C.C. Tatham & Associates Ltd.
Consulting Engineers

CHARLESTON HOMES RESIDENTIAL DEVELOPMENT

Town of Collingwood

Preliminary Stormwater Management Report

prepared by:

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prepared for

Charleston Homes

December 2015
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1 Introduction

1.1 Objectives

The following Preliminary Stormwater Management (SWM) Report has been prepared in support of a proposed residential subdivision, located north of Poplar Sideroad and west of High Street within the Town of Collingwood. The primary objective of this report is to demonstrate that the proposed development will not adversely affect local water resources and surface water quality and quantity conditions. This will be accomplished by evaluating the effect of development on local drainage conditions and, where necessary, providing solutions to mitigate any adverse impacts. This report was originally prepared and circulated in December 2015 and this version represents the revisions made to the report based on comments received on the original submission.

1.2 Guidelines and Background Information

This report was prepared recognizing provincial, municipal and Conservation Authority guidelines on water resources and the environment, including the following publications:

- The Ministry of the Environment (MOE) Stormwater Management Practices Planning and Design Manual (2003);
- Town of Collingwood Development Standards (2002);
- Nottawasaga Valley Conservation Authority Stormwater Technical Guide (2013); and
- The Credit Valley Conservation Authority (CVC) and the Toronto and Region Conservation Authority (TRCA) Low Impact Development Stormwater Management Planning and Design Guide (2010).

Information relating to existing topography, ground cover and drainage patterns was obtained through a review of relevant background studies, available plans and base mapping and site investigation. Detailed contour mapping was prepared based on a topographic survey of the site.

2 Existing Drainage Conditions

2.1 Existing Conditions

The property proposed for development is 31.4 ha and fronts on Poplar Sideroad and High Street. The proposed area of the site to be developed is 25.45 ha. A Zoning By-law Amendment and Draft Plan of Subdivision application are proposed for the property. The site is located in the south-west corner of the Town of Collingwood bounded currently by undeveloped residential land to the north, Black Ash Creek and rural land to the west, High Street and the existing Mountaincroft Subdivision to the east. Poplar Sideroad and rural and residential lands in the Township of Clearview are the land uses to the south. A handful of large residential lots front onto Poplar Sideroad along the south edge of the property.

For the purposes of hydrologic modelling, the soils have been classified as tioga sand loam (Type A). The site has been divided into three (3) drainage outlet locations for the purpose of this report and the required hydrologic modelling. The existing site conditions have been modelled using the Visual OTTHYMO (V02) hydrologic modelling software. Detailed model results are provided in Appendix A. Summary tables of the peak flows are provided in the following sections which further describe drainage conditions at each outlet. The existing condition drainage patterns are depicted on the appended Drawing DP-1.

2.1.1 Outlet #1 - Northwest

Under existing conditions, the northwest portion of the site drains via overland flow in a northwesterly direction to an intermittent drainage channel that outlets through the property to the north. The intermittent drainage channel flows north and west eventually outletting to Black Ash Creek. Black Ash Creek is the main receiver of flow from the site and was channelized for flood control +-15 years ago and outlets into Georgian Bay. This area is modeled as Catchment 101 (refer to Drawing DP-1) with a total area of 9.55 ha. The existing conditions peak flow summary for Outlet #1 is provided in Table 1.

2.1.2 Outlet #2 - Southwest

Under existing conditions, the southwest portion of the site drains via an overland flow swale that outlets in a northern direction to Black Ash Creek. This area is modeled as Catchment 102 (refer to Drawing DP-1) with a total area of 5.05 ha. The existing conditions peak flow summary for Outlet #2 is provided in Table 1.

2.1.3 Outlet #3 - East

Under existing conditions, the southeast portion of the site drains via overland flow in a northeastern direction towards High Street. Along High Street it is picked up by a series of culverts and conveyed

across High Street into the Mountaincroft Subdivision drainage system. The Mountaincroft Subdivision outlet flows to the Oak Street Canal drainage system. This area also includes some external flows from the south of Poplar Sideroad that currently get routed through the site. It is suspected, based on our previous work for the Mountaincroft site, that the existing site is tile drained on a south-west to north-east direction. This area is modeled as Catchment 115, Catchment 116 and Catchment 117 (refer to Drawing DP-1) with a total area of 20.80 ha north of Poplar Sideroad and another 15.90 ha south of Poplar Sideroad.

Table 1: Existing Conditions Peak Flow Summary

Storm Event	Outlet #1 (Catchment 101) (m^3/s)		Outlet #2 (Catchment 102) (m^3/s)		Outlet #3 (Catchments 115, 116 & 117) (m^3/s)	
	4-hr. CHI	24-hr. SCS	4-hr. CHI	24-hr. SCS	4-hr. CHI	24-hr. SCS
2-year	0.052	0.075	0.048	0.060	0.189	0.263
5-year	0.097	0.138	0.091	0.111	0.353	0.486
10-year	0.132	0.187	0.125	0.150	0.481	0.661
25-year	0.182	0.258	0.173	0.208	0.667	0.917
50-year	0.226	0.308	0.215	0.248	0.831	1.097
100-year	0.269	0.367	0.257	0.295	0.993	1.310
Timmins	0.509		0.350		1.826	
25 mm 4-hr. Chicago	0.024		0.022		0.087	

3 Future Drainage Conditions

3.1 Design Criteria

This Preliminary SWM Report is subject to the review and approval of the Town of Collingwood and NVCA. Applicable stormwater management design criteria for the proposed site development are presented below.

3.1.1 Stormwater Quality Control

Water quality controls must be provided to satisfy the *2003 MOE SWM Practices Planning and Design Manual*. Black Ash Creek and the Oak Street Canal are the receiving watercourse for site drainage and therefore Enhanced water quality protection, which corresponds to 80% long term suspended solids removal, is required. Phosphorous reduction is provided on a best effort basis as per NVCA policy.

3.1.2 Stormwater Quantity Control

The recent channelization of Black Ash Creek through the Town of Collingwood and Black Ash Creek Subwatershed Study allows for peak flows to be released uncontrolled to Black Ash Creek therefore post to pre-development control is not required. Major storm event flows must be conveyed safely to Black Ash Creek. Flows directed to High Street/Mountaincroft system must be controlled and discharged at pre-development levels or to the amount they have allowed for in their sizing of storm system. The Town has requested the amount of flow directed to High Street be minimized to the extent possible. We are also proposing to implement extended detention over-control for the 25 mm storm event for added water quality and erosion control purposes.

3.1.3 Siltation and Erosion Control

Recommendations for a siltation and erosion control strategy will be provided for implementation during construction.

3.2 Proposed Development

The proposed development is primarily residential, consisting of 234 single detached lots, 88 semi-detached lots, and 88 townhouse units. This allows for a total yield for the entire development of up to 410 residential units.

The property will be serviced by an extension of Findlay Drive across High Street in the Mountaincroft Subdivision and a network of internal streets with 20.0 m right-of-way widths, all designed with an urban cross-section in accordance with Town standards.

The majority of the drainage from the site will be outletted to Black Ash Creek via a SWM pond designed for quality control. A SWM block and a linear open space block that will include a perforated pipe system will be provided for a small area along the west developable boundary that requires water quality control to outlet flows to Black Ash Creek at this location.

4 Proposed Stormwater Management Plan

The preferred SWM strategy will involve the implementation of a series of Best Management Practices (BMP's) to achieve the necessary SWM objectives. These measures will include:

- the implementation of at-source soakaway pits on lots where soil and groundwater conditions permit;
- a perforated pipe system along the Black Ash Creek linear buffer to promote infiltration and quality controls for the small area that is to discharge to this location; and
- construction of a wet pond in the northwest corner to provide the required water quality and erosion control for the development areas discharging to Black Ash Creek.

A Post-development drainage plan has been provided on Drawing DP-2 to delineate the drainage catchments for each SWM facility. Post-development hydrologic modelling results are included in Appendix B for reference.

In order to manage minor storm runoff, storm sewers and catch basins have been designed as per Town standards to convey peak flows from the 5-year storm event. Major storm runoff will be conveyed via overland flow routes contained primarily in the right-of-way. They will discharge overland to the SWM facility which will control their release to Black Ash Creek. Flows to High Street will be controlled to pre-development levels or less. Detailed SWM plan components include the following.

4.1 SWM Pond

4.1.1 Contributing Drainage Area

The SWM Pond is in the north-west corner of the development and receives runoff from an upstream drainage area of 21.57 ha of on-site drainage. The proposed development within the drainage area includes single detached residential, townhouse residential and a public park, as well as some external future development lands to the south-east. These areas are represented by Catchment 201 and 301, which is shown on appended Drawing DP-2. Catchment 204 consists of rear yards which cannot because of grade constraints discharge to the SWM pond therefore are released uncontrolled under major storm events. Under minor storm events runoff from these areas when collected in rear yard catchbasin are conveyed to the internal storm sewer network and eventually to the SWM pond. The discharge from the SWM pond will be a storm pipe that will outlet to the floodplain of the Black Ash Creek (Outlet #1), location shown on Drawing DP-2. A level spreader and erosion control measures via natural stone placement and live plantings will be implemented to naturalize the discharge point at the creek.

4.1.2 Stormwater Quality

The SWM facility has been designed in accordance with MOECC Guidelines for Enhanced Level water quality protection. The water quality storage volume calculations are based on the water quality treatment provided by the wet pond. Table 3.2 of the MOE SWM Manual provides sizing criteria for Enhanced Level protection based on the imperviousness of the drainage area, which corresponds to 80% TSS removal. A conservative value of 50% imperviousness has been used to determine the water quality storage volume of the SWM pond.

A water quality storage volume of 176.4 m^3/ha is required for the pond to provide Enhanced protection. The total required storage volume in the wet pond is therefore 3967 m^3, of which 3068 m^3 is permanent pool, based on a contributing area of 22.49 ha. The water quality calculations and pond volume table can be found in Appendix C. The pond provides 3,295 m^3 of permanent pool and 4,049 m^3 of extended detention which meets the required volumes for water quality.

4.1.3 Erosion Control (Extended Detention)

The wet pond provides adequate erosion control by providing a minimum of 24-hour extended detention for the 25 mm 4-hour Chicago storm. The extended detention storage volume is the greater of the active storage requirement (40 m^3/ha) or the 25 mm storm volume (as per the MOECC SWM Manual). The runoff volume of the 25 mm 4-hour Chicago storm has been modelled for the contributing catchments using the Visual OTTHYMO (V02) hydrologic modelling software.

The governing volume occurs from the 25 mm storm, and is 2904 m^3 which is less than the 4,049 m^3 that is provided. Using the falling head orifice equation, the 25 mm storm is released over a period of 24 - 48 hours, exceeding the minimum requirements and providing additional time for infiltration to occur into the native soils. Detailed calculation sheets are provided in Appendix C. A summary of how the pond functions under different storm events is also included in Appendix C.

4.2 Perforated Pipe (LID) System

4.2.1 Contributing Drainage Area

A perforated pipe system is proposed as a Low Impact Development (LID) stormwater control technique for the small area draining to it. In total it receives runoff from catchment 202, an area totalling 2.1 ha, which is depicted on appended Drawing DP-2. The primary function of the perforated pipe system will be to encourage runoff infiltration to help maintain water balance conditions. Runoff that does not infiltrate will discharge from the perforated pipe system to Black Ash Creek at the former Outlet #2 location and utilize the same overland flow path to the creek as depicted on DP-2.

4.2.2 Stormwater Quality

The perforated pipe system has been designed in accordance with MOECC Guidelines for Enhanced Level water quality protection. The design also follows the recommendations of the CVCA LID Manual and a typical cross-section is included in Appendix D. Table 3.2 of the MOE SWM Manual provides sizing criteria for Enhanced Level protection based on the imperviousness of the drainage area, which corresponds to 80% TSS removal. A conservative value of 52% imperviousness has been used to determine the water quality storage volume of the swale.

A water quality infiltration volume of 29.7 m^3/ha is required for infiltration facilities to provide Enhanced protection for Catchment 202. The total required storage volume in an infiltration facility is therefore 62.4 m^3, based on a contributing area of 2.1 ha. The perforated pipe system provides a ponding storage volume of 85 m^3. The water quality calculations for the perforated pipe system are provided in Appendix D along with a typical cross-section.

Runoff is collected through the conventional catch basin/ storm sewer system which will convey flows to the perforated pipe system, which is sized to provide infiltration volume and water quality control prior to outletting to the Black Ash Creek floodplain.

4.3 Rear Yard Soakaway Pits

Preliminary pre and post development water balance calculations were completed to assess the current and future conditions. Proposed best management measures are recommended to offset losses to infiltration volumes including the perforated pipe system and soakaway pits. Preliminary water budget analysis is included in Appendix E for reference.

Approximately 30% of the proposed houses are located on lots with suitable soils and groundwater conditions to support the use of soakaway pits. Soakaway pits are useful LID measures to help promote infiltration and reduce volumes of runoff under post development conditions. The exact location and distribution of the soakaway pits will be resolved at the detailed design stage.

4.4 High Street/Mountaincroft Outlet

As requested we have directed as much drainage away from High Street as the constraints would allow. The post development discharge to High Street (Outlet #3) is modelled as Catchment 203, and consists of only 0.86 ha. Under major storm events flow from catchment 203 will be directed to the wet pond. As previously mentioned flows from catchment 204 will drain to the internal storm sewer network under minor storm events but under major storm events will drain to High Street. This reduced catchment represents only 29% of the site's original drainage area for the outlet to High Street, as the remaining area is routed to Black Ash Creek. Peak flows to High Street will decrease due to the proposed development and have been set to match the available capacity in the design of the Mountaincroft storm system. In the future the Town will have the ability to either discharge flows from

this site to Mountaincroft or north down High Street. A summary of the post development peak flows is provided in Table 2, with detailed model output provided in Appendix B.

Table 2: Outlet #3 (High Street) Proposed Condition Peak Flow Summary

Storm Event	Peak Flow Rate (m^3/s)	
	4-hour Chicago Storm	24-hour SCS Storm
2-year	0.059	0.099
5-year	0.189	0.291
10-year	0.282	0.391
25-year	0.390	0.489
50-year	0.455	0.558
100-year	0.508	0.885
Timmins	1.769	
25 mm 4-hr. Chicago	0.051	

External drainage (Catchment 302) currently discharges to High Street in a separate system south of the site and this will not be changed as a result of the development. Future stormwater management for these lands should be dealt with when it proceeds.

4.5 Phosphorous Calculations

Phosphorous calculations using the NVCA phosphorous budget tool are included in Appendix F for reference. Although they confirm the effectiveness of the LID measures these calculations are included for information purposes only as there is no criteria and phosphorous reduction is being achieved on a best effort basis.

5 Development Setback Limit

Extensive work was completed from the outset to establish an appropriate development setback boundary along the Black Ash Creek limit along the west portion of the property. This included assessing various setback limitations based on criteria established from the following:

- erosion and steep slope hazard as determined through geotechnical analysis;
- 30 m setback from Black Ash Creek as required from the Black Ash Creek Subwatershed Study;
- setbacks from confirmed natural environment features as identified through Azimuth Environmental; and
- setbacks as determined through floodplain hazard limit provided by the NVCA.

Through the combination of these constraints a development setback line was surveyed and transposed onto the base draft plan. The supporting information and a copy of the constraint map is included with this report for reference purposes. This setback has been used to establish the open space and development blocks used in this rezoning application and draft plan submission that accompanies this report.

6 Siltation & Erosion Control Plan

The proposed development is expected to occur in stages. The earthworks, roads and infrastructure will be constructed first, followed by construction of individual buildings. In all stages, erosion and sediment controls will be implemented for all construction activities including topsoil stripping, road construction, foundation excavation and stock piling of materials. The basic principles considered to minimize erosion and sedimentation and resultant negative environmental impacts include:

1. minimize wherever possible local disturbance activities (e.g. grading);
2. expose the smallest possible land area, where practical, to erosion for the shortest possible time;
3. institute control measures where needed and as required immediately;
4. implement control measures before the outset of construction activities; and
5. carry out regular inspections for all control measures and repair or maintain as necessary.

The proposed grading, servicing and building construction should be carried out in such a manner that a minimum amount of erosion occurs and such that sedimentation facilities control any erosion that does occur.

Erosion and silt/sediment control measures will include but not be limited to the following:

1. erection of silt fences around the construction sites;
2. provide sediment traps (e.g. berms, geotextiles, stone barriers and swales);
3. provide general “mud mats” at construction vehicle access points to minimize off-site tracking of sediments; and
4. confine refuelling/servicing equipment to areas well away from inlets to the minor or major system elements.

Removal of all erosion and sediment controls within the development should only be done once construction is complete and sediment runoff from the construction activities has stabilized.

7 Conclusions and Recommendations

The proposed development will consist of 25.45 ha of single detached residential, semi-detached residential, townhouse residential, and public park land uses in the Town of Collingwood. Existing drainage patterns will generally be maintained with stormwater runoff directed via storm sewers and the road network to the proposed SWM facility.

The SWM plan proposed utilizes an approach including a combination of low impact development (LID) and conventional end of pipe facilities consisting of soakaway pits, perforated pipe system and a wet pond. Water quantity controls are not required to Black Ash Creek, as the channelized Black Ash Creek can receive uncontrolled peak flows.

Siltation and erosion control will be provided with the proper construction mitigation efforts. Long-term erosion control will be enhanced with an effective revegetation strategy.

Detailed design of these systems will be provided at the final design stage but the work completed to date confirms that appropriate stormwater management can be provided. We trust the above presentation of the Preliminary SWM Report is sufficient for the proposed development.

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Reviewed by: Dan Hurley, B.A.Sc., P.Eng., LEED AP
Vice President,
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APPENDIX A:
EXISTING HYDROLOGIC CONDITIONS

C.C. Tatham & Associates Ltd. Consulting Engineers — Collingwood, Bracebridge, Orillia, Barrie	**Project:**	Charleston Subdivision
	File No.:	114056
	Date:	12-Nov-15
	Designed By:	NHF
	Checked By:	AW
	Subject:	CN Calculator

CURVE NUMBER, INITIAL ABSTRACTION & TIME TO PEAK CALCULATIONS

CONDITIONS

Catchment 115 **Area** 9.13 ha

WEIGHTED CN VALUE

Soil Series	Soil Series	Hydrologic Soil Group	Soil Texture	Runoff Coefficient Type	Catchment Soil Characteristics		Forest/Woodland			Pasture/Lawns			Meadows			Cultivated			Impervious			Wetland/Lakes/SWMF			Average CN for Soil Type
					Area	Percent	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	
tisl	TIOGA	A	Sand Loam	1	9.13	1	0		32	0		49	0		38	8.902	0.975	62	0.228	0.025	100	0		50	62.95
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
				Totals	9.13	1	0	0		0	0		0	0		8.90175	0.975		0.22825	0.025		0	0		63.0

Time of Concentration Calculations

For Runoff Coefficients greater than 0.4

Bransby-Williams Formula

Maximum Catchment Elevation	209.01	m
Minimum Catchment Elevation	199.93	m
Catchment length	617	m
Catchment Slope	1%	
Catchment Area	9.13	ha
Time of Concentration (Minutes)	26.09	
Time of Concentration (Hours)	0.43	
Time to Peak (2/3 x Time of Concentration)	0.29	

For Runoff Coefficients less than 0.4

Airport Method

Maximum Catchment Elevation	209.01	m
Minimum Catchment Elevation	199.93	m
Catchment length	617	m
Catchment Slope	1%	
Catchment Area	9.13	ha
Time of Concentration (Minutes)	61.43	
Time of Concentration (Hours)	1.02	
Time to Peak (2/3 x Time of Concentration)	0.68	

Time to Peak	0.68 hrs

Initial Abstraction	6.875 mm

Wetlands	12
Woods	10
Meadows	8
Cultivated	7
Lawns	5
Impervious	2

Runoff Coefficient	0.24

Landuse Type	Soil Series				
	tisl	0	0	0	0
	1	#N/A	#N/A	#N/A	#N/A
Forest/Woodland	0.08	#N/A	#N/A	#N/A	#N/A
Cultivated	0.22	#N/A	#N/A	#N/A	#N/A
Pasture/Lawn	0.1	#N/A	#N/A	#N/A	#N/A
Impervious	0.95	#N/A	#N/A	#N/A	#N/A
Wetland/Lake/SWMF	0.05	#N/A	#N/A	#N/A	#N/A
Meadows	0.09	#N/A	#N/A	#N/A	#N/A
Soil Series Total	0.238	#N/A	#N/A	#N/A	#N/A

C.C. Tatham & Associates Ltd. Consulting Engineers Collingwood Bracebridge Orillia Barrie	Project:	Charleston Subdivision
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	Checked By:	AW
	Subject:	CN Calculator

CURVE NUMBER, INITIAL ABSTRACTION & TIME TO PEAK CALCULATIONS

CONDITIONS

Catchment 116 **Area** 6.16 ha

WEIGHTED CN VALUE

Soil Series	Soil Series	Hydrologic Soil Group	Soil Texture	Runoff Coefficient Type	Catchment Soil Characteristics		Forest/Woodland			Pasture/Lawns			Meadows			Cultivated			Impervious			Wetland/Lakes/SWMF			Average CN for Soil Type
					Area	Percent	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	
tisl	TIOGA	A	Sand Loam	1	6.16	1	0		32	0		49	0		38	6.098	0.99	62	0.062	0.01	100	0		50	62.38
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
				Totals	6.16	1	0	0		0	0		0	0		6.0984	0.99		0.0616	0.01		0	0		62.4

Time of Concentration Calculations

Initial Abstraction	6.95 mm
Runoff Coefficient	0.23

Wetlands	12
Woods	10
Meadows	8
Cultivated	7
Lawns	5
Impervious	2

For Runoff Coefficients greater than 0.4

Bransby-Williams Formula

Maximum Catchment Elevation	206	m
Minimum Catchment Elevation	198.5	m
Catchment length	430	m
Catchment Slope	2%	
Catchment Area	6.16	ha
Time of Concentration (Minutes)	18.28	
Time of Concentration (Hours)	0.30	
Time to Peak (2/3 x Time of Concentration)	0.20	

Time to Peak	0.55 hrs

For Runoff Coefficients less than 0.4

Airport Method

Maximum Catchment Elevation	206	m
Minimum Catchment Elevation	198.5	m
Catchment length	430	m
Catchment Slope	2%	
Catchment Area	6.16	ha
Time of Concentration (Minutes)	49.10	
Time of Concentration (Hours)	0.82	
Time to Peak (2/3 x Time of Concentration)	0.55	

Landuse Type	Soil Series				
	tisl	0	0	0	0
	1	#N/A	#N/A	#N/A	#N/A
Forest/Woodland	0.08	#N/A	#N/A	#N/A	#N/A
Cultivated	0.22	#N/A	#N/A	#N/A	#N/A
Pasture/Lawn	0.1	#N/A	#N/A	#N/A	#N/A
Impervious	0.95	#N/A	#N/A	#N/A	#N/A
Wetland/Lake/SWMF	0.05	#N/A	#N/A	#N/A	#N/A
Meadows	0.09	#N/A	#N/A	#N/A	#N/A
Soil Series Total	0.227	#N/A	#N/A	#N/A	#N/A

C.C. Tatham & Associates Ltd. Consulting Engineers — Collingwood Bracebridge Orillia Barrie	
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Designed By:	NHF
Checked By:	AW
Subject:	CN Calculator

CURVE NUMBER, INITIAL ABSTRACTION & TIME TO PEAK CALCULATIONS

CONDITIONS

Catchment 117 **Area** 5.51 ha

WEIGHTED CN VALUE

Soil Series	Soil Series	Hydrologic Soil Group	Soil Texture	Runoff Coefficient Type	Catchment Soil Characteristics		Forest/Woodland			Pasture/Lawns			Meadows			Cultivated			Impervious			Wetland/Lakes/SWMF			Average CN for Soil Type
					Area	Percent	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	
tisl	TIOGA	A	Sand Loam	1	5.51	1	0		32	0		49	0		38	5.262	0.955	62	0.248	0.045	100	0		50	63.71
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
				Totals	5.51	1	0	0		0	0		0	0		5.26205	0.955		0.24795	0.045		0	0		63.7

Time of Concentration Calculations

Initial Abstraction	6.775 mm
Runoff Coefficient	0.25

Wetlands	12
Woods	10
Meadows	8
Cultivated	7
Lawns	5
Impervious	2

For Runoff Coefficients greater than 0.4

Bransby-Williams Formula

Maximum Catchment Elevation	209 m
Minimum Catchment Elevation	201.5 m
Catchment length	331 m
Catchment Slope	2%
Catchment Area	5.51 ha
Time of Concentration (Minutes)	13.51
Time of Concentration (Hours)	0.23
Time to Peak (2/3 x Time of Concentration)	0.15

For Runoff Coefficients less than 0.4

Airport Method

Maximum Catchment Elevation	209 m
Minimum Catchment Elevation	201.5 m
Catchment length	331 m
Catchment Slope	2%
Catchment Area	5.51 ha
Time of Concentration (Minutes)	38.36
Time of Concentration (Hours)	0.64
Time to Peak (2/3 x Time of Concentration)	0.43

Time to Peak	0.43 hrs

Landuse Type	Soil Series				
	tisl	0	0	0	0
	1	#N/A	#N/A	#N/A	#N/A
Forest/Woodland	0.08	#N/A	#N/A	#N/A	#N/A
Cultivated	0.22	#N/A	#N/A	#N/A	#N/A
Pasture/Lawn	0.1	#N/A	#N/A	#N/A	#N/A
Impervious	0.95	#N/A	#N/A	#N/A	#N/A
Wetland/Lake/SWMF	0.05	#N/A	#N/A	#N/A	#N/A
Meadows	0.09	#N/A	#N/A	#N/A	#N/A
Soil Series Total	0.253	#N/A	#N/A	#N/A	#N/A

C.C. Tatham & Associates Ltd. Consulting Engineers Collingwood Bracebridge Orillia Barrie		
	Project:	Charleston Subdivision
	File No.:	114056
	Date:	12-Nov-15
	Designed By:	NHF
	Checked By:	AW
	Subject:	CN Calculator

CURVE NUMBER, INITIAL ABSTRACTION & TIME TO PEAK CALCULATIONS

CONDITIONS

Catchment 102 **Area** 5.05 ha

WEIGHTED CN VALUE																									
Soil Series	Soil Series	Hydrologic Soil Group	Soil Texture	Runoff Coefficient Type	Catchment Soil Characteristics		Forest/Woodland			Pasture/Lawns			Meadows			Cultivated			Impervious			Wetland/Lakes/SWMF			Average CN for Soil Type
					Area	Percent	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	
tisl	TIOGA	A	Sand Loam	1	5.05	1	0		32	0		49	0		38	5	0.99	62	0.051	0.01	100	0		50	62.38
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
				Totals	5.05	1	0	0		0	0		0	0		4.9995	0.99		0.0505	0.01		0	0		62.4

Initial Abstraction	6.95 mm

Wetlands	12
Woods	10
Meadows	8
Cultivated	7
Lawns	5
Impervious	2

Time of Concentration Calculations

For Runoff Coefficients greater than 0.4

Bransby-Williams Formula

Maximum Catchment Elevation	214.5	m
Minimum Catchment Elevation	205	m
Catchment length	283	m
Catchment Slope	3%	
Catchment Area	5.05	ha
Time of Concentration (Minutes)	10.77	
Time of Concentration (Hours)	0.18	
Time to Peak (2/3 x Time of Concentration)	0.12	

For Runoff Coefficients less than 0.4

Airport Method

Maximum Catchment Elevation	214.5	m
Minimum Catchment Elevation	205	m
Catchment length	283	m
Catchment Slope	3%	
Catchment Area	5.05	ha
Time of Concentration (Minutes)	32.09	
Time of Concentration (Hours)	0.53	
Time to Peak (2/3 x Time of Concentration)	0.36	

Time to Peak	0.36 hrs

Runoff Coefficient	0.23

Landuse Type	Soil Series				
	tisl	0	0	0	0
	1	#N/A	#N/A	#N/A	#N/A
Forest/Woodland	0.08	#N/A	#N/A	#N/A	#N/A
Cultivated	0.22	#N/A	#N/A	#N/A	#N/A
Pasture/Lawn	0.1	#N/A	#N/A	#N/A	#N/A
Impervious	0.95	#N/A	#N/A	#N/A	#N/A
Wetland/Lake/SWMF	0.05	#N/A	#N/A	#N/A	#N/A
Meadows	0.09	#N/A	#N/A	#N/A	#N/A
Soil Series Total	0.227	#N/A	#N/A	#N/A	#N/A

C.C. Tatham & Associates Ltd.	
Consulting Engineers	
Collingwood Bracebridge Orillia Barrie	
Project:	Charleston Subdivision
File No.:	114056
Date:	12-Nov-15
Designed By:	NHF
Checked By:	AW
Subject:	CN Calculator

CURVE NUMBER, INITIAL ABSTRACTION & TIME TO PEAK CALCULATIONS

CONDITIONS

Catchment 101 **Area** 9.55 ha

WEIGHTED CN VALUE

Soil Series	Soil Series	Hydrologic Soil Group	Soil Texture	Runoff Coefficient Type	Catchment Soil Characteristics		Forest/Woodland			Pasture/Lawns			Meadows			Cultivated			Impervious			Wetland/Lakes/SWMF			Average CN for Soil Type
					Area	Percent	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	
tisl	TIOGA	A	Sand Loam	1	9.55	1	0		32	0		49	0		38	9.455	0.99	62	0.096	0.01	100	0		50	62.38
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
				Totals	9.55	1	0	0		0	0		0	0		9.4545	0.99		0.0955	0.01		0	0		62.4

Time of Concentration Calculations

For Runoff Coefficients greater than 0.4			For Runoff Coefficients less than 0.4		
Bransby-Williams Formula			**Airport Method**		
Maximum Catchment Elevation	209.5	m	Maximum Catchment Elevation	209.5	m
Minimum Catchment Elevation	199.5	m	Minimum Catchment Elevation	199.5	m
Catchment length	765	m	Catchment length	765	m
Catchment Slope	1%		Catchment Slope	1%	
Catchment Area	9.55	ha	Catchment Area	9.55	ha
Time of Concentration (Minutes)	32.98		Time of Concentration (Minutes)	72.03	
Time of Concentration (Hours)	0.55		Time of Concentration (Hours)	1.20	
Time to Peak (2/3 x Time of Concentration)	0.37		Time to Peak (2/3 x Time of Concentration)	0.80	

Time to Peak	0.80 hrs

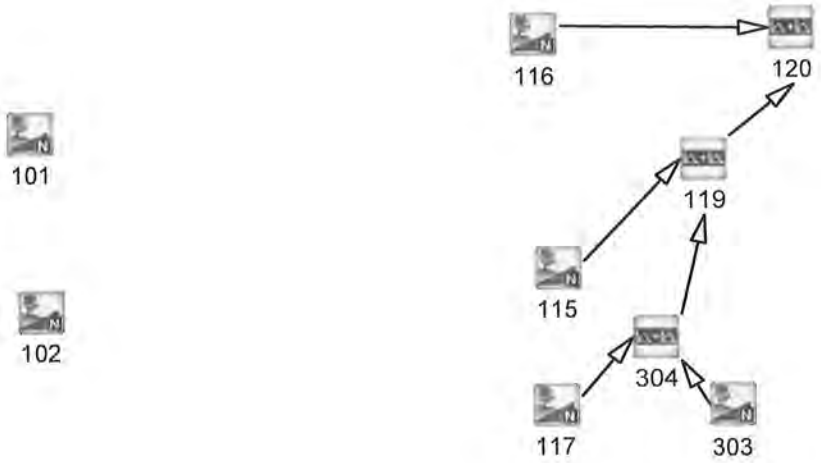
Initial Abstraction	5.95 mm

Runoff Coefficient	0.23

Wetlands	12
Woods	10
Meadows	8
Cultivated	7
Lawns	5
Impervious	2

Landuse Type	Soil Series				
	tisl	0	0	0	0
	1	#N/A	#N/A	#N/A	#N/A
Forest/Woodland	0.08	#N/A	#N/A	#N/A	#N/A
Cultivated	0.22	#N/A	#N/A	#N/A	#N/A
Pasture/Lawn	0.1	#N/A	#N/A	#N/A	#N/A
Impervious	0.95	#N/A	#N/A	#N/A	#N/A
Wetland/Lake/SWMF	0.05	#N/A	#N/A	#N/A	#N/A
Meadows	0.09	#N/A	#N/A	#N/A	#N/A
Soil Series Total	0.227	#N/A	#N/A	#N/A	#N/A

CHARLESTON SUBDIVISION
PRE-DEVELOPMENT CONDITIONS



Nashyd		Route Pipe		Duhyd	
Standhyd		Route Channel		Diverthyd	
Addhyd		Route Reservoir			

C.C. TATHAM & ASSOCIATES LTD.
Consulting Engineers

Project:	Charleston Subdivision
File No.:	114056
Subject:	Otthymo Flow Schematic
Date:	Nov-15 **Figure:** 1

```
 V    V   I    SSSSS  U   U    A    L
 V    V   I    SS     U   U   A A   L
  V  V    I     SS    U   U  AAAAA  L
  V  V    I      SS   U   U  A   A  L
   VV     I    SSSSS  UUUUU  A   A  LLLLL

  OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO
 O   O    T      T    H   H   Y Y   MM MM  O   O
 O   O    T      T    H   H    Y    M M M  O   O
  OOO     T      T    H   H    Y    M   M   OOO
```


***** S U M M A R Y O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 2.3.2\voin.dat
Output filename: I:\2014PR-1\114056-1\Design\STORMW-1\1SWMPO-2\VO2\CHARLE~1\114056-1\CHI Pre-Development.out
Summary filename: I:\2014PR-1\114056-1\Design\STORMW-1\1SWMPO-2\VO2\CHARLE~1\114056-1\CHI Pre-Development.sum

DATE: 10/06/2016 TIME: 9:01:59 AM

USER:

COMMENTS: _____

****
** SIMULATION NUMBER: 1 **
****

W/E	COMMAND	HYD ID	DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs								
	READ STORM		6.0						
	[Ptot= 33.75 mm]								
	fname : I:\2014 Projects\114056 - Charleston Subdivision (Poplar & High)\Design\Stormwater Management\1 SWM								
	remark: OWEN SOUND 2 YEAR 4 HOUR DURATION CHICAGO STORM								
*									
**	CALIB NASHYD (CN=62.4) [N = 3.0:Tp .36]	0102	1 5.0	5.05	.05	2.33	3.98	.12	.000
*									
**	CALIB NASHYD (CN=62.4) [N = 3.0:Tp .80]	0101	1 5.0	9.55	.05	2.92	3.98	.12	.000
*									
**	CALIB NASHYD (CN=51.6) [N = 3.0:Tp .94]	0303	1 5.0	15.90	.05	3.08	2.72	.08	.000
*									
**	CALIB NASHYD (CN=63.2) [N = 3.0:Tp .43]	0117	1 5.0	5.51	.05	2.42	4.16	.12	.000
*									
**	CALIB NASHYD (CN=63.0) [N = 3.0:Tp .68]	0115	1 5.0	9.13	.06	2.75	4.10	.12	.000
*									
**	CALIB NASHYD (CN=62.4) [N = 3.0:Tp .55]	0116	1 5.0	6.16	.04	2.58	3.85	.12	.000
*									
	ADD [0303 + 0117]	0304	3 5.0	21.41	.09	2.67	3.09	n/a	.000
*									
	ADD [0304 + 0115]	0119	3 5.0	30.54	.15	2.67	3.39	n/a	.000
*									
	ADD [0119 + 0116]	0120	3 5.0	36.70	.19	2.67	3.49	n/a	.000
*									

****
** SIMULATION NUMBER: 2 **
****

W/E	COMMAND	HYD ID	DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs								
	READ STORM		6.0						
	[Ptot= 44.07 mm]								
	fname : I:\2014 Projects\114056 - Charleston Subdivision (Poplar & High)\Design\Stormwater Management\1 SWM								
	remark: OWEN SOUND 5 YEAR 4 HOUR DURATION CHICAGO STORM								
*									
**	CALIB NASHYD (CN=62.4) [N = 3.0:Tp .36]	0102	1 5.0	5.05	.09	2.33	7.23	.16	.000
*									
**	CALIB NASHYD (CN=62.4) [N = 3.0:Tp .80]	0101	1 5.0	9.55	.10	2.83	7.23	.16	.000
*									
**	CALIB NASHYD (CN=51.6) [N = 3.0:Tp .94]	0303	1 5.0	15.90	.10	3.08	5.02	.11	.000
*									
**	CALIB NASHYD (CN=63.2) [N = 3.0:Tp .43]	0117	1 5.0	5.51	.09	2.42	7.51	.17	.000
*									
**	CALIB NASHYD (CN=63.0) [N = 3.0:Tp .68]	0115	1 5.0	9.13	.11	2.75	7.42	.17	.000
*									
**	CALIB NASHYD (CN=62.4) [N = 3.0:Tp .55]	0116	1 5.0	6.16	.08	2.58	7.23	.16	.000
*									
	ADD [0303 + 0117]	0304	3 5.0	21.41	.16	2.67	5.66	n/a	.000
*									
	ADD [0304 + 0115]	0119	3 5.0	30.54	.27	2.67	6.19	n/a	.000
*									
	ADD [0119 + 0116]	0120	3 5.0	36.70	.35	2.67	6.36	n/a	.000
*									

****
** SIMULATION NUMBER: 3 **
****

W/E	COMMAND	HYD ID	DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs								
	READ STORM		6.0						
	[Ptot= 50.59 mm]								
	fname : I:\2014 Projects\114056 - Charleston Subdivision (Poplar & High)\Design\Stormwater Management\1 SWM								
	remark: OWEN SOUND 10 YEAR 4 HOUR DURATION CHICAGO STORM								
*									
**	CALIB NASHYD (CN=62.4) [N = 3.0:Tp .36]	0102	1 5.0	5.05	.12	2.33	9.66	.19	.000
*									
**	CALIB NASHYD (CN=62.4) [N = 3.0:Tp .80]	0101	1 5.0	9.55	.13	2.83	9.66	.19	.000
*									
**	CALIB NASHYD (CN=51.6) [N = 3.0:Tp .94]	0303	1 5.0	15.90	.13	3.00	6.77	.13	.000
*									
**	CALIB NASHYD (CN=63.2) [N = 3.0:Tp .43]	0117	1 5.0	5.51	.12	2.42	10.01	.20	.000
*									
**	CALIB NASHYD (CN=63.0) [N = 3.0:Tp .68]	0115	1 5.0	9.13	.15	2.67	9.91	.20	.000
*									
**	CALIB NASHYD (CN=62.4) [N = 3.0:Tp .55]	0116	1 5.0	6.16	.11	2.50	9.66	.19	.000
*									
	ADD [0303 + 0117]	0304	3 5.0	21.41	.23	2.58	7.60	n/a	.000
*									
	ADD [0304 + 0115]	0119	3 5.0	30.54	.37	2.67	8.29	n/a	.000
*									
	ADD [0119 + 0116]	0120	3 5.0	36.70	.48	2.58	8.52	n/a	.000
*									

****
** SIMULATION NUMBER: 4 **
****

```
W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha     cms   hrs     mm          cms

    START @   .00 hrs
    --------------------
    READ STORM                    6.0
    [ Ptot= 59.08 mm ]
    fname : I:\2014 Projects\114056 - Charleston Subdivision (Poplar & High)\Design\Stormwater Management\1 SWM
    remark: OWEN SOUND 25 YEAR 4 HOUR DURATION CHICAGO STORM
*
 **  CALIB NASHYD      0102  1  5.0    5.05     .17  2.33  13.22  .22    .000
     [CN=62.4       ]
     [ N = 3.0:Tp  .36]
*
 **  CALIB NASHYD      0101  1  5.0    9.55     .18  2.83  13.22  .22    .000
     [CN=62.4       ]
     [ N = 3.0:Tp  .80]
*
 **  CALIB NASHYD      0303  1  5.0   15.90     .19  3.00   9.37  .16    .000
     [CN=51.6       ]
     [ N = 3.0:Tp  .94]
*
 **  CALIB NASHYD      0117  1  5.0    5.51     .17  2.42  13.66  .23    .000
     [CN=63.2       ]
     [ N = 3.0:Tp  .43]
*
 **  CALIB NASHYD      0115  1  5.0    9.13     .20  2.67  13.53  .23    .000
     [CN=63.0       ]
     [ N = 3.0:Tp  .68]
*
 **  CALIB NASHYD      0116  1  5.0    6.16     .16  2.50  13.22  .22    .000
     [CN=62.4       ]
     [ N = 3.0:Tp  .55]
*
     ADD [0303 + 0117] 0304  3  5.0   21.41     .31  2.58  10.48  n/a    .000
*
     ADD [0304 + 0115] 0119  3  5.0   30.54     .51  2.67  11.39  n/a    .000
*
     ADD [0119 + 0116] 0120  3  5.0   36.70     .67  2.58  11.70  n/a    .000
*
    ****************************
    ** SIMULATION NUMBER:   5 **
    ****************************

W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha     cms   hrs     mm          cms

    START @   .00 hrs
    --------------------
    READ STORM                    6.0
    [ Ptot= 65.65 mm ]
    fname : I:\2014 Projects\114056 - Charleston Subdivision (Poplar & High)\Design\Stormwater Management\1 SWM
    remark: OWEN SOUND 50 YEAR 4 HOUR DURATION CHICAGO STORM
*
 **  CALIB NASHYD      0102  1  5.0    5.05     .21  2.33  16.25  .25    .000
     [CN=62.4       ]
     [ N = 3.0:Tp  .36]
*
 **  CALIB NASHYD      0101  1  5.0    9.55     .23  2.83  16.25  .25    .000
     [CN=62.4       ]
     [ N = 3.0:Tp  .80]
*
 **  CALIB NASHYD      0303  1  5.0   15.90     .24  3.00  11.62  .18    .000
     [CN=51.6       ]
     [ N = 3.0:Tp  .94]
*
 **  CALIB NASHYD      0117  1  5.0    5.51     .21  2.42  16.76  .26    .000
     [CN=63.2       ]
     [ N = 3.0:Tp  .43]
*
 **  CALIB NASHYD      0115  1  5.0    9.13     .25  2.67  16.61  .25    .000
     [CN=63.0       ]
     [ N = 3.0:Tp  .68]
*
 **  CALIB NASHYD      0116  1  5.0    6.16     .19  2.50  16.25  .25    .000
     [CN=62.4       ]
     [ N = 3.0:Tp  .55]
*
     ADD [0303 + 0117] 0304  3  5.0   21.41     .39  2.58  12.95  n/a    .000
*
     ADD [0304 + 0115] 0119  3  5.0   30.54     .64  2.67  14.04  n/a    .000
*
     ADD [0119 + 0116] 0120  3  5.0   36.70     .83  2.58  14.41  n/a    .000
*
    ****************************
    ** SIMULATION NUMBER:   6 **
    ****************************

W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha     cms   hrs     mm          cms

    START @   .00 hrs
    --------------------
    READ STORM                    6.0
    [ Ptot= 71.77 mm ]
    fname : I:\2014 Projects\114056 - Charleston Subdivision (Poplar & High)\Design\Stormwater Management\1 SWM
    remark: OWEN SOUND 100 YEAR 4 HOUR DURATION CHICAGO STORM
*
 **  CALIB NASHYD      0102  1  5.0    5.05     .26  2.25  19.26  .27    .000
     [CN=62.4       ]
     [ N = 3.0:Tp  .36]
*
 **  CALIB NASHYD      0101  1  5.0    9.55     .27  2.83  19.26  .27    .000
     [CN=62.4       ]
     [ N = 3.0:Tp  .80]
*
 **  CALIB NASHYD      0303  1  5.0   15.90     .28  3.00  13.88  .19    .000
     [CN=51.6       ]
     [ N = 3.0:Tp  .94]
*
 **  CALIB NASHYD      0117  1  5.0    5.51     .26  2.33  19.84  .28    .000
     [CN=63.2       ]
     [ N = 3.0:Tp  .43]
*
 **  CALIB NASHYD      0115  1  5.0    9.13     .30  2.67  19.67  .27    .000
     [CN=63.0       ]
     [ N = 3.0:Tp  .68]
*
 **  CALIB NASHYD      0116  1  5.0    6.16     .23  2.50  19.26  .27    .000
     [CN=62.4       ]
     [ N = 3.0:Tp  .55]
*
     ADD [0303 + 0117] 0304  3  5.0   21.41     .47  2.58  15.42  n/a    .000
*
     ADD [0304 + 0115] 0119  3  5.0   30.54     .76  2.67  16.69  n/a    .000
*
     ADD [0119 + 0116] 0120  3  5.0   36.70     .99  2.58  17.12  n/a    .000
*
    ****************************
    ** SIMULATION NUMBER:   7 **
    ****************************

W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha     cms   hrs     mm          cms

    START @   .00 hrs
    --------------------
    READ STORM                   12.0
    [ Ptot=193.00 mm ]
    fname : I:\2014 Projects\114056 - Charleston Subdivision (Poplar & High)\Design\Stormwater Management\1 SWM
    remark: TIMMINS REGIONAL 12 HOUR DURATION STORM
*
 **  CALIB NASHYD      0102  1  5.0    5.05     .35  7.08 102.02  .53    .000
     [CN=62.4       ]
     [ N = 3.0:Tp  .36]
*
 **  CALIB NASHYD      0101  1  5.0    9.55     .51  7.50 102.04  .53    .000
     [CN=62.4       ]
     [ N = 3.0:Tp  .80]
*
 **  CALIB NASHYD      0303  1  5.0   15.90     .62  7.75  81.61  .42    .000
     [CN=51.6       ]
     [ N = 3.0:Tp  .94]
*
 **  CALIB NASHYD      0117  1  5.0    5.51     .37  7.08 103.78  .54    .000
     [CN=63.2       ]
     [ N = 3.0:Tp  .43]
*
 **  CALIB NASHYD      0115  1  5.0    9.13     .53  7.33 103.32  .54    .000
     [CN=63.0       ]
     [ N = 3.0:Tp  .68]
*
 **  CALIB NASHYD      0116  1  5.0    6.16     .38  7.25 102.03  .53    .000
     [CN=62.4       ]
     [ N = 3.0:Tp  .55]
*
     ADD [0303 + 0117] 0304  3  5.0   21.41     .92  7.33  87.32  n/a    .000
*
     ADD [0304 + 0115] 0119  3  5.0   30.54    1.45  7.33  92.10  n/a    .000
```

```
*
     ADD (0119 + 0116)  0120  3  5.0   36.70    1.83  7.33  93.77  n/a    .000
*
  ****************************
  ** SIMULATION NUMBER:   8 **
  ****************************

  W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                    min     ha     cms   hrs     mm          cms

     START @   .00 hrs
     ---------------------
     READ STORM                    6.0
     | Ptot= 24.97 mm |
     fname : I:\2014 Projects\114056 - Charleston Subdivision (Poplar & High)\Design\Stormwater Management\1 SWM
     remark: OWEN SOUND 25 mm (from a 2 year-4hr storm)
*
  **  CALIB NASHYD       0102  1  5.0    5.05     .02  2.33   1.89  .08    .000
     (CN=62.4          )
     | N = 3.0:Tp  .36|
*
  **  CALIB NASHYD       0101  1  5.0    9.55     .02  2.92   1.89  .08    .000
     (CN=62.4          )
     | N = 3.0:Tp  .80|
*
  **  CALIB NASHYD       0303  1  5.0   15.90     .02  3.17   1.27  .05    .000
     (CN=51.6          )
     | N = 3.0:Tp  .94|
*
  **  CALIB NASHYD       0117  1  5.0    5.51     .02  2.42   1.99  .08    .000
     (CN=63.2          )
     | N = 3.0:Tp  .43|
*
  **  CALIB NASHYD       0115  1  5.0    9.13     .03  2.75   1.96  .08    .000
     (CN=63.0          )
     | N = 3.0:Tp  .68|
*
  **  CALIB NASHYD       0116  1  5.0    6.16     .02  2.58   1.89  .08    .000
     (CN=62.4          )
     | N = 3.0:Tp  .55|
*
     ADD (0303 + 0117)  0304  3  5.0   21.41     .04  2.67   1.46  n/a    .000
*
     ADD (0304 + 0115)  0119  3  5.0   30.54     .07  2.75   1.61  n/a    .000
*
     ADD (0119 + 0116)  0120  3  5.0   36.70     .09  2.67   1.66  n/a    .000
*
  FINISH
```

```
 V    V   I    SSSSS  U   U    A    L
 V    V   I   SS      U   U   A A   L
  V  V    I    SS     U   U  AAAAA  L
  V  V    I     SS    U   U  A   A  L
   VV     I   SSSSS   UUUUU  A   A  LLLLL

  OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO
 O   O    T      T    H   H   Y Y   MM MM  O   O
 O   O    T      T    H   H    Y    M M M  O   O
  OOO     T      T    H   H    Y    M   M   OOO
```


***** S U M M A R Y O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 2.3.2\voin.dat
Output filename: I:\2014PR-1\114056-1\Design\STORMW~1\1SWMPO~2\VO2\CHARLE~1\114056~1\SCS Pre-Development.out
Summary filename: I:\2014PR-1\114056-1\Design\STORMW~1\1SWMPO~2\VO2\CHARLE~1\114056~1\SCS Pre-Development.sum

DATE: 10/06/2016 TIME: 9:04:06 AM

USER:

COMMENTS: _____

** SIMULATION NUMBER: 1 **

W/E	COMMAND	HYD	ID	DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs									
	MASS STORM			20.0						
	[Ptot= 52.40 mm]									
**	CALIB NASHYD [CN=62.4] [N = 3.0:Tp .36]	0102	1	5.0	5.05	.06	12.25	10.38	.20	.000
**	CALIB NASHYD [CN=62.4] [N = 3.0:Tp .80]	0101	1	5.0	9.55	.07	12.92	10.39	.20	.000
**	CALIB NASHYD [CN=62.4] [N = 3.0:Tp .55]	0116	1	5.0	6.16	.06	12.50	10.39	.20	.000
**	CALIB NASHYD [CN=63.0] [N = 3.0:Tp .68]	0115	1	5.0	9.13	.08	12.75	10.64	.20	.000
**	CALIB NASHYD [CN=63.2] [N = 3.0:Tp .43]	0117	1	5.0	5.51	.06	12.33	10.76	.21	.000
**	CALIB NASHYD [CN=51.6] [N = 3.0:Tp .94]	0303	1	5.0	15.90	.08	13.08	7.30	.14	.000
	ADD [0117 + 0303]	0304	3	5.0	21.41	.12	12.75	8.19	n/a	.000
	ADD [0115 + 0304]	0119	3	5.0	30.54	.21	12.75	8.92	n/a	.000
	ADD [0116 + 0119]	0120	3	5.0	36.70	.26	12.67	9.17	n/a	.000

** SIMULATION NUMBER: 2 **

W/E	COMMAND	HYD	ID	DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs									
	MASS STORM			20.0						
	[Ptot= 70.60 mm]									
**	CALIB NASHYD [CN=62.4] [N = 3.0:Tp .36]	0102	1	5.0	5.05	.11	12.25	18.67	.26	.000
**	CALIB NASHYD [CN=62.4] [N = 3.0:Tp .80]	0101	1	5.0	9.55	.14	12.83	18.67	.26	.000
**	CALIB NASHYD [CN=62.4] [N = 3.0:Tp .55]	0116	1	5.0	6.16	.11	12.50	18.67	.26	.000
**	CALIB NASHYD [CN=63.0] [N = 3.0:Tp .68]	0115	1	5.0	9.13	.15	12.67	19.07	.27	.000
**	CALIB NASHYD [CN=63.2] [N = 3.0:Tp .43]	0117	1	5.0	5.51	.11	12.33	19.24	.27	.000
**	CALIB NASHYD [CN=51.6] [N = 3.0:Tp .94]	0303	1	5.0	15.90	.15	13.08	13.44	.19	.000
	ADD [0117 + 0303]	0304	3	5.0	21.41	.23	12.67	16.93	n/a	.000
	ADD [0115 + 0304]	0119	3	5.0	30.54	.38	12.67	16.17	n/a	.000
	ADD [0116 + 0119]	0120	3	5.0	36.70	.49	12.67	16.59	n/a	.000

** SIMULATION NUMBER: 3 **

W/E	COMMAND	HYD	ID	DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs									
	MASS STORM			20.0						
	[Ptot= 82.70 mm]									
**	CALIB NASHYD [CN=62.4] [N = 3.0:Tp .36]	0102	1	5.0	5.05	.15	12.25	25.05	.30	.000
**	CALIB NASHYD [CN=62.4] [N = 3.0:Tp .80]	0101	1	5.0	9.55	.19	12.83	25.05	.30	.000
**	CALIB NASHYD [CN=62.4] [N = 3.0:Tp .55]	0116	1	5.0	6.16	.15	12.50	25.05	.30	.000
**	CALIB NASHYD [CN=63.0] [N = 3.0:Tp .68]	0115	1	5.0	9.13	.20	12.67	25.55	.31	.000
**	CALIB NASHYD [CN=63.2] [N = 3.0:Tp .43]	0117	1	5.0	5.51	.15	12.33	25.75	.31	.000
**	CALIB NASHYD [CN=51.6] [N = 3.0:Tp .94]	0303	1	5.0	15.90	.20	13.08	18.30	.22	.000
	ADD [0117 + 0303]	0304	3	5.0	21.41	.32	12.67	20.21	n/a	.000
	ADD [0115 + 0304]	0119	3	5.0	30.54	.52	12.67	21.81	n/a	.000
	ADD [0116 + 0119]	0120	3	5.0	36.70	.66	12.67	22.35	n/a	.000

** SIMULATION NUMBER: 4 **

W/E	COMMAND	HYD	ID	DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs									

```
     MASS STORM                    20.0
     [ Ptot= 98.50 mm ]
*
  **  CALIB NASHYD       0102  1  5.0    5.05     .21 12.25  34.23  .35    .000
      [CN=62.4       ]
      [ N = 3.0:Tp  .36]
*
  **  CALIB NASHYD       0101  1  5.0    9.55     .26 12.83  34.23  .35    .000
      [CN=62.4       ]
      [ N = 3.0:Tp  .80]
*
  **  CALIB NASHYD       0116  1  5.0    6.16     .20 12.50  34.23  .35    .000
      [CN=62.4       ]
      [ N = 3.0:Tp  .55]
*
  **  CALIB NASHYD       0115  1  5.0    9.13     .28 12.67  34.86  .35    .000
      [CN=63.0       ]
      [ N = 3.0:Tp  .68]
*
  **  CALIB NASHYD       0117  1  5.0    5.51     .21 12.33  35.11  .36    .000
      [CN=63.2       ]
      [ N = 3.0:Tp  .43]
*
  **  CALIB NASHYD       0303  1  5.0   15.90     .28 13.00  25.44  .26    .000
      [CN=51.6       ]
      [ N = 3.0:Tp  .94]
*
      ADD [0117 + 0303]  0304  3  5.0   21.41     .44 12.67  27.93  n/a    .000
*
      ADD [0115 + 0304]  0119  3  5.0   30.54     .72 12.67  30.00  n/a    .000
*
      ADD [0116 + 0119]  0120  3  5.0   36.70     .92 12.58  30.71  n/a    .000
*
  ****************************
  ** SIMULATION NUMBER:   5 **
  ****************************

  W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                    min     ha     cms   hrs     mm         cms

      START @   .00 hrs
      ------------------
      MASS STORM                   20.0
      [ Ptot=108.70 mm ]
*
  **  CALIB NASHYD       0102  1  5.0    5.05     .25 12.25  40.59  .37    .000
      [CN=62.4       ]
      [ N = 3.0:Tp  .36]
*
  **  CALIB NASHYD       0101  1  5.0    9.55     .31 12.83  40.60  .37    .000
      [CN=62.4       ]
      [ N = 3.0:Tp  .80]
*
  **  CALIB NASHYD       0116  1  5.0    6.16     .24 12.50  40.60  .37    .000
      [CN=62.4       ]
      [ N = 3.0:Tp  .55]
*
  **  CALIB NASHYD       0115  1  5.0    9.13     .33 12.67  41.31  .38    .000
      [CN=63.0       ]
      [ N = 3.0:Tp  .68]
*
  **  CALIB NASHYD       0117  1  5.0    5.51     .25 12.33  41.58  .38    .000
      [CN=63.2       ]
      [ N = 3.0:Tp  .43]
*
  **  CALIB NASHYD       0303  1  5.0   15.90     .34 13.00  30.48  .28    .000
      [CN=51.6       ]
      [ N = 3.0:Tp  .94]
*
      ADD [0117 + 0303]  0304  3  5.0   21.41     .53 12.67  33.33  n/a    .000
*
      ADD [0115 + 0304]  0119  3  5.0   30.54     .86 12.67  35.72  n/a    .000
*
      ADD [0116 + 0119]  0120  3  5.0   36.70    1.10 12.58  36.54  n/a    .000
*
  ****************************
  ** SIMULATION NUMBER:   6 **
  ****************************

  W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                    min     ha     cms   hrs     mm         cms

      START @   .00 hrs
      ------------------
      MASS STORM                   20.0
      [ Ptot=120.10 mm ]
*
  **  CALIB NASHYD       0102  1  5.0    5.05     .30 12.25  48.05  .40    .000
      [CN=62.4       ]
      [ N = 3.0:Tp  .36]
*
  **  CALIB NASHYD       0101  1  5.0    9.55     .37 12.83  48.06  .40    .000
      [CN=62.4       ]
      [ N = 3.0:Tp  .80]
*
  **  CALIB NASHYD       0116  1  5.0    6.16     .29 12.50  48.06  .40    .000
      [CN=62.4       ]
      [ N = 3.0:Tp  .55]
*
  **  CALIB NASHYD       0115  1  5.0    9.13     .39 12.67  48.86  .41    .000
      [CN=63.0       ]
      [ N = 3.0:Tp  .68]
*
  **  CALIB NASHYD       0117  1  5.0    5.51     .30 12.33  49.16  .41    .000
      [CN=63.2       ]
      [ N = 3.0:Tp  .43]
*
  **  CALIB NASHYD       0303  1  5.0   15.90     .41 13.00  36.46  .30    .000
      [CN=51.6       ]
      [ N = 3.0:Tp  .94]
*
      ADD [0117 + 0303]  0304  3  5.0   21.41     .64 12.67  39.73  n/a    .000
*
      ADD [0115 + 0304]  0119  3  5.0   30.54    1.03 12.67  42.46  n/a    .000
*
      ADD [0116 + 0119]  0120  3  5.0   36.70    1.31 12.58  43.40  n/a    .000
*
 FINISH
 ================================================================================
```

APPENDIX B:
PROPOSED HYDROLOGIC CONDITIONS

Project:	Charleston Subdivision
File No.:	114056
Date:	12-Nov-15
Designed By:	NHF
Checked By:	AW
Subject:	CN Calculator

C.C. Tatham & Associates Ltd.
Consulting Engineers

Collingwood Bracebridge Orillia Barrie

CURVE NUMBER, INITIAL ABSTRACTION & TIME TO PEAK CALCULATIONS

CONDITIONS

Catchment 301 **Area** 0.53 ha

WEIGHTED CN VALUE																									
Soil Series	Soil Series	Hydrologic Soil Group	Soil Texture	Runoff Coefficient	Catchment Soil Characteristics		Forest/Woodland			Pasture/Lawns			Meadows			Cultivated			Impervious			Wetland/Lakes/SWMF			Average CN for Soil Type
				Type	Area	Percent	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	Area	Percent	CN	
tisl	TIOGA	A	Sand Loam	1	0.53	1	0		32	0		49	0		38	0.488	0.92	62	0.042	0.08	100	0		50	65.04
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
	#N/A	#N/A	#N/A	#N/A	0		0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0		#N/A	0
				Totals	0.53	1	0	0		0	0		0	0		0.4876	0.92		0.0424	0.08		0	0		65.0

Time of Concentration Calculations

For Runoff Coefficients greater than 0.4

Bransby-Williams Formula

Maximum Catchment Elevation	209.25	m
Minimum Catchment Elevation	207.56	m
Catchment length	220	m
Catchment Slope	1%	
Catchment Area	0.53	ha
Time of Concentration (Minutes)	14.09	
Time of Concentration (Hours)	0.23	
Time to Peak (2/3 x Time of Concentration)	0.16	

For Runoff Coefficients less than 0.4

Airport Method

Maximum Catchment Elevation	209.25	m
Minimum Catchment Elevation	207.56	m
Catchment length	220	m
Catchment Slope	1%	
Catchment Area	0.53	ha
Time of Concentration (Minutes)	43.34	
Time of Concentration (Hours)	0.72	
Time to Peak (2/3 x Time of Concentration)	0.48	

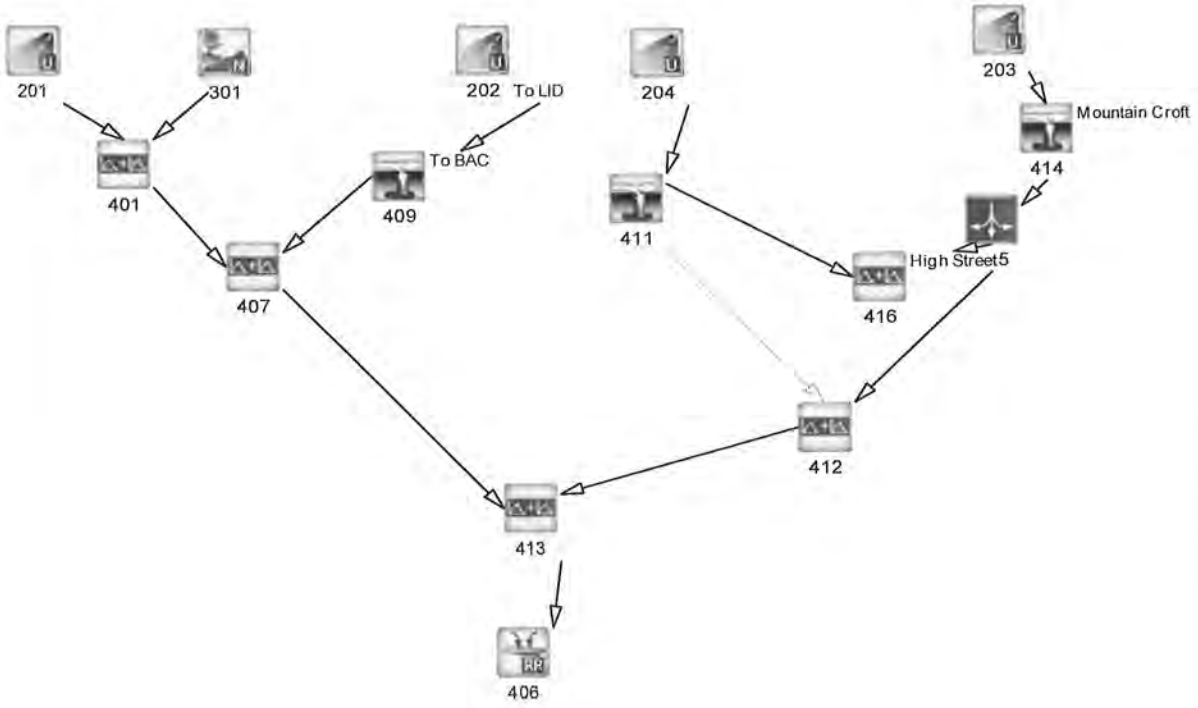
Time to Peak	0.48 hrs

Initial Abstraction	6.6 mm
Runoff Coefficient	0.28

Wetlands	12
Woods	10
Meadows	8
Cultivated	7
Lawns	5
Impervious	2

Landuse Type	Soil Series				
	tisl	0	0	0	0
	1	#N/A	#N/A	#N/A	#N/A
Forest/Woodland	0.08	#N/A	#N/A	#N/A	#N/A
Cultivated	0.22	#N/A	#N/A	#N/A	#N/A
Pasture/Lawn	0.1	#N/A	#N/A	#N/A	#N/A
Impervious	0.95	#N/A	#N/A	#N/A	#N/A
Wetland/Lake/SWMF	0.05	#N/A	#N/A	#N/A	#N/A
Meadows	0.09	#N/A	#N/A	#N/A	#N/A
Soil Series Total	0.278	#N/A	#N/A	#N/A	#N/A

CHARLESTON SUBDIVISION
PROPOSED CONDITIONS



Nashyd		Route Pipe		Duhyd	
Standhyd		Route Channel		Diverthyd	
Addhyd		Route Reservoir			

C.C. TATHAM & ASSOCIATES LTD.
Consulting Engineers

Project:	Charleston Subdivision
File No.:	114056
Subject:	Otthymo Flow Schematic
Date:	Nov-15 **Figure:** 2

```
 V    V   I   SSSSS  U   U    A    L
 V    V   I   SS     U   U   A A   L
  V  V    I    SS    U   U  AAAAA  L
  V  V    I     SS   U   U  A   A  L
   VV     I   SSSSS  UUUUU  A   A  LLLLL

  OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO
 O   O    T      T    H   H   Y Y   MM MM  O   O
 O   O    T      T    H   H    Y    M M M  O   O
  OOO     T      T    H   H    Y    M   M   OOO
```

Developed and Distributed by Clarifica Inc.

***** S U M M A R Y O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 2.3.2\voin.dat
Output filename: I:\2014PR-1\114056-1\Design\STORMW-1\1SWMPO-2\VO2\CHARLE-1\114056-1\SCS Detailed Model.out
Summary filename: I:\2014PR-1\114056-1\Design\STORMW-1\1SWMPO-2\VO2\CHARLE-1\114056-1\SCS Detailed Model.sum

DATE: 10/06/2016 TIME: 12:58:16 PM

USER:

COMMENTS: _____

****
** SIMULATION NUMBER: 1 **
****

W/E	COMMAND	HYD	ID	DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs									
	MASS STORM			20.0						
	[Ptot= 52.40 mm]									
*	CALIB STANDHYD	0204	1	5.0	.92	.04	12.00	30.17	.58	.000
	[I%=52.0:S%= 2.00]									
*	CALIB STANDHYD	0203	1	5.0	.86	.04	12.00	30.17	.58	.000
	[I%=52.0:S%= 2.00]									
*	CALIB STANDHYD	0201	1	5.0	21.57	.91	12.00	29.30	.56	.000
	[I%=50.0:S%= 2.00]									
*	CALIB NASHYD	0301	1	5.0	.53	.01	12.42	11.49	.22	.000
	[CN=65.0]									
	[N = 3.0:Tp .48]									
*	CALIB STANDHYD	0202	1	5.0	2.10	.10	12.00	30.18	.58	.000
	[I%=52.0:S%= 2.00]									
	DUHYD	0411	1	5.0	.92	.04	12.00	30.17	n/a	.000
	MAJOR SYSTEM:	0411	2	5.0	.00	.00	.00	.00	n/a	.000
	MINOR SYSTEM:	0411	3	5.0	.92	.04	12.00	30.17	n/a	.000
	DUHYD	0414	1	5.0	.86	.04	12.00	30.17	n/a	.000
	MAJOR SYSTEM:	0414	2	5.0	.00	.00	.00	.00	n/a	.000
	MINOR SYSTEM:	0414	3	5.0	.86	.04	12.00	30.17	n/a	.000
	ADD [0201 + 0301]	0401	3	5.0	22.10	.91	12.00	28.88	n/a	.000
	DUHYD	0409	1	5.0	2.10	.10	12.00	30.18	n/a	.000
	MAJOR SYSTEM:	0409	2	5.0	.00	.00	.00	.00	n/a	.000
	MINOR SYSTEM:	0409	3	5.0	2.10	.10	12.00	30.18	n/a	.000
	DIVERT HYD	0415	1	5.0	.00	.00	.00	.00	n/a	.000
	Outflow	0415	2	5.0	1#IND..	.00	.00	1#IND.	n/a	.000
	Outflow	0415	3	5.0	1#IND..	.00	.00	1#IND.	n/a	.000
	ADD [0401 + 0409]	0407	3	5.0	22.10	.91	12.00	28.88	n/a	.000
	ADD [0411 + 0415]	0412	3	5.0	1#IND..	.04	12.00	1#IND.	n/a	.000
	ADD [0411 + 0415]	0416	3	.0	.00	.00	.00	1#IND.	n/a	.000
	ADD [0412 + 0407]	0413	3	5.0	1#IND..	.96	12.00	1#IND.	n/a	.000
	RESRVR [2 : 0413]	0406	1	5.0	1#IND..	.10	14.42	1#IND.	n/a	.000
	(ST= .42 ha.m)									

****
** SIMULATION NUMBER: 2 **
****

W/E	COMMAND	HYD	ID	DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs									
	MASS STORM			20.0						
	[Ptot= 70.60 mm]									
*	CALIB STANDHYD	0204	1	5.0	.92	.06	12.00	42.44	.60	.000
	[I%=52.0:S%= 2.00]									
*	CALIB STANDHYD	0203	1	5.0	.86	.06	12.00	42.44	.60	.000
	[I%=52.0:S%= 2.00]									
*	CALIB STANDHYD	0201	1	5.0	21.57	1.29	12.00	41.32	.59	.000
	[I%=50.0:S%= 2.00]									
*	CALIB NASHYD	0301	1	5.0	.53	.01	12.42	20.40	.29	.000
	[CN=65.0]									
	[N = 3.0:Tp .48]									
*	CALIB STANDHYD	0202	1	5.0	2.10	.14	12.00	42.45	.60	.000
	[I%=52.0:S%= 2.00]									
	DUHYD	0411	1	5.0	.92	.06	12.00	42.44	n/a	.000
	MAJOR SYSTEM:	0411	2	5.0	.00	.00	.00	.00	n/a	.000
	MINOR SYSTEM:	0411	3	5.0	.92	.06	12.00	42.44	n/a	.000
	DUHYD	0414	1	5.0	.86	.06	12.00	42.44	n/a	.000
	MAJOR SYSTEM:	0414	2	5.0	.00	.00	.00	.00	n/a	.000
	MINOR SYSTEM:	0414	3	5.0	.86	.06	12.00	42.44	n/a	.000
	ADD [0201 + 0301]	0401	3	5.0	22.10	1.30	12.00	40.82	n/a	.000
	DUHYD	0409	1	5.0	2.10	.14	12.00	42.45	n/a	.000
	MAJOR SYSTEM:	0409	2	5.0	.00	.00	.00	.00	n/a	.000
	MINOR SYSTEM:	0409	3	5.0	2.10	.14	12.00	42.45	n/a	.000
	DIVERT HYD	0415	1	5.0	.00	.00	.00	.00	n/a	.000
	Outflow	0415	2	5.0	1#IND..	.00	.00	1#IND.	n/a	.000
	Outflow	0415	3	5.0	1#IND..	.00	.00	1#IND.	n/a	.000
	ADD [0401 + 0409]	0407	3	5.0	22.10	1.30	12.00	40.82	n/a	.000
	ADD [0411 + 0415]	0412	3	5.0	1#IND..	.06	12.00	1#IND.	n/a	.000
	ADD [0411 + 0415]	0416	3	.0	.00	.00	.00	1#IND.	n/a	.000
	ADD [0412 + 0407]	0413	3	5.0	1#IND..	1.36	12.00	1#IND.	n/a	.000
	RESRVR [2 : 0413]	0406	1	5.0	1#IND..	.29	13.08	1#IND.	n/a	.000
	(ST= .50 ha.m)									

****
** SIMULATION NUMBER: 3 **
****

W/E	COMMAND	HYD	ID	DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs									
	MASS STORM			20.0						
	[Ptot= 82.70 mm]									
*	CALIB STANDHYD	0204	1	5.0	.92	.07	12.00	50.94	.62	.000
	[I%=52.0:S%= 2.00]									
*	CALIB STANDHYD	0203	1	5.0	.86	.07	12.00	50.94	.62	.000
	[I%=52.0:S%= 2.00]									
*	CALIB STANDHYD	0201	1	5.0	21.57	1.57	12.00	49.67	.60	.000
	[I%=50.0:S%= 2.00]									

```
*  CALIB NASHYD      0301  1  5.0     .53     .01 12.42  27.20  .33    .000
   (CN=65.0       )
   ( N = 3.0:Tp  .48)
*
*  CALIB STANDHYD    0202  1  5.0    2.10     .17 12.00  50.95  .62    .000
   (I%=52.0:S%= 2.00)
*
   DUHYD             0411  1  5.0     .92     .07 12.00  50.94  n/a    .000
      MAJOR SYSTEM:  0411  2  5.0     .00     .00   .00    .00  n/a    .000
      MINOR SYSTEM:  0411  3  5.0     .92     .07 12.00  50.94  n/a    .000
*
   DUHYD             0414  1  5.0     .86     .07 12.00  50.94  n/a    .000
      MAJOR SYSTEM:  0414  2  5.0     .00     .00   .00    .00  n/a    .000
      MINOR SYSTEM:  0414  3  5.0     .86     .07 12.00  50.94  n/a    .000
*
   ADD [0201 + 0301] 0401  3  5.0   22.10    1.58 12.00  49.14  n/a    .000
*
   DUHYD             0409  1  5.0    2.10     .17 12.00  50.95  n/a    .000
      MAJOR SYSTEM:  0409  2  5.0     .00     .00   .00    .00  n/a    .000
      MINOR SYSTEM:  0409  3  5.0    2.10     .17 12.00  50.95  n/a    .000
*
   DIVERT HYD        0415  1  5.0     .00     .00   .00    .00  n/a    .000
      Outflow        0415  2  5.0 1#IND..     .00   .00 1#IND.  n/a    .000
      Outflow        0415  3  5.0 1#IND..     .00   .00 1#IND.  n/a    .000
*
   ADD [0401 + 0409] 0407  3  5.0   22.10    1.58 12.00  49.14  n/a    .000
*
   ADD [0411 + 0415] 0412  3  5.0 1#IND..     .07 12.00 1#IND.  n/a    .000
*
   ADD [0411 + 0415] 0416  3   .0     .00     .00   .00 1#IND.  n/a    .000
*
   ADD [0412 + 0407] 0413  3  5.0 1#IND..    1.66 12.00 1#IND.  n/a    .000
*
   RESRVR [ 2 : 0413] 0406  1  5.0 1#IND..     .39 13.00 1#IND.  n/a    .000
   (ST=   .57 ha.m )
*
*****************************
** SIMULATION NUMBER:   4 **
*****************************

W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha    cms   hrs     mm         cms

   START @   .00 hrs
   --------------------
   MASS STORM                20.0
   ( Ptot= 98.50 mm )
*
*  CALIB STANDHYD    0204  1  5.0     .92     .09 12.00  62.41  .63    .000
   (I%=52.0:S%= 2.00)
*
*  CALIB STANDHYD    0203  1  5.0     .86     .08 12.00  62.41  .63    .000
   (I%=52.0:S%= 2.00)
*
*  CALIB STANDHYD    0201  1  5.0   21.57    1.96 12.00  60.96  .62    .000
   (I%=50.0:S%= 2.00)
*
*  CALIB NASHYD      0301  1  5.0     .53     .02 12.42  36.93  .37    .000
   (CN=65.0       )
   ( N = 3.0:Tp  .48)
*
*  CALIB STANDHYD    0202  1  5.0    2.10     .21 12.00  62.42  .63    .000
   (I%=52.0:S%= 2.00)
*
   DUHYD             0411  1  5.0     .92     .09 12.00  62.41  n/a    .000
      MAJOR SYSTEM:  0411  2  5.0     .00     .00   .00    .00  n/a    .000
      MINOR SYSTEM:  0411  3  5.0     .92     .09 12.00  62.41  n/a    .000
*
   DUHYD             0414  1  5.0     .86     .08 12.00  62.41  n/a    .000
      MAJOR SYSTEM:  0414  2  5.0     .00     .00   .00    .00  n/a    .000
      MINOR SYSTEM:  0414  3  5.0     .86     .08 12.00  62.41  n/a    .000
*
   ADD [0201 + 0301] 0401  3  5.0   22.10    1.97 12.00  60.39  n/a    .000
*
   DUHYD             0409  1  5.0    2.10     .21 12.00  62.42  n/a    .000
      MAJOR SYSTEM:  0409  2  5.0     .00     .00   .00    .00  n/a    .000
      MINOR SYSTEM:  0409  3  5.0    2.10     .21 12.00  62.42  n/a    .000
*
   DIVERT HYD        0415  1  5.0     .00     .00   .00    .00  n/a    .000
      Outflow        0415  2  5.0 1#IND..     .00   .00 1#IND.  n/a    .000
      Outflow        0415  3  5.0 1#IND..     .00   .00 1#IND.  n/a    .000
*
   ADD [0401 + 0409] 0407  3  5.0   22.10    1.97 12.00  60.39  n/a    .000
*
   ADD [0411 + 0415] 0412  3  5.0 1#IND..     .09 12.00 1#IND.  n/a    .000
*
   ADD [0411 + 0415] 0416  3   .0     .00     .00   .00 1#IND.  n/a    .000
*
   ADD [0412 + 0407] 0413  3  5.0 1#IND..    2.06 12.00 1#IND.  n/a    .000
*
   RESRVR [ 2 : 0413] 0406  1  5.0 1#IND..     .49 13.00 1#IND.  n/a    .000
   (ST=   .69 ha.m )
*
*****************************
** SIMULATION NUMBER:   5 **
*****************************

W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha    cms   hrs     mm         cms

   START @   .00 hrs
   --------------------
   MASS STORM                20.0
   ( Ptot=108.70 mm )
*
*  CALIB STANDHYD    0204  1  5.0     .92     .10 12.00  70.02  .64    .000
   (I%=52.0:S%= 2.00)
*
*  CALIB STANDHYD    0203  1  5.0     .86     .10 12.00  70.02  .64    .000
   (I%=52.0:S%= 2.00)
*
*  CALIB STANDHYD    0201  1  5.0   21.57    2.20 12.00  68.46  .63    .000
   (I%=50.0:S%= 2.00)
*
*  CALIB NASHYD      0301  1  5.0     .53     .02 12.42  43.64  .40    .000
   (CN=65.0       )
   ( N = 3.0:Tp  .48)
*
*  CALIB STANDHYD    0202  1  5.0    2.10     .23 12.00  70.02  .64    .000
   (I%=52.0:S%= 2.00)
*
   DUHYD             0411  1  5.0     .92     .10 12.00  70.02  n/a    .000
      MAJOR SYSTEM:  0411  2  5.0     .00     .00   .00    .00  n/a    .000
      MINOR SYSTEM:  0411  3  5.0     .92     .10 12.00  70.02  n/a    .000
*
   DUHYD             0414  1  5.0     .86     .10 12.00  70.02  n/a    .000
      MAJOR SYSTEM:  0414  2  5.0     .00     .00   .00    .00  n/a    .000
      MINOR SYSTEM:  0414  3  5.0     .86     .10 12.00  70.02  n/a    .000
*
   ADD [0201 + 0301] 0401  3  5.0   22.10    2.22 12.00  67.86  n/a    .000
*
   DUHYD             0409  1  5.0    2.10     .23 12.00  70.02  n/a    .000
      MAJOR SYSTEM:  0409  2  5.0     .00     .00   .00    .00  n/a    .000
      MINOR SYSTEM:  0409  3  5.0    2.10     .23 12.00  70.02  n/a    .000
*
   DIVERT HYD        0415  1  5.0     .00     .00   .00    .00  n/a    .000
      Outflow        0415  2  5.0 1#IND..     .00   .00 1#IND.  n/a    .000
      Outflow        0415  3  5.0 1#IND..     .00   .00 1#IND.  n/a    .000
*
   ADD [0401 + 0409] 0407  3  5.0   22.10    2.22 12.00  67.86  n/a    .000
*
   ADD [0411 + 0415] 0412  3  5.0 1#IND..     .10 12.00 1#IND.  n/a    .000
*
   ADD [0411 + 0415] 0416  3   .0     .00     .00   .00 1#IND.  n/a    .000
*
   ADD [0412 + 0407] 0413  3  5.0 1#IND..    2.32 12.00 1#IND.  n/a    .000
*
   RESRVR [ 2 : 0413] 0406  1  5.0 1#IND..     .56 13.00 1#IND.  n/a    .000
   (ST=   .77 ha.m )
*
*****************************
** SIMULATION NUMBER:   6 **
*****************************

W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha    cms   hrs     mm         cms

   START @   .00 hrs
   --------------------
   MASS STORM                20.0
   ( Ptot=120.10 mm )
*
*  CALIB STANDHYD    0204  1  5.0     .92     .11 12.00  78.68  .66    .000
   (I%=52.0:S%= 2.00)
*
*  CALIB STANDHYD    0203  1  5.0     .86     .11 12.00  78.69  .66    .000
   (I%=52.0:S%= 2.00)
*
*  CALIB STANDHYD    0201  1  5.0   21.57    2.52 12.00  77.01  .64    .000
   (I%=50.0:S%= 2.00)
```

```
*
*   CALIB NASHYD       0301  1  5.0     .53     .03 12.33  51.47  .43    .000
    (CN=65.0       )
    ( N = 3.0:Tp  .48)
*
*   CALIB STANDHYD     0202  1  5.0    2.10     .26 12.00  76.68  .66    .000
    (I)=52.0:S)= 2.00)
*
    DUHYD              0411  1  5.0     .92     .11 12.00  76.68  n/a    .000
       MAJOR SYSTEM:   0411  2  5.0     .00     .00   .00    .00  n/a    .000
       MINOR SYSTEM:   0411  3  5.0     .92     .11 12.00  76.68  n/a    .000
*
    DUHYD              0414  1  5.0     .86     .11 12.00  78.68  n/a    .000
       MAJOR SYSTEM:   0414  2  5.0     .00     .01 12.00  78.68  n/a    .000
       MINOR SYSTEM:   0414  3  5.0     .86     .10 11.92  78.68  n/a    .000
*
    ADD (0201 + 0301)  0401  3  5.0   22.10    2.54 12.00  76.39  n/a    .000
*
    DUHYD              0409  1  5.0    2.10     .26 12.00  78.68  n/a    .000
       MAJOR SYSTEM:   0409  2  5.0     .00     .00   .00    .00  n/a    .000
       MINOR SYSTEM:   0409  3  5.0    2.10     .26 12.00  78.68  n/a    .000
*
    DIVERT HYD         0415  1  5.0     .00     .01 12.00  78.68  n/a    .000
       Outflow         0415  2  5.0     .00     .00 12.00  78.68  n/a    .000
       Outflow         0415  3  5.0     .00     .00 12.00  78.68  n/a    .000
*
    ADD (0401 + 0409)  0407  3  5.0   22.10    2.54 12.00  76.39  n/a    .000
*
    ADD (0411 + 0415)  0412  3  5.0     .92     .12 12.00  78.68  n/a    .000
*
    ADD (0411 + 0415)  0416  3  5.0     .00     .00 12.00  78.68  n/a    .000
*
    ADD (0412 + 0407)  0413  3  5.0   23.02    2.66 12.00  76.48  n/a    .000
*
    RESRVR ( 2 : 0413) 0406  1  5.0   23.02     .88 12.67  76.45  n/a    .000
    (ST=   .82 ha.m )
*
FINISH
```

```
 V    V   I    SSSSS  U   U    A    L
 V    V   I    SS     U   U   A A   L
  V  V    I     SS    U   U  AAAAA  L
  V  V    I      SS   U   U  A   A  L
   VV     I    SSSSS  UUUUU  A   A  LLLLL

  OOO    TTTTT  TTTTT  H   H  Y   Y  M   M   OOO
 O   O     T      T    H   H   Y Y   MM MM  O   O
 O   O     T      T    H   H    Y    M   M  O   O
  OOO      T      T    H   H    Y    M   M   OOO
```

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***** S U M M A R Y O U T P U T *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 2.3.2\voin.dat
Output filename: I:\2014PR-1\114056-1\Design\STORMW-1\1SWMPO-2\VO2\CHARLE-1\114056-1\CHI Detailed Model.out
Summary filename: I:\2014PR-1\114056-1\Design\STORMW-1\1SWMPO-2\VO2\CHARLE-1\114056-1\CHI Detailed Model.sum

DATE: 10/06/2016 TIME: 12:57:15 PM

USER:

COMMENTS: _____

****
** SIMULATION NUMBER: 1 **
****

W/E	COMMAND	HYD ID		DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs									
	READ STORM			6.0						
	[Ptot= 33.75 mm]									
	fname : C:\Users\awest\Desktop\Storms\Owen Sound\OSCHI2.4HR									
	remark: OWEN SOUND 2 YEAR 4 HOUR DURATION CHICAGO STORM									
*										
*	CALIB STANDHYD	0202	1	5.0	2.10	.24	1.92	18.38	.54	.000
	[I%=52.0:S%= 2.00]									
*										
*	CALIB NASHYD	0301	1	5.0	.53	.00	2.50	4.50	.13	.000
	[CN=65.0]									
	[N = 3.0:Tp .48]									
*										
*	CALIB STANDHYD	0201	1	5.0	21.57	2.02	1.92	17.79	.53	.000
	[I%=50.0:S%= 2.00]									
*										
*	CALIB STANDHYD	0203	1	5.0	.86	.10	1.92	18.37	.54	.000
	[I%=52.0:S%= 2.00]									
*										
*	CALIB STANDHYD	0204	1	5.0	.92	.11	1.92	18.37	.54	.000
	[I%=52.0:S%= 2.00]									
*										
	DUHYD	0409	1	5.0	2.10	.24	1.92	18.38	n/a	.000
	MAJOR SYSTEM:	0409	2	5.0	.00	.00	.00	.00	n/a	.000
	MINOR SYSTEM:	0409	3	5.0	2.10	.24	1.92	18.38	n/a	.000
*										
	ADD [0301 + 0201]	0401	3	5.0	22.10	2.02	1.92	17.47	n/a	.000
*										
	DUHYD	0414	1	5.0	.86	.10	1.92	18.37	n/a	.000
	MAJOR SYSTEM:	0414	2	5.0	.00	.00	1.92	18.37	n/a	.000
	MINOR SYSTEM:	0414	3	5.0	.86	.10	1.92	18.37	n/a	.000
*										
	DUHYD	0411	1	5.0	.92	.11	1.92	18.37	n/a	.000
	MAJOR SYSTEM:	0411	2	5.0	.00	.00	.00	.00	n/a	.000
	MINOR SYSTEM:	0411	3	5.0	.92	.11	1.92	18.37	n/a	.000
*										
	ADD [0409 + 0401]	0407	3	5.0	22.10	2.02	1.92	17.47	n/a	.000
*										
	DIVERT HYD	0415	1	5.0	.00	.00	1.92	18.37	n/a	.000
	Outflow	0415	2	5.0	.00	.00	1.92	18.37	n/a	.000
	Outflow	0415	3	5.0	.00	.00	1.92	18.37	n/a	.000
*										
	ADD [0415 + 0411]	0412	3	5.0	.92	.11	1.92	18.37	n/a	.000
*										
	ADD [0415 + 0411]	0416	3	5.0	.00	.00	1.92	18.37	n/a	.000
*										
	ADD [0407 + 0412]	0413	3	5.0	23.02	2.13	1.92	17.50	n/a	.000
*										
	RESRVR [2 : 0413]	0406	1	5.0	23.02	.06	4.00	17.47	n/a	.000
	(ST= .35 ha.m)									
*										

****
** SIMULATION NUMBER: 2 **
****

W/E	COMMAND	HYD ID		DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs									
	READ STORM			6.0						
	[Ptot= 44.07 mm]									
	fname : C:\Users\awest\Desktop\Storms\Owen Sound\OSCHI5.4HR									
	remark: OWEN SOUND 5 YEAR 4 HOUR DURATION CHICAGO STORM									
*										
*	CALIB STANDHYD	0202	1	5.0	2.10	.32	1.92	24.80	.56	.000
	[I%=52.0:S%= 2.00]									
*										
*	CALIB NASHYD	0301	1	5.0	.53	.01	2.42	8.05	.18	.000
	[CN=65.0]									
	[N = 3.0:Tp .48]									
*										
*	CALIB STANDHYD	0201	1	5.0	21.57	2.74	1.92	24.05	.55	.000
	[I%=50.0:S%= 2.00]									
*										
*	CALIB STANDHYD	0203	1	5.0	.86	.14	1.92	24.79	.56	.000
	[I%=52.0:S%= 2.00]									
*										
*	CALIB STANDHYD	0204	1	5.0	.92	.14	1.92	24.80	.56	.000
	[I%=52.0:S%= 2.00]									
*										
	DUHYD	0409	1	5.0	2.10	.32	1.92	24.80	n/a	.000
	MAJOR SYSTEM:	0409	2	5.0	.04	.03	1.92	24.80	n/a	.000
	MINOR SYSTEM:	0409	3	5.0	2.06	.29	1.92	24.80	n/a	.000
*										
	ADD [0301 + 0201]	0401	3	5.0	22.10	2.75	1.92	23.66	n/a	.000
*										
	DUHYD	0414	1	5.0	.86	.14	1.92	24.79	n/a	.000
	MAJOR SYSTEM:	0414	2	5.0	.04	.04	1.92	24.79	n/a	.000
	MINOR SYSTEM:	0414	3	5.0	.82	.10	1.92	24.79	n/a	.000
*										
	DUHYD	0411	1	5.0	.92	.14	1.92	24.80	n/a	.000
	MAJOR SYSTEM:	0411	2	5.0	.00	.00	.00	.00	n/a	.000
	MINOR SYSTEM:	0411	3	5.0	.92	.14	1.92	24.80	n/a	.000
*										
	ADD [0409 + 0401]	0407	3	5.0	22.14	2.78	1.92	23.67	n/a	.000
*										
	DIVERT HYD	0415	1	5.0	.04	.04	1.92	24.79	n/a	.000
	Outflow	0415	2	5.0	.02	.02	1.92	24.79	n/a	.000
	Outflow	0415	3	5.0	.02	.02	1.92	24.79	n/a	.000
*										
	ADD [0415 + 0411]	0412	3	5.0	.94	.16	1.92	24.80	n/a	.000
*										
	ADD [0415 + 0411]	0416	3	5.0	.02	.02	1.92	24.79	n/a	.000
*										
	ADD [0407 + 0412]	0413	3	5.0	23.08	2.94	1.92	23.71	n/a	.000
*										
	RESRVR [2 : 0413]	0406	1	5.0	23.08	.19	3.00	23.68	n/a	.000
	(ST= .44 ha.m)									
*										

****
** SIMULATION NUMBER: 3 **
****

W/E	COMMAND	HYD ID		DT min	AREA ha	Qpeak cms	Tpeak hrs	R.V. mm	R.C.	Qbase cms
	START @ .00 hrs									
	READ STORM			6.0						
	[Ptot= 50.59 mm]									
	fname : C:\Users\awest\Desktop\Storms\Owen Sound\OSchi10.4hr									
	remark: OWEN SOUND 10 YEAR 4 HOUR DURATION CHICAGO STORM									
*										
*	CALIB STANDHYD	0202	1	5.0	2.10	.38	1.92	29.00	.57	.000
	[I%=52.0:S%= 2.00]									
*										

```
*   CALIB NASHYD      0301  1  5.0     .53     .01  2.42  10.70  .21    .000
    [CN=65.0       ]
    [ N = 3.0:Tp  .46]
*
*   CALIB STANDHYD    0201  1  5.0   21.57    3.24  1.92  28.15  .56    .000
    [I%=50.0:S%= 2.00]
*
*   CALIB STANDHYD    0203  1  5.0     .86     .16  1.92  28.99  .57    .000
    [I%=52.0:S%= 2.00]
*
*   CALIB STANDHYD    0204  1  5.0     .92     .17  1.92  28.99  .57    .000
    [I%=52.0:S%= 2.00]
*
    DUHYD             0409  1  5.0    2.10     .38  1.92  29.00  n/a    .000
       MAJOR SYSTEM:  0409  2  5.0     .09     .09  1.92  29.00  n/a    .000
       MINOR SYSTEM:  0409  3  5.0    2.01     .29  1.92  29.00  n/a    .000
*
    ADD [0301 + 0201] 0401  3  5.0   22.10    3.24  1.92  27.73  n/a    .000
*
    DUHYD             0414  1  5.0     .86     .16  1.92  28.99  n/a    .000
       MAJOR SYSTEM:  0414  2  5.0     .07     .06  1.92  28.99  n/a    .000
       MINOR SYSTEM:  0414  3  5.0     .79     .10  1.83  28.99  n/a    .000
*
    DUHYD             0411  1  5.0     .92     .17  1.92  28.99  n/a    .000
       MAJOR SYSTEM:  0411  2  5.0     .03     .02  1.92  28.99  n/a    .000
       MINOR SYSTEM:  0411  3  5.0     .89     .14  1.92  28.99  n/a    .000
*
    ADD [0409 + 0401] 0407  3  5.0   22.19    3.33  1.92  27.73  n/a    .000
*
    DIVERT HYD        0415  1  5.0     .07     .06  1.92  28.99  n/a    .000
       Outflow        0415  2  5.0     .04     .03  1.92  28.99  n/a    .000
       Outflow        0415  3  5.0     .03     .03  1.92  28.99  n/a    .000
*
    ADD [0415 + 0411] 0412  3  5.0     .93     .18  1.92  28.99  n/a    .000
*
    ADD [0415 + 0411] 0416  3  5.0     .06     .05  1.92  28.99  n/a    .000
*
    ADD [0407 + 0412] 0413  3  5.0   23.12    3.51  1.92  27.78  n/a    .000
*
    RESRVR [ 2 : 0413] 0406  1  5.0   23.12     .28  2.83  27.75  n/a    .000
    (ST=   .49 ha.m )
*
 ****************************
 ** SIMULATION NUMBER:   4 **
 ****************************

 W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha     cms   hrs     mm         cms

    START @   .00 hrs
    ----    ------------
    READ STORM                    6.0
    [ Ptot= 59.06 mm ]
    fname : I:\2014 Projects\114056 - Charleston Subdivision (Poplar & High)\Design\Stormwater Management\1 SWM
    remark: OWEN SOUND 25 YEAR 4 HOUR DURATION CHICAGO STORM
*
*   CALIB STANDHYD    0202  1  5.0    2.10     .45  1.92  34.60  .59    .000
    [I%=52.0:S%= 2.00]
*
*   CALIB NASHYD      0301  1  5.0     .53     .02  2.42  14.55  .25    .000
    [CN=65.0       ]
    [ N = 3.0:Tp  .48]
*
*   CALIB STANDHYD    0201  1  5.0   21.57    3.89  1.92  33.63  .57    .000
    [I%=50.0:S%= 2.00]
*
*   CALIB STANDHYD    0203  1  5.0     .86     .19  1.92  34.60  .59    .000
    [I%=52.0:S%= 2.00]
*
*   CALIB STANDHYD    0204  1  5.0     .92     .20  1.92  34.60  .59    .000
    [I%=52.0:S%= 2.00]
*
    DUHYD             0409  1  5.0    2.10     .45  1.92  34.60  n/a    .000
       MAJOR SYSTEM:  0409  2  5.0     .15     .16  1.92  34.60  n/a    .000
       MINOR SYSTEM:  0409  3  5.0    1.95     .29  1.83  34.60  n/a    .000
*
    ADD [0301 + 0201] 0401  3  5.0   22.10    3.89  1.92  33.17  n/a    .000
*
    DUHYD             0414  1  5.0     .86     .19  1.92  34.60  n/a    .000
       MAJOR SYSTEM:  0414  2  5.0     .10     .09  1.92  34.60  n/a    .000
       MINOR SYSTEM:  0414  3  5.0     .76     .10  1.83  34.60  n/a    .000
*
    DUHYD             0411  1  5.0     .92     .20  1.92  34.60  n/a    .000
       MAJOR SYSTEM:  0411  2  5.0     .05     .05  1.92  34.60  n/a    .000
       MINOR SYSTEM:  0411  3  5.0     .87     .14  1.92  34.60  n/a    .000
*
    ADD [0409 + 0401] 0407  3  5.0   22.25    4.05  1.92  33.18  n/a    .000
*
    DIVERT HYD        0415  1  5.0     .10     .09  1.92  34.60  n/a    .000
       Outflow        0415  2  5.0     .05     .05  1.92  34.60  n/a    .000
       Outflow        0415  3  5.0     .05     .04  1.92  34.60  n/a    .000
*
    ADD [0415 + 0411] 0412  3  5.0     .93     .19  1.92  34.60  n/a    .000
*
    ADD [0415 + 0411] 0416  3  5.0     .09     .09  1.92  34.60  n/a    .000
*
    ADD [0407 + 0412] 0413  3  5.0   23.18    4.24  1.92  33.24  n/a    .000
*
    RESRVR [ 2 : 0413] 0406  1  5.0   23.18     .39  2.67  33.21  n/a    .000
    (ST=   .57 ha.m )
*
 ****************************
 ** SIMULATION NUMBER:   5 **
 ****************************

 W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha     cms   hrs     mm         cms

    START @   .00 hrs
    ----    ------------
    READ STORM                    6.0
    [ Ptot= 65.65 mm ]
    fname : I:\2014 Projects\114056 - Charleston Subdivision (Poplar & High)\Design\Stormwater Management\1 SWM
    remark: OWEN SOUND 50 YEAR 4 HOUR DURATION CHICAGO STORM
*
*   CALIB STANDHYD    0202  1  5.0    2.10     .50  1.92  39.05  .59    .000
    [I%=52.0:S%= 2.00]
*
*   CALIB NASHYD      0301  1  5.0     .53     .02  2.42  17.61  .27    .000
    [CN=65.0       ]
    [ N = 3.0:Tp  .48]
*
*   CALIB STANDHYD    0201  1  5.0   21.57    4.36  1.92  37.99  .58    .000
    [I%=50.0:S%= 2.00]
*
*   CALIB STANDHYD    0203  1  5.0     .86     .21  1.92  39.04  .59    .000
    [I%=52.0:S%= 2.00]
*
*   CALIB STANDHYD    0204  1  5.0     .92     .22  1.92  39.04  .59    .000
    [I%=52.0:S%= 2.00]
*
    DUHYD             0409  1  5.0    2.10     .50  1.92  39.05  n/a    .000
       MAJOR SYSTEM:  0409  2  5.0     .20     .21  1.92  39.05  n/a    .000
       MINOR SYSTEM:  0409  3  5.0    1.90     .29  1.83  39.05  n/a    .000
*
    ADD [0301 + 0201] 0401  3  5.0   22.10    4.37  1.92  37.50  n/a    .000
*
    DUHYD             0414  1  5.0     .86     .21  1.92  39.04  n/a    .000
       MAJOR SYSTEM:  0414  2  5.0     .13     .11  1.92  39.04  n/a    .000
       MINOR SYSTEM:  0414  3  5.0     .73     .10  1.83  39.04  n/a    .000
*
    DUHYD             0411  1  5.0     .92     .22  1.92  39.04  n/a    .000
       MAJOR SYSTEM:  0411  2  5.0     .07     .08  1.92  39.04  n/a    .000
       MINOR SYSTEM:  0411  3  5.0     .85     .14  1.83  39.04  n/a    .000
*
    ADD [0409 + 0401] 0407  3  5.0   22.30    4.57  1.92  37.52  n/a    .000
*
    DIVERT HYD        0415  1  5.0     .13     .11  1.92  39.04  n/a    .000
       Outflow        0415  2  5.0     .07     .06  1.92  39.04  n/a    .000
       Outflow        0415  3  5.0     .06     .05  1.92  39.04  n/a    .000
*
    ADD [0415 + 0411] 0412  3  5.0     .92     .20  1.92  39.04  n/a    .000
*
    ADD [0415 + 0411] 0416  3  5.0     .13     .13  1.92  39.04  n/a    .000
*
    ADD [0407 + 0412] 0413  3  5.0   23.22    4.77  1.92  37.58  n/a    .000
*
    RESRVR [ 2 : 0413] 0406  1  5.0   23.22     .48  2.67  37.55  n/a    .000
    (ST=   .64 ha.m )
*
 ****************************
 ** SIMULATION NUMBER:   6 **
 ****************************

 W/E COMMAND              HYD ID   DT    AREA   Qpeak Tpeak   R.V. R.C.   Qbase
                                  min     ha     cms   hrs     mm         cms

    START @   .00 hrs
    ----    ------------
    READ STORM                    6.0
```

```
[ Ptot= 71.77 mm ]
fname : I:\2014 Projects\114056 - Charleston Subdivision (Poplar & High)\Design\Stormwater Management\1 SWM
remark: OWEN SOUND 100 YEAR 4 HOUR DURATION CHICAGO STORM

*  CALIB STANDHYD     0202  1  5.0    2.10     .56  1.92  43.26  .60    .000
   [I%=52.0:S%= 2.00]
*
*  CALIB NASHYD       0301  1  5.0     .53     .02  2.42  21.03  .29    .000
   [CN=65.0       ]
   [ N = 3.0:Tp  .48]
*
*  CALIB STANDHYD     0201  1  5.0   21.57    4.86  1.92  42.12  .59    .000
   [I%=50.0:S%= 2.00]
*
*  CALIB STANDHYD     0203  1  5.0     .86     .23  1.92  43.25  .60    .000
   [I%=52.0:S%= 2.00]
*
*  CALIB STANDHYD     0204  1  5.0     .92     .25  1.92  43.25  .60    .000
   [I%=52.0:S%= 2.00]
*
   DUHYD              0409  1  5.0    2.10     .56  1.92  43.26  n/a    .000
      MAJOR SYSTEM:   0409  2  5.0     .27     .27  1.92  43.26  n/a    .000
      MINOR SYSTEM:   0409  3  5.0    1.83     .29  1.83  43.26  n/a    .000
*
   ADD [0301 + 0201]  0401  3  5.0   22.10    4.87  1.92  41.61  n/a    .000
*
   DUHYD              0414  1  5.0     .86     .23  1.92  43.25  n/a    .000
      MAJOR SYSTEM:   0414  2  5.0     .15     .13  1.92  43.25  n/a    .000
      MINOR SYSTEM:   0414  3  5.0     .71     .10  1.83  43.25  n/a    .000
*
   DUHYD              0411  1  5.0     .92     .25  1.92  43.25  n/a    .000
      MAJOR SYSTEM:   0411  2  5.0     .09     .10  1.92  43.25  n/a    .000
      MINOR SYSTEM:   0411  3  5.0     .83     .14  1.83  43.25  n/a    .000
*
   ADD [0409 + 0401]  0407  3  5.0   22.37    5.13  1.92  41.63  n/a    .000
*
   DIVERT HYD         0415  1  5.0     .15     .13  1.92  43.25  n/a    .000
      Outflow         0415  2  5.0     .08     .07  1.92  43.25  n/a    .000
      Outflow         0415  3  5.0     .07     .06  1.92  43.25  n/a    .000
*
   ADD [0415 + 0411]  0412  3  5.0     .91     .22  1.92  43.25  n/a    .000
*
   ADD [0415 + 0411]  0416  3  5.0     .16     .16  1.92  43.25  n/a    .000
*
   ADD [0407 + 0412]  0413  3  5.0   23.28    5.35  1.92  41.69  n/a    .000
*
   RESRVR [ 2 : 0413] 0406  1  5.0   23.28     .51  2.67  41.66  n/a    .000
   (ST=   .71 ha.m )
*
 ****************************
 ** SIMULATION NUMBER:   7 **
 ****************************

 W/E COMMAND              HYD ID   DT    AREA   Qpeak  Tpeak   R.V.  R.C.   Qbase
                                   min     ha     cms    hrs     mm            cms

   START @   .00 hrs
   -----   ------------
   READ STORM                 60.0
   [ Ptot=193.00 mm ]
   fname : C:\Users\awest\Desktop\Storms\Owen Sound\Timmins.stm
   remark: REGIONAL STORM TIMMINS - 12 hour storm
*
*  CALIB STANDHYD     0202  1  5.0    2.10     .18  7.00 137.34  .71    .000
   [I%=52.0:S%= 2.00]
*
*  CALIB NASHYD       0301  1  5.0     .53     .04  7.17 107.50  .56    .000
   [CN=65.0       ]
   [ N = 3.0:Tp  .48]
*
*  CALIB STANDHYD     0201  1  5.0   21.57    1.82  7.00 135.06  .70    .000
   [I%=50.0:S%= 2.00]
*
*  CALIB STANDHYD     0203  1  5.0     .86     .08  7.00 137.33  .71    .000
   [I%=52.0:S%= 2.00]
*
*  CALIB STANDHYD     0204  1  5.0     .92     .08  7.00 137.33  .71    .000
   [I%=52.0:S%= 2.00]
*
   DUHYD              0409  1  5.0    2.10     .18  7.00 137.34  n/a    .000
      MAJOR SYSTEM:   0409  2  5.0     .00     .00   .00   .00  n/a    .000
      MINOR SYSTEM:   0409  3  5.0    2.10     .18  7.00 137.34  n/a    .000
*
   ADD [0301 + 0201]  0401  3  5.0   22.10    1.86  7.00 134.40  n/a    .000
*
   DUHYD              0414  1  5.0     .86     .08  7.00 137.33  n/a    .000
      MAJOR SYSTEM:   0414  2  5.0     .00     .00   .00   .00  n/a    .000
      MINOR SYSTEM:   0414  3  5.0     .86     .08  7.00 137.33  n/a    .000
*
   DUHYD              0411  1  5.0     .92     .08  7.00 137.33  n/a    .000
      MAJOR SYSTEM:   0411  2  5.0     .00     .00   .00   .00  n/a    .000
      MINOR SYSTEM:   0411  3  5.0     .92     .08  7.00 137.33  n/a    .000
*
   ADD [0409 + 0401]  0407  3  5.0   22.10    1.86  7.00 134.40  n/a    .000
*
   DIVERT HYD         0415  1  5.0     .00     .00   .00   .00  n/a    .000
      Outflow         0415  2  5.0 1#IND..     .00   .00 1#IND.  n/a    .000
      Outflow         0415  3  5.0 1#IND..     .00   .00 1#IND.  n/a    .000
*
   ADD [0415 + 0411]  0412  3  5.0 1#IND..     .08  7.00 1#IND.  n/a    .000
*
   ADD [0415 + 0411]  0416  3   .0     .00     .00   .00 1#IND.  n/a    .000
*
   ADD [0407 + 0412]  0413  3  5.0 1#IND..    1.94  7.00 1#IND.  n/a    .000
*
   RESRVR [ 2 : 0413] 0406  1  5.0 1#IND..    1.77  7.08 1#IND.  n/a    .000
   (ST=   .88 ha.m )
*
 ****************************
 ** SIMULATION NUMBER:   8 **
 ****************************

 W/E COMMAND              HYD ID   DT    AREA   Qpeak  Tpeak   R.V.  R.C.   Qbase
                                   min     ha     cms    hrs     mm            cms

   START @   .00 hrs
   -----   ------------
   READ STORM                 6.0
   [ Ptot= 24.97 mm ]
   fname : I:\2014 Projects\114056 - Charleston Subdivision (Poplar & High)\Design\Stormwater Management\1 SWM
   remark: OWEN SOUND 25 mm (from a 2 year-4hr storm)
*
*  CALIB STANDHYD     0202  1  5.0    2.10     .18  1.92  13.13  .53    .000
   [I%=52.0:S%= 2.00]
*
*  CALIB NASHYD       0301  1  5.0     .53     .00  2.50   2.17  .09    .000
   [CN=65.0       ]
   [ N = 3.0:Tp  .48]
*
*  CALIB STANDHYD     0201  1  5.0   21.57    1.43  1.92  12.69  .51    .000
   [I%=50.0:S%= 2.00]
*
*  CALIB STANDHYD     0203  1  5.0     .86     .07  1.92  13.11  .53    .000
   [I%=52.0:S%= 2.00]
*
*  CALIB STANDHYD     0204  1  5.0     .92     .08  1.92  13.11  .53    .000
   [I%=52.0:S%= 2.00]
*
   DUHYD              0409  1  5.0    2.10     .18  1.92  13.13  n/a    .000
      MAJOR SYSTEM:   0409  2  5.0     .00     .00   .00   .00  n/a    .000
      MINOR SYSTEM:   0409  3  5.0    2.10     .18  1.92  13.13  n/a    .000
*
   ADD [0301 + 0201]  0401  3  5.0   22.10    1.43  1.92  12.43  n/a    .000
*
   DUHYD              0414  1  5.0     .86     .07  1.92  13.11  n/a    .000
      MAJOR SYSTEM:   0414  2  5.0     .00     .00   .00   .00  n/a    .000
      MINOR SYSTEM:   0414  3  5.0     .86     .07  1.92  13.11  n/a    .000
*
   DUHYD              0411  1  5.0     .92     .08  1.92  13.11  n/a    .000
      MAJOR SYSTEM:   0411  2  5.0     .00     .00   .00   .00  n/a    .000
      MINOR SYSTEM:   0411  3  5.0     .92     .08  1.92  13.11  n/a    .000
*
   ADD [0409 + 0401]  0407  3  5.0   22.10    1.43  1.92  12.43  n/a    .000
*
   DIVERT HYD         0415  1  5.0     .00     .00   .00   .00  n/a    .000
      Outflow         0415  2  5.0 1#IND..     .00   .00 1#IND.  n/a    .000
      Outflow         0415  3  5.0 1#IND..     .00   .00 1#IND.  n/a    .000
*
   ADD [0415 + 0411]  0412  3  5.0 1#IND..     .08  1.92 1#IND.  n/a    .000
*
   ADD [0415 + 0411]  0416  3   .0     .00     .00   .00 1#IND.  n/a    .000
*
   ADD [0407 + 0412]  0413  3  5.0 1#IND..    1.51  1.92 1#IND.  n/a    .000
*
   RESRVR [ 2 : 0413] 0406  1  5.0 1#IND..     .05  4.00 1#IND.  n/a    .000
   (ST=   .24 ha.m )
*
 FINISH
```

APPENDIX C:
PRELIMINARY SWM POND DESIGN CALCULATIONS

C.C. Tatham & Associates Ltd. Consulting Engineers Collingwood Bracebridge Orillia Barrie	Project:	Charleston Homes	Date:	01-Jun-16
	File No.:	114056	Designed:	AW
	Subject:	Impervious Calculator	Checked	DJH

Catchment 201

Landuse	% Impervious	Area (ha)
Lots	50	14.56
Road	60	5.87
Park	5	1.14
Total		21.57
%Imperv		50

Catchment 202

Landuse	% Impervious	Area (ha)
Lots	50	1.62
Road	60	0.48
Total		2.1
%Imperv		52

CHARLESTON SUBDIVISION
Volume Table - Pond

Active Pool

Side Slope 4 :1
Bottom Elev. 204.80
Water Level

Elev.	Depth	Areas		Volumes				
(m)	(m)	Area (m^2)	Avg. Area (m^2)	Dead (m^3)	Accum. Dead (m^3)	Live (m^3)	Accum. Live (m^3)	Total Volume (m^3)
197.30	0.00	1079.00	0.00	0.0	0.0	0.0	0.0	0.0
197.40	0.10	1180.12	1129.56	113.0	113.0	0.0	0.0	113.0
197.50	0.20	1281.24	1230.68	123.1	236.0	0.0	0.0	236.0
197.60	0.30	1382.35	1331.79	133.2	369.2	0.0	0.0	369.2
197.70	0.40	1483.47	1432.91	143.3	512.5	0.0	0.0	512.5
197.80	0.50	1584.59	1534.03	153.4	665.9	0.0	0.0	665.9
197.90	0.60	1685.71	1635.15	163.5	829.4	0.0	0.0	829.4
198.00	0.70	1786.82	1736.26	173.6	1003.0	0.0	0.0	1003.0
198.10	0.80	1887.94	1837.38	183.7	1186.8	0.0	0.0	1186.8
198.20	0.90	1989.06	1938.50	193.8	1380.6	0.0	0.0	1380.6
198.30	1.00	2090.18	2039.62	204.0	1584.6	0.0	0.0	1584.6
198.40	1.10	2191.29	2140.74	214.1	1798.7	0.0	0.0	1798.7
198.50	1.20	2292.41	2241.85	224.2	2022.8	0.0	0.0	2022.8
198.60	1.30	2393.53	2342.97	234.3	2257.1	0.0	0.0	2257.1
198.70	1.40	2494.65	2444.09	244.4	2501.6	0.0	0.0	2501.6
198.80	1.50	2595.76	2545.21	254.5	2756.1	0.0	0.0	2756.1
198.90	1.60	2696.88	2646.32	264.6	3020.7	0.0	0.0	3020.7
199.00	1.70	2798.00	2747.44	274.7	3295.4	0.0	0.0	3295.4
199.10	1.80	2958.52	2878.26		3295.4	287.8	287.8	3583.3
199.20	1.90	3119.04	3038.78		3295.4	303.9	591.7	3887.2
199.30	2.00	3279.57	3199.30		3295.4	319.9	911.6	4207.1
199.40	2.10	3440.09	3359.83		3295.4	336.0	1247.6	4543.1
199.50	2.20	3600.61	3520.35		3295.4	352.0	1599.7	4895.1
199.60	2.30	3761.13	3680.87		3295.4	368.1	1967.7	5263.2
199.70	2.40	3921.65	3841.39		3295.4	384.1	2351.9	5647.3
199.80	2.50	4082.17	4001.91		3295.4	400.2	2752.1	6047.5
199.90	2.60	4242.70	4162.43		3295.4	416.2	3168.3	6463.8
200.00	2.70	4403.22	4322.96		3295.4	432.3	3600.6	6896.1
200.10	2.80	4563.74	4483.48		3295.4	448.3	4049.0	7344.4
200.20	2.90	4724.26	4644.00		3295.4	464.4	4513.4	7808.8
200.30	3.00	4884.78	4804.52		3295.4	480.5	4993.8	8289.3
200.40	3.10	5045.30	4965.04		3295.4	496.5	5490.3	8785.8
200.50	3.20	5205.83	5125.57		3295.4	512.6	6002.9	9298.3
200.60	3.30	5366.35	5286.09		3295.4	528.6	6531.5	9826.9
200.70	3.40	5526.87	5446.61		3295.4	544.7	7076.1	10371.6
200.80	3.50	5687.39	5607.13		3295.4	560.7	7636.9	10932.3
200.90	3.60	5847.91	5767.65		3295.4	576.8	8213.6	11509.1
201.00	3.70	6008.43	5928.17		3295.4	592.8	8806.4	12101.9
201.10	3.80	6168.96	6088.70		3295.4	608.9	9415.3	12710.8
201.20	3.90	6329.48	6249.22		3295.4	624.9	10040.2	13335.7
201.30	4.00	6490.00	6409.74		3295.4	641.0	10681.2	13976.6

CHARLESTON SUBDIVISION
Pond Discharge Table

OUTLET CONTROL			OUTLET PIPE			WEIR CONTROL		
150 mm Pipe			450 mm pipe				overflow	
diameter =	150	mm	diameter =	450	mm	Length of Weir	6.4	m
area =	0.0177	m^2	area =	0.1590	m^2	Weir Sill Elevation	200.80	m
Orifice C =	0.80		Orifice C =	0.80		Weir constant K	1.6	
Invert =	199.00	m	Invert =	199.90	m	Side Slope (H:V)	5	

Q = flow rate (cms)
C = constant
A = area of opening(sq. m)
H = net head on the orifice
g = Acceleration due to gravity

Q = flow rate (cms)
C = constant
A = area of opening(sq. m)
H = net head on the orifice
g = Acceleration due to gravity

$Q = K \times L \times H^{1.5}$

where Q = flow rate (cms)
K = constant
L = length (m)
H = head on the weir (m)

	Outlet Pipe		Outlet Pipe		Emergency Spillway		Hydraulic Control	Total Discharge
Water Level	Head	Discharge	Head	Discharge	Head	Discharge		
(m)	(m)	(m^3/s)	(m)	(m3/s)	(m)	(cms)		(cms)
197.30	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
197.40	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
197.50	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
197.60	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
197.70	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
197.80	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
197.90	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
198.00	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
198.10	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
198.20	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
198.30	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
198.40	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
198.50	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
198.60	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
198.70	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
198.80	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
198.90	0.00	0.0000	0.0000	0.0000	0.00	0.0000		0.0000
199.00	0.00	0.0000	0.0000	0.0000	0.00	0.0000	Outlet Pipe	0.0000
199.10	0.02	0.0099	0.0000	0.0000	0.00	0.0000	Outlet Pipe	0.0099
199.20	0.12	0.0221	0.0000	0.0000	0.00	0.0000	Outlet Pipe	0.0221
199.30	0.22	0.0297	0.0000	0.0000	0.00	0.0000	Outlet Pipe	0.0297
199.40	0.32	0.0357	0.0000	0.0000	0.00	0.0000	Outlet Pipe	0.0357
199.50	0.42	0.0408	0.0000	0.0000	0.00	0.0000	Outlet Pipe	0.0408
199.60	0.52	0.0454	0.0000	0.0000	0.00	0.0000	Outlet Pipe	0.0454
199.70	0.62	0.0495	0.0000	0.0000	0.00	0.0000	Outlet Pipe	0.0495
199.80	0.72	0.0533	0.0000	0.0000	0.00	0.0000	Outlet Pipe	0.0533
199.90	0.82	0.0569	0.0000	0.0000	0.00	0.0000	Outlet Pipe	0.0569
200.00	0.92	0.0602	0.0000	0.0000	0.00	0.0000	Outlet Pipe	0.0602
200.10	1.02	0.0634	0.0000	0.0000	0.00	0.0000	Outlet Pipe	0.0634
200.20	1.12	0.0664	0.0750	0.1543	0.00	0.0000	Outlet Pipe	0.2208
200.30	1.22	0.0693	0.1750	0.2358	0.00	0.0000	Outlet Pipe	0.3051
200.40	1.32	0.0721	0.2750	0.2955	0.00	0.0000	Outlet Pipe	0.3676
200.50	1.42	0.0748	0.3750	0.3451	0.00	0.0000	Outlet Pipe	0.4199
200.60	1.52	0.0773	0.4750	0.3884	0.00	0.0000	Outlet Pipe	0.4657
200.70	1.62	0.0798	0.5750	0.4274	0.00	0.0000	Outlet Pipe	0.5072
200.80	1.72	0.0822	0.6750	0.4630	0.00	0.0000	Outlet Pipe	0.5453
200.90	1.82	0.0846	0.7750	0.4961	0.10	0.3491	Outlet Pipe	0.9299
201.00	1.92	0.0869	0.8750	0.5272	0.20	1.0590	Weir	1.6731
201.10	2.02	0.0891	0.9750	0.5565	0.30	2.0770	Weir	2.7226
201.20	2.12	0.0913	1.0750	0.5843	0.40	3.4001	Weir	4.0757
201.30	2.22	0.0934	1.1750	0.6109	0.50	5.0346	Weir	5.7389

CHARLESTON SUBDIVISION
Pond STAGE-STORAGE-DISCHARGE DATA

	Outlet Pipe	Outlet Pipe	WEIR FLOW			
			Overflow	Hydraulic	Total	Total
Water Level	Discharge	Discharge	Discharge	Control	Discharge	Storage
(m)	(m^3/s)	(m^3/s)	(m^3/s)		(m^3/s)	(ha-m)
197.30	0.0000	0.0000	0.0000		**0.000**	0.0000
197.40	0.0000	0.0000	0.0000		**0.000**	0.0000
197.50	0.0000	0.0000	0.0000		**0.000**	0.0000
197.60	0.0000	0.0000	0.0000		**0.000**	0.0000
197.70	0.0000	0.0000	0.0000		**0.000**	0.0000
197.80	0.0000	0.0000	0.0000		**0.000**	0.0000
197.90	0.0000	0.0000	0.0000		**0.000**	0.0000
198.00	0.0000	0.0000	0.0000		**0.000**	0.0000
198.10	0.0000	0.0000	0.0000		**0.000**	0.0000
198.20	0.0000	0.0000	0.0000		**0.000**	0.0000
198.30	0.0000	0.0000	0.0000		**0.000**	0.0000
198.40	0.0000	0.0000	0.0000		**0.000**	0.0000
198.50	0.0000	0.0000	0.0000		**0.000**	0.0000
198.60	0.0000	0.0000	0.0000		**0.000**	0.0000
198.70	0.0000	0.0000	0.0000		**0.000**	0.0000
198.80	0.0000	0.0000	0.0000		**0.000**	0.0000
198.90	0.0000	0.0000	0.0000		**0.000**	0.0000
199.00	0.0000	0.0000	0.0000	Outlet Pipe	**0.000**	0.0000
199.10	0.0099	0.0000	0.0000	Outlet Pipe	**0.010**	0.0288
199.20	0.0221	0.0000	0.0000	Outlet Pipe	**0.022**	0.0592
199.30	0.0297	0.0000	0.0000	Outlet Pipe	**0.030**	0.0912
199.40	0.0357	0.0000	0.0000	Outlet Pipe	**0.036**	0.1248
199.50	0.0408	0.0000	0.0000	Outlet Pipe	**0.041**	0.1600
199.60	0.0454	0.0000	0.0000	Outlet Pipe	**0.045**	0.1968
199.70	0.0495	0.0000	0.0000	Outlet Pipe	**0.050**	0.2352
199.80	0.0533	0.0000	0.0000	Outlet Pipe	**0.053**	0.2752
199.90	0.0569	0.0000	0.0000	Outlet Pipe	**0.057**	0.3168
200.00	0.0602	0.0000	0.0000	Outlet Pipe	**0.060**	0.3601
200.10	0.0634	0.0000	0.0000	Outlet Pipe	**0.063**	0.4049
200.20	0.0664	0.1543	0.0000	Outlet Pipe	**0.221**	0.4513
200.30	0.0693	0.2358	0.0000	Outlet Pipe	**0.305**	0.4994
200.40	0.0721	0.2955	0.0000	Outlet Pipe	**0.368**	0.5490
200.50	0.0748	0.3451	0.0000	Outlet Pipe	**0.420**	0.6003
200.60	0.0773	0.3884	0.0000	Outlet Pipe	**0.466**	0.6531
200.70	0.0798	0.4274	0.0000	Outlet Pipe	**0.507**	0.7076
200.80	0.0822	0.4630	0.0000	Outlet Pipe	**0.545**	0.7637
200.90	0.0846	0.4961	0.3491	Outlet Pipe	**0.930**	0.8214
201.00	0.0869	0.5272	1.0590	Weir	**1.673**	0.8806
201.10	0.0891	0.5565	2.0770	Weir	**2.723**	0.9415
201.20	0.0913	0.5843	3.4001	Weir	**4.076**	1.0040
201.30	0.0934	0.6109	5.0346	Weir	**5.739**	1.0681

CHARLESTON SUBDIVISION
WET POND

DRAWDOWN TIME FOR POND - EXTENDED DETENTION

(Using the falling head orifice equation)

$$t = \frac{2 A_p}{C A_o (2g)^{0.5}} \quad (h_1^{0.5} - h_2^{0.5})$$

where t = drawdown time in seconds

	Value			
A_p = surface area of pond (m^2)	4242.70	m^2 = Extended Detention level		
C = discharge coefficient (typically 0.63)	0.80			
A_o = cross-sectional area of orifice (m^2)	0.017671	m^2 for	150	mm dia
g = gravitational acceleration constant (9.81 m/s^2)	9.81	m/s^2		
h_1 = starting water elevation above the orifice (m)	0.825	m	199.90	m
h_2 = ending water elevation above the orifice (m)	0.000	m	199.00	m

t = 123,079.85 seconds

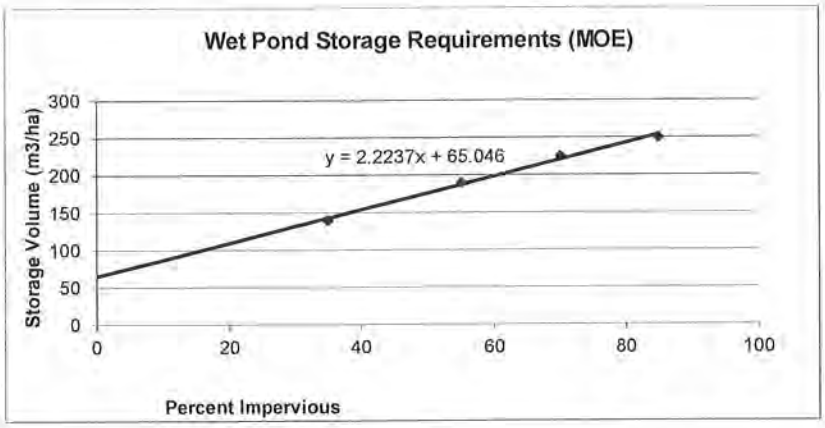
Q = 0.0569 m^3/s

t = 34.19 hours

CHARLESTON SUBDIVISION
MOE Water Quality Storage Volumes
Pond #2

Table 3.1 Values (MOE Drainage Manual)

% imp	storage (m^3/ha)
35	140
55	190
70	225
85	250



Contributing Areas

Catchment	201	Area	21.57	ha	%Impervious	50
Catchment	204	Area	0.92	ha	%Impervious	52
Catchment		Area		ha	%Impervious	
Catchment		Area		ha	%Impervious	
Catchment		Area		ha	%Impervious	
Catchment		Area		ha	%Impervious	
Catchment		Area		ha	%Impervious	
Catchment		Area		ha	%Impervious	
TOTAL AREA			**22.49**	**ha**	**%Impervious**	**50.1**

% Impervious	50.1	(imp area, excluding roof area)
Storage Volume (m^3/ha)	176.4	
Drainage Area (ha)	22.49	
Storage Volume (m^3)	**3967.5**	

24.13

Permanent Pool Volume (m^3) **3067.9**

Extended Detention Volume

Extended Detention volume is greater of 40 m^3/ha or 25 mm storm volume (from OTTHYMO)

Option 1

Active Storage requirement	40	m^3/ha
x contributing area	22.49	ha
Extended Detention volume	899.6	m^3

Option 2

25 mm storm runoff (from VO2)	12.9	mm
x contributing area	22.49	ha
Extended Detention Storage Volume	2,903	m^3

Extended Detention Storage Volume **2,903.5** m^3

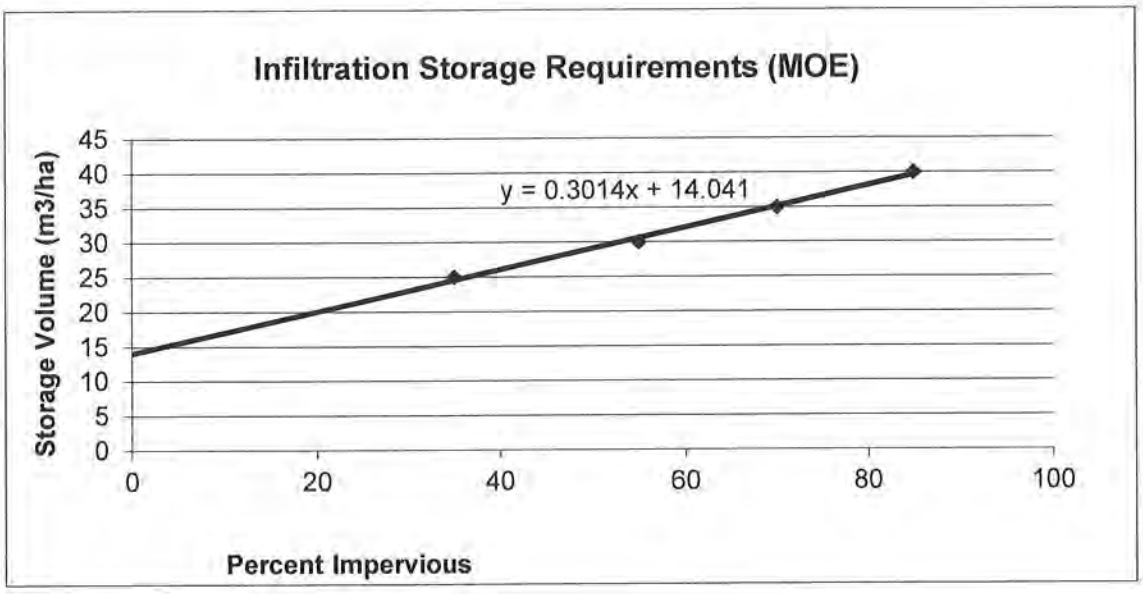
Total Storage Volume **5971.4** m^3

APPENDIX D:
PERFORATED PIPE DESIGN CALCUATIONS

CHARLESTON SUBDIVISION
MOE Water Quality Storage Volumes
Grass Swale

Table 3.1 Values (MOE Drainage Manual)

% imp	storage (m^3/ha)
35	25
55	30
70	35
85	40



Contributing Areas

Catchment	202	Area	2.1	ha	%Impervious	52
Catchment		Area		ha	%Impervious	
Catchment		Area		ha	%Impervious	
Catchment		Area		ha	%Impervious	
Catchment		Area		ha	%Impervious	
Catchment		Area		ha	%Impervious	
Catchment		Area		ha	%Impervious	
Catchment		Area		ha	%Impervious	
TOTAL AREA			**2.10 ha**		**%Impervious**	**52.0**

% Impervious	52.0 (imp area, excluding roof area)
Storage Volume (m^3/ha)	29.7
Drainage Area (ha)	2.10
Storage Volume (m^3)	**62.4**

CHARLESTON HOMES - 114056
PERFORATED PIPE SYSTEM VOLUME TABLE

Length	88.00 m	Pipe Radii:	
Width	3.00 m	Bottom Pipe	0.20 m
Void Ratio	0.40 Clear Stone	Top Pipe	0.45 m
Bottom Elev.	100.00 m		
Stage	0.1 m		

		Below Ground Storage			
Elev. (m)	Depth (m)	Profile Area (m^2)	Volume (m^3)	Accum. Total (m^3)	Accum. Total (ha-m)
100.00	0.00	0.000	0.00	0.00	0.00000
100.05	0.05	0.150	5.28	5.28	0.00053
100.10	0.05	0.150	5.28	10.56	0.00106
100.15	0.05	0.150	5.28	15.84	0.00158
100.20	0.05	0.150	5.28	21.12	0.00211
100.25	0.05	0.150	5.28	26.40	0.00264
100.30	0.05	0.150	5.28	31.68	0.00317
100.35	0.05	0.150	5.28	36.96	0.00370
100.40	0.05	0.150	5.28	42.24	0.00422
100.45	0.05	0.150	5.28	47.52	0.00475
100.50	0.05	0.150	5.28	52.80	0.00528
100.55	0.05	0.150	5.28	58.08	0.00581
100.60	0.05	0.150	5.28	63.36	0.00634
100.65	0.05	0.150	5.28	68.64	0.00686
100.70	0.05	0.150	5.28	73.92	0.00739
100.75	0.05	0.150	5.28	79.20	0.00792
100.80	0.05	0.150	5.28	84.48	0.00845

APPENDIX E:
WATER BUDGET

CHARLESTON SUBDIVISION
TOWNSHIP OF COLLINGWOOD
PRELIMINARY WATER BUDGET ASSESSMENT

June 2016
RUNOFF COEFFICIENTS

Land Use	MIN	MEDIAN	MAX
Pavement (asphalt or concrete)	0.8	0.875	0.95
Pavement (brick)	0.7	0.775	0.85
Gravel roads and shoulders	0.4	0.5	0.6
Roofs	0.7	0.825	0.95
Business- Downtown	0.7	0.825	0.95
Business- neighbourhood	0.5	0.6	0.7
business - light	0.5	0.65	0.8
Business- heavy	0.6	0.75	0.9
Residential- single family urban	0.3	0.4	0.5
residential- multiple, detached	0.4	0.5	0.6
Residential- multiple, attached	0.6	0.675	0.75
Residential- suburban	0.25	0.325	0.4
Industrial- light	0.5	0.6	0.7
Industrial- Heavy	0.6	0.75	0.9
Apartments	0.5	0.6	0.7
Parks, cemetaries	0.1	0.175	0.25
Playgrounds (unpaved)	0.2	0.275	0.35
Railroad yards	0.2	0.275	0.35
Unimproved areas	0.1	0.2	0.3
Lawns- Sandy soil- flat to 2%	0.05	0.075	0.1
Lawns- Sandy soil- average, 2 to 7%	0.1	0.125	0.15
Lawns- Sandy soil- steep, over 7%	0.15	0.175	0.2
Lawns- Clayey soil- flat to 2%	0.13	0.15	0.17
Lawns- Clayey soil-average, 2 to 7%	0.18	0.2	0.22
Lawns- Clayey soil- steep, over 7%	0.25	0.3	0.35

Note: Runoff Coefficients from MTO Drainage chart 1.07

Land Use	A	AB	B	BC	C	CD	D
Cultivated Land, 0 - 5% grade	0.22	0.22	0.35	0.35	0.55	0.55	0.55
Cultivated Land, 5 -10% grade	0.30	0.30	0.45	0.45	0.60	0.60	0.60
Cultivated Land, 10 - 30% grade	0.40	0.40	0.65	0.65	0.70	0.70	0.70
Pasture Land, 0 - 5% grade	0.10	0.10	0.28	0.28	0.40	0.40	0.40
Pasture Land, 5 -10% grade	0.15	0.15	0.35	0.35	0.45	0.45	0.45
Pasture Land, 10 - 30% grade	0.22	0.22	0.40	0.40	0.55	0.55	0.55
Woodlot or Cutover, 0 - 5% grade	0.08	0.08	0.25	0.25	0.35	0.35	0.35
Woodlot or Cutover, 5 -10% grade	0.12	0.12	0.30	0.30	0.42	0.42	0.42
Woodlot or Cutover, 10 -30% grade	0.18	0.18	0.35	0.35	0.52	0.52	0.52
Lakes and Wetlands	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Impervious Areas (i.e., buildings, roads, parking lots, etc.)	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Gravel (not to be used for proposed parking or storage areas)	0.40	0.40	0.50	0.50	0.60	0.60	0.60
Residential - Sinlge Family	0.30	0.30	0.40	0.40	0.50	0.50	0.50
Residential - Multiple (i.e., semi, townhouse, apartment)	0.50	0.50	0.60	0.60	0.70	0.70	0.70
Industrial - Light	0.55	0.55	0.65	0.65	0.75	0.75	0.75
Industrial - Heavy	0.65	0.65	0.75	0.75	0.85	0.85	0.85
Commercial	0.60	0.60	0.70	0.70	0.80	0.80	0.80
Unimproved Areas	0.10	0.10	0.20	0.20	0.30	0.30	0.30
Lawn, < 2% grade	0.05	0.05	0.11	0.11	0.17	0.17	0.17
Lawn, 2 - 7% grade	0.10	0.10	0.16	0.16	0.22	0.22	0.22
Lawn, > 7 % grade	0.15	0.15	0.25	0.25	0.35	0.35	0.35
Road Right-of-Way	0.60	0.60	0.70	0.70	0.80	0.80	0.80

CHARLESTON SUBDIVISION
TOWNSHIP OF COLLINGWOOD
PRELIMINARY WATER BUDGET ASSESSMENT

June 2016
RUNOFF COEFFICIENT - EXISTING CONDITIONS

Runoff Coeffcient "C" Generic 3
Min-2, Med-3, Max-4

Runoff Coeffcient "C" Reference No. for MTO chart: 2
Open Sand Loam-2, Loam or Silt Loam-3, Clay Loam or Clay-4

(Soils Group A - 2; AB - 3, B - 4, BC - 5, C - 6, CD - 7, D - 8)

Land Use	Runoff Coeffcient "C"	Total Area (Ha)	A*C
Generic Standards			
Pavement (asphalt or concrete)	0.88	0.0	0.00
Pavement (brick)	0.78	0.0	0.00
Gravel roads and shoulders	0.50	0.0	0.00
Roofs	0.83	0.0	0.00
Business- Downtown	0.83	0.0	0.00
Business- neighbourhood	0.60	0.0	0.00
business - light	0.65	0.0	0.00
Business- heavy	0.75	0.0	0.00
Residential- single family urban	0.40	0.0	0.00
residential- multiple, detached	0.50	0.0	0.00
Residential- multiple, attached	0.68	0.0	0.00
Residential- suburban	0.33	0.0	0.00
Industrial- light	0.60	0.0	0.00
Industrial- Heavy	0.75	0.0	0.00
Apartments	0.60	0.0	0.00
Parks, cemetaries	0.18	0.0	0.00
Playgrounds (unpaved)	0.28	0.0	0.00
Railroad yards	0.28	0.0	0.00
Unimproved areas	0.20	0.0	0.00
Lawns- Sandy soil- flat to 2%	0.08	0.0	0.00
Lawns- Sandy soil- average, 2 to 7%	0.13	0.0	0.00
Lawns- Sandy soil- steep, over 7%	0.18	0.0	0.00
Lawns- Clayey soil- flat to 2%	0.15	0.0	0.00
Lawns- Clayey soil-average, 2 to 7%	0.20	0.0	0.00
Lawns- Clayey soil- steep, over 7%	0.30	0.0	0.00
MTO Drainage Manual			
Cultivated Land, 0 - 5% grade	0.22	26.0	5.72
Cultivated Land, 5 -10% grade	0.30	0.0	0.00
Cultivated Land, 10 - 30% grade	0.40	0.0	0.00
Pasture Land, 0 - 5% grade	0.10	0.0	0.00
Pasture Land, 5 -10% grade	0.15	0.0	0.00
Pasture Land, 10 - 30% grade	0.22	0.0	0.00
Woodlot or Cutover, 0 - 5% grade	0.08	0.0	0.00
Woodlot or Cutover, 5 -10% grade	0.12	0.0	0.00
Woodlot or Cutover, 10 -30% grade	0.18	0.0	0.00
Lakes and Wetlands	0.05	0.0	0.00
Weighted Average		**25.45**	**0.22**

Note: Soil type was assumed to be AB (sandy loam) from GIS data

CHARLESTON SUBDIVISION
TOWNSHIP OF COLLINGWOOD
PRELIMINARY WATER BUDGET ASSESSMENT

June 2016
RUNOFF COEFFICIENT - PROPOSED CONDITIONS

Runoff Coeffcient "C" Generic 3
Min-2, Med-3, Max-4

Runoff Coeffcient "C" Reference No. for MTO chart: 4
Open Sand Loam-2, Loam or Silt Loam-3, Clay Loam or Clay-4

(Soils Group A - 2; AB - 3, B - 4, BC - 5, C - 6, CD - 7, D - 8)

Land Use	Runoff Coeffcient "C"	Total Area (Ha)	A*C
Generic Standards			
Pavement (asphalt or concrete)	0.88	0.0	0.00
Pavement (brick)	0.78	0.0	0.00
Gravel roads and shoulders	0.50	0.0	0.00
Roofs	0.83	0.0	0.00
Business- Downtown	0.83	0.0	0.00
Business- neighbourhood	0.60	0.0	0.00
business - light	0.65	0.0	0.00
Business- heavy	0.75	0.0	0.00
Residential- single family urban	0.40	26.0	10.40
residential- multiple, detached	0.50	0.0	0.00
Residential- multiple, attached	0.68	0.0	0.00
Residential- suburban	0.33	0.0	0.00
Industrial- light	0.60	0.0	0.00
Industrial- Heavy	0.75	0.0	0.00
Apartments	0.60	0.0	0.00
Parks, cemetaries	0.18	0.0	0.00
Playgrounds (unpaved)	0.28	0.0	0.00
Railroad yards	0.28	0.0	0.00
Unimproved areas	0.20	0.0	0.00
Lawns- Sandy soil- flat to 2%	0.08	0.0	0.00
Lawns- Sandy soil- average, 2 to 7%	0.13	0.0	0.00
Lawns- Sandy soil- steep, over 7%	0.18	0.0	0.00
Lawns- Clayey soil- flat to 2%	0.15	0.0	0.00
Lawns- Clayey soil-average, 2 to 7%	0.20	0.0	0.00
Lawns- Clayey soil- steep, over 7%	0.30	0.0	0.00
MTO Drainage Manual			
Cultivated Land, 0 - 5% grade	0.35	0.0	0.00
Cultivated Land, 5 -10% grade	0.45	0.0	0.00
Cultivated Land, 10 - 30% grade	0.65	0.0	0.00
Pasture Land, 0 - 5% grade	0.28	0.0	0.00
Pasture Land, 5 -10% grade	0.35	0.0	0.00
Pasture Land, 10 - 30% grade	0.40	0.0	0.00
Woodlot or Cutover, 0 - 5% grade	0.25	0.0	0.00
Woodlot or Cutover, 5 -10% grade	0.30	0.0	0.00
Woodlot or Cutover, 10 -30% grade	0.35	0.0	0.00
Lakes and Wetlands	0.05	0.0	0.00
Weighted Average		**25.45**	**0.41**

Note: Soil type was assumed to be AB (sandy loam) from GIS data

CHARLESTON SUBDIVISION
TOWNSHIP OF COLLINGWOOD
PRELIMINARY WATER BUDGET ASSESSMENT

June 2016
EXISTING CONDITIONS

Runoff Coefficient: 0.22
Thornthwaite Coefficient 1.081

Month	Temperature (°C)	Precipitation (mm)	Heat Index	PET (mm)	Daylight Factor	Adjusted PET (mm)	AET (mm)	Surplus (mm)	Deficit (mm)	Infiltration (mm)	Runoff (mm)
January	-7.7	82.5	0.0	0	0.8	0	0	83	0	64	19
February	-6.6	61.9	0.0	0	0.8	0	0	62	0	48	14
March	-2.1	58.2	0.0	0	1.0	0	0	58	0	45	13
April	5.6	62.3	1.2	28	1.1	31	31	31	0	24	7
May	12.3	82.4	3.9	74	1.3	94	82	0	12	0	0
June	17.9	84.8	6.9	113	1.3	144	85	0	60	0	0
July	20.8	77.2	8.7	134	1.3	174	77	0	97	0	0
August	19.7	89.9	8.0	116	1.2	139	90	0	49	0	0
September	15.3	94	5.4	76	1.0	79	79	15	0	12	3
October	8.7	77.5	2.3	37	1.0	35	35	42	0	33	9
November	2.7	88.8	0.4	9	0.8	7	7	82	0	63	18
December	-3.5	73.6	0.0	0	0.8	0	0	74	0	57	17
Total		**933.1**	**36.8**	**587.2**		**705.1**	**487.2**	**445.9**	**217.9**	**345.7**	**100.2**

Note:
1) Source - Barrie WPCC Climate Normal Data for 1981 - 2010 (Environment Canada).
2) Thornthwaite method used to determine the potential Evapotranspiration.
3) PET - potential evapotranspiration; AET - actual evapotranspiration.

CHARLESTON SUBDIVISION
TOWNSHIP OF COLLINGWOOD
PRELIMINARY WATER BUDGET ASSESSMENT

June 2016
PROPOSED CONDITIONS

Runoff Coefficient: 0.41
Thornthwaite Coefficient 1.081

Month	Temperature (°C)	Precipitation (mm)	Heat Index	PET (mm)	Daylight Factor	Adjusted PET (mm)	AET (mm)	Surplus (mm)	Deficit (mm)	Infiltration (mm)	Runoff (mm)
January	-7.7	82.5	0.0	0	0.8	0	0	83	0	49	34
February	-6.6	61.9	0.0	0	0.8	0	0	62	0	37	25
March	-2.1	58.2	0.0	0	1.0	0	0	58	0	34	24
April	5.6	62.3	1.2	28	1.1	31	31	31	0	18	13
May	12.3	82.4	3.9	74	1.3	94	82	0	12	0	0
June	17.9	84.8	6.9	113	1.3	144	85	0	60	0	0
July	20.8	77.2	8.7	134	1.3	174	77	0	97	0	0
August	19.7	89.9	8.0	116	1.2	139	90	0	49	0	0
September	15.3	94	5.4	76	1.0	79	79	15	0	9	6
October	8.7	77.5	2.3	37	1.0	35	35	42	0	25	17
November	2.7	88.8	0.4	9	0.8	7	7	82	0	48	33
December	-3.5	73.6	0.0	0	0.8	0	0	74	0	44	30
Total		**933.1**	**36.8**	**587.2**		**705.1**	**487.2**	**445.9**	**217.9**	**263.7**	**182.2**

Note:
1) Source - Barrie WPCC Climate Normal Data for 1981 - 2010 (Environment Canada).
2) Thornthwaite method used to determine the potential Evapotranspiration.
3) PET - potential evapotranspiration; AET - actual evapotranspiration.

CHARLESTON SUBDIVISION
TOWNSHIP OF COLLINGWOOD
PRELIMINARY WATER BUDGET ASSESSMENT

June 2016
WATER BALANCE SUMMARY

Total Area= 25.45 ha

	Existing Infiltration	Future Infiltration	Difference	Difference (%)	Proposed LID/SWM Infiltration Volume
Annual Depth (mm)	345.68	263.69	(82.00)	-24%	143.5
Annual Volume (cu.m)	87,976.15	67,108.01	(20,868.14)	-24%	21,029.00

Mitigation Proposed

Provide LID/SWM measures to infiltrate. For grassed swales target first 2.5 mm of precipitation. For soakaway pits assume each pit will infiltrate +/- 120 m^3/yr based on 800 mm and a 150 m^2 house.

1. First 2.5 mm of precipitation accounts for 287.1 mm of annual precipitation*

2.1 ha *287.1 mm = 6,029 m^3

2. Based on soil conditions and preliminary proposed SWM plan soakaway pits are proposed and suitable for at least 30% of the remaining site.

Therefore 125 houses x 120 m^3/house = 10,800 m^3

* 287.1 mm is the average annual rainfall depth in the first 2.5 mm of rainfall taken from the City of Barrie WPCP precipitation data 1998-2008

CHARLESTON SUBDIVISION
TOWNSHIP OF COLLINGWOOD
PRELIMINARY WATER BUDGET ASSESSMENT

Mitigation - LID Practices
June 2016
Infiltration Design Calculations
Total Required Area Contributing to LID/SWM Facility: 21.57 ha

Note: Red cell = user input

Average Annual Rainfall (2.5 mm)

Design Rainfall =	2.5	mm
Contributing Area =	21.57	ha
Volume Produced per 2.5 mm event =	539.3	cu.m
Average Total Yearly Depth (from 2.5 mm storm events) =	287.1	mm
Yearly Volume produced by Contributing Area=	61,927.47	cu.m
Annual Defecit =	20,868.14	cu.m
Volume check =	OK	
Yearly Infiltrated volume =	61,927.47	cu.m
Net Infiltration with mitigation =	41059.33	cu.m

Note: Infiltration will come from a combination of end of pipe SWM facilities and lot level LID practices

Rainfall Data summary: Barrie WPCC (1998-2008)		
Design Rainfall	2.5	mm
Min yearly depth	234.3	mm
Max yearly depth	333.2	mm
Average Yearly Depth	287.1	mm

Average Total Annual Rainfall 926.55 mm

APPENDIX F:
PHOSPHORUS BUDGET

Development Export Summary

Development :Charleston Subdivision

Pre-Development Phosphorus Export

DEVELOPMENT : Charleston Subdivision

Landuse		Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Agricultural				
Cropland	Existing Condition Developmen	25.45		4.17
	Agricultural Land use Class Total :	**25.45**		**4.17**
	Development Total :	**25.45**		**4.17**

Cropland Site Sediment & Phosphorus Pre-Development Export

DEVELOPMENT : Charleston Subdivision

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea : Existing Condition Development

Slope Area (ha)	25.45	R (rainfall / runoff for Lake Simcoe)	120.00
Surface Slope Gradient (%)	1.00	K (soil errodability factor)	0.29
Length of Slope (m)	1,100.00	NN (determined by slope)	0.30
Cropt Type Factor)	0.02	LS (slope length gradient factor)	0.38
Tillage Type Factor	0.25	C (crop management factor)	0.01
		P (prevention + capture)	0.37
		Soil Loss (kg/year)	0.02
		Phosphorus export (kg/ha/yr)	0.16
		Phosphorus load (kg/yr)	4.17

PRE Developed Area (ha) : **25.45**

Phosphorus export (kg/ha/yr) : **0.16**

Phosphorus load (kg/yr) : **4.17**

Updated : Sept 2014

Post-Development Phosphorus Export

DEVELOPMENT : Charleston Subdivision

Landuse	Area (ha)	P coeff (kg/ha)	Pload (kg/yr)
Urban			
Residential	25.45	0.41	22.91
Urban Land use Class Total :	**25.45**		**22.91**
Development Total :	**25.45**		**22.91**

Updated : Sept 2014

Cropland Site Sediment & Phosphorus Post-Development Export

DEVELOPMENT : Charleston Subdivision

COLOUR KEY : Site Specific Input | Constant / Lookup | Calculation

SubArea :

Slope Area (ha)
Surface Slope Gradient (%)
Length of Slope (m)

Cropt Type Factor)
Tillage Type Factor

R (rainfall / runoff for Lake Simcoe)
K (soil errodability factor)
NN (determined by slope)

LS (slope length gradient factor)
C (crop management factor)
P (prevention + capture)
Soil Loss (kg/year)
Phosphorus export (kg/ha/yr)
Phosphorus load (kg/yr)

PRE Developed Area (ha) :
Phosphorus export (kg/ha/yr) :
Phosphorus load (kg/yr) :

Updated : Sept 2014

Post Dev BMP

Area (ha)	Treated Area %	P coefficient	P coefficient	P Load Reduction (kg/yr)	Rationale
Best Management Practices (BMP) Applied (and Rationale)					
Residential					
3.72	100	0.88	100 %	3.27	
Enhanced Grass/Water Quality Swales					
Residential					
11.19	100	0.88	63 %	6.20	
Wet Detention Ponds					
Residential					
8.97	100	0.88	63 %	4.97	
Wet Detention Ponds					

Updated : Sept 2014

Development Area P and BMP Summary

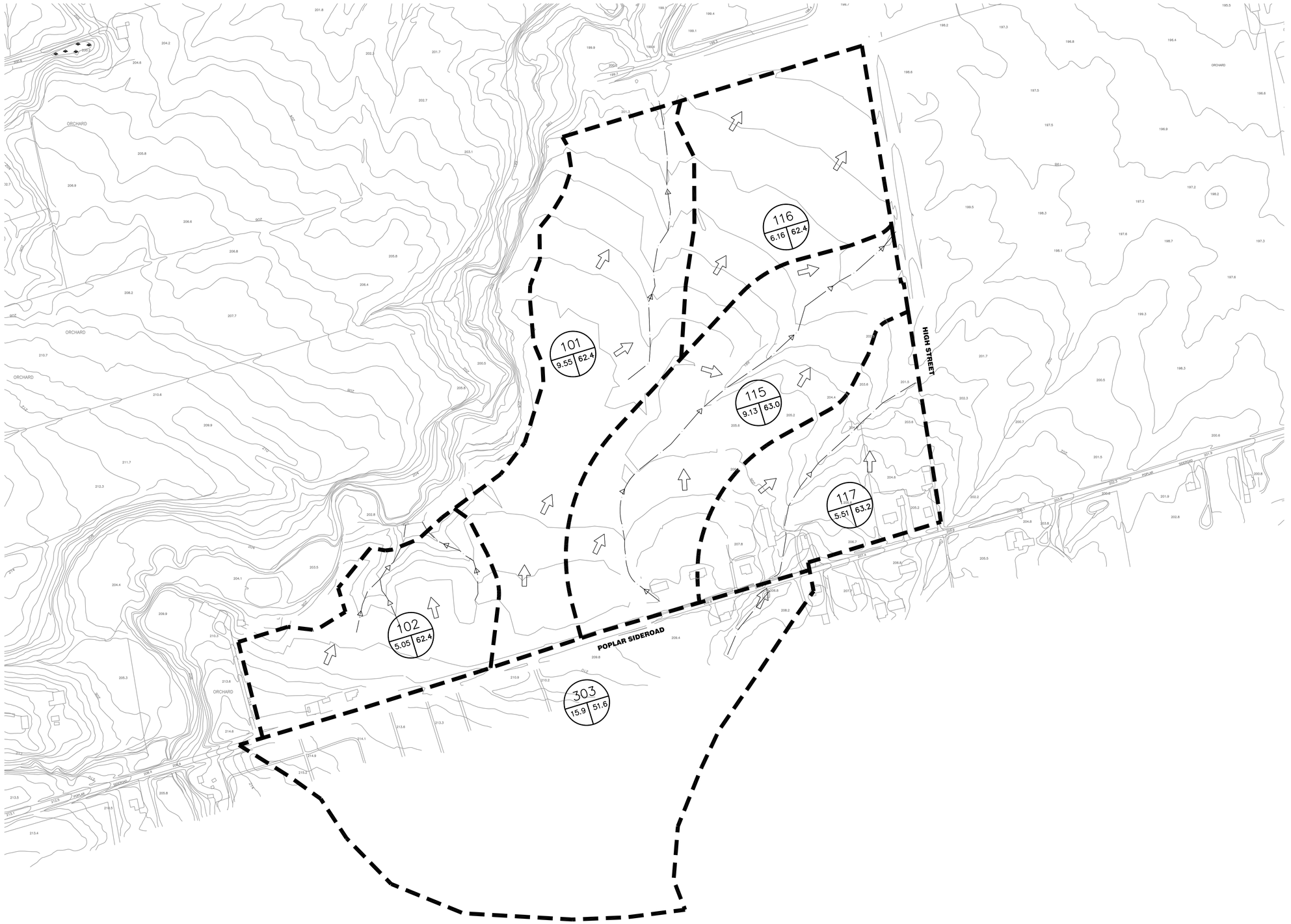
Total PreDevelopment Area (ha):	25.45
PreDevelopment Area excluding Wetlands (ha):	25.45
Total PostDevelopment Area (ha):	25.45
Total Area treated by BMP's (ha):	23.88
Treated Area total:	23.88
Total PreDevelopment Load (kg/yr):	4.17
Total PostDevelopment Load (kg/yr):	22.91
Total P Load Reduction with BMP's (kg/yr):	14.44
Minimum P Load Reduction Required:	18.74
Total PostDevelopment Load with BMP's (kg/yr)	8.47

Conclusion : No Net Increase in P Load.

Updated : Sept 2014

Post Dev Construction

Sediment/Silt Fence
Rock Check Dam



CONTRACT DRAWINGS

CONTRACTOR MUST VERIFY ALL DIMENSIONS AND BE RESPONSIBLE FOR SAME. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER BEFORE COMMENCING WORK. DRAWINGS ARE NOT TO BE SCALED.

NOTES

LEGAL SURVEY BOUNDARY ON THIS PLAN PREPARED BY VAN HARTEN SURVEY INC., PLAN 51R-35424, DATED MAY 30, 2007.

TOPOGRAPHIC SURVEY INFORMATION COMPLETED BY C.C. TATHAM & ASSOCIATES LTD.

DRAFT PLAN SHOWN BASED ON PLAN PREPARED BY MHBC PLANNING, DATED JUNE 7, 2016.

NO.	REVISIONS	DATE	INITIAL
1.	DRAFT PLAN RE-SUBMISSION	JUNE/2016	JRA/DJH

APPROVED

CHARLESTON HOMES
RESIDENTIAL DEVELOPMENT
TOWN OF COLLINGWOOD

PRE-DEVELOPMENT DRAINAGE PLAN

C.C. Tatham & Associates Ltd.
Consulting Engineers
Collingwood Bracebridge Orillia Barrie Ottawa

SCALE: 1:2,000		JOB NO. 114056	
DESIGN: AW	CHECKED: JRA	DWG. **DP-1**	
DRAWN: LL	DATE: JUNE 2016		

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TOPOGRAPHIC SURVEY INFORMATION COMPLETED BY C.C. TATHAM & ASSOCIATES LTD.

DRAFT PLAN SHOWN BASED ON PLAN PREPARED BY MHBC PLANNING, DATED JUNE 7, 2016.

NO.	REVISIONS	DATE	INITIAL
1.	DRAFT PLAN RE-SUBMISSION	JUNE/2016	JRA/DJH

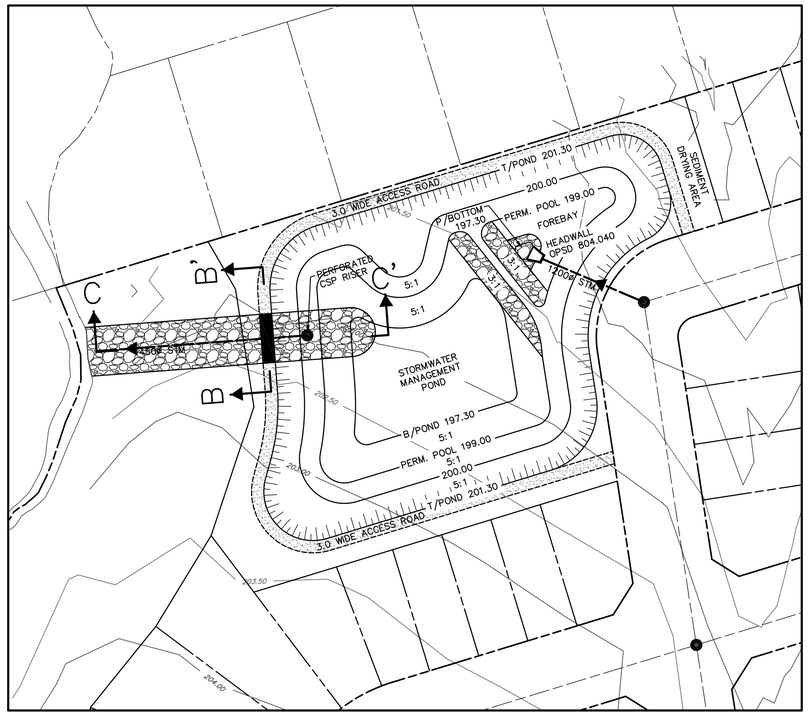
APPROVED

CHARLESTON HOMES RESIDENTIAL DEVELOPMENT
TOWN OF COLLINGWOOD

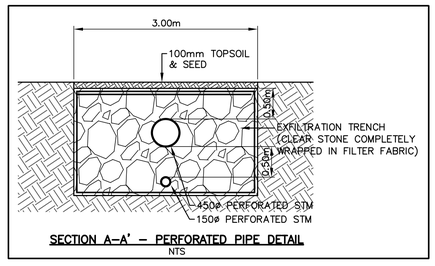
POST DEVELOPMENT DRAINAGE PLAN

C.C. Tatham & Associates Ltd.
Consulting Engineers
Collingwood Bracebridge Orillia Barrie Ottawa

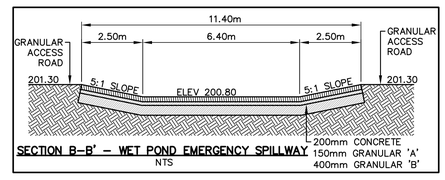
SCALE: 1:2,000		JOB NO. 114056	
DESIGN: AW	CHECKED: JRA	DWG.	DP-2
DRAWN: LL	DATE: JUNE 2016		



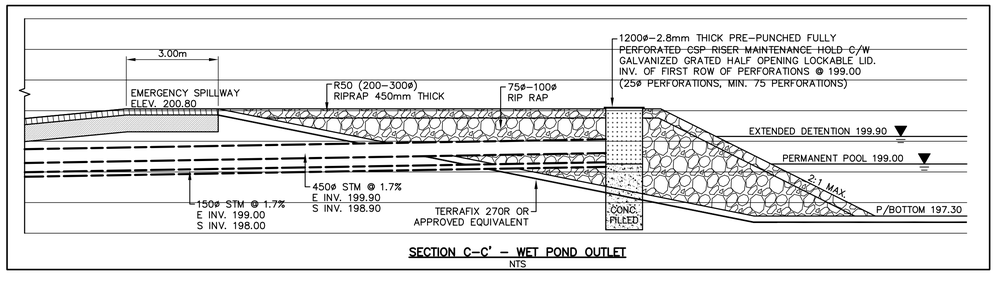
STORMWATER MANAGEMENT POND
SCALE 1:750



SECTION A–A' – PERFORATED PIPE DETAIL
NTS



SECTION B–B' – WET POND EMERGENCY SPILLWAY
NTS



SECTION C–C' – WET POND OUTLET
NTS

CONTRACT DRAWINGS

CONTRACTOR MUST VERIFY ALL DIMENSIONS AND BE RESPONSIBLE FOR SAME. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER BEFORE COMMENCING WORK. DRAWINGS ARE NOT TO BE SCALED.

NOTES

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TOPOGRAPHIC SURVEY INFORMATION COMPLETED BY C.C. TATHAM & ASSOCIATES LTD.

DRAFT PLAN SHOWN BASED ON PLAN PREPARED BY MHBC PLANNING, DATED JUNE 7, 2016.

NO.	REVISIONS	DATE	INITIAL
1.	DRAFT PLAN RE–SUBMISSION	JUNE/2016	JRA

APPROVED

CHARLESTON HOMES RESIDENTIAL DEVELOPMENT
TOWN OF COLLINGWOOD

STORMWATER MANAGEMENT POND PLAN

C.C. Tatham & Associates Ltd.
Consulting Engineers
Collingwood Bracebridge Orillia Barrie Ottawa

SCALE: AS NOTED		JOB NO.	114056
DESIGN: AW	CHECKED: JRA	DWG.	SWM-1
DRAWN: LL	DATE: JUNE 2016		