STORMWATER MANAGEMENT PLAN

THE VILLAGE OF EAST FONTHILL

TOWN OF PELHAM

Prepared for:

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June 2015

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References

1. Stormwater Management Planning and Design Manual
   Ontario Ministry of the Environment (March 2003)

2. 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.

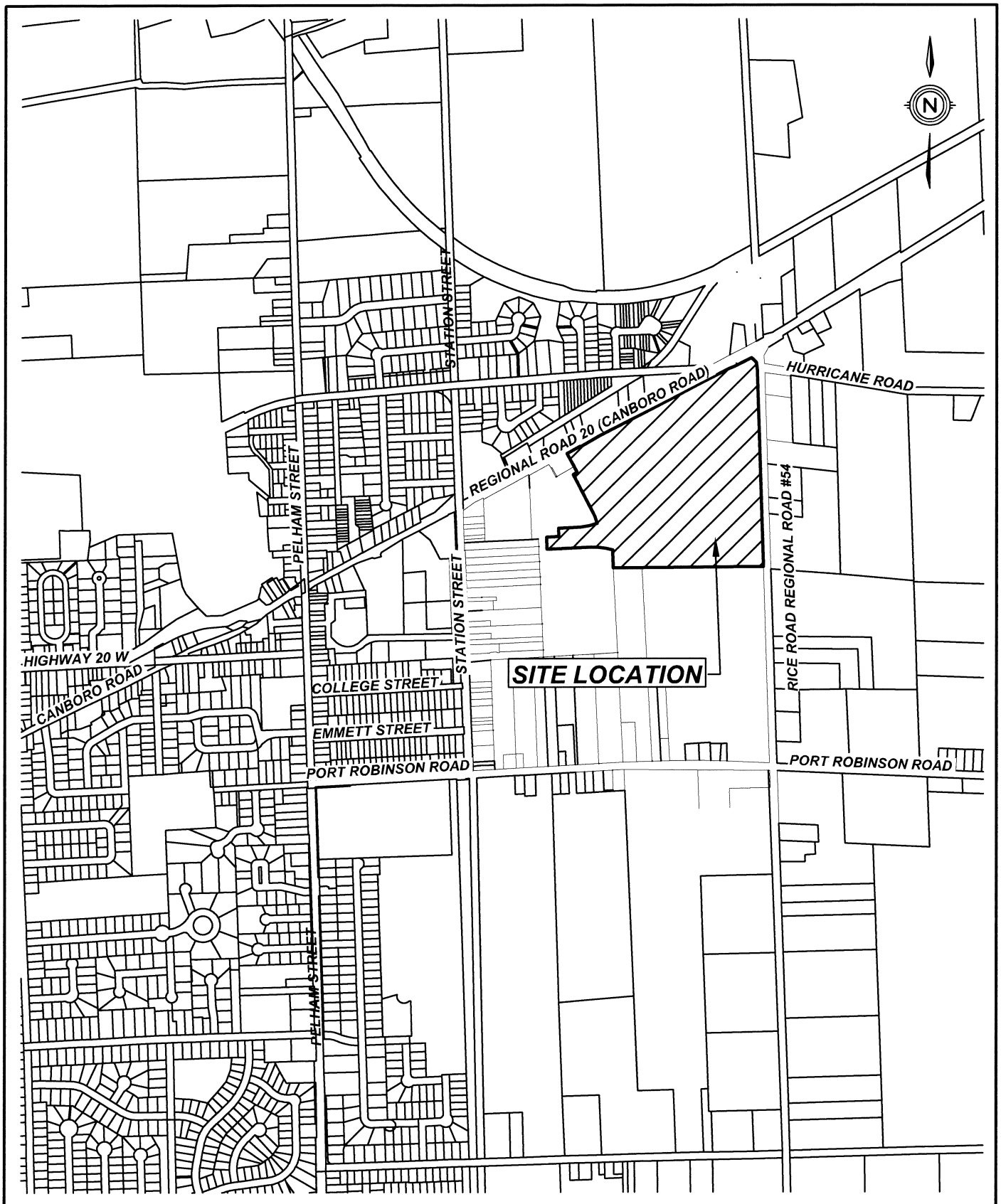
This stormwater management report has been prepared in support of the Draft Plan of Subdivision application for *The Village of East Fonthill.*

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.



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THE VILLAGE OF EAST FONTHILL

TOWN OF PELHAM

SITE LOCATION PLAN

DATE	2014-04-22
SCALE	NTS
REF. No.	-
DWG No.	FIGURE 1

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 (Return Period)	Chicago Distribution Parameters			Duration (minutes)
	a	b	c	
25mm	500.00	8.100	0.810	240
5- Year	830.00	7.300	0.777	240
100- Year	1,020.00	4.700	0.731	240

$$\text{Intensity}\left(\frac{\text{mm}}{\text{hr}}\right) = \frac{a}{(t_c + b)^c}$$

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 (ha)	Length (m)	Slope (%)	Manning 'n'		Soil type	SCS CN	Percent Impervious
				Perv	Imperv			
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**							

LEGEND

A0 — DRAINAGE AREA NUMBER

0.00 — DRAINAGE AREA IN HECTARES

0.00 — RUN-OFF COEFFICIENT

DRAINAGE AREA BOUNDARY

A — STORMWATER OUTLET

N

HURRICANE ROAD

REGIONAL ROAD 20 (CANBORO ROAD)

HURRICANE ROAD

101
21.98Ha
47.8%

PROJECT SITE

103
42.37Ha
5.6%

RICE ROAD REGIONAL ROAD #54

PELHAM STREET

STATION STREET

102
32.34Ha
49.3%

HIGHWAY 20 W

CHURCH HILL

PELHAM STREET

COLLEGE STREET

CANBORO ROAD

HIGHLAND AVENUE

ELIZABETH DR.

EMMETT STREET

104
11.49Ha
19.5%

STATION STREET

106
10.46Ha
2.8%

105
6.63Ha
11.3%

PORT ROBINSON ROAD

PORT ROBINSON ROAD

BROCK STREET

PORT ROBINSON ROAD

107
11.78Ha
4.0%

A

B

C

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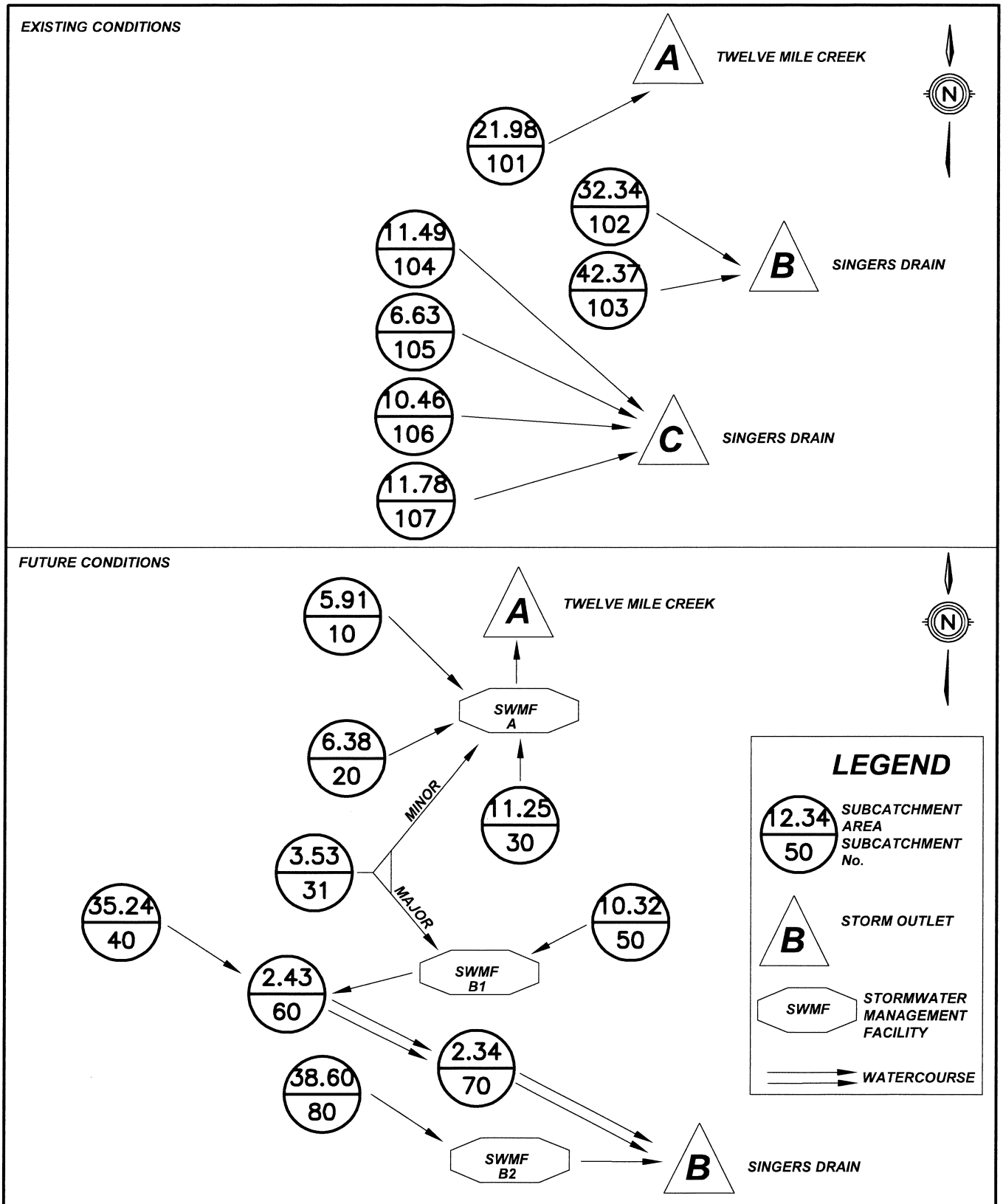
THE VILLAGE OF EAST FONTHILL
EXISTING STORM DRAINAGE AREA PLAN
TOWN OF PELHAM

DATE	2014-04-22
SCALE	NTS
REF. No.	-
DWG No.	FIGURE 2



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THE VILLAGE OF EAST FONTHILL

TOWN OF PELHAM

SHEMATIC OF HYDRAULIC MODELING CONDITIONS

DATE	2014-04-22
SCALE	NTS
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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.

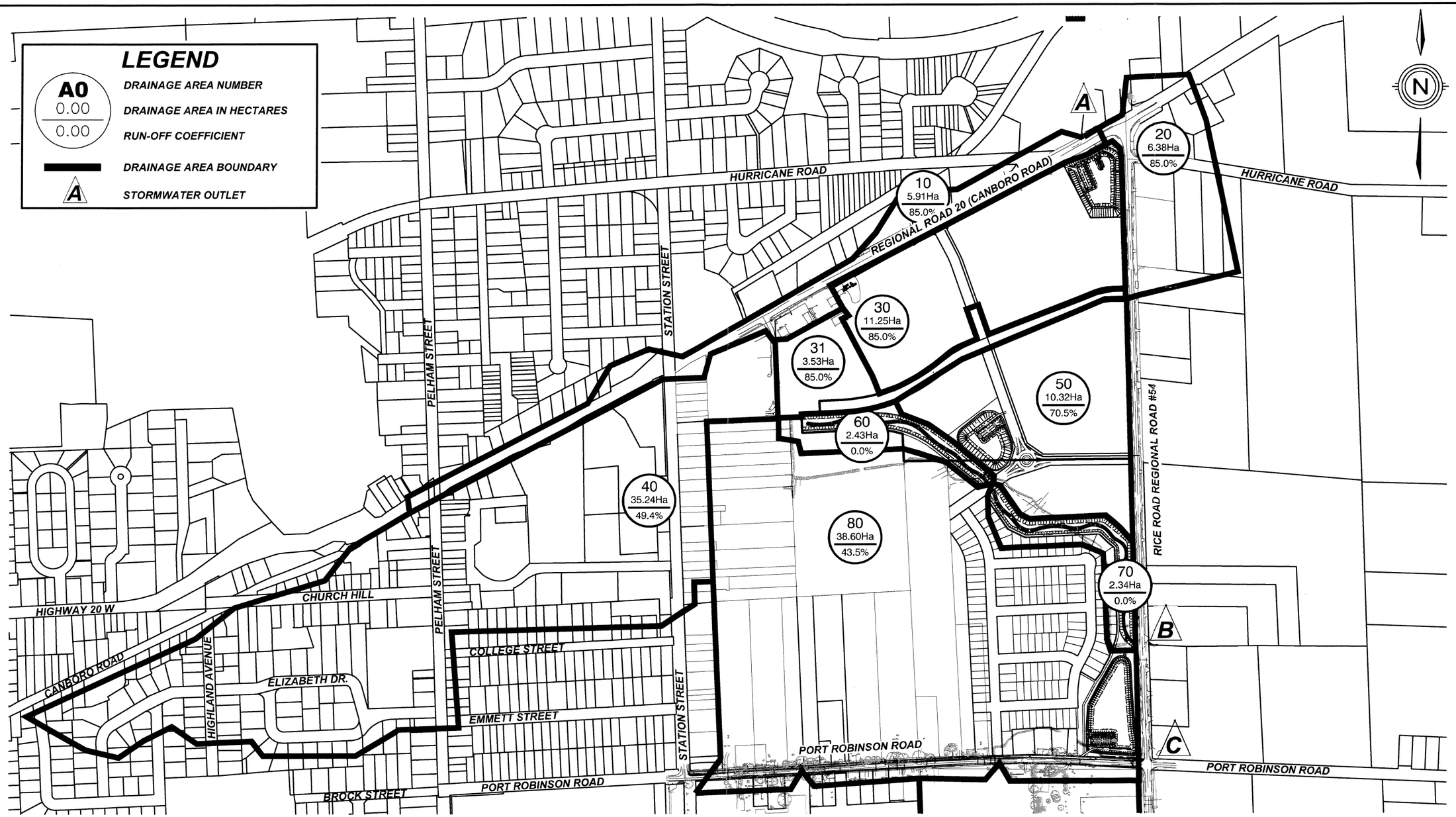
Sizing for this facility is based upon the sizing found within the Fonthill East Secondary Plan and has been refined in concert with that development proposal in preparation for their submission for Draft Plan of Subdivision Approvals.

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 (ha)	Length (m)	Slope (%)	Manning 'n'		Soil type	SCS CN	Percent Impervious
				Perv	Imperv			
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	C	74	70.5%
60	2.43	125	2.0	0.25	0.015	C	74	0%
70	2.34	120	2.0	0.25	0.015	C	74	0%
80	38.60	510	2.0	0.25	0.015	C	74	43.5%
Total area (ha)	**116.0116**							



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THE VILLAGE OF EAST FONTHILL
FUTURE STORM DRAINAGE AREA PLAN
TOWN OF PELHAM

DATE	2014-04-22
SCALE	NTS
REF. No.	-
DWG No.	FIGURE 4

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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. Vegetative Alternatives

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.

Table 4. Evaluation of Stormwater Management Practices

The Village of Fonthill East	Criteria for Implementation of Stormwater Management Practices (SWMP)					Technical Effectiveness (10 high)	Recommend Application Yes/No	Comments
	Topography	Soils	Bedrock	Groundwater	Area			
Site Conditions	*Variable 1 to 2%*	*Clay <12mm/hr*	*At Considerable Depth*	*At Considerable Depth*	*±90.4ha*			
Lot Level Controls								
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	6	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	9	No	Very effective quality control
Other								
Oil/Grit Separator	nlc	nlc	nlc	nlc	< 2.7 ha**	3	No	Limited benefit/area too large

Reference: Stormwater Management Practices Planning and Design Manual - 1994
Nlc - No Limiting Criteria
** As per Stormceptor Technical Manual

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 m^3/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 m^3 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 m^3. 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 m^3
B. Extended Detention Volume	1,083 m^3
C. Stormwater Volume from 25mm - 4 hour rainfall event	4,211 m^3
D. Maximum Extended Detention Volume (greater of B & C)	4,211 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)			
$\text{Settling length} = \sqrt{\frac{r * Q_p}{V_s}}$	r=	10.0	(Length: width ratio)
	Qp=	0.05	(25mm storm pond discharge) - m^3/s
	Vs=	0.00035	(Settling velocity) – m/s
	Settling Length= **37.80m**		
b) Dispersion Length (MOE SWMP & D, Equation 4.6)			
$\text{Dispersion length} = \frac{8 * Q}{D * V_f}$	Q=	3.815	5-yr storm sewer design inflow (m^3/s)
	D=	**1.50m**	Depth of forebay
	Vf=	0.55 m/s	Desired velocity
	Dispersion Length= **37.0 m**		
c) Minimum Forebay Deep Zone Bottom Width (MOE SWMP &D, Equation 4.7)			
$\text{Width} = \frac{\text{Dispersion length}}{\text{L: W}}$	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			
$\text{Average Velocity} = \frac{Q}{A}$	**Q=**	**1.836**	Quality design inflow (m^3/s)
	A=	12.00	(Cross sectional area) - m^2
	D=	**1.50 m**	(Depth of forebay)
	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			
	L=	**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 (Return Period)	**Peak Flows (m^3/s)**		**Maximum Depth (m)**	**Maximum Volume (m^3)**
	Inflow	**Outflow**		
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 m^3/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 m^3. Table 11 shows the stormwater storage volumes required using both the water quality and erosion control guidelines.

Table 11. South Pond Stormwater Quality Volume Requirements	
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 Criteria	
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 m^3
Maximum storage volume	8,534 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 Pond Forebay Sizing			
a) Forebay Settling Length (MOE SWMP&D, Equation 4.5)			
$\text{Settling length} = \sqrt{\frac{r * Q_p}{V_s}}$	r=	5.9	(Length: width ratio)
	Qp=	0.02	(25mm storm pond discharge) - m^3/s
	Vs=	0.00035	(Settling velocity) – m/s
	Settling Length= **18.36m**		
b) Dispersion Length (MOE SWMP & D, Equation 4.6)			
$\text{Dispersion length} = \frac{8 * Q}{D * V_f}$	Q=	1.480	5-yr storm sewer design inflow (m^3/s)
	D=	**1.50m**	Depth of forebay
	Vf=	0.55 m/s	Desired velocity
	Dispersion Length= **14.4 m**		
c) Minimum Forebay Deep Zone Bottom Width (MOE SWMP &D, Equation 4.7)			
$\text{Width} = \frac{\text{Dispersion length}}{\text{L: W}}$	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			
$\text{Average Velocity} = \frac{Q}{A}$	**Q=**	**0.703**	Quality design inflow (m^3/s)
	A=	12.75	(Cross sectional area) - m^2
	D=	**1.50 m**	(Depth of forebay)
	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 m^3 for the 100 year design storm event.

Table 13. Proposed South Pond Characteristics				
Design Storm (Return Period)	**Peak Flows (m^3/s)**		**Maximum depth (m)**	**Maximum Volume (m^3)**
	Inflow	**Outflow**		
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. Peak Flow Values				
Design Storm (Return Period)	**Peak Flow (m^3/s)**			
	Existing	**Future without SWMP**	**Future with SWMP**	**Change**
OUTLET A (TWELVE MILE 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 B (SINGER'S DRAIN)				
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 Parameters for Northern portion of Channel to Culvert	
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 Parameters for First Flat Portion of Southern Channel	
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 First Steep Portion of Southern Channel	
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 Second Flat Portion of Southern Channel	
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 Second Steep Portion of Southern Channel	
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 4.938m^3/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.

9.0 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.

Respectfully submitted,

Adam Keane, P.Eng.

APPENDICES

APPENDIX A

Detailed Calculations for Stormwater Management Facilities

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

BY: A. Keane
DATE: Jun-15

PROJECT NAME: THE VILLAGE OF EAST FONTHILL (NORTH POND), FONTHILL, TOWN OF PELHAM
PROJECT NO.: 0473

WET POND FACILITY

Quality Requirements		Quality Orifice		Ditch Inlet Weir		Outflow Pipe Orifice		Overflow Spillway	
Qlty Drng. Area (ha) =	20.69	Diameter (m) =	0.225	OPSD: 705.040 (TYPE A)		Diameter (m) =	0.675	Minor Length (m) =	0.00
Qnty Drng. Area (ha) =	27.07							Minor Slopes (X:1) =	0.00
Lvl 1 @ 85% (m3/ha) =	250	Cd =	0.63	Flow Width (m) =	1.20	Cd =	0.65	Major Slopes (X:1) =	3.00
Perm Pool (m3/ha) =	210	Invert (m) =	186.55	Inlet Depth (m) =	0.60	Invert (m) =	186.55	Minor Invert (m) =	189.58
Perm Pool Vol (m3) =	4,345			Grate Slope (X:1) =	4	Overt (m) =	187.23	Major Length (m) =	20.00
Active Vol (m3)	1,083			Inlet Elevation (m) =	187.38			Major Invert (m) =	189.58
25mm MOEE (m3)	4,211	1470.000		Cd =	1.32			MOE Equation 4.10 Drawdown Coefficient 'C2' =	2,163
10mm MOEE (m3)	1,307			Hydraulic Diameter =	0.40			MOE Equation 4.10 Drawdown Coefficient 'C3' =	4,346
Perm. Pool Elev. =	186.55	m						MOE Equation 4.10 Drawdown Time (h) =	**24.8**

Elevation	Increment Depth (m)	Active Depth (m)	Surface Area (m2)	Average Surface Area (m2)	Increment Volume (m3)	Permanent Volume (m3)	Active Volume (m3)	Quality Orifice (m3/s)	Ditch Inlet (m3/s)	Max Pipe Orifice (m3/s)	Overflow Spillway (m3/s)	Total Outflow (m3/s)	Average Discharge (m3/s)	Side Slope (H:V)
184.80		-1.75	**1,556**			0								
	0.75			2,020.50	1,515.38									5:1
185.55		-1.00	2,485			1,515								
	1.00			3,076.50	3,076.50									5:1
186.55		0.00	**3,668**			**4,592**	*<--5.7% Safety Buffer*							PERM
	0.00			3,973.50	3.97								0.041	5:1
186.55		0.00	**4,279**			0	0	0.000	0.000	0.000	0.000	0.000		PERM
	0.29			4,644.71	1,342.32								0.021	5:1
186.84		0.29	5,010				1,342	0.042	0.000	0.074	0.000	0.042		10mm Vol
	0.31			5,402.71	1,674.84								0.058	5:1
187.15		0.60	**5,795**				3,017	0.074	0.000	0.275	0.000	0.074		
	0.23			5,906.43	1,358.48								0.083	5:1
187.38		0.83	6,018				**4,376**	0.091	0.000	0.635	0.000	0.091		EXTND
	0.44			6,233.46	2,773.89								0.514	5:1
187.83		1.27	6,449				7,150	0.118	1.238	0.936	0.000	0.936		
	0.44			6,664.65	2,965.77								1.049	5:1
188.27		1.72	6,880				10,115	0.139	2.314	1.161	0.000	1.161		
	0.45			7,095.84	3,157.65								1.255	5:1
188.72		2.16	7,311				13,273	0.158	3.029	1.349	0.000	1.349		
	0.44			7,527.03	3,349.53								1.240	5:1
189.16		2.61	7,743				16,622	0.174	3.606	1.514	0.000	1.514		
	0.44			7,958.22	3,541.41								1.655	5:1
189.61		3.05	8,174				20,164	0.189	4.102	1.663	0.133	1.797		
	0.44			8,389.41	3,733.29								6.503	5:1
190.05		3.50	**8,605**				23,897	0.203	4.544	1.800	9.411	11.210		

Notes

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 calcuated 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.
5. Total Outflow is calculated by adding the Overflow Spillway with the lowest of Quality Orifice plus Ditch Inlet or Max Pipe Orifice.

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

BY: A. Keane, P.Eng.
DATE: October 9, 2014

PROJECT NAME: **THE VILLAGE OF EAST FONTHILL (SOUTH POND), FONTHILL, TOWN OF PELHAM**
PROJECT NO.: **0482**

WETPOND FACILITY

Quality Requirements		Quality Orifice	Ditch Inlet Weir	Outflow Pipe Orifice	Overflow Spillway
Drainage Area (ha) = 10.32		Diameter (m) = 0.127	OPSD: 705.03	Diameter (m) = 0.450	Minor Length (m) = 0.00
Level 2 (m3/ha) = 150	@85%	Cd = 0.63	Flow Width (m) = 0.60	Cd = 0.65	Slopes (X:1) = 1.00
Perm Pool (m3/ha) = 110		Invert (m) = 189.90	Inlet Depth (m) = 0.60	Invert (m) = 189.90	Minor Invert (m) = 192.10
Perm Pool Vol (m3) = 1,135			Grate Slope (X:1) = 4	Overt (m) = 190.35	Major Length (m) = 2.44
Active Vol (m3) 413			Inlet Elevation (m) = 190.68		Major Invert (m) = 192.10
25mm MOE (m3) 1,623		Avg. Discharge (m3/s) 0.0123	Cd = 1.32	MOE Equation 4.10 Drawdown Coefficient 'C2' = 947	
Perm. Pool Elev. = 189.90	m		Hydraulic Diameter = 0.30	MOE Equation 4.10 Drawdown Coefficient 'C3' = 2,230	
				MOE Equation 4.10 Drawdown Time (h) = **36.5**	

Elevation	Increment Depth (m)	Active Depth (m)	Surface Area (m2)	Average Surface Area (m2)	Increment Volume (m3)	Permanent Volume (m3)	Active Volume (m3)	Quality Orifice (m3/s)	Ditch Inlet (m3/s)	Max Pipe Orifice (m3/s)	Overflow Spillway (m3/s)	Total Outflow (m3/s)	Average Discharge (m3/s)	Side Slope (H:V)
188.90		-1.00	1,348			0.00								
	0.50			1,568.50	784.25									5:1
189.40		-0.50	1,789			784.3								
	0.50			2,009.50	1,004.75									5:1
189.90		0.00	2,230			**1,789.0**	<-Safety Factor 57.6%							
	0.00			2,230.00	0.02									5:1
189.90		0.00	2,230			0.0	0	0.000	0.000	0.000	0.000	0.000		
	0.17			2,308.91	384.82								0.005	5:1
190.07		0.17	2,388				385	0.010	0.000	0.022	0.000	0.010		
	0.17			2,466.71	411.12								0.014	5:1
190.23		0.33	2,546				796	0.018	0.000	0.076	0.000	0.018		
	0.45			2,757.06	1,231.47								0.024	5:1
190.68		0.78	2,969				**2,027**	0.029	0.000	0.317	0.000	0.029		
	0.02			2,977.98	59.56								0.031	5:1
190.70		0.80	2,987				2,087	0.030	0.003	0.324	0.000	0.033		
	0.03			3,003.23	100.12								0.038	5:1
190.73		0.83	3,019				2,187	0.031	0.013	0.334	0.000	0.043		
	0.17			3,097.91	516.32								0.155	5:1
190.90		1.00	3,177				2,703	0.034	0.233	0.383	0.000	0.267		
	0.17			3,255.71	542.62								0.192	5:1
191.07		1.17	3,335				3,246	0.037	0.712	0.426	0.000	0.426		
	0.17			3,413.51	568.91								0.446	5:1
191.23		1.33	3,492				3,815	0.040	0.980	0.466	0.000	0.466		
	1.17			4,044.70	4,718.82								0.799	5:1
192.40		2.50	4,597				8,534	0.055	2.033	0.679	0.453	1.132		

Notes

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 calcuated 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.
5. Total Outflow is calculated by adding the Overflow Spillway with the lowest of Quality Orifice plus Ditch Inlet or Max Pipe Orifice.

APPENDIX B

MIDUSS Output Files – Existing Drainage Conditions

```
      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
35    COMMENT
     3     line(s) of comment
      THE VILLAGE OF EAST FONTHILL, TOWN OF PELHAM
      STORMWATER MANAGEMENT PLAN, APRIL 2014
      EXISTING CONDITIONS
35    COMMENT
     1     line(s) of comment
      25mm - 4HOUR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES
 2    STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    500.000     Coefficient  a
      8.100     Constant  b    (min)
       .810     Exponent  c
       .400     Fraction to peak  r
    240.000     Duration ó  240 min
               22.981 mm     Total depth
 3    IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015     Manning "n"
     98.000     SCS Curve No or C
       .100     Ia/S Coefficient
       .518     Initial Abstraction
35    COMMENT
     3     line(s) of comment
      ********************************************
      * OUTLET A                                 *
      ********************************************
 4    CATCHMENT
    101.000     ID No.ó 99999
     21.980     Area in hectares
    385.000     Length (PERV) metres
      3.330     Gradient (%)
     47.800     Per cent Impervious
    385.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .831       .000       .000       .000 c.m/s
             .083       .787       .420     C perv/imperv/total
15    ADD RUNOFF
             .831       .831       .000       .000 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .2116845E+04 c.m
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      ********************************************
      * OUTLET B                                 *
      ********************************************
 4    CATCHMENT
    102.000     ID No.ó 99999
     32.340     Area in hectares
    465.000     Length (PERV) metres
     16.460     Gradient (%)
     49.300     Per cent Impervious
    465.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.280       .000       .000       .000 c.m/s
             .083       .785       .429     C perv/imperv/total
15    ADD RUNOFF
            1.280      1.280       .000       .000 c.m/s
 4    CATCHMENT
    103.000     ID No.ó 99999
     42.370     Area in hectares
    530.000     Length (PERV) metres
      2.450     Gradient (%)
      5.600     Per cent Impervious
    530.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .175      1.280       .000       .000 c.m/s
             .083       .793       .123     C perv/imperv/total
15    ADD RUNOFF
             .175      1.455       .000       .000 c.m/s
27    HYDROGRAPH DISPLAY
     4     is # of Hyeto/Hydrograph chosen
      Volume  =  .1197006E+04 c.m
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      ********************************************
      * OUTLET C                                 *
      ********************************************
 4    CATCHMENT
    104.000     ID No.ó 99999
     11.490     Area in hectares
    275.000     Length (PERV) metres
      4.430     Gradient (%)
     19.500     Per cent Impervious
    275.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .179       .000       .000       .000 c.m/s
             .083       .789       .221     C perv/imperv/total
15    ADD RUNOFF
             .179       .179       .000       .000 c.m/s
 4    CATCHMENT
    105.000     ID No.ó 99999
      6.630     Area in hectares
    210.000     Length (PERV) metres
      2.630     Gradient (%)
     11.300     Per cent Impervious
    210.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     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
15    ADD RUNOFF
             .060       .240       .000       .000 c.m/s
 4    CATCHMENT
    106.000     ID No.ó 99999
     10.460     Area in hectares
    265.000     Length (PERV) metres
      2.000     Gradient (%)
      2.800     Per cent Impervious
    265.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .024       .240       .000       .000 c.m/s
             .083       .791       .103     C perv/imperv/total
15    ADD RUNOFF
             .024       .263       .000       .000 c.m/s
 4    CATCHMENT
    107.000     ID No.ó 99999
     11.780     Area in hectares
    280.000     Length (PERV) metres
      2.780     Gradient (%)
      4.000     Per cent Impervious
    280.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .037       .263       .000       .000 c.m/s
             .083       .792       .112     C perv/imperv/total
15    ADD RUNOFF
             .037       .301       .000       .000 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .1380951E+04 c.m
14    START
     1     1=Zero; 2=Define
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      ********************************************************
      * 5 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
      ********************************************************
 2    STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    830.000     Coefficient  a
      7.300     Constant  b    (min)
       .777     Exponent  c
       .400     Fraction to peak  r
    240.000     Duration ó  240 min
               45.876 mm     Total depth
 3    IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015     Manning "n"
     98.000     SCS Curve No or C
       .100     Ia/S Coefficient
       .518     Initial Abstraction
35    COMMENT
     3     line(s) of comment
      ********************************************
      * OUTLET A                                 *
      ********************************************
 4    CATCHMENT
    101.000     ID No.ó 99999
     21.980     Area in hectares
    385.000     Length (PERV) metres
      3.330     Gradient (%)
     47.800     Per cent Impervious
    385.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.796       .000       .000       .000 c.m/s
             .236       .881       .544     C perv/imperv/total
15    ADD RUNOFF
            1.796      1.796       .000       .000 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .5489694E+04 c.m
14    START
```

```
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
      ********************************************
      * OUTLET B                                 *
      ********************************************
 4    CATCHMENT
    102.000     ID No.ó 99999
     32.340     Area in hectares
    465.000     Length (PERV) metres
     16.460     Gradient (%)
     49.300     Per cent Impervious
    465.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      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
15    ADD RUNOFF
           2.605      2.605       .000       .000 c.m/s
 4    CATCHMENT
    103.000     ID No.ó 99999
     42.370     Area in hectares
    530.000     Length (PERV) metres
      2.450     Gradient (%)
      5.600     Per cent Impervious
    530.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .446      2.605       .000       .000 c.m/s
          .236       .880       .272     C perv/imperv/total
15    ADD RUNOFF
          .446      3.051       .000       .000 c.m/s
27    HYDROGRAPH DISPLAY
      4     is # of Hyeto/Hydrograph chosen
      Volume  =  .5285372E+04 c.m
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
      ********************************************
      * OUTLET C                                 *
      ********************************************
 4    CATCHMENT
    104.000     ID No.ó 99999
     11.490     Area in hectares
    275.000     Length (PERV) metres
      4.430     Gradient (%)
     19.500     Per cent Impervious
    275.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .392       .000       .000       .000 c.m/s
          .236       .866       .359     C perv/imperv/total
15    ADD RUNOFF
          .392       .392       .000       .000 c.m/s
 4    CATCHMENT
    105.000     ID No.ó 99999
      6.630     Area in hectares
    210.000     Length (PERV) metres
      2.630     Gradient (%)
     11.300     Per cent Impervious
    210.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .139       .392       .000       .000 c.m/s
          .236       .867       .307     C perv/imperv/total
15    ADD RUNOFF
          .139       .531       .000       .000 c.m/s
 4    CATCHMENT
    106.000     ID No.ó 99999
     10.460     Area in hectares
    265.000     Length (PERV) metres
      2.000     Gradient (%)
      2.800     Per cent Impervious
    265.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .110       .531       .000       .000 c.m/s
          .236       .876       .254     C perv/imperv/total
15    ADD RUNOFF
          .110       .600       .000       .000 c.m/s
 4    CATCHMENT
    107.000     ID No.ó 99999
     11.780     Area in hectares
    280.000     Length (PERV) metres
      2.780     Gradient (%)
      4.000     Per cent Impervious
    280.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      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
15    ADD RUNOFF
          .132       .704       .000       .000 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
      Volume  =  .5452904E+04 c.m
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
      ************************************************************
      * 100 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
      ************************************************************
 2    STORM
         1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
   1020.000     Coefficient  a
      4.700     Constant  b    (min)
       .731     Exponent  c
       .400     Fraction to peak  r
    240.000     Duration ó  240 min
               73.207 mm     Total depth
 3    IMPERVIOUS
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015     Manning "n"
     98.000     SCS Curve No or C
       .100     Ia/S Coefficient
       .518     Initial Abstraction
35    COMMENT
      3     line(s) of comment
      ********************************************
      * OUTLET A                                 *
      ********************************************
 4    CATCHMENT
    101.000     ID No.ó 99999
     21.980     Area in hectares
    385.000     Length (PERV) metres
      3.330     Gradient (%)
     47.800     Per cent Impervious
    385.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           2.875       .000       .000       .000 c.m/s
            .367       .907       .625     C perv/imperv/total
15    ADD RUNOFF
           2.875      2.875       .000       .000 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
      Volume  =  .1006246E+05 c.m
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
      ********************************************
      * OUTLET B                                 *
      ********************************************
 4    CATCHMENT
    102.000     ID No.ó 99999
     32.340     Area in hectares
    465.000     Length (PERV) metres
     16.460     Gradient (%)
     49.300     Per cent Impervious
    465.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           4.439       .000       .000       .000 c.m/s
            .367       .916       .638     C perv/imperv/total
15    ADD RUNOFF
           4.439      4.439       .000       .000 c.m/s
 4    CATCHMENT
    103.000     ID No.ó 99999
     42.370     Area in hectares
    530.000     Length (PERV) metres
      2.450     Gradient (%)
      5.600     Per cent Impervious
    530.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      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
15    ADD RUNOFF
          1.137      4.969       .000       .000 c.m/s
27    HYDROGRAPH DISPLAY
      4     is # of Hyeto/Hydrograph chosen
      Volume  =  .1236434E+05 c.m
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
      ********************************************
      * OUTLET C                                 *
      ********************************************
 4    CATCHMENT
    104.000     ID No.ó 99999
     11.490     Area in hectares
```

```
   275.000     Length (PERV) metres
     4.430     Gradient (%)
    19.500     Per cent Impervious
   275.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .697       .000       .000       .000 c.m/s
           .367       .915       .474     C perv/imperv/total
15   ADD RUNOFF
            .697       .697       .000       .000 c.m/s
 4   CATCHMENT
   105.000     ID No.ó 99999
     6.630     Area in hectares
   210.000     Length (PERV) metres
     2.630     Gradient (%)
    11.300     Per cent Impervious
   210.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     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
15   ADD RUNOFF
            .284       .977       .000       .000 c.m/s
 4   CATCHMENT
   106.000     ID No.ó 99999
    10.460     Area in hectares
   265.000     Length (PERV) metres
     2.000     Gradient (%)
     2.800     Per cent Impervious
   265.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .361       .977       .000       .000 c.m/s
           .367       .903       .382     C perv/imperv/total
15   ADD RUNOFF
            .361      1.167       .000       .000 c.m/s
 4   CATCHMENT
   107.000     ID No.ó 99999
    11.780     Area in hectares
   280.000     Length (PERV) metres
     2.780     Gradient (%)
     4.000     Per cent Impervious
   280.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .426      1.167       .000       .000 c.m/s
           .368       .908       .389     C perv/imperv/total
15   ADD RUNOFF
            .426      1.519       .000       .000 c.m/s
27   HYDROGRAPH DISPLAY
 5     is # of Hyeto/Hydrograph chosen
 Volume  =  .1235576E+05 c.m
14   START
 1     1=Zero; 2=Define
20   MANUAL
```

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
   35   COMMENT
        3     line(s) of comment
        THE VILLAGE OF EAST FONTHILL, TOWN OF PELHAM
        STORMWATER MANAGEMENT PLAN, OCT 2014
        FUTURE CONDITIONS - WITH STORMWATER MANAGEMENT
   35   COMMENT
        1     line(s) of comment
        25mm - 4HOUR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES
    2   STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      500.000     Coefficient  a
        8.100     Constant  b    (min)
         .810     Exponent  c
         .400     Fraction to peak  r
      240.000     Duration ó  240 min
                 22.981 mm     Total depth
    3   IMPERVIOUS
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .015     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
   35   COMMENT
        3     line(s) of comment
        ****************************************
        * OUTLET A                             *
        ****************************************
   14   START
        1     1=Zero; 2=Define
    4   CATCHMENT
       31.000     ID No.ó 99999
        3.530     Area in hectares
      155.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      155.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .241       .000       .000       .000 c.m/s
                .053       .784       .674     C perv/imperv/total
   15   ADD RUNOFF
                .241       .241       .000       .000 c.m/s
   35   COMMENT
        3     line(s) of comment
        ****************************************
        * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)  *
        ****************************************
   12   DIVERT
            9     U/S Node No.ó 99999
         .478     Threshold Discharge
         .574     Max. Outflow reqd.
            Qmax & Vol.Diverted =      .000 c.m/s          .0 c.m
            No flow diverted
                .241       .241       .241       .000 c.m/s
   16   NEXT LINK
                .241       .241       .241       .000 c.m/s
    4   CATCHMENT
       10.000     ID No.ó 99999
        5.910     Area in hectares
      200.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      200.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .399       .241       .241       .000 c.m/s
                .053       .791       .680     C perv/imperv/total
   15   ADD RUNOFF
                .399       .640       .241       .000 c.m/s
    4   CATCHMENT
       20.000     ID No.ó 99999
        6.380     Area in hectares
      205.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      205.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .430       .640       .241       .000 c.m/s
                .053       .791       .680     C perv/imperv/total
   15   ADD RUNOFF
                .430      1.069       .241       .000 c.m/s
   27   HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
        Volume  =  .2459709E+04 c.m
    4   CATCHMENT
       30.000     ID No.ó 99999
       11.250     Area in hectares
      260.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      260.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .767      1.069       .241       .000 c.m/s
                .053       .791       .680     C perv/imperv/total
   15   ADD RUNOFF
                .767      1.836       .241       .000 c.m/s
   27   HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
        Volume  =  .4211089E+04 c.m
   35   COMMENT
        3     line(s) of comment
        ****************************************
        * NORTH VILLAGE OF EAST FONTHILL POND  *
        ****************************************
    9   ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
                .767      1.836      1.836       .000 c.m/s
   16   NEXT LINK
                .767      1.836      1.836       .000 c.m/s
   14   START
        1     1=Zero; 2=Define
   35   COMMENT
        3     line(s) of comment
        ****************************************
        * OUTLET B                             *
        ****************************************
    4   CATCHMENT
       40.000     ID No.ó 99999
       35.240     Area in hectares
      485.000     Length (PERV) metres
       15.480     Gradient (%)
       49.400     Per cent Impervious
      485.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              1.395       .000      1.836       .000 c.m/s
               .083       .787       .431     C perv/imperv/total
   15   ADD RUNOFF
              1.395      1.395      1.836       .000 c.m/s
   11   CHANNEL
        2.000     Base Width     =
        3.000     Left  bank slope  1:
        3.000     Right bank slope  1:
         .040     Manning's "n"
       1.500     O/a Depth in metres
         .900     Select Grade in %
        Depth          =      .414 metres
        Velocity       =     1.040 m/sec
        Flow Capacity  =    20.730 c.m/s
        Critical depth =      .312 metres
    9   ROUTE
      393.000     Conduit Length
         .470     Supply X-factor <.5
      283.376     Supply K-lag (sec)
         .500     Beta weighting factor
      300.000     Routing timestep
            1     No. of sub-reaches
              1.395      1.395      1.212       .000 c.m/s
   16   NEXT LINK
              1.395      1.212      1.212       .000 c.m/s
    4   CATCHMENT
       60.000     ID No.ó 99999
        2.430     Area in hectares
      125.000     Length (PERV) metres
        2.000     Gradient (%)
         .000     Per cent Impervious
      125.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
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          .100     Ia/S Coefficient
         8.924     Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              .003      1.212      1.212       .000 c.m/s
              .083       .000       .083     C perv/imperv/total
   15    ADD RUNOFF
              .003      1.212      1.212       .000 c.m/s
    9    ROUTE
         452.000     Conduit Length
            .475     Supply X-factor <.5
         339.120     Supply K-lag (sec)
            .500     Beta weighting factor
         300.000     Routing timestep
            1        No. of sub-reaches
              .003      1.212      1.141       .000 c.m/s
   17    COMBINE
            1     Junction Node No.
              .003      1.212      1.141      1.141 c.m/s
   14    START
            1     1=Zero; 2=Define
   22    FILE HYDROGRAPH
            1     1=READ: 2=WRITE
           12     DIV00009.25M          is Filename
            2     1=Overland: 2=Inflow: 3=Outflow: 4=Temp'ary
              .003       .000      1.141      1.141 c.m/s
    4    CATCHMENT
          50.000     ID No.ó 99999
          10.320     Area in hectares
         260.000     Length (PERV) metres
           2.000     Gradient (%)
          85.000     Per cent Impervious
         260.000     Length (IMPERV)
            .000     %Imp. with Zero Dpth
            1        Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250     Manning "n"
          74.000     SCS Curve No or C
           .100     Ia/S Coefficient
          8.924     Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              .703       .000      1.141      1.141 c.m/s
              .083       .791       .685     C perv/imperv/total
   15    ADD RUNOFF
              .703       .703      1.141      1.141 c.m/s
   27    HYDROGRAPH DISPLAY
            4     is # of Hyeto/Hydrograph chosen
           Volume  =  .1623832E+04 c.m
   35    COMMENT
            3     line(s) of comment
           ************************************************************
           * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND             *
           ************************************************************
    9    ROUTE
           .000     Conduit Length
           .500     Supply X-factor <.5
           .000     Supply K-lag (sec)
           .500     Beta weighting factor
         600.000     Routing timestep
            1        No. of sub-reaches
              .703       .703       .703      1.141 c.m/s
   17    COMBINE
            1     Junction Node No.
              .703       .703       .703      1.599 c.m/s
   14    START
            1     1=Zero; 2=Define
   18    CONFLUENCE
            1     Junction Node No.
              .703      1.599       .703       .000 c.m/s
    4    CATCHMENT
          70.000     ID No.ó 99999
           2.340     Area in hectares
         120.000     Length (PERV) metres
           2.000     Gradient (%)
            .000     Per cent Impervious
         120.000     Length (IMPERV)
            .000     %Imp. with Zero Dpth
            1        Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250     Manning "n"
          74.000     SCS Curve No or C
           .100     Ia/S Coefficient
          8.924     Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              .003      1.599       .703       .000 c.m/s
              .083       .000       .083     C perv/imperv/total
   15    ADD RUNOFF
              .003      1.599       .703       .000 c.m/s
    9    ROUTE
           .000     Conduit Length
           .500     Supply X-factor <.5
           .000     Supply K-lag (sec)
           .500     Beta weighting factor
         600.000     Routing timestep
            1        No. of sub-reaches
              .003      1.599      1.599       .000 c.m/s
   17    COMBINE
            2     Junction Node No.
              .003      1.599      1.599      1.599 c.m/s
   14    START
            1     1=Zero; 2=Define
    4    CATCHMENT
          80.000     ID No.ó 99999
          38.600     Area in hectares
         510.000     Length (PERV) metres
           2.000     Gradient (%)
          43.500     Per cent Impervious
         510.000     Length (IMPERV)
            .000     %Imp. with Zero Dpth
            1        Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250     Manning "n"
          74.000     SCS Curve No or C
           .100     Ia/S Coefficient
          8.924     Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             1.077       .000      1.599      1.599 c.m/s
              .083       .792       .392     C perv/imperv/total
   15    ADD RUNOFF
             1.077      1.077      1.599      1.599 c.m/s
   27    HYDROGRAPH DISPLAY
            4     is # of Hyeto/Hydrograph chosen
           Volume  =  .3466319E+04 c.m
   35    COMMENT
            3     line(s) of comment
           ************************************************************
           * FUTURE STORMWATER MANAGEMENT FACILITY 706                *
           ************************************************************
   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
           Maximum Depth   =   187.820 metres
           Maximum Storage =     2599. c.m
             1.077      1.077       .054      1.599 c.m/s
   17    COMBINE
            2     Junction Node No.
             1.077      1.077       .054      1.612 c.m/s
   14    START
            1     1=Zero; 2=Define
   18    CONFLUENCE
            2     Junction Node No.
             1.077      1.612       .054       .000 c.m/s
   27    HYDROGRAPH DISPLAY
            4     is # of Hyeto/Hydrograph chosen
           Volume  =  .3466319E+04 c.m
   14    START
            1     1=Zero; 2=Define
   35    COMMENT
            3     line(s) of comment
           ************************************************************
           * 5 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES   *
           ************************************************************
    2    STORM
               1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
         830.000     Coefficient  a
           7.300     Constant  b    (min)
            .777     Exponent  c
            .400     Fraction to peak  r
         240.000     Duration ó  240 min
                    45.876 mm     Total depth
    3    IMPERVIOUS
               1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
            .015     Manning "n"
          98.000     SCS Curve No or C
            .100     Ia/S Coefficient
            .518     Initial Abstraction
   35    COMMENT
            3     line(s) of comment
           ****************************************
           * OUTLET A                             *
           ****************************************
   14    START
            1     1=Zero; 2=Define
    4    CATCHMENT
          31.000     ID No.ó 99999
           3.530     Area in hectares
         155.000     Length (PERV) metres
           2.000     Gradient (%)
          85.000     Per cent Impervious
         155.000     Length (IMPERV)
            .000     %Imp. with Zero Dpth
            1        Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250     Manning "n"
          74.000     SCS Curve No or C
           .100     Ia/S Coefficient
          11.953     Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              .478       .000       .054       .000 c.m/s
              .204       .873       .773     C perv/imperv/total
   15    ADD RUNOFF
              .478       .478       .054       .000 c.m/s
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 35     COMMENT
        3     line(s) of comment
        ****************************************
        * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)     *
        ****************************************
 12     DIVERT
           9     U/S Node No.ó 99999
         .478     Threshold Discharge
         .574     Max. Outflow reqd.
              Qmax & Vol.Diverted =      .000 c.m/s          .0 c.m
              No flow diverted
             .478       .478       .478       .000 c.m/s
 16     NEXT LINK
             .478       .478       .478       .000 c.m/s
  4     CATCHMENT
        10.000     ID No.ó 99999
         5.910     Area in hectares
       200.000     Length (PERV) metres
         2.000     Gradient (%)
        85.000     Per cent Impervious
       200.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
          .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
        11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .829       .478       .478       .000 c.m/s
             .204       .864       .765     C perv/imperv/total
 15     ADD RUNOFF
             .829      1.306       .478       .000 c.m/s
  4     CATCHMENT
        20.000     ID No.ó 99999
         6.380     Area in hectares
       205.000     Length (PERV) metres
         2.000     Gradient (%)
        85.000     Per cent Impervious
       205.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
          .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
        11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .897      1.306       .478       .000 c.m/s
             .204       .866       .767     C perv/imperv/total
 15     ADD RUNOFF
             .897      2.203       .478       .000 c.m/s
 27     HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
        Volume  =  .5569779E+04 c.m
  4     CATCHMENT
        30.000     ID No.ó 99999
        11.250     Area in hectares
       260.000     Length (PERV) metres
         2.000     Gradient (%)
        85.000     Per cent Impervious
       260.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
          .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
        11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            1.613      2.203       .478       .000 c.m/s
             .204       .876       .775     C perv/imperv/total
 15     ADD RUNOFF
            1.613      3.815       .478       .000 c.m/s
 27     HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
        Volume  =  .9569145E+04 c.m
 35     COMMENT
        3     line(s) of comment
        ****************************************
        * NORTH VILLAGE OF EAST FONTHILL POND     *
        ****************************************
  9     ROUTE
          .000     Conduit Length
          .500     No Conduit defined
          .000     Zero lag
          .500     Beta weighting factor
       600.000     Routing timestep
            1     No. of sub-reaches
            1.613      3.815      3.815       .000 c.m/s
 16     NEXT LINK
            1.613      3.815      3.815       .000 c.m/s
 14     START
        1     1=Zero; 2=Define
 35     COMMENT
        3     line(s) of comment
        ****************************************
        * OUTLET B                              *
        ****************************************
  4     CATCHMENT
        40.000     ID No.ó 99999
        35.240     Area in hectares
       485.000     Length (PERV) metres
        15.480     Gradient (%)
        49.400     Per cent Impervious
       485.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
          .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
         8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            2.869       .000      3.815       .000 c.m/s
             .236       .869       .548     C perv/imperv/total
 15     ADD RUNOFF
            2.869      2.869      3.815       .000 c.m/s
 11     CHANNEL
        2.000     Base Width     =
        3.000     Left  bank slope  1:
        3.000     Right bank slope  1:
         .040     Manning's "n"
       1.500     O/a Depth in metres
         .900     Select Grade in %
        Depth          =      .596 metres
        Velocity       =     1.269 m/sec
        Flow Capacity  =    20.730 c.m/s
        Critical depth =      .468 metres
  9     ROUTE
       393.000     Conduit Length
          .458     Supply X-factor <.5
       232.207     Supply K-lag (sec)
          .500     Beta weighting factor
       200.000     Routing timestep
            1     No. of sub-reaches
            2.869      2.869      2.802       .000 c.m/s
 16     NEXT LINK
            2.869      2.802      2.802       .000 c.m/s
  4     CATCHMENT
        60.000     ID No.ó 99999
         2.430     Area in hectares
       125.000     Length (PERV) metres
         2.000     Gradient (%)
          .000     Per cent Impervious
       125.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
          .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
         8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .035      2.802      2.802       .000 c.m/s
             .236       .000       .236     C perv/imperv/total
 15     ADD RUNOFF
             .035      2.813      2.802       .000 c.m/s
  9     ROUTE
       452.000     Conduit Length
          .464     Supply X-factor <.5
       268.490     Supply K-lag (sec)
          .500     Beta weighting factor
       200.000     Routing timestep
            1     No. of sub-reaches
             .035      2.813      2.413       .000 c.m/s
 17     COMBINE
        1     Junction Node No.
             .035      2.813      2.413      2.413 c.m/s
 14     START
        1     1=Zero; 2=Define
 22     FILE HYDROGRAPH
        1     1=READ: 2=WRITE
       12     DIV00009.5YR         is Filename
        2     1=Overland: 2=Inflow: 3=Outflow: 4=Temp'ary
             .035       .000      2.413      2.413 c.m/s
  4     CATCHMENT
        50.000     ID No.ó 99999
        10.320     Area in hectares
       260.000     Length (PERV) metres
         2.000     Gradient (%)
        85.000     Per cent Impervious
       260.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
          .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
         8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            1.480       .000      2.413      2.413 c.m/s
             .236       .876       .780     C perv/imperv/total
 15     ADD RUNOFF
            1.480      1.480      2.413      2.413 c.m/s
 27     HYDROGRAPH DISPLAY
        4     is # of Hyeto/Hydrograph chosen
        Volume  =  .3691582E+04 c.m
 35     COMMENT
        3     line(s) of comment
        ********************************************************
        * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND          *
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      ************************************************************
 9    ROUTE
       .000     Conduit Length
       .500     Supply X-factor <.5
       .000     Supply K-lag (sec)
       .500     Beta weighting factor
      600.000   Routing timestep
          1     No. of sub-reaches
        1.480     1.480     1.480     2.413 c.m/s
17    COMBINE
      1     Junction Node No.
        1.480     1.480     1.480     3.893 c.m/s
14    START
      1     1=Zero; 2=Define
18    CONFLUENCE
      1     Junction Node No.
        1.480     3.893     1.480      .000 c.m/s
 4    CATCHMENT
      70.000    ID No.ó 99999
       2.340    Area in hectares
     120.000    Length (PERV) metres
       2.000    Gradient (%)
        .000    Per cent Impervious
     120.000    Length (IMPERV)
        .000    %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250    Manning "n"
      74.000    SCS Curve No or C
        .100    Ia/S Coefficient
       8.924    Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
        .034     3.893     1.480      .000 c.m/s
        .236      .000      .236     C perv/imperv/total
15    ADD RUNOFF
        .034     3.904     1.480      .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .500     Supply X-factor <.5
       .000     Supply K-lag (sec)
       .500     Beta weighting factor
      600.000   Routing timestep
          1     No. of sub-reaches
        .034     3.904     3.904      .000 c.m/s
17    COMBINE
      2     Junction Node No.
        .034     3.904     3.904     3.904 c.m/s
14    START
      1     1=Zero; 2=Define
 4    CATCHMENT
      80.000    ID No.ó 99999
      38.600    Area in hectares
     510.000    Length (PERV) metres
       2.000    Gradient (%)
      43.500    Per cent Impervious
     510.000    Length (IMPERV)
        .000    %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250    Manning "n"
      74.000    SCS Curve No or C
        .100    Ia/S Coefficient
       8.924    Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
        2.876      .000     3.904     3.904 c.m/s
         .236      .877      .515     C perv/imperv/total
15    ADD RUNOFF
        2.876     2.876     3.904     3.904 c.m/s
27    HYDROGRAPH DISPLAY
      4     is # of Hyeto/Hydrograph chosen
      Volume  =  .9116987E+04 c.m
35    COMMENT
      3     line(s) of comment
      ************************************************************
      * FUTURE STORMWATER MANAGEMENT FACILITY 706                *
      ************************************************************
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    =      .247 c.m/s
      Maximum Depth   =   188.191 metres
      Maximum Storage =     5955. c.m
        2.876     2.876      .247     3.904 c.m/s
17    COMBINE
      2     Junction Node No.
        2.876     2.876      .247     3.943 c.m/s
14    START
      1     1=Zero; 2=Define
18    CONFLUENCE
      2     Junction Node No.
        2.876     3.943      .247      .000 c.m/s
27    HYDROGRAPH DISPLAY
      4     is # of Hyeto/Hydrograph chosen
      Volume  =  .9116987E+04 c.m
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
      ************************************************************
      * 100 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
      ************************************************************
 2    STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    1020.000    Coefficient  a
       4.700    Constant  b    (min)
        .731    Exponent  c
        .400    Fraction to peak  r
     240.000    Duration ó  240 min
              73.207 mm     Total depth
 3    IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015    Manning "n"
      98.000    SCS Curve No or C
        .100    Ia/S Coefficient
        .518    Initial Abstraction
35    COMMENT
      3     line(s) of comment
      ****************************************
      * OUTLET A                             *
      ****************************************
14    START
      1     1=Zero; 2=Define
 4    CATCHMENT
      31.000    ID No.ó 99999
       3.530    Area in hectares
     155.000    Length (PERV) metres
       2.000    Gradient (%)
      85.000    Per cent Impervious
     155.000    Length (IMPERV)
        .000    %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250    Manning "n"
      74.000    SCS Curve No or C
        .100    Ia/S Coefficient
      11.953    Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
         .826      .000      .247      .000 c.m/s
         .340      .916      .830     C perv/imperv/total
15    ADD RUNOFF
         .826      .826      .247      .000 c.m/s
35    COMMENT
      3     line(s) of comment
      ****************************************
      * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)  *
      ****************************************
12    DIVERT
          9     U/S Node No.ó 99999
        .478    Threshold Discharge
        .574    Max. Outflow reqd.
          Qmax & Vol.Diverted =      .252 c.m/s       254.0 c.m
          No flow diverted
           .826      .826      .574      .000 c.m/s
16    NEXT LINK
           .826      .574      .574      .000 c.m/s
 4    CATCHMENT
      10.000    ID No.ó 99999
       5.910    Area in hectares
     200.000    Length (PERV) metres
       2.000    Gradient (%)
      85.000    Per cent Impervious
     200.000    Length (IMPERV)
        .000    %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250    Manning "n"
      74.000    SCS Curve No or C
        .100    Ia/S Coefficient
      11.953    Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
        1.311      .574      .574      .000 c.m/s
         .340      .914      .828     C perv/imperv/total
15    ADD RUNOFF
        1.311     1.885      .574      .000 c.m/s
 4    CATCHMENT
      20.000    ID No.ó 99999
       6.380    Area in hectares
     205.000    Length (PERV) metres
       2.000    Gradient (%)
      85.000    Per cent Impervious
     205.000    Length (IMPERV)
        .000    %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250    Manning "n"
      74.000    SCS Curve No or C
        .100    Ia/S Coefficient
      11.953    Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
        1.407     1.885      .574      .000 c.m/s
         .340      .913      .827     C perv/imperv/total
15    ADD RUNOFF
        1.407     3.292      .574      .000 c.m/s
```

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

```
      510.000     Length (PERV) metres
        2.000     Gradient (%)
       43.500     Per cent Impervious
      510.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            4.773       .000      6.752      6.752 c.m/s
             .368       .925       .610     C perv/imperv/total
   15    ADD RUNOFF
            4.773      4.773      6.752      6.752 c.m/s
   27    HYDROGRAPH DISPLAY
         4     is # of Hyeto/Hydrograph chosen
         Volume  =  .1723819E+05 c.m
   35    COMMENT
         3     line(s) of comment
         ************************************************************
         * FUTURE STORMWATER MANAGEMENT FACILITY 706                *
         ************************************************************
   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    =       .464 c.m/s
        Maximum Depth   =   188.699 metres
        Maximum Storage =    11313. c.m
            4.773      4.773       .464      6.752 c.m/s
   17    COMBINE
        2     Junction Node No.
            4.773      4.773       .464      6.869 c.m/s
   14    START
        1     1=Zero; 2=Define
   18    CONFLUENCE
        2     Junction Node No.
            4.773      6.869       .464       .000 c.m/s
   27    HYDROGRAPH DISPLAY
        4     is # of Hyeto/Hydrograph chosen
         Volume  =  .1723819E+05 c.m
   20    MANUAL
```

APPENDIX D

MIDUSS Output Files - Future Drainage Conditions with SWM

```
        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
   35   COMMENT
        3     line(s) of comment
         THE VILLAGE OF EAST FONTHILL, TOWN OF PELHAM
         STORMWATER MANAGEMENT PLAN, OCT 2014
         FUTURE CONDITIONS - WITH STORMWATER MANAGEMENT
   35   COMMENT
        1     line(s) of comment
         25mm - 4HOUR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES
    2   STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      500.000     Coefficient  a
        8.100     Constant  b    (min)
         .810     Exponent  c
         .400     Fraction to peak  r
      240.000     Duration ó  240 min
                 22.981 mm     Total depth
    3   IMPERVIOUS
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .015     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
   35   COMMENT
        3     line(s) of comment
         *****************************************
         * OUTLET A                              *
         *****************************************
   14   START
        1     1=Zero; 2=Define
    4   CATCHMENT
       31.000     ID No.ó 99999
        3.530     Area in hectares
      155.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      155.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .241       .000       .000       .000 c.m/s
                .053       .784       .674     C perv/imperv/total
   15   ADD RUNOFF
                .241       .241       .000       .000 c.m/s
   35   COMMENT
        3     line(s) of comment
         *****************************************
         * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)   *
         *****************************************
   12   DIVERT
            9     U/S Node No.ó 99999
         .478     Threshold Discharge
         .574     Max. Outflow reqd.
             Qmax & Vol.Diverted =      .000 c.m/s          .0 c.m
             No flow diverted
                .241       .241       .241       .000 c.m/s
   16   NEXT LINK
                .241       .241       .241       .000 c.m/s
    4   CATCHMENT
       10.000     ID No.ó 99999
        5.910     Area in hectares
      200.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      200.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .399       .241       .241       .000 c.m/s
                .053       .791       .680     C perv/imperv/total
   15   ADD RUNOFF
                .399       .640       .241       .000 c.m/s
    4   CATCHMENT
       20.000     ID No.ó 99999
        6.380     Area in hectares
      205.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      205.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .430       .640       .241       .000 c.m/s
                .053       .791       .680     C perv/imperv/total
   15   ADD RUNOFF
                .430      1.069       .241       .000 c.m/s
   27   HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
         Volume  =  .2459709E+04 c.m
    4   CATCHMENT
       30.000     ID No.ó 99999
       11.250     Area in hectares
      260.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      260.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .767      1.069       .241       .000 c.m/s
                .053       .791       .680     C perv/imperv/total
   15   ADD RUNOFF
                .767      1.836       .241       .000 c.m/s
   27   HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
         Volume  =  .4211089E+04 c.m
   35   COMMENT
        3     line(s) of comment
         *****************************************
         * NORTH VILLAGE OF EAST FONTHILL POND   *
         *****************************************
   10   POND
       10 Depth - Discharge - Volume sets
        186.550        .000          .0
        186.840       .0420       1342.3
        187.150       .0740       3017.2
        187.380       .0910       4375.6
        187.830        .936       7149.5
        188.270       1.161      10115.3
        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    =      .079 c.m/s
        Maximum Depth   =   187.217 metres
        Maximum Storage =     3412. c.m
                .767      1.836       .079       .000 c.m/s
   16   NEXT LINK
                .767       .079       .079       .000 c.m/s
   14   START
        1     1=Zero; 2=Define
   35   COMMENT
        3     line(s) of comment
         *****************************************
         * OUTLET B                              *
         *****************************************
    4   CATCHMENT
       40.000     ID No.ó 99999
       35.240     Area in hectares
      485.000     Length (PERV) metres
       15.480     Gradient (%)
       49.400     Per cent Impervious
      485.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
               1.395       .000       .079       .000 c.m/s
                .083       .787       .431     C perv/imperv/total
   15   ADD RUNOFF
               1.395      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:
         .040     Manning's "n"
       1.500     O/a Depth in metres
         .900     Select Grade in %
        Depth          =      .414 metres
        Velocity       =     1.040 m/sec
        Flow Capacity  =    20.730 c.m/s
        Critical depth =      .312 metres
    9   ROUTE
      393.000     Conduit Length
         .470     Supply X-factor <.5
      283.376     Supply K-lag (sec)
         .500     Beta weighting factor
      300.000     Routing timestep
            1     No. of sub-reaches
               1.395      1.395      1.212       .000 c.m/s
   16   NEXT LINK
               1.395      1.212      1.212       .000 c.m/s
    4   CATCHMENT
       60.000     ID No.ó 99999
        2.430     Area in hectares
      125.000     Length (PERV) metres
        2.000     Gradient (%)
         .000     Per cent Impervious
      125.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .003      1.212      1.212       .000 c.m/s
                .083       .000       .083     C perv/imperv/total
   15   ADD RUNOFF
                .003      1.212      1.212       .000 c.m/s
```

```
 9     ROUTE
      452.000     Conduit Length
        .475     Supply X-factor <.5
      339.120     Supply K-lag (sec)
        .500     Beta weighting factor
      300.000     Routing timestep
           1     No. of sub-reaches
               .003      1.212      1.141       .000 c.m/s
 17    COMBINE
       1     Junction Node No.
               .003      1.212      1.141      1.141 c.m/s
 14    START
       1     1=Zero; 2=Define
 22    FILE HYDROGRAPH
       1     1=READ: 2=WRITE
      12     DIV00009.25M          is Filename
       2     1=Overland: 2=Inflow: 3=Outflow: 4=Temp'ary
               .003       .000      1.141      1.141 c.m/s
  4    CATCHMENT
       50.000     ID No.ó 99999
       10.320     Area in hectares
      260.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      260.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
               .703       .000      1.141      1.141 c.m/s
               .083       .791       .685     C perv/imperv/total
 15    ADD RUNOFF
               .703       .703      1.141      1.141 c.m/s
 27    HYDROGRAPH DISPLAY
       4     is # of Hyeto/Hydrograph chosen
       Volume  =  .1623832E+04 c.m
 35    COMMENT
       3     line(s) of comment
       ************************************************************
       * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND             *
       ************************************************************
 10    POND
      10 Depth - Discharge - Volume sets
       189.900        .000          .0
       190.070      .01000       384.8
       190.230       .0180       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
       192.400      1.132       8533.8
       Peak Outflow    =      .023 c.m/s
       Maximum Depth   =   190.438 metres
       Maximum Storage =     1365. c.m
               .703       .703       .023      1.141 c.m/s
 17    COMBINE
       1     Junction Node No.
               .703       .703       .023      1.159 c.m/s
 14    START
       1     1=Zero; 2=Define
 18    CONFLUENCE
       1     Junction Node No.
               .703      1.159       .023       .000 c.m/s
  4    CATCHMENT
       70.000     ID No.ó 99999
        2.340     Area in hectares
      120.000     Length (PERV) metres
        2.000     Gradient (%)
         .000     Per cent Impervious
      120.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
               .003      1.159       .023       .000 c.m/s
               .083       .000       .083     C perv/imperv/total
 15    ADD RUNOFF
               .003      1.159       .023       .000 c.m/s
  9    ROUTE
         .000     Conduit Length
         .475     No Conduit defined
      339.120     Zero lag
         .500     Beta weighting factor
      300.000     Routing timestep
           1     No. of sub-reaches
               .003      1.159      1.159       .000 c.m/s
 17    COMBINE
       2     Junction Node No.
               .003      1.159      1.159      1.159 c.m/s
 14    START
       1     1=Zero; 2=Define
  4    CATCHMENT
       80.000     ID No.ó 99999
       38.600     Area in hectares
      510.000     Length (PERV) metres
        2.000     Gradient (%)
       43.500     Per cent Impervious
      510.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              1.077       .000      1.159      1.159 c.m/s
               .083       .792       .392     C perv/imperv/total
 15    ADD RUNOFF
              1.077      1.077      1.159      1.159 c.m/s
 27    HYDROGRAPH DISPLAY
       4     is # of Hyeto/Hydrograph chosen
       Volume  =  .3466319E+04 c.m
 35    COMMENT
       3     line(s) of comment
       ************************************************************
       * FUTURE STORMWATER MANAGEMENT FACILITY 706                *
       ************************************************************
 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
       Maximum Depth   =   187.820 metres
       Maximum Storage =     2599. c.m
              1.077      1.077       .054      1.159 c.m/s
 17    COMBINE
       2     Junction Node No.
              1.077      1.077       .054      1.172 c.m/s
 14    START
       1     1=Zero; 2=Define
 18    CONFLUENCE
       2     Junction Node No.
              1.077      1.172       .054       .000 c.m/s
 27    HYDROGRAPH DISPLAY
       4     is # of Hyeto/Hydrograph chosen
       Volume  =  .3466319E+04 c.m
 14    START
       1     1=Zero; 2=Define
 35    COMMENT
       3     line(s) of comment
       ************************************************************
       * 5 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES   *
       ************************************************************
  2    STORM
           1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      830.000     Coefficient  a
        7.300     Constant  b    (min)
         .777     Exponent  c
         .400     Fraction to peak  r
      240.000     Duration ó  240 min
                 45.876 mm     Total depth
  3    IMPERVIOUS
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .015     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
 35    COMMENT
       3     line(s) of comment
       *****************************************
       * OUTLET A                              *
       *****************************************
 14    START
       1     1=Zero; 2=Define
  4    CATCHMENT
       31.000     ID No.ó 99999
        3.530     Area in hectares
      155.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      155.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
      11.953     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
               .478       .000       .054       .000 c.m/s
               .204       .873       .773     C perv/imperv/total
 15    ADD RUNOFF
               .478       .478       .054       .000 c.m/s
 35    COMMENT
       3     line(s) of comment
       *****************************************
       * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)   *
       *****************************************
 12    DIVERT
           9     U/S Node No.ó 99999
        .478     Threshold Discharge
        .574     Max. Outflow reqd.
            Qmax & Vol.Diverted =       .000 c.m/s          .0 c.m
            No flow diverted
               .478       .478       .478       .000 c.m/s
 16    NEXT LINK
               .478       .478       .478       .000 c.m/s
  4    CATCHMENT
       10.000     ID No.ó 99999
```

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        5.910     Area in hectares
      200.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      200.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .829       .478       .478       .000 c.m/s
                .204       .864       .765     C perv/imperv/total
   15    ADD RUNOFF
                .829      1.306       .478       .000 c.m/s
    4    CATCHMENT
       20.000     ID No.ó 99999
        6.380     Area in hectares
      205.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      205.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .897      1.306       .478       .000 c.m/s
                .204       .866       .767     C perv/imperv/total
   15    ADD RUNOFF
                .897      2.203       .478       .000 c.m/s
   27    HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .5569779E+04 c.m
    4    CATCHMENT
       30.000     ID No.ó 99999
       11.250     Area in hectares
      260.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      260.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              1.613      2.203       .478       .000 c.m/s
                .204       .876       .775     C perv/imperv/total
   15    ADD RUNOFF
              1.613      3.815       .478       .000 c.m/s
   27    HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .9569145E+04 c.m
   35    COMMENT
       3     line(s) of comment
        ********************************************
        * NORTH VILLAGE OF EAST FONTHILL POND      *
        ********************************************
   10    POND
      10 Depth - Discharge - Volume sets
        186.550        .000          .0
        186.840       .0420       1342.3
        187.150       .0740       3017.2
        187.380       .0910       4375.6
        187.830        .936       7149.5
        188.270       1.161      10115.3
        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    =      .602 c.m/s
        Maximum Depth   =   187.652 metres
        Maximum Storage =    6053. c.m
              1.613      3.815       .602       .000 c.m/s
   16    NEXT LINK
              1.613       .602       .602       .000 c.m/s
   14    START
        1     1=Zero; 2=Define
   35    COMMENT
       3     line(s) of comment
        ********************************************
        * OUTLET B                                 *
        ********************************************
    4    CATCHMENT
       40.000     ID No.ó 99999
       35.240     Area in hectares
      485.000     Length (PERV) metres
       15.480     Gradient (%)
       49.400     Per cent Impervious
      485.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              2.869       .000       .602       .000 c.m/s
                .236       .869       .548     C perv/imperv/total
   15    ADD RUNOFF
              2.869      2.869       .602       .000 c.m/s
   11    CHANNEL
        2.000     Base Width     =
        3.000     Left  bank slope  1:
        3.000     Right bank slope  1:
         .040     Manning's "n"
       1.500     O/a Depth in metres
         .900     Select Grade in %
       Depth          =      .596 metres
       Velocity       =     1.269 m/sec
       Flow Capacity  =    20.730 c.m/s
       Critical depth =      .468 metres
    9    ROUTE
      393.000     Conduit Length
         .458     Supply X-factor <.5
      232.207     Supply K-lag (sec)
         .500     Beta weighting factor
      200.000     Routing timestep
            1     No. of sub-reaches
              2.869      2.869      2.802       .000 c.m/s
   16    NEXT LINK
              2.869      2.802      2.802       .000 c.m/s
    4    CATCHMENT
       60.000     ID No.ó 99999
        2.430     Area in hectares
      125.000     Length (PERV) metres
        2.000     Gradient (%)
         .000     Per cent Impervious
      125.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                .035      2.802      2.802       .000 c.m/s
                .236       .000       .236     C perv/imperv/total
   15    ADD RUNOFF
                .035      2.813      2.802       .000 c.m/s
    9    ROUTE
      452.000     Conduit Length
         .464     Supply X-factor <.5
      268.490     Supply K-lag (sec)
         .500     Beta weighting factor
      200.000     Routing timestep
            1     No. of sub-reaches
              .035      2.813      2.413       .000 c.m/s
   17    COMBINE
        1     Junction Node No.
              .035      2.813      2.413      2.413 c.m/s
   14    START
        1     1=Zero; 2=Define
   22    FILE HYDROGRAPH
        1     1=READ: 2=WRITE
       12     DIV00009.5YR          is Filename
        2     1=Overland: 2=Inflow: 3=Outflow: 4=Temp'ary
              .035       .000      2.413      2.413 c.m/s
    4    CATCHMENT
       50.000     ID No.ó 99999
       10.320     Area in hectares
      260.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      260.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              1.480       .000      2.413      2.413 c.m/s
                .236       .876       .780     C perv/imperv/total
   15    ADD RUNOFF
              1.480      1.480      2.413      2.413 c.m/s
   27    HYDROGRAPH DISPLAY
       4     is # of Hyeto/Hydrograph chosen
        Volume  =  .3691582E+04 c.m
   35    COMMENT
       3     line(s) of comment
        ************************************************************
        * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND             *
        ************************************************************
   10    POND
      10 Depth - Discharge - Volume sets
        189.900        .000          .0
        190.070      .01000        384.8
        190.230       .0180        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
        192.400       1.132       8533.8
        Peak Outflow    =      .187 c.m/s
        Maximum Depth   =   190.840 metres
        Maximum Storage =     2520. c.m
              1.480      1.480       .187      2.413 c.m/s
   17    COMBINE
        1     Junction Node No.
              1.480      1.480       .187      2.437 c.m/s
   14    START
        1     1=Zero; 2=Define
   18    CONFLUENCE
        1     Junction Node No.
```

```
          1.480      2.437       .187       .000 c.m/s
  4     CATCHMENT
       70.000     ID No.ó 99999
        2.340     Area in hectares
      120.000     Length (PERV) metres
        2.000     Gradient (%)
         .000     Per cent Impervious
      120.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
          .034      2.437       .187       .000 c.m/s
          .236       .000       .236     C perv/imperv/total
 15     ADD RUNOFF
          .034      2.448       .187       .000 c.m/s
  9     ROUTE
         .000     Conduit Length
         .464     No Conduit defined
      268.490     Zero lag
         .500     Beta weighting factor
      200.000     Routing timestep
            1     No. of sub-reaches
          .034      2.448      2.448       .000 c.m/s
 17     COMBINE
        2     Junction Node No.
          .034      2.448      2.448      2.448 c.m/s
 14     START
        1     1=Zero; 2=Define
  4     CATCHMENT
       80.000     ID No.ó 99999
       38.600     Area in hectares
      510.000     Length (PERV) metres
        2.000     Gradient (%)
       43.500     Per cent Impervious
      510.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
         2.876       .000      2.448      2.448 c.m/s
          .236       .877       .515     C perv/imperv/total
 15     ADD RUNOFF
          2.876      2.876      2.448      2.448 c.m/s
 27     HYDROGRAPH DISPLAY
        4     is # of Hyeto/Hydrograph chosen
        Volume  =  .9116987E+04 c.m
 35     COMMENT
        3     line(s) of comment
        ************************************************************
        * FUTURE STORMWATER MANAGEMENT FACILITY 706                *
        ************************************************************
 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    =      .247 c.m/s
        Maximum Depth   =   188.191 metres
        Maximum Storage =     5955. c.m
          2.876      2.876       .247      2.448 c.m/s
 17     COMBINE
        2     Junction Node No.
          2.876      2.876       .247      2.487 c.m/s
 14     START
        1     1=Zero; 2=Define
 18     CONFLUENCE
        2     Junction Node No.
           2.876      2.487       .247       .000 c.m/s
 27     HYDROGRAPH DISPLAY
        4     is # of Hyeto/Hydrograph chosen
        Volume  =  .9116987E+04 c.m
 14     START
        1     1=Zero; 2=Define
 35     COMMENT
        3     line(s) of comment
        ************************************************************
        * 100 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
        ************************************************************
  2     STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     1020.000     Coefficient  a
        4.700     Constant  b    (min)
         .731     Exponent  c
         .400     Fraction to peak  r
       240.000     Duration ó  240 min
                  73.207 mm     Total depth
  3     IMPERVIOUS
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .015     Manning "n"
        98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
 35     COMMENT
        3     line(s) of comment
        ************************************************
        * OUTLET A                                     *
        ************************************************
 14     START
        1     1=Zero; 2=Define
  4     CATCHMENT
       31.000     ID No.ó 99999
        3.530     Area in hectares
      155.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      155.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
          .826       .000       .247       .000 c.m/s
          .340       .916       .830     C perv/imperv/total
 15     ADD RUNOFF
          .826       .826       .247       .000 c.m/s
 35     COMMENT
        3     line(s) of comment
        ************************************************
        * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)          *
        ************************************************
 12     DIVERT
            9     U/S Node No.ó 99999
         .478     Threshold Discharge
         .574     Max. Outflow reqd.
            Qmax & Vol.Diverted =      .252 c.m/s       254.0 c.m
            No flow diverted
           .826       .826       .574       .000 c.m/s
 16     NEXT LINK
          .826       .574       .574       .000 c.m/s
  4     CATCHMENT
       10.000     ID No.ó 99999
        5.910     Area in hectares
      200.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      200.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
         1.311       .574       .574       .000 c.m/s
          .340       .914       .828     C perv/imperv/total
 15     ADD RUNOFF
          1.311      1.885       .574       .000 c.m/s
  4     CATCHMENT
       20.000     ID No.ó 99999
        6.380     Area in hectares
      205.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      205.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
         1.407      1.885       .574       .000 c.m/s
          .340       .913       .827     C perv/imperv/total
 15     ADD RUNOFF
          1.407      3.292       .574       .000 c.m/s
 27     HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
        Volume  =  .9333898E+04 c.m
  4     CATCHMENT
       30.000     ID No.ó 99999
       11.250     Area in hectares
      260.000     Length (PERV) metres
        2.000     Gradient (%)
       85.000     Per cent Impervious
      260.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
       11.953     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
         2.487      3.292       .574       .000 c.m/s
          .341       .904       .820     C perv/imperv/total
 15     ADD RUNOFF
          2.487      5.644       .574       .000 c.m/s
 27     HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
        Volume  =  .1608601E+05 c.m
 35     COMMENT
        3     line(s) of comment
        ************************************************
        * NORTH VILLAGE OF EAST FONTHILL POND          *
        ************************************************
 10     POND
       10 Depth - Discharge - Volume sets
```

```
        186.550        .000         .0
        186.840       .0420      1342.3
        187.150       .0740      3017.2
        187.380       .0910      4375.6
        187.830        .936      7149.5
        188.270       1.161     10115.3
        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       .000 c.m/s
  16    NEXT LINK
             2.487      1.089      1.089       .000 c.m/s
  14    START
        1     1=Zero; 2=Define
  35    COMMENT
        3     line(s) of comment
        ******************************************
        * OUTLET B                                *
        ******************************************
   4    CATCHMENT
        40.000     ID No.ó 99999
        35.240     Area in hectares
       485.000     Length (PERV) metres
        15.480     Gradient (%)
        49.400     Per cent Impervious
       485.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             4.772       .000      1.089       .000 c.m/s
              .367       .915       .638     C perv/imperv/total
  15    ADD RUNOFF
             4.772      4.772      1.089       .000 c.m/s
  11    CHANNEL
        2.000     Base Width     =
        3.000     Left  bank slope  1:
        3.000     Right bank slope  1:
         .040     Manning's "n"
        1.500     O/a Depth in metres
         .900     Select Grade in %
        Depth          =      .764 metres
        Velocity       =     1.454 m/sec
        Flow Capacity  =    20.730 c.m/s
        Critical depth =      .615 metres
   9    ROUTE
       393.000     Conduit Length
          .448     Supply X-factor <.5
       202.682     Supply K-lag (sec)
          .500     Beta weighting factor
       200.000     Routing timestep
            1      No. of sub-reaches
            4.772      4.772      4.594       .000 c.m/s
  16    NEXT LINK
             4.772      4.594      4.594       .000 c.m/s
   4    CATCHMENT
        60.000     ID No.ó 99999
         2.430     Area in hectares
       125.000     Length (PERV) metres
         2.000     Gradient (%)
          .000     Per cent Impervious
       125.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              .113       4.594      4.594       .000 c.m/s
              .367        .000       .367     C perv/imperv/total
  15    ADD RUNOFF
              .113       4.654      4.594       .000 c.m/s
   9    ROUTE
       452.000     Conduit Length
          .455     Supply X-factor <.5
       234.662     Supply K-lag (sec)
          .500     Beta weighting factor
       200.000     Routing timestep
            1      No. of sub-reaches
              .113       4.654      4.238       .000 c.m/s
  17    COMBINE
        1     Junction Node No.
              .113       4.654      4.238      4.238 c.m/s
  14    START
        1     1=Zero; 2=Define
  22    FILE HYDROGRAPH
        1     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/s
   4    CATCHMENT
        50.000     ID No.ó 99999
        10.320     Area in hectares
       260.000     Length (PERV) metres
         2.000     Gradient (%)
        85.000     Per cent Impervious
       260.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
          .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             2.284       .252      4.238      4.238 c.m/s
              .367       .904       .824     C perv/imperv/total
  15    ADD RUNOFF
             2.284      2.455      4.238      4.238 c.m/s
  27    HYDROGRAPH DISPLAY
        4     is # of Hyeto/Hydrograph chosen
        Volume  =  .6224218E+04 c.m
  35    COMMENT
        3     line(s) of comment
        ************************************************************
        * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND             *
        ************************************************************
  10    POND
       10 Depth - Discharge - Volume sets
        189.900        .000         .0
        190.070      .01000       384.8
        190.230       .0180       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
        192.400       1.132      8533.8
        Peak Outflow    =      .460 c.m/s
        Maximum Depth   =   191.207 metres
        Maximum Storage =     3734. c.m
             2.284      2.455       .460      4.238 c.m/s
  17    COMBINE
        1     Junction Node No.
             2.284      2.455       .460      4.537 c.m/s
  14    START
        1     1=Zero; 2=Define
  18    CONFLUENCE
        1     Junction Node No.
             2.284      4.537       .460       .000 c.m/s
   4    CATCHMENT
        70.000     ID No.ó 99999
         2.340     Area in hectares
       120.000     Length (PERV) metres
         2.000     Gradient (%)
          .000     Per cent Impervious
       120.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              .109       4.537       .460       .000 c.m/s
              .368        .000       .368     C perv/imperv/total
  15    ADD RUNOFF
              .109       4.596       .460       .000 c.m/s
   9    ROUTE
          .000     Conduit Length
          .455     No Conduit defined
       234.662     Zero lag
          .500     Beta weighting factor
       200.000     Routing timestep
            1      No. of sub-reaches
              .109       4.596      4.596       .000 c.m/s
  17    COMBINE
        2     Junction Node No.
              .109       4.596      4.596      4.596 c.m/s
  14    START
        1     1=Zero; 2=Define
   4    CATCHMENT
        80.000     ID No.ó 99999
        38.600     Area in hectares
       510.000     Length (PERV) metres
         2.000     Gradient (%)
        43.500     Per cent Impervious
       510.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             4.773       .000      4.596      4.596 c.m/s
              .368       .925       .610     C perv/imperv/total
  15    ADD RUNOFF
             4.773      4.773      4.596      4.596 c.m/s
  27    HYDROGRAPH DISPLAY
        4     is # of Hyeto/Hydrograph chosen
        Volume  =  .1723819E+05 c.m
  35    COMMENT
        3     line(s) of comment
        ************************************************************
        * FUTURE STORMWATER MANAGEMENT FACILITY 706                *
        ************************************************************
  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    =      .464 c.m/s
        Maximum Depth   =   188.699 metres
        Maximum Storage =    11313. c.m
              4.773      4.773       .464      4.596 c.m/s
17      COMBINE
       2     Junction Node No.
              4.773      4.773       .464      4.713 c.m/s
14      START
       1     1=Zero; 2=Define
18      CONFLUENCE
       2     Junction Node No.
              4.773      4.713       .464       .000 c.m/s
27      HYDROGRAPH DISPLAY
       4     is # of Hyeto/Hydrograph chosen
        Volume  =  .1723819E+05 c.m
14      START
       1     1=Zero; 2=Define
20      MANUAL
```

APPENDIX E

Detailed Channel Design Calculations

NATURAL CHANNEL DESIGN

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**	m^3/s	(Flood Full Storm Event)
Q_{25} =	3.987	m^3/s	
Q_{10} =	3.151	m^3/s	
Q_5 =	***2.780***	m^3/s	
Q_2 =	2.084	m^3/s	(Bank Full Storm Event)
Q_{25mm} =	***1.260***	m^3/s	

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

CHANNEL GEOMETRY

Soil Type: *Sandy Loam* — Maximum Stable Slope: 32°

Bottom Width = 2.00 — Substrate : *Gravel beds, straight*

Side Slopes (H:V) = 3.0 (18.4°) — Manning's n: 0.025 — Safety Factor: 5.0

	Height (m)	Top Width (m)	Flow Area (m^2)	$R_{(hydraulic)}$	Flow (m^3/s)	Velocity (m/s)	Shear Stress Strait (N/m^2)	Shear Stress Bend (N/m^2)	Stable D_{50} (mm)
$Depth_{100}$ =	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.

NATURAL CHANNEL DESIGN

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

Project :	Allen Property, Fonthill, ON	Design:	Adam Keane, P.Eng.
Project No :	0473	Reviewed:	Jason Schooley, P.Eng.
Watercourse:	Unknown	Date:	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**	m^3/s	(Flood Full Storm Event)
Q_{25} =	3.685	m^3/s	
Q_{10} =	2.950	m^3/s	
Q_5 =	***2.730***	m^3/s	
Q_2 =	1.996	m^3/s	(Bank Full Storm Event)
Q_{25mm} =	***1.214***	m^3/s	

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

CHANNEL GEOMETRY

Soil Type: *Sandy Loam* — Maximum Stable Slope: 32°
Bottom Width = 1.50 — Substrate : *Gravel beds, straight*
Side Slopes (H:V) = 4.0 (14°) — Manning's n: 0.025 — Safety Factor: 5.0

	Height (m)	Top Width (m)	Flow Area (m^2)	$R_{(hydraulic)}$	Flow (m^3/s)	Velocity (m/s)	Shear Stress Strait (N/m^2)	Shear Stress Bend (N/m^2)	Stable D_{50} (mm)
$Depth_{100}$ =	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
Depth =	0.285	3.780	1.568	0.165	1.214	**0.77**	3.9	4.7	24.0

Calculate Flow Values

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.

NATURAL CHANNEL DESIGN

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

Project :	Allen Property, Fonthill, ON	Design:	Adam Keane, P.Eng.
Project No :	0473	Reviewed:	Jason Schooley, P.Eng.
Watercourse:	Unknown	Date:	July 3, 2014

Upstream Elevation:	188.90	Strait Block Length (m):	49.6 m	
Downstream Elevation:	188.50	Thoretical Strait Slope (%):	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)

Q_{100} =	**4.938**	m^3/s	(Flood Full Storm Event)
Q_{25} =	3.685	m^3/s	
Q_{10} =	2.950	m^3/s	
Q_5 =	***2.730***	m^3/s	
Q_2 =	1.996	m^3/s	(Bank Full Storm Event)
Q_{25mm} =	***1.214***	m^3/s	

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

CHANNEL GEOMETRY

Soil Type: *Sandy Loam* Maximum Stable Slope: 32°
Bottom Width = 1.50 Substrate : *Gravel beds, straight*
Side Slopes (H:V) = 3.0 (18.4°) Manning's n: 0.025 Safety Factor: 5.0

	Height (m)	Top Width (m)	Flow Area (m^2)	$R_{(hydraulic)}$	Flow (m^3/s)	Velocity (m/s)	Shear Stress (N/m^2) Strait	Bend	Stable D_{50} (mm)
$Depth_{100}$ =	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
Depth =	0.206	2.736	0.927	0.123	1.214	**1.31**	11.9	14.3	17.8

Calculate Flow Values

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.

NATURAL CHANNEL DESIGN

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

Project :	Allen Property, Fonthill, ON	Design:	Adam Keane, P.Eng.
Project No :	0473	Reviewed:	Jason Schooley, P.Eng.
Watercourse:	Unknown	Date:	July 3, 2014

Upstream Elevation:	188.25	Strait Block Length (m):	57.7 m	
Downstream Elevation:	187.20	Thoretical Strait Slope (%):	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)

Q_{100} =	**4.938**	m^3/s	(Flood Full Storm Event)
Q_{25} =	3.685	m^3/s	
Q_{10} =	2.950	m^3/s	
Q_5 =	***2.730***	m^3/s	
Q_2 =	1.996	m^3/s	(Bank Full Storm Event)
Q_{25mm} =	***1.214***	m^3/s	

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

CHANNEL GEOMETRY

Soil Type: *Sandy Loam* — Maximum Stable Slope: 32°
Bottom Width = 1.50 — Substrate : *Gravel beds, straight*
Side Slopes (H:V) = 3.0 (18.4°) — Manning's n: 0.025 — Safety Factor: 5.0

	Height (m)	Top Width (m)	Flow Area (m^2)	$R_{(hydraulic)}$	Flow (m^3/s)	Velocity (m/s)	Shear Stress Strait (N/m^2)	Shear Stress Bend (N/m^2)	Stable D_{50} (mm)
$Depth_{100}$ =	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
Depth =	0.162	2.475	0.731	0.097	1.215	**1.66**	20.7	24.9	13.9

Calculate Flow Values

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

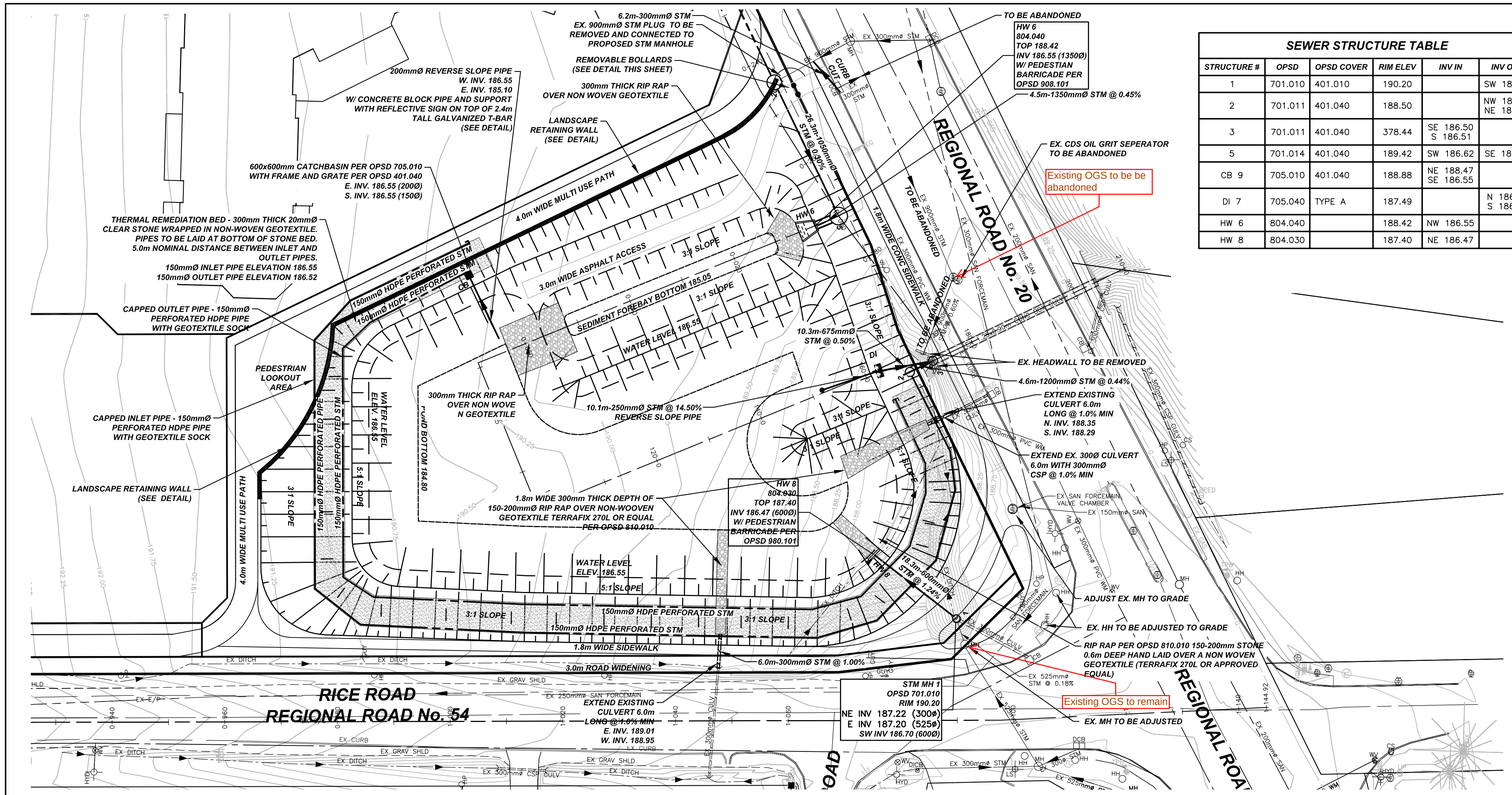
Prepared By: A. Keane Date: 19-Nov-14
Checked By: _____ Date: _____

STA.	DESIGN DATA							CULVERT DATA					INLET CONTROL			OUTLET CONTROL								GOV'N	VEL
	Q	d	de	AHW	Skew No	L	S	Descrip	D or B x D	N	Q N	A (Each)	Q NB	HW (Each)	HW	ke	H	dc	dc + D/2	TW	ho	LS	HW	HW	Vo
	m3/s	m	m	m		m	m/m				m3/s	m2	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
Proposed box culvert under Rice Road - 100yr Storm Event																									
	4.950	*0.378*	*0.00*	*0.38*		*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*	***1.611***	

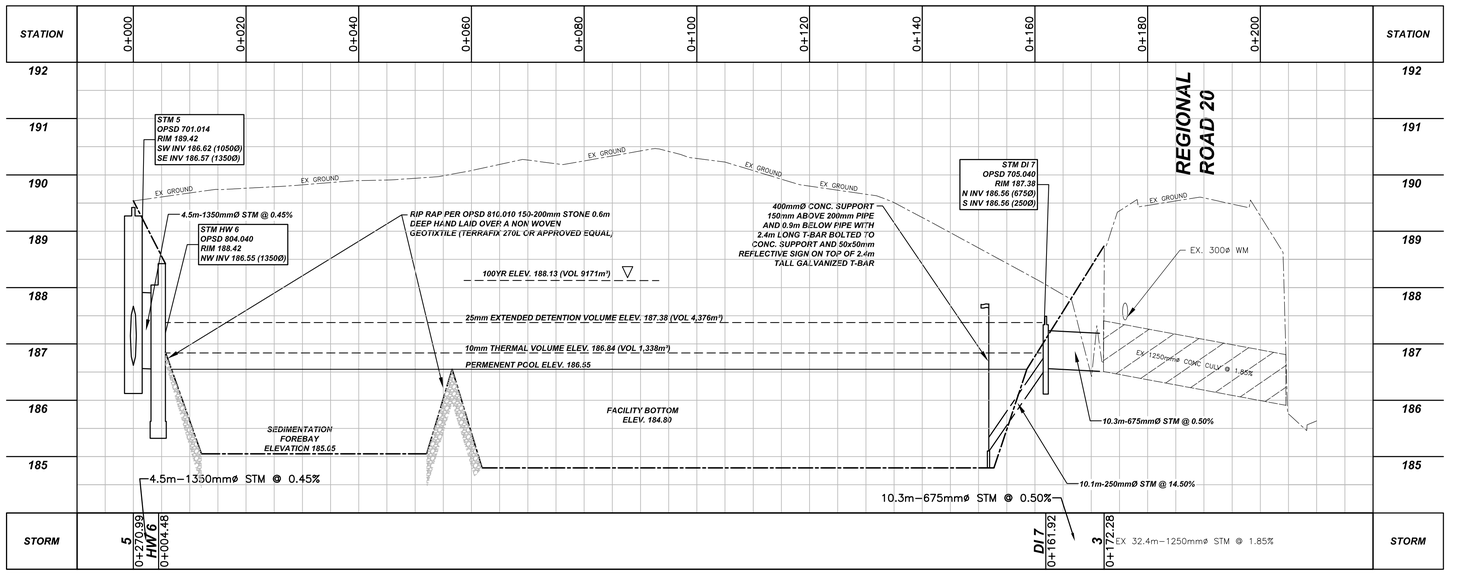
2 From form PH-D-533, col 12.
3 Flood Depth - Downstream.
4 Embedment below channel invert.
5 Col. 3 + col. 4 + allowable bkwtr.
7 Allow for skew if applicable.
8 Culvert slope.
10 D (Circular) or B x D (other).
11 No. of barrels.
13 Area per barrel.
14 For box only.
15 Charts D5-1A to C and E to J.
16 HW = col. 15 x D (col. 10).
17 Chart D5-8.
18 Charts D5-2A to G.
19 Charts D6-3A to F:(dc D).
21 Col. 3 + 4.
22 ho = larger of cols. 20 and 21.
23 Col. 7 x 8.
24 HW = col 18 + col. 22 - col. 23.
25 Larger of cols. 16 and 24.
26 Outlet vel. if req'd (Subsec. 3.2.3.1).

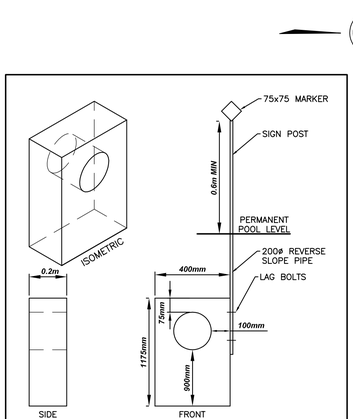
APPENDIX G

Drawings

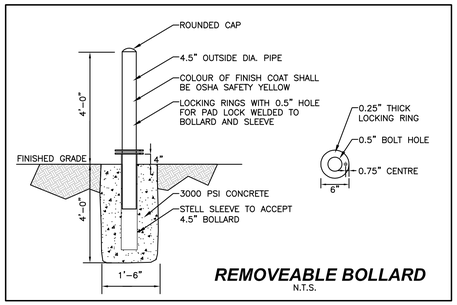


SEWER STRUCTURE TABLE					
STRUCTURE #	OPSD	OPSD COVER	RIM ELEV	INV IN	INV OUT
1	701.010	401.010	190.20		SW 186.70
2	701.011	401.040	188.50		NW 186.52 NE 186.52
3	701.011	401.040	378.44	SE 186.50 S 186.51	
5	701.014	401.040	189.42	SW 186.62	SE 186.57
CB 9	705.010	401.040	188.88	NE 188.47 SE 186.55	
DI 7	705.040	TYPE A	187.49		N 186.56 S 186.56
HW 6	804.040		188.42	NW 186.55	
HW 8	804.030		187.40	NE 186.47	

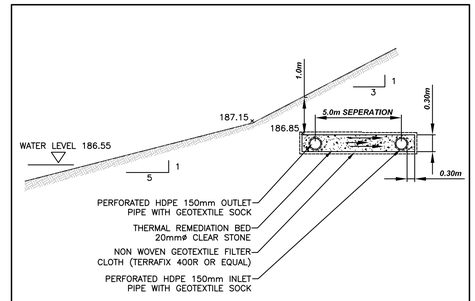




CONCRETE SUPPORT BLOCK
N.T.S



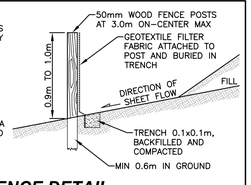
REMOVEABLE BOLLARD
N.T.S.



THERMAL REMEDIATION BED DETAIL
NTS

NOTES:

1. THIS TYPE OF FILTER BARRIER CONSISTS OF GEOTEXTILE FILTER FABRIC SECURELY ATTACHED ON THE UPSTREAM SIDE.
2. SILT FENCES SHOULD BE USED ONLY FOR INTERCEPTING SHEET FLOWS OF DRAINAGE AREA NO LONGER THAN 30m AND NO STEEPER THAN 2:1.
3. THE FENCE HEIGHT SHOULD BE 0.9m TO 1.0m AND THE LENGTH APPROX. 30m PER 1000m² OF DRAINAGE AREA.
4. THE FABRIC IS TO BE RECESSED INTO A TRENCH 0.1m x 0.1m, BACKFILLED, AND COMPACTED.
5. FENCE POST SHOULD BE SPACED NO MORE THAN 3.0m APART AND SET INTO THE GROUND AT LEAST 0.6m.



SILT FENCE DETAIL
NTS

NO	REVISION	DATE	INIT
0	ISSUED FOR MOE APPROVAL	2014-10-07	M.C.

NOTES/LEGEND

1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
2. PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.
3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING M.C.
DESIGN A.K.
CHECKED BY M.H.
APPROVED BY A.K.

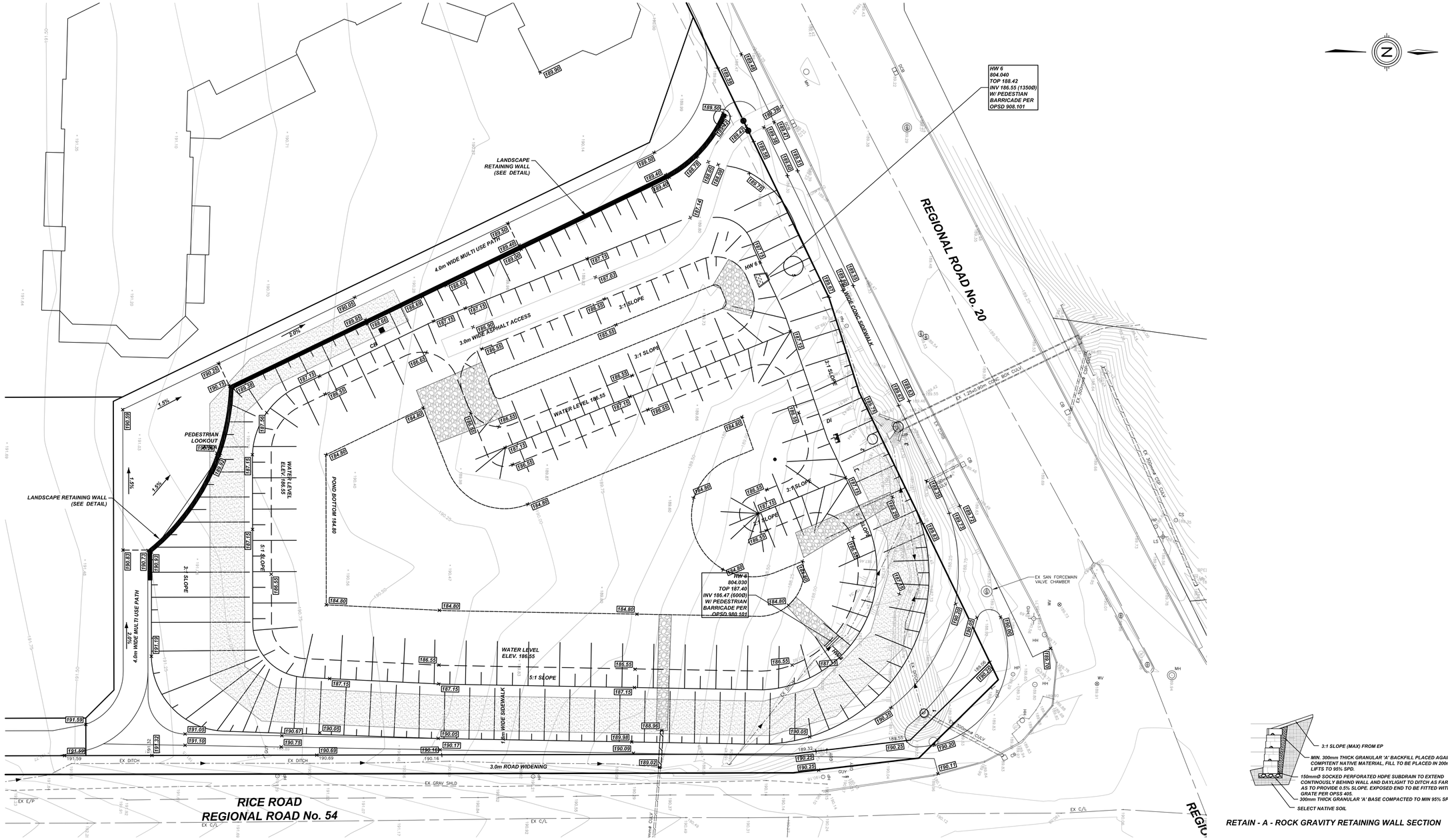
LICENSED PROFESSIONAL ENGINEER
A. S. KEANE
100109861
2014/11/14
PROVINCE OF ONTARIO

Pelham NIAGARA

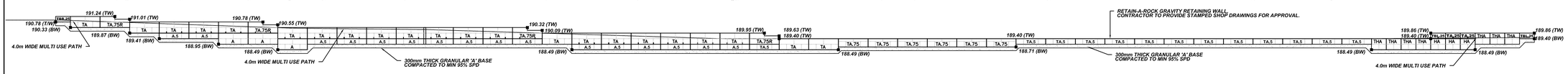
UPPER CANADA CONSULTANTS ENGINEERS / PLANNERS
261 Martindale Road Unit #1
St. Catharines, ON L2W 1A1
Phone: (905)688-9400
Fax: (905)688-5274

FONTHILL EAST NORTH POND
PLAN AND PROFILE FROM STA 0+000 to STA 0+210.00
TOWN OF PELHAM

CONSULTANT FILE No. 0473
DATE 2014-01-21
SCALE 1 : 500m
REF. No. -
DWG No. 0473PP
REV. 0



RETAIN - A - ROCK GRAVITY RETAINING WALL SECTION



RETAIN - A - ROCK GRAVITY RETAINING WALL DETAIL

NO	REVISION	DATE	INIT
0	ISSUED FOR MOE APPROVAL	2014.10.10	M.C.

NOTES/LEGEND

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3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING	M.C.
DESIGN	A.K.
CHECKED BY	M.H.
APPROVED BY	A.K.

LICENSED PROFESSIONAL ENGINEER
A. S. KEANE
100109861
2014/10/14
PROVINCE OF ONTARIO

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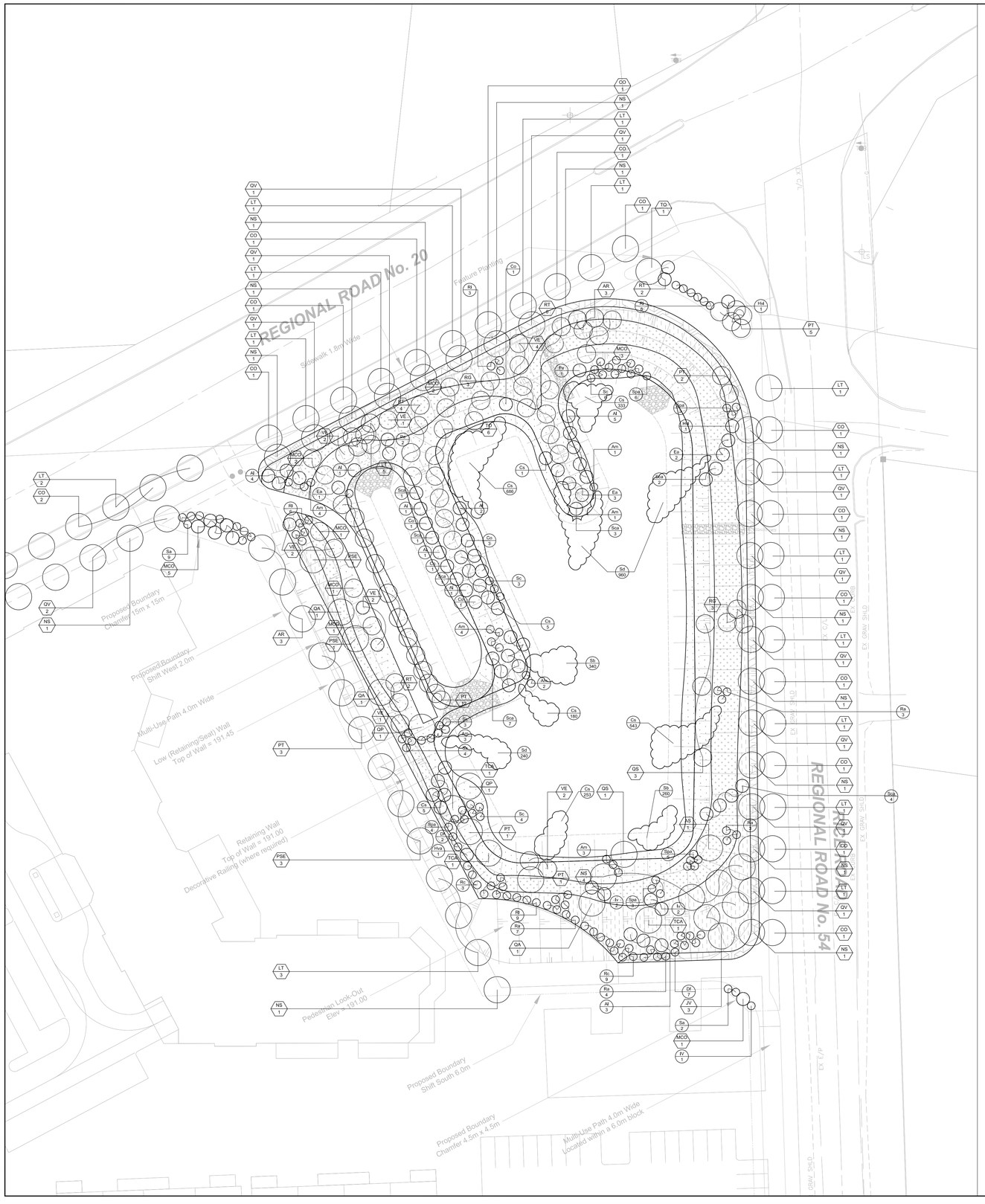
ENGINEERS / PLANNERS

261 Martindale Road
Unit #1
St. Catharines, ON
L2W 1A1
Phone: (905)688-9400
Fax: (905)688-5274

FONTHILL EAST
NORTH POND
GRADING PLAN

TOWN OF PELHAM

CONSULTANT FILE No.	0473
DATE	2014-01-21
SCALE	1 : 300m
REF. No.	-
DWG No.	0473GP
REV.	0



PLANTING LIST

Key	Botanical Name	Common Name	Qty.	Size	Spacing
DECIDUOUS TREES / LARGE SHRUBS					
AR	*Acer rubrum*	Red Maple	3	70MM B+B	AS INDICATED
AR	*Acer rubrum*	Red Maple	3	45MM W.B.	AS INDICATED
AS	*Acer saccharinum*	Silver Maple	1	70MM B+B	AS INDICATED
CO	*Celtis occidentalis*	Common Hackberry	15	70MM B+B	AS INDICATED
LT	*Liriodendron tulipifera*	Tulip Tree	14	70MM B+B	AS INDICATED
LT	*Liriodendron tulipifera*	Tulip Tree	5	45MM W.B.	AS INDICATED
MCO	*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	AS INDICATED
PT	*Populus tremuloides*	Trembling Aspen	12	45MM W.B	AS INDICATED
PSE	*Prunus serotina*	Black Cherry	5	70MM B+B	AS INDICATED
QA	*Quercus alba*	White Oak	3	70MM B+B	AS INDICATED
QP	*Quercus palustris*	Pin Oak	2	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.	AS INDICATED
QV	*Quercus velutina*	Black Oak	12	70MM B+B	AS INDICATED
RG	*Rhus glabra*	Smooth Sumac	6	70MM B+B	AS INDICATED
RT	*Rhus typhina*	Staghorn Sumac	14	70MM B+B	AS INDICATED
VE	*Viburnum lentago*	Nannyberry	14	70MM B+B	AS INDICATED
Coniferous Trees					
JV	*Juniperus virginiana*	Red Cedar	3	125cm W.B.	AS INDICATED
TO	*Thuja occidentalis*	White Cedar	7	125cm W.B.	AS INDICATED
TCA	*Tsuga canadensis*	Eastern Hemlock	3	125cm W.B.	AS INDICATED
Shrubs					
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	*Cornus sericea*	Red-Osier Dogwood	11	1 gal.	AS INDICATED
Cob	*Cornus 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
Iv	*Ilex verticillata*	Winterberry	6	1 gal.	AS INDICATED
Pe	*Prunus pennsylvanica*	Pin Cherry	3	1 gal.	AS INDICATED
Ra	*Ribes americanum*	Wild Black Currant	17	1 gal.	AS INDICATED
Rc	*Rosa carolina*	Pasture Rose	12	1 gal.	AS INDICATED
Ri	*Rubus idaeus*	Red Raspberry	24	1 gal.	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
Perennial Seed Mixes					
Dry Mix					
af	*Agastache foeniculum*	Blue Giant Hyssop	175	14 lbs./ha	
at	*Asclepias tuberosa*	Butterfly Milkweed	0	14 lbs./ha	
bc	*Bouteloua curtipendula*	Side Oats Grama	0	14 lbs./ha	
cp	*Carex pensylvanica*	Pennsylvania Sedge	0	14 lbs./ha	
cr	*Campanula rotundifolia*	Harebells	0	14 lbs./ha	
ec	*Elymus canadensis*	Canada Wild Rye	0	14 lbs./ha	
mf	*monarda fistulosa*	Wild Bergamot	0	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	0	14 lbs./ha	
sna	*Symphiotrichum novae-angliae*	New England Aster	0	14 lbs./ha	
Normal Mix					
ac	*Aquilegia canadensis*	Wild Columbine	0	14 lbs./ha	
ag	*Andropogon gerardii*	Big Bluestem	0	14 lbs./ha	
dc	*Desmodium canadense*	Showy Tick Trefoil	0	14 lbs./ha	
ec	*Elymus canadensis*	Canada Wild Rye	0	14 lbs./ha	
hd	*Helianthus decapitatus*	Thin Leaf Sunflower	0	14 lbs./ha	
pd	*Penstemon digitalis*	Foxglove Beardtongue	0	14 lbs./ha	
pv	*Physostegia virginiana*	Obedient Plant	0	14 lbs./ha	
rp	*Ratibida pinnata*	Green Headed Coneflower	0	14 lbs./ha	
se	*Symphiotrichum ericoides*	Heath Aster	0	14 lbs./ha	
sna	*Symphiotrichum novae-angliae*	New England Aster	0	14 lbs./ha	
st	*Silphium terebinthinaceum*	Prairie Dock	0	14 lbs./ha	
Wet Mix			0		
aa	*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	*Lobelia cardinalis*	Cardinal Flower	0	14 lbs./ha	
tl	*Typha latifolia*	Common Cattail	0	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	
Sidewalk Mix					
rh	*Rudbeckia hirta*	Black Eyed Susan	5	14 lbs./ha	25cm O.C.
ssc	*Schizachyrium scoparium*	Little Bluestem	25	14 lbs./ha	
sc	*Sporobolus cryptandrus*	Sand Dropseed	30	14 lbs./ha	
pc	*Poa compressa*	Canada Bluegrass	30	14 lbs./ha	10cm O.C.
pd	*Penstemon digitalis*	Foxglove Beardtongue	5	14 lbs./ha	
am	*Achillea Millefolium*	Yarrow	5	14 lbs./ha	

PLANTING NOTES

1. NO W.B. BURLAP TO BE ROLLED BACK TO REVEAL TOP $\frac{1}{3}$ - $\frac{1}{2}$ OF ROOT BALL, NO TRUNK WRAP, NO ANTI-DESICCANT.
2. ALL PLANT MATERIAL SHALL MEET SPECIFICATIONS FOR SIZE, HEIGHT, SPREAD, GRADING, QUALITY, METHOD OF CULTIVATION, AND BALLING AND BURLAP SPECIFICATIONS AS SET OUT IN THE LATEST GUIDE SPECIFICATION FOR NURSERY STOCK PREPARED BY THE CNTA.
3. NO SUBSTITUTIONS IN SPECIES, CULTIVAR, QUANTITY, SIZE OR CONDITION WILL BE PERMITTED WITHOUT THE WRITTEN APPROVAL OF THE LANDSCAPE ARCHITECT. ANY UNAPPROVED SUBSTITUTED MATERIAL WILL BE REQUIRED TO BE REMOVED FROM THE SITE.
4. ANY INCONSISTENCIES FOUND IN THE QUANTITIES AS SHOWN ON THE PLAN AND THE PLANT LIST SHALL IMMEDIATELY BE REPORTED TO THE LANDSCAPE ARCHITECT.
5. STAKE-OUT OF PLANT LOCATIONS AND DELIVERED PLANT MATERIAL TO BE APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLACEMENT.
6. NATIVE OR IMPORTED TOPSOIL SHALL BE TESTED AS SPECIFIED AND APPROVED BY THE LANDSCAPE ARCHITECT PRIOR TO PLACEMENT. PLANTING MIX, WHERE INDICATED, SHALL FOLLOW THE MIX SPECIFICATIONS.
7. PLANT MATERIAL SHALL BE THOROUGHLY WATERED AT THE TIME OF PLANTING.
8. THE CONTRACTOR SHALL PROVIDE MAINTENANCE IMMEDIATELY AFTER THE PLANTS ARE INSTALLED AND CONTINUE THROUGHOUT THE ENTIRE WARRANTY PERIOD. MAINTENANCE REQUIREMENTS SHALL INCLUDE ALL PROCEDURES CONSISTENT WITH PROPER HORTICULTURAL PRACTICES TO ENSURE NORMAL, VIGOROUS, AND HEALTHY GROWTH OF ALL MATERIAL PLANTED. ALL STAKES, WIRE, HOSE, AND OTHER ACCESSORIES MUST BE REMOVED PRIOR TO FINAL WARRANTY INSPECTION.
9. ALL PLANT MATERIAL USED AS REPLACEMENTS FOR UNACCEPTABLE MATERIAL SHALL BE OF THE SAME QUALITY AND REQUIREMENTS PRESCRIBED FOR THE ORIGINAL MATERIAL INCLUDING THE APPLICABLE WARRANTY PERIOD. REPLACEMENTS SHALL BE MADE ONCE UNDER THE WARRANTY.
10. ALL TREES LOCATIONS TO BE STAKED OUT AND APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLANTING. PROVIDE 48 HOUR NOTICE. ALL SHRUBS TO BE LAID OUT AND APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLANTING. PROVIDE 48 HOURS NOTICE.
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 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 PLANTING.

LEGEND

- Large Tree
- Small Tree
- Large Shrub
- Small Shrub
- Sidewalk Seed Mix
- Dry Seed Mix
- Medium Seed Mix
- Wet Seed Mix
- Live Staking
- Concrete Paving
- Asphalt Path
- Decking
- Railing
- Seatwall

TOWN OF PELHAM
EAST FONTHILL

Project /Client

TOWN OF PELHAM

20 PELHAM TOWN SQUARE
FONTHILL, ON L0S 1E0
T: (905) 892-2607 F: (905) 892-5055

Legend:

Issue / Revisions

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

Stamp

THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION PURPOSES UNTIL SIGNED BY THE LANDSCAPE ARCHITECT.

Drawn By: TB
Checked By: MOH/DL/WD
Date: SEPT. 8, 2014

The Planning Partnership
urban design . landscape architecture . planning . communications
1255 Bay Street, Suite 201 Toronto, Ontario, Canada M5R 2A9
t. 416.975.1556 f. 416.975.1580 info@planpart.ca

General Notes

BUILDING PERMIT ISSUANCE SHALL BE SUBJECT TO THE BUILDING PERMIT DRAWINGS NOT BEING IN CONTRAVENTION WITH THESE APPROVED PLANS AND DRAWINGS INCLUDING, BUT NOT LIMITED TO, THE EXTERIOR DESIGN OF THE BUILDING AND EXTERIOR BUILDING MATERIALS

Drawing Title

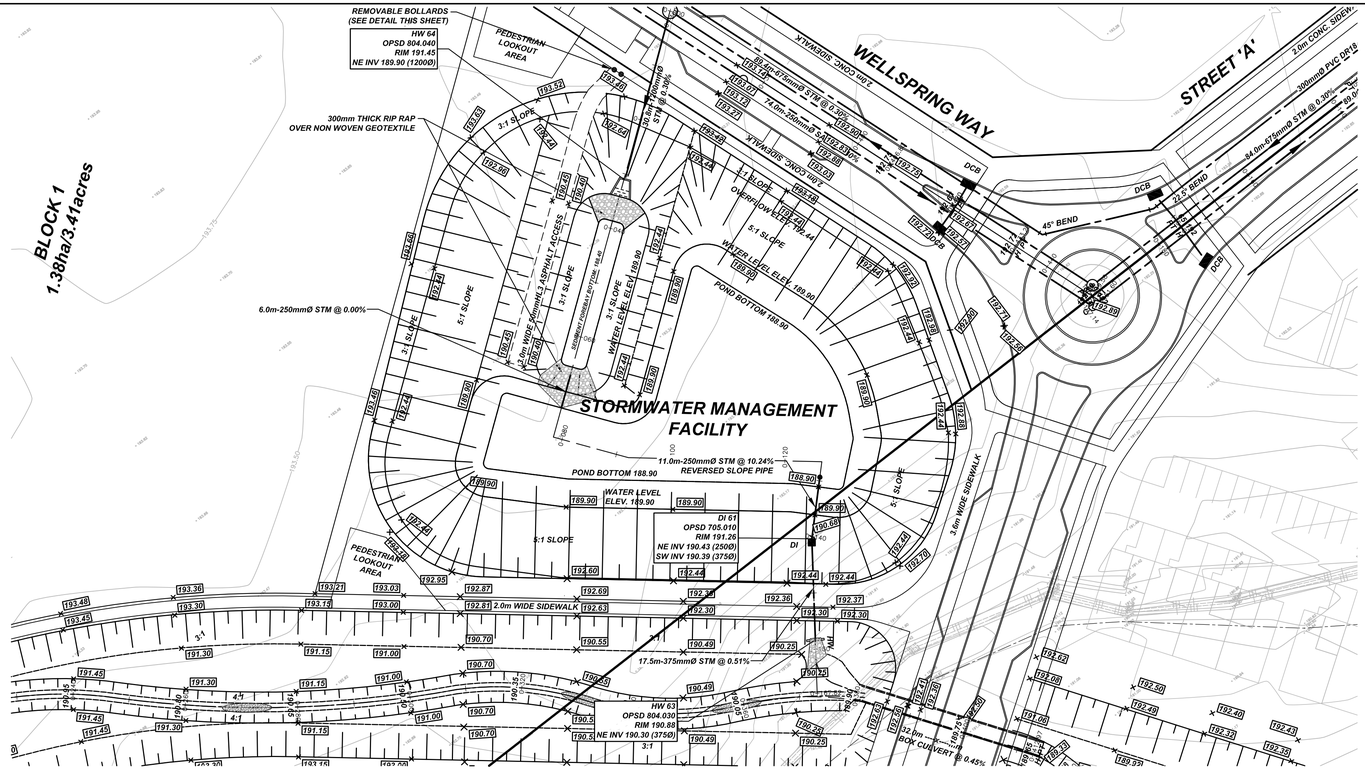
North Storm
Water Pond and
Gateway Planting Plan

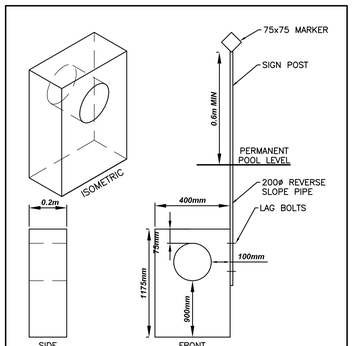
Scale: 1:400

Proj. No.: 1453

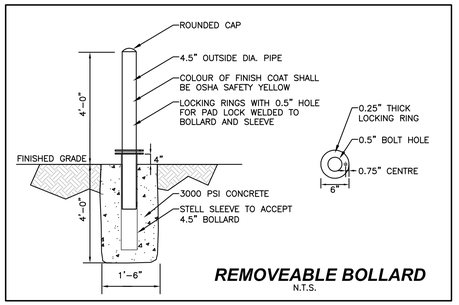
Drawing No.: L-2

Rev.





CONCRETE SUPPORT BLOCK
N.T.S



REMOVEABLE BOLLARD
N.T.S.

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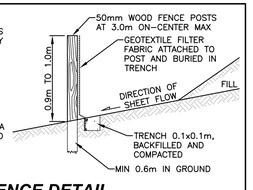

SILT FENCE DETAIL
NTS

NO	REVISION	DATE	INIT
0	ISSUED FOR MOE APPROVAL	2014-10-07	M.C.

NOTES/LEGEND

1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
2. PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.
3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING	M.C.
DESIGN	A.K.
CHECKED BY	M.H.
APPROVED BY	A.K.

LICENSED PROFESSIONAL ENGINEER — A.S.KEANE — 100109861 — 2014/8/14 — PROVINCE OF ONTARIO

Pelham NIAGARA
UPPER CANADA CONSULTANTS ENGINEERS / PLANNERS
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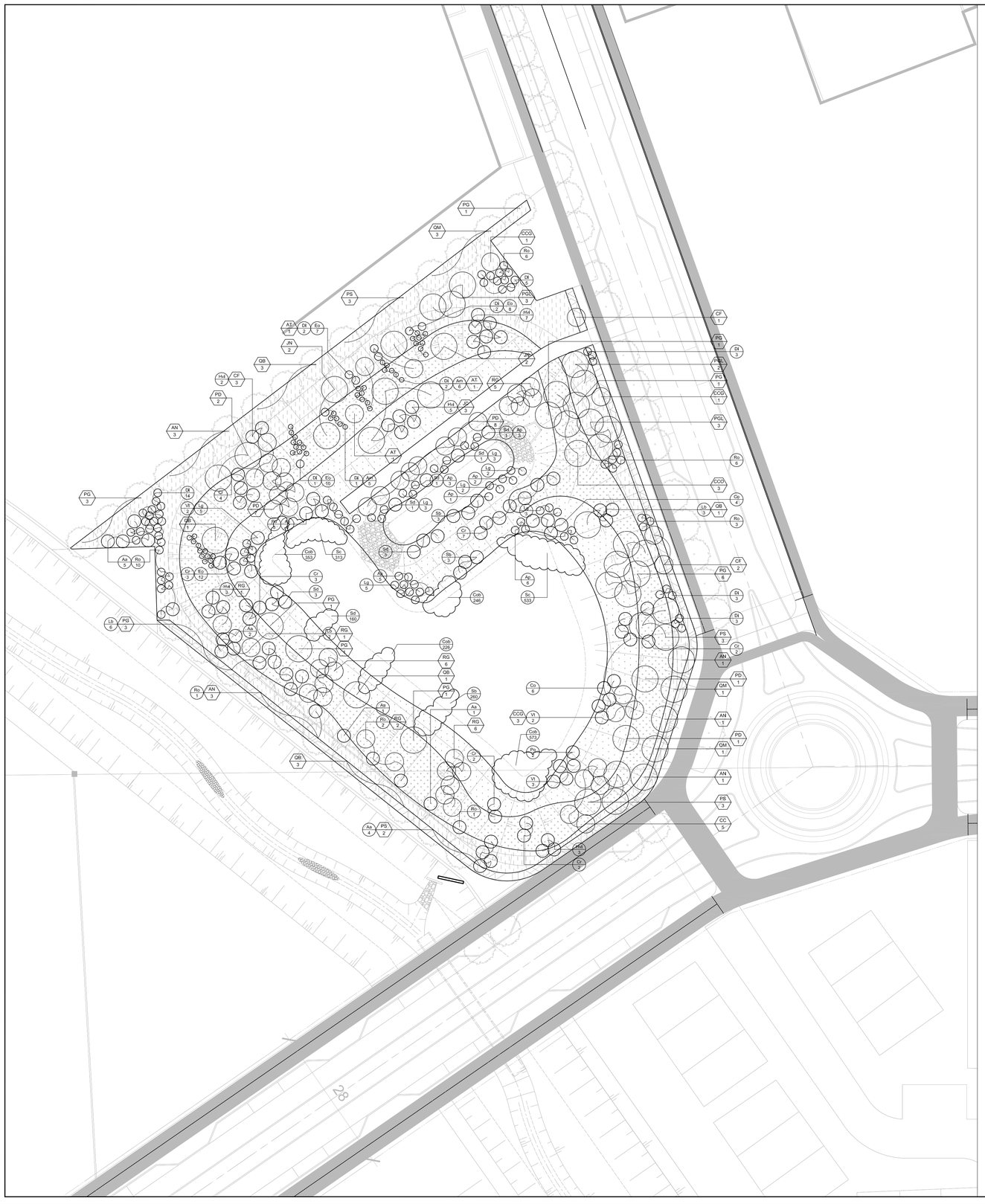
FONTHILL EAST SOUTH POND
PLAN AND PROFILE + GRADING PLAN FROM STA 0+000 to STA 0+177.95
TOWN OF PELHAM

CONSULTANT FILE No.	0473
DATE	2014-01-21
SCALE	1 : 500m
REF. No.	-
DWG No.	0473PP+GP
REV.	0



PLANTING LIST

Key	Botanical Name	Common Name	Qty.	Size	Spacing
DECIDUOUS TREES / LARGE SHRUBS					
AN	*Acer nigrum*	Black Maple	9	70MM B+B	AS INDICATED
AT	*Asimina triloba*	Paw Paw	3	40MM B+B	AS INDICATED
CC	*Cercis canadensis*	Eastern Redbud	5	50MM B+B	AS INDICATED
CCO	*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 B+B	AS INDICATED
JN	*Juglans nigra*	Black Walnut	4	70MM B+B	AS INDICATED
PD	*Populus deltoides*	Cottonwood	5	60MM B+B	AS INDICATED
PD	*Populus deltoides*	Cottonwood	15	35MM 15GAL	AS INDICATED
PG	*Populus grandidenta*	Big-Tooth Aspen	18	70MM B+B	AS INDICATED
QB	*Quercus bicolor*	Swamp White Oak	9	70MM 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
Coniferous Trees					
PL	*Picea glauca*	White Spruce	8	125CM W.B.	AS INDICATED
PS	*Pinus strobus*	White Pine	12	125CM W.B.	AS INDICATED
Shrubs					
Aa	*Amelanchier alnifolia*	Saskatoon Serviceberry	13	1 gal.	AS INDICATED
Am	*Aronia melanocarpa*	Black Chokeberry	11	1 gal.	AS INDICATED
Ap	*Andromeda polifolia*	Bog Rosemary	26	1 gal.	AS INDICATED
Co	*Cornus obliqua*	Silky Dogwood	10	1 gal.	AS INDICATED
Cs	*Cornus sericea*	Red Osier Dogwood	1995	live stakes	0.15m O.C.
Cr	*Cornus racemosa*	Grey Dogwood	23	1 gal.	AS INDICATED
Dl	*Dierville lonicera*	Low Bush Honeysuckle	36	1 gal.	AS INDICATED
Eo	*Euonymus obovata*	Running Serviceberry	37	1 gal.	AS INDICATED
Hvi	*Hamamelis virginiana*	Witch Hazel	20	1 gal.	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
Sd	*Salix discolor*	Pussy Willow	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
Perennial Seed Mixes					
Dry Mix					
af	*Agastache foeniculum*	Blue Giant Hyssop	175	14 lbs./ha	
at	*Asclepias tuberosa*	Butterfly Milkweed	0	14 lbs./ha	
bc	*Bouteloua curtipendula*	Side Oats Grama	0	14 lbs./ha	
cp	*Carex pensylvanica*	Pennsylvania Sedge	0	14 lbs./ha	
cr	*Campanula rotundifolia*	Harebells	0	14 lbs./ha	
ec	*Elymus canadensis*	Canada Wild Rye	0	14 lbs./ha	
mf	*monarda fistulosa*	Wild Bergamot	0	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	0	14 lbs./ha	
sna	*Symphiotrichum novae-angliae*	New England Aster	0	14 lbs./ha	
Normal Mix					
ac	*Aquilegia canadensis*	Wild Columbine	0	14 lbs./ha	
ag	*Andropogon gerardii*	Big Bluestem	0	14 lbs./ha	
dc	*Desmodium canadense*	Showy Tick Trefoil	0	14 lbs./ha	
ec	*Elymus canadensis*	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	*Physostegia virginiana*	Obedient Plant	0	14 lbs./ha	
rp	*Ratibida pinnata*	Green Headed Coneflower	0	14 lbs./ha	
se	*Symphiotrichum ericoides*	Heath Aster	0	14 lbs./ha	
sna	*Symphiotrichum novae-angliae*	New England Aster	0	14 lbs./ha	
st	*Silphium terebinthinaceum*	Prairie Dock	0	14 lbs./ha	
Wet Mix			0		
aa	*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	*Lobelia cardinalis*	Cardinal Flower	0	14 lbs./ha	
tl	*Typha latifolia*	Common Cattail	0	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	
Sidewalk Mix					
rh	*Rudbeckia hirta*	Black Eyed Susan	5	14 lbs./ha	25cm O.C.
ssc	*Schizachyrium scoparium*	Little Bluestem	25	14 lbs./ha	
sc	*Sporobolus cryptandrus*	Sand Dropseed	30	14 lbs./ha	
pc	*Poa compressa*	Canada Bluegrass	30	14 lbs./ha	10cm O.C.
pd	*Penstemon digitalis*	Foxglove Beardtongue	5	14 lbs./ha	
am	*Achillea Millefolium*	Yarrow	5	14 lbs./ha	

PLANTING NOTES

1. NO W.B. BURLAP TO BE ROLLED BACK TO REVEAL TOP $\frac{1}{3}$ - $\frac{1}{2}$ OF ROOT BALL, NO TRUNK WRAP, NO ANTI-DESICCANT.
2. ALL PLANT MATERIAL SHALL MEET SPECIFICATIONS FOR SIZE, HEIGHT, SPREAD, GRADING, QUALITY, METHOD OF CULTIVATION, AND BALLING AND BURLAP SPECIFICATIONS AS SET OUT IN THE LATEST GUIDE SPECIFICATION FOR NURSERY STOCK PREPARED BY THE CNTA.
3. NO SUBSTITUTIONS IN SPECIES, CULTIVAR, QUANTITY, SIZE OR CONDITION WILL BE PERMITTED WITHOUT THE WRITTEN APPROVAL OF THE LANDSCAPE ARCHITECT. ANY UNAPPROVED SUBSTITUTED MATERIAL WILL BE REQUIRED TO BE REMOVED FROM THE SITE.
4. ANY INCONSISTENCIES FOUND IN THE QUANTITIES AS SHOWN ON THE PLAN AND THE PLANT LIST SHALL IMMEDIATELY BE REPORTED TO THE LANDSCAPE ARCHITECT.
5. STAKE-OUT OF PLANT LOCATIONS AND DELIVERED PLANT MATERIAL TO BE APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLACEMENT.
6. NATIVE OR IMPORTED TOPSOIL SHALL BE TESTED AS SPECIFIED AND APPROVED BY THE LANDSCAPE ARCHITECT PRIOR TO PLACEMENT. PLANTING MIX, WHERE INDICATED, SHALL FOLLOW THE MIX SPECIFICATIONS.
7. PLANT MATERIAL SHALL BE THOROUGHLY WATERED AT THE TIME OF PLANTING.
8. THE CONTRACTOR SHALL PROVIDE MAINTENANCE IMMEDIATELY AFTER THE PLANTS ARE INSTALLED AND CONTINUE THROUGHOUT THE ENTIRE WARRANTY PERIOD. MAINTENANCE REQUIREMENTS SHALL INCLUDE ALL PROCEDURES CONSISTENT WITH PROPER HORTICULTURAL PRACTICES TO ENSURE NORMAL, VIGOROUS, AND HEALTHY GROWTH OF ALL MATERIAL PLANTED. ALL STAKES, WIRE, HOSE, AND OTHER ACCESSORIES MUST BE REMOVED PRIOR TO FINAL WARRANTY INSPECTION.
9. ALL PLANT MATERIAL USED AS REPLACEMENTS FOR UNACCEPTABLE MATERIAL SHALL BE OF THE SAME QUALITY AND REQUIREMENTS PRESCRIBED FOR THE ORIGINAL MATERIAL INCLUDING THE APPLICABLE WARRANTY PERIOD. REPLACEMENTS SHALL BE MADE ONCE UNDER THE WARRANTY.
10. ALL TREES LOCATIONS TO BE STAKED OUT AND APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLANTING. PROVIDE 48 HOUR NOTICE. ALL SHRUBS TO BE LAID OUT AND APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLANTING. PROVIDE 48 HOURS NOTICE.
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 PREPARED BY CONTRACTOR AND REVIEWED BY LANDSCAPE ARCHITECT.

LEGEND

- Large Tree
- Small Tree
- Large Shrub
- Small Shrub
- Sidewalk Seed Mix
- Dry Seed Mix
- Medium Seed Mix
- Wet Seed Mix
- Live Staking
- Concrete Paving
- Asphalt Path
- Decking
- Railing
- Seatwall

TOWN OF PELHAM
EAST FONTHILL

Project /Client

TOWN OF PELHAM

20 PELHAM TOWN SQUARE
FONTHILL, ON L0S 1E0
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Legend:

Issue / Revisions

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

Stamp

THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION PURPOSES UNTIL SIGNED BY THE LANDSCAPE ARCHITECT.

Drawn By: TB
Checked By: MOH/DL/WD
Date: SEPT. 8, 2014

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General Notes

BUILDING PERMIT ISSUANCE SHALL BE SUBJECT TO THE BUILDING PERMIT DRAWINGS NOT BEING IN CONTRAVENTION WITH THESE APPROVED PLANS AND DRAWINGS INCLUDING, BUT NOT LIMITED TO, THE EXTERIOR DESIGN OF THE BUILDING AND EXTERIOR BUILDING MATERIALS

Drawing Title

South Storm
Water Pond and
Gateway Planting Plan

Scale: 1:400

Proj. No.: 1453

Drawing No.: L-4

Rev.