales	< 5 %	nlc	nlc	nlc	nlc	7	Yes	Quality/quantity benefits
Filter Strips(Veg. Buffer)	< 10 %	nlc	nlc	>.5m Below Bottom	<2 ha	5	No	Unsuitable site conditions
Infiltration								
Infiltration Basins	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 5 ha	2	No	Unsuitable site soil conditions
Infiltration Trench	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	<2 ha	4	No	Unsuitable site soil conditions
Rear Yard Infiltration	< 2.0 %	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 0.5 ha	7	No	Unsuitable site soil conditions
Perforated Pipes	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	nlc	4	No	Unsuitable site soil conditions
Pervious Catch basins	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	nlc	3	No	Unsuitable site soil conditions
Sand Filters	nlc	nlc	nlc	>.5m Below Bottom	< 5 ha	5	No	High maintenance/poor aesthetics
Surface Storage								
Dry Ponds	nlc	nlc	nlc	nlc	> 5 ha	10	No	Less effective than wet facilities
Wet Ponds	nlc	nlc	nlc	nlc	> 5 ha	10	Yes	Greater volume of storage required
Wet Lands	nlc	nlc	nlc	nlc	> 5 ha	6	No	Very effective quality control
Other								
Oil/Grit Separator	nlc	nlc	nlc	nlc	< 2.7 ha**	3	No	Limited benefit/area too large
		Refe	Reference: Stormwater Management Practices Planning and Design Manual - 1994 NIc - No Limiting Criteria ** As per Stormceptor Technical Manual	ter Management Practices Planning and D NIc - No Limiting Criteria ** As per Stormceptor Technical Manual	and Design M	anual - 1994		
				4				

5.0 STORMWATER MANAGEMENT PLAN

A MIDUSS model was created to assess existing and future development peak flows and stormwater volumes generated by the proposed subdivision. The stormwater management facility was sized according to MOE Guidelines (MOE, March 2003) as follows:

5.1 North Stormwater Management Pond

This facility is located within the *The Village of East Fonthill* development site. Detailed plans showing the proposed grading, servicing and landscaping information are enclosed in Appendix G. This pond was identified as Facility 701 within the Secondary Plan Document.

Water Quality

The ultimate stormwater drainage outlet for this facility is Twelve Mile Creek (Lake Ontario), where *Enhanced* protection is recommended in accordance with MOE requirements. Based on Table 3.2 of SWMP & Design Manual, the *Enhanced* water quality storage requirement for wet pond facilities in a development with an effective impervious area of 65% is approximately 213 m³/ha. The effective imperviousness is based upon a weighted calculation where quality controls for area 20 (6.38ha) is provided by the existing stormwater management system (Oil/grit separator) upstream of the north stormwater management pond and is proposed to remain in place post construction.

For this stormwater management facility, it will not be necessary to provide stormwater quality control for the portion of stormwater runoff generated by Rice Road and Regional Road 20 east of the facility. Quality control for these flows will be provided by an existing oil/grit separator (OGS) located adjacent to the proposed stormwater management facility. The existing Regional Road 20 OGS will be decommissioned and quality controls for Regional Road 20 west of the facility will be provided by the proposed facility.

Quality volume calculations have been provided for the 27.07 ha portion of the development site and Regional Road 20 which will discharge to this facility.

Table 5. North Pond Stormwater Quality Volume Calculations					
Total Water Quality Volume = 27.07ha x 213 m ³ /ha = 5,766 m ³	Reference: Table 3.2, SWMP & Design Manual, (MOE 2003)				
Permanent Pool Volume = 27.07ha x 173m ³ /ha = 4683 m ³	Active Pool Volume = 27.07ha x 40m ³ /ha = 1,083 m ³				

Thermal Controls

To provide a measure of thermal mitigation, it is proposed to use an underground contact chamber comprising a volume of clear stone wrapped in filter cloth which to provide heat transfer from the earth. Based on the US Geological Service the Mean Earth Temperature for this latitude is approximately 9.5 degrees-C. Twin 150mm diameter perforated pipe are to be laid within the chamber with a 5.0m separation. Stormwater flows from the 10mm storm event are conveyed through these pipes and directed to the outlet.

The 10mm storm event produces approximately 1,307 m³ of stormwater, which based on the average outflow flow rate of 21 L/s will have an average bed velocity of 0.81mm/s, and a contact time of 102.5 minutes, which will serve to mitigate the increase in temperature.

Calculations have been included in Appendix F.

Erosion Control

Using the MIDUSS hydrological model, the stormwater volume from the 25mm - 4 hour design storm event for the entire 27.07 hectares (development site and Regional Road 20) is 4,211 m³. Table 6 shows the stormwater storage volumes required using both the water quality and erosion control guidelines.

Table 6. North Pond Stormwater Quality Volume Requirements				
A. Permanent Pool Volume	$4,683 \text{ m}^3$			
B. Extended Detention Volume	$1,083 \text{ m}^3$			
C. Stormwater Volume from 25mm - 4 hour rainfall event 4,211 m				
D. Maximum Extended Detention Volume (greater of B & C)	$4,211 \text{ m}^3$			
Total Quality and Extended Detention Volume (A+D)	8,894 m ³			

A four stage outlet control structure for the pond is suggested. The first stage of control consists of an orifice to detain the 25mm storm event extended detention volume and release it slowly over an extended period of time, minimum 24 hours.

The second stage consists of a perforated pipe contact chamber to slowly release the 10mm storm event thermal volume of an extended period of time. The third stage of control is provided by a ditch inlet catch basin and outlet pipe which provides an outlet for flows exceeding the extended detention volume. The fourth stage of control is provided by an overflow spillway which provides an outlet for flows exceeding the capacity of the ditch inlet catch basin and outlet pipe. The proposed configuration is summarized below in Table 7.

Table 7. North Stormwater Management Pond Design Criteria					
Permanent pool depth	1.75 m				
Total depth of facility	5.25 m				
Facility side slopes (horizontal : vertical)	5:1				
Permanent pool volume	4,745 m ³				
Active storage volume	4,376 m ³				
Maximum storage volume	23,897 m ³				
Quality control orifice diameter	225mm				
Outlet weir length	1.2 m				
Outlet weir elevation above permanent pool	0.83 m				
Outflow pipe orifice plate diameter	0.675 m				
Emergency overflow spillway width	20.0 m				
Emergency overflow spillway elevation	189.58				

A sediment forebay was included in this stormwater management facility to minimize the transport of heavy sediment from the storm sewer outlet throughout the facility, and to localize maintenance activities. Calculations for the forebay sizing follow MOE Guidelines and are shown below in Table 8.

Table 8. North Pond Forebay Sizing						
a) Forebay Settling Length (MOE SWMP&D, Equation 4.5)						
r * 0	r=	10.0	(Length: width ratio)			
Settling length = $\sqrt{\frac{r * Q_p}{V_s}}$	Qp=	0.05	(25mm storm pond discharge) - m ³ /s			
	$V_{S}=$	0.00035	(Settling velocity) – m/s			
	Settling Lea	ngth= 37.80 r	n			
b) Dispersion Length (MOE SWMP & D, Equation 4.6)						
	Q=	3.815	5-yr storm sewer design inflow (m ³ /s)			
Dispersion length = $\frac{8 * Q}{D * V_e}$	D=	1.50m	Depth of forebay			
Dispersion length $=\frac{1}{D*V_f}$	Vf=	0.55 m/s	Desired velocity			
	Dispersion Ler	ngth= 37.0 m	1			
c) Minimum Forebay Deep 7	Zone Bottom Width (MO	E SWMP &	D, Equation 4.7)			
$Width = \frac{Dispersion length}{L: W}$	Minimum Forebay Length from Equations 3.3 and 3.4	37.1 m	(Minimum required length)			
	Width=	3.71 m	Minimum required width			
d) Average Velocity of Flow		-				
	Q=	1.836	Quality design inflow (m ³ /s)			
	A=	12.00	(Cross sectional area) - m ²			
Average Velocity = $\frac{Q}{A}$	D=	1.50 m	(Depth of forebay)			
Average velocity $=\frac{1}{A}$	W=	4.00 m	(Proposed bottom width)			
	S=	3:1	(Side slopes- minimum)			
	Average Velocity =	0.15	m/s			
	Is this Acceptable?	Yes	Maximum velocity of flow= 0.15m/s)			
e) Cleanout Frequency		estation and the second				
		40.0 m	(Proposed bottom length)			
	ASL=	3.8	(Annual sediment loading) - m ³ /ha			
	A=	20.69	(Drainage area) – ha			
	FRC=	80%	(Facility removal efficiency)			
	FV=	792	(Forebay volume) - m ³			
	Cleanout Frequency=	12.59	(Minimum 10 Years)			
	Is this Acceptable?	Yes				

Based on the MIDUSS model, Table 9 shows the maximum wet pond depth of 1.58 m, and an active storage volume of 9,171 m3 for the 100 year design storm event.

Table 9. Proposed North Pond Characteristics							
Design Storm	Peak F	lows (m ³ /s)	Maximum	Maximum			
(Return Period)	(Return Period) Inflow Outflow		Depth (m)	Volume (m ³)			
25mm	1.836	0.079	0.67	3,412			
5- Year	3.815	0.602	1.1	6,053			
100- Year	5.644	1.089	1.58	9,171			

5.2 South Stormwater Management Pond

This facility is located within The Village of East Fonthill development site at the southern limit, and east of the drainage channel. Detailed plans showing the proposed grading, servicing and landscaping information are enclosed in Appendix G. This pond was identified as Facility 706 within the Secondary Plan Document.

Water Quality

The ultimate stormwater drainage outlet for the study area is Singers Drain, where *Normal* protection is recommended in accordance with MOE requirements. Based on Table 3.2 of SWMP & Design Manual, the *Normal* water quality storage requirement for wet pond facilities in a development with 85% impervious area is approximately 150 m³/ha. The total drainage area of approximately 10.32 hectares was used to determine the quality control sizing requirements.

Table 10. South Pond Stormwater Quality Volume Calculations				
Total Water Quality Volume = 10.32ha x 150 m ³ /ha = 1,548m ³	Reference: Table 3.2, SWMP & Design Manual, (MOE 2003)			
Permanent Pool Volume = 10.32ha x 110m ³ /ha = 1,135 m ³	Active Pool Volume = 10.32ha x 40m ³ /ha = 413 m ³			

Erosion Control

Using the MIDUSS hydrological model, the stormwater volume from the 25mm - 4 hour design storm event for 10.32 hectares is 1,623 m³. Table 11 shows the stormwater storage volumes required using both the water quality and erosion control guidelines.

Table 11. South Pond Stormwater Quality Volume Require	ments
A. Permanent Pool Volume	1,135
B. Extended Detention Volume	413
C. Stormwater Volume from 25mm - 6 hour rainfall event	1,623
D. Maximum Extended Detention Volume (greater of B & C)	1,623
Total Quality and Extended Detention Volume (A+D)	2,758

Quantity Control

A three stage outlet control structure for the pond is suggested. The first stage of control consists of an orifice to detain the extended detention volume and release it slowly over an extended period of time. The second stage of control is provided by a ditch inlet catch basin and outlet pipe which provides an outlet for flows exceeding the extended detention volume. The third stage of control is provided by an overflow spillway which provides an outlet for flows exceeding the capacity of the ditch inlet catch basin and outlet pipe. The proposed configuration is summarized below in Table 12.

Table 12. South Stormwater Management Pond Design C	riteria
Permanent pool depth	1.0 m
Total depth of facility	3.5m
Facility side slopes (horizontal : vertical)	5:1
Permanent pool volume	1,789 m ³
Active storage volume	$2,027 \text{ m}^3$
Maximum storage volume	$8,534 \text{ m}^3$
Quality control orifice diameter	127 mm
Outlet weir length	600 mm
Outlet weir elevation above permanent pool	0.78 m
Outflow pipe orifice plate diameter	450 mm
Emergency overflow spillway width	2.44 m
Emergency overflow spillway elevation above permanent pool	1.2 m

A sediment forebay was included in this stormwater management facility to minimize the transport of heavy sediment from the storm sewer outlet throughout the facility, and to localize maintenance activities. Calculations for the forebay sizing follow MOE Guidelines and are shown below in Table 13.

	Table 13. South Por	nd Forebay S	Sizing
a) Forebay Settling Length (MOE SWMP&D, Equat	ion 4.5)	
$r * 0_n$	r=	5.9	(Length: width ratio)
Settling length = $\sqrt{\frac{r * Q_p}{V_s}}$	Qp=	0.02	(25mm storm pond discharge) - m ³ /s
V 3	$V_{S}=$	0.00035	(Settling velocity) – m/s
	Settling Lea	ngth= 18.36n	n
b) Dispersion Length (MOE	SWMP & D, Equation 4	.6)	
	Q=	1.480	5-yr storm sewer design inflow (m ³ /s)
Dianagaian langth — 8 * Q	D=	1.50m	Depth of forebay
Dispersion length = $\frac{8 * Q}{D * V_f}$	Vf=	0.55 m/s	Desired velocity
	Dispersion Ler	ngth= 14.4 m	
c) Minimum Forebay Deep 2	Zone Bottom Width (MO	E SWMP &	D, Equation 4.7)
Width = $\frac{\text{Dispersion length}}{\text{L: W}}$	Minimum Forebay Length from Equations 3.3 and 3.4	18.36 m	(Minimum required length)
	Width=	1.85 m	Minimum required width
d) Average Velocity of Flow			
	Q=	0.703	Quality design inflow (m ³ /s)
	A=	12.75	(Cross sectional area) - m ²
Average Velocity = $\frac{Q}{A}$	D=	1.50 m	(Depth of forebay)
Average velocity $=\frac{-}{A}$	W =	4.50 m	(Proposed bottom width)
	S=	3:1	(Side slopes- minimum)
	Average Velocity =	0.06	m/s
	Is this Acceptable?	Yes	Maximum velocity of flow= 0.15m/s)
e) Cleanout Frequency			
	L=	26.5 m	(Proposed bottom length)
	ASL=	3.8	(Annual sediment loading) - m ³ /ha
	A=	10.32	(Drainage area) – ha
	FRC=	70%	(Facility removal efficiency)
	FV=	583.31	(Forebay volume) - m ³
	Cleanout Frequency=	21.2	(Minimum 10 Years)
	Is this Acceptable?	Yes	

Based on the MIDUSS model, Table 13 shows the maximum wet pond depth of 1.31m and an active storage volume of 3,734 m³ for the 100 year design storm event.

Table	13. Propo	sed South I	ond Characteri	stics
Design Storm	Peak F	lows (m ³ /s)	Maximum	Maximum
(Return Period)	Inflow	Outflow	depth (m)	Volume (m ³)
25mm	0.703	0.023	0.54	1,365
5 Year	1.480	0.187	0.94	2,520
100 Year	2.455	0.460	1.31	3,734

5.3 Impact of Stormwater Management Ponds on Outlet

The proposed stormwater management methods were assessed by the MIDUSS modeling program. The results are summarized below in Table 14 for each of the design storms

Future post- development peak flows can be controlled to pre- development peak flows for all storm events up to and including the 100- year event using the stormwater management techniques described herein.

	Table 14	4. Peak Flow Valu	es	
Design Storm		Peak Flo	$w (m^3/s)$	
(Return Period)		Future without	Future with	Channe
	Existing	SWMP	SWMP	Change
OU	TLET A (TWELVE MILE C	CREEK)	-
25mm Storm	0.831	1.836	0.079	-90.49%
5 Year Storm	1.796	3.815	0.602	-66.48%
100 Year Storm	2.875	5.644	1.089	-62.12%
	OUTLET I	B (SINGER'S DR.	4 <i>IN</i>)	
25mm Storm	1.455	1.612	1.172	-19.45%
5 Year Storm	3.051	3.943	2.487	-18.49%
100 Year Storm	4.969	6.869	4.713	-5.15%

5.4 Stormwater Management Pond Facility Maintenance

Maintenance is a necessary and important aspect of urban stormwater quality and quantity measures such as wet ponds. Many pollutants (ie. nutrients, metals, bacteria, etc.) bind to sediment and therefore removal of sediment on a scheduled basis is required.

The stormwater management facilities for this development may be subjected to infrequent wetting and deposition of sediments as a result of infrequent high intensity storm events. The purpose of these facilities is to reduce suspended solids loading on the receiving waterways and minimize potential downstream erosion. For the initial operation period of the stormwater management facilities, the required frequency of maintenance is not definitively known and many of the maintenance tasks will be performed on an 'as required' basis. For example, during the home construction phase of the development there will be a greater potential for increased maintenance frequency, which depends on the effectiveness of sediment and erosion control techniques employed.

Inspections of the facilities will indicate whether or not maintenance is required. Inspections should be made after every significant storm during the first two years of operation or until all development is completed to ensure the facility is functioning properly. This may translate into an average of six inspections per year. Once all building activity is finalized, inspections will be performed annually

The following points should be addressed during inspections of the facilities:

- a. Standing water above the outlet structure bottom a few days or more after a storm may indicate a blockage in the outlet or orifice. The blockage may be caused by trash or sediment and a visual inspection would be required to determine the cause.
- b. The vegetation around the pond should be inspected to ensure its function and aesthetics. Visual inspections will indicate whether replacement of plantings is required. A decline in vegetation habitat may indicate that other aspects of the facility are operating improperly, such as the detention times may be inadequate or excessive.
- c. The accumulation of sediment and debris at the inlet or around the high water line of the facility should be inspected. This will indicate the need for sediment removal or debris clean up.
- d. The facility has been created by excavating a detention volume. The integrity of the embankment should be periodically checked to ensure that it remains stable and the side slopes have not sloughed.

Grass cutting is a maintenance activity that is done solely for aesthetic purposes. It is recommended that grass cutting be limited to the upper embankment areas. It should be noted that municipal by-laws may require regular grass maintenance for weed control.

Trash removal is an integral part of maintenance and an annual cleanup, usually in the spring, is a minimum requirement. After this, trash removal is performed as required basis on observation of trash build-up during inspections.

To ensure long term effectiveness, the sediment that accumulates in the forebay area should be removed periodically. For sediment removal operations, typical grading/excavating equipment should be used to remove sediment from detention areas. Care should be taken to ensure that limited damage occurs to existing vegetation and habitat.

Generally, the sediment which is removed from the wet ponds will not be contaminated to the point that it would be classified as hazardous waste. However, the sediment should be tested to determine the disposal options. The MOE publishes sediment disposal guidelines which should be consulted for up-to-date information pertaining to the exact parameters and acceptable levels for the various disposal options.

6.0 CHANNEL DESIGN

As part of the development works, it is proposed to realign and deepen the existing channel. The design of this channel has been undertaken following Rosgen geomorphic channel design for the existing drainage corridor. It is proposed to construct a 29.0 m wide channel that shall consist of a northern and southern portion, and has been designed to accommodate stormwater flows from the development site and external areas for all storm events up to and including the 100 year storm event.

Proposed geometries for the northern portion of the channel are described below in Table 15.

Table 15. Natural Channel Design Parame Northern portion of Channel to Culv	1
Meander Slope	0.75%
Bottom Width (m)	1.50
Side Slope (H:V)	4.0
25mm Storm Event Depth of Flow (m)	0.207
2 Year Storm Event Depth of Flow (m)	0.260
100 Year Storm Event Depth of Flow (m)	0.432
Meander Ratio	1.1
Width/ Depth Ratio	13.8
Entrenchment Ratio	1.4

In order to comply with natural channel design, it will be necessary to develop four separate profiles for the southern portion of the channel. These geometries are detailed below in Table 16 to Table 19.

Table 16. Natural Channel Design Parame First Flat Portion of Southern Chan	
Meander Slope	0.19%
Bottom Width (m)	1.50
Side Slope (H:V)	4.0
25mm Storm Event Depth of Flow (m)	0.285
2 Year Storm Event Depth of Flow (m)	0.384
100 Year Storm Event Depth of Flow (m)	0.664
Meander Ratio	1.1
Width/ Depth Ratio	11.9
Entrenchment Ratio	1.5

Table 17. Natural Design Parameters for F Portion of Southern Channel	irst Steep
Meander Slope	0.79%
Bottom Width (m)	1.50
Side Slope (H:V)	3.0
25mm Storm Event Depth of Flow (m)	0.206
2 Year Storm Event Depth of Flow (m)	0.278
100 Year Storm Event Depth of Flow (m)	0.480
Meander Ratio	1.1
Width/ Depth Ratio	11.4
Entrenchment Ratio	1.4

Table 18. Natural Design Parameters for Flat Portion of Southern Channel	1
Meander Slope	0.19%
Bottom Width (m)	1.50
Side Slope (H:V)	3.0
25mm Storm Event Depth of Flow (m)	0.314
2 Year Storm Event Depth of Flow (m)	0.424
100 Year Storm Event Depth of Flow (m)	0.734
Meander Ratio	1.1
Width/ Depth Ratio	9.5
Entrenchment Ratio	1.5

Table 19. Natural Design Parameters for Steep Portion of Southern Channe	
Meander Slope	1.73%
Bottom Width (m)	1.50
Side Slope (H:V)	3.0
25mm Storm Event Depth of Flow (m)	0.162
2 Year Storm Event Depth of Flow (m)	0.219
100 Year Storm Event Depth of Flow (m)	0.378
Meander Ratio	1.1
Width/ Depth Ratio	122.9
Entrenchment Ratio	1.3

Detailed natural channel design calculations for the northern and southern portions of the drainage channel are enclosed in Appendix E.

7.0 100 YEAR STORM EVENT BACKWATER ELEVATION

It is proposed to direct stormwater flows from the realigned channel through an existing 1350 x 900mm arch culvert located north of Port Robinson Road running under Rice Road. During the 100 year storm event, the channel flow rate of $4.938 \mathrm{m}^3/\mathrm{s}$ will cause a headwater elevation of 190.54m. This will overtop the road and cause a flooding depth of 0.05m over Rice Road. This depth of flooding is not considered significant, and no additional modifications to the arch culvert will be required.

Stormwater flows at this culvert are less than the existing 100 year storm event flows and therefore the post development overtopping is less than that occurring during the predevelopment condition; and therefore consistent with the guidelines of the Region of Niagara.

Detailed calculations for backwater elevation have been attached in Appendix F.

8.0 SEDIMENT AND EROSION CONTROL

Sediment and erosion controls are required during all construction phases of this development to limit the transport of sediment into downstream watercourses. Proposed sediment and erosion controls will be provided during for the final design and will include:

- Silt control fencing to minimize the transport of sediment offsite from the construction process.
- Straw bale filters in accordance with MNR/MOE guidelines.
- Re-vegetate disturbed areas as soon as possible after grading works have been completed.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of this study, the following conclusions are offered:

- Infiltration techniques are not suitable for this site as the primary control facility due to the site size and soil conditions.
- Roof water leaders shall discharge to grade to enhance the future infiltration levels.
- Two wet pond facilities shall be constructed on this site to provide water quality controls.
- A thermal mitigation contact system shall be constructed to provide thermal controls.
- The existing channel be realigned according to Natural Channel Design principals.
- Various lot level and vegetative stormwater management practices can be implemented to enhance stormwater quality.
- This report was prepared in accordance with the provincial guidelines contained in "Stormwater Management Planning and Design Manual, March 2003".

The above conclusions lead to the following recommendations:

- That the stormwater management criteria established in this report be accepted.
- That two wet pond facilities shall be constructed to provide stormwater quality control.
- That a thermal mitigation contact system be constructed to provide thermal controls.
- That the existing channel be realigned according to Natural Channel Design principals.
- That additional lot level controls and vegetative stormwater management practices as described previously in this report be implemented.

That sediment and erosion controls during construction as described in this report be implemented. A.S. KEANE 1001000001

100109861

Respectfully submitted,

Adam Keane, P.Eng.

APPENDICES

APPENDIX A

Detailed Calculations for Stormwater Management Facilities

March Marc	261 Martin	261 Martindale Road, Unit 1,	ants ∫nit 1,									BY:	A. Keane		
	St. Cathar PROJECT	ines, Ontario	L2W 1A1	THE VILL	AGE OF EAS	ST FONTHII	LL (NORTH	POND), FO	NTHILL TO	IMN OF P	ELHAM	DATE:	Jun-15		
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Author A	Quality Re		0000	í	Quality Oril	fice	0	Ditch Inlet V	Veir		Outflow Pig	e Orifice		Overflow Spi	llway
Post (incitable) 200	Onty Drug	g. Area (ha) = r Area (ha) =	20.69	ä	iameter (m) = .	0.225	OPSD:	705.040 (IY	PE A)	Ω̈́	ımeter (m) =	0.675	Minor	Length $(m) = (C_{mag}(X_{i,1}) = (C_{mag}(X_{i,1}) = (C_{mag}(X_{i,1}) = C_{mag}(X_{i,1}) = C_{mag}(X_{i,1$	0.00
Prob Vol. (m.s) = 4.45 Prob P	Lvi 1 @ 8;	5% (m3/ha) =	250) = pO	0.63	Flow	Width (m) =	1.20		= pO	0.65	Maior S	lopes $(X:1) = 0$ lopes $(X:1) = 0$	3.00
Pool Pool Pool Pool Pool Pool Pool Poo	Perm Po	ool (m3/ha) =	210		Invert (m) =	186.55	Inlet	Depth (m) =	09.0		Invert (m) =	186.55	Minor	Invert (m) = 1	89.58
Activity 1,103 1,104 1	Perm Poo	ol Vol (m3) =	4,345				Grate S	Slope (X:1) =	4		Overt (m) =	187.23	Major	Length $(m) = 2$	20.00
Mode Equation 4, 1, 11 1470,000 1470,0	Ac	tive Vol (m3)	1,083				Inlet Ele	evation (m) =	187.38				Major	Invert (m) = 1	189.58
Paramire 1915 1937 Paramire Parami	25mm	MOEE (m3)	4,211		1470.000			= pO	1.32		MOE Eq	uation 4.10 Dr	awdown Coe		2,163
Intercement Active Surface Active Surface Active Surface Active Surface Active Surface Active	10mm Perm.	MOEE (m3)	1,307	E			Hydraulic	Diameter =	0.40		MOE Eq M	uation 4.10 Dr	rawdown Coe.	fficient 'C3' =	4,346
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86 0.23	187.15	10.0	09.0	5,795	7,405.71	1,0/4.04		3,017	0.074	0.000	0.275	0.000	0.074	0.038	2:1
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0.44 7,527.03 3,349.53 16,622 0.174 3.606 1.514 0.000 1.514 0.044 0.44 2.61 7,743 7,958.22 3,541.41 20,164 0.189 4,102 1.663 0.133 1.797 0.44 8,389.41 3,733.29 23,897 0.203 4,544 1.800 9,411 11.210 1.001 1.	188.72	÷.	2.16	7,311	1,020.04	0,101,6		13,273	0.158	3.029	1.349	0.000	1.349	1.233	2:1
0.44 3.05 8.174 7.958.22 3,541.41 20,164 0.189 4.102 1.663 0.133 1.797 0.44 3.50 8,605 8.174 8.389.41 3,733.29 23,897 0.203 4.544 1.800 9.411 11.210 1.04 0.100 0.1514 0.100 0.1514 0.100 0.1514 0.100 0.100 0.1514 0.100 0.10	100 16	0.44	5		7,527.03	3,349.53		000	i	,			,	1.240	5:1
3.05 8.174 2.0,164 0.189 4.102 1.663 0.133 1.797 1.797 8.389.41 3,733.29 20,164 0.189 4.102 1.663 0.133 1.797 1.797 3.50 8.605 2.389.41 3,733.29 23,897 0.203 4.544 1.800 9.411 11.210 11.210 1.0 Quality Orifice flow is the orifice controlling for the 24 hour detention period and uses an orifice formula. 2. Ditch Inlet flow is calculated using MTO charts and 50% debris coverage. 3. Pipe Orifice flow is calculated using an orifice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice. 4. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway.	109.10	0.44	7.01	/,/43	7.958.22	3.541.41		16,622	0.1/4	3.606	1.514	0.000	1.514	1 655	<u>5</u>
9.44 8.389.41 3,733.29 23,897 0.203 4.544 1.800 9,411 11.210 1. Quality Orifice flow is the orifice controlling for the 24 hour detention period and uses an orifice formula. 2. Ditch Inlet flow is calculated using MTO charts and 50% debris coverage. 3. Pipe Orifice flow is calculated using an orifice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice. 4. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway.	189.61		3.05	8,174				20,164	0.189	4.102	1.663	0.133	1.797	66.1	;
.1. 2. 2. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4.		0.44			8,389.41	3,733.29								6.503	5:1
2 6 4	190.05		3.50	8,605				23,897	0.203	4.544	1.800	9.411	11.210		
1. 2. 8. 4.															
 Dirch Inlet flow is calculated using MTO charts and 50% debris coverage. Pipe Orifice flow is calculated using an orifice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway. 	Notes	1. Quality C	rifice flow i	is the orifice	controlling for	the 24 hour de	etention period	l and uses an	orifice formul	la.					
 Pipe Uritice flow is calculated using an ortice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway. 		2. Ditch Ink	et flow is cal	lculated using	g MTO charts	and 50% debri	is coverage.								
		3. Pipe Orif	ice flow is c	alcuated usin	ig an orifice for	rmula on the p	ipe from the d	litch inlet to th	ne outlet and t	uses the tota	l head on the	orifice.	F		
			weir flow	is calculated i	using a trapezo	ondial weir to	convey outflor	w for less frec	quent storms t	hrough the e	mbankment v	with an emerge	ency spillway.		

Parisity Replication Parisity Chilles Parisit	2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,						WETPOND FACILITY	D FACII	LITY					
	2 Area (ha) = 15 2 (m3/ha) = 15 2 (m3/ha) = 11 3 (10 (m3/ha) = 11 3 (m3/ha) = 11 3 (m3/ha) = 11 3 (m3/ha) = 11 4 (m3) 4 (_	Quality Orifice	e		Ditch Inlet	Weir		Outflow Pip	e Orifice		Overflow Spillway	
Part	(m)			Diameter (m) =	0.127	OPSE	705.03	090	Dia	meter $(m) = 1$	0.450	Minor	Length (m) = 0.00	
Investigation Investigatio	lol (m3/ha) = 11 lol Vol (m3) = 1, ive Vol (m3) 4 iv rou Vol (m3) 4 iv lol Elev. = 18 loc leter = 18 loc leter = 10 loc leter	23	(to 2) /0	1 20	0.03	LION	— (III) IIIII M	0.00		5	0.03	-	Stopes $(A:1) = 1.00$	
National State Part	ive Vol (m3) 41 ive Vol (m3) 41 ive Vol (m3) 41 ive Vol (m3) 41 Pool Elev. = 18 Increment Depth	53		Invert (m) =	189.90	Inle	t Depth $(m) =$	0.60		Invert (m) =	189.90	Mine	or Invert (m) = 192.16	
Pool Experiment (1) 1.23.7 Avg Discharge (m38) 0 1013 Hydraulic Diameter = 0.30 Avg Discharge (m38) 0 1013 Hydraulic Diameter = 0.30 MDE Equation 4 10 Drawdown Certificient (72 - 5.22) Pool Experiment (20) Avg Surface Narface (m38) Narface	MOE (m3) 1, Pool Elev. = 18 Increment Depth (m)	23				Inlet El	avation (m) =	100 68		- (m) make	150.33	Majo.	: Lengin (m) = 2.44	
Holy Elization of Linear Holy Signature 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Pool Elev. = 18 Increment Depth (m)	06	Avg. Di	scharge (m3/s)	0.0123		Cd =	1.32		MG	E Equation 4.10	Drawdown Coe	officient 'C2' = 947	
Mistage Mist	Increment Depth (m)	;				Hydrauli	c Diameter =	0.30		MC	Equation 4.10	Drawdown Co.	efficient 'C3' = 2,230	
Depth Artic Sirflec Diric (ma) Frintage (ma) Active (ma) Cultic Figure (ma) Pipe Overlow Total (ma) Total (ma) Total (ma) Total (ma) More	Increment Depth (m)			Average						Max				
Column C	Depth (m)	, cuve	Surface	Surface	Increment	Permanent	Active	Quality	Ditch	Pipe	Overflow	Total	Average	Side
1.00 1.348 0.004 0.004 0.004 0.004 0.004 0.004 0.004 0.004 0.004 0.004 0.005 0.004 0.005 0.004 0.005 0.004 0.005 0.004 0.005 0.004 0.005 0.004 0.005 0.004 0.005		Septh (m)	Area	Area (m2)	Volume (m3)	Volume (m3)	Volume	Orifice (m3/s)	Inlet (m3/s)	Orifice (m3/s)	Spillway (m3/s)	Outflow (m3/s)	Discharge	Slope (H·V)
0.50 1,568.50 784.25 784.35 784.35 784.35 784.35 384.25 2,009.50 1,004.75 1,789.0 <a< td=""><td></td><td>1.00</td><td>1,348</td><td></td><td></td><td>00.00</td><td></td><td></td><td></td><td></td><td>(6)</td><td></td><td>(som)</td><td>(:)</td></a<>		1.00	1,348			00.00					(6)		(som)	(:)
0.50 1.780 C-Safety Factor 57.6% 1.780 C-Safety Factor 57.6% 0.00 2.230 2.230 0.02 0.00 0.001 0.001 <t< td=""><td>0.50</td><td></td><td></td><td>1,568.50</td><td>784.25</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>5:1</td></t<>	0.50			1,568.50	784.25									5:1
0.00 2,230 1,094 / 3 1,789.0 c-Safety Factor 57.6% 0.00 2,230 2,308.91 384.82 0.00 0.0	03.0	-0.50	1,789	00000	1 004 75	784.3								Ş
0.00 0.00 0.00 0.000 0.000 0.000 0.000 0.000 0.17 0.18 2,330 384.82 0.0 0 0.00 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.010 0.000 0.010 0.000 0.010 0.000 0.010 0.000 0.010 0.014 0.018 0.000 0.010 0.014 0.014 0.018 0.014 0.018 0.014 0.018 0.014 0.018 0.014 0.018 0.014 0.018 0.014 0.018 0.018 0.018 0.018	0.30	00.0	2.230	2,009.30	1,004.73	1.789.0	<-Safety Fac	stor 57 6%						136
0.17 0.00 2,338 0.00 0.001 0.000 0.001 0.000 0.001 0.001 0.000 0.001 0.	0.00		î	2,230.00	0.02		n c Gramm							5:1
0.17 2,388 2,308.91 384 82 385 0,010 0,000 0,022 0,000 0,010 0,005 0,000 0,010 0,000 0,010 0,014 0,018 0,014 0,018 0,014 0,018 <t< td=""><td></td><td>0.00</td><td>2,230</td><td></td><td></td><td>0.0</td><td>0</td><td>0.000</td><td>0.000</td><td>0.000</td><td>0.000</td><td>0.000</td><td></td><td></td></t<>		0.00	2,230			0.0	0	0.000	0.000	0.000	0.000	0.000		
0.17 2,388 2,466.71 411.12 385 0.010 0.000 0.022 0.000 0.010 0.010 0.010 0.010 0.010 0.010 0.010 0.010 0.010 0.010 0.010 0.010 0.010 0.010 0.014 0.014 0.014 0.018 0.014 0.018 0.018 0.018 0.018 0.018 0.024 0.024 0.029 0.031 0.031 0.031 0.031 0.031 0.031 0.031 0.032 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.033 0.034 0.153 0.034 0.153 0.034 0.153 0.034 <t< td=""><td>0.17</td><td>ţ</td><td>6</td><td>2,308.91</td><td>384.82</td><td></td><td></td><td>6</td><td>6</td><td></td><td>6</td><td></td><td>9000</td><td>5:1</td></t<>	0.17	ţ	6	2,308.91	384.82			6	6		6		9000	5:1
0.45 0.33 2,546 1,231.47 796 0.018 0.000 0.076 0.000 0.018 0.02 0.03 2,987 2,969 2,757.06 1,231.47 2,027 0.029 0.000 0.317 0.000 0.029 0.02 0.03 2,987 2,987 2,087 0.030 0.034 0.000 0.033 0.03 0.33 3,019 100.12 2,187 0.031 0.034 0.000 0.033 0.17 3,079 1.10 3,177 3,255.71 542.62 2,703 0.034 0.233 0.384 0.000 0.267 0.17 1.17 3,335 3,413.51 542.62 2,703 0.037 0.712 0.426 0.000 0.426 0.17 1.33 3,492 4,044.70 4,118.82 8,534 0.055 0.059 0.456 0.799 1.17 2.50 4,597 4,597 4,044.70 4,118.82 8,534 0.055 0.059	0.17	0.17	2,388	2.466.71	411.12		385	0.010	0.000	0.022	0.000	0.010	0.014	1.5
0.45 0.045 2,969 1,231.47 2,027 0.024 0.029 0.029 0.029 0.024 0.029 0.024 0.029 0.029 0.029 0.031 0.031 0.034 0.031 0.034 0.031 0.031 0.034 0.031 0.034 0.034 0.031 0.034 0.044 0.044 0.044 <		0.33	2,546	î			962	0.018	0.000	0.076	0.000	0.018	•	;
0.78 2,969 2,027 2,027 2,027 0.029 0.029 0.000 0.317 0.000 0.029 0.03 0.80 2,987 3,003.23 100.12 2,087 0.031 0.034 0.000 0.033 0.031 0.03 0.03 3,003.23 100.12 2,187 0.031 0.013 0.334 0.000 0.043 0.038 0.17 1.00 3,177 5,073 0.034 0.233 0.383 0.000 0.267 0.192 0.17 1.17 3,335 3,426 0.037 0.712 0,426 0.000 0,426 0.192 0.17 1.33 3,492 3,413.51 5,68.91 3,815 0,046 0,000 0,466 0,466 0,466 0,799 1.17 2,50 4,597 4,044.70 4,718.82 8,534 0,057 0,459 0,466 0,799 0,799	0.45	i	;	2,757.06	1,231.47								0.024	5:1
0.03 0.03 0.033 0.033 0.033 0.038 0.03 3,003 3,003 100.12 2,187 0.031 0.003 0.324 0.000 0.043 0.038 0.17 3,097 3,097 516.32 2,703 0.034 0.233 0.384 0.000 0.043 0.155 0.17 1.00 3,177 3,255.71 542.62 2,703 0.034 0.233 0.383 0.000 0.267 0.192 0.17 1.17 3,335 3,413.51 568.91 3,246 0.037 0.712 0.426 0.000 0.426 0.192 0.17 1.33 3,492 4,044.70 4,718.82 8,534 0.055 2.033 0.679 0.456 0.799 1.17 2,50 4,597 8,534 0.055 2.033 0.679 0.453 1.132	0.02	8/.0	2,969	2 977 98	95 65		7,027	0.029	0.000	0.317	0.000	0.029	0.031	<u> </u>
0.03 3,003.23 100.12 2,187 0.031 0.033 0.034 0.034 0.034 0.034 0.034 0.034 0.034 0.034 0.034 0.034 0.034 0.034 0.033 0.034 0.034 0.033 0.034 0.037 0.133 0.034 0.045 0.034 0.034 0.033 0.034 0.046 0.000 0.426 0.192 0.17 1.17 3,335 3,413.51 568.91 3,815 0.040 0.980 0.466 0.000 0.426 0.446 1.17 3,335 4,044.70 4,718.82 8,534 0.055 2.033 0.679 0.456 0.799	1	08.0	2,987				2,087	0.030	0.003	0.324	0.000	0.033		1.5
0.17	0.03			3,003.23	100.12								0.038	5:1
0.17 3,177 3,255.71 542.62 2,703 0,034 0,233 0,383 0,000 0,267 0.17 3,335 3,413.51 568.91 3,246 0,037 0,712 0,426 0,000 0,426 0.17 1.33 3,492 3,815 0,040 0,980 0,466 0,000 0,466 1.17 2.50 4,597 4,044.70 4,718.82 8,534 0,055 2,033 0,679 0,453 1,132	0.17	0.83	3,019	3.097.91	516.32		2,187	0.031	0.013	0.334	0.000	0.043	0.155	5:1
0.17 3,255.71 542.62 0.17 3,335 0.17 3,343.51 0.17 3,413.51 1.33 3,492 4,044.70 4,718.82 8,534 0.055 2.50 4,597		1.00	3,177				2,703	0.034	0.233	0.383	0.000	0.267		
1.17 3,335 3,413.51 568.91 3,246 0.037 0.712 0.426 0.000 0.426 0.446 0.17 1.33 3,492 3,413.51 568.91 3,815 0.040 0.980 0.466 0.000 0.466 0.466 0.466 0.466 0.446 0.446 0.446 0.446 0.446 0.44.70 4,718.82 8,534 0.055 2.033 0.679 0.453 1.132	0.17	!	,	3,255.71	542.62			:					0.192	5:1
1.33 3,492 3,815 0.040 0.980 0.466 0.000 0.466 0.799 1.17 2.50 4,597 8,534 0.055 2.033 0.679 0.453 1.132	0.17	1.17	3,335	3 413 51	568 91		3,246	0.037	0.712	0.426	0.000	0.426	0 446	5:1
1.17 4,044.70 4,718.82 0.799 2.50 4,597 4,044.70 8,534 0.055 2.033 0.679 0.453 1.132		1.33	3,492		•		3,815	0.040	086.0	0.466	0.000	0.466	2	:
2.50 4,597 8,534 0.055 2.033 0.679 0.453				4,044.70	4,718.82								0.799	5:1
		2.50	4,597				8,534	0.055	2.033	0.679	0.453	1.132		

APPENDIX B

MIDUSS Output Files – Existing Drainage Conditions

```
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
0.000 .000 c.m/s
0.000 .221 c perv/imperv/total
              Output File (4.7) EX.OUT opened 2014-04-25 15:30 Units used are defined by G = 9.810 24 144 10.000 are MAXDT MAXHYD & DTMIN values Licensee: UPPER CANADA CONSULTANTS
                                                                                                                                                                           74,000
              COMMENT
THE VILLAGE OF EAST FONTHILL, TOWN OF PELHAM
STORMWATER MANAGEMENT PLAN, APRIL 2014
EXISTING CONDITIONS
 35
                                                                                                                                                               15
                                                                                                                                                                             ADD RUNOFF
                                                                                                                                                                                            .179
                                                                                                                                                                         CATCHMENT
105.000
6.630
210.000
2.630
11.300
                                                                                                                                                                                            If y .000 .000 c.m/s

ID No.6 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.060 .179 .000 .000 c.m/s
.083 .788 .163 C perv/imperv/total
 35
              Comment | Tine(s) of comment | 25mm - 4HOUR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES
               STORM
                                 1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
Coefficient a
Constant b (min)
Exponent c
Fraction to peak r
Duration ó 240 min
22.981 mm Total depth
           500.000
                                                                                                                                                                         210.000
                3.100
.810
                                                                                                                                                                                .000
                                                                                                                                                                                 . 250
                   400
           240.000
                                                                                                                                                                           74.000
                                                                                                                                                                             .100
              IMPERVIOUS
   3
                                  S
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
                   .015
             98.000
                                                                                                                                                               15
                 .100
                                                                                                                                                                             ADD RUNOFF
                                                                                                                                                                                                                 .240
                                                                                                                                                                                                                                        .000
                                                                                                                                                                                                                                                              .000 c.m/s
                                                                                                                                                                                            .060
                                                                                                                                                                         CATCHMENT
106.000
10.460
               COMMENT
                                                                                                                                                                                                 ID No.ó 99999
               line(s) of comment
                                                                                                                                                                                            265.000
2.000
2.800
              * OUTLET A **
              CATCHMENT
                            ID No.ó 99999

Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp, with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.831 .000 .000 .000 c.m/s
.083 .787 .420 C perv/fotal
           101.000
21.980
385.000
                                                                                                                                                                         265.000
                                                                                                                                                                               .000
                                                                                                                                                                                 1
250.
           3.330
47.800
385.000
                                                                                                                                                                           74.000
.100
8.924
                 .000
            .250
74.000
                                                                                                                                                                            ADD RUNOFF
              .100
8.924
                                                                                                                                                              15
                                                                                                                                                                        CATCHMENT
107.000 ID
11.780 An
                                                                                                                                                                                                                  .263
                                                                                                                                                                                                                                        .000
                                                                                                                                                                                                                                                             .000 c.m/s
                                                                                                                                                                                                ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr: 2=Rectanglr: 3=SWM HYD: 4=Lin. Re
                                                                                                                                                                         280.000
2.780
4.000
              ADD RUNOFF
.831 .831
HYDROGRAPH DISPLAY
15
                                                                          .000
                                                                                                .000 c.m/s
              is # of Hyeto/Hydrograph chosen
Volume = .2116845E+04 c.m
                                                                                                                                                                         280.000
              START
                                                                                                                                                                                 250
                        1=zero; 2=Define
            COMMENT
3 line(s) of comment
                                                                                                                                                                           74.000
.100
8.924
                                                                                                                                                                                            * OUTLET B **
         CATCHMENT
102.000
32.340
465.000
16.460
49.300
465.000
.000
                         MENT

D No. 6 99999

Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)

%Imp. with Zero Dpth
Option 1=SCS CM/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
1.280
0.000
0.000 c.m/s
0.83
785
429 C perv/imperv/total
                                                                                                                                                              15
                                                                                                                                                                            AUNUTE .037 .301 .000
HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .1380951E+04 c.m
                                                                                                                                                                             ADD RUNOFF
                                                                                                                                                                                                                                                             .000 c.m/s
                                                                                                                                                               27
                                                                                                                                                                            START
1=Zero; 2=Define
                                                                                                                                                               14
                                                                                                                                                                           1 1=zero; 2=Define
COMMENT
3 line(s) of comment
            .250
74.000
                  100
              8.924
                                                                                                                                                                             * 5 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
                                                                                                                                                                             STORM
                                                                                                                                                                                               1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
Coefficient a
Constant b (min)
Exponent c
Fraction to peak r
Duration ó 240 min
45.876 mm Total depth
              ADD RUNOFF
1.280
CATCHMENT
                             830.000
7.300
.777
                                                1.280
                                                                         .000
                                                                                                .000 c.m/s
          103.000
42.370
530.000
                                                                                                                                                                         240.000
           2.450
5.600
530.000
                                                                                                                                                                             IMPERVIOUS
                                                                                                                                                                                                 Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
                                                                                                                                                                                1
015.
                                                                                                                                                                                                Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
                                                                                                                                                                           98.000
            .250
74.000
                                                                                                                                                                              .100
                                                                                                                                                                           8.924
                                                                                                                                                                             * OUTLET A
             .083 .793 .123
ADD RUNOFF .175 1.455 .000
HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .1197006E+04 c.m
                                                                                                                                                                        CATCHMENT
101.000
21.980
385.000
3.330
47.800
                                                                                                                                                                                                ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
14
                        1=Zero; 2=Define
                                                                                                                                                                         385,000
            COMMENT
3 line(s) of comment
                                                                                                                                                                               .000
                                                                                                                                                                          .250
74.000
.100
8.924
                                                                                                                                                                                       Manning "n"

SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
1.796 .000 .000 c.m/s
.236 .881 .544 C perv/imperv/total
              * OUTLET C **
                                 ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
              CATCHMENT
         104.000
11.490
275.000
              4.430
                                                                                                                                                              15
                                                                                                                                                                             ADD RUNOFF
                                                                                                                                                                             1.796 1.796 .000
HYDROGRAPH DISPLAY
is # of Hyeto/Hydrograph chosen
Volume = .5489694E+04 c.m
                                                                                                                                                                                                                                                             .000 c.m/s
            19.500
         275.000
                 . 250
                                                                                                                                                              14
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```
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.132 .600 .000 .000 c.m/s
.236 .872 .261 C perv/imperv/total
                                                                                                                                                                                                                                                                               .250
74.000
.100
                                        1=zero; 2=Define
                       COMMENT
35
                        line(s) of comment
                                                                                                                                                                                                                                                                                 8.924
                       * OUTLET B
                CATCHMENT
102.000
32.340
465.000
16.460
49.300
465.000
                                        MENT

ID No. 6 99999

Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
2.605
.000
.000
.000 c.m/s
.236
.872
.549
C perv/imperv/total
UNOFF
                                                                                                                                                                                                                                                                                 ADD RUNOFF
.132 .704
HYDROGRAPH DISPLAY
                                                                                                                                                                                                                                                            15
                                                                                                                                                                                                                                                                                                                                                                                                                   .000 c.m/s
                                                                                                                                                                                                                                                                                 is # of Hyeto/Hydrograph chosen
Volume = .5452904E+04 c.m
                                                                                                                                                                                                                                                                                 START
1=Zero; 2=Define
                           .000
                                                                                                                                                                                                                                                            35
                    .250
                                                                                                                                                                                                                                                                                  100
                                                                                                                                                                                                                                                                                   * 100 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
                                                                                                                                                                                                                                                                                 STORM
                                                                                                                                                                                                                                                                                                                  l=Chicago;2=Huff;3=User;4=Cdnlhr;5=Historic
Coefficient a
Constant b (min)
Exponent c
                                                                                                                                                                                                                                                                        1020.000
4.700
.731
                      .236
ADD RUNOFF
2.605
15
                                                                            2.605
                                                                                                                     .000
                                                                                                                                                       .000 c.m/s
                                                    ID No.6 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
46 2.605
36 .880 .272 C perv/iousla
                                                                                                                                                                                                                                                                                                               Fraction to peak r
Duration of 240 min
73.207 mm Total depth
                       CATCHMENT
                                                                                                                                                                                                                                                                                        400
               CATCHN
103.000
42.370
530.000
2.450
5.600
530.000
                                                                                                                                                                                                                                                                            240.000
                                                                                                                                                                                                                                                                                 IMPERVIOUS
                                                                                                                                                                                                                                                               3
                                                                                                                                                                                                                                                                                                                S
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
                                                                                                                                                                                                                                                                               .015
98.000
                                                                                                                                                                                                                                                                                  .100
.518
COMMENT
                           .000
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line(s) of comment
                    74.000
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ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
2.875
2.875
2.907
2.875
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                                                                                                                                                                                                                                                                                 CATCHMENT
                                                                                                                                                                                                                                                                           101.000
21.980
385.000
                    ADD RUNOFF .446 3.051 .000
HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .5285372E+04 c.m
15
                                                                                                                                                       .000 c.m/s
                                                                                                                                                                                                                                                                            3.330
47.800
385.000
                                                                                                                                                                                                                                                                                      .000
14
                                      1=zero; 2=Define
                                                                                                                                                                                                                                                                               .250
                       COMMENT
                       .100
                      * OUTLET C
                                             ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.392 .000 .000 c.m/s
.236 .866 .359 C perv/imperv/total
                       CATCHMENT
               CATCHN
104.000
11.490
275.000
4.430
19.500
275.000
                                                                                                                                                                                                                                                                                .36/ .50/ .025

ADD RUNGF

2.875 2.875 .000

HYDROGRAPH DISPLAY

5 is # of Hyeto/Hydrograph chosen

Volume = .1006246E+05 c.m
                                                                                                                                                                                                                                                            15
                                                                                                                                                                                                                                                                                                                                                                                                                  .000 c.m/s
                                                                                                                                                                                                                                                            27
                          .000
                                                                                                                                                                                                                                                            14
                                                                                                                                                                                                                                                                                                 1=Zero; 2=Define
                   .250
74.000
                                                                                                                                                                                                                                                                               .100
8.924
                                                                                                                                                                                                                                                                                  * OUTLET B **
                                                                                                                                                                                                                                                                                                   MENT

ID No.ó 99999

Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
4.439
0.00
0.00
0.000 c.m/s
367
916
638 C perv/imperv/total
                                                                                                                                                                                                                                                                                 CATCHMENT
                                                                                                                                                                                                                                                                           102.000
32.340
465.000
                     ADD RUNOFF .392
15
                                                                                 . 392
                                                                                                                    .000
                                                                                                                                                       .000 c.m/s
                                                    ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option I=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option I=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
39 392 .000 .000 c.m/s
36 .867 .307 C perv/imperv/total
                      CATCHMENT
                                                                                                                                                                                                                                                                               16.460
                105.000
6.630
210.000
                                                                                                                                                                                                                                                                           49.300
465.000
                                                                                                                                                                                                                                                                                     .000
                2.630
11.300
210.000
                                                                                                                                                                                                                                                                               .250
74.000
                           .000
                                                                                                                                                                                                                                                                                       .100
                                                                                                                                                                                                                                                                                 8.924
                   74.000
                            100
                                                                                                                                                                                                                                                                                 ADD RUNOFF
4.439
CATCHMENT
                                                                                                                                                                                                                                                                                                                                        4.439
                                                                                                                                                                                                                                                                                                                                                                               .000
                                                                                                                                                                                                                                                                                                                                                                                                                  .000 c.m/s
                                                                                                                                                                                                                                                                                                                ID No.ó 99999
Area in hectares
Length (PERV) metres
                                                                                                                                                                                                                                                                           103.000
42.370
530.000
                     ADD RUNOFF
                                               ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
110 .531 .000 .000 c.m/s
.876 .254 C perv/imperv/total

000 c.m/s
                                                                                                                                                                                                                                                                                                 Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
Mimp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
1.137 4.439 .000 .000 c.m/s
.367 .925 .399 C perv/imperv/total
                                             .139
                                                                                                                    .000
                                                                                                                                                       .000 c.m/s
                                                                               .531
                                                                                                                                                                                                                                                                           2.450
5.600
530.000
.000
                      CATCHMENT
               CATCHN
106.000
10.460
265.000
2.000
2.800
265.000
                                                                                                                                                                                                                                                                              .250
74.000
.100
                          .000
                             250
                   74.000
                                                                                                                                                                                                                                                                                 ADD RUNOFF
1.137
                                                                                                                                                                                                                                                                                                                                        4.969
                                                                                                                                                                                                                                                                                                                                                                              .000
                                                                                                                                                                                                                                                                                                                                                                                                                 .000 c.m/s
                                                                                                                                                                                                                                                                                 HYDROGRAPH DISPLAY
                                                                                                                                                                                                                                                                                 is # of Hyeto/Hydrograph chosen
Volume = .1236434E+05 c.m
                     ADD RUNOFF
                                                                                                                                                                                                                                                                                START
1=Zero; 2=Define
                                                                                                                                                                                                                                                           14
               .1.
CATCHMENT
107.000
11.780
280.000
2.780
4.000
280.000
                                                    ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
                                                                                                                                                                                                                                                                                 * OUTLET C **
                                                                                                                                                                                                                                                                                 CATCHMENT
                                                                                                                                                                                                                                                                                                               ID No.ó 99999
Area in hectares
                          .000
                                                                                                                                                                                                                                                                           104 000
                                                                                                                                                                                                                                                                              11.490
```

```
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "h"
SCS Curve No or C
Ia/s Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.697 .000 .000 c.m/s
.367 .915 .474 C perv/imperv/total
WOFF
                                                                                                                                                                                                                                                               Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
              275.000
                                                                                                                                                                                                                                      2.800
              4.430
19.500
275.000
                                                                                                                                                                                                                                265.000
                                                                                                                                                                                                                                          1
250.
                                                                                                                                                                                                                                                          option I=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"

SCS Curve No or C

Ia/S Coefficient

Initial Abstraction
Option I=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv

361 .977 .000 .000 c.m/s

367 .903 .382 C perv/imperv/total
                      .000
                                                                                                                                                                                                                                  74.000
.100
8.924
                        . 250
                 74.000
                   .100
8.924
                                                                                                                                                                                                                  15
                                                                                                                                                                                                                             CATCHMENT
107.000 ID
11.780 Are
280.000 Len
2.780 Gra
4.000 Per
280.000
                                                                                                                                                                                                                                     ADD RUNOFF
                                                                                                                                                                                                                                                                                                                   .000
                                                                                                                                                                                                                                                                                 1.167
                                                                                                                                                                                                                                                                                                                                               .000 c.m/s
                                                                                                                                                                                                                                                      15
                  ADD RUNOFF
.697
                                                                                                 .000
                                                                  . 697
                                                                                                                              .000 c.m/s
                   CATCHMENT
                                      ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
.284 697 .000 .000 c.m/s
.367 .915 .429 C perv/imperv/total
             CATCHN
105.000
6.630
210.000
2.630
11.300
210.000
.000
                                                                                                                                                                                                                                280.000
                                                                                                                                                                                                                                          .
250
                                                                                                                                                                                                                                  74.000
.100
8.924
                .250
74.000
                  .100
8.924
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                                                                                                                                                                                                                                     ADD RUNOFF
                                                                                                                                                                                                                                    ADD RUNOFF
.426 1.519 .000
HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .1235576E+05 c.m
                                                                                                                                                                                                                                                                                                                                                .000 c.m/s
                  ADD RUNOFF .284
15
                                                                  . 977
                                                                                                 .000
                                                                                                                             .000 c.m/s
             .2
CATCHMENT
106.000
10.460
265.000
2.000
                                            ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
                                                                                                                                                                                                                                     VOTUME
START
L 1=Zero; 2=Define
                                                                                                                                                                                                                  20
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APPENDIX C

MIDUSS Output Files - Future Drainage Conditions without SWM

```
Output File (4.7) OCTNONE.OUT opened 2014-10-10 11:22 Units used are defined by G = 9.810 24 144 10.000 are MAXDT MAXHYD & DTMIN values Licensee: UPPER CANADA CONSULTANTS
                                                                                                                    .791
                                                                                                                                 . 680
                                                                                                                                         C perv/imperv/total
                                                                                                        .053
                                                                                                ADD RUNOFF
                                                                                                        430
                                                                                                                   1.069
                                                                                                                                 .241
                                                                                                                                             .000 c.m/s
                                                                                                HYDROGRAPH DISPLAY
                                                                                                5 is # of Hyeto/Hydrograph chosen
Volume = .2459709E+04 c.m
           3 line(s) of comment
THE VILLAGE OF EAST FONTHILL, TOWN OF PELHAM
                                                                                                CATCHMENT
           STORMWATER MANAGEMENT PLAN, OCT 2014
FUTURE CONDITIONS - WITH STORMWATER MANAGEMENT
                                                                                               30,000
                                                                                                           ID No.6 99999
                                                                                                           Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
                                                                                               11.250
                                                                                              260.000
           l line(s) of comment
25mm - 4HOUR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES
                                                                                                2.000
          1.
                                                                                               85.000
                                                                                                            Length (IMPERV)
           STORM
                                                                                              260 000
                                                                                                            %Imp. with Zero Dpth
                       1=Chicago; 2=Huff; 3=User; 4=Cdn1hr; 5=Historic
                                                                                                 .000
                       Coefficient a
                                                                                                           Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
          500.000
                                                                                                  .250
                       Constant b (min)
Exponent c
           8.100
                                                                                               74.000
                                                                                                            SCS Curve No or C
            .810
                     Fraction to peak r
Duration ó 240 min
22.981 mm Total depth
                                                                                                            Ia/S Coefficient
             400
                                                                                                  .100
                                                                                               11.953
                                                                                                            Initial Abstraction
         240.000
                                                                                                           Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
           IMPERVIOUS
                                                                                     Reserv
                      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
SCS Curve No or C
                                                                                                                                 .241
                                                                                                                  1.069
                                                                                                                                             .000 c.m/s
                                                                                                                                         C perv/imperv/total
             .015
                                                                                                        .053
                                                                                                                                .680
                                                                                                                  .791
                                                                                                ADD RUNOFF
          98.000
           .100
                                                                                                .767 1.3
HYDROGRAPH DISPLAY
                       Ia/S Coefficient
                                                                                                                   1.836
                                                                                                                                .241
                                                                                                                                           .000 c.m/s
                      Initial Abstraction
             . 518
                                                                                                is # of Hyeto/Hydrograph chosen
Volume = .4211089E+04 c.m
           COMMENT
           line(s) of comment
                                                                                        3.5
                                                                                                COMMENT
                                                                                               3 line(s) of comment
           * NORTH VILLAGE OF EAST FONTHILL POND *
                1=Zero; 2=Define
           CATCHMENT
                                                                                          9
                                                                                                ROUTE
                      ID No.ó 99999
                                                                                                           Conduit Length
          31.000
                                                                                                  .000
           3.530
                      Area in hectares
                                                                                                  .000
                                                                                                           No Conduit defined
         155.000
                       Length (PERV) metres
                                                                                                  .000
                                                                                                           Zero lag
Beta weighting factor
                                                                                                  .000
                      Gradient (%)
Per cent Impervious
           2.000
          85.000
                                                                                                           Routing timestep
                                                                                                  .000
                      Length (IMPERV)
%Imp. with Zero Dpth
          155,000
                                                                                                    0
                                                                                                           No. of sub-reaches
                                                                                                        .767
                                                                                                                   1.836
                                                                                                                               1.836
                                                                                                                                             .000 c.m/s
            .000
                      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
                                                                                        16
                                                                                                NEXT LINK
                                                                                                       .767
             .250
                                                                                                                  1.836
                                                                                                                               1.836
          74.000
                       SCS Curve No or C
                                                                                        14
                                                                                                START
                                                                                                      1=Zero; 2=Define
             .100
                       Ia/S Coefficient
          11.953
                       Initial Abstraction
                                                                                                COMMENT
                                                                                               Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                                                                                                .000
                                            .000
                   .241
                                                         .000 c.m/s
                               .784
                                           .674
                                                      C perv/imperv/total
                   .053
           ADD RUNOFF
                                                                                                CATCHMENT
   15
           .241
COMMENT
                              .241
                                          .000
                                                                                                           ID No.6 99999
                                                       .000 c.m/s
                                                                                               40.000
                                                                                               35.240
                                                                                                           Area in hectares
           line(s) of comment
                                                                                              485.000
                                                                                                           Length (PERV) metres
                                                                                                           Gradient (%)
Per cent Impervious
Length (IMPERV)
                                                                                               15.480
           49 400
                                                                                              485.000
                                                                                                           %Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
   12
           DIVERT
                                                                                                 .000
                9
                      II/S Node No.6 99999
             .478
                      Threshold Discharge
             .574
                      Max. Outflow regd.
                                                                                               74.000
                                                                                                           SCS Curve No or C
                                                                                                           Ia/S Coefficient
                 Omax & Vol.Diverted =
                                              .000 c.m/s .0 c.m
                                                                                                  .100
                 No flow diverted .241 .241
                                                                                                8.924
                                                                                                           Initial Abstraction
                                           .241 .000 c.m/s
                                                                                                           Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
   16
           NEXT LINK
                                                                                    Reserv
                                                                                                                    .000
                                                                                                                               1.836
                                                                                                                                             .000 c.m/s
                   .241
                              .241 .241
                                                       .000 c.m/s
                                                                                                      1.395
                                                                                                                               .431
                                                                                                                                          C perv/imperv/total
           CATCHMENT
                                                                                                        .083
                                                                                                                  .787
          10.000
                      ID No.6 99999
                                                                                        15
                                                                                                ADD RUNOFF
                      Area in hectares
Length (PERV) metres
                                                                                                      1.395
                                                                                                                 1.395
                                                                                                                               1.836
                                                                                                                                             .000 c.m/s
           5.910
                                                                                                CHANNEL
         200.000
                                                                                        11
                                                                                                           Base Width
                      Gradient (%)
Per cent Impervious
           2.000
                                                                                                2.000
                                                                                                           Left bank slope 1:
Right bank slope 1:
Manning's "n"
          85.000
                                                                                                3.000
                      Length (IMPERV)
%Imp. with Zero Dpth
         200.000
                                                                                                3.000
                                                                                                 .040
            .000
                      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
SCS Curve No or C
                                                                                                1.500
                                                                                                           O/a Depth in metres
             .250
                                                                                                           Select Grade in %
                                                                                                 .900
                                                                                                            = .414 metres
= 1.040 m/sec
                                                                                                Depth
          74.000
          .100
11.953
                       Ia/S Coefficient
                                                                                                Velocity
                                                                                                Flow Capacity = 20.730 c.m/s
Critical depth = .312 metres
                       Initial Abstraction
                       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                                                                                                ROUTE
                                                                                                           Conduit Length
                                                                                              393.000
                                                                                                           Supply X-factor <.5
Supply K-lag (sec)
                                           .680
                                                     C perv/imperv/total
                   .053
                               .791
                                                                                                 .470
                                                                                              283.376
           ADD RUNOFF
   15
                    .399
                                                                                                           Beta weighting factor
Routing timestep
                               .640
                                            .241
                                                       .000 c.m/s
                                                                                                 500
           CATCHMENT
                                                                                              300.000
                                                                                                           No. of sub-reaches
          20.000
                      ID No.ó 99999
                                                                                                                              1.212
                                                                                                      1.395
                                                                                                                                             .000 c.m/s
                      Area in hectares
Length (PERV) metres
           6 380
                                                                                               NEXT LINK
         205.000
                                                                                                      1.395
                                                                                                                  1.212 1.212
                      Gradient (%)
Per cent Impervious
                                                                                                                                             .000 c.m/s
           2.000
                                                                                                CATCHMENT
          85.000
                      wength (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
         205.000
                                                                                               60.000
                                                                                                           ID No.ó 99999
            .000
                                                                                                2.430
                                                                                                           Area in hectares
                                                                                              125.000
                                                                                                           Length (PERV) metres
            .250
                                                                                               2.000
                                                                                                           Gradient (%)
Per cent Impervious
          74.000
                                                                                                  .000
            .100
                       Ia/S Coefficient
                                                                                              125.000
                                                                                                           Length (IMPERV)
                                                                                                            %Imp. with Zero Dpth
          11.953
                      Initial Abstraction
                                                                                                .000
                       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                           Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
                                                                                                  .250
                                                                                                           Manning "n"
Reserv
                                                                                               74.000
                                                                                                           SCS Curve No or C
                                           .241
```

	.100	Ta/S Co	efficient			4	CATCHMENT			
	8.924	Initial	Abstracti			•	80.000	ID No.ó 999		
Reserv	1	Option	l=Trianglr	; 2=Rectan	glr; 3=SWM HYD; 4=Lin.		38.600 510.000	Area in hec Length (PER		
			1.212	1.212	.000 c.m/s		2.000	Gradient (%		
15	ADD R	.083 UNOFF	.000	.083	C perv/imperv/total		43.500 510.000	Per cent Imp		
9	DOLLER	.003	1.212	1.212	.000 c.m/s		.000 1	%Imp. with		; 3=Green-Ampt; 4=Repeat
9	ROUTE 452.000	Conduit	Length				.250	Manning "n"		, 3-dreen-Ampt, 4-Nepeat
	.475		X-factor <				74.000 .100	SCS Curve No Ia/S Coeffic		
	.500		K-lag (sec eighting fa				8.924	Initial Abs	traction	
	300.000		g timestep sub-reache	-		Reserv	1	Option 1=Tr	ianglr; 2=Rectand	glr; 3=SWM HYD; 4=Lin.
	1		1.212	1.141	.000 c.m/s	veserv	1.0	77 .00	0 1.599	1.599 c.m/s
17	COMBII	NE Junction Nod	io No			15	.0 ADD RUNOF		2 .392	C perv/imperv/total
	1 1		1.212	1.141	1.141 c.m/s	13	1.0	77 1.07	7 1.599	1.599 c.m/s
14	START 1	l=Zero; 2=De	fino			27	HYDROGRAP: 4 is #		drograph chosen	
22		HYDROGRAPH	LINE				Volume =	.3466319E+		
		1=READ: 2=WB DIV00009.25M		s Filename		35	COMMENT 3 line	(s) of comme	nt	
			2=Inflow:	3=Outflow:	4=Temp'ary		******	******	******	******
4	CATCHI	.003	.000	1.141	1.141 c.m/s				ANAGEMENT FACILI	
4	50.000	ID No.ć				10	POND			
	10.320 260.000		hectares (PERV) met	rac			10 Depth - 1 187.500	Discharge - '	Volume sets	
	2.000	Gradien		162			187.670	.0140	1300.3	
	85.000		t Impervio	us			187.830 187.960	.0570 .0760	2689.4 3804.3	
	260.000		(IMPERV) ith Zero D	pth			188.170	.234	5733.6	
	1	Option	1=SCS CN/C		; 3=Green-Ampt; 4=Repeat		188.330	.334	7388.8	
	.250 74.000	Manning SCS Cur	r "n" ve No or C				188.500 188.670	.383 .426	9132.6 10965.2	
	.100	Ia/S Co	efficient				188.830	.637	12886.5	
	8.924 1		. Abstracti		glr; 3=SWM HYD; 4=Lin.		189.000 Peak Outf	.954	14896.4 .054 c.m/s	
Reserv	1	Operon	1-111angir	, z-nectan	gii, 3-5WH HID, 4-Bin.		Maximum D		87.820 metres	
		.703	.000 .791	1.141	1.141 c.m/s		Maximum S		2599. c.m 7 .054	1.599 c.m/s
15	ADD RU		. 191	.000	C perv/imperv/total	17	COMBINE	77 1.07	.034	1.399 C.M/S
0.77		.703	.703	1.141	1.141 c.m/s			tion Node No		1 612/-
27		GRAPH DISPLA is # of Hyet		ph chosen		14	1.0 START	77 1.07	7 .054	1.612 c.m/s
	Volume	e = .16238						ro; 2=Define		
35	COMMEN 3	NT Line(s) of c	omment			18	CONFLUENCE 2 June	i tion Node No	-	
	****	******	******		******		1.0	77 1.613		.000 c.m/s
	* PROI	POSED SOUTH	VILLAGE OF	EAST FONT	HILL POND *	27	HYDROGRAPI 4 is #		drograph chosen	
9	ROUTE						Volume =	.3466319E+0		
	.000		Length X-factor <	5		14	START 1 1=Ze:	ro; 2=Define		
	.000		K-lag (sec			35	COMMENT	LO, Z-Derine		
	.500		ighting fa	ctor				(s) of commen		*****
	1	No. of	timestep sub-reache							WELLAND IDF VALUES *
17	COMBIN	.703	.703	.703	1.141 c.m/s	2	STORM	******	******	******
1 /		unction Nod	le No.			۷	1	1=Chicago;2=	=Huff;3=User;4=Co	dn1hr;5=Historic
1.4	CMADM	.703	.703	.703	1.599 c.m/s		830.000	Coefficient		
14	START	=Zero; 2=De	fine				7.300 .777	Constant b Exponent c	(min)	
18	CONFLU	JENCE					.400	Fraction to		
	1 3	Junction Nod .703	le No. 1.599	.703	.000 c.m/s		240.000	Duration ó 45.876 mm	240 min Total depth	
4	CATCHN	MENT				3	IMPERVIOU:	3	-	3-0
	70.000	ID No.ó Area in	99999 hectares				.015	Option 1=SCS Manning "n"	o UN/U; Z=Horton;	: 3=Green-Ampt; 4=Repeat
	120.000	Length	(PERV) met	res			98.000	SCS Curve No		
	2.000	Gradien Per cen	t (%) t Impervio	us			.100 .518	Ia/S Coeffice Initial Abst		
	120.000	Length	(IMPERV)			35	COMMENT			
	.000		ith Zero D		; 3=Green-Ampt; 4=Repeat			(s) of commer		****
	.250	Manning		, z-norcon.	, 5-oreen rampe, 4-nepeac		* OUTLET A			*
	74.000		ve No or C efficient			14	START	******	*******	****
	8.924		Abstracti	on		14		ro; 2=Define		
D	1	Option	1=Trianglr	; 2=Rectan	glr; 3=SWM HYD; 4=Lin.	4	CATCHMENT 31.000	ID No.6 9999	20	
Reserv			1.599	.703	.000 c.m/s		3.530	Area in hect	tares	
1 0	זמ מחוג	.083	.000	.083	C perv/imperv/total		155.000	Length (PERV Gradient (%)		
15	ADD RU		1.599	.703	.000 c.m/s		2.000 85.000	Per cent Imp		
9	ROUTE						155.000	Length (IMPE	ERV)	
	.000	Conduit Supply	Length X-factor <	.5			.000	%Imp. with 2 Option 1=SCS		3=Green-Ampt; 4=Repeat
	.000	Supply	K-lag (sec)			.250	Manning "n"		
	.500		ighting fac	ctor			74.000	SCS Curve No Ia/S Coeffic		
	1		timestep sub-reache:	s			11.953	Initial Abst	raction	
17	COMBIN		1.599	1.599	.000 c.m/s	Reserv	1	Option 1=Tri	langlr; 2=Rectang	glr; 3=SWM HYD; 4=Lin.
Ι/		E Tunction Nod	e No.			vesetA	.4			.000 c.m/s
1.4	c m n n m	.003	1.599	1.599	1.599 c.m/s	15	.20 ADD RUNOFI		.773	C perv/imperv/total
14	START 1 1	=Zero; 2=De	fine			1.0	ADD RUNOF		.054	.000 c.m/s

```
35.240
                                                                                                                                                    Area in hectares
    35
               COMMENT
              485.000
                                                                                                                                                    Length (PERV) metres
                                                                                                                                   15.480
                                                                                                                                                    Gradient (%)
Per cent Impervious
                                                                                                                                   49.400
                * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)
                                                                                                                                                    Length (IMPERV)
%Imp. with Zero Dpth
                                                                                                                                 485.000
               DIVERT
                                                                                                                                     .000
    12
                               U/S Node No.ó 99999
                                                                                                                                                    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
                                                                                                                                      .250
                 .478
                               Threshold Discharge
                              Max. Outflow reqd.
                                                                                                                                   74.000
                                                                                                                                                    SCS Curve No or C
                       Qmax & Vol.Diverted = No flow diverted
                                                               .000 c.m/s .0 c.m
                                                                                                                                      .100
                                                                                                                                                    Ia/S Coefficient
                                                                                                                                    8.924
                                                                                                                                                    Initial Abstraction
                                                           .478
                                     .478
                                                                                                                                                    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                           .478
                                                                            .000 c.m/s
               NEXT LINK
                                                                                                                    Reserv
    16
                                          .478
                           .478
                                                           .478
                                                                             .000 c.m/s
                                                                                                                                                                               3.815
                                                                                                                                                                                                  .000 c.m/s
                                                                                                                                                                                             C perv/imperv/total
               CATCHMENT
                                                                                                                                               .236
                                                                                                                                                             .869
                                                                                                                                                                               .548
                               ID No.ó 99999
                                                                                                                                    ADD RUNOFF
                                                                                                                         15
              10.000
                                                                                                                                                         2.869
               5.910
                               Area in hectares
Length (PERV) metres
                                                                                                                                             2.869
                                                                                                                                                                               3.815
                                                                                                                                                                                                .000 c.m/s
            200,000
                                                                                                                         11
                                                                                                                                    CHANNEL
                                                                                                                                                   Base Width = Left bank slope 1:
               2.000
                               Gradient (%)
                                                                                                                                     2.000
              85,000
                               Per cent Impervious
                                                                                                                                    3.000
                                                                                                                                                   Right bank slope
Manning's "n"
            200.000
                               Length (IMPERV)
                                                                                                                                    3.000
                .000
                               %Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
                                                                                                                                    .040
1.500
                                                                                                                                                   O/a Depth in metres
                 .250
                               Manning "n"
                                                                                                                                      .900
                                                                                                                                                   Select Grade in %
                                                                                                                                    .900 Select Grade in %
Depth = .596 metres
Velocity = 1.269 m/sec
Flow Capacity = 20.730 c.m/s
Critical depth = .468 metres
              74.000
                               SCS Curve No or C
                .100
                               Ia/S Coefficient
              11.953
                               Initial Abstraction
                               Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                          9
                                                                                                                                    ROUTE
                                                           .478
                                                                                                                                                    Conduit Length
                          .829
                                                                             .000 c.m/s
                                                                                                                                 393.000
                                                                                                                                                   Supply X-factor <.5
Supply K-lag (sec)
Beta weighting factor
                                          .864
                                                           .765
                                                                         C perv/imperv/total
                                                                                                                                      .458
                           .204
                                                                                                                                 232.207
    1.5
               ADD RUNOFF
                                         1.306
                                                          .478
                          .829
                                                                          .000 c.m/s
                                                                                                                                 200.000
               CATCHMENT
                                                                                                                                                   Routing timestep
                                                                                                                                             No. of sub-reaches
2.869 2.869
                               ID No.6 99999
                                                                                                                                     1
             20.000
               6.380
                               Area in hectares
                                                                                                                                                                               2.802
                                                                                                                                                                                                  .000 c.m/s
                                                                                                                                    NEXT LINK
            205,000
                               Length (PERV) metres
                                                                                                                         16
                                                                                                                                                         2.802 2.802
               2.000
                               Gradient (%)
                                                                                                                                             2.869
                                                                                                                                                                                                  .000 c.m/s
                               Per cent Impervious
Length (IMPERV)
                                                                                                                                    CATCHMENT
              85.000
                                                                                                                          4
                                                                                                                                   60.000
                                                                                                                                                   ID No.ó 99999
            205.000
                .000
                               %Imp. with Zero Dpth
                                                                                                                                    2.430
                                                                                                                                                   Area in hectares
Length (PERV) metres
                                                                                                                                 125.000
                               Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
                 .250
                                                                                                                                                   Gradient (%)
Per cent Impervious
                               Manning "n"
                                                                                                                                    2.000
                               SCS Curve No or C
Ia/S Coefficient
              74.000
                                                                                                                                      .000
                                                                                                                                 125.000
                                                                                                                                                    Length (IMPERV)
                 .100
                                                                                                                                                   length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
                                                                                                                                    .000
              11.953
                               Initial Abstraction
                               Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                      .250
                                                                                                                                                    Manning "n"
Reserv
                          .897
                                         1.306
                                                                                                                                                    SCS Curve No or C
                                                            .478
                                                                                                                                  74.000
                                                                             .000 c.m/s
                                         .866
                                                                    C perv/imperv/total
                                                                                                                                    .100
                                                                                                                                                    Ia/S Coefficient
                           .204
                                                          .767
    15
               ADD RUNOFF
                                                                                                                                    8.924
                                                                                                                                                    Initial Abstraction
                                         2.203 .478
                                                                                                                                                   Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                          .897
                                                                           .000 c.m/s
             HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .5569779E+04 c.m
    27
                                                                                                                    Reserv
                                                                                                                                                                                                  .000 c.m/s
                                                                                                                                                         .000
                                                                                                                                                                              .236
                                                                                                                                                                                              C perv/imperv/total
                                                                                                                                                .236
                                                                                                                                  ADD RUNOFF
               CATCHMENT
                                                                                                                         1.5
              30.000
                              ID No.ó 99999
                                                                                                                                              .035
                                                                                                                                                         2.813 2.802
                                                                                                                                                                                                  .000 c.m/s
              11.250
                              Area in hectares
Length (PERV) metres
                                                                                                                          9
                                                                                                                                    ROUTE
                                                                                                                                 452.000
                                                                                                                                                   Conduit Length
            260,000
                              Gradient (%)
Per cent Impervious
Length (IMPERV)
                                                                                                                                                   Supply X-factor <.5
Supply K-lag (sec)
               2.000
                                                                                                                                      .464
                                                                                                                                 268.490
              85,000
            260.000
                                                                                                                                                   Beta weighting factor
                              Pengun (IMPENY)

**Imp. with Zero Dpth

Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
               .000
                                                                                                                                 200.000
                                                                                                                                                   Routing timestep
No. of sub-reaches
                                                                                                                                   NO. of sub-rea
.035 2.813
COMBINE
                 . 250
                               Manning "n"
                                                                                                                                                                              2 413
                                                                                                                                                                                                 .000 c.m/s
                              SCS Curve No or C
                                                                                                                         1.7
              74.000
                                                                                                                                  1 Junction Node No.
                               Ia/S Coefficient
                                                                                                                                                                               2.413
                                                                                                                                                                                                2.413 c.m/s
              11.953
                               Initial Abstraction
                                                                                                                                              .035 2.813
                              Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                         14
                                                                                                                                    START
                                                                                                                                           1=Zero; 2=Define
Reserv
                                                                                                                                    FILE HYDROGRAPH
                       1.613
                                         2,203
                                                                             .000 c.m/s
                                                                      C perv/imperv/total
                                       .876
                                                                                                                                           HISTOCKARIN IN THE CONTROL OF THE CO
                                                       .775
                          .204
               ADD RUNOFF
    1.5
                                                                                                                                 12
                       1.613
                                                                           .000 c.m/s
                                                                                                                                                         .000
    27
               HYDROGRAPH DISPLAY
                                                                                                                                              .035
                                                                                                                                                                              2.413
                                                                                                                                                                                               2.413 c.m/s
                    is # of Hyeto/Hydrograph chosen
                                                                                                                                    CATCHMENT
               Volume = .9569145E+04 c.m
                                                                                                                                               ID No.ó 99999
Area in hectares
                                                                                                                                  50.000
10.320
    35
               COMMENT
               line(s) of comment
                                                                                                                                 260.000
                                                                                                                                                    Length (PERV) metres
                                                                                                                                    2.000
                                                                                                                                                   Gradient (%)
Per cent Impervious
               * NORTH VILLAGE OF EAST FONTHILL POND *
                                                                                                                                  85.000
                                                                                                                                                   Length (IMPERV) %Imp. with Zero Dpth
                                                                                                                                 260.000
               ROUTE
                                                                                                                                     .000
                              Conduit Length
                                                                                                                                                   Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
                                                                                                                                      .250
                 .500
                              No Conduit defined
                                                                                                                                                    SCS Curve No or C
                 .000
                              Zero lag
                                                                                                                                  74.000
                              Beta weighting factor
                  500
                                                                                                                                      .100
                                                                                                                                                   Ia/S Coefficient
                                                                                                                                    8.924
                                                                                                                                                    Initial Abstraction
            600.000
                              Routing timestep
                              No. of sub-reaches
                                                                                                                                                   Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                        1.613 3.815 3.815
                                                                         .000 c.m/s
                                                                                                                    Reserv
                                                                                                                                                              .000
                                                                                                                                                                              2.413
               NEXT LINK
                                                                                                                                                                                               2.413 c.m/s
                                                                                                                                                                                          C perv/imperv/total
                                    3.815 3.815
                                                                            000 c m/s
                        1.613
                                                                                                                                               .236
                                                                                                                                                              .876
                                                                                                                                                                              .780
                                                                                                                                    ADD RUNOFF
               START
    14
                                                                                                                                                         1.480
                                                                                                                                    1.480 1.
HYDROGRAPH DISPLAY
                                                                                                                                                                              2.413
                       1=Zero; 2=Define
                                                                                                                                                                                           2.413 c.m/s
    35
               COMMENT
                                                                                                                                    is # of Hyeto/Hydrograph chosen
Volume = .3691582E+04 c.m
COMMENT
                                                                                                                                  CATCHMENT
              40.000 ID No.6 99999
                                                                                                                                    * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND
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is # of Hveto/Hvdrograph chosen
                                                                                           Volume = .9116987E+04 c.m
           ROUTE
            .000
                      Conduit Length
                                                                                    1.4
                                                                                           START
                                                                                                1=Zero; 2=Define
            .500
                     Supply X-factor <.5
Supply K-lag (sec)
            .000
                                                                                    35
                                                                                           COMMENT
                                                                                           line(s) of comment
             .500
                     Beta weighting factor
                     Routing timestep
         600.000
                                                                                           * 100 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
                     No. of sub-reaches
                 1.480
                                                    2.413 c.m/s
                            1.480
           COMBINE
                                                                                           STORM
                                                                                                      1=Chicago; 2=Huff; 3=User; 4=Cdnlhr; 5=Historic
               Junction Node No.
                                                                                                      Coefficient a
                 1.480 1.480
                                                    3.893 c.m/s
                                                                                        1020.000
                                        1.480
                                                                                                      Constant b Exponent c
                                                                                                                     (min)
   14
           START
                                                                                           4.700
                1=Zero; 2=Define
                                                                                           .731
           CONFLUENCE

Junction Node No.
                                                                                                      Fraction to peak r
Duration ó 240 min
                                                                                            400
                                                                                         240.000
          1
                 1.480
                         3.893
                                        1.480
                                                      .000 c.m/s
                                                                                                     73.207 mm
                                                                                                                  Total depth
                                                                                           IMPERVIOUS
           CATCHMENT
                                                                                     3
    4
                                                                                                     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n" SCS Curve No or C
                     ID No.ó 99999
          70.000
           2.340
                     Area in hectares
Length (PERV) metres
                                                                                            .015
                                                                                          98.000
         120.000
                                                                                           .100
                     Gradient (%)
Per cent Impervious
           2.000
                                                                                                      Ia/S Coefficient
                                                                                                     Initial Abstraction
            .000
                                                                                             .518
                     Length (IMPERV)
         120.000
                                                                                           COMMENT
                     Mengel (IMFBAY)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
                                                                                           line(s) of comment
           .000
                                                                                           .250
                     Manning "n"
                     SCS Curve No or C
          74.000
           .100
                      Ia/S Coefficient
                                                                                               1=Zero; 2=Define
           8.924
                      Initial Abstraction
                     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                           CATCHMENT
                                                                                          31.000
                                                                                                     ID No.6 99999
                            3.893
                                        1.480
                                                      .000 c.m/s
                  .034
                                                                                           3.530
                                                                                                      Area in hectares
                   .236
                             .000
                                         .236
                                                   C perv/imperv/total
                                                                                         155 000
                                                                                                      Length (PERV) metres
          ADD RUNOFF
                                                                                                      Gradient (%)
Per cent Impervious
   1.5
                                                                                           2.000
                  .034
                                                     .000 c.m/s
                                                                                          85.000
    9
           ROUTE
                                                                                         155.000
                                                                                                      Length (IMPERV)
                     Conduit Length
                                                                                                      %Imp. with Zero Dpth
                                                                                            .000
           .000
                     Supply X-factor <.5
Supply K-lag (sec)
Beta weighting factor
                                                                                                     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
            .500
                                                                                            .250
            .000
                                                                                          74.000
                                                                                                      SCS Curve No or C
            .500
         600 000
                     Routing timestep
No. of sub-reaches
                                                                                            .100
                                                                                                      Ta/S Coefficient
                                                                                          11.953
                                                                                                      Initial Abstraction
          No.
.034
COMBINE
             1
                         3.904
                                        3.904
                                                     .000 c.m/s
                                                                                                     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
   17
                                                                                Reserv
         2 Junction Node No.
                                                                                                  826
                                                                                                              .000
                                                                                                                          247
                                                                                                                                      .000 c.m/s
                         3.904
                                        3.904
                                                    3.904 c.m/s
                                                                                                              .916
                                                                                                                                   C perv/imperv/total
                 .034
                                                                                                  .340
                                                                                                                          .830
                                                                                           ADD RUNOFF
          START
                                                                                           .826
COMMENT
                                                                                                              .826
                                                                                                                         .247
               1=Zero; 2=Define
                                                                                                                                     .000 c.m/s
          CATCHMENT
                                                                                    35
                                                                                           line(s) of comment
          80.000
                     ID No.ó 99999
                     Area in hectares
Length (PERV) metres
         38.600
                                                                                           510.000
                     Gradient (%)
Per cent Impervious
          2,000
          43.500
                                                                                           DIVERT
        510.000
                     Length (IMPERV)
                                                                                               9
                                                                                                     II/S Node No. 6 99999
                     %Imp. with Zero Dpth
                                                                                            .478
                                                                                                     Threshold Discharge
           .000
                     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
                                                                                            .574
                                                                                                     Max. Outflow reqd.
            .250
                                                                                                                            .252 c.m/s
                                                                                                                                             254.0 c.m
                                                                                                Omax & Vol.Diverted =
                                                                                                No flow diverted .826 .826
                     SCS Curve No or C
          74.000
                                                                                                                         .574 .000 c.m/s
            .100
                     Ia/S Coefficient
          8.924
                     Initial Abstraction
                                                                                   16
                                                                                           NEXT LINK
                                                                                                            .574
                                                                                                                       .574
                     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                   .826
                                                                                                                                     .000 c.m/s
                                                                                           CATCHMENT
                                                                                    4
Reserv
                                        3.904
                                                                                          10.000
                                                                                                     ID No.ó 99999
                 2.876
                                                    3.904 c.m/s
                                                  C perv/imperv/total
                            .877
                                        .515
          .236
ADD RUNOFF
                                                                                           5.910
                                                                                                     Area in hectares
Length (PERV) metres
   1.5
                                                                                         200.000
                                                3.904 c.m/s
                                                                                                     Gradient (%)
Per cent Impervious
                 2.876
                            2.876
                                        3.904
                                                                                           2.000
          HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .9116987E+04 c.m
                                                                                          85.000
   27
                                                                                         200.000
                                                                                                      Length (IMPERV)
                                                                                                      %Imp. with Zero Dpth
                                                                                           .000
                                                                                                      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
   35
                                                                                            . 250
                                                                                                     Manning "n"
SCS Curve No or C
           line(s) of comment
                                                                                          74.000
          * FUTURE STORMWATER MANAGEMENT FACILITY 706
                                                                                          .100
11.953
                                                                                                      Ia/S Coefficient
                                                                                                      Initial Abstraction
                                                                                                     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
          POND
        10 Depth - Discharge - Volume sets
                                                                                Reserv
                         .000
          187.500
                                                                                                 1.311
                                                                                                                                      .000 c.m/s
                                     1300.3
                                                                                                             .914
                                                                                                                         .828
           187.670
                                                                                          .340
ADD RUNOFF
                                                                                                                                  C perv/imperv/total
                         .0570
                                     2689.4
                                                                                   15
          187.830
                         .0760
                                     3804.3
                                                                                                            1.885
                                                                                                                          .574
                                                                                                                                     .000 c.m/s
                                                                                                 1.311
                                                                                    4
                                                                                           CATCHMENT
          188.170
                          .234
                                     5733.6
           188.330
                                                                                                     ID No.ó 99999
                          .334
                                                                                          20.000
          188.500
188.670
                                                                                                     Area in hectares
Length (PERV) metres
                          .383
                                     9132.6
                                                                                           6.380
                                                                                         205.000
                          .426
                                    10965.2
                                                                                                     Gradient (%)
Per cent Impervious
           188.830
                          .637
                                    12886.5
                                                                                          2.000
                          .954
                                                                                          85.000
          189.000
                                    14896.4
          Maximum Depth = 188.191 metres
Maximum Storage = 5955. c.m
           Peak Outflow
                                                                                                      Length (IMPERV)
                                                                                         205.000
                                                                                                     Simp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
                                                                                           .000
                                         .247
                                                                                                     Manning "n"
SCS Curve No or C
                2.876
                           2.876
                                                    3.904 c.m/s
                                                                                            250
          COMBINE
                                                                                          74.000
   17
              Junction Node No.
                                                                                            .100
                                                                                                     Ia/S Coefficient
                         2.876
                2.876
                                         .247
                                                    3.943 c.m/s
                                                                                          11.953
                                                                                                     Initial Abstraction
          START 1=Zero; 2=Define
   1.4
                                                                                                     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                Reserv
                                                                                                            1.885
          CONFLUENCE
                                                                                                                                     .000 c.m/s
   18
          Junction Node No.
2.876 3.943
HYDROGRAPH DISPLAY
                                                                                                  .340
                                                                                                             .913
                                                                                                                          .827
                                                                                                                                  C perv/imperv/total
                                         .247
                                                     .000 c.m/s
                                                                                   15
                                                                                          ADD RUNOFF
                            3.943
                                                                                                 1.407
                                                                                                            3.292
                                                                                                                          574
                                                                                                                                     .000 c.m/s
   27
```

```
HYDROGRAPH DISPLAY
          5 is # of Hyeto/Hydrograph chosen
Volume = .9333898Fi04
                                                                             Reserv
                                                                                                       4.594
                                                                                                                    4.594
                                                                                                                                 .000 c.m/s
                    .9333898E+04 c.m
                                                                                                                              C perv/imperv/total
                                                                                               .367
                                                                                                          .000
                                                                                                                     .367
          CATCHMENT
                                                                                15
                                                                                       ADD RUNOFF
                                                                                              .113
                                                                                                                    4.594
         30.000
                    ID No.ó 99999
                                                                                                        4.654
                                                                                                                                 .000 c.m/s
                                                                                       ROUTE
                    Area in hectares
Length (PERV) metres
                                                                                 9
         11.250
                                                                                                  Conduit Length
        260.000
                                                                                     452.000
          2.000
                    Gradient (%)
Per cent Impervious
                                                                                        .455
                                                                                                  Supply X-factor <.5
Supply K-lag (sec)
         85.000
                                                                                                  Beta weighting factor
Routing timestep
        260.000
                     Length (IMPERV)
                                                                                        500
                                                                                     200.000
                    %Imp. with Zero Dpth
           .000
                    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
                                                                                                  No. of sub-reaches
                                                                                                      4.654
           250
                                                                                               .113
                                                                                                                    4.238
                                                                                                                                .000 c.m/s
                    SCS Curve No or C
                                                                                       COMBINE
         74.000
                                                                                        Junction Node No.
         .100
11.953
                    Ia/S Coefficient
                                                                                      1
                                                                                              .113 4.654
                    Initial Abstraction
                                                                                                                                4.238 c.m/s
                    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                14
                                                                                       START
                                                                                             1=Zero: 2=Define
Reserv
                         3.292 .574
                2.487
                                                   .000 c.m/s
                                                                                       FILE HYDROGRAPH
                          .904
                                                                                             1=READ: 2=WRITE
                                                C perv/imperv/total
                 .341
                                       .820
                                                                                            ADD RUNOFF
2.487
   15
                                                                                     12
                                   .574
                           5.644
                                              .000 c.m/s
          HYDROGRAPH DISPLAY
                                                                                                                               4.238 c.m/s
   27
               is # of Hyeto/Hydrograph chosen
                                                                                       CATCHMENT
          Volume
                 = .1608601E+05 c.m
                                                                                      50.000
                                                                                                 ID No.6 99999
                                                                                                  Area in hectares
          COMMENT
                                                                                                  Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
         260.000
                                                                                       2.000
          85.000
                                                                                     260,000
                                                                                                  %Imp. with Zero Dpth
          ROUTE
                                                                                        .000
                                                                                                  Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
           .000
                    Conduit Length
                    No Conduit defined
           .500
                    Zero lag
                                                                                                  SCS Curve No or C
Ia/S Coefficient
           .000
                                                                                       74.000
                    Beta weighting factor
                                                                                         .100
           .500
                    Routing timestep
                                                                                                  Initial Abstraction
                                                                                                  Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
           1 No. of sub-reaches
2.487 5.644
                                      5.644
                                                .000 c.m/s
                                                                             Reserv
                                                                                              2 284
  16
          NEXT LINK
                                                                                                          252
                                                                                                                    4 238
                                                                                                                               4.238 c.m/s
               2.487
                                                                                                                    .824
                                                                                                                              C perv/imperv/total
                         5.644
                                      5.644
                                                   .000 c.m/s
                                                                                                         .904
                                                                                              .367
          START
                                                                                15
                                                                                       ADD RUNOFF
   14
              1=Zero; 2=Define
                                                                                             2.284
                                                                                                         2.455
                                                                                                                    4.238
                                                                                                                               4.238 c.m/s
                                                                                       HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .6224218E+04 c.m
          line(s) of comment
          35
                                                                                       COMMENT
                                                                                      CATCHMENT
                                                                                       * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND
         40.000
35.240
                    ID No.ó 99999
                    Area in hectares
        485.000
                    Length (PERV) metres
                                                                                       ROUTE
                                                                                                  Conduit Length
                    Gradient (%)
Per cent Impervious
                                                                                        .000
         15.480
                                                                                                  Supply X-factor <.5
Supply K-lag (sec)
         49.400
                                                                                         .500
        485.000
                    Length (IMPERV)
                                                                                         .000
                    %Imp. with Zero Dpth
                                                                                                  Beta weighting factor
           .000
                                                                                         .500
                    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
                                                                                                 Routing timestep
No. of sub-reaches
                                                                                     600.000
           .250
         74.000
                    SCS Curve No or C
                                                                                             2.284
                                                                                                        2.455
                                                                                                                   2.455
                                                                                                                               4.238 c.m/s
                                                                                       COMBINE
                    Ia/S Coefficient
                                                                                17
           .100
                                                                                      1 Junction Node No.
                    Initial Abstraction
          8.924
                    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                    2.455
                                                                                                                               6.693 c.m/s
                                                                                             2.284 2.455
                                                                                14
                                                                                       START
Reserv
                            .000
                4.772
                                      5.644
                                                   000 c m/s
                                                                                            1=Zero; 2=Define
                                                                                       CONFLUENCE
                           .915
                                                C perv/imperv/total
                                                                                18
                 .367
                                      .638
          ADD RUNOFF
                                                                                            Junction Node No.
  15
                4.772
                          4.772
                                      5.644
                                                                                                                    2.455
                                                                                                                                .000 c.m/s
                                                  .000 c.m/s
                                                                                             2.284 6.693
                                                                                       CATCHMENT
  11
          CHANNEL
                                                                                                 ID No.ó 99999
          2.000
                    Base Width
                                                                                      70.000
                    Left bank slope 1:
Right bank slope 1:
Manning's "n"
                                                                                       2.340
                                                                                                  Area in hectares
          3.000
          3.000
                                                                                     120.000
                                                                                                  Length (PERV) metres
                                                                                       2,000
                                                                                                  Gradient (%)
           .040
          1.500
                    O/a Depth in metres
                                                                                                  Per cent Impervious
                                                                                         .000
                    Select Grade in %
= .764 metres
= 1.454 m/sec
                                                                                                  Length (IMPERV)
                                                                                     120,000
           .900
                                                                                                  %Imp. with Zero Dpth
          Depth
                                                                                        .000
          Velocity
                                                                                                  Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
                                                                                                  Manning "n"
                                                                                         . 250
          Flow Capacity = 20.730 c.m/s
Critical depth = .615 metres
                                                                                      74.000
                                                                                                  SCS Curve No or C
                                                                                                  Ia/S Coefficient
          ROUTE
                                                                                        .100
                                                                                                  Initial Abstraction
        393.000
                    Conduit Length
                                                                                       8,924
                                                                                                 Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
           .448
                    Supply X-factor <.5
Supply K-lag (sec)
        202.682
                                                                             Reserv
                                                                                              .109
                    Beta weighting factor
                                                                                                        6.693
                                                                                                                    2.455
                                                                                                                                 .000 c.m/s
           .500
                                                                                                       .000
                                                                                                                              C perv/imperv/total
        200.000
                    Routing timestep
No. of sub-reaches
                                                                                               .368
                                                                                                                    .368
                                                                                       ADD RUNOFF
                                                                                15
                                   4.594
                                                                                              .109
                                                                                                      6.752
                                                                                                                    2.455
                                                                                                                                .000 c.m/s
               4.772
                          4.772
                                                   .000 c.m/s
  16
         NEXT LINK
                                                                                 9
                                                                                       ROUTE
                                                                                        .000
                4.772
                          4.594
                                   4.594
                                                   .000 c.m/s
                                                                                                 Conduit Length
                                                                                                 Supply X-factor <.5
          CATCHMENT
                                                                                        .500
                    ID No.ó 99999
                                                                                        .000
                                                                                                  Supply K-lag (sec)
                    Area in hectares
Length (PERV) metres
          2.430
                                                                                         .500
                                                                                                 Beta weighting factor
        125.000
                                                                                     600.000
                                                                                                 Routing timestep
                    Gradient (%)
Per cent Impervious
                                                                                                 No. of sub-reaches
09 6.752
         2.000
                                                                                              .109
                                                                                                                    6.752
                                                                                                                                .000 c.m/s
           .000
                    Length (IMPERV)
%Imp. with Zero Dpth
        125.000
                                                                                17
                                                                                       COMBINE
                                                                                      2 Junction Node No.
          .000
                    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
                                                                                              .109 6.752
                                                                                                                    6.752
                                                                                                                               6.752 c.m/s
           250
                    Manning "n"
SCS Curve No or C
                                                                                14
                                                                                       START
         74.000
                                                                                            1=Zero; 2=Define
                                                                                       CATCHMENT
CO 000 ID No.6 99999
           .100
                    Ia/S Coefficient
          8.924
                    Initial Abstraction
                                                                                      80.000
                    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                 Area in hectares
                                                                                      38.600
```

	510.000	Longt	h (PERV) m	atres				187	.500	.000		.0	
	2.000		ent (%)	ecres						.0140	1300		
	43.500		ent Imperv	ions						.0570	2689		
	510.000		h (IMPERV)							.0760	3804		
	.000		with Zero						.170	.234	5733		
	1				on; 3=Green-Ampt; 4	=Reneat			.330	.334	7388		
	.250		ng "n"	/0, 2 110200	on, o dicen rampe, a	персис			.500	.383	9132		
	74.000		urve No or	C					.670	.426	10965		
	.100		Coefficien	-					.830	.637			
	8.924		al Abstrac						.000	.954	14896		
	1				anglr; 3=SWM HYD; 4	=Lin.			k Outflow		.464 c		
Reserv	-	opero		11, 1 11000		2221			imum Depth				
	4.	773	.000	6.752	6.752 c.m/s				imum Storag		11313. c		
		368	.925	.610	C perv/imperv/to	tal			4.773	4.7		.464	6.752 c.m/s
15	ADD RUNG	FF					17	COM	BINE				
	4.	773	4.773	6.752	6.752 c.m/s			2	Junction	Node N	0.		
27	HYDROGRA	PH DISP	LAY						4.773	4.7	73	.464	6.869 c.m/s
	4 is	# of Hv	eto/Hvdrog	raph choser	n.		14	STA	RT				
			3819E+05 c					1	1=Zero; 2	=Defin	е		
35	COMMENT						18	CON	FLUENCE				
	3 lin	e(s) of	comment					2	Junction	Node N	ο.		
	******	*****	*****	******	*******	*****			4.773	6.8	69	.464	.000 c.m/s
	* FUTURE	STORMW	ATER MANAGI	EMENT FACII	LITY 706	*	27	HYD	ROGRAPH DIS	PLAY			
	******	*****	*****	*****	******	****		4	is # of H	yeto/H	ydrograph	chosen	
10	POND							Vol	ume = $.17$	23819E	+05 c.m		
	10 Depth -	Discha	rge - Volu	me sets			20	MAN	UAL				
	-		_										

APPENDIX D

MIDUSS Output Files - Future Drainage Conditions with SWM

```
11.250
260.000
2.000
85.000
260.000
                      Output File (4.7) SWMNEW.OUT opened 2014-10-06 16:28
Units used are defined by G = 9.810
24 144 10.000 are MAXDT MAXHYD & DTMIN values
Licensee: UPPER CANADA CONSULTANTS
                                                                                                                                                                                                                  Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                                                    Area in hectares
                      LICENSEE: UPPER CANADA CONSULTANTS
COMMENT
3 line(s) of comment
THE VILLAGE OF EAST FONTHILL, TOWN OF PELHAM
STORMWATER MANAGEMENT PLAN, OCT 2014
FUTURE CONDITIONS - WITH STORMWATER MANAGEMENT
COMMENT
Line(s) of comment
      35
                                                                                                                                                                                                .000
                                                                                                                                                                                           .250
                                                                                                                                                                                           .100
                      l line(s) of comment
25mm - 4HOUR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES
                                                                                                                                                                                           .767 1.069 .241
.053 .791 .680
ADD RUNOFF 1.836 .241
HYDROGRAPH DISPLAY
5 is # of Hyeto/Hydrograph chosen
Volume = .4211089E+04 c.m
                                                                                                                                                                       Reserv
                                            1=Chicago; 2=Huff; 3=User; 4=Cdn1hr; 5=Historic
                                                                                                                                                                                                                                                                               .000 c.m/s
C perv/imperv/total
                  500.000
                                          Coefficient a
Constant b (min)
Exponent c
Fraction to peak r
Duration ó 240 min
22.981 mm Total depth
                      8.100
                                                                                                                                                                              15
                                                                                                                                                                                                                                                                                    .000 c.m/s
                                                                                                                                                                              27
                           400
                  240.000
         3
                      IMPERVIOUS
                                                                                                                                                                              35
                                           Soption 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
                                                                                                                                                                                             COMMENT
| line(s) of comment
| ********************************
                          .
015
                    98.000
                                                                                                                                                                                             * NORTH VILLAGE OF EAST FONTHILL POND **
                        .100
                                                                                                                                                                              10
                                                                                                                                                                                             POND
                                                                                                                                                                                                           - Discharge - Volume sets
0 .000 .0
0 .0420 1342.3
0 .0740 3017.2
                                                                                                                                                                                        10 Depth -
186.550
186.840
                      35
                                                                                                                                                                                                                                                 .0
1342.3
3017.2
4375.6
7149.5
10115.3
13272.9
                      187,150
                                                                                                                                                                                             187.380
187.830
188.270
188.720
                                                                                                                                                                                                                            .0910
                                                                                                                                                                                                                         .0910
.936
1.161
1.349
1.514
1.797
11.210
                     START
1 1=Zero; 2=Define
      14
                 CATCHMENT
31.000
3.530
155.000
2.000
85.000
                                           ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CM/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS CUrve No or C
                                                                                                                                                                                            189.160 1.514 16622.5

189.160 1.514 16622.5

189.610 1.797 20163.9

190.050 11.210 23897.2

Peak Outflow = .079 c.m/s

Maximum Depth = 187.217 metres

Maximum Storage = 3412. c.m

.767 1.836 .079
                                                                                                                                                                                                                                                                                     .000 c.m/s
                        .000
                                                                                                                                                                                             NEXT LINK
.767
                                                                                                                                                                              16
                          1
250.
                                           Manning "n"

SCS Curve No or C

Ia/S Coefficient

Initial Abstraction

Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                                                                    .079
                                                                                                                                                                                                                                                            .079
                                                                                                                                                                                                                                                                                     .000 c.m/s
                   74.000
.100
11.953
                                                                                                                                                                              14
                                                                                                                                                                                             START
                                                                                                                                                                                                        1=Zero; 2=Define
                                                                                                                                                                                             COMMENT
                                                                                                                                                                                           line(s) of comment
Reserv
                                      .241
.053
                                                                                                         .000 c.m/s
C perv/imperv/total
                                                                                                                                                                                             * OUTLET B
                                                                                                                                                                                             CATCHMENT
                                                                                                                                                                                                                 ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
      15
                     COMMENT
3
                      ADD RUNOFF
                                                                                                                                                                                         40.000
35.240
485.000
                                                             .241
                                                                                       .000
                                                                                                              .000 c.m/s
      35
                      line(s) of comment
                                                                                                                                                                                         15.480
49.400
485.000
.000
                      * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR) *
      12
                      DTVFRT
                                RT
9 U/S Node No.ó 99999
8 Threshold Discharge
4 Max. Outflow reqd.
Qmax & VOl.Diverted =
No flow diverted
.241
LINK
                        .478
.574
                                                                                                                                                                                                 . 250
                                                                                                                                                                                           74.000
                                                                                          .000 c.m/s
                                                                                                                                        .0 c.m
                                                                                                                                                                                                 .100
                                                                                                                                                                                                                   Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                            8.924
                                                                                      .241
                                                                                                    .000 c.m/s
                     NEXT LINK
.241
CATCHMENT
      16
                                                                                                                                                                       Reserv
                                                                                                                                                                                            1.395
.083
ADD RUNOFF
1.395
                                                             .241
                                                                                      .241
                                                                                                                                                                                                                                                                                .000 c.m/s
C perv/imperv/total
                                                                                                              .000 c.m/s
                                           ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CM/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
                 CATCHM
10.000
5.910
200.000
2.000
85.000
200.000
.000
                                                                                                                                                                              15
                                                                                                                                                                                                                                  1.395
                                                                                                                                                                                                                                                             .079
                                                                                                                                                                                                                                                                                    .000 c.m/s
                                                                                                                                                                              11
                                                                                                                                                                                            CHANNEL
2.000 Base Width =
3.000 Left bank slope 1:
3.000 Right bank slope 1:
0.40 Manning's "n"
1.500 O/a Depth in metres
0.900 Select Grade in %
Depth = .414 metres
Velocity = 1.040 m/sec
Flow Capacity = 20.730 c.m/s
Critical depth = .312 metres
ROUTF
                                                                                                                                                                                             CHANNEL
                   .250
74.000
.100
11.953
                                           ROUTE
393.000
.470
283.376
                                                                                                                                                                                9
Reserv
                                                                                                                                                                                                                  Conduit Length
Supply X-factor <.5
Supply K-lag (sec)
Beta weighting factor
Routing timestep
No. of sub-reaches
1.395
1.22
                                                                                                         .000 c.m/s
C perv/imperv/total
                                      .399
.053
                                                              .241
                                                                                      .241
                     ADD RUNOFF
      15
                                                             . 640
                                                                                                                                                                                        .500
                                                                                                              .000 c.m/s
                                          ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                      CATCHMENT
                 20.000
6.380
205.000
                                                                                                                                                                                                     1
                                                                                                                                                                                            1.395
NEXT LINK
1.395
                                                                                                                                                                                                                                                          1.212
                                                                                                                                                                                                                                                                                     .000 c.m/s
                 2.000
85.000
205.000
                                                                                                                                                                                                                                 1.212
                                                                                                                                                                                                                                                         1.212
                                                                                                                                                                                                                                                                                    .000 c.m/s
                                                                                                                                                                                             CATCHMENT
                                                                                                                                                                                                                 ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                        60.000
2.430
125.000
                        .000
                   .250
74.000
                                                                                                                                                                                        2.000
.000
125.000
                          100
                   11.953
                                                                                                                                                                                                .000
                                                                                                                                                                                           .250
Reserv
                                                                                                         .000 c.m/s
C perv/imperv/total
                                       430
                                                             .640
.791
                     .053
ADD RUNOFF
.430
                                                                                                                                                                                            .100
8.924
      15
                                                          1.069
                                                                                      .241
                                                                                                             .000 c.m/s
                     HYDROGRAPH DISPLAY
is # of Hyeto/Hydrograph chosen
Volume = .2459709E+04 c.m
      27
                                                                                                                                                                       Reserv
                                                                                                                                                                                                                                                          1.212
                                                                                                                                                                                                                                                                               .000 c.m/s
C perv/imperv/total
                                                                                                                                                                                                              003
                                                                                                                                                                                            ADD RUNOFF .003
                      CATCHMENT
                                                                                                                                                                             15
                                                                                                                                                                                                                                  1 212
                                                                                                                                                                                                                                                          1.212
                                                                                                                                                                                                                                                                                    .000 c.m/s
                                           ID No.ó 99999
                    30.000
```

```
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
                                                                                                                                                                    1
.250
74.000
.100
8.924
        9
                    ROUTE
                                       Conduit Length
                452.000
                                 Conduit Length
Supply X-factor <.5
Supply K-lag (sec)
Beta weighting factor
Routing timestep
No. of sub-reaches
.003 1.212 1.1
                .475
                .500
                                                                                                                                                                                          Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                   Reserv
                                                                          1.141
                                                                                                                                                                      1.077
.083
ADD RUNOFF
                                                                                                                                                                                                                            1.159
.392
                                                                                                                                                                                                                                               1.159 c.m/s
C perv/imperv/total
                                                                                                .000 c.m/s
                                                                                                                                                                     ADD RUNOFF
1.077
1.077
1.159
HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .3466319E+04 c.m
COMMENT
Jing(C)
                   COMBINE
      17
                             Junction Node No.
.003 1.212
                                                                                                                                                        15
                                                                         1.141
                                                                                              1.141 c.m/s
                                                                                                                                                                                                                                                 1.159 c.m/s
                                                                                                                                                         27
      14
                   START
                             1=zero; 2=Define
                   l 1=Zero; 2=DeTine

FILE HyDROGRAPH

l 1=READ: 2=WRITE

DIV00009:25M is Filename

2 1=Overland: 2=Inflow: 3=Outflow: 4=Temp'ary

.003 .000 1.141 1.141 c.m/s
                1
12
2
                                                                                                                                                                      * FUTURE STORMWATER MANAGEMENT FACILITY 706
                                     ID No.6 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                   CATCHMENT
               50.000
10.320
260.000
                                                                                                                                                        10
                                                                                                                                                                  POND
10 Depth - Discharge - Volume sets
187.500 .000 .0
187.670 .0140 1300.3
187.830 .0570 2689.4
187.960 .0760 3804.3
188.170 .234 5733.6
188.330 .334 7388.8
188.500 .383 9132.6
188.670 .426 10965.2
188.830 .637 12886.5
189.000 .954 14896.4
Peak Outflow - 054 c m/s
                                                                                                                                                                      POND
                   2.000
                85.000
260.000
.000
                       .
250
                  74.000
                       100
                   8.924
                                                                                                                                                                      Peak Outflow = Maximum Depth = Maximum Storage = 1.077
                                                                                                                                                                                                    = .054 c.m/s
= 187.820 metres
                                                                                                                                                                                                   = 2599. c.m
1.077
                  .703 .000 1.141
.083 .791 .685
ADD RUNOFF
.703 .703 1.141
HYDROGRAPH DISPLAY
volume = .1623832E+04 c.m
Reserv
                                                                                              1.141 c.m/s
                                                                                                                                                                                                                               .054
                                                                                            C perv/imperv/total
                                                                                                                                                                                                                                                 1.159 c.m/s
                                                                                                                                                                      COMBINE
2 Junction Node No.
1.077 1.077
      15
                                                                                                                                                        17
                                                                                             1.141 c.m/s
                                                                                                                                                                                                                              .054
      27
                                                                                                                                                                                                                                                 1.172 \text{ c.m/s}
                                                                                                                                                        14
                                                                                                                                                                      START
                                                                                                                                                                               1=Zero; 2=Define
                                                                                                                                                                    1 I=ZETO, Z-DC....

CONFLUENCE
2 JUNCTION NODE NO.
1.077 1.172 .054

HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .3466319E+04 c.m
                                                                                                                                                        18
      35
                   line(s) of comment
                                                                                                                                                                                                                                                   .000 c.m/s
                     27
     10
                   POND
                                   Discharge - Volume sets

.000 .0

.01000 384.8

.0180 795.9

.0290 2027.4

.0330 2087.0

.0430 2187.1

.267 2703.4

.426 3246.0

.466 3814.9

1.132 8533.8
                                                                                                                                                                      START
1 = Zero; 2=Define
               10 Depth - 189.900
                                                                                                                                                                    190.070
190.230
190.680
                                                                                                                                                        35
                                                                                                                                                                      190.700
190.730
190.900
                                                                                                                                                          2
                                                                                                                                                                                       1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
Coefficient a
Constant b (min)
Exponent c
Fraction to peak r
Duration ó 240 min
45.876 mm Total depth
                   191.070
                                                                                                                                                                  830.000
                  191.070 .44
191.230 .44
192.400 1.1:
Peak Outflow =
Maximum Depth =
Maximum Storage =
.703
COMBINE
                                                .466 3814.9
.132 8533.8
= .023 c.m/s
= 190.438 metres
                                                                                                                                                                      7.300
                                                                                                                                                                          400
                                                    = 1365. c.m
.703 .023
                                                                                                                                                                  240,000
                                                                                              1.141 \text{ c.m/s}
                                                                                                                                                                      IMPERVIOUS
     17
                                                                                                                                                                                        S
option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
                           Junction Node No.
.703 .703
                                                                                                                                                                         .015
                                                                                              1.159 c.m/s
                                                                            .023
                                                                                                                                                                    98.000
     14
                   START
                             1=Zero; 2=Define
                                                                                                                                                                        . 100
                 CONFLUENCE
Junction Node No.
.703 1.159
      18
                                                                                                                                                                         518
                                                                           .023
                                                                                                .000 c.m/s
                                                                                                                                                                    line(s) of comment
                                     ID No.ó 99999

Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                   CATCHMENT
               70.000
2.340
120.000
                                                                                                                                                                      * OUTLET A ***************************
                                                                                                                                                        14
                                                                                                                                                                      START
               2.000
.000
120.000
                                                                                                                                                                               1=zero; 2=Define
                                                                                                                                                                    CATCHMENT
31.000
3.530
                                                                                                                                                                                       ID No.6 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                     .000
                                                                                                                                                                  155.000
2.000
85.000
                 .250
                   .100
8.924
                                                                                                                                                                  155,000
                                                                                                                                                                        .000
                                                                                                                                                                         1
250.
Reserv
                                                                                                                                                                    74.000
.100
11.953
                                 .003
                                                                                            .000 c.m/s
C perv/imperv/total
                  ADD RUNOFF
     15
                                .003
                                                  1.159
                                                                           .023
                                                                                                .000 c.m/s
                   ROUTE
                                                                                                                                                   Reserv
                                     Conduit Length
No Conduit defined
Zero lag
Beta weighting factor
Routing timestep
No. of sub-reaches
03 1.159 1.15
                                                                                                                                                                                                                                              .000 c.m/s
C perv/imperv/total
                     .000
               .475
339.120
.500
300.000
                                                                                                                                                                                     . 204
                                                                                                                                                                     ADD RUNOFF
.478
COMMENT
                                                                                                                                                        15
                                                                                                                                                                                                       . 478
                                                                                                                                                                                                                             .054
                                                                                                                                                                                                                                                  .000 c.m/s
                                                                                                                                                        35
                                                                                                                                                                      line(s) of comment
                                                                         1.159
                                                                                                .000 c.m/s
                                 .003
                   COMBINE
                                                                                                                                                                      * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR) *
     17
                            Junction Node No.
.003 1.159
                                                                        1.159
                                                                                             1.159 c.m/s
                                                                                                                                                        12
                                                                                                                                                                      DIVERT
                  START
1 =Zero; 2=Define
                                                                                                                                                                               9 U/S Node No.ó 99999
B Threshold Discharge
4 Max. Outflow reqd.
Qmax & Vol.Diverted =
No flow diverted
478 .478
                                                                                                                                                                        . 478
. 574
     14
                   CATCHMENT
                                     ID No. 6 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
                 80.000
38.600
                                                                                                                                                                                                                                   .000 c.m/s
                                                                                                                                                                                                                                                                          .0 c.m
                                                                                                                                                                                                                              . 478
                                                                                                                                                                                                                                                  .000 c.m/s
               510.000
               2.000
43.500
510.000
                                                                                                                                                        16
                                                                                                                                                                      NEXT LINK
                                                                                                                                                                      .478
CATCHMENT
                                                                                                                                                                                                       . 478
                                                                                                                                                                                                                              .478
                                                                                                                                                                                                                                                  .000 c.m/s
                                                                                                                                                                                        ID No.ó 99999
                                                                                                                                                                    10.000
                      000
```

```
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr: 2=Rectanglr: 3=SWM HYD: 4=Lin.
                                                                                                                                                                                                                                                 2.869
                                                                                                                                                                                                                                                                             . 602
                        5.910
                                                                                                                                                                                                                        2.869
                                                                                                                                                                                                                                                                                                      .000 c.m/s
                  200.000
2.000
85.000
200.000
                                                                                                                                                                                                         CHANNEL
2.000
3.000
3.000
                                                                                                                                                                                         11
                                                                                                                                                                                                                                Base Width =
Left bank slope 1:
Right bank slope 1:
Manning's "l"
O/a Depth in metres
Select Grade in %
= .596 metres
1.269 m/sec
city = 20.730 c.m/s
depth = .468 metres
                                                                                                                                                                                                         .040
1.500
.900
                          .000
                            1
250.
                                                                                                                                                                                                         Depth = Velocity = Flow Capacity = Critical depth =
                     74.000
                     .100
                                               Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                                                                                            .468 metres
                                                                                                                                                                                                     ROUTE
393.000
                                                                                                                                                                                                                                Conduit Length
Supply X-factor <.5
Supply K-factor <.5
Supply K-lag (sec)
Beta weighting factor
Routing timestep
No. of sub-reaches
69 2.869 2.86
                                                                 . 478
. 864
                                                                                                               .000 c.m/s
C perv/imperv/total
                                          204
                                                                                                                                                                                                     .458
       15
                       ADD RUNOFF
                                         .829
                                                              1.306
                                                                                            . 478
                                                                                                                                                                                                     .500
                                                                                                                     .000 c.m/s
                                             ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                       CATCHMENT
                  CATCHN
20.000
6.380
205.000
2.000
85.000
205.000
.000
                                                                                                                                                                                                                  1
                                                                                                                                                                                                                       2.869
                                                                                                                                                                                                                                                                          2.802
                                                                                                                                                                                                                                                                                                       .000 c.m/s
                                                                                                                                                                                                         NEXT LINK
2.869
                                                                                                                                                                                                                                               2.802
                                                                                                                                                                                                                                                                          2.802
                                                                                                                                                                                                                                                                                                       .000 c.m/s
                                                                                                                                                                                                                               ID No.6 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                                          CATCHMENT
                                                                                                                                                                                                     60.000
2.430
125.000
                    . 250
                                                                                                                                                                                                     2.000
.000
125.000
                            100
                     11.953
                                                                                                                                                                                                             .000
                                                                                                                                                                                                       .250
74.000
Reserv
                                         . 897
                                                             1.306
                                                                                                                .000 c.m/s
C perv/imperv/total
                      .89/ 1.306 .4/8

.204 .866 .767

ADD RUNOFF .897 2.203 .478

HYDROGRAPH DISPLAY

5 is # of Hyeto/Hydrograph chosen

Volume = .5569779E+04 c.m

CATCHMENT
                                                                                                                                                                                                         8.924
                                                                                                                     .000 c.m/s
       27
                                                                                                                                                                                  Reserv
                                                                                                                                                                                                                          .035
                                                                                                                                                                                                                                                                                                  .000 c.m/s
C perv/imperv/total
                                             ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                         15
                                                                                                                                                                                                         ADD RUNOFF
                       CATCHMENT
                  30.000
11.250
260.000
2.000
85.000
260.000
                                                                                                                                                                                                                                                                           2.802
                                                                                                                                                                                                                          .035
                                                                                                                                                                                                                                                 2.813
                                                                                                                                                                                                                                                                                                      .000 c.m/s
                                                                                                                                                                                                    ROUTE
452.000
.464
268.490
.500
200.000
                                                                                                                                                                                                       Conduit Length
464 Supply X-factor <.5
808.490 Supply K-lag (sec)
500 Beta weighting factor
00.000 Routing timestep
1 No. of sub-reaches
035 2.813 2.45
                          .000
                    .250
74.000
.100
                                                                                                                                                                                                                                                                                                      .000 c.m/s
                                                                                                                                                                                                                                                                           2.413
                                                                                                                                                                                                                    Junction Node No.
.035 2.813
                     11.953
                                                                                                                                                                                                                                                                          2.413
                                                                                                                                                                                                                                                                                                    2.413 c.m/s
                     1.613 2.203 .478 .204 .876 .775

ADD RUNOFF 1.613 3.815 .478 HYDROGRAPH DISPLAY 5 is # of Hyeto/Hydrograph chosen Volume = .9569145E+04 c.m
                                                                                                                                                                                                                     1=zero; 2=Define
Reserv
                                                                                                                                                                                                         FILE HYDROGRAPH
                                                                                                               .000 c.m/s
C perv/imperv/total
                                                                                                                                                                                         22
                                                                                                                                                                                                                    15
                                                                                                                    .000 c.m/s
      27
                                                                                                                                                                                                    .03
CATCHMENT
50.000
10.320
260.000
2.000
85.000
260.000
                                                                                                                                                                                                                              ID No.6 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option I=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option I=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                       line(s) of comment
                       * NORTH VILLAGE OF EAST FONTHILL POND *
                                                                                                                                                                                                            .000
                  POND
10 Depth -
186.550
186.840
187.150
187.380
                                      - Discharge - Volume sets

0 .000 .0

.0420 1342.3

0 .0740 3017.2

0 .0910 4375.6
                                                                                                                                                                                                       .250
74.000
.100
8.924
                                                    .936
1.161
1.349
1.514
1.797
11.210
                                                                              7149.5
10115.3
13272.9
16622.5
                       187.830
                       188.270
188.720
                                                                                                                                                                                                                       1.480
.236
                                                                                                                                                                                                                                                                                                 2.413 c.m/s
C perv/imperv/total
                       189 160
                      189.610 1.797 20163.9

190.050 11.210 23897.2

Peak Outflow = .602 c.m/s

Maximum Depth = 187.652 metres

Maximum Storage = 6053. c.m

1.613 3.815 .602
                                                                                                                                                                                                        ADD RUNOFF
1.480
1.480
2.413
HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .3691582E+04 c.m
COMMENT
Line(s) of comment
                                                                                                                                                                                         15
                                                                                                                                                                                                                                                                                                   2.413 c.m/s
                                                                                                                                                                                         27
                                                                                                                    .000 c.m/s
                      NEXT LINK
1.613
                                                                                                                                                                                                       3 line(s) of comment
      16
                                                           . 602
                                                                                          .602
                                                                                                                     .000 c.m/s
                      START 1=Zero; 2=Define
                                                                                                                                                                                                         * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND
                       COMMENT
                                                                                                                                                                                                    POND

10 pepth - Discharge - Volume sets

189.900 .000 384.8
190.230 .01800 795.9
190.680 .0290 2027.4
190.700 .0330 2087.0
190.730 .0430 2187.1
190.900 .267 2703.4
191.070 426 3246.0
191.230 466 3814.9
                                                                                                                                                                                         10
                                                                                                                                                                                                         POND
                       * OUTLET B **
                                                                                                                                                                                                         190.230
190.680
190.700
190.730
190.900
191.070
191.230
192.400
                                            ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
MIMPE. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                       CATCHMENT
                     40.000 35.240
                  485.000
15.480
49.400
                                                                                                                                                                                                       485.000
                          .000
                           1
250.
                    74.000
                                                                                                                                                                                                                                                                                                    2.413 c.m/s
                                                                                                                                                                                                                   Junction Node No.
1.480 1.480
                      8.924
                                                                                                                                                                                                                                                                             .187
                                              Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                                                                                                                                   2.437 c.m/s
                                                                                                                                                                                                        START
L 1=Zero; 2=Define
                                                                                                               .000 c.m/s
C perv/imperv/total
                                    2.869
                                                                                                                                                                                        18
                                                                                                                                                                                                         CONFLUENCE
                                         236
                                                                                                                                                                                                                    Junction Node No.
      15
                      ADD RUNOFF
```

```
1 480
                                                       2.437
                                                                                 . 187
                                                                                                        .000 c.m/s
                                                                                                                                                                                 1.48
CATCHMENT
70.000
2.340
120.000
2.000
.000
                                        ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
Wimp. with Zero Dpth
Option 1=SCS CM/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS CUrve No.or C
                                                                                                                                                                                   * OUTLET A
                                                                                                                                                                                 START

1 1=Zero; 2=Define
CATCHMENT
                                                                                                                                                                     14
                                                                                                                                                                                                      ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                               31.000
3.530
155.000
                 120.000
                        1
250
                                         2.000
                  74.000
.100
8.924
                                                                                                                                                                               85.000
155.000
.000
                                                                                                                                                                                       . 250
Reserv
                                   .034
                                                                                                   .000 c.m/s
C perv/imperv/total
                                                                                                                                                                                 74.000
                                                                                                                                                                                      .100
                                                                                                                                                                                 11.953
                    ADD RUNOFF .034
      15
                                                       2.448
                                                                                  .187
                                                                                                        .000 c.m/s
        9
                    ROUTE
                                                                                                                                                              Reserv
                                  Conduit Length
No Conduit defined
Zero lag
Beta weighting factor
Routing timestep
No. of sub-reaches
.034 2.448 2.44
                .000
.464
268.490
                                                                                                                                                                                                                         000
                                                                                                                                                                                                                                                                 .000 c.m/s
C perv/imperv/total
                                                                                                                                                                                   ADD RUNOFF
                                                                                                                                                                    15
                                                                                                                                                                                 .000 c.m/s
                        .500
                200.000
                                                                                                                                                                     35
                                                                               2.448
                                                                                                        .000 c.m/s
      17
                    COMBINE
                             Junction Node No.
.034 2.448
                                                                              2.448
                                                                                                     2.448 c.m/s
                                                                                                                                                                     12
                                                                                                                                                                                   DIVERT
                                                                                                                                                                                            RT
9 U/S Node No.ó 99999
8 Threshold Discharge
4 Max. Outflow reqd.
Qmax & Vol.Diverted =
No flow diverted
.826 .826
      14
                    START
               START
1 1=Zero; 2=Define
CATCHMENT
80.000 ID No.6 9999
38.600 Area in hect
510.000 Length (PERV
2.000 Gradient (%)
43.500 Per cent Imp
510.000 Length (IMPE
.000 Wimp. with Z
1 Option 1=SCS
                                                                                                                                                                                       . 478
                                       ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option I=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                                                                                    .252 c.m/s
                                                                                                                                                                                                                                                                                      254.0 c.m
                                                                                                                                                                                                                                               . 574
                                                                                                                                                                                                                                                                     .000 c.m/s
                                                                                                                                                                                   NEXT LINK
.826
                                                                                                                                                                    16
                                                                                                                                                                                                                        . 574
                                                                                                                                                                                                                                               . 574
                                                                                                                                                                                                                                                                     .000 c.m/s
                                                                                                                                                                                                      ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                   CATCHMENT
                                                                                                                                                                               10.000
5.910
200.000
                        .250
                                                                                                                                                                               2.000
85.000
200.000
                  74.000
                    .100
8.924
                                         Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                     .000
                                                                                                                                                                                 .250
74.000
Reserv
                                2.876
                                                                                                  2.448 c.m/s
C perv/imperv/total
                                                          .000
                                                                              2.448
                   .236 .87/ .515
ADD RUNOFF
2.876 2.876 2.448
HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .9116987E+04 c.m
COMMENT
Lina(s) of comment
                                                                                                                                                                                 .100
      15
                                                                                                     2.448 c.m/s
      27
                                                                                                                                                              Reserv
                                                                                                                                                                              1.311

CATCHMENT

20.000 10

6.380 Ar

205.000 Le

2.000 Gr

85.000 Le

205.000 Le

3000 Le
                                                                                                                                                                                                                       .574
.914
                                                                                                                                                                                                                                                                 .000 c.m/s
C perv/imperv/total
      35
                     15
                                                                                                                                                                                                                     1.885
                                                                                                                                                                                                                                               574
                                                                                                                                                                                                                                                                     .000 c.m/s
                    * FUTURE STORMWATER MANAGEMENT FACILITY 706
                                                                                                                                                                                                       ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
      10
                    POND
                                 - Discharge -

0 .000

0 .0140

0 .0570

0 .0760

0 .234

0 .383

0 .426

10 .637
                10
                    187.500
187.670
187.830
187.960
188.170
188.330
                                                                       .0
1300.3
2689.4
3804.3
5733.6
7388.8
                                                                                                                                                                                      1
250.
                                                                                                                                                                                                       Option 1=355 CM, C, 2=16.154, Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                74.000
.100
11.953
                    188.500
188.670
                                                                      9132.6
10965.2
                     188.830
                                                    .637
                                                                      12886.5
                     189,000
                                                    .954
                                                                      14896.4
                   189.000 .95
Peak Outflow =
Maximum Depth =
Maximum Storage =
2.876 2
COMBINE
                                                    = .247 c.m/s
= 188.191 metres
                                                                                                                                                                                              1.407
                                                                                                                                                                                                                                                                 .000 c.m/s
C perv/imperv/total
                                                                                                                                                                                                                     1.885
.913
                                                                 5955. c.m
5 .247
                                                                                                                                                                                  .340 .913 .827
ADD RUNGF 1.407 3.292 .574
HYDROGRAPH DISPLAY
5 i # of Hyeto/Hydrograph chosen
Volume = .9333898E+04 c.m
                                                      2.876
                                                                                                     2.448 c.m/s
                                                                                                                                                                    15
                                                                                                                                                                        HYDROG.
5 is "
Volume = CATCHMENT
30.000
11.250
260.000
2.000
85.000
260.000
.000
.000
                                                                                                                                                                                                                                                                     .000 c.m/s
     17
                             Junction Node No.
2.876 2.876
                                                                                                                                                                    27
                                                                                 247
                                                                                                     2.487 c.m/s
                    START
1=Zero; 2=Define
      14
                                                                                                                                                                                                      ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                  1 1=ZeFO; Z=DeTITIE
CONFLUENCE
2 JUNCTION NODE NO.
2.876 2.487 .247
HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .9116987E+04 c.m
      18
                                                                                                       .000 c.m/s
     27
     14
                              1=Zero; 2=Define
                                                                                                                                                                                .250
74.000
.100
                  35
                                                                                                                                                                                 11.953
                     * 100 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
                    STORM
                                                                                                                                                             Reserv
                                      1=Chicago; 2=Huff; 3=User; 4=Cdn1hr; 5=Historic
Coefficient a
Constant b (min)
Exponent c
Fraction to peak r
Duration ó 240 min
73.207 mm Total depth
                                                                                                                                                                                              2.487
.341
                                                                                                                                                                                                                                                                 .000 c.m/s
C perv/imperv/total
                                                                                                                                                                                                                                               .574
.820
             1020.000
4.700
.731
                                                                                                                                                                                  ADD RUNOFF
2.487 5.644
HYDROGRAPH DISPLAY
                                                                                                                                                                   15
                                                                                                                                                                                                                                              . 574
                                                                                                                                                                                                                                                                     .000 c.m/s
                                                                                                                                                                    27
                                                                                                                                                                                  is # of Hyeto/Hydrograph chosen to 1608601E+05 c.m
                       400
                240.000
       3
                   IMPERVIOUS
                                                                                                                                                                    35
                                       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
                                                                                                                                                                                   line(s) of comment
                  .015
98.000
                                                                                                                                                                                  * NORTH VILLAGE OF EAST FONTHILL POND **
                      .100
                                                                                                                                                                   10
                                                                                                                                                                              10 Depth - Discharge - Volume sets
                    COMMENT
```

```
186.550
186.840
187.150
187.380
187.830
188.270
188.720
                                                              .000
.0420
.0740
                                                                                                                                                                                                                                                  Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
                                                                                                                                                                                                                              250
                                                                                      .0
1342.3
3017.2
4375.6
7149.5
10115.3
13272.9
                                                                                                                                                                                                                       74.000
                                                                                                                                                                                                                         .100
8.924
                                                         .0740
.0910
.936
1.161
1.349
1.514
1.797
                                                                                                                                                                                                                                                  Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                                Reserv
                                                                                                                                                                                                                                                                       .252
.904
                                                                                                                                                                                                                                                                                               4.238
                                                                                                                                                                                                                                        2.284
                                                                                                                                                                                                                                                                                                                        4.238 c.m/s
C perv/imperv/total
                         188.720 1.349 13272.9
189.160 1.514 16622.5
189.610 1.797 20163.9
190.050 11.210 23897.2
Peak Outflow = 1.089 c.m/s
Maximum Depth = 188.130 metres
Maximum Storage = 9171. c.m
2.487 5.644 1.089
                                                                                                                                                                                                                                             . 367
                                                                                                                                                                                                                         ADD RUNOFF
2.284 2
HYDROGRAPH DISPLAY
                                                                                                                                                                                                        15
                                                                                                                                                                                                                                                                   2.455
                                                                                                                                                                                                                                                                                                                           4.238 c.m/s
                                                                                                                                                                                                        27
                                                                                                                                                                                                                         is # of Hyeto/Hydrograph chosen volume = .6224218E+04 c.m
                                                                                                                              .000 c.m/s
                                                                                                                                                                                                        35
                                                                                                                                                                                                                          COMMENI
line(s) of comment
                         NEXT LINK
2.487
START
        16
                                                                    1.089
                                                                                                1.089
                                                                                                                              .000 c.m/s
                                                                                                                                                                                                                         * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND
        14
                                     1=zero; 2=Define
                                                                                                                                                                                                                   POND
10 Depth -
189.900
190.070
190.230
190.680
190.700
190.730
190.900
191.070
                       COMMENT
3 line(s) of comment
                                                                                                                                                                                                       10
                                                                                                                                                                                                                                          - Discharge - Volume sets
) .000 .0
) .01000 384.8
                                                                                                                                                                                                                                                                                        .0
384.8
795.9
2027.4
2087.0
                         .0180
.0290
.0330
                       CATCHMENT
40.000
                                                ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                                                                                             .0430
                                                                                                                                                                                                                                                                                        2187.1
2703.4
3246.0
3814.9
                     35.240
485.000
                     15.480
49.400
485.000
.000
                                                                                                                                                                                                                        191.230 .46
192.400 1.13
Peak Outflow =
Maximum Depth =
Maximum Storage =
2.284 2
COMBINE
                                                                                                                                                                                                                                                            1.132 8533.8
= .460 c.m/s
= 191.207 metres
                       .250
74.000
                                                                                                                                                                                                                                                                                3734. c.m
.460
                                                                                                                                                                                                                                                                   2.455
                                                                                                                                                                                                                                                                                                                           4.238 c.m/s
                                                                                                                                                                                                        17
                         .100
8.924
                                                                                                                                                                                                                        COMBINE
Junction Node No.
2.284 2.455
START
1 1=Zero; 2=Define
                                                                                                                                                                                                                                                                                                  .460
                                                                                                                                                                                                                                                                                                                           4.537 c.m/s
Reserv
                                                                                               1.089
.638
                                        4.772
                                                                      .000
                                                                                                                               .000 c.m/s
                                                                                                                                                                                                                        CONFLUENCE
Junction Node No.
2.284 4.537
                                                                                                                         C perv/imperv/total
                                                                                                                                                                                                        18
                         ADD RUNOFF
4.772
       15
                                                                    4.772
                                                                                                                                                                                                                                                                                                                             .000 c.m/s
                                                                                               1.089
                                                                                                                              .000 c.m/s
                                                                                                                                                                                                                                                                                                  460
                        CHANNEL
2.000 Base width = 3.000 Left bank slope 1:
3.000 Right bank slope 1:
3.040 Manning's "n"
1.500 O/a Depth in metres
900 Select Grade in %
Depth = 7.64 metres
Velocity = 1.454 m/sec
Flow Capacity = 20.730 c.m/s
Critical depth = .615 metres
                         CHANNEL
                                                                                                                                                                                                                                                ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
Ximp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
       11
                                                                                                                                                                                                                    70.000
2.340
120.000
                                                                                                                                                                                                                    2.000
.000
120.000
.000
                                                                                                                                                                                                                       .250
74.000
                   ROUTE
393.000
.448
202.682
.500
200.000
                                                 Conduit Length
Supply X-factor <.5
Supply K-lag (sec)
Beta weighting factor
Routing timestep
No. of sub-reaches
72
4.572
4.59
                                                                                                                                                                                                                         8.924
                                                                                                                                                                                               Reserv
                                                                                                                                                                                                                                                                                                                        .000 c.m/s
C perv/imperv/total
                                                                                                                                                                                                                         ADD RUNOFF
                                                                                                                                                                                                       15
                                   1
                                                                                                                                                                                                                                                                                                                             .000 c.m/s
                                        4.772
                                                                                               4.594
                                                                                                                              .000 c.m/s
                                                                                                                                                                                                                                          .109
                                                                                                                                                                                                                                                                   4.596
                                                                                                                                                                                                                                                                                                  .460
                                                                                                                                                                                                                        ROUTE
.000
                        NEXT LINK
4.772
                                                                                                                                                                                                                                                 Conduit Length
No Conduit defined
Zero lag
Beta weighting factor
Routing timestep
No. of sub-reaches
09 4.596 4.59
                                                                 4.594
                                                                                             4.594
                                                                                                                              .000 c.m/s
                                                ID No.6 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                         CATCHMENT
                                                                                                                                                                                                                    .455
234.662
.500
200.000
                    60.000
2.430
125.000
                    2.000
.000
125.000
.000
                                                                                                                                                                                                                        COMBINE . 109
                                                                                                                                                                                                                                                                                               4.596
                                                                                                                                                                                                                                                                                                                             .000 c.m/s
                                                                                                                                                                                                       17
                                                                                                                                                                                                                                    Junction Node No.
.109 4.596
                                                                                                                                                                                                                                                                                              4.596
                                                                                                                                                                                                                                                                                                                          4.596 c.m/s
                      .250
                                                                                                                                                                                                       14
                                                                                                                                                                                                                        START
L 1=Zero; 2=Define
                                                                                                                                                                                                                        CATCHMENT
                                                                                                                                                                                                                                              ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
Manning "n"
SCS Curve No or C
Ia/S Coefficient
Initial Abstraction
Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
                                                                                                                                                                                                                    80.000
38.600
510.000
Reserv
                                                                                                                                                                                                                    2.000
43.500
510.000
.000
                                                                                                                         .000 c.m/s
C perv/imperv/total
       15
                        ADD RUNOFF
                                                                                                                             .000 c.m/s
                                           .113
                                                                    4.654
                                                                                               4.594
                                                                                                                                                                                                                      .000
1
.250
74.000
.100
8.924
                    ROUTE
452.000
                       Conduit Length
.455 Supply X-factor <.5
34.662 Supply K-lag (sec)
.500 Beta Weighting factor
00.000 Routing timestep
1 No. of sub-reaches
.113 4.654 4.23
                    .455
234.662
.500
200.000
                                                                                                                                                                                               Reserv
                                                                                                                                                                                                                      4.773 .000 4.596 4.596 c.m/s
.368 .925 .610 c perv/imperv/total
ADD RUNOFF
4.773 4.773 4.596 4.596 c.m/s
HYDROGRAPH DISPLAY
4 is # of Hyeto/Hydrograph chosen
Volume = .1723819E+05 c.m
COMMENT
3 line(s) of comment
                                                                                               4.238
                                                                                                                              .000 c.m/s
       17
                                    Junction Node No.
.113 4.654
                                                                                                                                                                                                       15
                   .113 4.654 4.238 4.238 c.m,

START

1 =Zero; 2=Define
FILE HYDROGRAPH

1 =READ: 2=WRITE

12 DIV00009.100 is Filename
2 1=Overland: 2=Inflow: 3=Outflow: 4=Temp'ary
.113 .252 4.238 4.238 c.m,

CATCHMENT
50.000 ID No.6 99999
10.320 Area in hectares
260.000 Length (PRV) metres
2.000 Gradient (%)
85.000 Per cent Impervious
260.000 Length (MPERV)
                                                                                               4.238
                                                                                                                           4.238 c.m/s
                                                                                                                                                                                                       27
                                                                                                                                                                                                       35
                                                                                                                                                                                                                         ID No.ó 99999
Area in hectares
Length (PERV) metres
Gradient (%)
Per cent Impervious
Length (IMPERV)
%Imp. with Zero Dpth
Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
                                                                                                                                                                                                                         POND
                                                                                                                                                                                                                   10 Depth - Discharge - Volume sets
187.500 .000 .0
187.670 .0140 1300.3
187.830 .0570 2689.4
187.960 .0760 3804.3
                                                                                                                                                                                                                                                                                       .0
1300.3
2689.4
3804.3
5733.6
7388.8
                    260.000
                                                                                                                                                                                                                         188.170
```

APPENDIX E Detailed Channel Design Calculations

Upper Canada Consultants 1-261 Martindale Road St. Catharines, ON L2W 1A1

Project : Saffron Meadows, Town of Pelham Design: Adam Keane, P.Eng.

Project No: 0478 Reviewed: Jason Schooley, P.Eng. Watercourse: Tributary of Singer's Drain Date: July 3, 2014

Upstream Elevation: 187.60 Strait Block Length (m): 165.0 m

Downstream Elevation: 187.38 Thoretical Strait Slope (%): 0.13%

Fall (m): 0.22 Meander Length (m): 191.0 m

Meander Slope (%): 0.12%

Block Width (m): 33 Mean Meander Wavelength (m): 96.7 (C.W.Carlston, 1965)

Curvature of Meander Radius (±15%) (m): 27.2 to 36.9 (B.P.Leopold, 1957)

STORM FLOWS (Leave Blank If Not Known)

 $Q_{100} = 5.550$ m³/s (Flood Full Storm Event)

 $Q_{25} = 3.987 \text{ m}^3/\text{s}$ $Q_{10} = 3.151 \text{ m}^3/\text{s}$

 $Q_{10} = 3.151 \text{ m/s}$ $Q_5 = 2.780 \text{ m}^3/\text{s}$

 $Q_2 = 2.084$ m³/s (Bank Full Storm Event)

 $Q_{25mm} = 1.260$ m³/s

NOTE: Minor storm events determined from standard curve fitting to EPA Normalized Type Storm Distribution.

CHANNEL GEOMETRY

Soil Type:	Sandy L	oam	М	aximum Stat	ole Slope:	32°			
Bottom Width =	2.00		Substrate:	Gravel beds,	, straight				
Side Slopes (H:V) =	3.0	(18.4°)	M	anning's n:	0.025		Safety	Factor:	5.0
	Height	Top Width	Flow Area	R _(hydraulic)	Flow	Velocity	Shear	Stress	Stable D ₅₀
	(m)	(m)	(m ²)		(m^3/s)	(m/s)	Strait	Bend	(mm)
							(N/	m²)	
Depth ₁₀₀ =	0.852	7.111	4.259	0.517	5.550	1.30	7.2	8.7	79.1
$Depth_{25} =$	0.696	6.175	3.479	0.426	3.987	1.15	5.9	7.1	64.7
Depth ₁₀ =	0.603	5.618	3.015	0.371	3.151	1.04	5.1	6.1	56.0
Depth ₅ =	0.559	5.354	2.795	0.345	2.780	0.99	4.7	5.7	51.9
Depth ₂ =	0.469	4.817	2.347	0.291	2.084	0.89	4.0	4.8	43.4
Depth _{25mm} =	0.347	4.079	1.733	0.216	1.260	0.73	2.9	3.5	31.8

Calculate Flow Values

ROSGEN CLASSIFICATION OF NATURAL RIVERS

MEANDER RATIO: 1.2 : MODERATE SINUOSITY
WIDTH / DEPTH RATIO: 10.3 : LOW WIDTH / DEPTH RATIO
ENTRENCHMENT RATIO: 1.5 : MODERATELY ENTRENCHED

STREAM TYPE:

B - STABLE Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools. Very stable plan and profile. Stable banks.

Upper Canada Consultants 1-261 Martindale Road St. Catharines, ON L2W 1A1

Project :Allen Property, Fonthill, ONDesign:Adam Keane, P.Eng.Project No :0473Reviewed:Jason Schooley, P.Eng.Watercourse:UnknownDate:July 3, 2014

Upstream Elevation: 189.33 Strait Block Length (m): 220.0 m

Downstream Elevation: 188.90 Thoretical Strait Slope (%): 0.20%

Fall (m): 0.43 Meander Length (m): 230.0 m

Meander Slope (%): 0.19%

Block Width (m): 33 Mean Meander Wavelength (m): 95.1 (C.W.Carlston, 1965)

Curvature of Meander Radius (±15%) (m): 26.6 to 36.1 (B.P.Leopold, 1957)

STORM FLOWS (Leave Blank If Not Known)

 $Q_{100} = 4.938 \text{ m}^3/\text{s}$ (Flood Full Storm Event)

 $Q_{25} = 3.685 \text{ m}^3/\text{s}$ $Q_{12} = 2.950 \text{ m}^3/\text{s}$

 $Q_{10} = 2.950 \text{ m}^3/\text{s}$ $Q_5 = 2.730 \text{ m}^3/\text{s}$

 $Q_2 = 1.996$ m³/s (Bank Full Storm Event)

 $Q_{25mm} = 1.214$ m³/s

NOTE: Minor storm events determined from standard curve fitting to EPA Normalized Type Storm Distribution.

CHANNEL GEOMETRY

			CHAMILE	CECIVILITAT					
Soil Type:	Sandy L	oam	M	laximum Stal	ble Slope:	32°			
Bottom Width =	1.50		Substrate:	Gravel beds	, straight				
Side Slopes (H:V) =	4.0	(14°)	M	lanning's n:	0.025		Safety	Factor:	5.0
	Height	Top Width	Flow Area	$R_{(hydraulic)}$	Flow	Velocity	Shear	Stress	Stable D ₅₀
	(m)	(m)	(m^2)		(m³/s)	(m/s)	Strait	Bend	(mm)
							(N/ı	m²)	
Depth ₁₀₀ =	0.664	6.812	3.652	0.380	4.937	1.35	9.1	11.0	57.4
Depth ₂₅ =	0.556	5.950	3.059	0.319	3.684	1.20	7.7	9.2	47.9
Depth ₁₀ =	0.486	5.391	2.675	0.280	2.949	1.10	6.7	8.0	41.7
Depth ₅ =	0.464	5.214	2.553	0.267	2.730	1.07	6.4	7.7	39.8
Depth ₂ =	0.384	4.575	2.114	0.222	1.995	0.94	5.3	6.3	32.7
Danth -	ባ ኃይፍ	3 7፬∩	1.568	0.165	1.214	0.77	3.9	4.7	24.0
Calcula	te Flow √	/alues							

ROSGEN CLASSIFICATION OF NATURAL RIVERS

MEANDER RATIO: 1.1 : LOW SINUOSITY

WIDTH / DEPTH RATIO: 11.9 : LOW WIDTH / DEPTH RATIO ENTRENCHMENT RATIO: 1.5 : MODERATELY ENTRENCHED

STREAM TYPE:

B - STABLE Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools. Very stable plan and profile. Stable banks.

Upper Canada Consultants 1-261 Martindale Road

St. Catharines, ON L2W 1A1

Allen Property, Fonthill, ON Project:

Project No: 0473

Watercourse: Unknown

Design:

Adam Keane, P.Eng.

Reviewed:

Jason Schooley, P.Eng.

Date:

July 3, 2014

Upstream Elevation: 188.90

Downstream Elevation:

Strait Block Length (m): Thoretical Strait Slope (%): 188.50

49.6 m 0.81%

Fall (m): 0.40

Meander Length (m):

50.9 m

Meander Slope (%):

0.79%

Block Width (m):

33 Mean Meander Wavelength (m):

95.1 (C.W.Carlston, 1965)

Curvature of Meander Radius (±15%) (m): 26.6 to 36.1 (B.P.Leopold, 1957)

STORM FLOWS (Leave Blank If Not Known) (Flood Full Storm Event)

 $Q_{100} = 4.938$

 $Q_{25} = 3.685 \text{ m}^3/\text{s}$

 $Q_{10} = 2.950 \text{ m}^3/\text{s}$

 $Q_5 = 2.730 \text{ m}^3/\text{s}$

 $Q_2 = 1.996 \text{ m}^3/\text{s}$

(Bank Full Storm Event)

 $Q_{25mm} = 1.214$ m³/s

NOTE: Minor storm events determined from standard curve fitting to EPA Normalized Type Storm Distribution.

CHANNEL GEOMETRY

			·						
Soil Type:	Sandy L	oam	М	laximum Stat	ble Slope:	32°			
Bottom Width =	1.50		Substrate:	Gravel beds,	, straight				
Side Slopes (H:V) =	3.0	(18.4°)	M	lanning's n:	0.025		Safety	Factor:	5.0
·	Height	Top Width	Flow Area	$R_{(hydraulic)}$	Flow	Velocity	Shear	Stress	Stable D ₅₀
	(m)	(m)	(m^2)		(m^3/s)	(m/s)	Strait	Bend	(mm)
							(N/i	m²)	
Depth ₁₀₀ =	0.480	4.378	2.158	0.285	4.939	2.29	27.8	33.3	42.5
Depth ₂₅ =	0.402	3.911	1.808	0.239	3.685	2.04	23.3	27.9	35.5
Depth ₁₀ =	0.351	3.608	1.581	0.210	2.950	1.87	20.3	24.4	30.9
Depth ₅ =	0.335	3.512	1.509	0.200	2.730	1.81	19.4	23.3	29.4
Depth ₂ =	0.278	3.166	1.250	0.166	1.996	1.60	16.1	19.3	24.2
Danth -	U 206	2 726	0.927	0.123	1.214	1.31	11.9	14.3	17.8
Calcula	ite Flow V	/alues							

ROSGEN CLASSIFICATION OF NATURAL RIVERS

MEANDER RATIO:

1.1

: LOW SINUOSITY

WIDTH / DEPTH RATIO:

11.4

: LOW WIDTH / DEPTH RATIO

ENTRENCHMENT RATIO:

1.4

: MODERATELY ENTRENCHED

STREAM TYPE:

B - STABLE Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools. Very stable plan and profile. Stable banks.

Upper Canada Consultants

1-261 Martindale Road

St. Catharines, ON L2W 1A1

Allen Property, Fonthill, ON Project:

Project No: 0473

Watercourse: Unknown

Design: Reviewed: Adam Keane, P.Eng.

Jason Schooley, P.Eng.

Date:

July 3, 2014

Upstream Elevation: 188.25

Downstream Elevation: 187.20

Strait Block Length (m): Thoretical Strait Slope (%):

57.7 m 1.82%

Fall (m): 1.05

Meander Length (m):

60.5 m

Meander Slope (%):

1.73%

Block Width (m):

33 Mean Meander Wavelength (m):

95.1 (C.W.Carlston, 1965)

Curvature of Meander Radius (±15%) (m): 26.6 to 36.1 (B.P.Leopold, 1957)

STORM FLOWS (Leave Blank If Not Known) (Flood Full Storm Event)

 $Q_{100} = 4.938$

 $Q_{25} = 3.685 \text{ m}^3/\text{s}$

 $Q_{10} = 2.950 \text{ m}^3/\text{s}$

 $Q_5 = 2.730 \text{ m}^3/\text{s}$

 $Q_2 = 1.996 \text{ m}^3/\text{s}$

(Bank Full Storm Event)

 $Q_{25mm} = 1.214 \text{ m}^3/\text{s}$

NOTE: Minor storm events determined from standard curve fitting to EPA Normalized Type Storm Distribution.

CHANNEL GEOMETRY

Soil Type:	Sandy L	oam	M	aximum Stat	ole Slope:	32°			
Bottom Width =	1.50		Substrate:	Gravel beds,	, straight				
Side Slopes (H:V) =	3.0	(18.4°)	M	lanning's n:	0.025		Safety	Factor:	5.0
	Height	Top Width	Flow Area	$R_{(hydraulic)}$	Flow	Velocity	Shear	Stress	Stable D ₅₀
	(m)	(m)	(m ²)		(m^3/s)	(m/s)	Strait	Bend	(mm)
							(N/r	m²)	
Depth ₁₀₀ =	0.378	3.766	1.700	0.225	4.938	2.91	48.2	57.8	33.3
Depth ₂₅ =	0.317	3.400	1.425	0.189	3.685	2.59	40.4	48.5	27.7
Depth ₁₀ =	0.277	3.162	1.246	0.166	2.950	2.37	35.3	42.4	24.1
Depth ₅ =	0.264	3.086	1.189	0.158	2.730	2.30	33.7	40.5	23.0
Depth ₂ =	0.219	2.814	0.985	0.131	1.996	2.03	27.9	33.5	18.9
Danth -	n 162	2 175	0.731	0.097	1.215	1.66	20.7	24.9	13.9
Calcula	ate Flow V	/alues							ļ

ROSGEN CLASSIFICATION OF NATURAL RIVERS

MEANDER RATIO:

1.1

: LOW SINUOSITY

WIDTH / DEPTH RATIO:

12.9

: MODERATE WIDTH / DEPTH RATIO

ENTRENCHMENT RATIO:

1.3 : ENTRENCHED

STREAM TYPE:

B - STABLE Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools. Very stable plan and profile. Stable banks.

APPENDIX F

Form 22 Output File for 100- Year Culvert Backwater Calculation

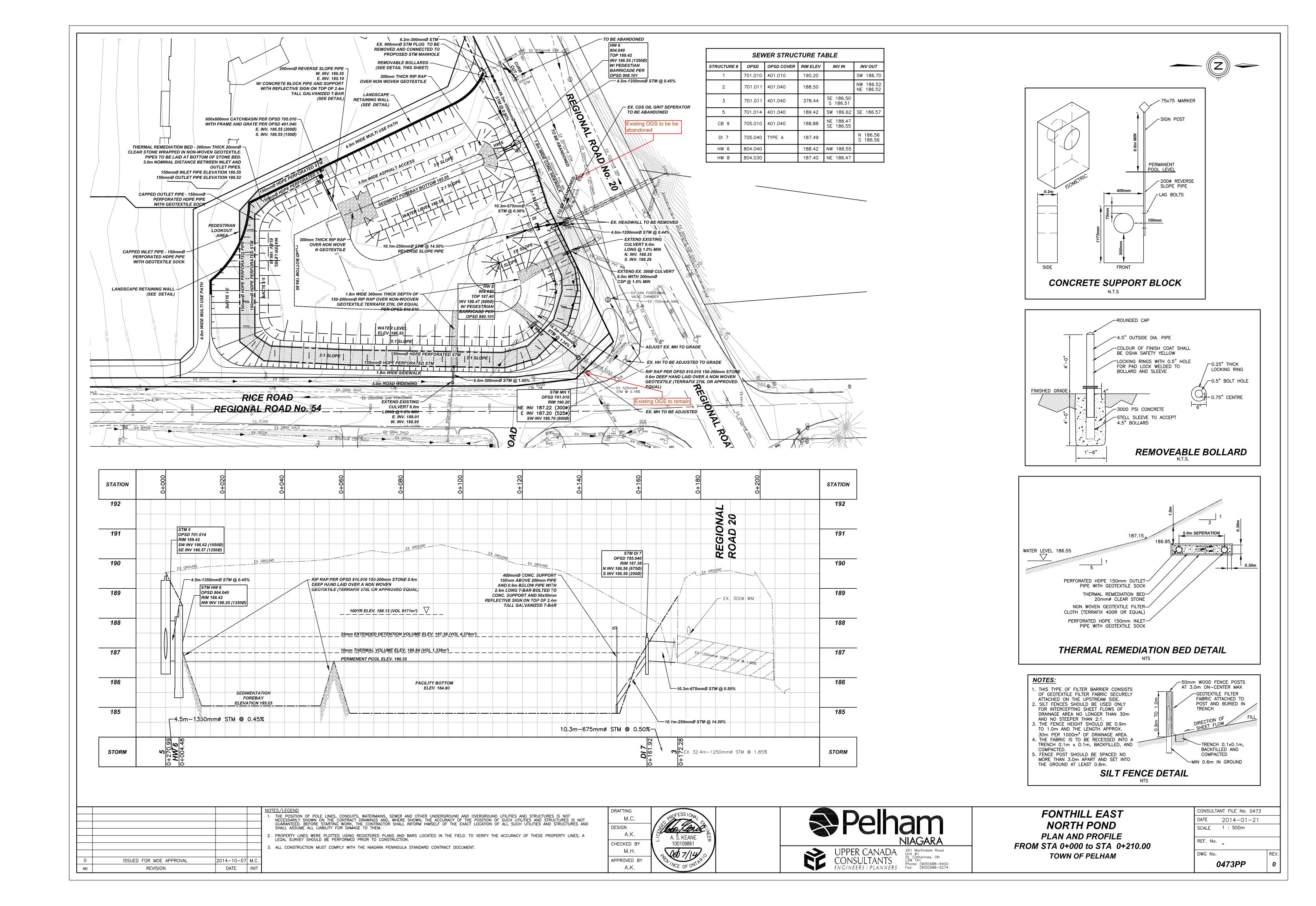
HWY. NO.	
W.P. NO.	

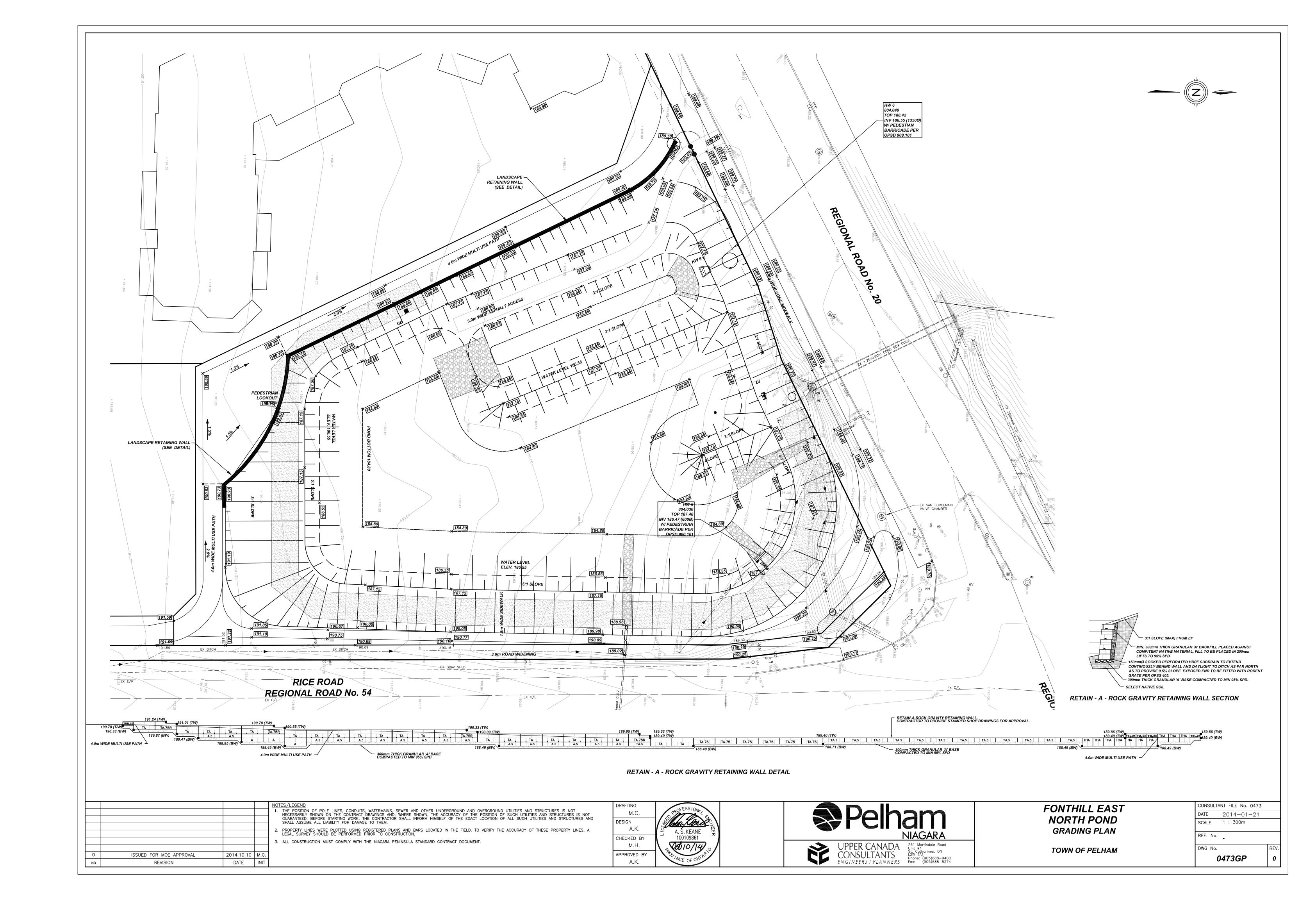
CONVENTIONAL CULVERT DESIGN

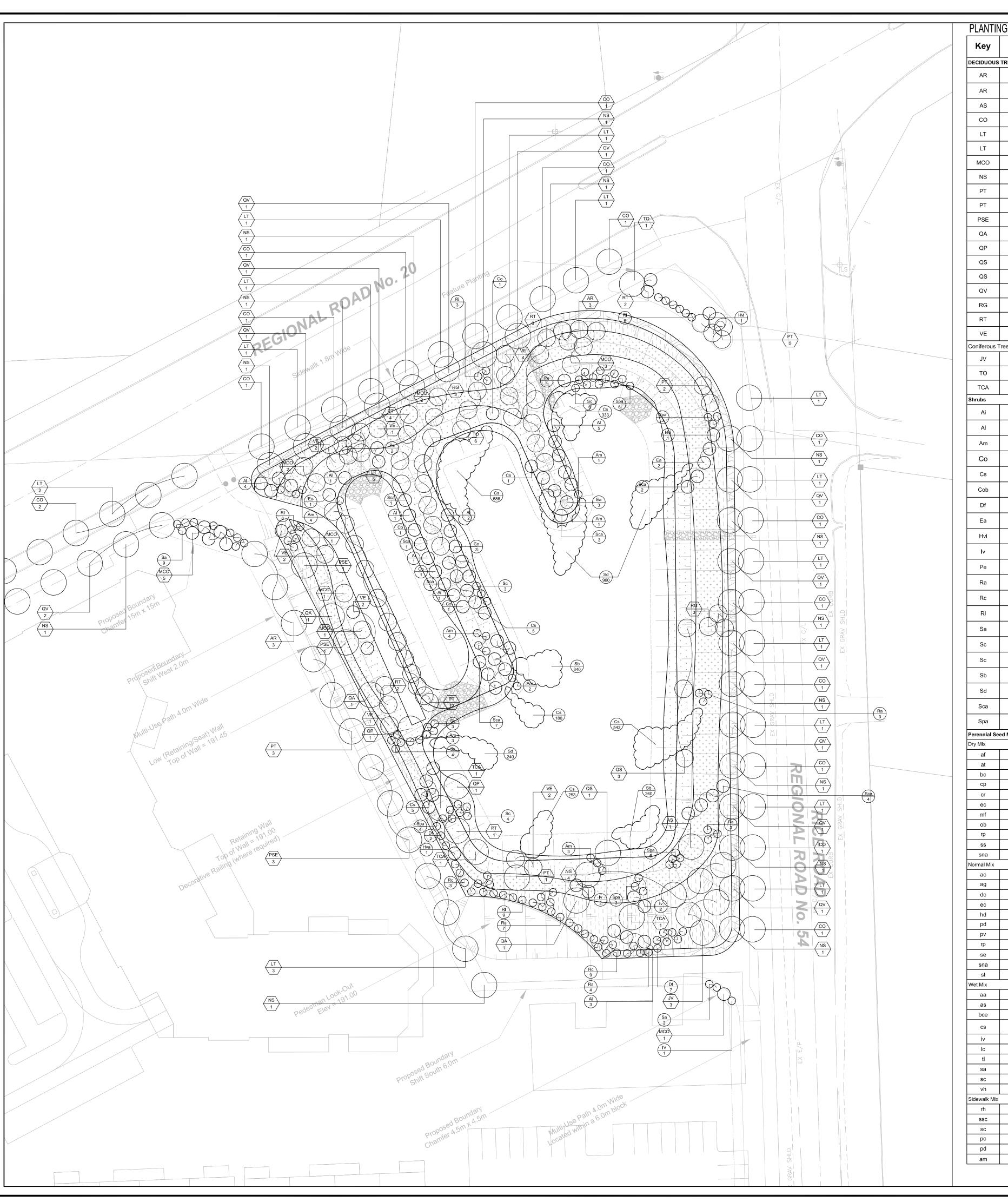
Prepared By: A. Keane Date: 19-Nov-14
Checked By: _____ Date: ____

W.P. I	NO.				_														Checi	keu by.			- Date.		
			DE	SIGN D	ATA				CUL	VERT D	ATA		INLE	T CONT	ROL	<u> </u>		0	UTLET C	ONTRO)L			GOV'N	VEL
STA.	Q	d	de	AHW	Skew	L	S	Descrip		N	Q N	A (Each)	Q NB	<u>HW</u> (Each)	HW	ke	Н	dc	dc + D 2	TW	ho	LS	HW	HW	Vo
	m3/s	m	m	m		m	m/m				m3/s		m3/s/m		m		m	m	m	m	m	m	m	m	m/s
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
																						l			
Propos	ed box c					Storm								···				T	1		0.070		10444	1 044	
	4.950	0.378	0.00	0.38	<u> </u>	44.0	0.0011	1.5x2.4	3.600	1	4.950	3.600	2.063	1.611	1.611	0.500	0.116	0.252	0.126	0.378	0.378	0.050	0.444	7.677	
	2 From 3 Floo			•			11 No. o					19 Ch 21 Co		3A to F:	(dc D).										
	4 Emb	•					14 For b	•				22 ho	= larger	of cols.	20 and	21.									
	5 Col.	3 + col.	4 + allo	wable b	kwtr.		15 Char	rts D5-1	to C ar	nd E to	J.	23 Co	l. 7 x 8.												
	7 Allov	v for ske	ew if app	olicable.			16 HW	= col. 15	x D (col	l. 10).		24 HV	√ = col 1	8 + col.	22 - col	. 23.									
	8 Culv	ert slop	e				17 Chai	rt D5-8.						ols. 16 a											
	10 D (C	ircular)	or B x D	(other)			18 Chai	rts D5-2/	A to G.			26 Ou	tlet vel.	if req'd (Subsec	. 3.2.3.1	1).								

APPENDIX G Drawings







ANTIN	NG LIST				
Čey	Botanical Name	Common Name	Qty.	Size	Spacing
DUOUS	TREES / LARGE SHRUBS				
AR	Acer rubrum	Red Maple	3	70MM B+B	AS INDICATED
AR	Acer rubrum	Red Maple	3	45MM W.B. 70MM	AS INDICATED
AS	Acer saccharinum	Silver Maple Common Hackberry	1	B+B 70MM	AS INDICATED
CO LT	Celtis occidentalis Liriodendron tulipifera	Tulip Tree	15	B+B 70MM	AS INDICATED AS INDICATED
LT	Liriodendron tulipifera	Tulip Tree	5	B+B 45MM W.B.	AS INDICATED
1CO	Malus coronaria	Wild Crabapple	16	70MM B+B	AS INDICATED
NS	Nyssa sylvatica	Black Gum	18	70MM B+B	AS INDICATED
PT 	Populus tremuloides	Trembling Aspen	13	70MM B+B 45MM	AS INDICATED
PT PSE	Populus tremuloides Prunus serotina	Trembling Aspen Black Cherry	12	W.B 70MM	AS INDICATED AS INDICATED
QA	Quercus alba	White Oak	3	B+B 70MM	AS INDICATED
QP	Quercus palustris	Pin Oak	2	8+B 70MM B+B	AS INDICATED
QS	Quercus shumardii	Shumard Oak	1	70MM B+B	AS INDICATED
QS	Quercus shumardii	Shumard Oak	3	50MM W.B. 70MM	AS INDICATED
QV	Quercus velutina	Black Oak	12	B+B 70MM	AS INDICATED
RG RT	Rhus glabra Rhus typhina	Smooth Sumac Staghorn Sumac	14	B+B 70MM	AS INDICATED AS INDICATED
VE	Viburnum lentago	Nannyberry	14	8+B 70MM B+B	AS INDICATED
ferous 7	Trees				
JV	Juniperus virginiana	Red Cedar	3	125cm W.B. 125cm	AS INDICATED
TO CA	Thuja occidentalis Tsuga canadensis	White Cedar Eastern Hemlock	3	W.B. 125cm	AS INDICATED AS INDICATED
bs	, odga varradoridio	_astom Homiloux	J	W.B.	, .o habioateb
Ai	Alnus incana	Speckled Alder	5	1 gal.	AS INDICATED
Al	Amelanchier laevis	Smooth Serviceberry	13	1 gal.	AS INDICATED
Am	Aronia melanocarpa	Black Chokeberry	19	1 gal.	AS INDICATED
Co	Cephalanthus occidentalis	Buttonbush	7	1 gal.	AS INDICATED
Cs	Comus sericea	Red-Osier Dogwood	11	1 gal.	AS INDICATED
Cob	Comus obliqua	Silky Dogwood	1398	live stakes	0.15m O.C.
Df	Dasiphora fruticosa	Shrubby Cinquefoil	9	1 gal.	AS INDICATED
Ea	Euonymous atropurpurea	Burning Bush / Wahoo	6	1 gal.	AS INDICATED
Hvi	Hamamelis virginiana	Witch Hazel	3	1 gal.	AS INDICATED
lv -	Ilex verticillata	Winterberry	6	1 gal.	AS INDICATED
Pe	Prunus pennsylvanica	Pin Cherry	3	1 gal.	AS INDICATED AS INDICATED
Ra ——	Ribes americanum	Wild Black Currant	17	1 gal. 1 gal.	
Rc Ri	Rosa carolina Rubus idaeus	Pasture Rose Red Raspberry	12	1 gal.	AS INDICATED AS INDICATED
Sa	Symphoricarpos albus	Snowberry	13	1 gal.	AS INDICATED
Sc	Salix candida	Sageleaf Willow	16	1 gal.	AS INDICATED
Sc	Salix candida	Sageleaf Willow	846	live stakes	0.15m O.C.
Sb	Salix bebbiana	Bebb's Willow	260	live stakes	0.15m O.C.
Sd	Salix discolor	Pussy Willow	160	live stakes	0.15m O.C.
Sca	Sambucus canadensis	Elderberry	17	1 gal.	AS INDICATED
Spa	Spiraea alba	Meadowsweet	21	1 gal.	AS INDICATED
nnial Se ⁄lix	ed Mixes				
af	Agastache foeniculum	Blue Giant Hyssop	175	14 lbs./ha	
at bc	Asclepias tuberosa Bouteloua curtipendula	Butterfly Milkweed Side Oats Grama	0	14 lbs./ha 14 lbs./ha	
ср	Carex pensylvanica Campanula rotundifolia	Pennsylvania Sedge Harebells	0	14 lbs./ha 14 lbs./ha	
cr ec	Elymus canadensis	Canada Wild Rye	0	14 lbs./ha	
mf ob	monarda fistulosa Oenothera biennis	Wild Bergamot Common Evening Primrose	0	14 lbs./ha 14 lbs./ha	
rp	Ratibida pinnata	Green Headed Coneflower	0	14 lbs./ha	
ss sna	Solidago speciosa Symphiotrichum novae-angliae	Showy Goldenrod New England Aster	0	14 lbs./ha 14 lbs./ha	
al Mix ac	Aquilegia canadensis	Wild Columbine	0	14 lbs./ha	
ag	Andropogon gerardii	Big Bluestem	0	14 lbs./ha	
dc ec	Desmodium canadense Elymus canadensis	Showy Tick Trefoil Canada Wild Rye	0	14 lbs./ha 14 lbs./ha	
hd pd	Helianthus decapitalus Penstemon digitalis	Thin Leaf Sunflower Foxglove Beardtongue	0	14 lbs./ha	
pv	Physostegia virginiana	Obedient Plant	0	14 lbs./ha	
rp se	Ratibida pinnata Symphiotrichum ericoides	Green Headed Coneflower Heath Aster	0	14 lbs./ha 14 lbs./ha	
sna	Symphiotrichum novae-angliae Silphium terebinthinaceum	New England Aster Prairie Dock	0	14 lbs./ha	
st Vix	Suprium terebiritiinideeulli		0		
aa as	Acorus americanus Asclepias syriaca	Sweet Flag Common Milkweed	263 0	14 lbs./ha 14 lbs./ha	25cm O.C.
осе	Bidens cernua	Nodding Wild Marigold	0	14 lbs./ha	
cs iv	Carex stipata Iris versicolor	Awlfruit Sedge Blue Flag Iris	656 0	14 lbs./ha	10cm O.C.
lc	Lobelia cardinalis	Cardinal Flower	0	14 lbs./ha	
tl sa	Typha latifolia Scirpus atrovirens	Common Cattail Gree Bullrush	0	14 lbs./ha 14 lbs./ha	
sc	Scirpus cyperinus	Wool Grass	0	14 lbs./ha	
vh valk Mix	Verbena hastata	Blue Vervain	0	14 lbs./ha	
rh ssc	Rudbeckia hirta Schizachyrium soparium	Black Eyed Susan Little Bluestem	5 25	14 lbs./ha 14 lbs./ha	25cm O.C.
sc	Sporobolus cryptandrus	Sand Dropseed	30	14 lbs./ha	40
pc pd	Poa compressa Penstemon digitalis	Canada Bluegrass Foxglove Beardtongue	30 5	14 lbs./ha 14 lbs./ha	10cm O.C.
am	Achillea Millefolium	Varrow	5	14 lbs /ba	

5 14 lbs./ha

Achillea Millefolium

PLANTING NOTES

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- PREPARED BY CONTRACTOR AND REVIEWED BY LANDSCAPE ARCHITECT. 12. CONTRACTOR TO STAKE OUT THERMAL BED LOCATION AND LOCATE ROOTBALLS ACCORDINGLY SO AS NOT TO PENETRATE THERMAL BED DURING

LEGEND

Large Tree

○ Small Tree

Large Shrub

Small Shrub

Dry Seed Mix

Wet Seed Mix

Live Staking

Asphalt Path

Decking

— Railing

Seatwall

Sidewalk Seed Mix

Medium Seed Mix

Concrete Paving

11. SINGLE-NET STRAW BLANKET TO COVER FIRST 2 METRES OF SEED MIX EXTENDING UPWARDS FROM BASE OF SLOPE TO ENSURE MINIMAL SEED DISPLACEMENT BY WATER OR BY WILDLIFE.SHOP DRAWINGS TO BE

TOWN OF PELHAM EAST FONTHILL

Project /Client



20 PELHAM TOWN SQUARE FONTHILL, ON LOS 1E0 T: (905) 892-2607 F: (905) 892-5055

Issue / Revisions

No.	Description	Date	By
1	Planting Plan - For Discussion	2014-09-08	TB

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MOH/DL/WD

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255 Bay Street, Suite 201 Toronto. Ontario. Canada M5R 2A9 t. 416.975.1556 f. 416.975.1580 info@planpart.ca

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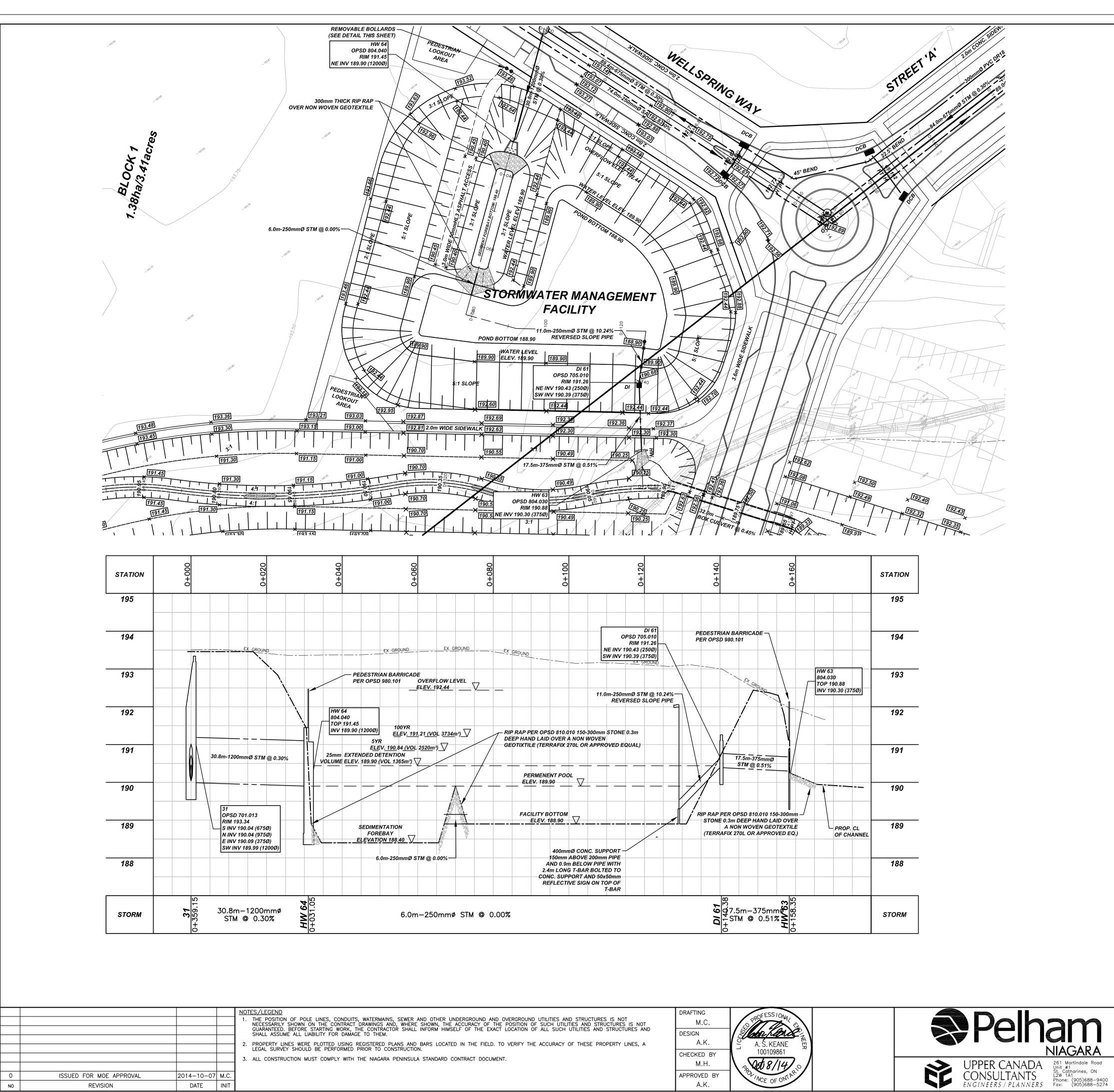
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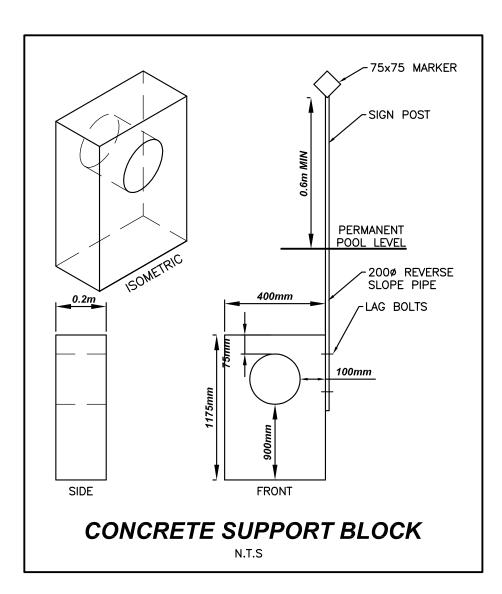
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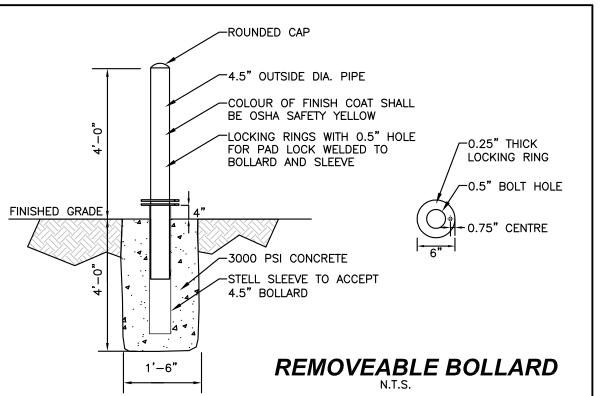
North Storm Water Pond and Gateway Planting Plan

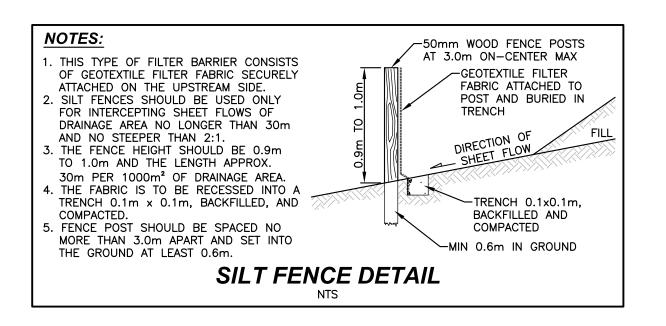
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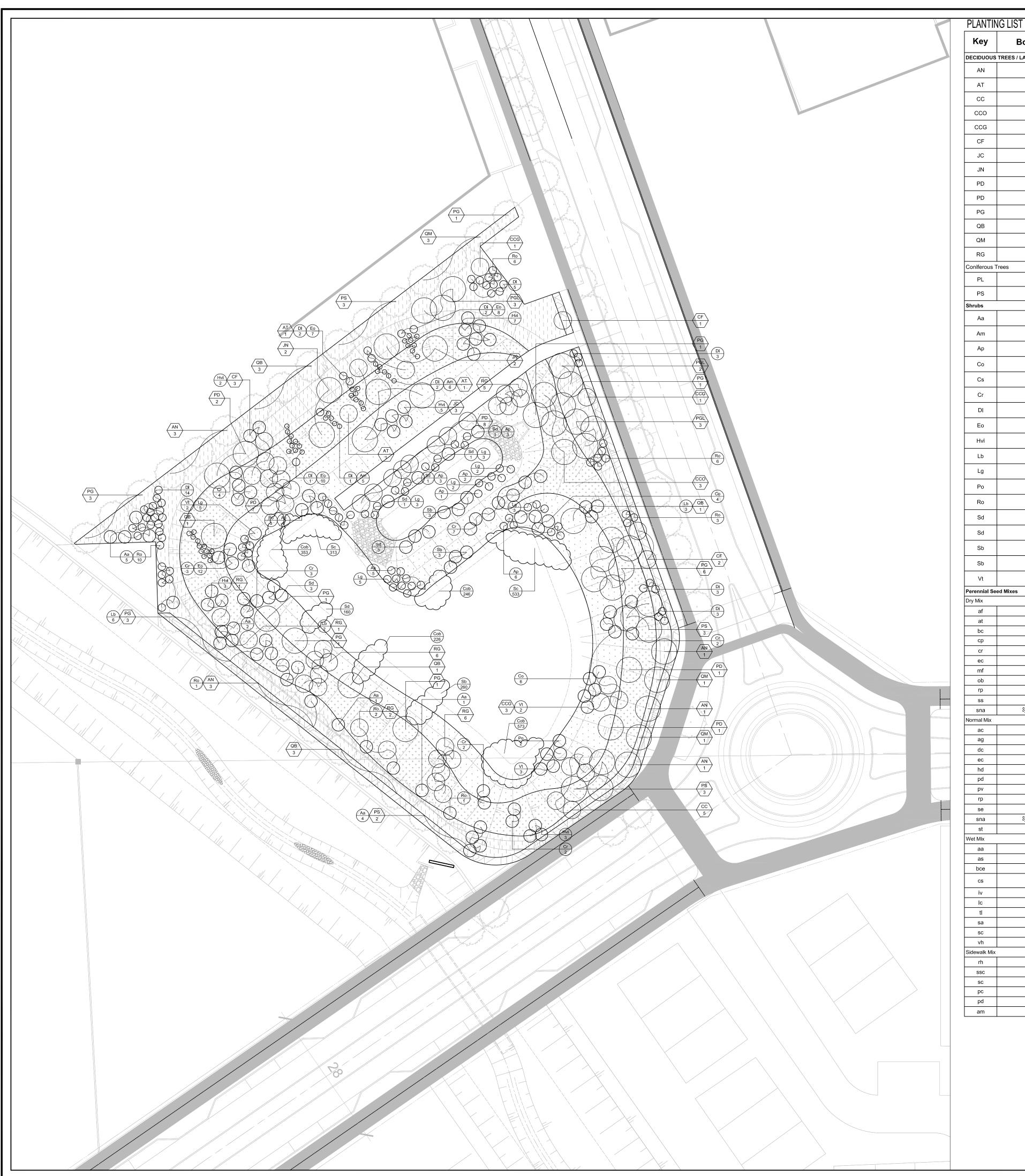




FONTHILL EAST **SOUTH POND** PLAN AND PROFILE + GRADING PLAN FROM STA 0+000 to STA 0+177.95 TOWN OF PELHAM

CONSULTA	NT FILE No. 0473
DATE	2014-01-21
SCALE	1 : 500m
REF. No.	-

0473PP+GP



	G LIST	1	T	1	
Key	Botanical Name	Common Name	Qty.	Size	Spacing
ECIDUOUS T	REES / LARGE SHRUBS	1			
AN	Acer nigrum	Black Maple	9	70MM B+B	AS INDICATED
AT	Asimina triloba	Paw Paw	3	40MM B+B	AS INDICATED
СС	Cercis canadensis	Eastern Redbud	5	50MM B+B	AS INDICATED
ССО	Carya cordiformis	Bitternut Hickory	3	60MM B+B	AS INDICATED
CCG	Crataegus crus-galli	Cockspur Hawthorn	5	60MM B+B	AS INDICATED
CF	Crataegus flabellata	Fanleaf Hawthorn	6	60MM B+B	AS INDICATED
JC	Juglans cinerea	Butternut	3	70MM	AS INDICATED
JN	Juglans nigra	Black Walnut	4	B+B 70MM	AS INDICATED
PD	Populus deltoides	Cottonwood	5	B+B 60MM	AS INDICATED
	,			B+B 35MM	
PD	Populus deltoides	Cottonwood	15	15GAL 70MM	AS INDICATED
PG	Populus grandidenta	Big-Tooth Aspen	18	B+B 70MM	AS INDICATED
QB	Quercus bicolor	Swamp White Oak	9	B+B	AS INDICATED
QM	Quercus macrocarpa	Burr Oak	8	70MM B+B	AS INDICATED
RG	Rhus glabra	Smooth Sumac	21	50MM B+B	AS INDICATED
oniferous Tr	ees				
PL	Picea glauca	White Spruce	8	125CM W.B.	AS INDICATED
PS	Pinus strobus	White Pine	12	125CM W.B.	AS INDICATED
rubs					
Aa	Amelanchier alnifolia	Saskatoon Serviceberry	13	1 gal.	AS INDICATED
Am	Aronia melanocarpa	Black Chokeberry	11	1 gal.	AS INDICATED
Ар	Andromeda polifolia	Bog Rosemary	26	1 gal.	AS INDICATED
	<u> </u>	-			
Co	Comus obliqua	Silky Dogwood	10	1 gal.	AS INDICATED
Cs	Cornus sericea	Red Osier Dogwood	1995	live stakes	0.15m O.C.
Cr	Comus racemosa	Grey Dogwood	23	1 gal.	AS INDICATED
DI	Diervilla Ionicera	Low Bush Honeysuckle	36	1 gal.	AS INDICATED
Eo	Euonymus obovata	Running Serviceberry	37	1 gal.	AS INDICATED
	Hamamelis virginiana			1 gal.	
Hvi		Witch Hazel	20		AS INDICATED
Lb	Lindera benzoin	Spice Bush	11	1 gal.	AS INDICATED
Lg	Ledum groenlandicum	Labrador Tea	23	1 gal.	AS INDICATED
Po	Physocarpos opulifolius	Ninebark	5	1 gal.	AS INDICATED
Ro	Rubus odoratus	Purple Flowering Raspberry	28	1 gal.	AS INDICATED
		Pussy Willow			
Sd	Salix discolor		10	1 gal.	AS INDICATED
Sd	Salix discolor	Pussy Willow	1300	live stakes	0.15m O.C.
Sb	Salix bebbiana	Bebb's Willow	6	1 gal.	AS INDICATED
Sb	Salix bebbiana	Bebb's Willow	600	live stakes	0.15m O.C.
Vt	Viburnum trilobum	Highbush Cranberry	7	1 gal.	AS INDICATED
rennial See	d Mixes				
/ Mix					
af	Agastache foeniculum	Blue Giant Hyssop Butterfly Milkweed	175	14 lbs./ha	
at bc	Asclepias tuberosa Bouteloua curtipendula	Side Oats Grama	0	14 lbs./ha 14 lbs./ha	
ср	Carex pensylvanica	Pennsylvania Sedge	0	14 lbs./ha	
cr	Campanula rotundifolia	Harebells	0	14 lbs./ha	
ec mf	Elymus canadensis monarda fistulosa	Canada Wild Rye Wild Bergamot	0	14 lbs./ha 14 lbs./ha	
ob	Oenothera biennis	Common Evening Primrose	0	14 lbs./ha	
rp	Ratibida pinnata	Green Headed Coneflower	0	14 lbs./ha	
ss	Solidago speciosa	Showy Goldenrod New England Aster	0	14 lbs./ha	
sna rmal Mix	Symphiotrichum novae-angliae	New Eligianu Astei	0	14 lbs./ha	
ac	Aquilegia canadensis	Wild Columbine	0	14 lbs./ha	
ag	Andropogon gerardii	Big Bluestem	0	14 lbs./ha	
dc ec	Desmodium canadense Elymus canadensis	Showy Tick Trefoil Canada Wild Rye	0	14 lbs./ha	
hd	Helianthus decapitalus	Thin Leaf Sunflower	0	14 lbs./ha	
pd	Penstemon digitalis	Foxglove Beardtongue	0	14 lbs./ha	
pv rn	Physostegia virginiana Ratibida pinnata	Obedient Plant Green Headed Coneflower	0	14 lbs./ha 14 lbs./ha	
rp se	Symphiotrichum ericoides	Heath Aster	0	14 lbs./na 14 lbs./ha	
sna	Symphiotrichum novae-angliae	New England Aster	0	14 lbs./ha	
st Mix	Silphium terebinthinaceum	Prairie Dock	0	14 lbs./ha	
aa a	Acorus americanus	Sweet Flag	263	14 lbs./ha	25cm O.C.
as	Asclepias syriaca	Common Milkweed	0	14 lbs./ha	
bce	Bidens cernua	Nodding Wild Marigold	0	14 lbs./ha	
cs	Carex stipata	Awlfruit Sedge	656	14 lbs./ha	10cm O.C.
iv	Iris versicolor	Blue Flag Iris	0	14 lbs./ha	
lc tl	Lobelia cardinalis Typha latifolia	Cardinal Flower Common Cattail	0	14 lbs./ha 14 lbs./ha	
sa	Scirpus atrovirens	Gree Bullrush	0	14 lbs./ha	
sc	Scirpus cyperinus	Wool Grass	0	14 lbs./ha	
vh	Verbena hastata	Blue Vervain	0	14 lbs./ha	
dewalk Mix	Rudbeckia hirta	Black Eyed Susan	5	14 lbs./ha	25cm O.C.
rh		Little Bluestem	25	14 lbs./ha	
rn ssc	Schizachyrium soparium				
ssc sc	Sporobolus cryptandrus	Sand Dropseed	30	14 lbs./ha	-
ssc	<u> </u>	Sand Dropseed Canada Bluegrass Foxglove Beardtongue	30 30 5	14 lbs./ha 14 lbs./ha 14 lbs./ha	10cm O.C.

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LEGEND

○ Large Tree

Small Tree

Large Shrub

Small Shrub

Dry Seed Mix

Wet Seed Mix

□ Concrete Paving

Live Staking

Asphalt Path

Decking

— Railing

Seatwall

Sidewalk Seed Mix

Medium Seed Mix

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.egend:

Issue / Revisions

No. Des

No. Description Date By
1 Planting Plan - For Discussion 2014-09-08 TE

Stamp

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Drawn By
TB
Checked By
MOH/DL/WD
Date

The Planning Partnership

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Drawing Tit

South Storm Water Pond and Gateway Planting Plan

Scale 1:400

Proj. No.

1453
Rev.

L-4

Drawing No.