

**Site Servicing & Stormwater
Management Report**

**Greely Commercial Center
The Village of Greely**

**WMI 11-183
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Prepared by

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1.0 Introduction

WMI & Associates Limited has been retained by Alium Investments (Greely) Limited to prepare a Site Servicing & Stormwater Management Report in support of a Site Plan Application and ultimately construction of the first-phase of a commercial development located in the City of Ottawa (Village of Greely), Ontario. The Site Servicing & Stormwater Management Report provided herein has been based on discussions with the City of Ottawa staff and all proposed works are considered to be in conformance with the current City engineering design standards.

The subject site comprises a total area of 13.7ha, of which only 5.7ha at the east limit of the property is currently zoned for commercial use (Phase 1). The property is located east of Old Prescott Road, north of an existing residential subdivision along Marco Street, south of Mitch Owens Road and west of Bank Street. The site was previously used for aggregate extraction (gravel pit) and more recently was back filled with clay soils from an adjacent development and left vacant. Currently the site is considered to be unimproved lands made up of some native re-growth such as long grasses, shrubs, small trees, etc. The legal description of the property is Part of Lot 1, Concession 5, Geographic Township of Osgoode in the City of Ottawa, Ontario. Refer to **Figure 1** in **Appendix A** for the Site Location Plan.

2.0 Sanitary Servicing

2.1 Background

As per the City of Ottawa's current Official Plan, no sanitary servicing is currently allocated to the subject lands. Considering this, a private sanitary sewage collection and treatment system is proposed to facilitate the development of approximately 9,290m² (100,000ft²) of commercial retail space. The proposed sanitary services for the subject site have been designed in accordance with the City of Ottawa's Sewer Design Guidelines. Estimated sanitary sewage design flows have been calculated using the sewage flow design criteria set-out in the Ontario Building Code (2012), as well as the criteria of the MOE's Design Guidelines for Sewage Works (2008).

The sewage flows for the proposed development were determined via the use of the Ministry of the Environment's (MOE's) standard calculations and the Ontario Building Code's (OBC's) total daily sewage flow data. To determine the total daily sewage flow rate for each of the buildings proposed in Phase 1, Table 8.2.1.3.B. of the 2012 Ontario Building Code (OBC) was referenced. Using Table 8.2.1.3.B., the total daily sewage flow rate for all of Phase 1 was determined to be 69,212L/day and based on the City of Ottawa's Sewer Design Guidelines, a peaking factor of 1.5 for commercial development was used to size the sites sanitary sewer conveyance system (sewers and pump station only). Refer to **Appendix B** for the Sanitary Service Design Calculations and Sanitary Sewer Design Sheet.

2.2 Proposed Sanitary Sewer System

An internal sanitary sewer system is proposed within the commercial development, complete with sanitary service laterals to each commercial retail unit (CRU) space as illustrated on the Site Servicing Plan (SS). The proposed sanitary sewer system will drain to the southwest corner of Phase 1 adjacent to CRU 1, to a sewage pumping station which will ultimately convey the sewage to a proposed Waterloo Biofilter and Area Bed treatment system.

The proposed sewer system and pump station have been designed to accommodate all of Phase 1 of the development. The sewer system will consist of stubbed laterals terminating at the west limit of Phase 1 which will eventually be used to accommodate additional sewage flows from future phases of the development located west of Phase 1.

To accomplish adequate sewage pumping from the sanitary sewer system into the treatment facility (Waterloo Biofilter and Area Bed), the proposed lift station will be subject to a range of duties considering that it will initially accommodate only the Phase 1 lands with future phases brought online as the development grows. Upon future zoning approval, the proposed treatment facility will be shifted further west within the property to allow for the future expansion of the development west of Phase 1. In order to accommodate the increased duty as a result of additional sewage flows and total dynamic head (TDH) which the pump station will have to overcome, the proposed duplex pumps within the pumping station will simply be replaced with higher capacity pumps.

The initial duty that the pump station will be subjected to during Phase 1 is on average, 2.4L/s at 2.88m of TDH. Without knowing the details of the future phases of the development it is difficult to accurately determine the ultimate scenario but the pump station design is such that modifications to pump sizes can easily be made to accommodate increases in peak flow and TDH.

The Sewage Pump Station Wet Well and System Head Curve Design Sheets are provided in **Appendix B** for reference. Refer to Site Servicing Plan (SS), Biofilter & Area Bed Plan (BIO 1) and the Sanitary Drainage Plan (SAN) for additional details.

2.3 Proposed Treatment & Subsurface Disposal System

Due to the larger footprint required by a typical leaching bed system as well as the restriction of a maximum sewage flow rate of 5000L/day, a Waterloo Biofilter system complete with Area Bed is proposed to treat and ultimately distribute the effluent into the existing site soils is proposed immediately west of Phase 1 of the development. Based on both the Geotechnical Investigation prepared by BAE & Associates Environmental Inc. dated August 9, 2013 (provided herein) and the Hydrogeologic Evaluation prepared by Ian D. Wilson Associates Limited dated July 18, 2012 (under separate cover), the in-situ soils in the area of the proposed treatment system are considered to be a sandy silt fill which is likely to exhibit a percolation rate in the range of 40min/cm. Under Table 22-1 of the MOE "Design Guidelines for Sewage Works", the fill corresponds with a massive, structureless silt loam. Table 22-1 of the MOE Guidelines recommends a maximum loading rate of 8L/m²/day for treated sewage, and does not recommend a loading rate for untreated sewage.

The proposed Waterloo Biofilter and Area Bed system have been designed based on Waterloo Biofilter's BMEC Authorization, the in-situ soils characteristics noted above and Part 8 of the Ontario Building Code (2012) as noted below and provided by Waterloo Biofilter.

Refer to **Appendix F** for the Geotechnical Investigation noted above.

2.3.1 Waterloo Biofilter & Area Bed

The proposed sewage treatment and subsurface disposal system detailed below along with the associated collection, transmission, treatment and disposal of domestic sewage from Phase 1 of the Greely Commercial Center has been designed based on a *Rated Capacity* of **69,212 L/day** total daily design flow. Approximately one (1) days worth of storage has been built into the design of the Waterloo Biofilter system which is considered to balance out any peaking of sewage inflows:

Grease Interceptors (by others and external to the buildings)

- two (2) grease interceptors, each having a capacity of approximately 2840 L, to receive all kitchen wastewater from the proposed grocery store and restaurants, discharging into the sanitary sewer system and ultimately pumped into the trash tank;

Trash Tank

- one (1) trash tank, having a capacity of approximately 22,500 L, to receive all sanitary wastewater, discharging into the aeration tank;

Aeration Tank

- one (1) aeration tank, having a capacity of approximately 45,400 L, equipped with diffusers, discharging into septic tank #1;

Septic Tanks

- three (3) septic tanks, operating in series, each having a capacity of approximately 45,400 L, with the second and third septic tank in the series each equipped with two (2) Waterloo Biofilter submerged media chambers and two (2) effluent filters, discharging into balance tank #1;

Balance Tanks

- two (2) balance tanks, each having a capacity of approximately 36,000 L, connected with bottom drains; balance tank #2 is equipped with a simplex pump, rated at approximately 216 L/min at an estimated total dynamic head (TDH) of 12.2 m, discharging to the closed loop (Bulk Filled) Waterloo Biofilter tank; balance tank #2 is also equipped with two (2) pairs of duplex pumps, with each pump rated at approximately 341 L/min at an estimated total dynamic head (TDH) of 16.2 m, discharging to the nitrifying Waterloo Biofilter tanks;

Closed Loop (Bulk Filled) Waterloo Biofilter Tank

- one (1) closed loop (bulk filled) tank, having a capacity of approximately 27,000 L, filled with approximately 26.8 cubic metres of Biofilter media, bottom draining back to the aforementioned balance tank #2;

Nitrifying Waterloo Biofilter Tanks

- four (4) nitrifying tanks, each having a capacity of approximately 45,400 L, operating in parallel and connected with bottom drains, each comprising three (3) Waterloo Biofilter baskets with approximately 9.68 cubic metres of Biofilter media (116.16 cubic metres total); nitrifying biofilter tank #4 is equipped with a simplex pump, rated at approximately 197 L/min at an estimated total dynamic head (TDH) of 7.3 m, recirculating the nitrified effluent; nitrifying tank #4 is also equipped with duplex pumps, with each pump rated at approximately 212 L/min at an estimated total dynamic head (TDH) of 7.0 m, discharging to the Waterloo Biofilter WaterNOx-S tank;

WaterNOx-S Waterloo Biofilter Tank

- one (1) WaterNOx-S two-compartment de-nitrifying tank, having a capacity of approximately 45,400 L, comprising eight (8) Waterloo Biofilter submerged media chambers filled with Biofilter media, the first compartment equipped with duplex submersible pumps to dose the chambers; the second compartment equipped with duplex submersible pumps, rated at approximately 204 L/min at an estimated total dynamic head (TDH) of 12.5 m, recirculating a portion of the de-nitrified effluent and discharging a portion to the polishing Waterloo Biofilter tanks;

Polishing Waterloo Biofilter Tanks

- two (2) polishing tanks, each having a capacity of approximately 27,500 L, operating in parallel and connected with bottom drains, each comprising two (2) Waterloo Biofilter baskets with approximately 9.07 cubic metres of Biofilter media (36.28 cubic metres total); polishing tank #2 is equipped with duplex pumps, with each pump rated at approximately 310 L/min at an estimated total dynamic head (TDH) of 7.2 m, recirculating a portion of the polished effluent and discharging a portion to the area bed;

Waterloo Biofilter Area Bed

- a **stone area** of 1384 square metres (16.1 metres x 87.5 metres) consisting of a minimum 250 millimetre thick layer of 19 millimetre washed stone, divided into four (4) cells, each cell equipped with fifteen (15) runs of 75 millimetre diameter distribution pipes 20.5 metres in length; and covered with a permeable Geotextile fabric;

$$\begin{aligned} \text{Minimum Stone Area} &= Q/50 \\ &= (69212)/50 \\ &= 1384\text{m}^2 \\ \text{Proposed Dimensions} &= 16.1\text{m(L)} \times 87.5\text{m(W)} \end{aligned}$$

- a **sand area** of 6921 square metres (65.0 metres x 107.7 metres) consisting of a layer of sand with a minimum thickness of 250 millimetres and a percolation rate of 6 to 10 minutes per centimeter, with less than 5% fines;

- a cover layer comprising topsoil and grass, with a thickness of 150 millimetres, on the top of the area bed; and

$$\begin{aligned} \text{Minimum Sand Area} &= QT/400 \\ &= (69212)(40)/400 \\ &= 6921\text{m}^2 \\ \text{Proposed Dimensions} &= 65\text{m(L)} \times 107.7\text{m(W)} \end{aligned}$$

- one (1) carbon dose system, injecting carbon source to the nitrifying tank #1; and
- one (1) alkalinity dose system, injection alkalinity dosing chemical into the recirculation line from nitrifying tank #1;
- all controls, electrical equipment, instrumentation, piping, pumps, valves and appurtenances essential for the proper operation of the aforementioned sewage works;

Effluent Objectives

(1) Best efforts shall be used to design, construct and operate the *Works* with the objective that the concentrations of the materials named below as effluent parameters are not exceeded in the effluent being discharged from the tertiary sewage treatment system.

Table 1 – Effluent Objectives		
Effluent Parameter	Concentration Objective (milligrams per litre unless otherwise indicated)	Loading Objective (kilograms per day unless otherwise indicated)
cBOD5	10	-
Total Suspended Solids	10	-
Nitrate Nitrogen	-	0.22

The Ministry of the Environment Procedure D-5-4 describes the methodology for nitrogen loading. In order for a development not to exceed the allowable concentration of nitrate in the groundwater directed to a neighbouring property, the loading objective noted above is used as the property boundary condition. This method calculates the allowable mass of nitrogen in kg/year exiting the treatment plant that will yield the appropriate concentration at the property boundary after being diluted by annual infiltration. It is considered preferable and reasonable to use this same method by providing the Objectives in kg/day to conform to the original Procedure D-5-4 method. In an effort to encourage water conservation methods but considering that these methods result in increased effluent concentrations as a result of a reduction in dilution of the effluent, the most relevant way to measure the contamination of nitrogen discharged to the environment has been considered to be based on mass loading in kg/day as described above. Based on a total flow volume (69,212L/day) and target concentration (3.2mg/L, refer to the Hydrogeologic Evaluation prepared by Ian D. Wilson Associates Limited dated July 18, 2012 provided under separate cover), the mass loading objective for the site is considered to be 0.22kg/day.

Monitoring & Recording

Upon commencement of operation of the sewage treatment system, the owner shall carry out the following monitoring program:

- (1) All samples and measurements are to be taken at a time and in a location characteristic of the quality and quantity of the effluent stream over the time period being monitored.

- (2) Samples shall be collected at the locations and frequencies as specified below, by means of the specified sample type and analyzed for each parameter listed and all results recorded:

Influent Monitoring

Sampling Location: Trash Tank
Sampling Type: Grab
Sampling Frequency: Monthly
Sampling Parameters: BOD₅, Total Suspended Solids, Total Kjeldahl Nitrogen (TKN), Total Phosphorus, Temperature, pH, and Alkalinity, Fats Oils and Grease (FOG)

Effluent Monitoring

Sampling Location: Polishing Tank #1
Sampling Type: Grab
Sampling Frequency: Monthly
Sampling Parameters: cBOD₅, Total Suspended Solids, (Ammonia + Ammonium), Nitrogen, Nitrate Nitrogen, Nitrite Nitrogen, Total Kjeldahl Nitrogen (TKN), Total Phosphorus, Temperature, pH, and Alkalinity

3.0 Water Servicing

3.1 General

Although an existing municipal watermain is present at the east limit of the site (Bank Street), no existing water servicing is provided to the site. As per the City of Ottawa's current Official Plan, no water servicing is currently allocated to the subject lands and as a result a municipal connection request has been denied. Considering this, a private on-site water supply (well) will be utilized to supply the necessary domestic and fire protection water supply for the proposed commercial retail development. Based on the Ministry of the Environments classification provided under the Drinking-Water Systems (DWS) Regulation (O. Reg. 170/03) mandated under the Safe Drinking Water Act (SDWA), the proposed DWS is classified as a "Small Non-Municipal Non-Residential" drinking water system. The proposed developments drinking water system will ultimately be detailed in an Engineers Evaluation Report (EER) upon the completion of construction of the system as regulated under O. Reg. 170/03 Schedule 21. The supply and distribution system external to the proposed water treatment building are detailed in the following section of this report.

3.2 Existing Water Supply

There are three (3) existing drilled wells located on the subject site which extend to depths ranging from 55-61m. As per the recommendations outlined within the Hydrogeologic Evaluation prepared by Ian D. Wilson Associates Limited dated July 18, 2012 (under separate cover) as well as the Hydrogeologic Work Plan for Water Supply Letter prepared by Ian D. Wilson Associates Limited dated January 24, 2014, the three (3) existing on-site wells will be abandoned in accordance with the Ontario Regulation 903, once all testing is concluded to the satisfaction of the City.

Refer to the documents noted above for detailed information related to the existing wells located on-site.

3.3 Proposed Water Supply

As per the City of Ottawa's request, a single deeper well will be constructed on-site to supply both the domestic and fire protection water supply for the commercial retail development. The new drilled well will consist of a 150mmØ (6 inch nominal) casing will be extended to a depth of approximately 70-80m and will be located at the northwest corner of Phase 1, between the sites main access off of Mitch Owens Road and proposed CRU 13 building. The new drilled well will be connected to a proposed water treatment unit/space located at the west limit of CRU 13 which will house all the necessary equipment to provide both primary and secondary treatment of the raw water prior to pumping it through the proposed potable water distribution system (50mmØ water service lines). From the well the raw water will enter the water treatment unit where it will receive both primary and secondary disinfection via the use of cartridge filtration, ultraviolet light and chlorination respectively before entering a 9,000L storage tank (final size subject to actual well production flow rate) located external to the water treatment unit. Based on demand, water will be pumped from the treated storage tank back into the water treatment unit where the distribution systems pump is located along with the additional water monitoring and metering equipment. From the proposed water treatment unit a 50mmØ water distribution system will be constructed to provide the treated domestic water supply to each of the proposed CRU spaces located within Phase 1. Assuming a minimum pressure within the 50mmØ water service lines at the furthest (governing) location to be conservative (CRU 9) and based on the PHD flows for each CRU space all occurring simultaneously, the minimum pressure required by the pump located within the water utility unit of CRU 13 is 379KPa (55psi).

The proposed 9,000L domestic water tank size will need to be confirmed once the new well is drilled and a pump rate is recommended by the hydrogeologist. As outlined in the Hydrogeologic Work Plan for Water Supply Letter noted above, a well yield in the range of 90L/min is anticipated.

Refer to the Water Facility & Fire Storage Plan (WF) for details related to the water quality equipment proposed within the water treatment unit. Considering that the proposed water system will be privately operated and that all water treatment equipment will be housed within a single unit/building, it has been assumed that all equipment and construction are governed by the plumbing section of the Ontario Building Code. As previously noted, upon completion of construction of the water treatment unit an Engineers Evaluation Report will be prepared and submitted to the MOE to confirm the DWS's compliance with O. Reg. 170/03.

3.4 Design

Using the methodology outlined in the Ministry of the Environments (MOE) Design Guidelines for Drinking-Water Systems & Sewage Works dated 2008 and the total daily sewage flow rates calculated for each of the buildings proposed in Phase 1 based on Table 8.2.1.3.B. of the 2012 Ontario Building Code (OBC), the Average Daily Demand (ADD) for each unit was determined. Using Table 8.2.1.3.B., the Average Daily Demand (ADD) anticipated for the proposed development was determined to be 69,212L/day (48.1L/min), the Maximum Daily Demand (MDD) was determined to be 103,818L/day (72.1L/min) based on a peaking factor of 1.5 as per the MOE Guidelines and the Peak Hourly Demand (PHD) was determined to be 207,637L/day (144.2L/min) based on a peaking factor of 3. Considering the new drilled wells assumed recommended pumping rate of 90L/min and the proposed storage volume of 9,000L for reserve capacity, the Peak Hourly Demand (PHD) can be provided for more than the necessary 1-hour minimum duration. Considering the information noted above, we do not anticipate any issues with the new well supplying the water necessary to accommodate the proposed commercial development.

3.5 Fire Protection

As a result of the sites absence of an accessible municipal water supply for fire protection and based on Subsections 3.2.5.7. and A-3.2.5.7. of the 2012 Ontario Building Code (OBC), Division B, Part 3, the proposed development is required to provide on-site Fire Protection Water Storage. Excluding proposed CRU 1-3, the future addition and CRU 10 which are all to consist of an internal sprinkler systems, each of the other proposed CRU spaces were analyzed individually to determine an associated fire protection water storage volume and flow rate based on the guidelines listed above. The fire protection water supply for these buildings will share the same reservoir as the sprinklered buildings but will be conveyed via a separate 200mmØ dry hydrant system consisting of two (2) hydrants located adjacent to CRU 1 and CRU 10. As a result of the significantly large exposure distances between each of the CRU spaces as well as the 4-hour firewalls located between CRU 3/Future Addition and CRU 4 and between CRU 8 and CRU 9, the potential for a fire in one building to transfer to the other is considered to be minimal. The largest of the non-sprinklered CRU spaces (CRU 13) governed the fire storage systems design with a total volume of 228,532L. Based on Table 2 provided in the OBC A.3.2.5.7., the required minimum water supply flow rate is 6300L/min and is to be provided at the furthest hydrant near CRU 10. Considering the total storage volume of 228,532L, the minimum water supply flow rate of 6300L/min can be provided for longer than the 30min minimum as required by the OBC. Based on discussions with Ottawa Fire Services, only 4500L/min is required at the furthest hydrant and this flow rate is to govern the design of the dry hydrant system rather than the value determined from the OBC. Based on correspondence from Ottawa Fire Services (OFS), the maximum allowable pressure to be applied to a remote hydrant system is 690KPa (100psi). Considering this maximum pressure and the minimum required flow rate of 4500L/min (75L/s), the proposed 200mmØ dry hydrant

main is capable of conveying the required flow rate to the furthest hydrant located just west of CRU 10 at a pressure of approximately 645KPa (93.5psi). This is considered to be well within the capabilities of OFS's pumper truck as noted in the attached correspondence. Refer to **Appendix F** for correspondence with OFS.

As noted above, the fire protection water supply for the sprinklered buildings will share the same reservoir as the non-sprinklered buildings but will be conveyed via a separate 150mmØ diameter watermain connected to a diesel powered fire pump located within a designated space at the west limit of CRU 13. Based on a design memo prepared by Bird Engineering Ltd. dated January 3, 2010 related to the sites Fire Sprinkler Water Requirements for CRU 1-3 including the future addition and CRU 10, the proposed fire pump will be capable of providing 27.8L/s (440usgpm) @ 483KPa (70psi) pressure to the base of the most remote sprinkler system riser. The total required storage volume for the fire pump system is approximately 150,000L which is less than that required by the dry hydrant system for the non-sprinklered buildings which is considered to govern the water reservoirs design at 228,532L. Refer to **Appendix F** for the Fire Sprinkler Water Requirements Memo prepared by Bird Engineering Ltd. In order to provide the minimum pressure of 483KPa (70psi) at the base of the most remote (governing) sprinkler system riser located within CRU 10 and based on the minimum required flow rate of 27.8L/s (440usgpm) to be conveyed by the 150mmØ sprinkler main, the minimum pressure required by the fire pump located within the water utility unit of CRU 13 is 586KPa (85psi). Based on correspondence with Xylem Inc. (pump supplier), a fire pump capable of 31.5L/s (500usgpm) at pressures ranging from 372 - 1724KPa (54psi - 250psi) in 35KPa (5psi) increments is available.

In order to provide the necessary fire protection water storage on-site, six (6) 45,400L concrete tanks are proposed to be connected in series via 200mmØ pipes at the base of the tanks to both the fire pump system located within CRU 13 and the dry hydrant system located along the edge of the drive aisle between CRU 13 and the sites main access off of Mitch Owens Road. A 50mmØ water connection complete with float activation located internal to Fire Storage Tank #1 provided from the water utility room at the west limit of CRU 13 will ensure that the fire storage system remains full at all times.

The Water Supply Design Calculations and Fire Protection Water Storage Design Calculations are provided in **Appendix B** for reference. Refer to Site Servicing Plan (SS) and Water Facility & Fire Storage Plan (WF) for additional details.

4.0 Stormwater Management

4.1 Design Criteria Guidelines

The stormwater management facility that has been designed for this site is considered as a depressed storage basin which will work in conjunction with an oil/grit separator (OGS) unit. The proposed depressed storage basin has been designed to address the necessary quantity control as well as aiding the OGS unit in providing quality for the proposed development.

The stormwater management design for the site will incorporate the policies and criteria of a number of agencies, including the Ministry of the Environment (MOE), South Nation Conservation Authority (SNCA) and the City of Ottawa (City). From these, the stormwater management design criteria for the subject site are summarized below:

- Stormwater Quality controls will be provided based on the guidelines described in the Ministry of the Environment 2003 Stormwater Management Planning and Design Manual at an Enhanced Level of Protection (Total Suspended Solids removal efficiency of 80%).
- City/SNCA Guidelines will be used as a reference for the design of the stormwater management system.
- The Ottawa MacDonald-Cartier International Airport rainfall intensity-duration-frequency (IDF) curves will be used to determine the peak flow rates and runoff volumes generated on the site.
- Post-development peak flows will be controlled to pre-development levels for each of the 2-100 year design storm events which are based on the governing of the 6, 12 and 24-hour SCS Type-II storm distributions and the 3-hour Chicago storm distribution.
- Erosion and sediment control shall be provided during the construction phase and until the site is fully stabilized.

4.2 Pre-Development Condition

4.2.1. General

The subject lands existing condition for all intents and purposes of this stormwater management report has been considered the condition prior to the site alterations resulting from the original aggregate extraction (gravel pit) and backfilling of material (clay) imported from a local development. Based on this assumption, the sites original drainage path/outlet remains consistent with the overall watersheds characteristics and both the pre-development peak flows and runoff volumes are considered to be conservative (low) as a result of the sites original soil conditions being that of a granular with cobbles/boulders composition.

The majority of the site is considered to be unimproved lands consisting of small trees shrubs along with heavy grass cover. Runoff from the majority (east portion) of the site has been assumed to originally concentrate via overland sheet flow at the predominant drainage feature along the perimeter of the site which is a large concrete box culvert located under Bank Street at the southeast corner of the site. The topography of the Phase 1 lands can be described as gently sloping, with an average slope in the range of approximately 3.2% in a west to east direction when considering an average elevation between the south and north property boundaries along the west limit of Phase 1 and the existing elevation at the east property line adjacent to the site outlet described above. The Phase 1 lands are considered to be self-contained with no external drainage contributing runoff. Phase 1 is bound to the north by Mitch Owens Road, to the east by the Bank Street, to the west by additional lands intended for future phases of development and to the south by an existing residential development which drains mainly in a west to east direction along Marco Street. A portion of the sites residual lands to the west of Phase 1 are assumed to originally be directed towards the east limit of the property but due to the existing topography of these lands, no runoff will be conveyed to the Phase 1 outlet until future development occurs.

4.2.2. Soil Conditions

According to the Soils Map of the Regional Municipality of Ottawa-Carleton (excluding the Ottawa Urban Fringe), Sheet 2, Ontario, Soil Survey Report No. 58 prepared for the Department of Agriculture, the site originally consisted of Kars Gravelly Sandy Loam which is described as having excessive to good drainage. Gravelly Sandy Loam belongs to Hydrologic Soil Group 'A'.

Based on the Geotechnical Investigation completed by BAE & Associates Environmental Inc. and dated August 9, 2013, the current in-situ soils that located within the center of the site where previous aggregate extraction works occurred was determined to consist predominantly of clay with traces of shale pebbles. The soils along the perimeter of the site consist of the original granular/cobble/boulder material as these lands were not disturbed. Groundwater was encountered at a several different levels based on the 31 boreholes examined with the majority experiencing groundwater at approximately 2.4m (8ft) below the existing ground grades. Refer to **Appendix E** for the Geotechnical Investigation prepared by BAE & Associates Environmental Inc.

The Runoff Coefficients and Curve Numbers associated with the site drainage area were computed by calculating weighted values based on corresponding land uses and soil type. The Hydrologic Soil Group was determined in accordance with the Ontario Ministry of Transportation (MTO) Soil Classification System. As previously noted, to be conservative and to account for peak flows and runoff volumes representative of that experienced on-site prior to the aggregate extraction works, the original in-situ soils (granular/cobble/boulder material) has been considered in the design calculations and hydrologic modelling of the existing condition. Since the majority of the pervious areas in the post-development condition are located along the perimeter of the property where no aggregate extraction occurred, the original in-situ soils were also considered in the design calculations and hydrologic modelling of these areas.

4.3 Post-Development Conditions

4.3.1. General

The proposed site works include 5 new commercial buildings comprising a total of 13 commercial retail units (CRUs) along with a potential future addition and a new asphalt parking lot. The development is intended to proceed in phases with the first phase (Phase 1) consisting of approximately 9,290m² (100,000ft²) of building area on 5.7ha of land located at the east limit of the property as previously described.

Phase 1 of the development has been designed in detail as contained herein. It contains the majority of the east half of the property (5.7ha). Future phases of the development are unknown at this point and as a result, have not yet been designed in detail however 2.26ha west of Phase 1 has been accounted for in the proposed storm sewer systems design to ensure a sufficient drainage outlet is provided. The proposed storm sewer design has accounted for the 2.26ha of undeveloped lands which ultimately will require independent on-site quantity and quality controls. Finally, during the design of the future lands an analysis of the outlet structures located within the proposed depressed storage basin will be completed to ensure the safe conveyance of any additional peak flows are accommodated downstream.

The sites residual lands west of the 2.26ha noted above are assumed to be directed west towards Old Prescott Road/Mitch Owens Road as suggested by the original site topography prior to the aggregate extraction works.

Refer to **Figure 2** in **Appendix A** for the Post-Development Drainage Plan.

4.3.2. Post-Development Drainage

Post-development drainage patterns on-site will be generally consistent with that of the existing condition. Phase 1 of the site is considered to be self-contained for the purposes of sizing the stormwater management facility (depressed storage basin).

The proposed development will consist of overland sheet flow drainage which will concentrate at a series of proposed catchbasins prior to being conveyed via a proposed storm sewer system connected to the depressed storage basin. Two (2) sections of storm sewer are proposed to capture and convey the runoff from Phase 1 and direct it into the depressed storage basin located at the southeast corner of the property. One section of storm sewer is proposed centrally within Phase 1 and will capture the majority of the sites runoff while the other is located along the south limit of Phase 1 and will also provide a future drainage outlet for the Phase 2 lands as previously described. Downstream of the depressed storage basin, stormwater will pass through a proposed Oil / Grit separator before outletting to the west ditch within the Bank Street right-of-way. Ultimately from the west ditch of the Bank Street right-of-way the sites stormwater runoff will enter the existing concrete box culvert located under Bank Street and be conveyed west as experienced in the existing condition.

The existing concrete box culvert under Bank Street is considered to also accept runoff from the municipal right-of-way prior to outletting to an existing swale located downstream (east) of the right-of-way.

The proposed depressed storage basin will be used to attenuate the post-development peak flows to the corresponding pre-development target rates for each of the 2-100 year design storm events.

4.3.3. Rainfall Data

The 6, 12 and 24-hour SCS Type-II and the 3-hour Chicago Storm rainfall distributions were used for the 1:2, 1:5, 1:10, 1:25, 1:50 and 1:100 year design storm event calculations. The SCS and Chicago storms were developed from the recorded rainfall data from the Ottawa MacDonald-Cartier International Airport rainfall Intensity-Duration-Frequency (IDF) curves/values. Due to the more conservative values calculated for the storage volumes required to attenuate the post-development peak flows to the corresponding pre-development target rates for each of the design storm events, the design utilizes the 12-hour SCS Type-II storm distribution.

4.4 Pre-Development Condition Modelling Results

Using the site drainage area as illustrated on **Figure 2** and the program SWMHYMO, the total flows were determined for the 2-year, 5-year, 10-year, 25-year, 50-year and 100-year design storm events. These flows are summarized in **Table 1** below. The hydrologic model runs for the pre-development 6-hour, 12-hour and 24-hour SCS Type-II and 3-hour Chicago storm distributions can be found in **Appendix D**.

Table 1: Pre-Development Peak Flows

Catchment	Area (ha)	Pre-Development Peak Flows (m ³ /s) (12-hour SCS Type-II Storm Distribution)					
		2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Total D.A. (Phase 1)	4.83	0.042	0.084	0.118	0.167	0.208	0.251

4.5 Post-Development Condition Modelling Results

The post-development peak flows are summarized in **Table 2** below.

Table 2: Post-Development Uncontrolled Peak Flows

Catchment	Area (ha)	Post-Development Uncontrolled Peak Flows (m ³ /s) (12-hour SCS Type-II Storm Distribution)					
		2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Total D.A. (Phase 1)	4.83	0.368	0.530	0.642	0.785	0.895	1.005

By comparing **Tables 1** and **2**, it is evident that the total uncontrolled post-development peak flows exceed the pre-development levels for 'Phase 1' of the development and thus some peak flow attenuation is required before releasing the sites runoff to the outlet (existing concrete box culvert under Bank Street). The proposed stormwater management facility will be designed to incorporate quantity control for the runoff generated on-site.

4.6 Stormwater Quantity Control

A comparison between the 6-hour, 12-hour and 24-hour SCS Type-II and 3-hour Chicago storm distributions was completed to determine which storm distribution would be used for sizing the proposed stormwater management facility. The design storms based on the 12-hour SCS Type-II storm distribution required greater storage volumes than the same design storms based on the other three (3) storm distributions when modelled using SWMHYMO. Therefore, the 12-hour SCS Type-II storm distribution was used to size the proposed stormwater management facility (Depressed Storage Basin). The other three (3) storm distributions have also been run to confirm that the proposed stormwater management design will work effectively under all conditions.

Table 3 below summarizes the storage-storage-discharge characteristics for the depressed storage basin and the corresponding uncontrolled and controlled post-development peak flows and pre-development target rates.

Table 3: Depressed Storage Basin Characteristics

Storm Event (Year)	Area (ha)	Pre-Development Peak Flow (m ³ /s) (per Table 1)	Basin Inflow Post-Development <u>Uncontrolled</u> Peak Flow (m ³ /s) (per Table 2)	Basin Outflow Post-Development <u>Controlled</u> Peak Flow (m ³ /s)	Basin Storage Provided (m ³)	Estimated Water Levels (m)
2	4.83	0.042	0.368	0.024	1014	104.25
5		0.084	0.530	0.057	1385	104.53
10		0.118	0.642	0.097	1609	104.68
25		0.167	0.785	0.136	1903	104.87
50		0.208	0.895	0.169	2135	105.02
100		0.251	1.005	0.230	2328	105.13

Refer to **Section 4.8** for the Stormwater Management Facility Characteristics.

4.7 Stormwater Quality Control

The stormwater management requirements for this site were determined based on the City of Ottawa Design Guidelines. The appropriate level of quality control was determined to be an 'enhanced' level of protection as defined by the MOE's Stormwater Management Planning & Design Manual (2003), which equates to the provision of 80% total suspended solids (TSS) removal efficiency.

In determining the stormwater management practices to implement for the proposed development, various methods were considered. During the review, the main factors considered were as follows:

- Existing land characteristics and uses (soils, topography, location, etc.).
- Municipal requirements with regard to quality and/or quantity control and maintenance.
- Facility feasibility.

Based on the above and the known characteristics of the native soils (based on the Geotechnical Investigation prepared by BAE & Associates Environmental Inc. provided in **Appendix E**) the use of an oil-grit separator (CDS PMSU2015_6 or approved equivalent) is considered to provide sufficient TSS removal. It is proposed to be located downstream of the control-manhole (orifice plate) and the depressed storage basin. Pre-treatment for the oil/grit separator will be provided via sumps located within the catchbasins and catchbasin manholes, within a vegetated overland basin inlet swale and within the vegetated depressed storage basin. In addition to the required total suspended solids removal efficiency the overall stormwater management system is proposed to provide, some inherent water balance and filtration benefits due to the stormwater runoff traveling through the vegetated surfaces of the overland basin inlet swale and depressed storage basin (i.e. nutrient uptake, evapotranspiration, etc.).

For detailed quality control sizing calculations refer to **Appendix C**.

4.8 Stormwater Management Facility Characteristics

Details of the proposed stormwater management facility are summarized below:

- The proposed depressed storage basin is designed to attenuate the site's stormwater runoff prior to releasing it off-site. Quantity control will be provided to attenuate each of the 2-100 year design storm post-development peak flows to the corresponding pre-development target rates. This form of stormwater attenuation will also provide some inherent water balance benefits via evapotranspiration, suspended solids removal capabilities, and nutrient uptake through the vegetation provided within the depressed storage basin.

- The proposed depressed storage basin will consist of a single inlet structure located centrally and at the north limit of the basin. The proposed 825mmØ inlet pipe complete with headwall located at the downstream end of the on-site storm sewer system will convey the minor system (up to and including the 5-year design storm peak flow) from Phase 1 into the depressed storage basin. Peak flows in excess of the minor system flows (greater than the 5-year design storm peak flow) will be conveyed via overland sheet flow to the depressed storage basin based on the proposed topographic relief in this direction. A proposed Overland Basin Inlet swale complete with a triangular cross-section, grass cover, 5:1 (H:V) side slopes and minimum depth of 0.45m will convey the major system peak flows from the parking lot into the northwest corner of the depressed storage basin.
- The site's internal grading has been designed such that during a 100-year storm event, there will be minor surcharging through catchbasin grates, however stormwater will remain contained within the parking lot. If a storm event greater than the 100-year design storm were to occur or if any sewers throughout the site were to become clogged, parking lot surface ponding would build up to no more than 0.30m depth prior to spilling downstream into the depressed storage basin.
- The depressed storage basin consists of 2.5:1 (H:V) side slopes, a maximum depth of 2.1m and a total storage capacity of 2821m³.
- The design storm flows (up to and including the 100-year design storm) entering the depressed storage basin will be collected via a 600mm x 600mm Ditch Inlet Catchbasin located at the base of the basin (crest elevation of 103.30m) and then conveyed to a 95mmØ orifice plate located within the control manhole via a 250mmØ storm pipe connection. In conjunction with the proposed orifice plate, a triangular shaped sharp-crested weir cut into the face of a standard 600mm x 600mm catchbasin structure is proposed to control the stormwater runoff within the depressed storage basin. The sharp-crested weir will consist of 0.25:1 (H:V) side slopes, a crest elevation of 104.15m and a crown elevation of 104.65m. This outlet configuration has been designed to provide sufficient stormwater attenuation within the depressed storage basin to control the post-development peak flows to the corresponding pre-development target rates for each of the 2-100 year design storm events. All storm events greater than the 100-year design storm will be controlled via an overflow spillway weir as described below. Additional capacity not accounted for in the design calculations but will be provided during less frequent storm events, is that from the submergence of the proposed catchbasin structures grate (elevation of 105.15m). Above an elevation of 105.15m, the catchbasin structure will provide increased inlet capacity and conveyance downstream via the 300mmØ storm pipe connection to the downstream control manhole.

- In the event of a partial blockage in the storm sewer system or a storm event less frequent than the 100-year storm, a proposed overflow spillway weir (broad-crested weir) will be located centrally at the east limit of the depressed storage basin. The overflow spillway weir will be trapezoidal in shape and will consist of a crest elevation of 104.95m, turf stone lining and 3:1 (H:V) side slopes. The overflow spillway weir has been designed to be capable of safely conveying post-development peak flows generated by storm events less frequent than the 100-year design storm without any restriction in order to prevent any potential flood hazards associated with larger peak flows/runoff volumes. The overflow spillway weir will discharge to the west ditch of Bank Street adjacent to the existing concrete box culvert crossing under Bank Street and outleting on the east side of the right-of-way.

Refer to **Appendix C** for supporting calculations.

4.9 Sediment and Erosion Controls

In accordance with City policy, effective erosion and sediment control must be established prior to construction commencement and maintained until the site has been stabilized. Exposure of the soil during construction should be minimized to avoid erosion and sedimentation. The sites erosion potential may be mitigated through the use of sound erosion and sedimentation control measures. The following measures shall be carried out prior to construction and maintained until disturbed areas have regained a significant grass cover:

Topsoil Stripping: Topsoil stripping will be reduced as much as possible on-site. Where grading is necessary, the exposed soil will be stabilized by seeding immediately upon being set to grade. Should topsoil stockpiling be required, the stockpiles will be kept at manageable levels for grass/weed cutting purposes.

Silt Fence: Silt fence will be placed along the down slope of all excavated material and along the perimeter of the site where grading is directed towards the property line to prevent sediment transport onto adjacent lands. Periodic inspections and repairs to the silt fence should be performed regularly, as well as after every rainfall event.

Catchbasin Inlet Protection: Filter fabric and clear stone will be placed over all storm sewer inlet structures (i.e. catchbasins), which will ensure sediment laden overland runoff during construction is cleansed before entering the storm sewer system.

Mud Mat: Mud tracking from construction traffic must be controlled through the use of a mud-mat consisting of clear stone and rip-rap located at the site's construction entrances/exits.

Vegetated Buffers: Existing grassland vegetation, wooded and/or lawn areas along the development limits are to be maintained wherever possible. These areas will provide a natural barrier to filter potentially sediment-laden overland flow before it is released from the site.

Finally, the Site Engineer will be responsible for completing routine inspections of the sediment and erosion control structures throughout the construction phase of the development, particularly after rainfall events. All damaged or clogged control devices or fencing must be repaired immediately.

5.0 Stormwater Operations and Maintenance

5.1 General

Recommended maintenance of the storm sewer system is as follows:

- Inspection of the pipes should be completed on an annual basis.
- Manual or power flushing of any sewers that contain a build-up of debris.
- Major blockages may require the services of a sewer contractor.
- Monitoring of overland flow channels within the property limits for erosion, and sediment / debris build-up.

An inspection of all storm sewer manholes and catchbasins is required if a significant amount of debris is present within these structures. Many of the structures consist of sumps which must be cleaned via vacuum if necessary to ensure they are free from debris. All maintenance activities on the storm drainage system will be the responsibility of the developer both during and after construction.

Erosion and sediment control for the construction of the development including the depressed storage basin shall be in accordance with the engineering drawing (**Drawing SED**) prepared by WMI & Associates Limited.

5.2 Inspection Frequency

The depressed storage basin will require careful monitoring, particularly in the initial years of operation. Inspections are an important part of this monitoring program. Regular visual inspections should be conducted as follows:

- After every significant rainfall (> 10mm) for the first two years of operation; and,
- Minimum of four visits per year after the first two years of operation (spring, summer, fall and winter).

5.3 General Maintenance Tasks

Grass cutting is not recommended for the depressed storage basin as increased water quality benefits have been determined to be associated with more “natural” environments (i.e. vegetative buffers). Should the owner wish to cut the grass around the facility for aesthetic purposes, the following practices should be considered:

- Minimize frequency of cutting where possible and maintain a minimum height of 0.3m for grasses;
- Do not cut grass up to the edge of the depressed storage basin (to maintain shading and nutrient uptake); and
- Do not blow grass clippings into the depressed storage basin (to minimize organic loading).

Weed control is not an anticipated or recommended practice for this facility. Should the owner wish to control weeds around the depressed storage basin, the following items should be considered:

- Prohibit the use of herbicides and insecticides (potential water quality concerns associated with the downstream uses); and
- Limit the use of fertilizer with weed control (to prevent potential nutrient loading to downstream areas).

Any replacement plantings required due to disturbance or die-out are to be in accordance with the approved Landscape Plans, or as otherwise deemed appropriate by the City. Native species should be utilized where possible for all replaced plantings.

Accumulated litter and debris within the depressed storage basin can be removed by hand during the regular inspection periods.

5.4 Sediment Removal & Disposal

The following is a suggested method of sediment removal for the depressed storage basin:

- Excavate accumulated sediment using a backhoe/excavator.
- Excavated sediment shall be placed immediately into a truck for disposal to minimize disturbance of existing vegetation or placed in a sediment decant area if one exists to dry sediment prior to its disposal.
- Restore vegetation as deemed appropriate by the City.

Sediment is to be tested in accordance with MOE sediment disposal guidelines.

Sediment is to be removed off-site to either a sanitary landfill or to a drying and then fill area (as deemed appropriate upon testing of the sediment).

5.5 Winter Operation

There are no special requirements for winter operation.

6.0 Summary and Conclusions

In conclusion, this Site Servicing and Stormwater Management Report demonstrates how the proposed commercial development can be serviced and integrated into the existing community of Greely, without imposing any adverse effects. Specifically, we note the following:

- The commercial development (Phase 1) can be accommodated via a new drilled well, water treatment unit complete with the equipment necessary to treat the raw water in order to meet the requirements of O. Reg. 170/03 and a 9,000L concrete storage tank used for additional domestic water supply, all of which are proposed to be located at the northwest corner of Phase 1. A new 50mmØ domestic water distribution system and individual service connections will then provide potable water to each of the proposed CRU spaces.
- Six (6) – 45,400L concrete storage tanks will be used to provide fire protection for the site. Both a 200mmØ dry hydrant and 150mmØ sprinkler main distribution system will utilize the fire storage water supply to ensure sufficient fire protection is provided for each building proposed within Phase 1. The dry hydrant system will provide fire protection to all CRU spaces with the exception of CRU 1-3, the future addition and CRU 10 via the use of a pumper truck connection and two (2) proposed fire hydrants located on-site. The sprinkler system will provide fire protection to CRU 1-3, the future addition and CRU 10 via the use of a fire pump located within a space dedicated for water system equipment located at the west limit of CRU 13. The location of the proposed fire hydrants and the siamese connections (on sprinklered buildings) are within the distances required by the OBC to provide adequate fire protection.
- Sanitary drainage will be provided by a new sanitary sewer system which will discharge to a proposed sewage pumping station located at the southwest corner of Phase 1. The sanitary sewer system along with the proposed pump station have been designed to accommodate connections from future phases of the development.
- The proposed sewage pump station will discharge the developments effluent into a Waterloo Biofilter and Area Bed system where it will be treated and distributed safely into the environment.

- Stormwater quantity control will be provided to attenuate the 2-100 year design storm peak flows to their corresponding pre-development target rates via the use of a vegetated depressed storage basin complete with an orifice plate, sharp-crested weir structure and overflow spillway weir.
- An integrated treatment train approach will be implemented into the design of the internal storm drainage system which will help minimize any negative impacts the proposed development may have on the existing quality of stormwater runoff. An 'Enhanced' Level of Protection, as defined in the MOE's Stormwater Management Planning & Design Manual will be provided through the use of sediment traps via sumps within each proposed catchbasin/catchbasin manhole, inherent water balance benefits and pre-treatment through the use of a vegetated overland basin inlet swale and the depressed storage basin and ultimately end-of-pipe treatment will be provided by an oil/grit separator unit.
- The use of silt fence, filter fabric and clear stone cover over all catchbasin grates, existing vegetated buffers and a construction mud mat, will ensure downstream stormwater quality is maintained during construction.

The site servicing design as described above is considered to be capable of adequately servicing the proposed development and the stormwater management system can be constructed and maintained as a functional method of treating all stormwater run-off generated at the site. This Site Servicing and Stormwater Management Report and the associated engineering design drawings are based on information provided at the time of their preparation and are considered only applicable to the proposed works as described in this report. Any changes subsequent to the report and drawings data of issuance should be reviewed by WMI & Associates Ltd. to ensure applicability of the design contained within the documents.

Based on the above, we request that this report be received by the City and MOE in support of detailed design and ultimately the construction of the proposed development.

Respectfully submitted,

WMI & Associates Limited



Jeremy W. Lighthouse, P. Eng.

APPENDIX A

FIGURES



Drawing Title
 Site Location Plan

Project Name:
 GREELY COMMERCIAL CENTER

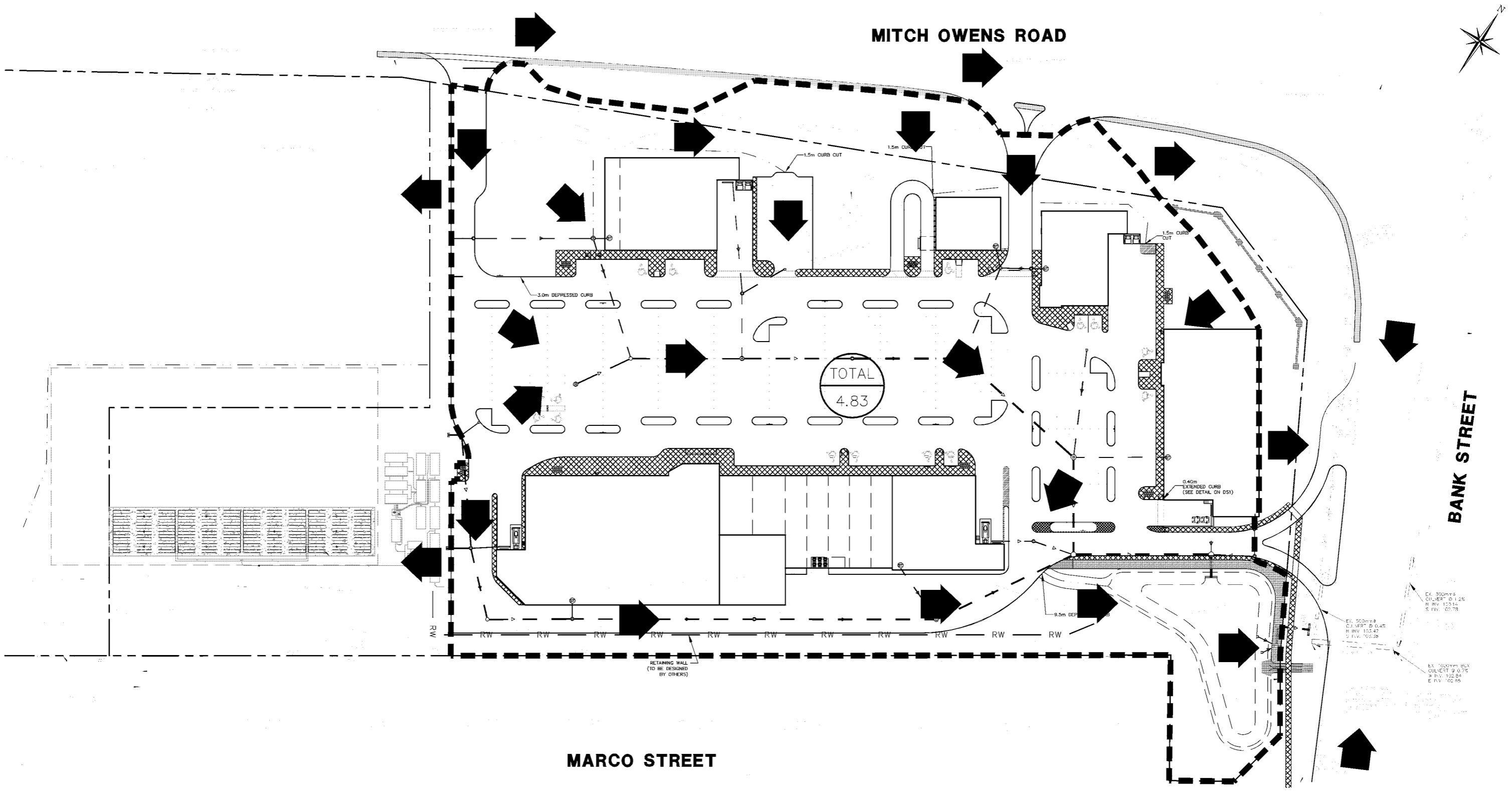


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Drawn By
 TG
 Scale
 N.T.S.

Checked By
 JWL
 Project No.
 11-183

Figure No.
FIG1



LEGEND:



Drawing Title	Post-Development Drainage Plan
Project Name:	GREELY COMMERCIAL CENTER

	WMI & Associates Limited 119 Collier Street Barrie, Ontario L4M 1H5 705-797-2027 www.wmiengineering.ca	
	Drawn By TG	Checked By JWJ
Scale 1:1250	Project No. 11-183	

APPENDIX B

**WATER & SANITARY SEWAGE
CALCULATIONS**



SANITARY SERVICE DESIGN CALCULATIONS (CRU 1-13)

Date: Monday November 4, 2013

Project No.: 11-183

Project: Greely Commercial Center

Prepared By: TG

Sanitary Sewer Design Calculations

References: Ontario Building Code (OBC), 2006, Division B, Part 8 Table 8.2.1.3.B., Other Occupancies
Ministry of the Environment (MOE), Design Guidelines for Sewage Works (2008), Chapter 5

Proposed Condition:

Establishment:	# of Seats	Gross Floor Area (m²)	Daily Sewage Volumes (L)	Total Daily Design Sewage Flow (L/day)
CRU 1 & Future Addition (Food Outlet)*	-	3385	(40L - 380L) / 9.25m ² *	30,261
CRU 2-3 Restaurants (Assumed)	60	-	125L / Seat**	7,500
CRU 4-8 Stores	-	1067.5	5L / 1.0m ²	5,338
CRU 9 Store	-	933.5	5L / 1.0m ²	4,668
CRU 10 Store	-	1859	5L / 1.0m ²	9,295
CRU 11 Store	-	743	5L / 1.0m ²	3,715
CRU 12 Office Building (Bank)	-	372	75L / 9.3m ²	3,000
CRU 13 Store	-	1087.3	5L / 1.0m ²	5,437
Total =	60	9447.3		69,212

Notes:

- * - To be conservative, it has been assumed that 20% of the retail food outlet's GFA is equally divided amongst the delicatessen, bakery, and meat dept floor space (6.67% each). The daily sewage volume for the deli is 190L / 9.25m² of floor space, for the bakery is 190L / 9.25m² of floor space, for the meat department is 380L / 9.25m² of floor space, and for the remaining 80% GFA is 40L / 9.25m² of floor space. This equates to a total flow shown in the respective column above.
- ** - To be conservative, it has been assumed that 30 seats will be provided in each restaurant and 2 restaurants are assumed within CRU 2-3 to be conservative.
- Refer to the Sanitary Sewer Design Sheet for all sanitary sewer, peak flow and extraneous flows.



Sanitary Sewer Design Sheet Greely Commercial Center

<<< Elements Requiring Input Information

<p>Peaking Factor: Commercial Peak Factor = 1.5 (Refer to Figure 4.3, page 4.5 of the Ottawa Sewer Design Guidelines, Second Edition, October 2012)</p> <p>Peak Infiltration Flow Rate: Infiltration (L/s/ha), i: 0.28</p> <p>Mannings Coefficient, 'n': 0.013</p>	<p>Peak Flow Formulae: Q_c = peak commercial flow (L/s) Q_i = peak extraneous (i.e. infiltration) flow (L/s) Q_d = peak design flow (L/s) Q_c = Refer to Sanitary Service Design Calculation Sheet (L/s) $Q_i = i \cdot A$ (L/s), where A = Area (ha) $Q_d = Q_c + Q_i$ (L/s)</p> <p>MOE Velocity Requirements: 0.6m/s - 3.0m/s</p>
--	--

Date: **Monday November 4, 2013**
 Project No: **11-183**
 Prepared by: **TG/JWL**

Location			Sewage Flow Calculation Data								Sewer Calculation Data					Sewer Profile Data						
Street	Upstream MH	Downstream MH	Individual Avg Daily Sewage Flow (L/day)	Cumulative Avg Daily Sewage Flow (L/day)	Peaking Factor	Peak Sewage Flow (L/s)	Peak Infiltration			Total Flow (L/s)	Dia. (mm)	Slope (%)	Length (m)	Capacity (L/s)	Velocity (m/s)	Fall in Sewer (m)	Drop in MH (m)		Top of Grate Elevation (m)		Invert Elevation (m)	
							Individual Area (ha)	Cumulative Area (ha)	Flow (L/s)								DS	US	DS	US	DS	US
	S10	G	9,295	9,295	1.50	0.16	0.46	0.46	0.13	0.29	150	2.00	27.3	22.47	1.23	0.55	0.05	106.15	105.66	104.60	104.05	
	S11	G	3,715	3,715	1.50	0.06	0.08	0.08	0.02	0.09	150	2.00	8.1	22.47	1.23	0.16	0.05	106.1	105.66	104.21	104.05	
	G	F	0	13,010	1.50	0.23	0.33	0.87	0.24	0.47	250	0.50	49.0	43.87	0.87	0.25	0.03	105.66	105.68	104.00	103.76	
	S12	F	3,000	3,000	1.50	0.05	0.18	0.18	0.05	0.10	150	2.00	24.5	22.47	1.23	0.49	0.05	106.55	105.68	104.27	103.78	
	F	E	0	16,010	1.50	0.28	0.69	1.74	0.49	0.77	250	0.50	67.8	43.87	0.87	0.34	0.05	105.68	105.68	103.73	103.39	
	S13	E	5,437	5,437	1.50	0.09	0.59	0.59	0.17	0.26	150	2.00	25.2	22.47	1.23	0.50	0.35	106.8	105.68	104.19	103.69	
	E	D	0	21,447	1.50	0.37	0.23	2.56	0.72	1.09	250	0.50	35.5	43.87	0.87	0.18	0.05	105.68	106.20	103.34	103.16	
	S2,9	D	17,505	17,505	1.50	0.30	0.45	0.45	0.13	0.43	150	2.00	13.2	22.47	1.23	0.26	0.9	106.65	106.20	104.27	104.01	
	D	C	0	38,952	1.50	0.68	0.40	3.41	0.95	1.63	250	0.50	77.5	43.87	0.87	0.39	0.05	106.20	106.68	103.11	102.72	
	C	B	0	38,952	1.50	0.68	0.07	3.48	0.97	1.65	250	0.50	37.0	43.87	0.87	0.19	0.05	106.68	105.85	102.67	102.49	
	S1	B	30,261	30,261	1.50	0.53	0.53	0.53	0.15	0.67	150	2.00	4.8	22.47	1.23	0.10	1.42	106.65	105.85	103.95	103.86	
	B	A	0	69,212	1.50	1.20	0.06	4.07	1.14	2.34	250	0.50	13.6	43.87	0.87	0.07		105.85	105.15	102.44	102.37	

NOTES: - Industrial/Commercial/Institutional sewage flows can be inserted as hard values under the **Sewage Flow** column or calculated based on an equivalent **No. of Units OR Area (ha)** considering the **Average Residential Sewage Flow Rate & Population Density** provided above).
 - Refer to the Sanitary Service Design Calculation Sheet for the Average Sewage Flow Calculations for each of the Proposed CRU1-13 Buildings.

EXAMPLE CALCULATION

CRU10 (Store) = 1859 m²
 = 5 L/1.0m² (Average Sewage Flow Rate based on 2006 OBC, Table 8.2.1.3.B.)
 = 9295 L/day
 = 0.11 L/s



Sewage Pump Station Wet Well Design Sheet Greely Commercial Center - Sanitary Lift Station (MH A)



<<< Elements Requiring Input Information

Wet Well Diameter, D = 2.4 m (See Notes Below)	Date: 15-Jan-14
Peak Sewage Influent Rate, Q _P = 0.0024 m ³ /s (See Notes Below)	Project No: 11-183
Invert Elevation of Lowest Inlet Sewer Pipe, Pipe _{INV} = 102.36 m	Prepared by: JWL
Freeboard, f = 0.60 m (See Notes Below)	

	Peak Sewage Influent Rate		Pump Cycle/Down Time (min)	Wet Well Storage (m ³)	Wet Well Vertical Storage Depth (m)	Wet Well Storage	
	(m ³ /s)	(m ³ /min)				Top Elev. (m)	Bottom Elev. (m)
	0.0024	0.144	20	0.72	0.16	101.76	101.60

<p>Wet Well Storage, S = $\frac{T \times Q_P}{4}$ (m³)</p> <p>where, Q_P = Peak Sewage Influent/Pump Rate (m³/s) T = Pump Cycle Time (s)</p> <p>Wet Well Storage Top Elev., Elev₁ = Pipe_{INV} - f (m)</p> <p>where, f = freeboard (m) Pipe_{INV} = Invert Elevation of Lowest Inlet Sewer Pipe (m)</p>	<p>Wet Well Vertical Storage Depth, d = $\frac{S}{A}$ (m)</p> <p>where, S = Wet Well Storage Volume (m³) A = Wet Well Plan Area (m²)</p> <p>Wet Well Storage Bottom Elev., Elev₂ = Elev₁ - d (m)</p> <p>where, d = Wet Well Vertical Storage Depth (m) Elev₁ = Wet Well Storage Top Elev. (m)</p>
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- NOTES:**
- Based on the MOE Guidelines, the **minimum** plan area of a wet well should be **4.5m²** (i.e. 2.4m dia. OR 2.15m x 2.15m square)
 - Based on the MOE Guidelines, the **minimum** pump cycle time (i.e. pump start time) is every **10 minutes**.
 - The critical Influent rate is when the inflow to the pumping station wet well is exactly one half (1/2) of the sewage pump capacity (Influent Flow Rate = 1/2 x Pump Rate).
- The formula for determining the minimum operating volume of the wet well is as follows:
 Cycle Time = Time to Fill + Time to Draw Down; Time to Fill = Volume/Influent Rate; Time to Draw Down = Volume (Pump Rate - Influent Rate)
- Peak Sewage Inflow Rate is typically based on the MOE Guidelines **OR** Historical Peaking Factors based on existing information.
 - Freeboard is between Top of Wet Well Storage Volume and the Invert Elevation of the Lowest Inlet Sewer Pipe.
 - If conditions permit (i.e. depth constraints exist), the freeboard can be considered as a negative value meaning that the Top of the Wet Well Storage Volume is higher than the Invert Elevation of the Lowest Inlet Sewer Pipe.
 - Vertical Storage Depth is the difference between the Lead Pump ON and all pumps OFF set points.



**Sewage Pump Station Design - System Head Curve
 Greely Commercial Center -Sanitary Lift Station (MH A)
 Interim Condition (Phase 1 Only)**

[] <<< Elements Requiring Input Information

Date: 15-Jan-14
 Project No: 11-183
 Prepared by: JWJ

Velocity, $V = \frac{Q_p}{A}$ (m/s, MOE Requirements: 0.8m/s - 2.5m/s) Hazen -Williams Equation (re-arranged for Friction Slope)
 where, $Q_p =$ Peak Sewage Flow (m^3/s) Friction Slope, $S = \frac{(V)^{1/0.54}}{(0.85CR)^{0.63/1/0.54}} \times 100$ (m/100m)
 $A =$ Cross-Sectional Area (m^2)
 Head Loss, $H_L = (K_1+K_2+K_3...) \times V^2/2g$ where, $V =$ mean velocity (m/s)
 where, $\sum K = (K_1+K_2+K_3...)$ $k = 0.85$ for SI units
 $V =$ mean velocity (m/s) $C =$ Roughness Coefficient
 $g = 9.81$ (acceleration due to gravity, m/s^2) $R =$ hydraulic radius (m)

Static Head, $h_{S, MAX} = h_F - h_{LWL}$ (m) where, $h_F =$ Forcemain US End Elev. (m)
 Static Head, $h_{S, MEDIAN} = h_F - h_{MWL}$ (m) $h_{LWL} =$ Wet Well Low Water Level (m)
 Static Head, $h_{S, MIN} = h_F - h_{HWL}$ (m) $h_{MWL} =$ Wet Well Median Water Level (m)
 Total Dynamic Head, $h_{D, MAX} = h_{S, MAX} + h_{T.H.L.}$ (m) where, $h_{S, MAX} =$ Maximum Static Head (m)
 Total Dynamic Head, $h_{D, MEDIAN} = h_{S, MEDIAN} + h_{T.H.L.}$ (m) $h_{S, MEDIAN} =$ Median Static Head (m)
 Total Dynamic Head, $h_{D, MIN} = h_{S, MIN} + h_{T.H.L.}$ (m) $h_{S, MIN} =$ Minimum Static Head (m)
 $h_{T.H.L.} =$ Total Head Loss (m)

Pipe Design Coefficient C	Forcemain						Fittings Head Loss (m)	Pump Station Head Loss (m)	Total Head Loss (m)	Wet Well Low Water Level (m)	Wet Well Median Water Level (m)	Wet Well High Water Level (m)	Forcemain US End Elev. (m)	Static Head			Total Dynamic Head		
	Flow (L/s)	Diameter (mm)	Velocity (m/s)	Head Loss (m/100m)	Distance (m)	Head Loss (m)								MAX. (m)	Median (m)	MIN. (m)	MAX. (m)	Median (m)	MIN. (m)
Wet Well Low Water Level							$\sum K_F =$	$\sum K_{PS} =$											
120	1	50	0.51	0.91	5.00	0.05	0.00	0.00	0.05	101.61	101.69	101.76	104.37	2.76	2.69	2.61	2.81	2.73	2.66
120	1.7	50	0.87	2.43	5.00	0.12	0.00	0.00	0.12	101.61	101.69	101.76	104.37	2.76	2.69	2.61	2.88	2.81	2.73
120	2.4	50	1.22	4.59	5.00	0.23	0.00	0.00	0.23	101.61	101.69	101.76	104.37	2.76	2.69	2.61	2.99	2.91	2.84
120	3.1	50	1.58	7.38	5.00	0.37	0.00	0.00	0.37	101.61	101.69	101.76	104.37	2.76	2.69	2.61	3.13	3.05	2.98
120	3.8	50	1.94	10.76	5.00	0.54	0.00	0.00	0.54	101.61	101.69	101.76	104.37	2.76	2.69	2.61	3.30	3.22	3.15
Wet Well Median Water Level																			
130	1	50	0.51	0.78	5.00	0.04	0.00	0.00	0.04	101.61	101.69	101.76	104.37	2.76	2.69	2.61	2.80	2.72	2.65
130	1.7	50	0.87	2.09	5.00	0.10	0.00	0.00	0.10	101.61	101.69	101.76	104.37	2.76	2.69	2.61	2.86	2.79	2.71
130	2.4	50	1.22	3.96	5.00	0.20	0.00	0.00	0.20	101.61	101.69	101.76	104.37	2.76	2.69	2.61	2.96	2.88	2.81
130	3.1	50	1.58	6.36	5.00	0.32	0.00	0.00	0.32	101.61	101.69	101.76	104.37	2.76	2.69	2.61	3.08	3.00	2.93
130	3.8	50	1.94	9.27	5.00	0.46	0.00	0.00	0.46	101.61	101.69	101.76	104.37	2.76	2.69	2.61	3.22	3.15	3.07
Wet Well High Water Level																			
140	1	50	0.51	0.68	5.00	0.03	0.00	0.00	0.03	101.61	101.69	101.76	104.37	2.76	2.69	2.61	2.79	2.72	2.64
140	1.7	50	0.87	1.82	5.00	0.09	0.00	0.00	0.09	101.61	101.69	101.76	104.37	2.76	2.69	2.61	2.85	2.78	2.70
140	2.4	50	1.22	3.45	5.00	0.17	0.00	0.00	0.17	101.61	101.69	101.76	104.37	2.76	2.69	2.61	2.93	2.86	2.78
140	3.1	50	1.58	5.55	5.00	0.28	0.00	0.00	0.28	101.61	101.69	101.76	104.37	2.76	2.69	2.61	3.04	2.96	2.89
140	3.8	50	1.94	8.09	5.00	0.40	0.00	0.00	0.40	101.61	101.69	101.76	104.37	2.76	2.69	2.61	3.16	3.09	3.01

NOTES: - The Forcemain Flow (Peak Design Sewage Inflow/Pumpage Flow Rate) used to design the Pump Station should be bound above and below with a range of values to provide a sufficient assessment of the System Head Curve for the particular pump station under all three (3) Pipe Design Conditions/Coefficients.
 - The Pump/Pump Curve and motor selected for the pump station will be selected based on the Wet Well Median Water Level System Curve (C=130) since this will reflect the normal operating condition. The extreme operating ranges will be given by the intersections of Wet Well Low and High Water Level System Curves (C=120 & C=140) and with the selected Pump Curve. The pump and motor should be able to operate satisfactorily over this full range.



WATER SUPPLY DESIGN CALCULATIONS (CRU 1-13)

Date: Tuesday January 21, 2014

Project No.: 11-183

Project: Greely Commercial Center

Prepared By: JWL

<<< Elements Requiring Input Information

Water Supply Design Calculations

References: Sanitary Service Design Calculations (CRU 1-13) spreadsheet prepared by WMI & Associates Limited.

Proposed Condition:

Establishment:	Avg. Daily Demand ADD (L/day)	Max. Daily Demand MDD (L/day)	Peak Hourly Demand PHD (L/day)
CRU 1 & Future Addition (Food Outlet)*	30,261	45,391	90,782
CRU 2-3 Restaurants (Assumed)	7,500	11,250	22,500
CRU 4-8 Stores	5,338	8,006	16,013
	12,838	19,256	38,513
CRU 9 Store	4,668	7,001	14,003
CRU 10 Store	9,295	13,943	27,885
CRU 11 Store	3,715	5,573	11,145
CRU 12 Office Building (Bank)	3,000	4,500	9,000
CRU 13 Store	5,437	8,155	16,310
Total =	69,212	103,818	207,637
	48.1 L/min	72.1 L/min	144.2 L/min
Peaking Factor =	N/A	1.5	3

NOTE: - Considering the property use (i.e. commercial) with minimal grass cover, lawn watering is considered to be negligible in comparison to the sites domestic demand and is also assumed to occur at night when the majority of the CRU space is closed/vacant (i.e. minimal domestic usage). To be conservative and to account for some lawn watering, a peaking factor of 3 has been considered in the calculation of the developments peak hourly demand and in addition to that, storage has also been provided for the domestic water supply.

Flow Deficit during the Peak Hourly Demand Rate:

$$\begin{aligned}
 \text{Flow Deficit} &= \text{Peak Hourly Demand Rate} - \text{Maximum Well Supply Rate} \\
 &= 144.2 \text{ L/min} - 90.0 \text{ L/min (see Hydrogeologic Work Plan for Water} \\
 &= 54.2 \text{ L/min} \quad \text{Supply Letter prepared by Wilson Associates} \\
 & \quad \text{dated January 24, 2014)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Required Inline Storage Capacity} &= \text{Draw Down for Peak Hourly Demand Rate (1hr) x Flow Deficit} \\
 &= 60 \text{ min} \quad \times \quad 54.2 \text{ L/min} \\
 &= 3252 \text{ L}
 \end{aligned}$$

$$\text{Proposed Inline Storage Capacity} = 9000 \text{ L}$$



**FIRE PROTECTION WATER STORAGE
 DESIGN CALCULATIONS (CRU 1-13)**

Date: Tuesday January 21, 2014

Project No.: 11-183

Project: Greely Commercial Center

Prepared By: JWJ

◻ <<< Elements Requiring Input Information

Fire Protection Water Storage

Reference: Ontario Building Code (OBC), 2012, Division B, Part 3, Subsection 3.2.5.7. & A-3.2.5.7., Water Supply.

1 Determine Building Classification:

- CRU 1-3 (incl. Future Addition) and CRU 10 have not been included in this calculation as they will be sprinklered. Refer to the Fire Sprinkler Water Requirements Memo from BIRD Engineering Ltd. to dated January 3, 2014 for additional details related to fire protection water supply for these CRU spaces.
 - Based on email correspondence (January 17, 2014) from Tony Chau at ADA Architect Inc., the proposed buildings are all classified as Group 'E' with the exception of CRU 12 which is classified as a Group 'A2' building.
 - Based on email correspondence (January 21, 2014) from Tony Chau at ADA Architect Inc., the proposed buildings total volumes are as follows and all buildings are considered to be built of "combustible construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2., including loadbearing walls, columns and arches. Noncombustible construction may be used in lieu of fire-resistance rating where permitted in Subsection 3.2.2." as referred to in Table 1 of the 2012 OBC, Appendix A, Volume 2, Division B, Subsection A-3.2.5.7.:

CRU 4-8 =	6676	m ³	CRU 12 =	1850	m ³
CRU 9 =	5805	m ³	CRU 13 =	7372	m ³
CRU 11 =	4606	m ³			

Therefore, based on Table 1 of the 2012 OBC, Appendix A, Volume 2, Division B, Subsection A-3.2.5.7. and considering that all buildings are Classified as Group E except for CRU 12 which is Classified as Group A2, the following 'K' values are associated with each respective building:

CRU 4-8 =	31	CRU 12 =	18
CRU 9 =	31	CRU 13 =	31
CRU 11 =	31		

2 Check parameters of 2012 OBC, Appendix A, Volume 2, Division B, Subsection A-3.2.5.7.1. to determine whether the building requires an on-site water supply:

Based on Subsection A-3.2.5.7.1. as noted above, the new buildings require on-site water supply.

3 Calculate Q=KVS_{TOTAL}

(The area of unprotected openings is unknown at this stage. Considering the distances between the proposed buildings and/or the adjacent property lines it is safe to assume that the exposure distances will be governed by the distances to property line and/or mid-point between proposed buildings and not the "limiting distances" which are based on the area of unprotected openings. As a result, the spatial coefficients do not considered any "limiting distances".)

CRU 4-8

Exposure Distance from proposed building to:

West to CRU 1 =	-	m	4-hour Firewall
North to CRU 13 =	35.1	m	Mid-point
East to CRU 9 =	-	m	4-hour Firewall
South to P/L =	16.7	m	

from Figure 1 (OBC, A.3.2.5.7.)

$$\begin{aligned}
 S_W &= 0 \\
 S_N &= 0 \\
 S_E &= 0 \\
 S_S &= 0 \\
 S_{TOTAL} &= 1 + (S_W + S_N + S_E + S_S) \\
 &= 1 + 0 \\
 S_{TOTAL} &= 1
 \end{aligned}$$

Minimum Water Supply,

$$\begin{aligned}
 Q &= KVS_{TOTAL} \\
 &= 31 \times 6676 \times 1 \\
 Q &= 206,956 \text{ L}
 \end{aligned}$$

where,
 Q = Minimum Water Supply (L)
 K = Water Supply Coefficient
 V = Building Volume (m³)
 S_{TOTAL} = Total Spatial Coefficient

CRU 9

Exposure Distance from proposed building to:

West to CRU 8 =	-	m	4-hour Firewall
North to CRU 12 =	37.2	m	Mid-point
East to CRU 10 =	26.3	m	Mid-point
South to P/L =	28.2	m	

from Figure 1 (OBC, A.3.2.5.7.)

$$\begin{aligned}
 S_W &= 0 \\
 S_N &= 0 \\
 S_E &= 0 \\
 S_S &= 0 \\
 S_{TOTAL} &= 1 + (S_W + S_N + S_E + S_S) \\
 &= 1 + 0 \\
 S_{TOTAL} &= 1
 \end{aligned}$$

Minimum Water Supply,

$$Q = KVS_{TOTAL}$$

$$= 31 \quad \times \quad 5805 \quad \times \quad 1$$

$$Q = 179,955 \quad L$$

where, Q = Minimum Water Supply (L)
K = Water Supply Coefficient
V = Building Volume (m³)
S_{TOTAL} = Total Spatial Coefficient

CRU 11

Exposure Distance from proposed building to:

West to CRU 12 =	7.0	m	Mid-point
North to center of R.O.W. =	55.3	m	
East to CRU 10 =	9.1	m	Mid-point
South to CRU 9 =	27.7	m	Mid-point

from Figure 1 (OBC, A.3.2.5.7.)

$$S_W = 0.3$$

$$S_N = 0$$

$$S_E = 0.1$$

$$S_S = 0$$

$$S_{TOTAL} = 1 + (S_W + S_N + S_E + S_S)$$

$$= 1 + 0.4$$

$$S_{TOTAL} = 1.4$$

Minimum Water Supply,

$$Q = KVS_{TOTAL}$$

$$= 31 \quad \times \quad 4606 \quad \times \quad 1.4$$

$$Q = 199,900 \quad L$$

where, Q = Minimum Water Supply (L)
K = Water Supply Coefficient
V = Building Volume (m³)
S_{TOTAL} = Total Spatial Coefficient

CRU 12

Exposure Distance from proposed building to:

West to CRU 13 =	32.4	m	Mid-point
North to center of R.O.W. =	51.0	m	
East to CRU 11 =	7.0	m	Mid-point
South to CRU 9 =	37.2	m	Mid-point

from Figure 1 (OBC, A.3.2.5.7.)

$$S_W = 0$$

$$S_N = 0$$

$$S_E = 0.3$$

$$S_S = 0$$

$$S_{TOTAL} = 1 + (S_W + S_N + S_E + S_S)$$

$$= 1 + 0.3$$

$$S_{TOTAL} = 1.3$$

Minimum Water Supply,

$$Q = KVS_{TOTAL}$$

$$= 18 \quad \times \quad 1850 \quad \times \quad 1.3$$

$$Q = 43,290 \quad L$$

where, Q = Minimum Water Supply (L)
K = Water Supply Coefficient
V = Building Volume (m³)
S_{TOTAL} = Total Spatial Coefficient

CRU 13

Exposure Distance from proposed building to:

West to P/L =	57.8	m	
North to center of R.O.W. =	38.3	m	
East to CRU 12 =	32.4	m	Mid-point
South to CRU 1 =	35.1	m	Mid-point

from Figure 1 (OBC, A.3.2.5.7.)

$$S_W = 0$$

$$S_N = 0$$

$$S_E = 0$$

$$S_S = 0$$

$$S_{TOTAL} = 1 + (S_W + S_N + S_E + S_S)$$

$$= 1 + 0$$

$$S_{TOTAL} = 1$$

Minimum Water Supply,

$$Q = KVS_{TOTAL}$$

$$= 31 \quad \times \quad 7372 \quad \times \quad 1$$

$$Q = 228,532 \quad L$$

where, Q = Minimum Water Supply (L)
K = Water Supply Coefficient
V = Building Volume (m³)
S_{TOTAL} = Total Spatial Coefficient

The governing water supply for fire protection considering all non-sprinklered buildings on-site is,

Q = 228,532 L

4 Determine the water supply flow rate:

From Table 2, Required Minimum Water Supply Flow Rate (L/min), provided in the OBC A.3.2.5.7.,

F = 6300 L/min > 4500 L/min minimum required by the City at the furthest hydrant

Based on OBC A.3.2.5.7., the water supply volume required should not be less than that needed to provide the minimum flow rate specified in Table 2 for a minimum duration of 30-minutes

$$T = \text{Minimum Water Supply/Flow Rate}$$

$$= Q/F$$

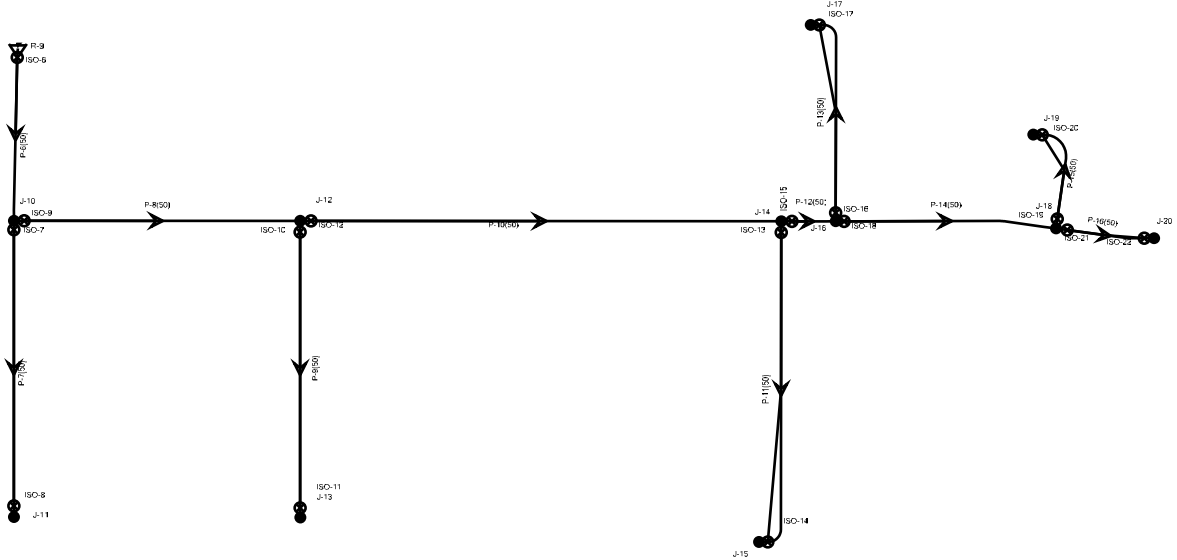
$$= 228,532 \div 6300$$

T = 37 min > minimum 30min

where, T = Duration (min)
Q = Minimum Water Supply (L)
F = Flow Rate (L/min)

NOTE: Based on emailed correspondence with Duncan McNaughton of Ottawa Fire Services, 4500L/min is all that is required to be provided by the City at the furthest hydrant regardless of the calculation provided above.

140131_Domestic_Supply_System (50mm Water Service)



Average Day Demand

(ADD)

FlexTable: Junction Table (140131_Domestic_Supply_System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-10	106.48	0.00	145.30	55.1
J-11	106.65	0.35	145.21	54.7
J-12	105.70	0.00	145.20	56.1
J-13	106.65	0.15	145.18	54.7
J-14	105.70	0.00	145.14	56.0
J-15	106.65	0.05	145.13	54.6
J-16	105.85	0.00	145.13	55.8
J-17	106.55	0.03	145.13	54.8
J-18	105.55	0.00	145.12	56.2
J-19	106.10	0.04	145.12	55.4
J-20	106.15	0.11	145.11	55.3

Maximum Day Demand

(MDD)

FlexTable: Junction Table (140131_Domestic_Supply_System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-10	106.48	0.00	145.08	54.8
J-11	106.65	0.53	144.89	54.3
J-12	105.70	0.00	144.86	55.6
J-13	106.65	0.22	144.82	54.2
J-14	105.70	0.00	144.72	55.4
J-15	106.65	0.08	144.72	54.0
J-16	105.85	0.00	144.71	55.2
J-17	106.55	0.05	144.71	54.2
J-18	105.55	0.00	144.68	55.5
J-19	106.10	0.06	144.68	54.8
J-20	106.15	0.16	144.68	54.7

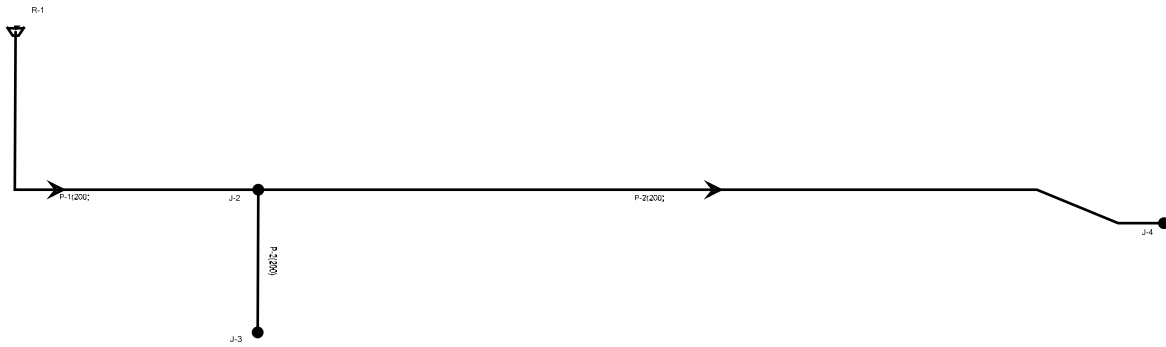
Peak Hourly Demand (PHD)

FlexTable: Junction Table (140131_Domestic_Supply_System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-10	106.48	0.00	143.95	53.2
J-11	106.65	1.05	143.28	52.0
J-12	105.70	0.00	143.16	53.2
J-13	106.65	0.45	143.01	51.6
J-14	105.70	0.00	142.63	52.4
J-15	106.65	0.16	142.61	51.0
J-16	105.85	0.00	142.60	52.2
J-17	106.55	0.10	142.59	51.2
J-18	105.55	0.00	142.49	52.4
J-19	106.10	0.13	142.49	51.7
J-20	106.15	0.32	142.47	51.6

140131_Dry_Hydrant_System (200mm Dry Hydrant Main)

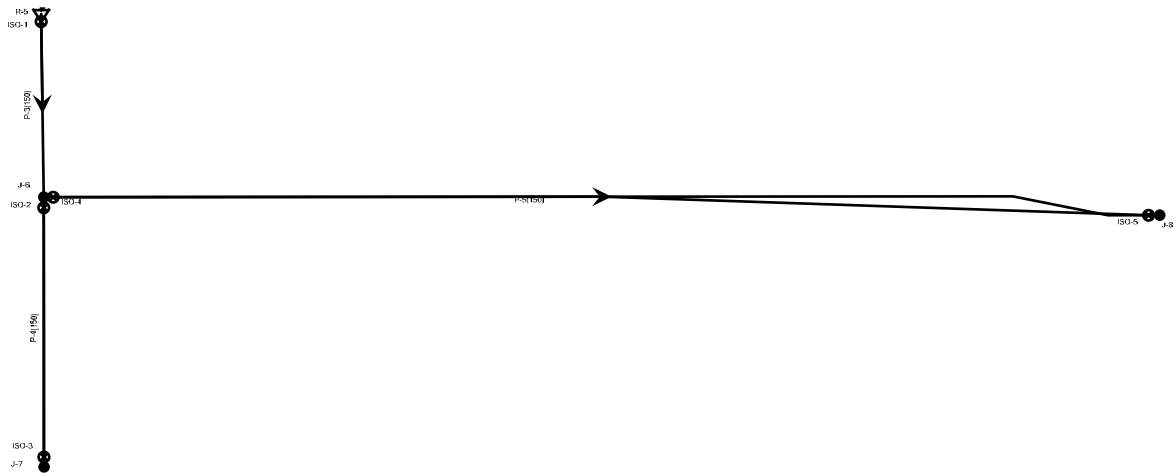


FlexTable: Junction Table (140131_Dry_Hydrant_System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-2	106.20	0	176.33	99.5
J-3	106.50	0	176.33	99.1
J-4	105.80	75	171.64	93.5

140131_Sprinkler_System (150mm Sprinkler Main)



FlexTable: Junction Table (140131_Sprinkler_System.wtg)

Current Time: 0.000 hours

Label	Elevation (m)	Demand (L/s)	Hydraulic Grade (m)	Pressure (psi)
J-6	106.45	0	162.32	79.3
J-7	106.65	0	162.32	79.0
J-8	106.15	28	157.65	73.1

APPENDIX C

**STORMWATER MANAGEMENT
CALCULATIONS**



**STORMWATER MANAGEMENT CALCULATIONS
 PRE-DEVELOPMENT CONDITION PARAMETERS**

Date: Thursday November 7, 2013

Project No.: 11-183

Project: Greely Commercial Center

Prepared By: JWL

Pre-Development Condition

TOTAL D.A. = 4.83 ha

Soil Characteristics

(Soil Map of Regional Municipality of Ottawa-Carleton (excluding the Ottawa Urban Fringe), Sheet 2, Ontario, Soil Survey Report No. 58)

TOTAL D.A.

- > K1 - S2.3
- > Kars
- > Gravelly Sandy Loam
- > Excessive to Good Drainage
- > Hydrologic Soil Group (A)

TOTAL D.A.

(Calib Nashyd Command)

Total Area	=	4.83 ha	
<u>Pervious Areas:</u>			
Unimproved Lands	=	4.83 ha	
CN	=	49 *	C = 0.10 **
I _A	=	5.0 mm*	** Refer to the C spreadsheet
* Refer to the CN & I _A spreadsheet			
Treed Areas were assumed based on aerial photography and the grassed areas were determined to be the residual area after all others were calculated.			
			T _C = 0.55 hr*
			T _P = 0.37 hr*
*Refer to T _C & T _P Spreadsheet			

SWMHYMO Results

The pre-development condition peak flow rates generated using SWMHYMO for the 12-hour SCS Type II Storm Distribution are listed below:

12hr SCS Type II Storm Distribution

TOTAL D.A.

Q ₂	=	0.042 m ³ /s
Q ₅	=	0.084 m ³ /s
Q ₁₀	=	0.118 m ³ /s
Q ₂₅	=	0.167 m ³ /s
Q ₅₀	=	0.208 m ³ /s
Q ₁₀₀	=	0.251 m ³ /s



**STORMWATER MANAGEMENT CALCULATIONS
 POST-DEVELOPMENT CONDITION PARAMETERS**

Date: Thursday November 7, 2013

Project No.: 11-183

Project: Greely Commercial Center

Prepared By: JWL

Post-Development Condition

TOTAL D.A.

(Calib Standhyd Command)

Total Area	=	4.83 ha			
<u>Impervious Areas:</u>			<u>Pervious Areas:</u>		
Asphalt Roadway (incl. sidewalks & curbs)	=	2.35 ha	Grass/Landscaping	=	1.48 ha
Rooftops	=	1.00 ha			
XIMP	=	69 %*	CN	=	49 *
TIMP	=	69 %	I _A	=	5.0 mm*
LGI	=	230.0 m	LGP	=	30.0 m
SLPI	=	0.4 %	SLPP	=	7.0 %
* XIMP was based on the assumption that the directly connected areas are the following:			* Refer to the CN & I _A spreadsheet		
- All impervious areas					

SWMHYMO Results

The **12-hour SCS Type-II Storm Distribution** was determined to govern the design of the proposed Depressed Storage Basin due to the greater storage volumes required to attenuate the post-development peak flows to their corresponding pre-development target rates.

Depressed Storage Basin

Uncontrolled Peak Flow Rates		Controlled Peak Flow Rates	
Q ₂	= 0.368 m ³ /s	Q ₂	= 0.024 m ³ /s
Q ₅	= 0.530 m ³ /s	Q ₅	= 0.057 m ³ /s
Q ₁₀	= 0.642 m ³ /s	Q ₁₀	= 0.097 m ³ /s
Q ₂₅	= 0.785 m ³ /s	Q ₂₅	= 0.136 m ³ /s
Q ₅₀	= 0.895 m ³ /s	Q ₅₀	= 0.169 m ³ /s
Q ₁₀₀	= 1.005 m ³ /s	Q ₁₀₀	= 0.230 m ³ /s

Storage Volumes	
V ₂	= 1014 m ³ /s
V ₅	= 1385 m ³ /s
V ₁₀	= 1609 m ³ /s
V ₂₅	= 1903 m ³ /s
V ₅₀	= 2135 m ³ /s
V ₁₀₀	= 2328 m ³ /s

Total Peak Flow Released to the Site Outlet

<u>Pre-Development Condition</u>			<u>Post-Development Condition</u>		
Q ₂	=	0.042 m ³ /s	Q ₂	=	0.024 m ³ /s
Q ₅	=	0.084 m ³ /s	Q ₅	=	0.057 m ³ /s
Q ₁₀	=	0.118 m ³ /s	Q ₁₀	=	0.097 m ³ /s
Q ₂₅	=	0.167 m ³ /s	Q ₂₅	=	0.136 m ³ /s
Q ₅₀	=	0.208 m ³ /s	Q ₅₀	=	0.169 m ³ /s
Q ₁₀₀	=	0.251 m ³ /s	Q ₁₀₀	=	0.230 m ³ /s

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\Spreadsheets\Issue_1\Storm\131107-SWMHYMO_Input_Parameters.xls|Post-Development Condition



**CURVE NUMBER & INITIAL ABSTRACTION CALCULATIONS
 CN & IA SPREADSHEET**

Date: Thursday November 7, 2013

Project No.: 11-183

Project: Greely Commercial Center

Prepared By: TG


Land Cover	SCS CURVE NUMBERS (AMC II (NORMAL) CONDITION)							INITIAL RAINFALL ABSTRACTION IA (mm)
	Hydrologic Soil Groups							
	A	AB	B	BC	C	CD	D	
Wetlands/Lakes/SWMP's	50	50	50	50	50	50	50	
Woods	32	46	60	67	73	76	79	10
Meadows	38	51	65	71	76	79	81	8
Pasture/Lawn/Unimproved	49	59	69	74	79	82	84	5
Cultivated	62	68	74	78	82	84	86	7
Impervious Areas	100	100	100	100	100	100	100	2

Ref: SCS Curve Numbers - Adapted from Design Chart 1.09, Ontario Ministry of Transportation, "MTO Drainage Management Manual", MTO.(1997)

Ref: Initial Rainfall Abstraction Values - UNESCO, Manual on Drainage in Urbanized Areas, (1987)

Ref: AMC I & III Condition SCS Curve Number Values - Modern Sewer Design, Third Edition (Canadian), pg. 69, Table 3.6, (1996)

- NOTES:**
- **AMC II Condition** SCS Curve Number values are not applicable to frozen soils or to the period where snowmelt contributes to stormwater runoff.
 - **STANDHYD COMMANDS** (Swmhymo) - CN values are based solely on the **pervious surfaces** within the catchment.
 - **NASHYD COMMANDS** (Swmhymo) - CN values are based on both the **pervious and impervious surfaces** within the catchment (composite CN value).

 <<< Elements Requiring Input Information

PRE-DEVELOPMENT CONDITION - TOTAL

Land Cover	Area per Land Cover Type and Hydrologic Soil Group							(for Nashyd Command) Total Area (ha) =
	Hydrologic Soil Groups							
	A	AB	B	BC	C	CD	D	
Wetlands/Lakes/SWMP's								4.83
Woods								CN(I) = 30
Meadows								CN(II) = 49
Pasture/Lawn/Unimproved	4.83							CN(III) = 69
Cultivated								
Impervious Areas								IA (mm) = 5.0

POST-DEVELOPMENT CONDITION - TOTAL

Land Cover	Area per Land Cover Type and Hydrologic Soil Group							(for Standhyd Command) Pervious Area (ha) =
	Hydrologic Soil Groups							
	A	AB	B	BC	C	CD	D	
Wetlands/Lakes/SWMP's								1.48
Woods								CN(I) = 30
Meadows								CN(II) = 49
Pasture/Lawn/Unimproved	1.48							CN(III) = 69
Cultivated								
Impervious Areas								IA (mm) = 5.0



**RUNOFF COEFFICIENT CALCULATIONS
 "C" SPREADSHEET**

Date: Thursday November 7, 2013

Project No.: 11-183

Project: Greely Commercial Center

Prepared By: TG

RUNOFF COEFFICIENT NUMBERS

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade	0.22	0.35	0.55
	5 - 10% grade	0.3	0.45	0.6
	10 - 30% grade	0.4	0.65	0.7
Pasture Land	0 - 5% grade	0.1	0.28	0.4
	5 - 10% grade	0.15	0.35	0.45
	10 - 30% grade	0.22	0.4	0.55
Woodlot or Cutover	0 - 5% grade	0.08	0.25	0.35
	5 - 10% grade	0.12	0.3	0.42
	10 - 30% grade	0.18	0.35	0.52
Lakes and Wetlands		0.05	0.05	0.05
Impervious Area	(i.e. buildings, roads, parking lot, etc.)	0.9	0.9	0.9
Gravel	(not used for proposed parking or storage areas)	0.4	0.5	0.6
Residential	Single Family	0.3	0.4	0.5
	Multiple (i.e. semi, townhouse, apartment, etc.)	0.5	0.6	0.7
Industrial	Light	0.55	0.65	0.75
	Heavy	0.65	0.75	0.85
Commercial		0.6	0.7	0.8
Unimproved Areas		0.1	0.2	0.3
Lawn	< 2% grade	0.05	0.11	0.17
	2 - 7% grade	0.1	0.16	0.22
	> 7% grade	0.15	0.25	0.35

Ref: Runoff Coefficient Numbers - Adapted from Design Chart 1.07, Ontario Ministry of Transportation, "MTO Drainage Management Manual", MTO. (1997)

 <<< Elements Requiring Input Information

PRE-DEVELOPMENT CONDITION - TOTAL

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Pasture Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Woodlot or Cutover	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)			
Gravel	(not used for proposed parking or storage areas)			
Residential	Single Family			
	Multiple (i.e. semi, townhouse, apartment, etc.)			
Industrial	Light			
	Heavy			
Commercial				
Unimproved Areas		4.83		
Lawn	< 2% grade			
	2 - 7% grade			
	> 7% grade			

Total Area (ha) = 4.83

Runoff Coefficient, C = 0.10

POST-DEVELOPMENT CONDITION - EAST

Land Cover		Hydrologic Soil Groups		
		A-AB	B-BC	C-D
Cultivated Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Pasture Land	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Woodlot or Cutover	0 - 5% grade			
	5 - 10% grade			
	10 - 30% grade			
Lakes and Wetlands				
Impervious Area	(i.e. buildings, roads, parking lot, etc.)			
Gravel	(not used for proposed parking or storage areas)			
Residential	Single Family			
	Multiple (i.e. semi, townhouse, apartment, etc.)			
Industrial	Light			
	Heavy			
Commercial				
Unimproved Areas				
Lawn	< 2% grade			
	2 - 7% grade	0.38		
	> 7% grade			

Total Area (ha) = 0.38

Runoff Coefficient, C = 0.10

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\Spreadsheets\Issue_1\Storm\131107-C_CALCS.xls]C CALCS



**TIME OF CONCENTRATION & TIME TO PEAK CALCULATIONS
 T_C & T_P SPREADSHEET**

Date: Thursday November 7, 2013

Project No.: 11-183

Project: Greely Commercial Center

Prepared By: TG

OVERLAND SHEET FLOW TIME OF CONCENTRATION (T_C) CALCULATION, T_{C, OVER}

The Runoff Coefficient 'C' governs which Time of Concentration Formula is used:

C ≥ 0.40 Bransby Williams Formula

C < 0.40 Airport Formula (FAA Equation)

Ref: MTO, Drainage Management Manual, pg 28, Ch. 8, 1997

Elements Requiring Input Information

Catchment I.D.	Area (ha)	h ₁ (m)	h ₂ (m)	Length (m)	Runoff Coefficient	h _{DELTA} (m)	Slope (%)
PRE - TOTAL	4.83	112.25	105	225	0.1	7.3	3.2
POST - EAST	0.38			82	0.1		3.5

T _{C, OVER} (min.)	
Airport Formula	Bransby Williams Formula
33.2	
19.5	

Airport Formula (FAA Equation)

$$T_{C, OVER} = \frac{3.26 (1.1-C) (L)^{0.5}}{(S)^{0.33}} \text{ (min.)}$$

where, C = Runoff Coefficient
 L = Length of Overland Flow Path, (m)
 S = Avg. Slope of Overland Flow Path, (%)

Bransby Williams Formula

$$T_{C, OVER} = \frac{0.057 (L)}{(S)^{0.2} (A)^{0.1}} \text{ (min.)}$$

where, L = Length of Overland Flow Path, (m)
 S = Avg. Slope of Overland Flow Path, (%)
 A = Catchment Area, (ha)

CHANNELIZED FLOW TIME OF CONCENTRATION (T_C) CALCULATION, T_{C, CHAN}

Refer to separate sheet attached for the calculation of the Velocity values (i.e. Flow Master Output, Manning's Channel Spreadsheet, etc.).

Catchment I.D.	Length (m)	Velocity (m/s)

T _{C, CHAN} (min.)

$$T_{C, CHAN} = \frac{L}{V} \text{ (min.)}$$

where, L = Length of Channel, (m)
 V = Flow Velocity in Channel, (m/s)

PIPED FLOW TIME OF CONCENTRATION (T_C) CALCULATION, T_{C, PIPE}

Refer to separate sheet attached for the calculation of the Velocity values (i.e. Culvert Master Output, Manning's Pipe Spreadsheet, etc.).

Catchment I.D.	Length (m)	Velocity (m/s)

T _{C, PIPE} (min.)

$$T_{C, PIPE} = \frac{L}{V} \text{ (min.)}$$

where, L = Length of Pipe, (m)
 V = Flow Velocity in Pipe, (m/s)

TOTAL TIME OF CONCENTRATION (T_C) AND TIME TO PEAK (T_P) CALCULATION, T_{C, TOTAL}, T_{P, TOTAL}

The Total Time of Concentration and Time to Peak values consist of a combination of the Overland, Channel and/or Pipe travel times.

Catchment I.D.	T _{C, OVER} (min.)	T _{C, CHAN} (min.)	T _{C, PIPE} (min.)
TOTAL - PRE	33.2		
EAST - POST	19.5		

T _{C, TOTAL} (min.)	T _{P, TOTAL} (min.)
33.2	22.2
19.5	13.1

$$T_{C, TOTAL} = T_{C, OVER} + T_{C, CHAN} + T_{C, PIPE} \text{ (min.)}$$

$$T_{P, TOTAL} = 0.67 \times T_{C, TOTAL} \text{ (min.)}$$



**STAGE-STORAGE CALCULATIONS
 SWM FACILITY (BASIN) DESIGN SPREADSHEET**

Date: Thursday November 7, 2013

Project No.: 11-183

Project: Greely Commercial Center

Prepared By: JWL



<<<

Elements Requiring Input Information

Required Permanent Pool Volume	=		m ³
Provided Permanent Pool Volume	=	#N/A	m ³
Bottom Elevation, Base	=	103.30	m
Normal Water Level Elevation, NWL	=	103.30	m (for dry facilities, NWL is assumed at Base)
Top Elevation, Top	=	105.40	m

Stage-Storage Information:

	Elevation (m)	Stage (m)	Surface Area 1 (m ²)	Surface Area 2 (m ²)	Total Surface Area (m ²)	Avg. Surface Area (m ²)	Incremental Storage Volume (m ³)	Total Storage Volume (m ³)	Total Storage Volume Above NWL (m ³)
Base	103.30	0.00	869.6		869.6	-	-	0.0	0.0
Top	105.40	2.10	1816.8		1816.8	1343.2	2820.7	2820.7	#N/A

Determining the Water Surface Elevation of a known Storage Volume:

	Total Storage Incl. P.P.	Active Storage Only
25mm	Storage Volume = 634 W.S. Elevation = 103.94	
2-year	Storage Volume = 1014 W.S. Elevation = 104.25	
5-year	Storage Volume = 1385 W.S. Elevation = 104.53	
10-year	Storage Volume = 1609 W.S. Elevation = 104.68	
25-year	Storage Volume = 1903 W.S. Elevation = 104.87	
50-year	Storage Volume = 2135 W.S. Elevation = 105.02	
100-year	Storage Volume = 2328 W.S. Elevation = 105.13	

Determining the Storage Volume at a known Water Surface Elevation:

Description	Total Storage Incl. P.P.	Active Storage Only
W.S. Elevation =		
Storage Volume =		

Ditch Inlet Catch Basin

Enter Slope Ratio	(1 ; 2 ; 6)	2
Enter Flow Depth	(m)	
Unobstructed Capacity Per Meter Width	(m ³ /s)	
Obstructed Capacity Per Meter Width	(m ³ /s)	

DICB Grate Slope Ratio		
1	2	6
a = 6.39E-03	-1.21E-02	-7.05E-03
b = 6.31E-01	7.06E-01	1.13E+00
c = -2.20E+00	-2.17E+00	-2.81E+00
d = 1.83E+00	1.60E+00	2.64E+00

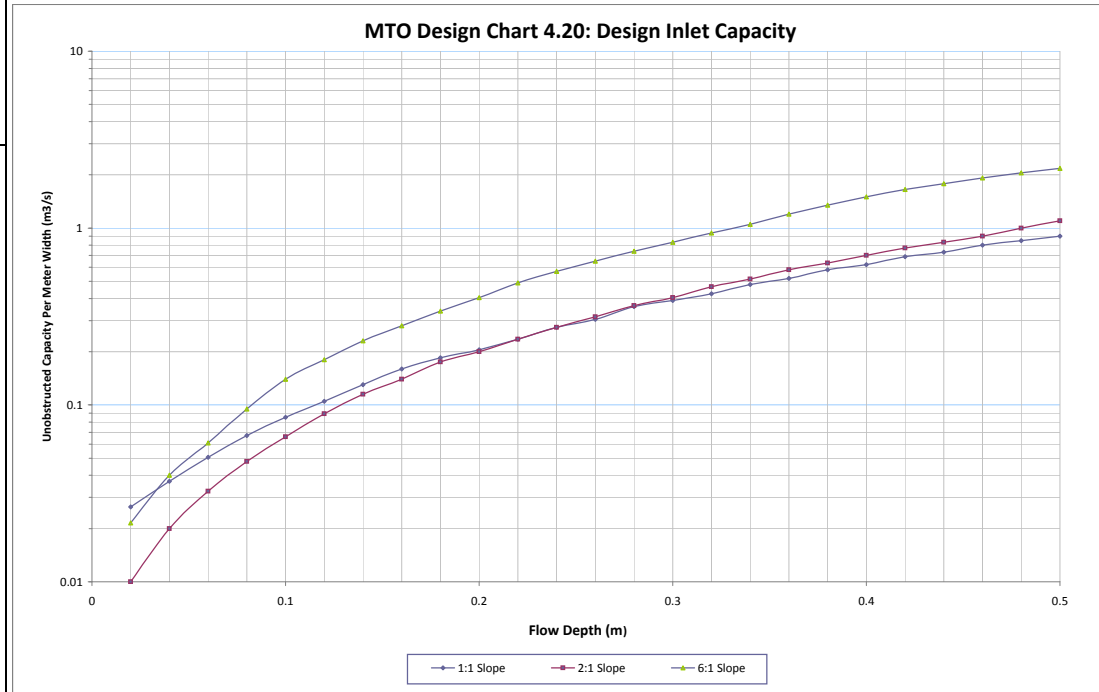
Coefficients

NOTE: When designing for a Grate Slope not shown on the Graph, choose the next closest (lower) Grate Slope to be conservative (i.e. if designing 4:1 use 2:1 graph data).

Incremental Depth = 0.050 m (0.010m MIN.)
 Width @ Crest of DICB = 0.600 m
 Obstructed/Unobstructed Capacity = Unobstructed

Obstructed Capacity = 0.5 x Unobstructed Capacity

Flow Depth (m)	Grate Slope Capacity (m ³ /s)		
	1:1	2:1	6:1
0.000	0.000	0.000	0.000
0.050	0.025	0.016	0.034
0.100	0.052	0.044	0.085
0.150	0.085	0.079	0.153
0.200	0.126	0.123	0.242
0.250	0.175	0.177	0.357
0.300	0.233	0.243	0.504
0.350	0.301	0.324	0.685
0.400	0.377	0.419	0.893
0.450	0.459	0.529	1.111
0.500	0.542	0.651	1.308



Slope 1:1
 Rational Function: $y=(a+bx)/(1+cx+dx^2)$

Coefficient Data:
 a = 6.39E-03
 b = 6.31E-01
 c = -2.20E+00
 d = 1.83E+00

x = Flow Depth (m)

Slope 2:1
 Rational Function: $y=(a+bx)/(1+cx+dx^2)$

Coefficient Data:
 a = -1.21E-02
 b = 7.06E-01
 c = -2.17E+00
 d = 1.60E+00

x = Flow Depth (m)

Slope 6:1
 Rational Function: $y=(a+bx)/(1+cx+dx^2)$

Coefficient Data:
 a = -7.05E-03
 b = 1.13E+00
 c = -2.81E+00
 d = 2.64E+00

x = Flow Depth (m)



STAGE-STORAGE-DISCHARGE (S-S-D) CALCULATIONS
DEPRESSED STORAGE AREA (BASIN)

Date: Thursday November 7, 2013 Project No.: 11-183
 Project: Greely Commercial Centers Prepared By: JWJ

Unsubmerged Orifice (Weir Flow)
Submerged Orifice (Orifice Flow)
Unsubmerged Weir (Weir Flow)
Submerged Weir (Orifice Flow)

$Q = C_w L H^{3/2}$ (m³/s)

where, Q = Flow through unsubmerged orifice (m³/s)
C_w = Weir Coefficient
H = Head/Depth of water acting on weir measured from above the crest/invert of orifice (m)
L = Length of weir (m)
D = Diameter of Pipe/Orifice (m)

For circular vertical weir,
L = Wetted Perimeter
L = $D \times \cos^{-1}((D/2 - H)/(D/2))$

For circular horizontal weir,
L = Circumference
L = 3.14 x D

$Q = C_o A_o (2gH)^{1/2}$ (m³/s)

where, Q = Flow through submerged orifice (m³/s)
C_o = Orifice Discharge Coefficient
A_o = Cross-sectional area of orifice (m²)
g = Gravitational acceleration (9.81m²/s)

For circular vertical orifice,
H = Head/Depth of water acting on orifice measured from centroid of the opening (m)

For circular horizontal orifice,
H = Head/Depth of water acting on orifice measured from above the invert (m)

Rectangular Broad- & Sharp-Crested Weirs
 $Q = C_w L H^{3/2}$ (m³/s)

Triangular Broad-Crested Weirs
 $Q = 1.225 H^{3/2} \tan(\Theta/2)$ (m³/s)
Triangular Sharp-Crested Weirs
 $Q = 0.581 (8/15) (2g)^{1/2} \tan(\Theta/2) H^{5/2}$ (m³/s)

Trapezoidal Broad- & Sharp-Crested Weirs
 $Q_{TRAPEZOIDAL} = Q_{RECTANGULAR} + Q_{TRIANGULAR}$ (m³/s)

where, Q = Flow through unsubmerged weir (m³/s)
C_w = Weir Coefficient
(1.65 for Broad-Crested)
(1.80 for Sharp-Crested)
H = Head/Depth of water acting on weir measured from above the crest (m)
L = Length of weir measured perpendicular to flow direction (m)
Theta/2 = Angle of side slope measured from vertical axis (degrees)
g = Gravitational acceleration (9.81m²/s)

Submerged Sharp-Crested Weirs
 $Q = C_o A_o (2gH)^{1/2}$ (m³/s)

where, Q = Flow through submerged weir opening (m³/s)
C_o = Orifice Discharge Coefficient
A_o = Cross-sectional area of opening (m²)
g = Gravitational acceleration (9.81m²/s)
H = Head/Depth of water acting on orifice measured from centroid of the opening (m)

NOTES: Orifice Flow Notes

- **Vertical Orifice Flow** calculations assume weir flow up to the centroid/center of orifice and then orifice flow above the crown/top of the orifice. Between the centroid and crown of the orifice is a flow transition stage from weir to orifice flow and is calculated based on a linear interpolation between the known weir flow at the centroid of the orifice and the known orifice flow at the crown.
- **Horizontal Orifice Flow** calculations assume weir flow up to one-quarter of the orifices diameter (0.25xD) and then orifice flow above three-quarters of the orifices diameter (0.75xD). Between (0.25xD) and (0.75xD) exists a flow transition stage which is calculated based on a linear interpolation between the known weir flow at (0.25xD) and the known orifice flow at (0.75xD).

Weir Flow Notes

- **Orifice control** is only applicable if the weir opening is submerged and not exposed to atmospheric pressure for all ranges of water elevations.
- For all Weir Types, **orifice control** occurs when the water surface elevation is equal to or greater than the crown/top of the opening.

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\Spreadsheets\Issue_1\Storm\131107-Detailed_S-S-D_Table(Basin).xls\SS-D Table

Starting Water Elevation, m = **103.300**
 Incremental Depth, m = **0.050**

	2-100yr Orifice	DICB	Orifice 3	Weir 1	Weir 2	Spillway
Orifice Type =	Vertical	Horizontal	Horizontal	Triangular Sharp-Crested	Rectangular Sharp-Crested	Triangular Broad-Crested
Orifice Invert Elev., m =	102.950			104.150		104.950
Incremental Depth, m =	0.050	0.050	0.050	0.050	0.050	0.050
Water Elev. @ Inflow, m =	103.300			104.650		
Orifice Diameter, m =	0.095					0.50
Centroid of Orifice, m =	102.998			1.80	1.80	1.65
Orifice Area, m ² =	0.0071	0.0000	0.0000	0.25		3
Orifice Coefficient =	0.63			14	0	72
Weir Coefficient =	1.80			104.483		
				0.06		
				0.63		

Elevation (m)	Surface Area (m ²)	Storage Volume (m ³)
103.300	869.6	0.0
105.400	1816.8	2820.7

NOTE: - The governing of the DICB and 2-100 year Orifice Flow values are used in the Total Flow Column (not both). The DICB Flow values provided below are derived from Design Chart 4.20: Ditch Inlet Capacity provided in the MTO Drainage Management Manual dated 1995-1997. Please note that the Design Chart only extends to a depth of 0.5m above the crest of the DICB but the orifice located downstream within the control manhole is considered to govern beyond this point so additional Ditch Inlet Capacity values are not critical. The DICB Flow values are considered to be Unobstructed flow values (i.e. no 0.5 factor applied to the flow values for obstruction purposes) as this is typical for SWM Pond design since an emergency overflow weir is present to safely convey all necessary peak flows in the event of a blockage. The proposed DICB Grate Slope is 4:1 (H:V), being as the MTO Design Chart does not consider this Grate Slope the next lower flow Grate Slope of 2:1 (H:V) has been considered to be conservative.

Description	Elevation (m)	2-100yr Orifice Flow (m ³ /s)	DICB Flow (m ³ /s)	Orifice 3 Flow (m ³ /s)	Weir 1 Flow (m ³ /s)	Weir 2 Flow (m ³ /s)	Spillway Flow (m ³ /s)	Total Flow (m ³ /s)	Total Storage Volume (m ³)	Notes
Base	103.300	0.0000	0.000	0.000				0.0000	0	
	103.350	0.0117	0.016	0.000				0.0117	44	
	103.400	0.0125	0.044	0.000				0.0125	89	
	103.450	0.0133	0.079	0.000				0.0133	135	
	103.500	0.0140	0.123	0.000				0.0140	181	
	103.550	0.0147	0.177	0.000				0.0147	229	
	103.600	0.0154	0.243	0.000				0.0154	278	
	103.650	0.0160	0.324	0.000				0.0160	328	
	103.700	0.0166	0.419	0.000				0.0166	379	
	103.750	0.0172	0.529	0.000				0.0172	430	
	103.800	0.0177	0.651	0.000				0.0177	483	
	103.850	0.0183		0.000				0.0183	537	
	103.900	0.0188		0.000				0.0188	592	
	103.950	0.0193		0.000				0.0193	649	25mm storm (Q=0.019m3/s, V=634m3 at 103.94m)
	104.000	0.0198		0.000				0.0198	706	
	104.050	0.0203		0.000				0.0203	764	
	104.100	0.0208		0.000				0.0208	824	
	104.150	0.0212		0.000	0.000	0.000		0.0212	884	
	104.200	0.0217		0.000	0.000	0.000		0.022	946	
	104.250	0.0221		0.000	0.001	0.000		0.023	1009	2-year storm (Q=0.024m3/s, V=1014m3 at 104.25m)
	104.300	0.0226		0.000	0.003	0.000		0.026	1074	
	104.350	0.0230		0.000	0.006	0.000		0.029	1139	
	104.400	0.0234		0.000	0.011	0.000		0.034	1206	
	104.450	0.0238		0.000	0.017	0.000		0.041	1274	
	104.500	0.0242		0.000	0.025	0.000		0.049	1343	
	104.550	0.0246		0.000	0.035	0.000		0.059	1413	5-year storm (Q=0.057m3/s, V=1385m3 at 104.53m)
	104.600	0.0250		0.000	0.047	0.000		0.072	1485	
	104.650	0.0254		0.000	0.071	0.000		0.097	1558	
	104.700	0.0258		0.000	0.081	0.000		0.107	1633	10-year storm (Q=0.097m3/s, V=1609m3 at 104.68m)
	104.750	0.0262		0.000	0.090	0.000		0.116	1708	
	104.800	0.0266		0.000	0.098	0.000		0.125	1785	
	104.850	0.0269		0.000	0.106	0.000		0.133	1864	25-year storm (Q=0.136m3/s, V=1903m3 at 104.87m)
	104.900	0.0273		0.000	0.113	0.000		0.140	1944	
	104.950	0.0276		0.000	0.119	0.000		0.147	2025	
	105.000	0.0280		0.000	0.125	0.000	0.002	0.155	2107	50-year storm (Q=0.169m3/s, V=2135m3 at 105.02m)
	105.050	0.0283		0.000	0.131	0.000	0.012	0.171	2191	
Freeboard	105.100	0.0287		0.000	0.137	0.000	0.032	0.198	2277	100-year storm (Q=0.230m3/s, V=2328m3 at 105.13m)
	105.150	0.0290		0.000	0.142	0.000	0.066	0.237	2364	
	105.200	0.0294		0.000	0.148	0.000	0.115	0.292	2452	
	105.250	0.0297		0.000	0.153	0.000	0.181	0.364	2542	
	105.300	0.0300		0.000	0.158	0.000	0.266	0.454	2633	
	105.350	0.0303		0.000	0.162	0.000	0.372	0.565	2726	
Top	105.400	0.0307		0.000	0.167	0.000	0.499	0.697	2821	

Rating Table for Triangular Channel - Overland Basin Inlet Swale

Project Description

Friction Method Manning Formula
 Solve For Discharge

Input Data

Roughness Coefficient 0.035
 Channel Slope 1.10 %
 Normal Depth 0.45 m
 Left Side Slope 5.0 H:V
 Right Side Slope 5.0 H:V

Normal Depth (m)	Discharge (m ³ /s)	Velocity (m/s)	Flow Area (m ²)	Wetted Perimeter (m)	Top Width (m)
0.00			0.00	0.00	0.00
0.05	0.003	0.25	0.01	0.51	0.50
0.10	0.020	0.40	0.05	1.02	1.00
0.15	0.059	0.53	0.11	1.53	1.50
0.20	0.127	0.64	0.20	2.04	2.00
0.25	0.231	0.74	0.31	2.55	2.50
0.30	0.376	0.83	0.45	3.06	3.00
0.35	0.567	0.93	0.61	3.57	3.50
0.40	0.809	1.01	0.80	4.08	4.00
0.45	1.108	1.09	1.01	4.59	4.50

Rating Table for Overflow Spillway Swale

Project Description

Friction Method Manning Formula
Solve For Discharge

Input Data

Roughness Coefficient 0.035
Channel Slope 2.00 %
Normal Depth 0.30 m
Left Side Slope 3.0 H:V
Right Side Slope 3.0 H:V
Bottom Width 1.00 m

Normal Depth (m)	Discharge (m ³ /s)	Velocity (m/s)	Flow Area (m ²)	Wetted Perimeter (m)	Top Width (m)
0.00		0.00	0.00	1.00	1.00
0.05	0.029	0.50	0.06	1.32	1.30
0.10	0.097	0.75	0.13	1.63	1.60
0.15	0.204	0.94	0.22	1.95	1.90
0.20	0.351	1.10	0.32	2.26	2.20
0.25	0.541	1.24	0.44	2.58	2.50
0.30	0.779	1.37	0.57	2.90	2.80



Storm Sewer Design Sheet Greely Commercial Center

Elements Requiring Input Information

Rational Method Calculation:

$$Q = 2.78 * (C_F * C * I * A)$$

where,

Q = peak flow rate (L/s)

C_F = runoff coefficient factor for storms **> 10-yr**

(C_F = 1.0 for the 2, 5 & 10-yr storm events and
 C_F = 1.1, 1.2 & 1.25 for the 25, 50 & 100-yr
 storm events respectively)

C = runoff coefficient

I = rainfall intensity (mm/hr)

A = area (ha)

Manning's Formula Calculation:

$$V = (k * R^{2/3} * S^{1/2}) / n$$

$$Q = V * A$$

MOE Velocity Requirements: 0.8m/s - 6.0m/s

where,

V = mean velocity (m/s)

k = 1.0 for SI units

R = hydraulic radius (m)

S = friction slope (m/m)

n = Mannings Coefficient **0.013**

Rainfall Intensity Calculation:

$$I = A * T_C^B$$

Rainfall IDF Data:

where,

T_C = Time of Concentration (hr)

A = Rainfall IDF Coefficient

B = Rainfall IDF Coefficient

Runoff Coeff. Factors, C_F =

Ottawa IDF Table:
 1967 to 1997

5-year 100-year

A = 998.071 1735.688

B = 6.053 6.014

C = 0.814 0.820

1.00 1.25

Date: **Thursday November 7, 2013**

Project No: **11-183**

Prepared by: **TG/JWL**

Location			Runoff Calculation Data								Sewer Calculation Data							Sewer Profile Data								
Street	Upstream MH	Downstream MH	Drainage Areas (ha)				Individual 2.78CA	Accumulated 2.78CA	Time of Concentration (mins)	Storm Event	Rainfall Intensity (mm/hr)	Peak Runoff Flow (L/s)	Diameter (mm)	Slope (%)	Length (m)	Capacity (L/s)	Velocity (m/s)	Pipe Flow Time (mins)	Pipe Storage Volume (m ³)	Fall in Sewer (m)	Drop in MH (m)		Top of Grate Elevation (m)		Invert Elevation (m)	
			C = 0.20	C = 0.55	C = 0.75	C = 0.90															DS	US	DS	US	DS	US
	CBMH 17	DCBMH 16				0.13	0.13	15.00	5-year	83.56	10.45	300	8.00	38.10	285.34	3.91	0.16	2.8	3.05	0.06	110.58	106.55	107.79	104.74		
	DCBMH 16	MH 14	0.38			0.58	0.71	15.16	5-year	83.04	58.63	300	0.40	40.20	63.80	0.87	0.77	2.9	0.16	0.06	106.55	106.49	104.68	104.52		
	DCBMH 15	MH 14				0.83	0.83	15.00	5-year	83.56	68.99	375	0.30	18.50	100.18	0.88	0.35	2.1	0.06	0.03	106.25	106.49	104.55	104.49		
	MH 14	DCBMH 11				0.00	1.53	15.93	5-year	80.67	123.57	375	0.70	35.30	153.03	1.34	0.44	4.0	0.25	0.01	106.49	105.45	104.46	104.21		
	CB 13	CBMH 12	0.26			0.40	0.40	15.00	5-year	83.56	33.22	300	3.20	15.30	180.46	2.47	0.10	1.1	0.49	0.03	106.00	105.90	104.92	104.43		
	CBMH 12	DCBMH 11				0.38	0.77	15.10	5-year	83.23	64.32	300	0.50	20.10	71.33	0.98	0.34	1.5	0.10	0.10	105.90	105.45	104.40	104.30		
	DCBMH 11	CBMH 10				0.78	3.08	16.37	5-year	79.39	244.53	525	0.35	35.00	265.43	1.19	0.49	7.8	0.12	0.01	105.45	105.45	104.20	104.08		
	CBMH 10	CBMH 7	0.38			0.58	3.66	16.86	5-year	78.00	285.57	600	0.30	34.90	350.85	1.20	0.48	10.2	0.10	0.03	105.45	105.45	104.07	103.97		
	CBMH 8	CBMH 7				0.40	0.40	15.00	5-year	83.56	33.45	300	2.00	31.00	142.67	1.96	0.26	2.3	0.62	0.44	106.45	105.45	105.00	104.38		
	CBMH 7	CBMH 5	0.37			0.57	4.63	17.34	5-year	76.68	354.83	600	0.35	47.30	378.96	1.30	0.61	13.8	0.17	0.05	105.45	105.45	103.94	103.77		
	CB 6	CBMH 5	0.35			0.54	0.54	15.00	5-year	83.56	44.72	300	1.80	34.40	135.35	1.85	0.31	2.5	0.62	0.03	105.45	105.45	104.37	103.75		
	CBMH 5	MH 3				0.93	6.09	17.95	5-year	75.10	457.22	675	0.40	30.30	554.62	1.50	0.34	11.2	0.12	0.07	105.45	105.75	103.72	103.60		
	CBMH 4	MH 3				0.23	0.23	15.00	5-year	83.56	18.82	300	4.70	12.50	218.71	3.00	0.07	0.9	0.59	0.03	105.45	105.75	104.15	103.56		
	CBMH 24	CBMH 23	2.26			1.28	1.28	15.00	5-year	83.56	107.09	450	0.30	36.30	162.91	0.99	0.61	6.0	0.11	0.01	106.78	105.75	104.51	104.40		
	CBMH 23	MH 22				0.33	1.61	15.61	5-year	81.64	131.18	450	0.30	22.90	162.91	0.99	0.38	3.8	0.07	0.06	105.75	106.18	104.39	104.32		
	MH 22	CBMH 21			0.00	0.00	1.61	15.99	5-year	80.48	129.31	450	0.30	26.80	162.91	0.99	0.45	4.4	0.08	0.01	106.18	105.75	104.26	104.18		
	CBMH 21	CBMH 20			0.12	0.25	1.86	16.44	5-year	79.16	147.01	450	0.30	58.80	162.91	0.99	0.99	9.7	0.18	0.01	105.75	105.75	104.17	103.99		
	CBMH 20	CBMH 19			0.47	0.98	2.84	17.43	5-year	76.44	216.87	525	0.30	58.60	245.74	1.10	0.89	13.1	0.18	0.05	105.75	105.75	103.98	103.80		
	CBMH 19	MH 3			0.40	0.83	3.67	18.32	5-year	74.17	272.27	525	0.40	48.40	283.76	1.27	0.64	10.8	0.19	0.03	105.75	105.75	103.75	103.56		
	MH 3	MH 2	0.00			0.00	9.98	18.96	5-year	72.63	725.17	825	0.35	43.60	885.93	1.61	0.45	24.1	0.15	0.06	105.75	105.16	103.53	103.38		
	CBMH 26	MH 2			0.10	0.25	0.25	15.00	5-year	83.56	20.91	300	0.30	12.80	55.26	0.76	0.28	0.9	0.04	0.06	104.93	105.16	103.42	103.38		
	MH 2	HEADWALL	0.00			0.00	10.23	19.41	5-year	71.58	732.57	825	0.35	6.70	885.93	1.61	0.07	3.7	0.02		105.16	104.69	103.32	103.30		

Sum of Drainage Areas (ha): 2.26 1.74 0.99 1.70
 Total Drainage Area (ha): 6.69

NOTES: - Pipes downstream of the control manhole have been reduced in size since additional capacity is not required downstream of the control devices (i.e. peak flows are attenuated upstream).

CDS Average Annual Efficiency For TSS Removal & Total Annual Volume Treated

Modified: FK, 10/11/05 Orlando

Area = 4.83 ha
 Impervious: 69 %
 CDS Model: PMSU20_15_6
 Flowrate: 20 l/s
 IDF Data: Ottawa
 PSD: FINE

Upstream Storage:
 Storage 2328 m³

Engineer: WMI & Associates Limited
 Contact: Jeremy W. Lighthouse, P. Eng.
 Date: 15-Jan-14

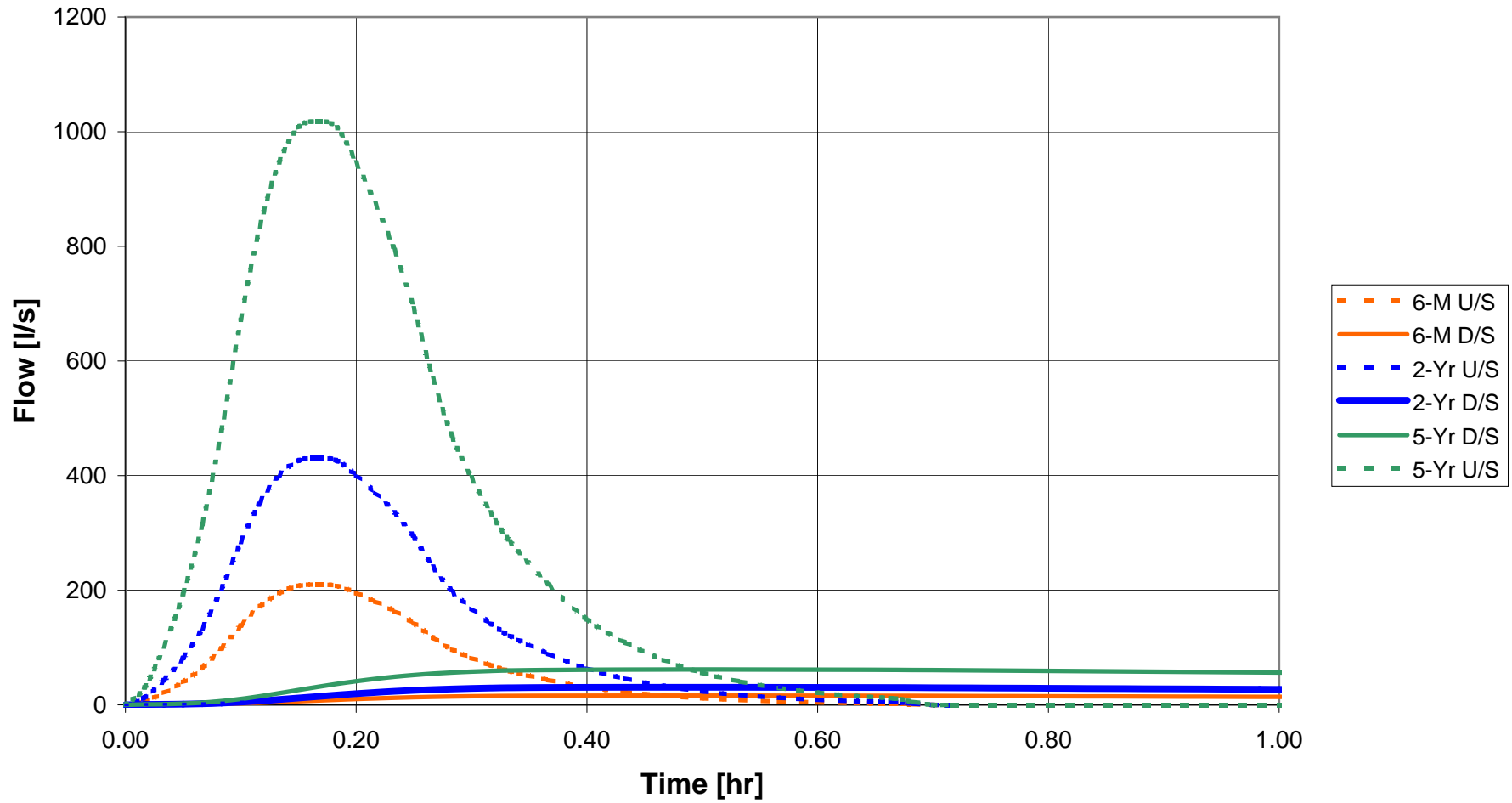
Project: Greely Commercial Center
 Location: Greely, ON
 OGS ID: CDS

Return	Period	Peak Flow	TSS Percentage Captured	Treated Flow Volume	Total Flow Volume	Annual Exceedance Probability	System Flow	CDS Flow	By-Pass Flow	Volume Percentage Treated
month / yr	Yr	l/s	%	litres	litres	%	l/s	l/s	l/s	%
1-M	0.08	5.21	93.22	34229	34229	100.00	5.21	5.21	0.00	100.00
2-M	0.17	8.14	90.00	53539	53539	99.75	8.14	8.14	0.00	100.00
3-M	0.25	10.57	87.33	69670	69670	98.17	10.57	10.57	0.00	100.00
4-M	0.33	12.77	84.89	84377	84377	95.04	12.77	12.77	0.00	100.00
5-M	0.42	14.45	83.01	95788	95788	90.91	14.45	14.45	0.00	100.00
6-M	0.50	16.14	81.13	107199	107199	86.47	16.14	16.14	0.00	100.00
7-M	0.58	17.39	79.71	115785	115785	82.01	17.39	17.39	0.00	100.00
8-M	0.67	18.65	78.30	124371	124371	77.67	18.65	18.65	0.00	100.00
9-M	0.75	19.90	76.89	132956	132956	73.64	19.90	19.90	0.00	100.00
10-M	0.83	20.88	75.40	138211	139737	69.90	20.88	20.10	0.77	99.00
11-M	0.92	21.85	73.91	143466	146517	66.40	21.85	20.10	1.75	98.01
1-Yr	1	22.83	72.42	148721	153297	63.21	22.83	20.10	2.73	97.01
2-Yr	2	30.76	59.26	173664	209537	39.35	30.76	20.10	10.66	82.88
5-Yr	5	61.73	28.79	183911	449432	18.13	61.73	20.10	41.62	40.92
10-Yr	10	100.81	15.95	185658	818135	9.52	100.81	20.10	80.70	22.69
25-Yr	25	138.25	11.73	186567	1117458	3.92	138.25	20.10	118.15	16.70
50-Yr	50	171.91	10.07	186811	1304099	1.98	171.91	20.10	151.81	14.32
100-Yr	100	233.18	8.21	187074	1601664	1.00	233.18	20.10	213.07	11.68

Average Annual TSS Removal Efficiency [%]: **81.0** Ave. Ann. T. Volume [%]: **97.5**

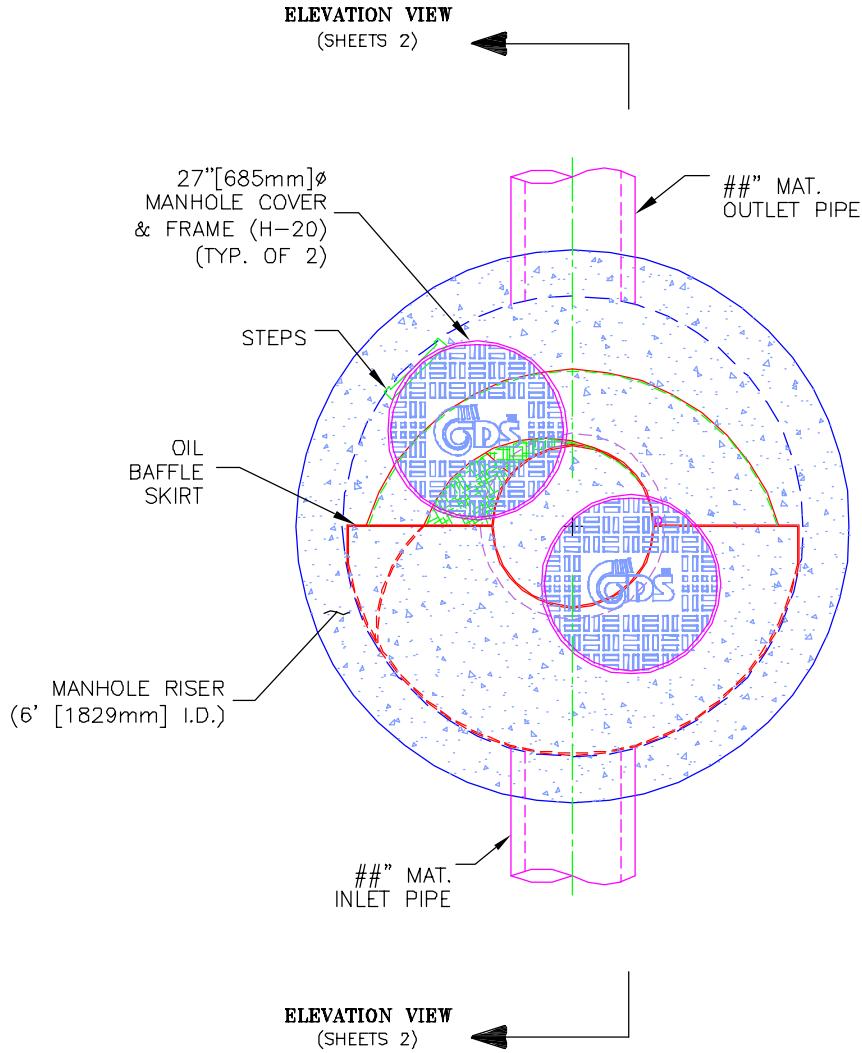


Greely Commercial Center - CDS OGS Inflow and Routed Outflow Hydrographs





PLAN VIEW



CDS MODEL PMSU20_15_6m, 0.7 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT



PROJECT NAME
CITY, STATE

JOB# XX-##-###

DATE ##/##/##

DRAWN INITIALS

APPROV.

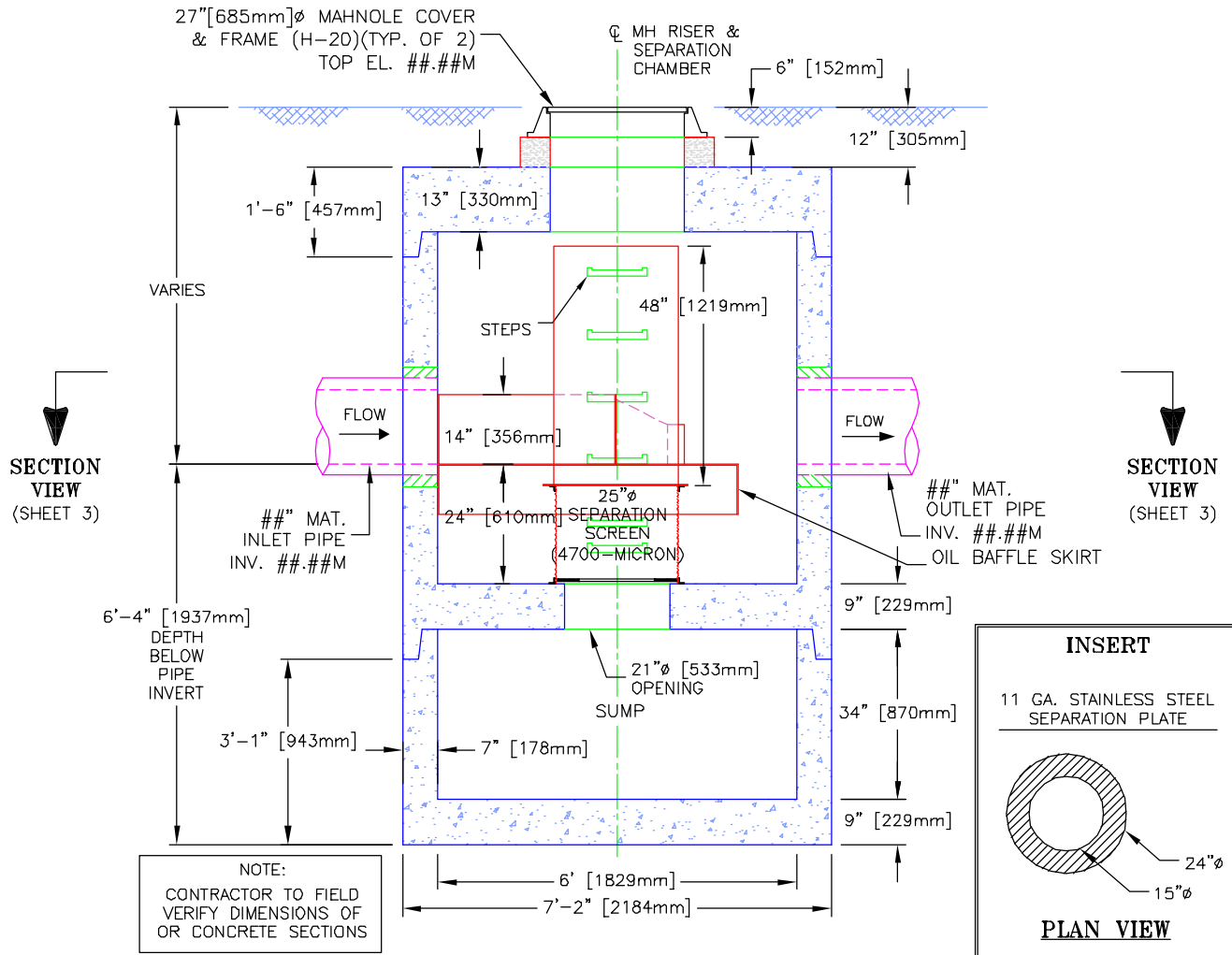
SCALE
1" = 2.5'

SHEET

1



ELEVATION VIEW



CDS MODEL PMSU20_15_6m, 0.7 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT



PROJECT NAME
CITY, STATE

JOB# XX-##-###

DATE ##/##/##

DRAWN INITIALS

APPROV.

SCALE
1" = 3'

SHEET

2



STORMWATER TREATMENT UNIT OPERATION & MAINTENANCE MANUAL

PROJECT NAME
CITY, ON
CDS JOB #



E C H E L O N
ENVIRONMENTAL

505 Hood Road, Unit 26
Markham, ON L3R 5V6
Tel: (905) 948-0000 Fax: (905) 948-0577
Email: info@echelonenvironmental.ca
Website: www.echelonenvironmental.ca



OPERATIONS AND MAINTENANCE GUIDELINES FOR CDS[®] UNIT MODEL PMSU (Continuous Deflective Separation Unit)

PROJECT NAME

1. INTRODUCTION

The CDS[®] unit is an important and effective component of your stormwater management program and proper operation and maintenance of the unit are essential to demonstrate your compliance with local, provincial and federal water pollution control requirements.

Your CDS[®] system utilizes patented “continuous deflective separation” (CDS[®]) technology to separate and trap debris, sediment and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material that is larger than the screen aperture.

2. OPERATION OVERVIEW

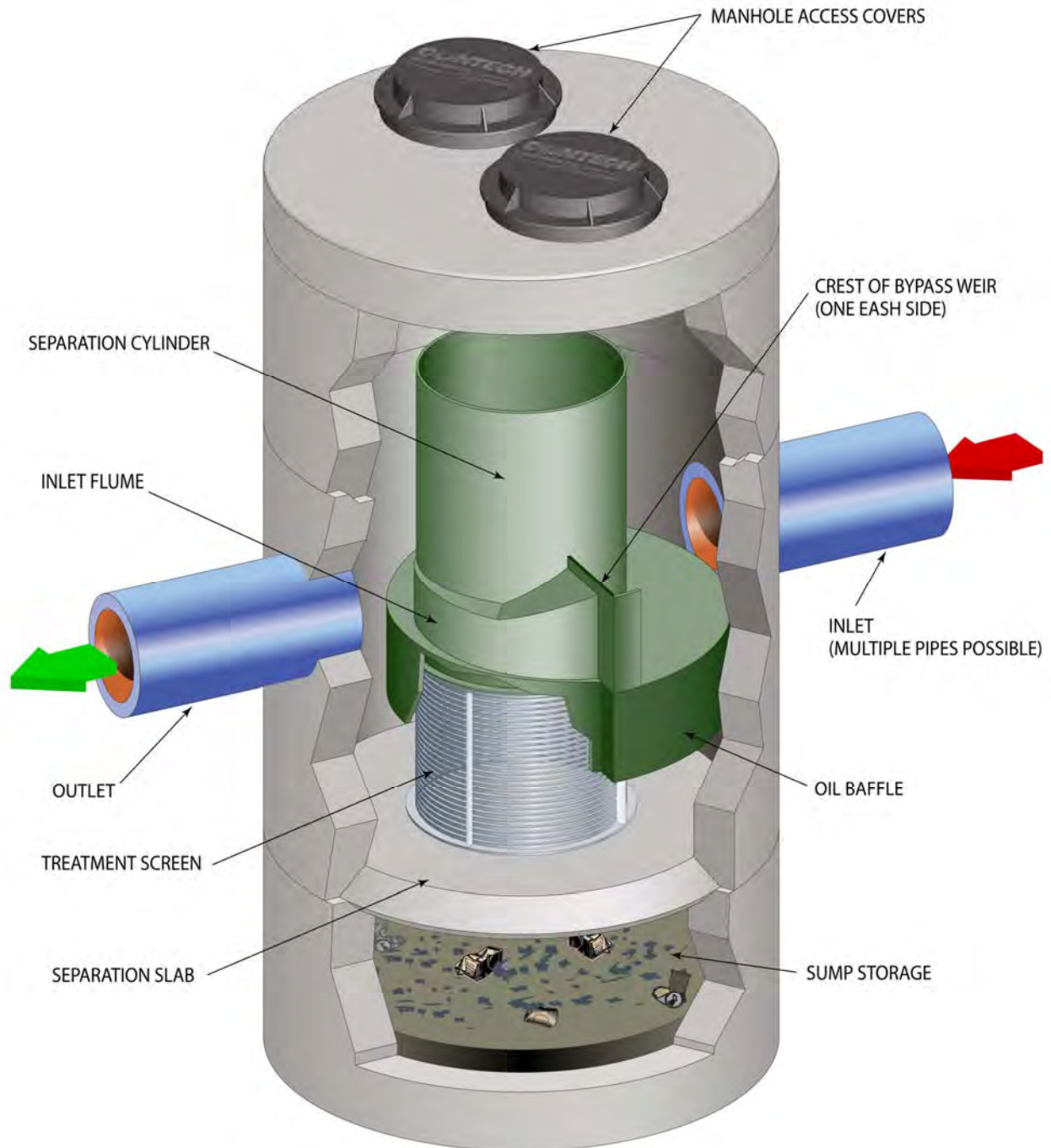
The CDS[®] unit is a non-mechanical hydraulically driven technology that will function any time there is flow in the storm drainage system. Stormwater enters the CDS[®] System (Figure 1) where the bypass weir guides the flow into the unit’s separation chamber and pollutants are removed from the flow. All flows up to the system’s treatment design capacity enter the separation chamber and are treated. Flows in excess of the treatment capacity spill over the bypass weir and exit the system through the outlet pipe.

Stormwater entering the CDS[®] System circulates in a torriodial flow path. This flow pattern helps to maintain the non-blocking attributes of the treatment screen as well as creating a hydraulic condition at the screen surface that effects pollutant separation. Treated stormwater passes through the screen into the outer volute area where it moves toward the outlet pipe and out of the system.

The separation chamber is shrouded by an integral oil baffle that traps free oil and grease that floats to the water surface during treatment.

During normal operation captured grit will fall by gravity into the lower storage sump located beneath the treatment chamber. Floatables will be captured at the water surface inside the separation chamber and oil, if present, will be located at the water surface underneath the integral oil baffle.

Figure One: In-Line CDS® Systems



3. INSPECTION OVERVIEW

The frequency of cleaning for the CDS[®] unit will depend upon the generation of trash and debris and sediments in each application. Cleanout and preventive maintenance schedules will be determined based on operating experience unless precise pollutant loadings have been determined. The unit should be periodically inspected to determine the amount of accumulated pollutants and to ensure that the cleanout frequency is adequate to handle the predicted pollutant load being processed by the CDS[®] unit. The recommended cleanout of solids within the CDS[®] unit's sump should occur at 85% of the sump capacity. Note that the sump may be completely full with no impact on the CDS[®] unit's performance.

Access to the CDS[®] unit is typically achieved through two manhole access covers – one allows inspection and cleanout of the separation chamber (screen/cylinder) & sump and another allows inspection and cleanout of sediment captured and retained behind the screen. The PSW & PSWC off-line models have an additional access cover over the weir of the diversion vault. Inspections of the internal components and cleanout maintenance can, in most cases, be accomplished from the ground surface without requiring entry into the unit.

IMPORTANT - CONFINED SPACE

The CDS[®] unit is a confined space environment and only properly trained personnel possessing the necessary safety equipment should enter the unit to perform maintenance and/or inspection. Personnel inspecting the system or performing maintenance must have proper training certification in Fall Protection and Confined Space entry as a minimum.

4. MAINTENANCE

Contech Engineered Solutions recommends the following:

NEW INSTALLATIONS – Check the condition of the unit after every runoff event for the first 30 days. The visual inspection should ascertain that the unit is functioning properly (no blockages or obstructions to inlet and/or separation screen), and should measure the amount of solid materials that have accumulated in the sump, the amount of fine sediment accumulated behind the screen, and determining the amount of floating trash and debris in the separation chamber. This can be done with a calibrated “dip stick” so that the depth of deposition can be tracked. Refer to the “Inspection Schematic” (**Appendix C**) for allowable deposition depths and critical distances. Schedules for inspections and cleanout should be based on storm events and pollutant accumulation.



ONGOING OPERATION – Once the site is established, the inspection frequency should be based on historical pollutant loading. In general, CDS sumps are sized for a cleanout frequency in the order of 12 to 24 months. If floatables accumulate more rapidly than the settleable solids, the floatables should be removed using a vactor truck or dip net before the layer thickness exceeds one to two feet.

Cleanout of the CDS[®] unit at the end of a rainfall season is recommended because of the nature of pollutants collected and the potential for odor generation from the decomposition of material collected and retained. This end of season cleanout will assist in preventing the discharge of pore water from the CDS[®] unit during summer months.

It is recommended to pump down the CDS[®] unit and remove pollutants at least one time per year. (This may be extended for fully developed sites that generate small pollutant loadings.) During cleanout, the internal components normally below the water line should be inspected. If any parts appear to be damaged please contact Contech Engineered Solutions or Echelon Environmental to make arrangements to have the damaged items repaired or replaced:

CONTECH ENGINEERED SOLUTIONS
200 Enterprise Drive
Scarborough, ME 04074
Phone: 877-907-8676
www.conteches.com

ECHELON ENVIRONMENTAL
505 Hood Road, Unit #26
Markham, ON L3R 5V6
Phone: 905-948-0000
Email: info@echelonenvironmental.ca

CLEANOUT AND DISPOSAL

A vactor truck is recommended for cleanout of the CDS[®] unit and can be easily accomplished in less than 30-40 minutes for most installations. Cleanout should be conducted by a licensed waste management company. Disposal of material from the CDS[®] unit should be in accordance with the local municipality's requirements. During cleanout the vactor truck will evacuate all stormwater and pollutants from the CDS[®] unit. (Local waste receiving stations may require the solids to have minimal water content. If decanting of stormwater from the vactor truck is required then the local permitting and regulatory authority should be contacted to determine if this is permissible.) Vactor trucks are typically equipped with a power wash system that may be used to wash the screen if required.

If oil is present in the CDS[®] unit it should be removed separately by a licensed liquid waste hauler. The CDS[®] unit should be cleaned immediately if a hydrocarbon spill has occurred. CDS[®] Technologies only recommends the addition of sorbents to the separation chamber if there are specific land use activities in the catchment watershed that could produce exceptionally large concentrations of hydrocarbons. Alternatively, the local regulator may allow the use of sorbents to capture and remove hydrocarbons from the CDS[®] system. Disposal of sorbents may be less costly and disposing of an oily-water mixture created by vacuum removal.

5. OPTIONAL FEATURES

USE OF SORBENTS FOR ENHANCED OIL CAPTURE

It should be emphasized that the addition of sorbents is not a requirement for CDS[®] units to effectively capture oil and grease from storm water runoff. The CDS[®] unit separation chamber effectively captures free oil and grease and CDS[®] units are also equipped with a conventional oil baffle for the capture of gross quantities. However, the addition of sorbents is a unique capability of CDS[®] units that enables enhanced oil and grease capture efficiencies beyond that obtainable by conventional oil baffle systems as well as permanent retention of captured oil and grease in solid form that prevents emulsification and conveyance.

Under normal operations, CDS[®] units will provide effluent concentrations of oil and grease that are less than 15 parts per million (ppm) for all dry weather spills where the volume is less than or equal to the spill capture volume of the CDS[®] unit. During wet weather flows, the oil baffle system can be expected to remove between 40 and 70% of the free oil and grease from the storm water runoff.

Contech Engineered Solutions only recommends the addition of sorbents to the separation chamber if there are specific land use activities in the catchment watershed that could produce exceptionally large concentrations of oil and grease in the runoff, or for large amounts that may be subjected to extended periods of inattention. If site evaluations merit an increased control of free oil and grease then oil sorbents can be added to the CDS[®] unit to thoroughly address these particular pollutants of concern.

Recommended Oil Sorbents - Rubberizer[®] Particulate 8-4 mesh or OARS[™] Particulate for Filtration, HPT4100, or equal, available from Haz-Mat Response Technologies, Inc. 4626 Santa Fe Street, San Diego, CA 92109 (800) 542-3036. OARS[™] is supplied by AbTech Industries, 4110 N. Scottsdale Road, Suite 235, Scottsdale, AZ 85251 (800) 545-8999.

The amount of sorbent to be added to the CDS[®] separation chamber can be determined if sufficient information is known about the concentration of oil and grease in the runoff. Frequently the actual concentrations of oil and grease are too variable and the amount to be added and frequency of cleaning will be determined by periodic observation of the sorbent. As an initial application, CDS[®] recommends that approximately 4 to 8 pounds of sorbent material be added to the separation chamber of the CDS[®] units per acre of parking lot or road surface per year. Typically this amount of sorbent results in a ½ inch to one (1") inch depth of sorbent material on the liquid surface of the separation chamber. The oil and grease loading of the sorbent material should be observed after major storm events. Oil Sorbent material may also be furnished in pillow or boom configurations.

The sorbent material should be replaced when it is fully discolored by skimming the sorbent from the surface. The sorbent may require disposal as a special or hazardous waste, but will depend on local and state regulatory requirements.



VECTOR CONTROL

Most CDS[®] units do not readily facilitate vector infestation. However, for CDS[®] units that may experience extended periods of non-operation (stagnant flow conditions for more than approximately one week) there may be the potential for vector infestation. In the event that these conditions exist, the CDS[®] unit may be designed to minimize potential vector habitation through the use of physical barriers (such as seals, plugs and/or netting) to seal out potential vectors. The CDS[®] unit may also be configured to allow drain-down under favorable soil conditions where infiltration of storm water runoff is permissible. For standard CDS[®] units that show evidence of mosquito infestation, the application of larvicide is one control strategy that is recommended. Typical larvicide applications are as follows:

SOLID B.t.i. LARVICIDE: ½ to 1 briquet (typically treats 50-100 sq. ft.) one time per month (30-days) or as directed by manufacturer.

SOLID METHOPRENE LARVICIDE (not recommended for some locations): ½ to 1 briquet (typically treats 50-100 sq. ft.) one time per month (30-days) to once every 4-½ to 5-months (150-days) or as directed by manufacturer.

6. RECORDS OF OPERATION AND MAINTENANCE

Contech Engineered Solutions recommends that the owner maintain annual records of the operation and maintenance of the CDS[®] unit to document the effective maintenance of this important component of your storm water management program. The attached **Annual Record of Operations and Maintenance** form (see **Appendix A**) is suggested and should be retained for a minimum period of three years.



APPENDIX A
CDS[®] UNIT RECORD OF
OPERATIONS & MAINTENANCE



CDS[®] UNIT RECORD OF OPERATION & MAINTENANCE

OWNER _____

ADDRESS _____

OWNER REPRESENTATIVE _____ PHONE _____

CDS[®] INSTALLATION:

MODEL DESIGNATION _____ DATE _____

SITE LOCATION _____

DEPTH FROM COVER TO BOTTOM OF SUMP (SUMP INVERT) _____

VOLUME OF SUMP _____ CUBIC METERS

INSPECTIONS:

DATE/INSPECTOR	SCREEN/INLET INTEGRITY	FLOATABLES DEPTH	DEPTH TO SEDIMENT (meters)	SEDIMENT VOLUME* (cubic meters)	SORBENT DISCOLORATION

Calculate Sediment Volume = (Depth to Sump Invert – Depth to Sediment)(Volume/meter)

OBSERVATIONS OF FUNCTION: _____

CLEANOUT:

DATE	VOLUME FLOATABLES	VOLUME SEDIMENTS	METHOD OF DISPOSAL OF FLOATABLES, SEDIMENTS, DECANT AND SORBENTS

SCREEN MAINTENANCE:

Note is Power Washing Performed: _____

CERTIFICATION: _____ TITLE: _____

DATE: _____



APPENDIX B
CDS[®] UNIT
INSPECTION CHECKLIST

Date: _____

INSPECTION CHECKLIST

1. During initial rainfall season, inspect and check condition of unit once every 30 days (as needed, thereafter)
2. Ascertain that unit is functioning properly (no blockages or obstructions to inlet and/or separation screen)
3. Measure amount of solid materials that have accumulated in sump
4. Measure amount of fine sediment accumulated behind screen
5. Measure amount of floating trash and debris in separation chamber

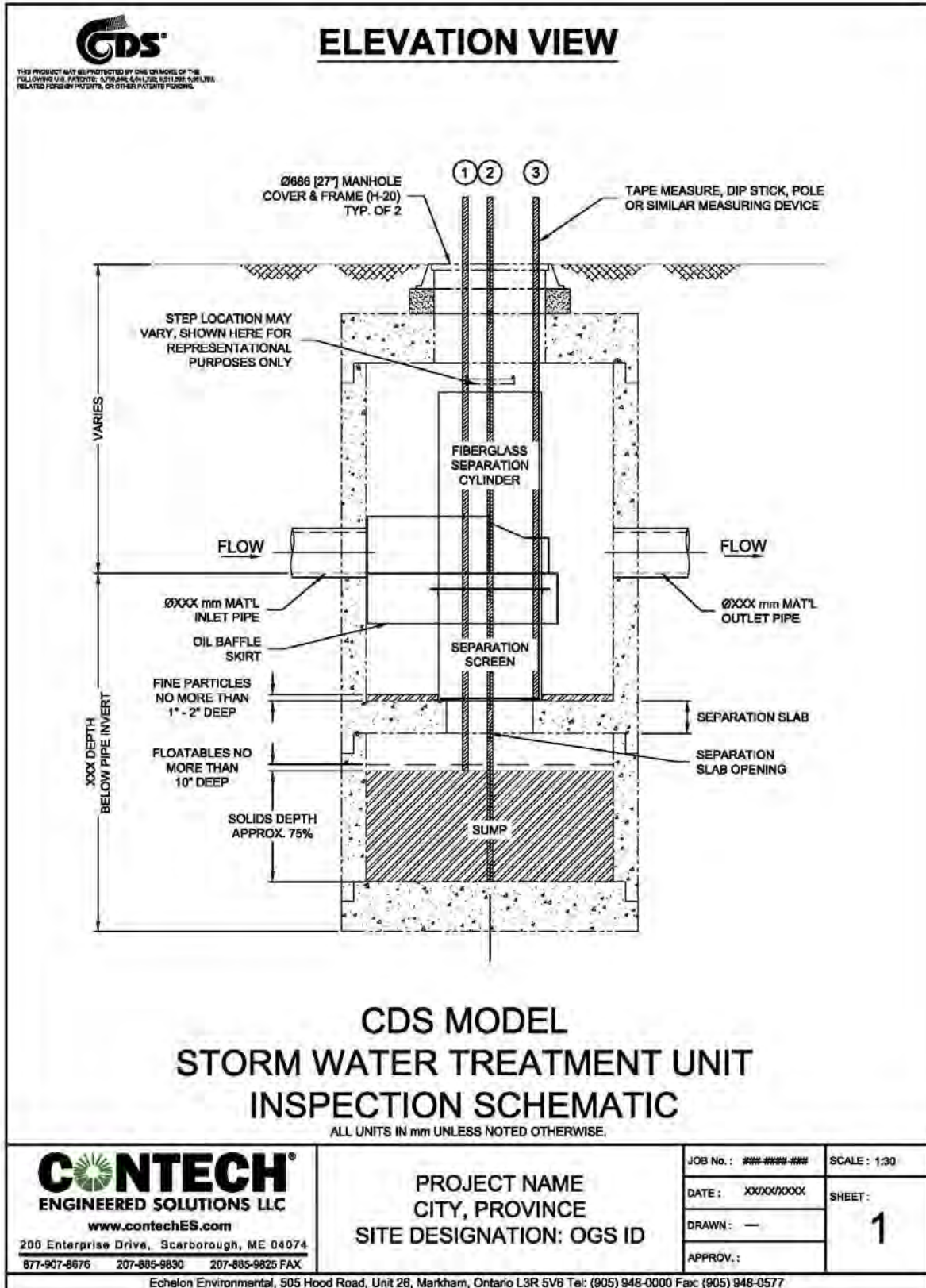
MAINTENANCE CHECKLIST

1. Cleanout unit at beginning and end of rainfall season
2. Pump down unit (at least once a year) and thoroughly inspect separation chamber, separation screen and oil baffle
3. No visible signs of damage to internal components observed



APPENDIX C

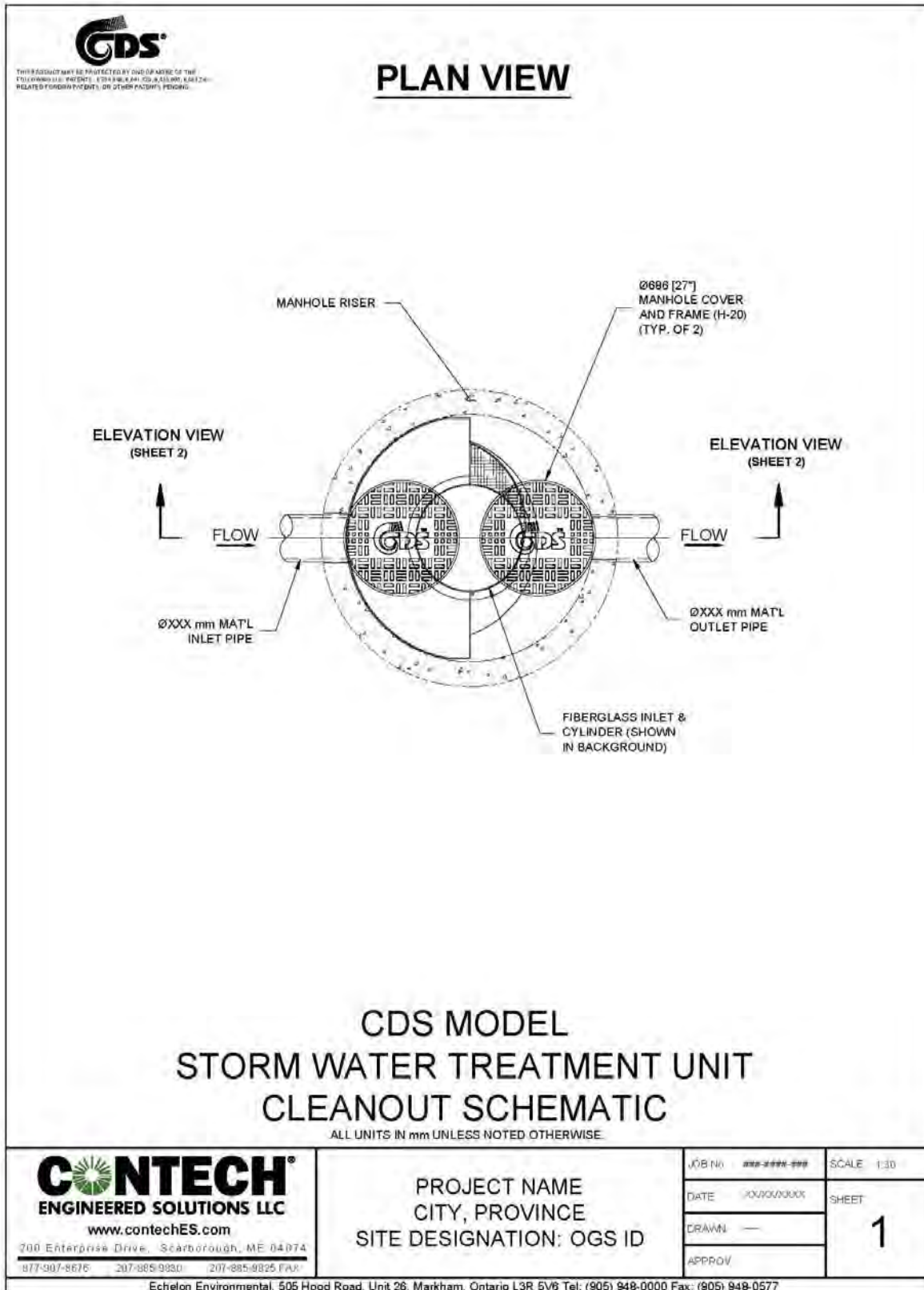
INSPECTION SCHEMATIC

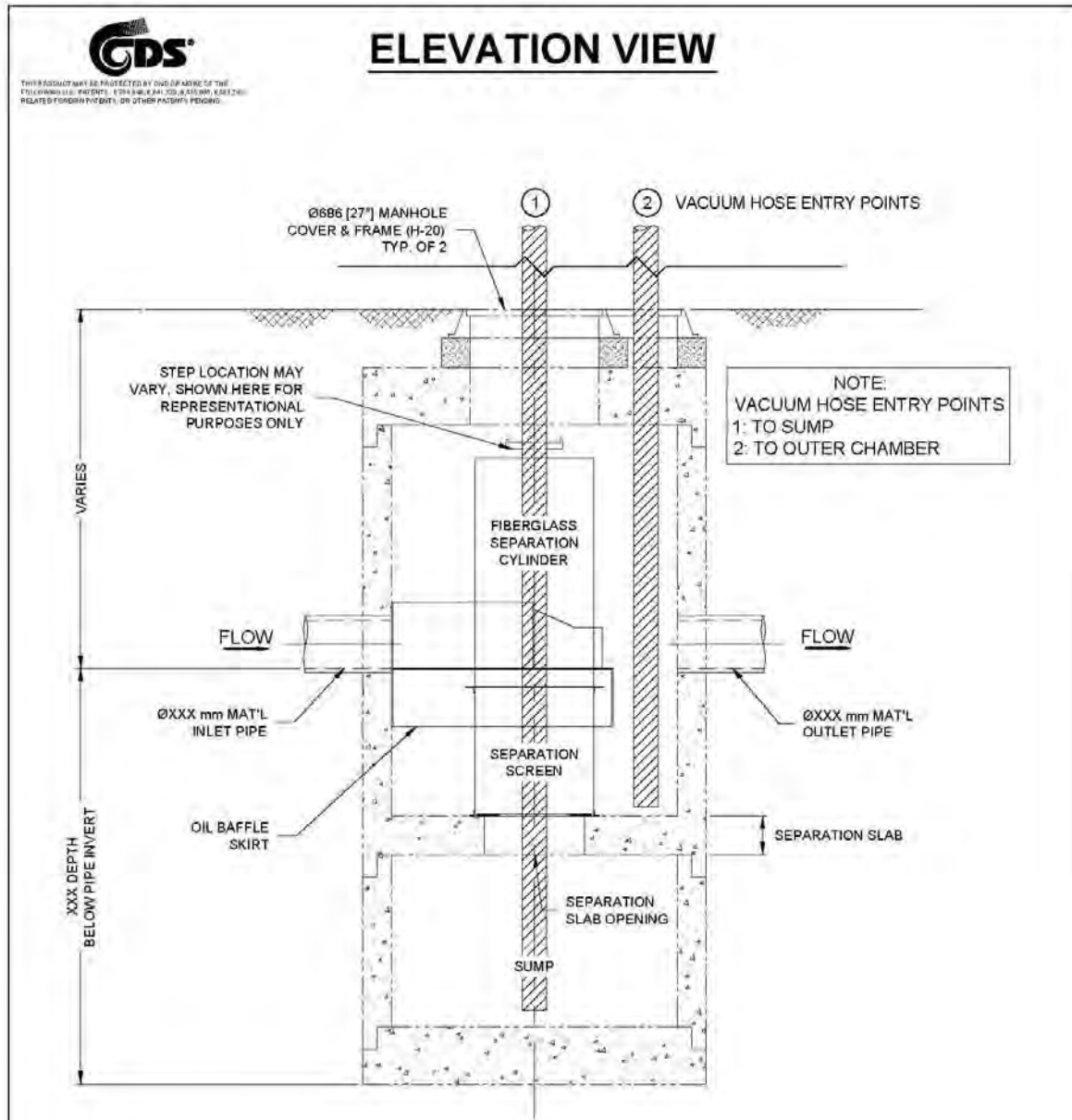




APPENDIX D

CLEANOUT SCHEMATIC





CDS MODEL
STORM WATER TREATMENT UNIT
CLEANOUT SCHEMATIC

ALL UNITS IN mm UNLESS NOTED OTHERWISE

<p>CONTECH ENGINEERED SOLUTIONS LLC www.contechES.com 700 Enterprise Drive, Scarborough, ME 04074 817-907-8676 207-885-9980 207-885-9825 FAX</p>	PROJECT NAME	JOB No. ###-###-###	SCALE 1:30
	CITY, PROVINCE	DATE XX/XX/XXXX	SHEET 2
	SITE DESIGNATION: OGS ID	DRAWN —	
		APPROV —	
<p>Echelon Environmental, 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577</p>			



APPENDIX E
AS-BUILT CDS[®] UNIT
PLAN & PROFILE
DRAWINGS

APPENDIX D

HYDROLOGIC MODELING (SWMHYMO)

- **Pre-Development Condition**
- **Post-Development Condition**

**Pre-Development Condition
12-hour SCS Type-II Storm Distribution**

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+\12hr+\2-CYRSCS.dat

```
2      Metric units
*****
*# Project Name: [Greely Commercial Center]   Project Number: [11-183]
*# Date       : 11-13-2013
*# Modeller   : [J. Lightheart]
*# Company    : WMI & Associates Ltd.
*# License #  : 2880720
*****
*
* Pre-Development Condition - Greely Commercial Center
*
*% 2-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (12-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[1]
*%         ["2SCS12.stm"] <--storm filename
*%-----|-----
READ STORM  STORM_FILENAME=["STORM.001"]
*%-----|-----
* Site Drainage Area
CALIB NASHYD ID=[1], NHYD=["TOTAL"], DT=[2]min, AREA=[4.83](ha),
              DWF=[0](cms), CN/C=[49], IA=[5.0](mm),
              N=[3], TP=[0.37]hrs,
              RAINFALL=[ , , , ](mm/hr), END=-1
*%-----|-----
*% 5-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (12-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[2]
*%         ["5SCS12.stm"] <--storm filename
*%-----|-----
*% 10-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (12-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[3]
*%         ["10SCS12.stm"] <--storm filename
*%-----|-----
*% 25-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (12-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[4]
*%         ["25SCS12.stm"] <--storm filename
*%-----|-----
*% 50-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (12-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[5]
*%         ["50SCS12.stm"] <--storm filename
*%-----|-----
*% 100-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (12-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[6]
*%         ["100SCS12.stm"] <--storm filename
*%-----|-----
FINISH
```

=====

```

SSSSS W W M M H H Y Y M M OOO      999 999  =====
S      W W W MM MM H H Y Y MM MM O O  9 9 9 9
SSSSS W W W M M M H H H H Y M M M O O ## 9 9 9 9 Ver 4.05
S      W W M M H H Y M M O O 9999 9999 Sept 2011
SSSSS W W M M H H Y M M OOO      9 9
StormWater Management HYdrologic Model 999 999  =====

```

```

*****
***** SWMHYMO Ver/4.05 *****
***** A single event and continuous hydrologic simulation model *****
***** based on the principles of HYMO and its successors *****
***** OTTHYMO-83 and OTTHYMO-89. *****
***** Distributed by: J.F. Sabourin and Associates Inc. *****
***** Ottawa, Ontario: (613) 836-3884 *****
***** Gatineau, Quebec: (819) 243-6858 *****
***** E-Mail: swmhymo@jfsa.Com *****

```

```

+++++ Licensed user: WMI & Associates Ltd. +++++
+++++ Barrie SERIAL#:2880720 +++++

```

```

*****
***** +++++ PROGRAM ARRAY DIMENSIONS +++++ *****
***** Maximum value for ID numbers : 10 *****
***** Max. number of rainfall points: 105408 *****
***** Max. number of flow points : 105408 *****

```

```

***** D E T A I L E D O U T P U T *****
*****
***** DATE: 2013-11-20 TIME: 16:37:57 RUN COUNTER: 000480 *****
* Input filename: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\2-CYRSCS.dat*
* Output filename: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\2-CYRSCS.out*
* Summary filename: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\2-CYRSCS.sum*
* User comments:
* 1:
* 2:
* 3:

```

001:0001-----

```

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthart]

```

```

*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
*
* Pre-Development Condition - Greely Commercial Center

```

```

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\
----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\

```

```

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 001
NSTORM= 1
# 1=2SCS12.stm

```

001:0002-----

```

| READ STORM | Filename: 2-Year SCS Type-II Storm Distribution (1
| Ptotal= 44.50 mm | Comments: 2-Year SCS Type-II Storm Distribution (1

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	.890	3.50	1.780	6.50	8.010	9.50	1.780
1.00	.890	4.00	1.780	7.00	3.560	10.00	.890
1.50	.890	4.50	2.670	7.50	2.670	10.50	.890
2.00	.890	5.00	3.560	8.00	2.670	11.00	.890
2.50	1.780	5.50	5.340	8.50	1.780	11.50	.890
3.00	1.780	6.00	40.050	9.00	1.780	12.00	.890

001:0003-----

```

* Site Drainage Area
| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= .370

```

```

Unit Hyd Qpeak (cms)= .499
PEAK FLOW (cms)= .042 (i)
TIME TO PEAK (hrs)= 6.267
RUNOFF VOLUME (mm)= 5.135
TOTAL RAINFALL (mm)= 44.500
RUNOFF COEFFICIENT = .115

```

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

001:0004-----

** END OF RUN : 1

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+12hr+2-CYRSCS.out

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\

Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 002
NSTORM= 1
1=5SCS12.stm

002:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthouse]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

*
* Pre-Development Condition - Greely Commercial Center
*

002:0002-----
| READ STORM | Filename: 5-Year SCS Type-II Storm Distribution (1
| Ptotal= 61.80 mm | Comments: 5-Year SCS Type-II Storm Distribution (1

TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
.50 1.236 | 3.50 2.472 | 6.50 11.124 | 9.50 2.472
1.00 1.236 | 4.00 2.472 | 7.00 4.944 | 10.00 1.236
1.50 1.236 | 4.50 3.708 | 7.50 3.708 | 10.50 1.236
2.00 1.236 | 5.00 4.944 | 8.00 3.708 | 11.00 1.236
2.50 2.472 | 5.50 7.416 | 8.50 2.472 | 11.50 1.236
3.00 2.472 | 6.00 55.620 | 9.00 2.472 | 12.00 1.236

002:0003-----
* Site Drainage Area

| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
| U.H. Tp(hrs)= .370

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .084 (i)
TIME TO PEAK (hrs)= 6.233

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+12hr+2-CYRSCS.out

RUNOFF VOLUME (mm)= 10.045
TOTAL RAINFALL (mm)= 61.800
RUNOFF COEFFICIENT = .163

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

002:0004-----

002:0002-----
** END OF RUN : 2

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\

Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 003
NSTORM= 1
1=10SCS12.stm

003:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthouse]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

*
* Pre-Development Condition - Greely Commercial Center
*

003:0002-----
| READ STORM | Filename: 10-Year SCS Type-II Storm Distribution (
| Ptotal= 73.30 mm | Comments: 10-Year SCS Type-II Storm Distribution (

TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
.50 1.466 | 3.50 2.932 | 6.50 13.194 | 9.50 2.932
1.00 1.466 | 4.00 2.932 | 7.00 5.864 | 10.00 1.466
1.50 1.466 | 4.50 4.398 | 7.50 4.398 | 10.50 1.466
2.00 1.466 | 5.00 5.864 | 8.00 4.398 | 11.00 1.466
2.50 2.932 | 5.50 8.796 | 8.50 2.932 | 11.50 1.466
3.00 2.932 | 6.00 65.970 | 9.00 2.932 | 12.00 1.466

003:0003-----

* Site Drainage Area

CALIB NASHYD Area (ha)= 4.83 Curve Number (CN)=49.00
01:TOTAL DT= 2.00 Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= .370

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .118 (i)
TIME TO PEAK (hrs)= 6.233
RUNOFF VOLUME (mm)= 14.023
TOTAL RAINFALL (mm)= 73.300
RUNOFF COEFFICIENT = .191

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

003:0004-----

003:0002-----

003:0002-----

** END OF RUN : 3

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\

----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 004
NSTORM= 1
1=25SCS12.stm

004:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

*

* Pre-Development Condition - Greely Commercial Center

*

004:0002-----

| READ STORM | Filename: 25-Year SCS Type-II Storm Distribution (
| Ptotal= 87.70 mm | Comments: 25-Year SCS Type-II Storm Distribution (

Table with 8 columns: TIME, RAIN, TIME, RAIN, TIME, RAIN, TIME, RAIN. Rows show time intervals and corresponding rainfall amounts.

004:0003-----

* Site Drainage Area

CALIB NASHYD Area (ha)= 4.83 Curve Number (CN)=49.00
01:TOTAL DT= 2.00 Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= .370

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .167 (i)
TIME TO PEAK (hrs)= 6.233
RUNOFF VOLUME (mm)= 19.706
TOTAL RAINFALL (mm)= 87.700
RUNOFF COEFFICIENT = .225

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

004:0004-----

004:0002-----

004:0002-----

004:0002-----

** END OF RUN : 4

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\

----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+\12hr+\2-CYRSCS.out

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 005
NSTORM= 1
1=50SCS12.stm

005:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

* Pre-Development Condition - Greely Commercial Center
*

005:0002-----

| READ STORM | Filename: 50-Year SCS Type-II Storm Distribution (
| Ptotal= 98.40 mm | Comments: 50-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	1.968	3.50	3.936	6.50	17.712	9.50	3.936
1.00	1.968	4.00	3.936	7.00	7.872	10.00	1.968
1.50	1.968	4.50	5.904	7.50	5.904	10.50	1.968
2.00	1.968	5.00	7.872	8.00	5.904	11.00	1.968
2.50	3.936	5.50	11.808	8.50	3.936	11.50	1.968
3.00	3.936	6.00	88.560	9.00	3.936	12.00	1.968

005:0003-----
* Site Drainage Area

| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= .370

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .208 (i)
TIME TO PEAK (hrs)= 6.233
RUNOFF VOLUME (mm)= 24.383
TOTAL RAINFALL (mm)= 98.400
RUNOFF COEFFICIENT = .248

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

005:0004-----

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+\12hr+\2-CYRSCS.out

005:0002-----

005:0002-----

005:0002-----

005:0002-----

** END OF RUN : 5

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\

Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\12hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 006
NSTORM= 1
1=100SCS12.stm

006:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

* Pre-Development Condition - Greely Commercial Center
*

006:0002-----

| READ STORM | Filename: 100-Year SCS Type-II Storm Distribution
| Ptotal= 109.10 mm | Comments: 100-Year SCS Type-II Storm Distribution

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	2.182	3.50	4.364	6.50	19.638	9.50	4.364
1.00	2.182	4.00	4.364	7.00	8.728	10.00	2.182
1.50	2.182	4.50	6.546	7.50	6.546	10.50	2.182
2.00	2.182	5.00	8.728	8.00	6.546	11.00	2.182
2.50	4.364	5.50	13.092	8.50	4.364	11.50	2.182
3.00	4.364	6.00	98.190	9.00	4.364	12.00	2.182

006:0003-----

\\wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+\12hr+\2-CYRSCS.out

* Site Drainage Area

```
-----  
| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00  
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00  
-----  
U.H. Tp(hrs)= .370
```

```
Unit Hyd Qpeak (cms)= .499  
  
PEAK FLOW (cms)= .251 (i)  
TIME TO PEAK (hrs)= 6.233  
RUNOFF VOLUME (mm)= 29.410  
TOTAL RAINFALL (mm)= 109.100  
RUNOFF COEFFICIENT = .270
```

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```
-----  
006:0004-----  
-----  
006:0002-----  
-----  
006:0002-----  
-----  
006:0002-----  
-----  
006:0002-----  
-----  
006:0002-----  
-----  
FINISH
```

```
*****  
WARNINGS / ERRORS / NOTES  
-----  
Simulation ended on 2013-11-20 at 16:37:58  
=====
```

**Pre-Development Condition
6-hour SCS Type-II Storm Distribution**

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+\6hr-\2-CYRSCS.dat

```
2      Metric units
*****
*# Project Name: [Greely Commercial Center]   Project Number: [11-183]
*# Date       : 11-13-2013
*# Modeller   : [J. Lightheart]
*# Company    : WMI & Associates Ltd.
*# License #  : 2880720
*****
*
* Pre-Development Condition - Greely Commercial Center
*
*% 2-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (6-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[1]
*%
*% ["2SCS6.stm"] <--storm filename
*%-----|-----
READ STORM  STORM_FILENAME=["STORM.001"]
*%-----|-----
* Site Drainage Area
CALIB NASHYD ID=[1], NHYD=["TOTAL"], DT=[2]min, AREA=[4.83](ha),
              DWF=[0](cms), CN/C=[49], IA=[5.0](mm),
              N=[3], TP=[0.37]hrs,
              RAINFALL=[ , , , ](mm/hr), END=-1
*%-----|-----
*% 5-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (6-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[2]
*%
*% ["5SCS6.stm"] <--storm filename
*%-----|-----
*% 10-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (6-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[3]
*%
*% ["10SCS6.stm"] <--storm filename
*%-----|-----
*% 25-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (6-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[4]
*%
*% ["25SCS6.stm"] <--storm filename
*%-----|-----
*% 50-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (6-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[5]
*%
*% ["50SCS6.stm"] <--storm filename
*%-----|-----
*% 100-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (6-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[6]
*%
*% ["100SCS6.stm"] <--storm filename
*%-----|-----
FINISH
```

=====

```

SSSSS W W M M H H Y Y M M OOO      999 999  =====
S      W W W MM MM H H Y Y MM MM O O  9 9 9 9
SSSSS W W W M M M HHHHH Y M M M O O ## 9 9 9 9 Ver 4.05
S      W W M M H H Y M M O O 9999 9999 Sept 2011
SSSSS W W M M H H Y M M OOO      9 9
StormWater Management HYdrologic Model 999 999  =====

```

```

*****
***** SWMHYMO Ver/4.05 *****
***** A single event and continuous hydrologic simulation model *****
***** based on the principles of HYMO and its successors *****
***** OTHYMO-83 and OTHYMO-89. *****
***** Distributed by: J.F. Sabourin and Associates Inc. *****
***** Ottawa, Ontario: (613) 836-3884 *****
***** Gatineau, Quebec: (819) 243-6858 *****
***** E-Mail: swmhymo@jfsa.Com *****
*****

```

```

+++++ Licensed user: WMI & Associates Ltd. +++++
+++++ Barrie SERIAL#:2880720 +++++
+++++

```

```

*****
***** +++++ PROGRAM ARRAY DIMENSIONS +++++ *****
***** Maximum value for ID numbers : 10 *****
***** Max. number of rainfall points: 105408 *****
***** Max. number of flow points : 105408 *****
*****

```

```

***** D E T A I L E D   O U T P U T *****
*****
***** DATE: 2013-11-22 TIME: 10:54:19 RUN COUNTER: 000488 *****
*****
* Input filename: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\2-CYRSCS.dat *
* Output filename: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\2-CYRSCS.out *
* Summary filename: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\2-CYRSCS.sum *
* User comments:
* 1:
* 2:
* 3:
*****

```

001:0001-----

```

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthouse]

```

```

*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
*
* Pre-Development Condition - Greely Commercial Center
*

```

```

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\
----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\

```

```

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 001
NSTORM= 1
# 1=2SCS6.stm

```

001:0002-----

READ STORM		Filename: 2-Year SCS Type-II Storm Distribution (6	
Ptotal= 38.10 mm		Comments: 2-Year SCS Type-II Storm Distribution (6	
TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr
.50	1.524	2.00	3.048
1.00	1.524	2.50	5.334
1.50	3.048	3.00	38.862
		4.50	3.048
		6.00	1.524

001:0003-----

```

* Site Drainage Area
-----
| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
| U.H. Tp(hrs)= .370

```

```

Unit Hyd Qpeak (cms)= .499
PEAK FLOW (cms)= .033 (i)
TIME TO PEAK (hrs)= 3.300
RUNOFF VOLUME (mm)= 3.683
TOTAL RAINFALL (mm)= 38.100
RUNOFF COEFFICIENT = .097

```

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

001:0004-----

** END OF RUN : 1

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\

Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 002
NSTORM= 1
1=5SCS6.stm

002:0002-----
*#*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
*
* Pre-Development Condition - Greely Commercial Center
*

002:0002-----
| READ STORM | Filename: 5-Year SCS Type-II Storm Distribution (6
| Ptotal= 53.10 mm | Comments: 5-Year SCS Type-II Storm Distribution (6

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	2.124	2.00	4.248	3.50	13.806	5.00	3.186
1.00	2.124	2.50	7.434	4.00	6.372	5.50	2.124
1.50	4.248	3.00	54.162	4.50	4.248	6.00	2.124

002:0003-----
* Site Drainage Area

| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00

U.H. Tp(hrs)= .370

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .067 (i)
TIME TO PEAK (hrs)= 3.300
RUNOFF VOLUME (mm)= 7.404
TOTAL RAINFALL (mm)= 53.100
RUNOFF COEFFICIENT = .139

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

002:0004-----

002:0002-----
** END OF RUN : 2

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\

Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 003
NSTORM= 1
1=10SCS6.stm

003:0002-----
*#*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
*
* Pre-Development Condition - Greely Commercial Center
*

003:0002-----
| READ STORM | Filename: 10-Year SCS Type-II Storm Distribution (
| Ptotal= 63.00 mm | Comments: 10-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	2.520	2.00	5.040	3.50	16.380	5.00	3.780
1.00	2.520	2.50	8.820	4.00	7.560	5.50	2.520
1.50	5.040	3.00	64.260	4.50	5.040	6.00	2.520

003:0003-----
* Site Drainage Area

| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00

U.H. Tp(hrs)= .370

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+6hr-2-CYRSCS.out

Unit Hyd Qpeak (cms)= .499
PEAK FLOW (cms)= .095 (i)
TIME TO PEAK (hrs)= 3.300
RUNOFF VOLUME (mm)= 10.435
TOTAL RAINFALL (mm)= 63.000
RUNOFF COEFFICIENT = .166

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

003:0004-----

003:0002-----

003:0002-----

** END OF RUN : 3

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\

----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 004
NSTORM= 1
1=25SCS6.stm

004:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthouse]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

* Pre-Development Condition - Greely Commercial Center
*

004:0002-----

| READ STORM | Filename: 25-Year SCS Type-II Storm Distribution (
| Ptotal= 75.50 mm | Comments: 25-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+6hr-2-CYRSCS.out

.50	3.020	2.00	6.040	3.50	19.630	5.00	4.530
1.00	3.020	2.50	10.570	4.00	9.060	5.50	3.020
1.50	6.040	3.00	77.010	4.50	6.040	6.00	3.020

004:0003-----

* Site Drainage Area

CALIB NASHYD	Area (ha)=	4.83	Curve Number (CN)=	49.00
01:TOTAL DT= 2.00	Ia (mm)=	5.000	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=	.370		

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .136 (i)
TIME TO PEAK (hrs)= 3.267
RUNOFF VOLUME (mm)= 14.842
TOTAL RAINFALL (mm)= 75.500
RUNOFF COEFFICIENT = .197

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

004:0004-----

004:0002-----

004:0002-----

004:0002-----

** END OF RUN : 4

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\

----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 005
NSTORM= 1
1=50SCS6.stm

005:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthouse]

*# Company : WMI & Associates Ltd.
*# License # : 2880720

*
* Pre-Development Condition - Greely Commercial Center
*

005:0002-----

| READ STORM | Filename: 50-Year SCS Type-II Storm Distribution (
| Ptotal= 84.80 mm | Comments: 50-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	3.392	2.00	6.784	3.50	22.048	5.00	5.088
1.00	3.392	2.50	11.872	4.00	10.176	5.50	3.392
1.50	6.784	3.00	86.496	4.50	6.784	6.00	3.392

005:0003-----

* Site Drainage Area

| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
| U.H. Tp(hrs)= .370

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .171 (i)
TIME TO PEAK (hrs)= 3.267
RUNOFF VOLUME (mm)= 18.503
TOTAL RAINFALL (mm)= 84.800
RUNOFF COEFFICIENT = .218

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

005:0004-----

005:0002-----

005:0002-----

005:0002-----

005:0002-----

** END OF RUN : 5

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\

Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\6hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 006
NSTORM= 1
1=100SCS6.stm

006:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthouse]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

* Pre-Development Condition - Greely Commercial Center
*

006:0002-----

| READ STORM | Filename: 100-Year SCS Type-II Storm Distribution
| Ptotal= 94.00 mm | Comments: 100-Year SCS Type-II Storm Distribution

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	3.760	2.00	7.520	3.50	24.440	5.00	5.640
1.00	3.760	2.50	13.160	4.00	11.280	5.50	3.760
1.50	7.520	3.00	95.880	4.50	7.520	6.00	3.760

006:0003-----

* Site Drainage Area

| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
| U.H. Tp(hrs)= .370

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .208 (i)
TIME TO PEAK (hrs)= 3.267
RUNOFF VOLUME (mm)= 22.416
TOTAL RAINFALL (mm)= 94.000
RUNOFF COEFFICIENT = .238

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

006:0004-----

\\wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+\6hr-\2-CYRSCS.out

```
-----  
006:0002-----  
-----  
006:0002-----  
-----  
006:0002-----  
-----  
006:0002-----  
-----  
006:0002-----  
-----  
FINISH  
-----  
*****  
WARNINGS / ERRORS / NOTES  
-----  
Simulation ended on 2013-11-22 at 10:54:20  
=====
```

**Pre-Development Condition
24-hour SCS Type-II Storm Distribution**

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+\24hr-\2-CYRSCS.dat

```
2      Metric units
*****
*# Project Name: [Greely Commercial Center]   Project Number: [11-183]
*# Date       : 11-13-2013
*# Modeller   : [J. Lightheart]
*# Company    : WMI & Associates Ltd.
*# License #  : 2880720
*****
*
* Pre-Development Condition - Greely Commercial Center
*
*% 2-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (24-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[1]
*#
*#-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
*# READ STORM      STORM_FILENAME=["STORM.001"]
*#-----|-----|-----|-----|-----|-----|-----|-----|-----|
* Site Drainage Area
CALIB NASHYD      ID=[1], NHYD=["TOTAL"], DT=[2]min, AREA=[4.83](ha),
                  DWF=[0](cms), CN/C=[49], IA=[5.0](mm),
                  N=[3], TP=[0.37]hrs,
                  RAINFALL=[ , , , ](mm/hr), END=-1
*#-----|-----|-----|-----|-----|-----|-----|-----|-----|
*% 5-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (24-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[2]
*#
*#-----|-----|-----|-----|-----|-----|-----|-----|-----|
*% 10-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (24-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[3]
*#
*#-----|-----|-----|-----|-----|-----|-----|-----|-----|
*% 25-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (24-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[4]
*#
*#-----|-----|-----|-----|-----|-----|-----|-----|-----|
*% 50-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (24-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[5]
*#
*#-----|-----|-----|-----|-----|-----|-----|-----|-----|
*% 100-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (24-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[6]
*#
*#-----|-----|-----|-----|-----|-----|-----|-----|-----|
FINISH
```


=====
SSSS W W M M H H Y Y M M OOO 999 999 =====
S W W W MM MM H H Y Y MM MM O O 9 9 9 9
SSSS W W W M M M H H H H Y M M M O O ## 9 9 9 9 Ver 4.05
S W W M M H H Y M M O O 9999 9999 Sept 2011
SSSS W W M M H H Y M M OOO 9 9
9 9 9 9 # 2880720
StormWater Management HYdrologic Model 999 999 =====

***** SWMHYMO Ver/4.05 *****
***** A single event and continuous hydrologic simulation model *****
***** based on the principles of HYMO and its successors *****
***** OTTHYMO-83 and OTTHYMO-89. *****
***** Distributed by: J.F. Sabourin and Associates Inc. *****
***** Ottawa, Ontario: (613) 836-3884 *****
***** Gatineau, Quebec: (819) 243-6858 *****
***** E-Mail: swmhymo@jfsa.Com *****

++++++ Licensed user: WMI & Associates Ltd. ++++++
++++++ Barrie SERIAL#:2880720 ++++++

***** +++++ PROGRAM ARRAY DIMENSIONS +++++ *****
***** Maximum value for ID numbers : 10 *****
***** Max. number of rainfall points: 105408 *****
***** Max. number of flow points : 105408 *****

***** D E T A I L E D O U T P U T *****

* DATE: 2013-11-20 TIME: 16:38:29 RUN COUNTER: 000481 *

* Input filename: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\2-CYRSCS.dat*
* Output filename: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\2-CYRSCS.out*
* Summary filename: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\2-CYRSCS.sum*
* User comments: *
* 1: _____ *
* 2: _____ *
* 3: _____ *

001:0001-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthart]

*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
*
* Pre-Development Condition - Greely Commercial Center
*

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\

Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 001
NSTORM= 1
1=2SCS24.stm

001:0002-----

| READ STORM | Filename: 2-Year SCS Type-II Storm Distribution (2
| Ptotal= 49.40 mm | Comments: 2-Year SCS Type-II Storm Distribution (2

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.20	.494	6.20	.988	12.20	9.880	18.20	.741
.40	.494	6.40	.988	12.40	6.175	18.40	.741
.60	.494	6.60	.988	12.60	4.446	18.60	.988
.80	.494	6.80	.988	12.80	4.199	18.80	.741
1.00	.494	7.00	.988	13.00	2.964	19.00	.741
1.20	.494	7.20	.988	13.20	2.470	19.20	.988
1.40	.494	7.40	.988	13.40	2.470	19.40	.741
1.60	.494	7.60	.988	13.60	2.470	19.60	.988
1.80	.494	7.80	.988	13.80	2.470	19.80	.741
2.00	.494	8.00	.988	14.00	2.470	20.00	.988
2.20	.494	8.20	1.482	14.20	1.482	20.20	.741
2.40	.494	8.40	1.482	14.40	1.482	20.40	.741
2.60	.494	8.60	1.482	14.60	1.482	20.60	.494
2.80	.494	8.80	1.482	14.80	1.482	20.80	.741
3.00	.494	9.00	1.482	15.00	1.482	21.00	.741
3.20	.494	9.20	1.482	15.20	1.235	21.20	.494
3.40	.494	9.40	1.482	15.40	1.235	21.40	.741
3.60	.494	9.60	1.482	15.60	1.235	21.60	.494
3.80	.494	9.80	1.482	15.80	1.235	21.80	.741
4.00	.494	10.00	1.482	16.00	1.235	22.00	.494
4.20	.988	10.20	2.717	16.20	1.235	22.20	.494
4.40	.988	10.40	2.717	16.40	1.235	22.40	.741
4.60	.988	10.60	2.717	16.60	1.235	22.60	.494
4.80	.988	10.80	2.717	16.80	1.235	22.80	.741
5.00	.988	11.00	2.717	17.00	.741	23.00	.494
5.20	.988	11.20	3.705	17.20	.741	23.20	.494
5.40	.988	11.40	5.434	17.40	.988	23.40	.494
5.60	.988	11.60	13.091	17.60	.741	23.60	.741
5.80	.988	11.80	27.170	17.80	.988	23.80	.494
6.00	.988	12.00	55.575	18.00	.741	24.00	.494

001:0003-----

* Site Drainage Area

CALIB NASHYD	Area (ha)=	4.83	Curve Number (CN)=	49.00
01:TOTAL DT= 2.00	Ia (mm)=	5.000	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=	.370		

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .047 (i)
 TIME TO PEAK (hrs)= 12.300
 RUNOFF VOLUME (mm)= 6.384
 TOTAL RAINFALL (mm)= 49.400
 RUNOFF COEFFICIENT = .129

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

001:0004-----

** END OF RUN : 1

START | Project dir.: C:\USERS\JLIGHT~1\TEMP_S~1\11-183\EX\SCS\24hr\
 Rainfall dir.: C:\USERS\JLIGHT~1\TEMP_S~1\11-183\EX\SCS\24hr\
 TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 002
 NSTORM= 1
 # 1=5SCS24.stm

002:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
 *# Date : 11-13-2013
 *# Modeller : [J. Lighthouse]
 *# Company : WMI & Associates Ltd.
 *# License # : 2880720
 *#*****

* Pre-Development Condition - Greely Commercial Center

002:0002-----

READ STORM	Filename: 5-Year SCS Type-II Storm Distribution (2)
Ptotal= 67.30 mm	Comments: 5-Year SCS Type-II Storm Distribution (2)

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.20	.673	6.20	1.346	12.20	13.460	18.20	1.010
.40	.673	6.40	1.346	12.40	8.413	18.40	1.009
.60	.673	6.60	1.346	12.60	6.057	18.60	1.346
.80	.673	6.80	1.346	12.80	5.721	18.80	1.010
1.00	.673	7.00	1.346	13.00	4.038	19.00	1.010
1.20	.673	7.20	1.346	13.20	3.365	19.20	1.346
1.40	.673	7.40	1.346	13.40	3.365	19.40	1.010
1.60	.673	7.60	1.346	13.60	3.365	19.60	1.346
1.80	.673	7.80	1.346	13.80	3.365	19.80	1.010
2.00	.673	8.00	1.346	14.00	3.365	20.00	1.346
2.20	.673	8.20	2.019	14.20	2.019	20.20	1.010
2.40	.673	8.40	2.019	14.40	2.019	20.40	1.010
2.60	.673	8.60	2.019	14.60	2.019	20.60	.673
2.80	.673	8.80	2.019	14.80	2.019	20.80	1.010
3.00	.673	9.00	2.019	15.00	2.019	21.00	1.009
3.20	.673	9.20	2.019	15.20	1.682	21.20	.673
3.40	.673	9.40	2.019	15.40	1.682	21.40	1.010
3.60	.673	9.60	2.019	15.60	1.682	21.60	.673
3.80	.673	9.80	2.019	15.80	1.682	21.80	1.010
4.00	.673	10.00	2.019	16.00	1.682	22.00	.673
4.20	1.346	10.20	3.701	16.20	1.683	22.20	.673
4.40	1.346	10.40	3.702	16.40	1.682	22.40	1.010
4.60	1.346	10.60	3.701	16.60	1.682	22.60	.673
4.80	1.346	10.80	3.702	16.80	1.682	22.80	1.009
5.00	1.346	11.00	3.701	17.00	1.009	23.00	.673
5.20	1.346	11.20	5.048	17.20	1.010	23.20	.673
5.40	1.346	11.40	7.403	17.40	1.346	23.40	.673
5.60	1.346	11.60	17.834	17.60	1.010	23.60	1.010
5.80	1.346	11.80	37.015	17.80	1.346	23.80	.673
6.00	1.346	12.00	75.713	18.00	1.010	24.00	.673

002:0003-----

* Site Drainage Area

CALIB NASHYD	Area (ha)=	4.83	Curve Number (CN)=	49.00
01:TOTAL DT= 2.00	Ia (mm)=	5.000	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=	.370		

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .088 (i)
 TIME TO PEAK (hrs)= 12.300
 RUNOFF VOLUME (mm)= 11.881
 TOTAL RAINFALL (mm)= 67.300
 RUNOFF COEFFICIENT = .177

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+\24hr-\2-CYRSCS.out

002:0004-----

002:0002-----

** END OF RUN : 2

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\

----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 003
NSTORM= 1
1=10SCS24.stm

003:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

* Pre-Development Condition - Greely Commercial Center
*

003:0002-----

| READ STORM | Filename: 10-Year SCS Type-II Storm Distribution (
| Ptotal= 79.20 mm | Comments: 10-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.20	.792	6.20	1.584	12.20	15.840	18.20	1.188
.40	.792	6.40	1.584	12.40	9.900	18.40	1.188
.60	.792	6.60	1.584	12.60	7.128	18.60	1.584
.80	.792	6.80	1.584	12.80	6.732	18.80	1.188
1.00	.792	7.00	1.584	13.00	4.752	19.00	1.188
1.20	.792	7.20	1.584	13.20	3.960	19.20	1.584
1.40	.792	7.40	1.584	13.40	3.960	19.40	1.188
1.60	.792	7.60	1.584	13.60	3.960	19.60	1.584
1.80	.792	7.80	1.584	13.80	3.960	19.80	1.188
2.00	.792	8.00	1.584	14.00	3.960	20.00	1.584
2.20	.792	8.20	2.376	14.20	2.376	20.20	1.188
2.40	.792	8.40	2.376	14.40	2.376	20.40	1.188

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5/12

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2.60	.792	8.60	2.376	14.60	2.376	20.60	.792
2.80	.792	8.80	2.376	14.80	2.376	20.80	1.188
3.00	.792	9.00	2.376	15.00	2.376	21.00	1.188
3.20	.792	9.20	2.376	15.20	1.980	21.20	.792
3.40	.792	9.40	2.376	15.40	1.980	21.40	1.188
3.60	.792	9.60	2.376	15.60	1.980	21.60	.792
3.80	.792	9.80	2.376	15.80	1.980	21.80	1.188
4.00	.792	10.00	2.376	16.00	1.980	22.00	.792
4.20	1.584	10.20	4.356	16.20	1.980	22.20	.792
4.40	1.584	10.40	4.356	16.40	1.980	22.40	1.188
4.60	1.584	10.60	4.356	16.60	1.980	22.60	.792
4.80	1.584	10.80	4.356	16.80	1.980	22.80	1.188
5.00	1.584	11.00	4.356	17.00	1.188	23.00	.792
5.20	1.584	11.20	5.940	17.20	1.188	23.20	.792
5.40	1.584	11.40	8.712	17.40	1.584	23.40	.792
5.60	1.584	11.60	20.988	17.60	1.188	23.60	1.188
5.80	1.584	11.80	43.560	17.80	1.584	23.80	.792
6.00	1.584	12.00	89.100	18.00	1.188	24.00	.792

003:0003-----

* Site Drainage Area

| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
----- U.H. Tp(hrs)= .370

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .122 (i)
TIME TO PEAK (hrs)= 12.267
RUNOFF VOLUME (mm)= 16.261
TOTAL RAINFALL (mm)= 79.200
RUNOFF COEFFICIENT = .205

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

003:0004-----

003:0002-----

003:0002-----

** END OF RUN : 3

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\

2/6/2014 2:33:41 PM

6/12

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\SCS+\24hr-\2-CYRSCS.out

----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 004
NSTORM= 1
1=25SCS24.stm

004:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthouse]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

* Pre-Development Condition - Greely Commercial Center

004:0002-----

READ STORM Filename: 25-Year SCS Type-II Storm Distribution (
Ptotal= 94.30 mm Comments: 25-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.20	.943	6.20	1.886	12.20	18.860	18.20	1.415
.40	.943	6.40	1.886	12.40	11.788	18.40	1.414
.60	.943	6.60	1.886	12.60	8.487	18.60	1.886
.80	.943	6.80	1.886	12.80	8.016	18.80	1.415
1.00	.943	7.00	1.886	13.00	5.658	19.00	1.415
1.20	.943	7.20	1.886	13.20	4.715	19.20	1.886
1.40	.943	7.40	1.886	13.40	4.715	19.40	1.415
1.60	.943	7.60	1.886	13.60	4.715	19.60	1.886
1.80	.943	7.80	1.886	13.80	4.715	19.80	1.415
2.00	.943	8.00	1.886	14.00	4.715	20.00	1.886
2.20	.943	8.20	2.829	14.20	2.829	20.20	1.415
2.40	.943	8.40	2.829	14.40	2.829	20.40	1.415
2.60	.943	8.60	2.829	14.60	2.829	20.60	.943
2.80	.943	8.80	2.829	14.80	2.829	20.80	1.415
3.00	.943	9.00	2.829	15.00	2.829	21.00	1.414
3.20	.943	9.20	2.829	15.20	2.357	21.20	.943
3.40	.943	9.40	2.829	15.40	2.357	21.40	1.415
3.60	.943	9.60	2.829	15.60	2.357	21.60	.943
3.80	.943	9.80	2.829	15.80	2.357	21.80	1.415
4.00	.943	10.00	2.829	16.00	2.357	22.00	.943
4.20	1.886	10.20	5.186	16.20	2.358	22.20	.943
4.40	1.886	10.40	5.187	16.40	2.357	22.40	1.415
4.60	1.886	10.60	5.186	16.60	2.357	22.60	.943
4.80	1.886	10.80	5.187	16.80	2.357	22.80	1.414
5.00	1.886	11.00	5.186	17.00	1.414	23.00	.943
5.20	1.886	11.20	7.073	17.20	1.415	23.20	.943
5.40	1.886	11.40	10.373	17.40	1.886	23.40	.943

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5.60	1.886	11.60	24.989	17.60	1.415	23.60	1.415
5.80	1.886	11.80	51.865	17.80	1.886	23.80	.943
6.00	1.886	12.00	106.088	18.00	1.415	24.00	.943

004:0003-----
* Site Drainage Area

CALIB NASHYD Area (ha)= 4.83 Curve Number (CN)=49.00
01:TOTAL DT= 2.00 Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= .370

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .170 (i)
TIME TO PEAK (hrs)= 12.267
RUNOFF VOLUME (mm)= 22.548
TOTAL RAINFALL (mm)= 94.301
RUNOFF COEFFICIENT = .239

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

004:0004-----

004:0002-----

004:0002-----

004:0002-----

** END OF RUN : 4

START Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\

----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 005
NSTORM= 1
1=50SCS24.stm

005:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthouse]

*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
*
* Pre-Development Condition - Greely Commercial Center
*

005:0002-----

READ STORM Ptotal= 105.40 mm
Filename: 50-Year SCS Type-II Storm Distribution (
Comments: 50-Year SCS Type-II Storm Distribution (

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.20	1.054	6.20	2.108	12.20	21.080	18.20	1.581
.40	1.054	6.40	2.108	12.40	13.175	18.40	1.581
.60	1.054	6.60	2.108	12.60	9.486	18.60	2.108
.80	1.054	6.80	2.108	12.80	8.959	18.80	1.581
1.00	1.054	7.00	2.108	13.00	6.324	19.00	1.581
1.20	1.054	7.20	2.108	13.20	5.270	19.20	2.108
1.40	1.054	7.40	2.108	13.40	5.270	19.40	1.581
1.60	1.054	7.60	2.108	13.60	5.270	19.60	2.108
1.80	1.054	7.80	2.108	13.80	5.270	19.80	1.581
2.00	1.054	8.00	2.108	14.00	5.270	20.00	2.108
2.20	1.054	8.20	3.162	14.20	3.162	20.20	1.581
2.40	1.054	8.40	3.162	14.40	3.162	20.40	1.581
2.60	1.054	8.60	3.162	14.60	3.162	20.60	1.054
2.80	1.054	8.80	3.162	14.80	3.162	20.80	1.581
3.00	1.054	9.00	3.162	15.00	3.162	21.00	1.581
3.20	1.054	9.20	3.162	15.20	2.635	21.20	1.054
3.40	1.054	9.40	3.162	15.40	2.635	21.40	1.581
3.60	1.054	9.60	3.162	15.60	2.635	21.60	1.054
3.80	1.054	9.80	3.162	15.80	2.635	21.80	1.581
4.00	1.054	10.00	3.162	16.00	2.635	22.00	1.054
4.20	2.108	10.20	5.797	16.20	2.635	22.20	1.054
4.40	2.108	10.40	5.797	16.40	2.635	22.40	1.581
4.60	2.108	10.60	5.797	16.60	2.635	22.60	1.054
4.80	2.108	10.80	5.797	16.80	2.635	22.80	1.581
5.00	2.108	11.00	5.797	17.00	1.581	23.00	1.054
5.20	2.108	11.20	7.905	17.20	1.581	23.20	1.054
5.40	2.108	11.40	11.594	17.40	2.108	23.40	1.054
5.60	2.108	11.60	27.931	17.60	1.581	23.60	1.581
5.80	2.108	11.80	57.970	17.80	2.108	23.80	1.054
6.00	2.108	12.00	118.575	18.00	1.581	24.00	1.054

005:0003-----

* Site Drainage Area

CALIB NASHYD Area (ha)= 4.83 Curve Number (CN)=49.00
01:TOTAL DT= 2.00 Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
U.H. Tp(hrs)= .370

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .210 (i)
TIME TO PEAK (hrs)= 12.267
RUNOFF VOLUME (mm)= 27.634
TOTAL RAINFALL (mm)= 105.400
RUNOFF COEFFICIENT = .262

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

005:0004-----

005:0002-----

005:0002-----

005:0002-----

005:0002-----

** END OF RUN : 5

START Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\
Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\SCS\24hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 006
NSTORM= 1
1=100SCS24.stm

006:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]

*# Date : 11-13-2013

*# Modeller : [J. Lighthart]

*# Company : WMI & Associates Ltd.

*# License # : 2880720

* Pre-Development Condition - Greely Commercial Center
*

006:0002-----

READ STORM Ptotal= 116.50 mm
Filename: 100-Year SCS Type-II Storm Distribution
Comments: 100-Year SCS Type-II Storm Distribution

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.20	1.165	6.20	2.330	12.20	23.300	18.20	1.748
.40	1.165	6.40	2.330	12.40	14.563	18.40	1.747
.60	1.165	6.60	2.330	12.60	10.485	18.60	2.330
.80	1.165	6.80	2.330	12.80	9.903	18.80	1.748
1.00	1.165	7.00	2.330	13.00	6.990	19.00	1.748
1.20	1.165	7.20	2.330	13.20	5.825	19.20	2.330
1.40	1.165	7.40	2.330	13.40	5.825	19.40	1.748
1.60	1.165	7.60	2.330	13.60	5.825	19.60	2.330
1.80	1.165	7.80	2.330	13.80	5.825	19.80	1.748
2.00	1.165	8.00	2.330	14.00	5.825	20.00	2.330
2.20	1.165	8.20	3.495	14.20	3.495	20.20	1.748
2.40	1.165	8.40	3.495	14.40	3.495	20.40	1.748
2.60	1.165	8.60	3.495	14.60	3.495	20.60	1.165
2.80	1.165	8.80	3.495	14.80	3.495	20.80	1.748
3.00	1.165	9.00	3.495	15.00	3.495	21.00	1.747
3.20	1.165	9.20	3.495	15.20	2.912	21.20	1.165
3.40	1.165	9.40	3.495	15.40	2.912	21.40	1.748
3.60	1.165	9.60	3.495	15.60	2.912	21.60	1.165
3.80	1.165	9.80	3.495	15.80	2.912	21.80	1.748
4.00	1.165	10.00	3.495	16.00	2.912	22.00	1.165
4.20	2.330	10.20	6.407	16.20	2.913	22.20	1.165
4.40	2.330	10.40	6.408	16.40	2.912	22.40	1.748
4.60	2.330	10.60	6.407	16.60	2.912	22.60	1.165
4.80	2.330	10.80	6.408	16.80	2.912	22.80	1.747
5.00	2.330	11.00	6.407	17.00	1.747	23.00	1.165
5.20	2.330	11.20	8.738	17.20	1.748	23.20	1.165
5.40	2.330	11.40	12.815	17.40	2.330	23.40	1.165
5.60	2.330	11.60	30.872	17.60	1.748	23.60	1.748
5.80	2.330	11.80	64.075	17.80	2.330	23.80	1.165
6.00	2.330	12.00	131.063	18.00	1.748	24.00	1.165

006:0003-----
* Site Drainage Area

CALIB NASHYD	Area (ha)=	4.83	Curve Number (CN)=	49.00
01:TOTAL DT= 2.00	Ia (mm)=	5.000	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=	.370		

Unit Hyd Qpeak (cms)= .499
PEAK FLOW (cms)= .252 (i)
TIME TO PEAK (hrs)= 12.267
RUNOFF VOLUME (mm)= 33.077
TOTAL RAINFALL (mm)= 116.501
RUNOFF COEFFICIENT = .284

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

006:0004-----

006:0002-----
006:0002-----
006:0002-----
006:0002-----
006:0002-----
FINISH

WARNINGS / ERRORS / NOTES

Simulation ended on 2013-11-20 at 16:38:29
=====

**Pre-Development Condition
3-hour Chicago Storm Distribution**

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\CHI-\3hr-\2-CYRCHI.dat

```
2      Metric units
*****
*# Project Name: [Greely Commercial Center]   Project Number: [11-183]
*# Date       : 11-13-2013
*# Modeller   : [J. Lightheart]
*# Company    : WMI & Associates Ltd.
*# License #  : 2880720
*****
*
* Pre-Development Condition - Greely Commercial Center
*
*% 2-year Chicago Storm Distribution based on Ottawa, ON. rainfall (3-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[1]
*%         ["2CHI3.stm"] <--storm filename
*%-----|-----
READ STORM | STORM_FILENAME=["STORM.001"]
*%-----|-----
* Site Drainage Area
CALIB NASHYD ID=[1], NHYD=["TOTAL"], DT=[2]min, AREA=[4.83](ha),
              DWF=[0](cms), CN/C=[49], IA=[5.0](mm),
              N=[3], TP=[0.37]hrs,
              RAINFALL=[ , , , ](mm/hr), END=-1
*%-----|-----
*% 5-year Chicago Storm Distribution based on Owen Sound, ON. rainfall (4-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[2]
*%         ["5CHI3.stm"] <--storm filename
*%-----|-----
*% 10-year Chicago Storm Distribution based on Owen Sound, ON. rainfall (4-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[3]
*%         ["10CHI3.stm"] <--storm filename
*%-----|-----
*% 25-year Chicago Storm Distribution based on Owen Sound, ON. rainfall (4-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[4]
*%         ["25CHI3.stm"] <--storm filename
*%-----|-----
*% 50-year Chicago Storm Distribution based on Owen Sound, ON. rainfall (4-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[5]
*%         ["50CHI3.stm"] <--storm filename
*%-----|-----
*% 100-year Chicago Storm Distribution based on Owen Sound, ON. rainfall (4-hr)
START      TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[6]
*%         ["100CHI3.stm"] <--storm filename
*%-----|-----
FINISH
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=====

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SSSSS W W M M H H Y Y M M OOO      999 999  =====
S      W W W MM MM H H Y Y MM MM O O  9 9 9 9
SSSSS W W W M M M HHHHH Y M M M O O ## 9 9 9 9 Ver 4.05
S      W W M M H H Y M M O O 9999 9999 Sept 2011
SSSSS W W M M H H Y M M OOO      9 9 9 9  =====
StormWater Management HYdrologic Model 999 999  =====

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*****
***** SWMHYMO Ver/4.05 *****
***** A single event and continuous hydrologic simulation model *****
***** based on the principles of HYMO and its successors *****
***** OTHYMO-83 and OTHYMO-89. *****
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***** Ottawa, Ontario: (613) 836-3884 *****
***** Gatineau, Quebec: (819) 243-6858 *****
***** E-Mail: swmhymo@jfsa.Com *****
*****

```

```

+++++ Licensed user: WMI & Associates Ltd. +++++
+++++ Barrie SERIAL#:2880720 +++++
+++++

```

```

*****
***** +++++ PROGRAM ARRAY DIMENSIONS +++++ *****
***** Maximum value for ID numbers : 10 *****
***** Max. number of rainfall points: 105408 *****
***** Max. number of flow points : 105408 *****
*****

```

```

***** D E T A I L E D O U T P U T *****
*****
***** DATE: 2013-11-20 TIME: 16:34:37 RUN COUNTER: 000478 *****
*****
* Input filename: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\CHI\3hr\2-CYRCHI.dat *
* Output filename: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\CHI\3hr\2-CYRCHI.out *
* Summary filename: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\CHI\3hr\2-CYRCHI.sum *
* User comments:
* 1:
* 2:
* 3:
*****

```

001:0001-----

```

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthart]

```

```

*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
*
* Pre-Development Condition - Greely Commercial Center
*

```

```

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\CHI\3hr\
----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\CHI\3hr\

```

```

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 001
NSTORM= 1
# 1=2CHI3.stm

```

001:0002-----

```

| READ STORM | Filename: 2-Year Chicago Storm Distribution (3-hou
| Ptotal= 30.74 mm | Comments: 2-Year Chicago Storm Distribution (3-hou
-----

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	3.321	1.00	77.041	1.83	5.341	2.67	3.195
.33	3.960	1.17	18.393	2.00	4.664	2.83	2.978
.50	4.997	1.33	10.654	2.17	4.160	3.00	2.793
.67	7.063	1.50	7.830	2.33	3.768		
.83	14.515	1.67	6.309	2.50	3.454		

001:0003-----

```

* Site Drainage Area
-----
| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
-----
U.H. Tp(hrs)= .370

```

```

Unit Hyd Qpeak (cms)= .499
PEAK FLOW (cms)= .021 (i)
TIME TO PEAK (hrs)= 1.467
RUNOFF VOLUME (mm)= 2.284
TOTAL RAINFALL (mm)= 30.739
RUNOFF COEFFICIENT = .074

```

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

001:0004-----

```

** END OF RUN : 1
*****

```

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\CHI-\3hr-\2-CYRCHI.out

| START | Project dir.: C:\USERS\JLIGHT~1\TEMP_S~1\11-183\EX\CHI\3hr\

Rainfall dir.: C:\USERS\JLIGHT~1\TEMP_S~1\11-183\EX\CHI\3hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 002
NSTORM= 1
1=5CHI3.stm

002:0002-----
*#*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthearth]
*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
*
* Pre-Development Condition - Greely Commercial Center
*

002:0002-----
| READ STORM | Filename: 5-Year Chicago Storm Distribution (3-hou
| Ptotal= 41.52 mm | Comments: 5-Year Chicago Storm Distribution (3-hou

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	4.606	1.00	101.795	1.83	7.365	2.67	4.434
.33	5.481	1.17	24.920	2.00	6.442	2.83	4.136
.50	6.897	1.33	14.557	2.17	5.754	3.00	3.882
.67	9.704	1.50	10.744	2.33	5.219		
.83	19.727	1.67	8.681	2.50	4.788		

002:0003-----
* Site Drainage Area

| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00

U.H. Tp(hrs)= .370

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .042 (i)
TIME TO PEAK (hrs)= 1.467
RUNOFF VOLUME (mm)= 4.433
TOTAL RAINFALL (mm)= 41.522

2/6/2014 2:35:21 PM

3/9

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\CHI-\3hr-\2-CYRCHI.out

RUNOFF COEFFICIENT = .107

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

002:0004-----

002:0002-----
** END OF RUN : 2

*#*****

| START | Project dir.: C:\USERS\JLIGHT~1\TEMP_S~1\11-183\EX\CHI\3hr\

Rainfall dir.: C:\USERS\JLIGHT~1\TEMP_S~1\11-183\EX\CHI\3hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 003
NSTORM= 1
1=10CHI3.stm

003:0002-----
*#*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthearth]
*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
*
* Pre-Development Condition - Greely Commercial Center
*

003:0002-----
| READ STORM | Filename: 10-Year Chicago Storm Distribution (3-ho
| Ptotal= 48.94 mm | Comments: 10-Year Chicago Storm Distribution (3-ho

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	5.500	1.00	118.657	1.83	8.768	2.67	5.295
.33	6.537	1.17	29.410	2.00	7.676	2.83	4.942
.50	8.214	1.33	17.250	2.17	6.861	3.00	4.640
.67	11.531	1.50	12.759	2.33	6.226		
.83	23.317	1.67	10.324	2.50	5.716		

003:0003-----

2/6/2014 2:35:21 PM

4/9

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\CHI-3hr-2-CYRCHI.out

* Site Drainage Area

CALIB NASHYD	Area (ha)=	4.83	Curve Number (CN)=	49.00
01:TOTAL DT= 2.00	Ia (mm)=	5.000	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=	.370		

Unit Hyd Qpeak (cms) = .499

PEAK FLOW (cms) = .059 (i)

TIME TO PEAK (hrs) = 1.467

RUNOFF VOLUME (mm) = 6.262

TOTAL RAINFALL (mm) = 48.937

RUNOFF COEFFICIENT = .128

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

003:0004-----

003:0002-----

003:0002-----

** END OF RUN : 3

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\CHI\3hr\

----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\CHI\3hr\

TZERO = .00 hrs on 0

METOUT= 2 (output = METRIC)

NRUN = 004

NSTORM= 1

1=25CHI3.stm

004:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]

*# Date : 11-13-2013

*# Modeller : [J. Lightheart]

*# Company : WMI & Associates Ltd.

*# License # : 2880720

* Pre-Development Condition - Greely Commercial Center

004:0002-----

2/6/2014 2:35:21 PM

5/9

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\CHI-3hr-2-CYRCHI.out

READ STORM	Filename: 25-Year Chicago Storm Distribution (3-ho
Ptotal= 58.05 mm	Comments: 25-Year Chicago Storm Distribution (3-ho

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	6.587	1.00	139.602	1.83	10.479	2.67	6.343
.33	7.823	1.17	34.921	2.00	9.179	2.83	5.922
.50	9.820	1.33	20.546	2.17	8.209	3.00	5.562
.67	13.762	1.50	15.221	2.33	7.453		
.83	27.718	1.67	12.329	2.50	6.845		

004:0003-----

* Site Drainage Area

CALIB NASHYD	Area (ha)=	4.83	Curve Number (CN)=	49.00
01:TOTAL DT= 2.00	Ia (mm)=	5.000	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=	.370		

Unit Hyd Qpeak (cms) = .499

PEAK FLOW (cms) = .085 (i)

TIME TO PEAK (hrs) = 1.433

RUNOFF VOLUME (mm) = 8.867

TOTAL RAINFALL (mm) = 58.054

RUNOFF COEFFICIENT = .153

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

004:0004-----

004:0002-----

004:0002-----

004:0002-----

** END OF RUN : 4

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\CHI\3hr\

----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\CHI\3hr\

TZERO = .00 hrs on 0

METOUT= 2 (output = METRIC)

NRUN = 005

2/6/2014 2:35:21 PM

6/9

NSTORM= 1
1=50CHI3.stm

005:0002-----
*#*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****

* Pre-Development Condition - Greely Commercial Center
*

005:0002-----
| READ STORM | Filename: 50-Year Chicago Storm Distribution (3-ho
| Ptotal= 64.85 mm | Comments: 50-Year Chicago Storm Distribution (3-ho

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	7.406	1.00	155.099	1.83	11.764	2.67	7.132
.33	8.791	1.17	39.035	2.00	10.309	2.83	6.660
.50	11.026	1.33	23.013	2.17	9.223	3.00	6.256
.67	15.436	1.50	17.066	2.33	8.376		
.83	31.007	1.67	13.834	2.50	7.694		

005:0003-----
* Site Drainage Area

| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
| U.H. Tp(hrs)= .370

Unit Hyd Qpeak (cms)= .499

PEAK FLOW (cms)= .106 (i)
TIME TO PEAK (hrs)= 1.433
RUNOFF VOLUME (mm)= 11.050
TOTAL RAINFALL (mm)= 64.854
RUNOFF COEFFICIENT = .170

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

005:0004-----

005:0002-----

005:0002-----

005:0002-----

005:0002-----
** END OF RUN : 5

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\CHI\3hr\
----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\11-183\EX\CHI\3hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 006
NSTORM= 1
1=100CHI3.stm

006:0002-----
*#*****

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****

* Pre-Development Condition - Greely Commercial Center
*

006:0002-----
| READ STORM | Filename: 100-Year Chicago Storm Distribution (3-h
| Ptotal= 71.92 mm | Comments: 100-Year Chicago Storm Distribution (3-h

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	8.291	1.00	170.585	1.83	13.142	2.67	7.986
.33	9.833	1.17	43.325	2.00	11.524	2.83	7.459
.50	12.321	1.33	25.620	2.17	10.314	3.00	7.009
.67	17.220	1.50	19.029	2.33	9.371		
.83	34.453	1.67	15.441	2.50	8.612		

006:0003-----
* Site Drainage Area

| CALIB NASHYD | Area (ha)= 4.83 Curve Number (CN)=49.00
| 01:TOTAL DT= 2.00 | Ia (mm)= 5.000 # of Linear Res.(N)= 3.00
| U.H. Tp(hrs)= .370

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\EX\CHI-\3hr-\2-CYRCHI.out

Unit Hyd Qpeak (cms)= .499
PEAK FLOW (cms)= .130 (i)
TIME TO PEAK (hrs)= 1.433
RUNOFF VOLUME (mm)= 13.519
TOTAL RAINFALL (mm)= 71.923
RUNOFF COEFFICIENT = .188

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

006:0004-----

006:0002-----

006:0002-----

006:0002-----

006:0002-----

006:0002-----

006:0002-----

FINISH

WARNINGS / ERRORS / NOTES

Simulation ended on 2013-11-20 at 16:34:37
=====

**Post-Development Condition
12-hour SCS Type-II Storm Distribution**

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\PR\SCS+12hr+2-CYRSCS.dat

```

2 Metric units
*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720
*****
* Post-Development Condition - Greely Commercial Center
*
*% 25mm Chicago Storm Distribution based on Ottawa, ON. rainfall (3-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[1]
*% ["25mm3hr.stm"] <--storm filename
*-----|-----
*%-----|-----
*%-----|-----
*%-----|-----
*%-----|-----
* Total Drainage Area
CALIB STANDHYD ID=[1], NHYD=["TOTAL"], DT=[2](min), AREA=[4.83](ha),
XIMP=[0.69], TIMP=[0.69], DWF=[0](cms), LOSS=[2],
SCS curve number CN=[49],
Pervious surfaces: IApr=[5.0](mm), SLPP=[7.0](%),
LGP=[30](m), MNP=[0.25], SCP=[0](min),
Impervious surfaces: IAimp=[2.0](mm), SLPI=[0.4](%),
LGI=[230](m), MNI=[0.013], SCI=[0](min),
RAINFALL=[ , , , ](mm/hr), END=-1
*-----|-----
* Depressed Storage Area (Basin)
ROUTE RESERVOIR IDout=[2], NHYD=["Basin"], IDin=[1],
RDT=[2](min),
TABLE of ( OUTFLOW-STORAGE ) values
(cms) - (ha-m)
[ 0.000 , 0.0000 ]
[ 0.013 , 0.0135 ]
[ 0.015 , 0.0278 ]
[ 0.017 , 0.0430 ]
[ 0.019 , 0.0592 ]
[ 0.020 , 0.0764 ]
[ 0.021 , 0.0884 ]
[ 0.026 , 0.1074 ]
[ 0.041 , 0.1274 ]
[ 0.072 , 0.1485 ]
[ 0.116 , 0.1708 ]
[ 0.133 , 0.1864 ]
[ 0.147 , 0.2025 ]
[ 0.198 , 0.2277 ]
[ 0.364 , 0.2542 ]
[ 0.697 , 0.2821 ]
[ -1 , -1 ] (max twenty pts)
IDovf=[ ], NHYDovf=[ ]
*-----|-----
*% 2-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (12-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[2]
*% ["2SCS12.stm"] <--storm filename

```

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\PR\SCS+12hr+2-CYRSCS.dat

```

*%-----|-----
*% 5-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (12-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[3]
*% ["5SCS12.stm"] <--storm filename
*-----|-----
*% 10-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (12-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[4]
*% ["10SCS12.stm"] <--storm filename
*-----|-----
*% 25-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (12-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[5]
*% ["25SCS12.stm"] <--storm filename
*-----|-----
*% 50-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (12-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[6]
*% ["50SCS12.stm"] <--storm filename
*-----|-----
*% 100-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (12-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[7]
*% ["100SCS12.stm"] <--storm filename
*-----|-----
FINISH

```

=====
SSSSS W W M M H H Y Y M M OOO 999 999 =====
S W W W MM MM H H Y Y MM MM O O 9 9 9 9
SSSSS W W W M M M H H H H Y M M M O O ## 9 9 9 9 Ver 4.05
S W W M M H H Y M M O O 9999 9999 Sept 2011
SSSSS W W M M H H Y M M OOO 9 9
StormWater Management HYdrologic Model 9 9 9 9 # 2880720
=====

***** SWMHYMO Ver/4.05 *****
***** A single event and continuous hydrologic simulation model *****
***** based on the principles of HYMO and its successors *****
***** OTTHYMO-83 and OTTHYMO-89. *****
***** Distributed by: J.F. Sabourin and Associates Inc. *****
***** Ottawa, Ontario: (613) 836-3884 *****
***** Gatineau, Quebec: (819) 243-6858 *****
***** E-Mail: swmhymo@jfsa.Com *****

++++++ Licensed user: WMI & Associates Ltd. ++++++
++++++ Barrie SERIAL#:2880720 ++++++

***** +++++ PROGRAM ARRAY DIMENSIONS +++++ *****
***** Maximum value for ID numbers : 10 *****
***** Max. number of rainfall points: 105408 *****
***** Max. number of flow points : 105408 *****

***** D E T A I L E D O U T P U T *****
***** DATE: 2013-12-13 TIME: 16:33:04 RUN COUNTER: 000565 *****
* Input filename: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\2-CYRSCS.dat *
* Output filename: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\2-CYRSCS.out *
* Summary filename: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\2-CYRSCS.sum *
* User comments: *
* 1: *
* 2: *
* 3: *

001:0001-----
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]

*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
* Post-Development Condition - Greely Commercial Center
*

| START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\
----- Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 001
NSTORM= 1
1=25mm3hr.stm

001:0002-----

| READ STORM | Filename: 25mm Chicago Storm Distribution (3-hour)
| Ptotal= 24.99 mm | Comments: 25mm Chicago Storm Distribution (3-hour)

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	2.700	1.00	62.660	1.83	4.340	2.67	2.600
.33	3.220	1.17	14.960	2.00	3.790	2.83	2.420
.50	4.060	1.33	8.660	2.17	3.380	3.00	2.270
.67	5.740	1.50	6.370	2.33	3.060		
.83	11.800	1.67	5.130	2.50	2.810		

001:0003-----
* Total Drainage Area

| CALIB STANDHYD | Area (ha)= 4.83
| 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250
Max.eff.Inten.(mm/hr)=	62.66	1.48
over (min)	6.00	28.00
Storage Coeff. (min)=	6.68 (ii)	28.69 (ii)
Unit Hyd. Tpeak (min)=	6.00	28.00
Unit Hyd. peak (cms)=	.17	.04

PEAK FLOW (cms)= .43 .00 *TOTALS*
TIME TO PEAK (hrs)= 1.03 1.57 1.033 (iii)
RUNOFF VOLUME (mm)= 22.99 1.41 16.302
TOTAL RAINFALL (mm)= 24.99 24.99 24.995

RUNOFF COEFFICIENT = .92 .06 .652

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

001:0004-----
* Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

ROUTE RESERVOIR		OUTFLOW STORAGE TABLE	
IN>01:(TOTAL)	OUT<02:(Basin)	OUTFLOW (cms)	STORAGE (ha.m.)
		.041	.1274E+00
		.072	.1485E+00
		.116	.1708E+00
		.133	.1864E+00
		.147	.2025E+00
		.198	.2277E+00
		.364	.2542E+00
		.697	.2821E+00

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >01: (TOTAL)	4.83	.433	1.033	16.302
OUTFLOW <02: (Basin)	4.83	.019	3.067	16.302

PEAK FLOW REDUCTION [Qout/Qin](%)= 4.441
 TIME SHIFT OF PEAK FLOW (min)= 122.00
 MAXIMUM STORAGE USED (ha.m.)=.6336E-01

001:0005-----
** END OF RUN : 1

START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\
 Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\
 TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 002
 NSTORM= 1

1=2SCS12.stm

002:0002-----

 * Project Name: [Greely Commercial Center] Project Number: [11-183]
 * Date : 11-13-2013
 * Modeller : [J. Lightheart]
 * Company : WMI & Associates Ltd.
 * License # : 2880720

 * Post-Development Condition - Greely Commercial Center
 *

002:0002-----

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	.890	3.50	1.780	6.50	8.010	9.50	1.780
1.00	.890	4.00	1.780	7.00	3.560	10.00	.890
1.50	.890	4.50	2.670	7.50	2.670	10.50	.890
2.00	.890	5.00	3.560	8.00	2.670	11.00	.890
2.50	1.780	5.50	5.340	8.50	1.780	11.50	.890
3.00	1.780	6.00	40.050	9.00	1.780	12.00	.890

002:0003-----
* Total Drainage Area

CALIB STANDHYD	Area (ha)=	PERVIOUS	PERVIOUS (i)
01:TOTAL DT= 2.00	4.83	3.33	1.50
	Total Imp(%)= 69.00	2.00	5.00
		.40	7.00
		230.00	30.00
		.013	.250
		40.05	5.12
		8.00	22.00
		7.99 (ii)	21.38 (ii)
		8.00	22.00
		.14	.05
			TOTALS
		.36	.01
		6.00	6.23
		42.50	5.13
		44.50	44.500
		.96	.12
			.695

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

002:0004-----

* Depressed Storage Area (Basin)

ROUTE RESERVOIR		Requested routing time step = 2.0 min.			
IN>01:(TOTAL)		===== OUTFLOW STORAGE TABLE =====			
OUT<02:(Basin)		OUTFLOW	STORAGE	OUTFLOW	STORAGE
		(cms)	(ha.m.)	(cms)	(ha.m.)
		.000	.0000E+00	.041	.1274E+00
		.013	.1350E-01	.072	.1485E+00
		.015	.2780E-01	.116	.1708E+00
		.017	.4300E-01	.133	.1864E+00
		.019	.5920E-01	.147	.2025E+00
		.020	.7640E-01	.198	.2277E+00
		.021	.8840E-01	.364	.2542E+00
		.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	.368	6.000	30.917
OUTFLOW <02: (Basin)	4.83	.024	8.133	30.917

PEAK FLOW REDUCTION [Qout/Qin](%)= 6.631
 TIME SHIFT OF PEAK FLOW (min)= 128.00
 MAXIMUM STORAGE USED (ha.m.)=.1014E+00

002:0005-----

002:0002-----

** END OF RUN : 2

| START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\

----- Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\

TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 003
 NSTORM= 1

1=5SCS12.stm

003:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
 *# Date : 11-13-2013
 *# Modeller : [J. Lightheart]
 *# Company : WMI & Associates Ltd.
 *# License # : 2880720

* Post-Development Condition - Greely Commercial Center

003:0002-----

READ STORM	Filename: 5-Year SCS Type-II Storm Distribution (1
Ptotal= 61.80 mm	Comments: 5-Year SCS Type-II Storm Distribution (1

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	1.236	3.50	2.472	6.50	11.124	9.50	2.472
1.00	1.236	4.00	2.472	7.00	4.944	10.00	1.236
1.50	1.236	4.50	3.708	7.50	3.708	10.50	1.236
2.00	1.236	5.00	4.944	8.00	3.708	11.00	1.236
2.50	2.472	5.50	7.416	8.50	2.472	11.50	1.236
3.00	2.472	6.00	55.620	9.00	2.472	12.00	1.236

003:0003-----

* Total Drainage Area

CALIB STANDHYD	Area (ha)=	4.83	
01:TOTAL DT= 2.00	Total Imp(%)=	69.00	Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250

Max. eff. Inten. (mm/hr)=	55.62	10.99
over (min)	8.00	16.00
Storage Coeff. (min)=	7.01 (ii)	16.87 (ii)
Unit Hyd. Tpeak (min)=	8.00	16.00
Unit Hyd. peak (cms)=	.15	.07

TOTALS

PEAK FLOW (cms)=	.50	.03	.530 (iii)
TIME TO PEAK (hrs)=	6.00	6.13	6.000
RUNOFF VOLUME (mm)=	59.80	10.04	44.376
TOTAL RAINFALL (mm)=	61.80	61.80	61.800
RUNOFF COEFFICIENT =	.97	.16	.718

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

003:0004-----

* Depressed Storage Area (Basin)

ROUTE RESERVOIR	Requested routing time step = 2.0 min.			
IN>01:(TOTAL)	===== OUTFLOW STORAGE TABLE =====		=====	
OUT<02:(Basin)	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	.000	.0000E+00	.041	.1274E+00
	.013	.1350E-01	.072	.1485E+00
	.015	.2780E-01	.116	.1708E+00
	.017	.4300E-01	.133	.1864E+00
	.019	.5920E-01	.147	.2025E+00
	.020	.7640E-01	.198	.2277E+00
	.021	.8840E-01	.364	.2542E+00
	.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	.530	6.000	44.376
OUTFLOW <02: (Basin)	4.83	.057	6.933	44.376

PEAK FLOW REDUCTION [Qout/Qin](%)= 10.816
 TIME SHIFT OF PEAK FLOW (min)= 56.00
 MAXIMUM STORAGE USED (ha.m.)=.1385E+00

003:0005-----

003:0002-----

003:0002-----

** END OF RUN : 3

| START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\

----- Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\

TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)

NRUN = 004
 NSTORM= 1
 # 1=10SCS12.stm

004:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
 *# Date : 11-13-2013
 *# Modeller : [J. Lighthouse]
 *# Company : WMI & Associates Ltd.
 *# License # : 2880720
 *#*****

* Post-Development Condition - Greely Commercial Center

004:0002-----

READ STORM	Filename: 10-Year SCS Type-II Storm Distribution (
Ptotal= 73.30 mm	Comments: 10-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	1.466	3.50	2.932	6.50	13.194	9.50	2.932
1.00	1.466	4.00	2.932	7.00	5.864	10.00	1.466
1.50	1.466	4.50	4.398	7.50	4.398	10.50	1.466
2.00	1.466	5.00	5.864	8.00	4.398	11.00	1.466
2.50	2.932	5.50	8.796	8.50	2.932	11.50	1.466
3.00	2.932	6.00	65.970	9.00	2.932	12.00	1.466

004:0003-----

* Total Drainage Area

CALIB STANDHYD	Area (ha)=	4.83
01:TOTAL DT= 2.00	Total Imp(%)=	69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250

Max.eff.Inten.(mm/hr)=	65.97	15.33
over (min)	6.00	16.00
Storage Coeff. (min)=	6.55 (ii)	15.18 (ii)
Unit Hyd. Tpeak (min)=	6.00	16.00
Unit Hyd. peak (cms)=	.18	.07

		TOTALS
PEAK FLOW (cms)=	.60	.642 (iii)
TIME TO PEAK (hrs)=	6.00	6.13
RUNOFF VOLUME (mm)=	71.30	14.02
TOTAL RAINFALL (mm)=	73.30	73.30

RUNOFF COEFFICIENT = .97 .19 .730

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

004:0004-----
* Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

ROUTE RESERVOIR		===== OUTFLOW STORAGE TABLE =====			
IN>01:(TOTAL)	OUT<02:(Basin)	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
		.000	.0000E+00	.041	.1274E+00
		.013	.1350E-01	.072	.1485E+00
		.015	.2780E-01	.116	.1708E+00
		.017	.4300E-01	.133	.1864E+00
		.019	.5920E-01	.147	.2025E+00
		.020	.7640E-01	.198	.2277E+00
		.021	.8840E-01	.364	.2542E+00
		.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >01: (TOTAL)	4.83	.642	6.000	53.544
OUTFLOW<02: (Basin)	4.83	.097	6.667	53.544

PEAK FLOW REDUCTION [Qout/Qin](%)= 15.035
 TIME SHIFT OF PEAK FLOW (min)= 40.00
 MAXIMUM STORAGE USED (ha.m.)=.1609E+00

004:0005-----

004:0002-----

004:0002-----

004:0002-----
** END OF RUN : 4

| START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\

----- Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 005
NSTORM= 1
1=25SCS12.stm

005:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthouse]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

* Post-Development Condition - Greely Commercial Center

005:0002-----

| READ STORM | Filename: 25-Year SCS Type-II Storm Distribution (
| Ptotal= 87.70 mm | Comments: 25-Year SCS Type-II Storm Distribution (

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.50	1.754	3.50	3.508	6.50	15.786	9.50	3.508
1.00	1.754	4.00	3.508	7.00	7.016	10.00	1.754
1.50	1.754	4.50	5.262	7.50	5.262	10.50	1.754
2.00	1.754	5.00	7.016	8.00	5.262	11.00	1.754
2.50	3.508	5.50	10.524	8.50	3.508	11.50	1.754
3.00	3.508	6.00	78.930	9.00	3.508	12.00	1.754

005:0003-----

* Total Drainage Area

| CALIB STANDHYD | Area (ha)= 4.83
| 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250
Max.eff.Inten.(mm/hr)=	78.93	22.05
over (min)	6.00	14.00
Storage Coeff. (min)=	6.09 (ii)	13.56 (ii)
Unit Hyd. Tpeak (min)=	6.00	14.00
Unit Hyd. peak (cms)=	.19	.08

TOTALS

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\PR\SCS+12hr+2-CYRSCS.out

PEAK FLOW (cms)= .72 .07 .785 (iii)
TIME TO PEAK (hrs)= 6.00 6.10 6.000
RUNOFF VOLUME (mm)= 85.70 19.71 65.242
TOTAL RAINFALL (mm)= 87.70 87.70 87.700
RUNOFF COEFFICIENT = .98 .22 .744

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

005:0004
* Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.
ROUTE RESERVOIR IN>01:(TOTAL) OUT<02:(Basin)
===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE OUTFLOW STORAGE
(cms) (ha.m.) (cms) (ha.m.)
.000 .0000E+00 .041 .1274E+00
.013 .1350E-01 .072 .1485E+00
.015 .2780E-01 .116 .1708E+00
.017 .4300E-01 .133 .1864E+00
.019 .5920E-01 .147 .2025E+00
.020 .7640E-01 .198 .2277E+00
.021 .8840E-01 .364 .2542E+00
.026 .1074E+00 .697 .2821E+00

ROUTING RESULTS AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW >01: (TOTAL) 4.83 .785 6.000 65.242
OUTFLOW<02: (Basin) 4.83 .136 6.600 65.242
PEAK FLOW REDUCTION [Qout/Qin](%)= 17.368
TIME SHIFT OF PEAK FLOW (min)= 36.00
MAXIMUM STORAGE USED (ha.m.)=.1903E+00

005:0005
005:0002
005:0002
005:0002
005:0002
005:0002
** END OF RUN : 5

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\PR\SCS+12hr+2-CYRSCS.out

START Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\
Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\12hr\
TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 006
NSTORM= 1
1=50SCS12.stm

006:0002
Project Name: [Greely Commercial Center] Project Number: [11-183]
Date : 11-13-2013
Modeller : [J. Lighthearth]
Company : WMI & Associates Ltd.
License # : 2880720
Post-Development Condition - Greely Commercial Center

006:0002
READ STORM Ptotal= 98.40 mm
Filename: 50-Year SCS Type-II Storm Distribution (
Comments: 50-Year SCS Type-II Storm Distribution (

Table with 8 columns: TIME, RAIN, TIME, RAIN, TIME, RAIN, TIME, RAIN. Rows show time intervals from 0.50 to 3.00 hours and corresponding rainfall amounts in mm/hr.

006:0003
* Total Drainage Area
CALIB STANDHYD Area (ha)= 4.83
01:TOTAL DT= 2.00 Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 3.33 1.50
Dep. Storage (mm)= 2.00 5.00
Average Slope (%)= .40 7.00
Length (m)= 230.00 30.00
Mannings n = .013 .250

```

Max.eff.Inten.(mm/hr)= 88.56 27.84
                    over (min) 6.00 12.00
Storage Coeff. (min)= 5.82 (ii) 12.62 (ii)
Unit Hyd. Tpeak (min)= 6.00 12.00
Unit Hyd. peak (cms)= .19 .09
                    *TOTALS*
PEAK FLOW (cms)= .81 .09 .895 (iii)
TIME TO PEAK (hrs)= 6.00 6.07 6.000
RUNOFF VOLUME (mm)= 96.40 24.38 74.075
TOTAL RAINFALL (mm)= 98.40 98.40 98.400
RUNOFF COEFFICIENT = .98 .25 .753

```

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

006:0004-----
* Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

ROUTE RESERVOIR	Requested routing time step = 2.0 min.	=====	OUTFLOW STORAGE TABLE	=====
IN>01:(TOTAL)		OUTFLOW	STORAGE	OUTFLOW STORAGE
OUT<02:(Basin)		(cms)	(ha.m.)	(cms) (ha.m.)
		.000	.0000E+00	.041 .1274E+00
		.013	.1350E-01	.072 .1485E+00
		.015	.2780E-01	.116 .1708E+00
		.017	.4300E-01	.133 .1864E+00
		.019	.5920E-01	.147 .2025E+00
		.020	.7640E-01	.198 .2277E+00
		.021	.8840E-01	.364 .2542E+00
		.026	.1074E+00	.697 .2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
-----	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	.895	6.000	74.075
OUTFLOW<02: (Basin)	4.83	.169	6.567	74.075

PEAK FLOW REDUCTION [Qout/Qin](%)= 18.897
TIME SHIFT OF PEAK FLOW (min)= 34.00
MAXIMUM STORAGE USED (ha.m.)=.2135E+00

006:0005-----
006:0002-----
006:0002-----
006:0002-----

006:0002-----
006:0002-----
** END OF RUN : 6

| START | Project dir.: C:\Users\JLIGHT~1\TEMP_S~1\SCS\12hr\

Rainfall dir.: C:\Users\JLIGHT~1\TEMP_S~1\SCS\12hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 007
NSTORM= 1
1=100SCS12.stm

007:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

* Post-Development Condition - Greely Commercial Center
*

007:0002-----

| READ STORM | Filename: 100-Year SCS Type-II Storm Distribution
| Ptotal= 109.10 mm | Comments: 100-Year SCS Type-II Storm Distribution

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	2.182	3.50	4.364	6.50	19.638	9.50	4.364
1.00	2.182	4.00	4.364	7.00	8.728	10.00	2.182
1.50	2.182	4.50	6.546	7.50	6.546	10.50	2.182
2.00	2.182	5.00	8.728	8.00	6.546	11.00	2.182
2.50	4.364	5.50	13.092	8.50	4.364	11.50	2.182
3.00	4.364	6.00	98.190	9.00	4.364	12.00	2.182

007:0003-----
* Total Drainage Area

| CALIB STANDHYD | Area (ha)= 4.83
| 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

**Post-Development Condition
6-hour SCS Type-II Storm Distribution**

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\PR\SCS+\6hr-\2-CYRSCS.dat

```
2 Metric units
*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720
*****
* Post-Development Condition - Greely Commercial Center
*
*% 25mm Chicago Storm Distribution based on Ottawa, ON. rainfall (3-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[1]
*% ["25mm3hr.stm"] <--storm filename
*%-----|-----
*%-----|-----
*%-----|-----
*%-----|-----
*%-----|-----
* Total Drainage Area
CALIB STANDHYD ID=[1], NHYD=["TOTAL"], DT=[2](min), AREA=[4.83](ha),
XIMP=[0.69], TIMP=[0.69], DWF=[0](cms), LOSS=[2],
SCS curve number CN=[49],
Pervious surfaces: IAPer=[5.0](mm), SLPP=[7.0](%),
LGP=[30](m), MNP=[0.25], SCP=[0](min),
Impervious surfaces: IAImp=[2.0](mm), SLPI=[0.4](%),
LGI=[230](m), MNI=[0.013], SCI=[0](min),
RAINFALL=[ , , , ](mm/hr), END=-1
*%-----|-----
* Depressed Storage Area (Basin)
ROUTE RESERVOIR IDout=[2], NHYD=["Basin"], IDin=[1],
RDT=[2](min),
TABLE of ( OUTFLOW-STORAGE ) values
(cms) - (ha-m)
[ 0.000 , 0.0000 ]
[ 0.013 , 0.0135 ]
[ 0.015 , 0.0278 ]
[ 0.017 , 0.0430 ]
[ 0.019 , 0.0592 ]
[ 0.020 , 0.0764 ]
[ 0.021 , 0.0884 ]
[ 0.026 , 0.1074 ]
[ 0.041 , 0.1274 ]
[ 0.072 , 0.1485 ]
[ 0.116 , 0.1708 ]
[ 0.133 , 0.1864 ]
[ 0.147 , 0.2025 ]
[ 0.198 , 0.2277 ]
[ 0.364 , 0.2542 ]
[ 0.697 , 0.2821 ]
[ -1 , -1 ] (max twenty pts)
IDovf=[ ], NHYDovf=[ ]
*%-----|-----
*% 2-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (6-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[2]
*% ["2SCS6.stm"] <--storm filename
```

2/6/2014 2:39:05 PM

1/2

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\PR\SCS+\6hr-\2-CYRSCS.dat

```
*%-----|-----
*% 5-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (6-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[3]
*% ["5SCS6.stm"] <--storm filename
*%-----|-----
*% 10-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (6-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[4]
*% ["10SCS6.stm"] <--storm filename
*%-----|-----
*% 25-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (6-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[5]
*% ["25SCS6.stm"] <--storm filename
*%-----|-----
*% 50-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (6-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[6]
*% ["50SCS6.stm"] <--storm filename
*%-----|-----
*% 100-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (6-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[7]
*% ["100SCS6.stm"] <--storm filename
*%-----|-----
FINISH
```

2/6/2014 2:39:05 PM

2/2

```

=====
SSSSS W W M M H H Y Y M M OOO 999 999 =====
S W W W MM MM H H Y Y MM MM O O 9 9 9 9
SSSSS W W W M M M H H H H Y M M M O O ## 9 9 9 9 Ver 4.05
S W W M M H H Y M M O O 9999 9999 Sept 2011
SSSSS W W M M H H Y M M OOO 9 9
StormWater Management HYdrologic Model 9 9 9 9 # 2880720
=====

```

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*****
***** SWMHYMO Ver/4.05 *****
***** A single event and continuous hydrologic simulation model *****
***** based on the principles of HYMO and its successors *****
***** OTTHYMO-83 and OTTHYMO-89. *****
***** Distributed by: J.F. Sabourin and Associates Inc. *****
***** Ottawa, Ontario: (613) 836-3884 *****
***** Gatineau, Quebec: (819) 243-6858 *****
***** E-Mail: swmhymo@jfsa.Com *****
*****

```

```

+++++ Licensed user: WMI & Associates Ltd. +++++
+++++ Barrie SERIAL#:2880720 +++++
+++++

```

```

*****
***** +++++ PROGRAM ARRAY DIMENSIONS +++++ *****
***** Maximum value for ID numbers : 10 *****
***** Max. number of rainfall points: 105408 *****
***** Max. number of flow points : 105408 *****
*****

```

```

***** D E T A I L E D O U T P U T *****
*****
***** DATE: 2013-12-13 TIME: 16:31:34 RUN COUNTER: 000564 *****
*****
* Input filename: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\2-CYRSCS.dat *
* Output filename: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\2-CYRSCS.out *
* Summary filename: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\2-CYRSCS.sum *
* User comments: *
* 1: *
* 2: *
* 3: *
*****

```

```

-----
001:0001-----
*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]

```

```

*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
*
* Post-Development Condition - Greely Commercial Center
*

```

```

| START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\
----- Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\

```

```

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 001
NSTORM= 1
# 1=25mm3hr.stm

```

```

-----
001:0002-----
| READ STORM | Filename: 25mm Chicago Storm Distribution (3-hour)
| Ptotal= 24.99 mm | Comments: 25mm Chicago Storm Distribution (3-hour)
-----

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	2.700	1.00	62.660	1.83	4.340	2.67	2.600
.33	3.220	1.17	14.960	2.00	3.790	2.83	2.420
.50	4.060	1.33	8.660	2.17	3.380	3.00	2.270
.67	5.740	1.50	6.370	2.33	3.060		
.83	11.800	1.67	5.130	2.50	2.810		

```

-----
001:0003-----
* Total Drainage Area
| CALIB STANDHYD | Area (ha)= 4.83
| 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00
-----

```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250
Max.eff.Inten.(mm/hr)=	62.66	1.48
over (min)	6.00	28.00
Storage Coeff. (min)=	6.68 (ii)	28.69 (ii)
Unit Hyd. Tpeak (min)=	6.00	28.00
Unit Hyd. peak (cms)=	.17	.04

```

-----
*#*****
PEAK FLOW (cms)= .43 .00 *TOTALS*
TIME TO PEAK (hrs)= 1.03 1.57 .433 (iii)
RUNOFF VOLUME (mm)= 22.99 1.41 16.302
TOTAL RAINFALL (mm)= 24.99 24.99 24.995

```

RUNOFF COEFFICIENT = .92 .06 .652

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

001:0004-----
 * Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

ROUTE RESERVOIR	Requested routing time step = 2.0 min.	===== OUTFLOW STORAGE TABLE =====			
IN>01:(TOTAL)		OUTFLOW	STORAGE	OUTFLOW	STORAGE
OUT<02:(Basin)		(cms)	(ha.m.)	(cms)	(ha.m.)
		.000	.0000E+00	.041	.1274E+00
		.013	.1350E-01	.072	.1485E+00
		.015	.2780E-01	.116	.1708E+00
		.017	.4300E-01	.133	.1864E+00
		.019	.5920E-01	.147	.2025E+00
		.020	.7640E-01	.198	.2277E+00
		.021	.8840E-01	.364	.2542E+00
		.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	.433	1.033	16.302
OUTFLOW<02: (Basin)	4.83	.019	3.067	16.302

PEAK FLOW REDUCTION [Qout/Qin](%)= 4.441
 TIME SHIFT OF PEAK FLOW (min)= 122.00
 MAXIMUM STORAGE USED (ha.m.)=.6336E-01

001:0005-----
 ** END OF RUN : 1

 | START | Project dir.: C:\Users\JLIGHT~1\TEMP_S~1\SCS\6hr\

 Rainfall dir.: C:\Users\JLIGHT~1\TEMP_S~1\SCS\6hr\

TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 002
 NSTORM= 1

1=2SCS6.stm

002:0002-----

 *# Project Name: [Greely Commercial Center] Project Number: [11-183]
 *# Date : 11-13-2013
 *# Modeller : [J. Lightheart]
 *# Company : WMI & Associates Ltd.
 *# License # : 2880720

 *
 * Post-Development Condition - Greely Commercial Center
 *

002:0002-----

 | READ STORM | Filename: 2-Year SCS Type-II Storm Distribution (6
 | Ptotal= 38.10 mm | Comments: 2-Year SCS Type-II Storm Distribution (6

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	1.524	2.00	3.048	3.50	9.906	5.00	2.286
1.00	1.524	2.50	5.334	4.00	4.572	5.50	1.524
1.50	3.048	3.00	38.862	4.50	3.048	6.00	1.524

002:0003-----
 * Total Drainage Area

| CALIB STANDHYD | Area (ha)= 4.83
 | 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)= 3.33	1.50
Dep. Storage	(mm)= 2.00	5.00
Average Slope	(%)= .40	7.00
Length	(m)= 230.00	30.00
Mannings n	= .013	.250

Max.eff.Inten.(mm/hr)= 38.86 3.76
 over (min) 8.00 24.00
 Storage Coeff. (min)= 8.09 (ii) 23.24 (ii)
 Unit Hyd. Tpeak (min)= 8.00 24.00
 Unit Hyd. peak (cms)= .14 .05

TOTALS
 PEAK FLOW (cms)= .35 .01 .353 (iii)
 TIME TO PEAK (hrs)= 3.00 3.30 3.000
 RUNOFF VOLUME (mm)= 36.10 3.68 26.051
 TOTAL RAINFALL (mm)= 38.10 38.10 38.100
 RUNOFF COEFFICIENT = .95 .10 .684

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL

THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

002:0004-----
 * Depressed Storage Area (Basin)

ROUTE RESERVOIR Requested routing time step = 2.0 min.
 IN>01:(TOTAL)
 OUT<02:(Basin)

===== OUTFLOW STORAGE TABLE =====			
OUTFLOW	STORAGE	OUTFLOW	STORAGE
(cms)	(ha.m.)	(cms)	(ha.m.)
.000	.0000E+00	.041	.1274E+00
.013	.1350E-01	.072	.1485E+00
.015	.2780E-01	.116	.1708E+00
.017	.4300E-01	.133	.1864E+00
.019	.5920E-01	.147	.2025E+00
.020	.7640E-01	.198	.2277E+00
.021	.8840E-01	.364	.2542E+00
.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(mm)	
INFLOW >01: (TOTAL)	4.83	.353	3.000	26.051
OUTFLOW<02: (Basin)	4.83	.023	5.033	26.051

PEAK FLOW REDUCTION [Qout/Qin](%)= 6.629
 TIME SHIFT OF PEAK FLOW (min)= 122.00
 MAXIMUM STORAGE USED (ha.m.)=.9762E-01

002:0005-----

002:0002-----
 ** END OF RUN : 2

START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\
 Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\
 TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 003
 NSTORM= 1
 # 1=5SCS6.stm

003:0002-----

 *# Project Name: [Greely Commercial Center] Project Number: [11-183]
 *# Date : 11-13-2013
 *# Modeller : [J. Lightheart]
 *# Company : WMI & Associates Ltd.
 *# License # : 2880720
 *# *****

* Post-Development Condition - Greely Commercial Center

003:0002-----

READ STORM | Filename: 5-Year SCS Type-II Storm Distribution (6
 Ptotal= 53.10 mm | Comments: 5-Year SCS Type-II Storm Distribution (6

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
1.50	2.124	2.00	4.248	3.50	13.806	5.00	3.186
1.00	2.124	2.50	7.434	4.00	6.372	5.50	2.124
1.50	4.248	3.00	54.162	4.50	4.248	6.00	2.124

003:0003-----

* Total Drainage Area

CALIB STANDHYD	Area (ha)=	4.83
01:TOTAL DT= 2.00	Total Imp(%)=	69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250

Max.eff.Inten.(mm/hr)= 54.16 8.62
 over (min) 8.00 18.00
 Storage Coeff. (min)= 7.08 (ii) 17.96 (ii)
 Unit Hyd. Tpeak (min)= 8.00 18.00
 Unit Hyd. peak (cms)= .15 .06

TOTALS

PEAK FLOW (cms)=	.49	.02	.508 (iii)
TIME TO PEAK (hrs)=	3.00	3.20	3.000
RUNOFF VOLUME (mm)=	51.10	7.40	37.554
TOTAL RAINFALL (mm)=	53.10	53.10	53.100
RUNOFF COEFFICIENT =	.96	.14	.707

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

003:0004-----
 * Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

ROUTE RESERVOIR	Requested routing time step = 2.0 min.			
IN>01: (TOTAL)	===== OUTFLOW STORAGE TABLE =====			
OUT<02: (Basin)	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	.000	.0000E+00	.041	.1274E+00
	.013	.1350E-01	.072	.1485E+00
	.015	.2780E-01	.116	.1708E+00
	.017	.4300E-01	.133	.1864E+00
	.019	.5920E-01	.147	.2025E+00
	.020	.7640E-01	.198	.2277E+00
	.021	.8840E-01	.364	.2542E+00
	.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	.508	3.000	37.554
OUTFLOW <02: (Basin)	4.83	.052	4.233	37.554

PEAK FLOW REDUCTION [Qout/Qin](%)= 10.180
 TIME SHIFT OF PEAK FLOW (min)= 74.00
 MAXIMUM STORAGE USED (ha.m.)=.1347E+00

003:0005-----
 003:0002-----
 003:0002-----
 ** END OF RUN : 3

 | START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\

 Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\
 TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 004
 NSTORM= 1
 # 1=10SCS6.stm

004:0002-----
 *#*****

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
 *# Date : 11-13-2013
 *# Modeller : [J. Lightheart]
 *# Company : WMI & Associates Ltd.
 *# License # : 2880720
 *#*****

* Post-Development Condition - Greely Commercial Center

004:0002-----

| READ STORM | Filename: 10-Year SCS Type-II Storm Distribution (
 | Ptotal= 63.00 mm | Comments: 10-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	2.520	2.00	5.040	3.50	16.380	5.00	3.780
1.00	2.520	2.50	8.820	4.00	7.560	5.50	2.520
1.50	5.040	3.00	64.260	4.50	5.040	6.00	2.520

004:0003-----

* Total Drainage Area

| CALIB STANDHYD | Area (ha)= 4.83
 | 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250

Max.eff.Inten.(mm/hr)=	64.26	12.57
over (min)	6.00	16.00
Storage Coeff. (min)=	6.62 (ii)	15.96 (ii)
Unit Hyd. Tpeak (min)=	6.00	16.00
Unit Hyd. peak (cms)=	.18	.07

PEAK FLOW (cms)=	.59	.04	.616 (iii)
TIME TO PEAK (hrs)=	3.00	3.17	3.000
RUNOFF VOLUME (mm)=	61.00	10.44	45.325
TOTAL RAINFALL (mm)=	63.00	63.00	63.000
RUNOFF COEFFICIENT =	.97	.17	.719

- *TOTALS*
 (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 49.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

004:0004-----
 * Depressed Storage Area (Basin)

ROUTE RESERVOIR
 IN>01:(TOTAL)
 OUT<02:(Basin)

Requested routing time step = 2.0 min.

===== OUTFLOW STORAGE TABLE =====			
OUTFLOW	STORAGE	OUTFLOW	STORAGE
(cms)	(ha.m.)	(cms)	(ha.m.)
.000	.0000E+00	.041	.1274E+00
.013	.1350E-01	.072	.1485E+00
.015	.2780E-01	.116	.1708E+00
.017	.4300E-01	.133	.1864E+00
.019	.5920E-01	.147	.2025E+00
.020	.7640E-01	.198	.2277E+00
.021	.8840E-01	.364	.2542E+00
.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	.616	3.000	45.325
OUTFLOW<02: (Basin)	4.83	.085	3.967	45.325

PEAK FLOW REDUCTION [Qout/Qin](%)= 13.722
 TIME SHIFT OF PEAK FLOW (min)= 58.00
 MAXIMUM STORAGE USED (ha.m.)=.1548E+00

004:0005-----

004:0002-----

004:0002-----

004:0002-----

** END OF RUN : 4

| START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\
 ----- Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\
 TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 005
 NSTORM= 1
 # 1=25SCS6.stm

005:0002-----

 * Project Name: [Greely Commercial Center] Project Number: [11-183]
 * Date : 11-13-2013
 * Modeller : [J. Lightheart]
 * Company : WMI & Associates Ltd.
 * License # : 2880720

* Post-Development Condition - Greely Commercial Center

005:0002-----

| READ STORM | Filename: 25-Year SCS Type-II Storm Distribution (
 | Ptotal= 75.50 mm | Comments: 25-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
1.50	3.020	2.00	6.040	3.50	19.630	5.00	4.530
1.00	3.020	2.50	10.570	4.00	9.060	5.50	3.020
1.50	6.040	3.00	77.010	4.50	6.040	6.00	3.020

005:0003-----

* Total Drainage Area

CALIB STANDHYD	Area (ha)=	4.83
01:TOTAL DT= 2.00	Total Imp(%)=	69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250

Max.eff.Inten.(mm/hr)=	77.01	18.42
over (min)	6.00	14.00
Storage Coeff. (min)=	6.15 (ii)	14.18 (ii)
Unit Hyd. Tpeak (min)=	6.00	14.00
Unit Hyd. peak (cms)=	.18	.08

TOTALS

PEAK FLOW (cms)=	.71	.05	.753 (iii)
TIME TO PEAK (hrs)=	3.00	3.13	3.000
RUNOFF VOLUME (mm)=	73.50	14.84	55.316
TOTAL RAINFALL (mm)=	75.50	75.50	75.500
RUNOFF COEFFICIENT =	.97	.20	.733

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

005:0004-----
 * Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

ROUTE RESERVOIR		===== OUTFLOW STORAGE TABLE =====			
IN>01: (TOTAL)	OUT<02: (Basin)	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
		.000	.0000E+00	.041	.1274E+00
		.013	.1350E-01	.072	.1485E+00
		.015	.2780E-01	.116	.1708E+00
		.017	.4300E-01	.133	.1864E+00
		.019	.5920E-01	.147	.2025E+00
		.020	.7640E-01	.198	.2277E+00
		.021	.8840E-01	.364	.2542E+00
		.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >01: (TOTAL)	4.83	.753	3.000	55.316
OUTFLOW<02: (Basin)	4.83	.127	3.700	55.316

PEAK FLOW REDUCTION [Qout/Qin](%)= 16.829
 TIME SHIFT OF PEAK FLOW (min)= 42.00
 MAXIMUM STORAGE USED (ha.m.)=.1807E+00

005:0005-----

005:0002-----

005:0002-----

005:0002-----

005:0002-----
 ** END OF RUN : 5

START | Project dir.: C:\Users\JLIGHT~1\TEMP_S~1\SCS\6hr\
 Rainfall dir.: C:\Users\JLIGHT~1\TEMP_S~1\SCS\6hr\

TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 006
 NSTORM= 1

1=50SCS6.stm

006:0002-----

 *# Project Name: [Greely Commercial Center] Project Number: [11-183]
 *# Date : 11-13-2013
 *# Modeller : [J. Lighthead]
 *# Company : WMI & Associates Ltd.
 *# License # : 2880720

* Post-Development Condition - Greely Commercial Center
 *

006:0002-----

READ STORM | Ptotal= 84.80 mm | Filename: 50-Year SCS Type-II Storm Distribution (
 Comments: 50-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	3.392	2.00	6.784	3.50	22.048	5.00	5.088
1.00	3.392	2.50	11.872	4.00	10.176	5.50	3.392
1.50	6.784	3.00	86.496	4.50	6.784	6.00	3.392

006:0003-----

* Total Drainage Area

CALIB STANDHYD | Area (ha)= 4.83
 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250

Max.eff.Inten.(mm/hr)= 86.50 22.97
 over (min) 6.00 14.00
 Storage Coeff. (min)= 5.87 (ii) 13.22 (ii)
 Unit Hyd. Tpeak (min)= 6.00 14.00
 Unit Hyd. peak (cms)= .19 .08

TOTALS

PEAK FLOW (cms)= .79 .07 .856 (iii)
 TIME TO PEAK (hrs)= 3.00 3.10 3.000
 RUNOFF VOLUME (mm)= 82.80 18.50 62.868
 TOTAL RAINFALL (mm)= 84.80 84.80 84.800
 RUNOFF COEFFICIENT = .98 .22 .741

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 49.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL

THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

006:0004-----
 * Depressed Storage Area (Basin)

ROUTE RESERVOIR	Requested routing time step = 2.0 min.			
IN>01:(TOTAL)	===== OUTFLOW STORAGE TABLE =====			
OUT<02:(Basin)	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	.000	.0000E+00	.041	.1274E+00
	.013	.1350E-01	.072	.1485E+00
	.015	.2780E-01	.116	.1708E+00
	.017	.4300E-01	.133	.1864E+00
	.019	.5920E-01	.147	.2025E+00
	.020	.7640E-01	.198	.2277E+00
	.021	.8840E-01	.364	.2542E+00
	.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	.856	3.000	62.868
OUTFLOW<02: (Basin)	4.83	.147	3.700	62.868

PEAK FLOW REDUCTION [Qout/Qin](%)= 17.199
 TIME SHIFT OF PEAK FLOW (min)= 42.00
 MAXIMUM STORAGE USED (ha.m.)=.2026E+00

006:0005-----

006:0002-----

006:0002-----

006:0002-----

006:0002-----

006:0002-----

** END OF RUN : 6

| START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\

 Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\SCS\6hr\

TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 007
 NSTORM= 1
 # 1=100SCS6.stm

007:0002-----

 * Project Name: [Greely Commercial Center] Project Number: [11-183]
 * Date : 11-13-2013
 * Modeller : [J. Lighthearth]
 * Company : WMI & Associates Ltd.
 * License # : 2880720
 *
 * Post-Development Condition - Greely Commercial Center
 *

007:0002-----

READ STORM	Filename: 100-Year SCS Type-II Storm Distribution
Ptotal= 94.00 mm	Comments: 100-Year SCS Type-II Storm Distribution

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.50	3.760	2.00	7.520	3.50	24.440	5.00	5.640
1.00	3.760	2.50	13.160	4.00	11.280	5.50	3.760
1.50	7.520	3.00	95.880	4.50	7.520	6.00	3.760

007:0003-----

* Total Drainage Area

CALIB STANDHYD	Area (ha)=	4.83
01:TOTAL DT= 2.00	Total Imp(%)=	69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250

Max.eff.Inten.(mm/hr)=	95.88	28.53
over (min)	6.00	12.00
Storage Coeff. (min)=	5.64 (ii)	12.37 (ii)
Unit Hyd. Tpeak (min)=	6.00	12.00
Unit Hyd. peak (cms)=	.20	.09

TOTALS

PEAK FLOW (cms)=	.88	.09	.963 (iii)
TIME TO PEAK (hrs)=	3.00	3.10	3.000
RUNOFF VOLUME (mm)=	92.00	22.42	70.429
TOTAL RAINFALL (mm)=	94.00	94.00	94.000

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\PR\SCS+\6hr-\2-CYRSCS.out

RUNOFF COEFFICIENT = .98 .24 .749

- (i) CN PROCEDURE SELECTED FOR PVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

007:0004-----

* Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

===== OUTFLOW STORAGE TABLE =====			
OUTFLOW	STORAGE	OUTFLOW	STORAGE
(cms)	(ha.m.)	(cms)	(ha.m.)
.000	.0000E+00	.041	.1274E+00
.013	.1350E-01	.072	.1485E+00
.015	.2780E-01	.116	.1708E+00
.017	.4300E-01	.133	.1864E+00
.019	.5920E-01	.147	.2025E+00
.020	.7640E-01	.198	.2277E+00
.021	.8840E-01	.364	.2542E+00
.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
-----	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	.963	3.000	70.429
OUTFLOW<02: (Basin)	4.83	.188	3.633	70.429

PEAK FLOW REDUCTION [Qout/Qin](%)= 19.569
 TIME SHIFT OF PEAK FLOW (min)= 38.00
 MAXIMUM STORAGE USED (ha.m.)=.2230E+00

007:0005-----

007:0002-----

007:0002-----

007:0002-----

007:0002-----

007:0002-----

007:0002-----

FINISH

WARNINGS / ERRORS / NOTES

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\PR\SCS+\6hr-\2-CYRSCS.out

Simulation ended on 2013-12-13 at 16:31:35

=====

**Post-Development Condition
24-hour SCS Type-II Storm Distribution**

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\PR\SCS+\24hr-\2-CYRSCS.dat

```

2 Metric units
*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720
*****
* Post-Development Condition - Greely Commercial Center
*
*% 25mm Chicago Storm Distribution based on Ottawa, ON. rainfall (3-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[1]
*% ["25mm3hr.stm"] <--storm filename
*%-----|-----
READ STORM STORM_FILENAME=["STORM.001"]
*%-----|-----
* Total Drainage Area
CALIB STANDHYD ID=[1], NHYD=["TOTAL"], DT=[2](min), AREA=[4.83](ha),
XIMP=[0.69], TIMP=[0.69], DWF=[0](cms), LOSS=[2],
SCS curve number CN=[49],
Pervious surfaces: IApr=[5.0](mm), SLPP=[7.0](%),
LGP=[30](m), MNP=[0.25], SCP=[0](min),
Impervious surfaces: IAimp=[2.0](mm), SLPI=[0.4](%),
LGI=[230](m), MNI=[0.013], SCI=[0](min),
RAINFALL=[ , , , ](mm/hr), END=-1
*%-----|-----
* Depressed Storage Area (Basin)
ROUTE RESERVOIR IDout=[2], NHYD=["Basin"], IDin=[1],
RDT=[2](min),
TABLE of ( OUTFLOW-STORAGE ) values
(cms) - (ha-m)
[ 0.000 , 0.0000 ]
[ 0.013 , 0.0135 ]
[ 0.015 , 0.0278 ]
[ 0.017 , 0.0430 ]
[ 0.019 , 0.0592 ]
[ 0.020 , 0.0764 ]
[ 0.021 , 0.0884 ]
[ 0.026 , 0.1074 ]
[ 0.041 , 0.1274 ]
[ 0.072 , 0.1485 ]
[ 0.116 , 0.1708 ]
[ 0.133 , 0.1864 ]
[ 0.147 , 0.2025 ]
[ 0.198 , 0.2277 ]
[ 0.364 , 0.2542 ]
[ 0.697 , 0.2821 ]
[ -1 , -1 ] (max twenty pts)
IDovf=[ ], NHYDovf=[ ]
*%-----|-----
*% 2-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (24-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[2]
*% ["2SCS24.stm"] <--storm filename

```

2/6/2014 2:40:24 PM

1/2

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\PR\SCS+\24hr-\2-CYRSCS.dat

```

*%-----|-----
*% 5-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (24-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[3]
*% ["5SCS24.stm"] <--storm filename
*%-----|-----
*% 10-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (24-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[4]
*% ["10SCS24.stm"] <--storm filename
*%-----|-----
*% 25-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (24-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[5]
*% ["25SCS24.stm"] <--storm filename
*%-----|-----
*% 50-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (24-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[6]
*% ["50SCS24.stm"] <--storm filename
*%-----|-----
*% 100-year SCS Type-II Storm Distribution based on Ottawa, ON. rainfall (24-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[7]
*% ["100SCS24.stm"] <--storm filename
*%-----|-----
FINISH

```

2/6/2014 2:40:24 PM

2/2

=====

```

SSSSS W W M M H H Y Y M M OOO          999 999  =====
S      W W W MM MM H H Y Y MM MM O O     9 9 9 9
SSSSS W W W M M M HHHHH Y M M M O O ## 9 9 9 9 Ver 4.05
S      W W M M H H Y M M O O           9999 9999 Sept 2011
SSSSS W W M M H H Y M M OOO           9 9
StormWater Management HYdrologic Model    9 9 9 9 # 2880720
                                           999 999  =====

```

```

*****
***** SWMHYMO Ver/4.05 *****
***** A single event and continuous hydrologic simulation model *****
***** based on the principles of HYMO and its successors *****
***** OTHYMO-83 and OTHYMO-89. *****
***** Distributed by: J.F. Sabourin and Associates Inc. *****
***** Ottawa, Ontario: (613) 836-3884 *****
***** Gatineau, Quebec: (819) 243-6858 *****
***** E-Mail: swmhymo@jfsa.Com *****
*****

```

```

+++++ Licensed user: WMI & Associates Ltd. +++++
+++++ Barrie SERIAL#:2880720 +++++
+++++

```

```

*****
***** +++++ PROGRAM ARRAY DIMENSIONS +++++ *****
***** Maximum value for ID numbers : 10 *****
***** Max. number of rainfall points: 105408 *****
***** Max. number of flow points : 105408 *****
*****

```

```

***** D E T A I L E D   O U T P U T *****
*****
***** DATE: 2013-12-13 TIME: 16:34:52 RUN COUNTER: 000566 *****
*****
* Input filename: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\2-CYRSCS.dat *
* Output filename: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\2-CYRSCS.out *
* Summary filename: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\2-CYRSCS.sum *
* User comments: *
* 1: *
* 2: *
* 3: *
*****

```

001:0001-----

```

*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthart]

```

```

*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
*
* Post-Development Condition - Greely Commercial Center
*

```

```

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\
----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\

```

```

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 001
NSTORM= 1
# 1=25mm3hr.stm

```

001:0002-----

```

| READ STORM | Filename: 25mm Chicago Storm Distribution (3-hour)
| Ptotal= 24.99 mm | Comments: 25mm Chicago Storm Distribution (3-hour)
-----

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	2.700	1.00	62.660	1.83	4.340	2.67	2.600
.33	3.220	1.17	14.960	2.00	3.790	2.83	2.420
.50	4.060	1.33	8.660	2.17	3.380	3.00	2.270
.67	5.740	1.50	6.370	2.33	3.060		
.83	11.800	1.67	5.130	2.50	2.810		

001:0003-----

```

* Total Drainage Area
-----
| CALIB STANDHYD | Area (ha)= 4.83
| 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00
-----

```

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250
Max.eff.Inten.(mm/hr)=	62.66	1.48
over (min)	6.00	28.00
Storage Coeff. (min)=	6.68 (ii)	28.69 (ii)
Unit Hyd. Tpeak (min)=	6.00	28.00
Unit Hyd. peak (cms)=	.17	.04

```

*#TOTALS*
PEAK FLOW (cms)= .43 .00 .433 (iii)
TIME TO PEAK (hrs)= 1.03 1.57 1.033
RUNOFF VOLUME (mm)= 22.99 1.41 16.302
TOTAL RAINFALL (mm)= 24.99 24.99 24.995

```

RUNOFF COEFFICIENT = .92 .06 .652

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

001:0004-----
* Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

ROUTE RESERVOIR		Requested routing time step = 2.0 min.	
IN>01:(TOTAL)	OUT<02:(Basin)	===== OUTFLOW STORAGE TABLE =====	
		OUTFLOW STORAGE	OUTFLOW STORAGE
		(cms) (ha.m.)	(cms) (ha.m.)
		.000 .0000E+00	.041 .1274E+00
		.013 .1350E-01	.072 .1485E+00
		.015 .2780E-01	.116 .1708E+00
		.017 .4300E-01	.133 .1864E+00
		.019 .5920E-01	.147 .2025E+00
		.020 .7640E-01	.198 .2277E+00
		.021 .8840E-01	.364 .2542E+00
		.026 .1074E+00	.697 .2821E+00

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >01: (TOTAL)	4.83	.433	1.033	16.302
OUTFLOW<02: (Basin)	4.83	.019	3.067	16.302
PEAK FLOW REDUCTION [Qout/Qin](%)=		4.441		
TIME SHIFT OF PEAK FLOW (min)=		122.00		
MAXIMUM STORAGE USED (ha.m.)=		.6336E-01		

001:0005-----
** END OF RUN : 1

| START | Project dir.: C:\USERS\JLIGHT~1\TEMP_S~1\SCS\24HR\

Rainfall dir.: C:\USERS\JLIGHT~1\TEMP_S~1\SCS\24HR\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 002
NSTORM= 1

1=2SCS24.stm

002:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

*
* Post-Development Condition - Greely Commercial Center
*

002:0002-----

READ STORM	Filename: 2-Year SCS Type-II Storm Distribution (2
Ptotal= 49.40 mm	Comments: 2-Year SCS Type-II Storm Distribution (2

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.20	.494	6.20	.988	12.20	9.880	18.20	.741
.40	.494	6.40	.988	12.40	6.175	18.40	.741
.60	.494	6.60	.988	12.60	4.446	18.60	.988
.80	.494	6.80	.988	12.80	4.199	18.80	.741
1.00	.494	7.00	.988	13.00	2.964	19.00	.741
1.20	.494	7.20	.988	13.20	2.470	19.20	.988
1.40	.494	7.40	.988	13.40	2.470	19.40	.741
1.60	.494	7.60	.988	13.60	2.470	19.60	.988
1.80	.494	7.80	.988	13.80	2.470	19.80	.741
2.00	.494	8.00	.988	14.00	2.470	20.00	.988
2.20	.494	8.20	1.482	14.20	1.482	20.20	.741
2.40	.494	8.40	1.482	14.40	1.482	20.40	.741
2.60	.494	8.60	1.482	14.60	1.482	20.60	.494
2.80	.494	8.80	1.482	14.80	1.482	20.80	.741
3.00	.494	9.00	1.482	15.00	1.482	21.00	.741
3.20	.494	9.20	1.482	15.20	1.235	21.20	.494
3.40	.494	9.40	1.482	15.40	1.235	21.40	.741
3.60	.494	9.60	1.482	15.60	1.235	21.60	.494
3.80	.494	9.80	1.482	15.80	1.235	21.80	.741
4.00	.494	10.00	1.482	16.00	1.235	22.00	.494
4.20	.988	10.20	2.717	16.20	1.235	22.20	.494
4.40	.988	10.40	2.717	16.40	1.235	22.40	.741
4.60	.988	10.60	2.717	16.60	1.235	22.60	.494
4.80	.988	10.80	2.717	16.80	1.235	22.80	.741
5.00	.988	11.00	2.717	17.00	.741	23.00	.494
5.20	.988	11.20	3.705	17.20	.741	23.20	.494
5.40	.988	11.40	5.434	17.40	.988	23.40	.494
5.60	.988	11.60	13.091	17.60	.741	23.60	.741
5.80	.988	11.80	27.170	17.80	.988	23.80	.494
6.00	.988	12.00	55.575	18.00	.741	24.00	.494

002:0003-----

* Total Drainage Area

```

-----
| CALIB STANDHYD      | Area (ha)= 4.83
| 01:TOTAL DT= 2.00  | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00
-----
                IMPERVIOUS    PERVIOUS (i)
Surface Area (ha)= 3.33      1.50
Dep. Storage (mm)= 2.00     5.00
Average Slope (%)= .40      7.00
Length (m)= 230.00         30.00
Mannings n = .013         .250

Max.eff.Inten.(mm/hr)= 55.57 6.04
over (min) 8.00 20.00
Storage Coeff. (min)= 7.01 (ii) 19.55 (ii)
Unit Hyd. Tpeak (min)= 8.00 20.00
Unit Hyd. peak (cms)= .15 .06

                *TOTALS*
PEAK FLOW (cms)= .43 .02 .439 (iii)
TIME TO PEAK (hrs)= 12.03 12.23 12.033
RUNOFF VOLUME (mm)= 47.40 6.38 34.685
TOTAL RAINFALL (mm)= 49.40 49.40 49.400
RUNOFF COEFFICIENT = .96 .13 .702
    
```

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

002:0004-----
* Depressed Storage Area (Basin)

```

-----
| ROUTE RESERVOIR    | Requested routing time step = 2.0 min.
| IN>01:(TOTAL )    |
| OUT<02:(Basin )   |
-----
                ===== OUTFLOW STORAGE TABLE =====
                OUTFLOW STORAGE OUTFLOW STORAGE
                (cms) (ha.m.) (cms) (ha.m.)
                .000 .0000E+00 .041 .1274E+00
                .013 .1350E-01 .072 .1485E+00
                .015 .2780E-01 .116 .1708E+00
                .017 .4300E-01 .133 .1864E+00
                .019 .5920E-01 .147 .2025E+00
                .020 .7640E-01 .198 .2277E+00
                .021 .8840E-01 .364 .2542E+00
                .026 .1074E+00 .697 .2821E+00
    
```

```

ROUTING RESULTS          AREA    QPEAK    TPEAK    R.V.
-----
                (ha)    (cms)    (hrs)    (mm)
INFLOW >01: (TOTAL )    4.83    .439    12.033    34.685
OUTFLOW<02: (Basin )    4.83    .023    14.100    34.685

                PEAK FLOW REDUCTION [Qout/Qin](%)= 5.253
    
```

TIME SHIFT OF PEAK FLOW (min)= 124.00
MAXIMUM STORAGE USED (ha.m.)=.9623E-01

002:0005-----

002:0002-----
** END OF RUN : 2

```

-----
| START              | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\
-----
                Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 003
NSTORM= 1
# 1=5SCS24.stm
    
```

003:0002-----

```

*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthouse]
*# Company : WMI & Associates Ltd.
*# License # : 2880720
*****
    
```

* Post-Development Condition - Greely Commercial Center

003:0002-----

```

| READ STORM          | Filename: 5-Year SCS Type-II Storm Distribution (2)
| Ptotal= 67.30 mm   | Comments: 5-Year SCS Type-II Storm Distribution (2)
-----
    
```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.20	.673	6.20	1.346	12.20	13.460	18.20	1.010
.40	.673	6.40	1.346	12.40	8.413	18.40	1.009
.60	.673	6.60	1.346	12.60	6.057	18.60	1.346
.80	.673	6.80	1.346	12.80	5.721	18.80	1.010
1.00	.673	7.00	1.346	13.00	4.038	19.00	1.010
1.20	.673	7.20	1.346	13.20	3.365	19.20	1.346
1.40	.673	7.40	1.346	13.40	3.365	19.40	1.010
1.60	.673	7.60	1.346	13.60	3.365	19.60	1.346
1.80	.673	7.80	1.346	13.80	3.365	19.80	1.010

2.00	.673	8.00	1.346	14.00	3.365	20.00	1.346
2.20	.673	8.20	2.019	14.20	2.019	20.20	1.010
2.40	.673	8.40	2.019	14.40	2.019	20.40	1.010
2.60	.673	8.60	2.019	14.60	2.019	20.60	.673
2.80	.673	8.80	2.019	14.80	2.019	20.80	1.010
3.00	.673	9.00	2.019	15.00	2.019	21.00	1.009
3.20	.673	9.20	2.019	15.20	1.682	21.20	.673
3.40	.673	9.40	2.019	15.40	1.682	21.40	1.010
3.60	.673	9.60	2.019	15.60	1.682	21.60	.673
3.80	.673	9.80	2.019	15.80	1.682	21.80	1.010
4.00	.673	10.00	2.019	16.00	1.682	22.00	.673
4.20	1.346	10.20	3.701	16.20	1.683	22.20	.673
4.40	1.346	10.40	3.702	16.40	1.682	22.40	1.010
4.60	1.346	10.60	3.701	16.60	1.682	22.60	.673
4.80	1.346	10.80	3.702	16.80	1.682	22.80	1.009
5.00	1.346	11.00	3.701	17.00	1.009	23.00	.673
5.20	1.346	11.20	5.048	17.20	1.010	23.20	.673
5.40	1.346	11.40	7.403	17.40	1.346	23.40	.673
5.60	1.346	11.60	17.834	17.60	1.010	23.60	1.010
5.80	1.346	11.80	37.015	17.80	1.346	23.80	.673
6.00	1.346	12.00	75.713	18.00	1.010	24.00	.673

003:0003-----
* Total Drainage Area

CALIB STANDHYD	Area (ha)=	4.83
01:TOTAL DT= 2.00	Total Imp(%)=	69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250

Max. eff. Inten. (mm/hr)=	75.71	12.95
over (min)	6.00	16.00
Storage Coeff. (min)=	6.20 (ii)	15.43 (ii)
Unit Hyd. Tpeak (min)=	6.00	16.00
Unit Hyd. peak (cms)=	.18	.07

		TOTALS
PEAK FLOW (cms)=	.62	.04 .642 (iii)
TIME TO PEAK (hrs)=	12.00	12.17 12.000
RUNOFF VOLUME (mm)=	65.30	11.88 48.740
TOTAL RAINFALL (mm)=	67.30	67.30 67.300
RUNOFF COEFFICIENT =	.97	.18 .724

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

003:0004-----
* Depressed Storage Area (Basin)

ROUTE RESERVOIR	Requested routing time step = 2.0 min.			
IN>01:(TOTAL)				
OUT<02:(Basin)				
	=====	OUTFLOW STORAGE TABLE	=====	
	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	.000	.0000E+00	.041	.1274E+00
	.013	.1350E-01	.072	.1485E+00
	.015	.2780E-01	.116	.1708E+00
	.017	.4300E-01	.133	.1864E+00
	.019	.5920E-01	.147	.2025E+00
	.020	.7640E-01	.198	.2277E+00
	.021	.8840E-01	.364	.2542E+00
	.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	.642	12.000	48.740
OUTFLOW <02: (Basin)	4.83	.047	13.033	48.740

PEAK FLOW REDUCTION [Qout/Qin](%)=	7.313
TIME SHIFT OF PEAK FLOW (min)=	62.00
MAXIMUM STORAGE USED (ha.m.)=	.1315E+00

003:0005-----

003:0002-----

003:0002-----

** END OF RUN : 3

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\

----- Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 004
NSTORM= 1
1=10SCS24.stm

004:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
 *# Date : 11-13-2013
 *# Modeller : [J. Lightheart]
 *# Company : WMI & Associates Ltd.
 *# License # : 2880720

* Post-Development Condition - Greely Commercial Center

004:0002-----

READ STORM Filename: 10-Year SCS Type-II Storm Distribution (
 Ptotal= 79.20 mm Comments: 10-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.20	.792	6.20	1.584	12.20	15.840	18.20	1.188
.40	.792	6.40	1.584	12.40	9.900	18.40	1.188
.60	.792	6.60	1.584	12.60	7.128	18.60	1.584
.80	.792	6.80	1.584	12.80	6.732	18.80	1.188
1.00	.792	7.00	1.584	13.00	4.752	19.00	1.188
1.20	.792	7.20	1.584	13.20	3.960	19.20	1.584
1.40	.792	7.40	1.584	13.40	3.960	19.40	1.188
1.60	.792	7.60	1.584	13.60	3.960	19.60	1.584
1.80	.792	7.80	1.584	13.80	3.960	19.80	1.188
2.00	.792	8.00	1.584	14.00	3.960	20.00	1.584
2.20	.792	8.20	2.376	14.20	2.376	20.20	1.188
2.40	.792	8.40	2.376	14.40	2.376	20.40	1.188
2.60	.792	8.60	2.376	14.60	2.376	20.60	.792
2.80	.792	8.80	2.376	14.80	2.376	20.80	1.188
3.00	.792	9.00	2.376	15.00	2.376	21.00	1.188
3.20	.792	9.20	2.376	15.20	1.980	21.20	.792
3.40	.792	9.40	2.376	15.40	1.980	21.40	1.188
3.60	.792	9.60	2.376	15.60	1.980	21.60	.792
3.80	.792	9.80	2.376	15.80	1.980	21.80	1.188
4.00	.792	10.00	2.376	16.00	1.980	22.00	.792
4.20	1.584	10.20	4.356	16.20	1.980	22.20	.792
4.40	1.584	10.40	4.356	16.40	1.980	22.40	1.188
4.60	1.584	10.60	4.356	16.60	1.980	22.60	.792
4.80	1.584	10.80	4.356	16.80	1.980	22.80	1.188
5.00	1.584	11.00	4.356	17.00	1.188	23.00	.792
5.20	1.584	11.20	5.940	17.20	1.188	23.20	.792
5.40	1.584	11.40	8.712	17.40	1.584	23.40	.792
5.60	1.584	11.60	20.988	17.60	1.188	23.60	1.188
5.80	1.584	11.80	43.560	17.80	1.584	23.80	.792
6.00	1.584	12.00	89.100	18.00	1.188	24.00	.792

004:0003-----

* Total Drainage Area

CALIB STANDHYD Area (ha)= 4.83
 01:TOTAL DT= 2.00 Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

 IMPERVIOUS PERVIOUS (i)
 Surface Area (ha)= 3.33 1.50
 Dep. Storage (mm)= 2.00 5.00
 Average Slope (%)= .40 7.00
 Length (m)= 230.00 30.00
 Mannings n = .013 .250
 Max.eff.Inten.(mm/hr)= 89.10 19.24
 over (min) 6.00 14.00
 Storage Coeff. (min)= 5.81 (ii) 13.69 (ii)
 Unit Hyd. Tpeak (min)= 6.00 14.00
 Unit Hyd. peak (cms)= .19 .08
 TOTALS
 PEAK FLOW (cms)= .74 .05 .776 (iii)
 TIME TO PEAK (hrs)= 12.00 12.13 12.000
 RUNOFF VOLUME (mm)= 77.20 16.26 58.309
 TOTAL RAINFALL (mm)= 79.20 79.20 79.200
 RUNOFF COEFFICIENT = .97 .21 .736

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 49.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

004:0004-----

* Depressed Storage Area (Basin)

ROUTE RESERVOIR Requested routing time step = 2.0 min.
 IN>01:(TOTAL)
 OUT<02:(Basin)

OUTFLOW	STORAGE	OUTFLOW	STORAGE
(cms)	(ha.m.)	(cms)	(ha.m.)
.000	.0000E+00	.041	.1274E+00
.013	.1350E-01	.072	.1485E+00
.015	.2780E-01	.116	.1708E+00
.017	.4300E-01	.133	.1864E+00
.019	.5920E-01	.147	.2025E+00
.020	.7640E-01	.198	.2277E+00
.021	.8840E-01	.364	.2542E+00
.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS AREA QPEAK TPEAK R.V.
 (ha) (cms) (hrs) (mm)
 INFLOW >01: (TOTAL) 4.83 .776 12.000 58.309
 OUTFLOW<02: (Basin) 4.83 .079 12.767 58.309

PEAK FLOW REDUCTION [Qout/Qin](%)= 10.156
 TIME SHIFT OF PEAK FLOW (min)= 46.00
 MAXIMUM STORAGE USED (ha.m.)=.1520E+00

004:0005-----

 004:0002-----

 004:0002-----

 004:0002-----
 ** END OF RUN : 4

| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\

 Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\

TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 005
 NSTORM= 1
 # 1=25SCS24.stm

005:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
 *# Date : 11-13-2013
 *# Modeller : [J. Lightheart]
 *# Company : WMI & Associates Ltd.
 *# License # : 2880720

* Post-Development Condition - Greely Commercial Center
 *

005:0002-----

| READ STORM | Filename: 25-Year SCS Type-II Storm Distribution (
 | Ptotal= 94.30 mm | Comments: 25-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.20	.943	6.20	1.886	12.20	18.860	18.20	1.415
.40	.943	6.40	1.886	12.40	11.788	18.40	1.414
.60	.943	6.60	1.886	12.60	8.487	18.60	1.886
.80	.943	6.80	1.886	12.80	8.016	18.80	1.415
1.00	.943	7.00	1.886	13.00	5.658	19.00	1.415
1.20	.943	7.20	1.886	13.20	4.715	19.20	1.886
1.40	.943	7.40	1.886	13.40	4.715	19.40	1.415
1.60	.943	7.60	1.886	13.60	4.715	19.60	1.886
1.80	.943	7.80	1.886	13.80	4.715	19.80	1.415

2.00	.943	8.00	1.886	14.00	4.715	20.00	1.886
2.20	.943	8.20	2.829	14.20	2.829	20.20	1.415
2.40	.943	8.40	2.829	14.40	2.829	20.40	1.415
2.60	.943	8.60	2.829	14.60	2.829	20.60	.943
2.80	.943	8.80	2.829	14.80	2.829	20.80	1.415
3.00	.943	9.00	2.829	15.00	2.829	21.00	1.414
3.20	.943	9.20	2.829	15.20	2.357	21.20	.943
3.40	.943	9.40	2.829	15.40	2.357	21.40	1.415
3.60	.943	9.60	2.829	15.60	2.357	21.60	.943
3.80	.943	9.80	2.829	15.80	2.357	21.80	1.415
4.00	.943	10.00	2.829	16.00	2.357	22.00	.943
4.20	1.886	10.20	5.186	16.20	2.358	22.20	.943
4.40	1.886	10.40	5.187	16.40	2.357	22.40	1.415
4.60	1.886	10.60	5.186	16.60	2.357	22.60	.943
4.80	1.886	10.80	5.187	16.80	2.357	22.80	1.414
5.00	1.886	11.00	5.186	17.00	1.414	23.00	.943
5.20	1.886	11.20	7.073	17.20	1.415	23.20	.943
5.40	1.886	11.40	10.373	17.40	1.886	23.40	.943
5.60	1.886	11.60	24.989	17.60	1.415	23.60	1.415
5.80	1.886	11.80	51.865	17.80	1.886	23.80	.943
6.00	1.886	12.00	106.088	18.00	1.415	24.00	.943

005:0003-----
 * Total Drainage Area

CALIB STANDHYD	Area (ha)=	4.83
01:TOTAL DT= 2.00	Total Imp(%)=	69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250
Max.eff.Inten.(mm/hr)=	106.09	29.34
over (min)	6.00	12.00
Storage Coeff. (min)=	5.41 (ii)	12.07 (ii)
Unit Hyd. Tpeak (min)=	6.00	12.00
Unit Hyd. peak (cms)=	.20	.09

TOTALS
 PEAK FLOW (cms)= .89 .08 .954 (iii)
 TIME TO PEAK (hrs)= 12.00 12.10 12.000
 RUNOFF VOLUME (mm)= 92.30 22.55 70.678
 TOTAL RAINFALL (mm)= 94.30 94.30 94.301
 RUNOFF COEFFICIENT = .98 .24 .749

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
 CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

005:0004-----
* Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

ROUTE RESERVOIR		Requested routing time step = 2.0 min.			
IN>01: (TOTAL)		===== OUTFLOW STORAGE TABLE =====			
OUT<02: (Basin)		OUTFLOW	STORAGE	OUTFLOW	STORAGE
		(cms)	(ha.m.)	(cms)	(ha.m.)
		.000	.0000E+00	.041	.1274E+00
		.013	.1350E-01	.072	.1485E+00
		.015	.2780E-01	.116	.1708E+00
		.017	.4300E-01	.133	.1864E+00
		.019	.5920E-01	.147	.2025E+00
		.020	.7640E-01	.198	.2277E+00
		.021	.8840E-01	.364	.2542E+00
		.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
-----	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	.954	12.000	70.678
OUTFLOW <02: (Basin)	4.83	.125	12.533	70.678

PEAK FLOW REDUCTION [Qout/Qin](%)= 13.098
 TIME SHIFT OF PEAK FLOW (min)= 32.00
 MAXIMUM STORAGE USED (ha.m.)=.1790E+00

005:0005-----
 005:0002-----
 005:0002-----
 005:0002-----
 005:0002-----
 ** END OF RUN : 5

START | Project dir.: C:\USERS\JLIGHT~1\TEMP_S~1\SCS\24HR\
 Rainfall dir.: C:\USERS\JLIGHT~1\TEMP_S~1\SCS\24HR\

TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 006
 NSTORM= 1

1=50SCS24.stm

006:0002-----

 *# Project Name: [Greely Commercial Center] Project Number: [11-183]
 *# Date : 11-13-2013
 *# Modeller : [J. Lighthearth]
 *# Company : WMI & Associates Ltd.
 *# License # : 2880720

 * Post-Development Condition - Greely Commercial Center
 *

006:0002-----
 READ STORM | Filename: 50-Year SCS Type-II Storm Distribution (
 Ptotal= 105.40 mm | Comments: 50-Year SCS Type-II Storm Distribution (

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.20	1.054	6.20	2.108	12.20	21.080	18.20	1.581
.40	1.054	6.40	2.108	12.40	13.175	18.40	1.581
.60	1.054	6.60	2.108	12.60	9.486	18.60	2.108
.80	1.054	6.80	2.108	12.80	8.959	18.80	1.581
1.00	1.054	7.00	2.108	13.00	6.324	19.00	1.581
1.20	1.054	7.20	2.108	13.20	5.270	19.20	2.108
1.40	1.054	7.40	2.108	13.40	5.270	19.40	1.581
1.60	1.054	7.60	2.108	13.60	5.270	19.60	2.108
1.80	1.054	7.80	2.108	13.80	5.270	19.80	1.581
2.00	1.054	8.00	2.108	14.00	5.270	20.00	2.108
2.20	1.054	8.20	3.162	14.20	3.162	20.20	1.581
2.40	1.054	8.40	3.162	14.40	3.162	20.40	1.581
2.60	1.054	8.60	3.162	14.60	3.162	20.60	1.054
2.80	1.054	8.80	3.162	14.80	3.162	20.80	1.581
3.00	1.054	9.00	3.162	15.00	3.162	21.00	1.581
3.20	1.054	9.20	3.162	15.20	2.635	21.20	1.054
3.40	1.054	9.40	3.162	15.40	2.635	21.40	1.581
3.60	1.054	9.60	3.162	15.60	2.635	21.60	1.054
3.80	1.054	9.80	3.162	15.80	2.635	21.80	1.581
4.00	1.054	10.00	3.162	16.00	2.635	22.00	1.054
4.20	2.108	10.20	5.797	16.20	2.635	22.20	1.054
4.40	2.108	10.40	5.797	16.40	2.635	22.40	1.581
4.60	2.108	10.60	5.797	16.60	2.635	22.60	1.054
4.80	2.108	10.80	5.797	16.80	2.635	22.80	1.581
5.00	2.108	11.00	5.797	17.00	1.581	23.00	1.054
5.20	2.108	11.20	7.905	17.20	1.581	23.20	1.054
5.40	2.108	11.40	11.594	17.40	2.108	23.40	1.054
5.60	2.108	11.60	27.931	17.60	1.581	23.60	1.581
5.80	2.108	11.80	57.970	17.80	2.108	23.80	1.054
6.00	2.108	12.00	118.575	18.00	1.581	24.00	1.054

006:0003-----

* Total Drainage Area

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| CALIB STANDHYD      | Area (ha)= 4.83
| 01:TOTAL DT= 2.00  | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00
-----
                IMPERVIOUS    PERVIOUS (i)
Surface Area (ha)= 3.33      1.50
Dep. Storage (mm)= 2.00     5.00
Average Slope (%)= .40      7.00
Length (m)= 230.00        30.00
Mannings n = .013         .250

Max.eff.Inten.(mm/hr)= 118.58    36.03
over (min) = 6.00         12.00
Storage Coeff. (min)= 5.18 (ii) 11.31 (ii)
Unit Hyd. Tpeak (min)= 6.00     12.00
Unit Hyd. peak (cms)= .21       .10

PEAK FLOW (cms)= 1.00         .10
TIME TO PEAK (hrs)= 12.00     12.10
RUNOFF VOLUME (mm)= 103.40    27.63
TOTAL RAINFALL (mm)= 105.40   105.400
RUNOFF COEFFICIENT = .98      .26

*TOTALS*
PEAK FLOW (cms)= 1.00         .1084 (iii)
TIME TO PEAK (hrs)= 12.00     12.000
RUNOFF VOLUME (mm)= 103.40    79.913
TOTAL RAINFALL (mm)= 105.40   105.400
RUNOFF COEFFICIENT = .98      .758
    
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- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

006:0004-----
* Depressed Storage Area (Basin)

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| ROUTE RESERVOIR    | Requested routing time step = 2.0 min.
| IN>01:(TOTAL )    |
| OUT<02:(Basin )   |
-----
                ===== OUTFLOW STORAGE TABLE =====
                OUTFLOW STORAGE | OUTFLOW STORAGE
                (cms) (ha.m.) | (cms) (ha.m.)
                .000 .0000E+00 | .041 .1274E+00
                .013 .1350E-01 | .072 .1485E+00
                .015 .2780E-01 | .116 .1708E+00
                .017 .4300E-01 | .133 .1864E+00
                .019 .5920E-01 | .147 .2025E+00
                .020 .7640E-01 | .198 .2277E+00
                .021 .8840E-01 | .364 .2542E+00
                .026 .1074E+00 | .697 .2821E+00
    
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ROUTING RESULTS          AREA    QPEAK    TPEAK    R.V.
-----
| INFLOW >01: (TOTAL ) | (ha) (cms) (hrs) (mm)
| OUTFLOW<02: (Basin ) | 4.83 1.084 12.000 79.913
|                       | 4.83 .146 12.500 79.913

PEAK FLOW REDUCTION [Qout/Qin](%)= 13.495
    
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TIME SHIFT OF PEAK FLOW (min)= 30.00
MAXIMUM STORAGE USED (ha.m.)=.2017E+00

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006:0005-----
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006:0002-----
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006:0002-----
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006:0002-----
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006:0002-----
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006:0002-----
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** END OF RUN : 6
    
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| START | Project dir.: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\
-----
-----
Rainfall dir.: C:\USERS\JLIGHT-1\TEMP_S-1\SCS\24HR\
    
```

```

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 007
NSTORM= 1
# 1=100SCS24.stm
    
```

```

007:0002-----
*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720
*****
* Post-Development Condition - Greely Commercial Center
*
    
```

```

-----
007:0002-----
| READ STORM | Filename: 100-Year SCS Type-II Storm Distribution
| Ptotal= 116.50 mm | Comments: 100-Year SCS Type-II Storm Distribution
-----
    
```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.20	1.165	6.20	2.330	12.20	23.300	18.20	1.748

.40	1.165	6.40	2.330	12.40	14.563	18.40	1.747
.60	1.165	6.60	2.330	12.60	10.485	18.60	2.330
.80	1.165	6.80	2.330	12.80	9.903	18.80	1.748
1.00	1.165	7.00	2.330	13.00	6.990	19.00	1.748
1.20	1.165	7.20	2.330	13.20	5.825	19.20	2.330
1.40	1.165	7.40	2.330	13.40	5.825	19.40	1.748
1.60	1.165	7.60	2.330	13.60	5.825	19.60	2.330
1.80	1.165	7.80	2.330	13.80	5.825	19.80	1.748
2.00	1.165	8.00	2.330	14.00	5.825	20.00	2.330
2.20	1.165	8.20	3.495	14.20	3.495	20.20	1.748
2.40	1.165	8.40	3.495	14.40	3.495	20.40	1.748
2.60	1.165	8.60	3.495	14.60	3.495	20.60	1.165
2.80	1.165	8.80	3.495	14.80	3.495	20.80	1.748
3.00	1.165	9.00	3.495	15.00	3.495	21.00	1.747
3.20	1.165	9.20	3.495	15.20	2.912	21.20	1.165
3.40	1.165	9.40	3.495	15.40	2.912	21.40	1.748
3.60	1.165	9.60	3.495	15.60	2.912	21.60	1.165
3.80	1.165	9.80	3.495	15.80	2.912	21.80	1.748
4.00	1.165	10.00	3.495	16.00	2.912	22.00	1.165
4.20	2.330	10.20	6.407	16.20	2.913	22.20	1.165
4.40	2.330	10.40	6.408	16.40	2.912	22.40	1.748
4.60	2.330	10.60	6.407	16.60	2.912	22.60	1.165
4.80	2.330	10.80	6.408	16.80	2.912	22.80	1.747
5.00	2.330	11.00	6.407	17.00	1.747	23.00	1.165
5.20	2.330	11.20	8.738	17.20	1.748	23.20	1.165
5.40	2.330	11.40	12.815	17.40	2.330	23.40	1.165
5.60	2.330	11.60	30.872	17.60	1.748	23.60	1.748
5.80	2.330	11.80	64.075	17.80	2.330	23.80	1.165
6.00	2.330	12.00	131.063	18.00	1.748	24.00	1.165

007:0003-----
* Total Drainage Area

CALIB STANDHYD	Area (ha)=	4.83		
01:TOTAL DT= 2.00	Total Imp(%)=	69.00	Dir. Conn.(%)=	69.00
	IMPERVIOUS	PERVIOUS (i)		
Surface Area (ha)=	3.33	1.50		
Dep. Storage (mm)=	2.00	5.00		
Average Slope (%)=	.40	7.00		
Length (m)=	230.00	30.00		
Mannings n =	.013	.250		
Max.eff.Inten.(mm/hr)=	131.06	44.42		
over (min)	4.00	10.00		
Storage Coeff. (min)=	4.97 (ii)	10.62 (ii)		
Unit Hyd. Tpeak (min)=	4.00	10.00		
Unit Hyd. peak (cms)=	.24	.11		
			TOTALS	
PEAK FLOW (cms)=	1.14	.12	1.249 (iii)	
TIME TO PEAK (hrs)=	12.00	12.07	12.000	
RUNOFF VOLUME (mm)=	114.50	33.08	89.259	
TOTAL RAINFALL (mm)=	116.50	116.50	116.501	

RUNOFF COEFFICIENT = .98 .28 .766

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

007:0004-----
* Depressed Storage Area (Basin)

ROUTE RESERVOIR	Requested routing time step = 2.0 min.			
IN>01:(TOTAL)				
OUT<02:(Basin)	=====	OUTFLOW STORAGE TABLE	=====	
	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	.000	.0000E+00	.041	.1274E+00
	.013	.1350E-01	.072	.1485E+00
	.015	.2780E-01	.116	.1708E+00
	.017	.4300E-01	.133	.1864E+00
	.019	.5920E-01	.147	.2025E+00
	.020	.7640E-01	.198	.2277E+00
	.021	.8840E-01	.364	.2542E+00
	.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	1.249	12.000	89.259
OUTFLOW<02: (Basin)	4.83	.189	12.433	89.259

PEAK FLOW REDUCTION [Qout/Qin](%)= 15.133
TIME SHIFT OF PEAK FLOW (min)= 26.00
MAXIMUM STORAGE USED (ha.m.)=.2233E+00

007:0005-----
007:0002-----
007:0002-----
007:0002-----
007:0002-----
007:0002-----
007:0002-----
007:0002-----
007:0002-----
007:0002-----
007:0002-----
FINISH

WARNINGS / ERRORS / NOTES

**Post-Development Condition
3-hour Chicago Storm Distribution**

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\PR\CHI-\3hr-\2-CYRCHI.dat

```
2 Metric units
*****
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720
*****
* Post-Development Condition - Greely Commercial Center
*
*% 25mm Chicago Storm Distribution based on Ottawa, ON. rainfall (3-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[1]
*% ["25mm3hr.stm"] <--storm filename
*-----|-----
*%-----|-----
READ STORM STORM_FILENAME=["STORM.001"]
*-----|-----
* Total Drainage Area
CALIB STANDHYD ID=[1], NHYD=["TOTAL"], DT=[2](min), AREA=[4.83](ha),
XIMP=[0.69], TIMP=[0.69], DWF=[0](cms), LOSS=[2],
SCS curve number CN=[49],
Pervious surfaces: IApr=[5.0](mm), SLPP=[7.0](%),
LGP=[30](m), MNP=[0.25], SCP=[0](min),
Impervious surfaces: IAimp=[2.0](mm), SLPI=[0.4](%),
LGI=[230](m), MNI=[0.013], SCI=[0](min),
RAINFALL=[ , , , ](mm/hr), END=-1
*-----|-----
* Depressed Storage Area (Basin)
ROUTE RESERVOIR IDout=[2], NHYD=["Basin"], IDin=[1],
RDT=[2](min),
TABLE of ( OUTFLOW-STORAGE ) values
(cms) - (ha-m)
[ 0.000 , 0.0000 ]
[ 0.013 , 0.0135 ]
[ 0.015 , 0.0278 ]
[ 0.017 , 0.0430 ]
[ 0.019 , 0.0592 ]
[ 0.020 , 0.0764 ]
[ 0.021 , 0.0884 ]
[ 0.026 , 0.1074 ]
[ 0.041 , 0.1274 ]
[ 0.072 , 0.1485 ]
[ 0.116 , 0.1708 ]
[ 0.133 , 0.1864 ]
[ 0.147 , 0.2025 ]
[ 0.198 , 0.2277 ]
[ 0.364 , 0.2542 ]
[ 0.697 , 0.2821 ]
[ -1 , -1 ] (max twenty pts)
IDovf=[ ], NHYDovf=[ ]
*-----|-----
*% 2-year Chicago Storm Distribution based on Ottawa, ON. rainfall (3-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[2]
*% ["2CHI3.stm"] <--storm filename
```

2/6/2014 2:41:49 PM

1/3

\\Wmi-server\wmi-server\Data\Projects\2011\11-183\SWMHYMO\Issue_1\PR\CHI-\3hr-\2-CYRCHI.dat

```
*-----|-----
*% 5-year Chicago Storm Distribution based on Owen Sound, ON. rainfall (3-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[3]
*% ["5CHI3.stm"] <--storm filename
*-----|-----
*% 10-year Chicago Storm Distribution based on Owen Sound, ON. rainfall (3-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[4]
*% ["10CHI3.stm"] <--storm filename
*-----|-----
*% 25-year Chicago Storm Distribution based on Owen Sound, ON. rainfall (3-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[5]
*% ["25CHI3.stm"] <--storm filename
*-----|-----
*% 50-year Chicago Storm Distribution based on Owen Sound, ON. rainfall (3-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[6]
*% ["50CHI3.stm"] <--storm filename
*-----|-----
*% 100-year Chicago Storm Distribution based on Owen Sound, ON. rainfall (3-hr)
START TZERO=[0.0], METOUT=[2], NSTORM=[1], NRUN=[7]
*% ["100CHI3.stm"] <--storm filename
*-----|-----
FINISH
```

2/6/2014 2:41:49 PM

2/3

```

=====
SSSSS W W M M H H Y Y M M OOO 999 999 =====
S W W W MM MM H H Y Y MM MM O O 9 9 9 9
SSSSS W W W M M M H H H H Y M M M O O ## 9 9 9 9 Ver 4.05
S W W M M H H Y M M O O 9999 9999 Sept 2011
SSSSS W W M M H H Y M M OOO 9 9
StormWater Management HYdrologic Model 9 9 9 9 # 2880720
=====

***** SWMHYMO Ver/4.05 *****
***** A single event and continuous hydrologic simulation model *****
***** based on the principles of HYMO and its successors *****
***** OTTHYMO-83 and OTTHYMO-89. *****
***** Distributed by: J.F. Sabourin and Associates Inc. *****
***** Ottawa, Ontario: (613) 836-3884 *****
***** Gatineau, Quebec: (819) 243-6858 *****
***** E-Mail: swmhymo@jfsa.Com *****

++++++ Licensed user: WMI & Associates Ltd. ++++++
++++++ Barrie SERIAL#:2880720 ++++++

*****
+++++ PROGRAM ARRAY DIMENSIONS +++++
*****
Maximum value for ID numbers : 10
*****
Max. number of rainfall points: 105408
*****
Max. number of flow points : 105408
*****

***** D E T A I L E D O U T P U T *****
*****
***** DATE: 2013-12-13 TIME: 16:41:14 RUN COUNTER: 000567 *****
* Input filename: C:\Users\JLIGHT-1\TEMP_S-1\3hr\2-CYRCHI.dat *
* Output filename: C:\Users\JLIGHT-1\TEMP_S-1\3hr\2-CYRCHI.out *
* Summary filename: C:\Users\JLIGHT-1\TEMP_S-1\3hr\2-CYRCHI.sum *
* User comments: *
* 1: *
* 2: *
* 3: *
*****

001:0001-----
*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lightheart]

```

```

*# Company : WMI & Associates Ltd.
*# License # : 2880720
*#*****
*
* Post-Development Condition - Greely Commercial Center
*
-----
| START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\3hr\
-----
Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\3hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 001
NSTORM= 1
# 1=25mm3hr.stm

-----
001:0002-----
| READ STORM | Filename: 25mm Chicago Storm Distribution (3-hour)
| Ptotal= 24.99 mm | Comments: 25mm Chicago Storm Distribution (3-hour)
-----

TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
.17 2.700 | 1.00 62.660 | 1.83 4.340 | 2.67 2.600
.33 3.220 | 1.17 14.960 | 2.00 3.790 | 2.83 2.420
.50 4.060 | 1.33 8.660 | 2.17 3.380 | 3.00 2.270
.67 5.740 | 1.50 6.370 | 2.33 3.060 |
.83 11.800 | 1.67 5.130 | 2.50 2.810 |

-----
001:0003-----
* Total Drainage Area
-----
| CALIB STANDHYD | Area (ha)= 4.83
| 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00
-----

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 3.33 1.50
Dep. Storage (mm)= 2.00 5.00
Average Slope (%)= .40 7.00
Length (m)= 230.00 30.00
Mannings n = .013 .250

Max.eff.Inten.(mm/hr)= 62.66 1.48
over (min) 6.00 28.00
Storage Coeff. (min)= 6.68 (ii) 28.69 (ii)
Unit Hyd. Tpeak (min)= 6.00 28.00
Unit Hyd. peak (cms)= .17 .04

*TOTALS*
PEAK FLOW (cms)= .43 .00 .433 (iii)
TIME TO PEAK (hrs)= 1.03 1.57 1.033
RUNOFF VOLUME (mm)= 22.99 1.41 16.302
TOTAL RAINFALL (mm)= 24.99 24.99 24.995

```

RUNOFF COEFFICIENT = .92 .06 .652

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

001:0004-----
 * Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

ROUTE RESERVOIR	Requested routing time step = 2.0 min.	===== OUTFLOW STORAGE TABLE =====			
IN>01:(TOTAL)		OUTFLOW	STORAGE	OUTFLOW	STORAGE
OUT<02:(Basin)		(cms)	(ha.m.)	(cms)	(ha.m.)
		.000	.0000E+00	.041	.1274E+00
		.013	.1350E-01	.072	.1485E+00
		.015	.2780E-01	.116	.1708E+00
		.017	.4300E-01	.133	.1864E+00
		.019	.5920E-01	.147	.2025E+00
		.020	.7640E-01	.198	.2277E+00
		.021	.8840E-01	.364	.2542E+00
		.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	.433	1.033	16.302
OUTFLOW <02: (Basin)	4.83	.019	3.067	16.302

PEAK FLOW REDUCTION [Qout/Qin](%)= 4.441
 TIME SHIFT OF PEAK FLOW (min)= 122.00
 MAXIMUM STORAGE USED (ha.m.)=.6336E-01

001:0005-----
 ** END OF RUN : 1

 | START | Project dir.: C:\Users\JLIGHT~1\TEMP_S~1\3hr\

 Rainfall dir.: C:\Users\JLIGHT~1\TEMP_S~1\3hr\

TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 002
 NSTORM= 1

1=2CHI3.stm

002:0002-----
 * Project Name: [Greely Commercial Center] Project Number: [11-183]
 * Date : 11-13-2013
 * Modeller : [J. Lightheart]
 * Company : WMI & Associates Ltd.
 * License # : 2880720
 *
 * Post-Development Condition - Greely Commercial Center
 *

002:0002-----
 | READ STORM | Filename: 2-Year Chicago Storm Distribution (3-hou
 | Ptotal= 30.74 mm | Comments: 2-Year Chicago Storm Distribution (3-hou

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	3.321	1.00	77.041	1.83	5.341	2.67	3.195
.33	3.960	1.17	18.393	2.00	4.664	2.83	2.978
.50	4.997	1.33	10.654	2.17	4.160	3.00	2.793
.67	7.063	1.50	7.830	2.33	3.768		
.83	14.515	1.67	6.309	2.50	3.454		

002:0003-----
 * Total Drainage Area
 | CALIB STANDHYD | Area (ha)= 4.83
 | 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)= 3.33	1.50
Dep. Storage	(mm)= 2.00	5.00
Average Slope	(%)= .40	7.00
Length	(m)= 230.00	30.00
Mannings n	= .013	.250
Max. eff. Inten. (mm/hr)=	77.04	2.65
over (min)	6.00	24.00
Storage Coeff. (min)=	6.15 (ii)	23.57 (ii)
Unit Hyd. Tpeak (min)=	6.00	24.00
Unit Hyd. peak (cms)=	.18	.05

PEAK FLOW (cms)= .55 .01 *TOTALS*
 TIME TO PEAK (hrs)= 1.03 1.40 1.033
 RUNOFF VOLUME (mm)= 28.74 2.28 20.538
 TOTAL RAINFALL (mm)= 30.74 30.74 30.739
 RUNOFF COEFFICIENT = .93 .07 .668

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 49.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

002:0004-----
* Depressed Storage Area (Basin)

Table with columns: ROUTE RESERVOIR, Requested routing time step = 2.0 min., OUTFLOW STORAGE TABLE. Includes rows for IN>01:(TOTAL) and OUT<02:(Basin).

ROUTING RESULTS table with columns: AREA, QPEAK, TPEAK, R.V. Includes rows for INFLOW >01: (TOTAL) and OUTFLOW<02: (Basin).

PEAK FLOW REDUCTION [Qout/Qin](%)= 3.740
TIME SHIFT OF PEAK FLOW (min)= 122.00
MAXIMUM STORAGE USED (ha.m.)=.8253E-01

002:0005-----

002:0002-----

** END OF RUN : 2

START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\3hr\

----- Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\3hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 003
NSTORM= 1
1=5CHI3.stm

003:0002-----

Project Name: [Greely Commercial Center] Project Number: [11-183]
Date : 11-13-2013
Modeller : [J. Lighthouse]
Company : WMI & Associates Ltd.
License # : 2880720
* Post-Development Condition - Greely Commercial Center

003:0002-----

READ STORM | Filename: 5-Year Chicago Storm Distribution (3-hou
Ptotal= 41.52 mm | Comments: 5-Year Chicago Storm Distribution (3-hou

Table with columns: TIME, RAIN, TIME, RAIN, TIME, RAIN, TIME, RAIN. Includes rows for various time intervals and rainfall amounts.

003:0003-----

* Total Drainage Area

CALIB STANDHYD | Area (ha)= 4.83
01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= 3.33 1.50
Dep. Storage (mm)= 2.00 5.00
Average Slope (%)= .40 7.00
Length (m)= 230.00 30.00
Mannings n = .013 .250

Max.eff.Inten.(mm/hr)= 101.80 6.12
over (min) 6.00 18.00
Storage Coeff. (min)= 5.50 (ii) 17.97 (ii)
Unit Hyd. Tpeak (min)= 6.00 18.00
Unit Hyd. peak (cms)= .20 .06

TOTALS
PEAK FLOW (cms)= .75 .01 .753 (iii)
TIME TO PEAK (hrs)= 1.03 1.27 1.033
RUNOFF VOLUME (mm)= 39.52 4.43 28.644
TOTAL RAINFALL (mm)= 41.52 41.52 41.522
RUNOFF COEFFICIENT = .95 .11 .690

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)

- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

003:0004-----
 * Depressed Storage Area (Basin)

ROUTE RESERVOIR	Requested routing time step = 2.0 min.			
IN>01:(TOTAL)	=====	OUTFLOW STORAGE TABLE	=====	
OUT<02:(Basin)	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	.000	.0000E+00	.041	.1274E+00
	.013	.1350E-01	.072	.1485E+00
	.015	.2780E-01	.116	.1708E+00
	.017	.4300E-01	.133	.1864E+00
	.019	.5920E-01	.147	.2025E+00
	.020	.7640E-01	.198	.2277E+00
	.021	.8840E-01	.364	.2542E+00
	.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	.753	1.033	28.644
OUTFLOW<02: (Basin)	4.83	.032	3.067	28.644

PEAK FLOW REDUCTION [Qout/Qin](%)= 4.294
 TIME SHIFT OF PEAK FLOW (min)= 122.00
 MAXIMUM STORAGE USED (ha.m.)=.1158E+00

003:0005-----

003:0002-----

003:0002-----

** END OF RUN : 3

 | START | Project dir.: C:\Users\JLIGHT~1\TEMP_S~1\3hr\

Rainfall dir.: C:\Users\JLIGHT~1\TEMP_S~1\3hr\

TZERO = .00 hrs on 0
 METOUT= 2 (output = METRIC)
 NRUN = 004
 NSTORM= 1

1=10CHI3.stm

004:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
 *# Date : 11-13-2013
 *# Modeller : [J. Lighthearth]
 *# Company : WMI & Associates Ltd.
 *# License # : 2880720

* Post-Development Condition - Greely Commercial Center

004:0002-----

READ STORM	Filename: 10-Year Chicago Storm Distribution (3-ho
Ptotal= 48.94 mm	Comments: 10-Year Chicago Storm Distribution (3-ho

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	5.500	1.00	118.657	1.83	8.768	2.67	5.295
.33	6.537	1.17	29.410	2.00	7.676	2.83	4.942
.50	8.214	1.33	17.250	2.17	6.861	3.00	4.640
.67	11.531	1.50	12.759	2.33	6.226		
.83	23.317	1.67	10.324	2.50	5.716		

004:0003-----

* Total Drainage Area

CALIB STANDHYD	Area (ha)= 4.83
01:TOTAL DT= 2.00	Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250

Max.eff.Inten.(mm/hr)= 118.66 9.07
 over (min) 6.00 16.00
 Storage Coeff. (min)= 5.18 (ii) 15.83 (ii)
 Unit Hyd. Tpeak (min)= 6.00 16.00
 Unit Hyd. peak (cms)= .21 .07

TOTALS
 PEAK FLOW (cms)= .89 .02 .896 (iii)
 TIME TO PEAK (hrs)= 1.03 1.23 1.033
 RUNOFF VOLUME (mm)= 46.94 6.26 34.328
 TOTAL RAINFALL (mm)= 48.94 48.94 48.937
 RUNOFF COEFFICIENT = .96 .13 .701

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 49.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
 THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

004:0004-----
 * Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

ROUTE RESERVOIR		===== OUTFLOW STORAGE TABLE =====			
IN>01:(TOTAL)	OUT<02:(Basin)	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
		.000	.0000E+00	.041	.1274E+00
		.013	.1350E-01	.072	.1485E+00
		.015	.2780E-01	.116	.1708E+00
		.017	.4300E-01	.133	.1864E+00
		.019	.5920E-01	.147	.2025E+00
		.020	.7640E-01	.198	.2277E+00
		.021	.8840E-01	.364	.2542E+00
		.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)
INFLOW >01: (TOTAL)	4.83	.896	1.033	34.328
OUTFLOW<02: (Basin)	4.83	.050	2.967	34.328

PEAK FLOW REDUCTION [Qout/Qin](%)= 5.552
 TIME SHIFT OF PEAK FLOW (min)= 116.00
 MAXIMUM STORAGE USED (ha.m.)=.1334E+00

004:0005-----

004:0002-----

004:0002-----

004:0002-----

** END OF RUN : 4

| START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\3hr\

----- Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\3hr\

TZERO = .00 hrs on 0

METOUT= 2 (output = METRIC)
 NRUN = 005
 NSTORM= 1
 # 1=25CHI3.stm

005:0002-----

 * Project Name: [Greely Commercial Center] Project Number: [11-183]
 * Date : 11-13-2013
 * Modeller : [J. Lightheart]
 * Company : WMI & Associates Ltd.
 * License # : 2880720

* Post-Development Condition - Greely Commercial Center

005:0002-----

| READ STORM | Filename: 25-Year Chicago Storm Distribution (3-ho
 | Ptotal= 58.05 mm | Comments: 25-Year Chicago Storm Distribution (3-ho

TIME (hrs)	RAIN (mm/hr)	TIME (hrs)	RAIN (mm/hr)	TIME (hrs)	RAIN (mm/hr)	TIME (hrs)	RAIN (mm/hr)
.17	6.587	1.00	139.602	1.83	10.479	2.67	6.343
.33	7.823	1.17	34.921	2.00	9.179	2.83	5.922
.50	9.820	1.33	20.546	2.17	8.209	3.00	5.562
.67	13.762	1.50	15.221	2.33	7.453		
.83	27.718	1.67	12.329	2.50	6.845		

005:0003-----

* Total Drainage Area

| CALIB STANDHYD | Area (ha)= 4.83
 | 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250

Max.eff.Inten.(mm/hr)=	139.60	13.85
over (min)	4.00	14.00
Storage Coeff. (min)=	4.85 (ii)	13.84 (ii)
Unit Hyd. Tpeak (min)=	4.00	14.00
Unit Hyd. peak (cms)=	.25	.08

		TOTALS
PEAK FLOW (cms)=	1.12	.04
TIME TO PEAK (hrs)=	1.00	1.20
1.000		
RUNOFF VOLUME (mm)=	56.05	8.87
41.426		
TOTAL RAINFALL (mm)=	58.05	58.05
58.054		

RUNOFF COEFFICIENT = .97 .15 .714

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

005:0004-----
* Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

ROUTE RESERVOIR	Requested routing time step = 2.0 min.			
IN>01:(TOTAL)	===== OUTFLOW STORAGE TABLE =====			
OUT<02:(Basin)	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	.000	.0000E+00	.041	.1274E+00
	.013	.1350E-01	.072	.1485E+00
	.015	.2780E-01	.116	.1708E+00
	.017	.4300E-01	.133	.1864E+00
	.019	.5920E-01	.147	.2025E+00
	.020	.7640E-01	.198	.2277E+00
	.021	.8840E-01	.364	.2542E+00
	.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	1.133	1.000	41.426
OUTFLOW <02: (Basin)	4.83	.077	2.400	41.426

PEAK FLOW REDUCTION [Qout/Qin](%)= 6.799
 TIME SHIFT OF PEAK FLOW (min)= 84.00
 MAXIMUM STORAGE USED (ha.m.)=.1510E+00

005:0005-----

005:0002-----

005:0002-----

005:0002-----

005:0002-----

** END OF RUN : 5

| START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\3hr\

----- Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\3hr\

TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 006
NSTORM= 1
1=50CHI3.stm

006:0002-----

*# Project Name: [Greely Commercial Center] Project Number: [11-183]
*# Date : 11-13-2013
*# Modeller : [J. Lighthart]
*# Company : WMI & Associates Ltd.
*# License # : 2880720

* Post-Development Condition - Greely Commercial Center

006:0002-----

| READ STORM | Filename: 50-Year Chicago Storm Distribution (3-ho
| Ptotal= 64.85 mm | Comments: 50-Year Chicago Storm Distribution (3-ho

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	7.406	1.00	155.099	1.83	11.764	2.67	7.132
.33	8.791	1.17	39.035	2.00	10.309	2.83	6.660
.50	11.026	1.33	23.013	2.17	9.223	3.00	6.256
.67	15.436	1.50	17.066	2.33	8.376		
.83	31.007	1.67	13.834	2.50	7.694		

006:0003-----

* Total Drainage Area

| CALIB STANDHYD | Area (ha)= 4.83
| 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00
Mannings n =	.013	.250

Max.eff.Inten.(mm/hr)=	155.10	18.86
over (min)	4.00	12.00
Storage Coeff. (min)=	4.65 (ii)	12.60 (ii)
Unit Hyd. Tpeak (min)=	4.00	12.00
Unit Hyd. peak (cms)=	.25	.09

```

*TOTALS*
PEAK FLOW      (cms)=      1.26      .05      1.280 (iii)
TIME TO PEAK   (hrs)=      1.00      1.17      1.000
RUNOFF VOLUME  (mm)=      62.85     11.05     46.795
TOTAL RAINFALL (mm)=      64.85     64.85     64.854
RUNOFF COEFFICIENT =      .97      .17      .722

```

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

006:0004-----
* Depressed Storage Area (Basin)

Requested routing time step = 2.0 min.

ROUTE RESERVOIR	Requested routing time step = 2.0 min.			
IN>01:(TOTAL)	===== OUTFLOW STORAGE TABLE =====			
OUT<02:(Basin)	OUTFLOW	STORAGE	OUTFLOW	STORAGE
	(cms)	(ha.m.)	(cms)	(ha.m.)
	.000	.0000E+00	.041	.1274E+00
	.013	.1350E-01	.072	.1485E+00
	.015	.2780E-01	.116	.1708E+00
	.017	.4300E-01	.133	.1864E+00
	.019	.5920E-01	.147	.2025E+00
	.020	.7640E-01	.198	.2277E+00
	.021	.8840E-01	.364	.2542E+00
	.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	1.280	1.000	46.795
OUTFLOW <02: (Basin)	4.83	.102	2.167	46.795

PEAK FLOW REDUCTION [Qout/Qin](%)= 7.951
 TIME SHIFT OF PEAK FLOW (min)= 70.00
 MAXIMUM STORAGE USED (ha.m.)=.1636E+00

006:0005-----
 006:0002-----
 006:0002-----
 006:0002-----
 006:0002-----
 006:0002-----
 ** END OF RUN : 6

```

-----
| START | Project dir.: C:\Users\JLIGHT-1\TEMP_S-1\3hr\
-----
| Rainfall dir.: C:\Users\JLIGHT-1\TEMP_S-1\3hr\
-----
TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 007
NSTORM= 1
# 1=100CHI3.stm
-----

```

007:0002-----

 *# Project Name: [Greely Commercial Center] Project Number: [11-183]
 *# Date : 11-13-2013
 *# Modeller : [J. Lighthouse]
 *# Company : WMI & Associates Ltd.
 *# License # : 2880720

 * Post-Development Condition - Greely Commercial Center
 *

007:0002-----
 | READ STORM | Filename: 100-Year Chicago Storm Distribution (3-h
 | Ptotal= 71.92 mm | Comments: 100-Year Chicago Storm Distribution (3-h

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	8.291	1.00	170.585	1.83	13.142	2.67	7.986
.33	9.833	1.17	43.325	2.00	11.524	2.83	7.459
.50	12.321	1.33	25.620	2.17	10.314	3.00	7.009
.67	17.220	1.50	19.029	2.33	9.371		
.83	34.453	1.67	15.441	2.50	8.612		

007:0003-----
 * Total Drainage Area
 | CALIB STANDHYD | Area (ha)= 4.83
 | 01:TOTAL DT= 2.00 | Total Imp(%)= 69.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.33	1.50
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	.40	7.00
Length (m)=	230.00	30.00

```

Mannings n      =      .013      .250

Max.eff.Inten.(mm/hr)=    170.59      23.16
  over (min)      =      4.00      12.00
Storage Coeff. (min)=    4.48 (ii)  11.80 (ii)
Unit Hyd. Tpeak (min)=    4.00      12.00
Unit Hyd. peak (cms)=    .26        .10

PEAK FLOW (cms)=      1.40      .06      1.426 (iii)
TIME TO PEAK (hrs)=    1.00      1.17      1.000
RUNOFF VOLUME (mm)=    69.92      13.52      52.437
TOTAL RAINFALL (mm)=    71.92      71.92      71.923
RUNOFF COEFFICIENT =    .97        .19        .729
    
```

TOTALS

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 49.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

007:0004-----
* Depressed Storage Area (Basin)

ROUTE RESERVOIR		Requested routing time step = 2.0 min.			
IN>01:(TOTAL)		===== OUTFLOW STORAGE TABLE =====			
OUT<02:(Basin)		OUTFLOW	STORAGE	OUTFLOW	STORAGE
		(cms)	(ha.m.)	(cms)	(ha.m.)
		.000	.0000E+00	.041	.1274E+00
		.013	.1350E-01	.072	.1485E+00
		.015	.2780E-01	.116	.1708E+00
		.017	.4300E-01	.133	.1864E+00
		.019	.5920E-01	.147	.2025E+00
		.020	.7640E-01	.198	.2277E+00
		.021	.8840E-01	.364	.2542E+00
		.026	.1074E+00	.697	.2821E+00

ROUTING RESULTS	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW >01: (TOTAL)	4.83	1.426	1.000	52.437
OUTFLOW <02: (Basin)	4.83	.123	2.033	52.437

PEAK FLOW REDUCTION [Qout/Qin](%)= 8.652
 TIME SHIFT OF PEAK FLOW (min)= 62.00
 MAXIMUM STORAGE USED (ha.m.)=.1776E+00

007:0005-----
 007:0002-----
 007:0002-----

```

007:0002-----
007:0002-----
007:0002-----
007:0002-----
FINISH
*****
WARNINGS / ERRORS / NOTES
Simulation ended on 2013-12-13 at 16:41:14
=====
    
```

APPENDIX E

GEOTECHNICAL INVESTIGATION



Geotechnical Investigation



5640 Bank Street, 7107 Marco Street, and 7041 Mitch Owens Road, City of Ottawa, Ontario

Ref: BAE-1241.3

Prepared For

Alium Investments Ltd.

August 9th, 2013

BAE & Associates Environmental Inc.

RR#1 Oro Station, ON L0L 2E0

Phone 705 715 1881

Fax 705 487 5600

envsol@rogers.com

Providing Environmental Solutions Since 1997!



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 - 1.2 Scope of Services
 - 1.3 Authorisation
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 - 2.2 Site Description
- 3.0 INVESTIGATION AND TESTING
 - 3.1 Subsurface Investigation
 - 3.2 Laboratory Testing
- 4.0 SUBSURFACE CONDITIONS
 - 4.1 Stratigraphy
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- 5.0 RECOMMENDATIONS
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 - 5.10 Earthquake Conditions
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APPENDICES

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- Appendix B Project Photographs
- Appendix C Borehole Locations and Surface Elevations
- Appendix D Numbered Field Borehole Locations - Clay Delineation

**LIST OF ACRONYMS AND ABBREVIATIONS**

ACM	Asbestos Containing Materials
AEC	Area of Environmental Concern
a.k.a.	Also Known As
APEC	Area of Potential Environmental Concern
AST	Aboveground Storage Tank
BH	Borehole
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CCEA	Central Canada Exhibition Association
CFC	Chlorofluorocarbon
CNSC	Canadian Nuclear Safety Commission
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CSA	Canadian Standards Association
CSFL	Contaminated Site on Federal Land
CWAC	Canadian Women's Army Corporation
CWS	Canada Wide Standards
DSS	Designated Substance Survey
DSHMS	Designated Substance and Hazardous Materials Survey
ESA	Environmental Site Assessment
FIP	Fire Insurance Plan
FOI	Freedom of Information
HCFC	Hydro chlorofluorocarbon
HLUI	Historical Land Use Inventory
HVAC	Heating Ventilation and Air Conditioning
LCP	Lead-Containing Paint
masl	Metres Above Sea Level
mbgs	Metres Below Ground Surface
MOE	Ministry of the Environment
MOL	Ministry of Labour
MSDS	Material Safety Data Sheet
MW	Monitoring Well
ODS	Ozone Depleting Substance
OHSA	Occupational Health and Safety Act
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
PHC	Petroleum Hydrocarbon
RSC	Record of Site Condition
SAR	Sodium Absorption Ratio
SCS	Site Condition Standard
TPH	Total Petroleum Hydrocarbons
TSSA	Technical Standards and Safety Authority
UST	Underground Storage Tank
UFFI	Urea Formaldehyde Foam Insulation
VOC	Volatile Organic Compounds



1.0 INTRODUCTION

1.1 Purpose

This report presents the results of a Geotechnical Investigation prepared by BAE & Associates for the proposed commercial development at 5640 Bank Street, 7107 Marco Street, and 7041 Mitch Owens Road, City of Ottawa (Greely), for Alium Investments Inc. The purpose of the assessment was to further delineate the fill (clay) conditions at the Site and provide recommendations for the geotechnical aspects of the proposed construction.

1.2 Scope of Services

The scope of work included the following:

- Review of available data pertinent to the site.
- Conduct a subsurface investigation.
- Conduct basic laboratory testing of select soils.
- Perform a geotechnical analysis regarding the proposed construction, using the information obtained from the subsurface investigation and laboratory testing.
- Prepare this report of our findings, conclusions, and tentative recommendations for the geotechnical aspects of the proposed construction.

1.3 Authorisation

This assessment was performed and the report prepared in general accordance with and authorisation from Alium Investments Inc. to proceed with the work.

1.4 Standard of Care

The services performed by BAE were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the geotechnical profession practising contemporaneously under similar conditions in the locality of the project. No other warranty, expressed or implied, is made.



Limitations of this report are discussed in Appendix A. These limitations further explain the realities of geotechnical engineering and the limitations that exist in evaluating geotechnical issues.

This report has been prepared for the exclusive use of Alium Investments Inc. with specific application to the proposed project.

2.0 PROJECT and PROPERTY DESCRIPTION

2.1 Proposed Development

It is understood that the proposed development will consist of multiple commercial slab on grade structures. If the locations of the assumed loadings, proposed structures, floor elevations, or any other site features change BAE should be notified so that the changes can be reviewed to determine if the recommendations presented in this report are still applicable.

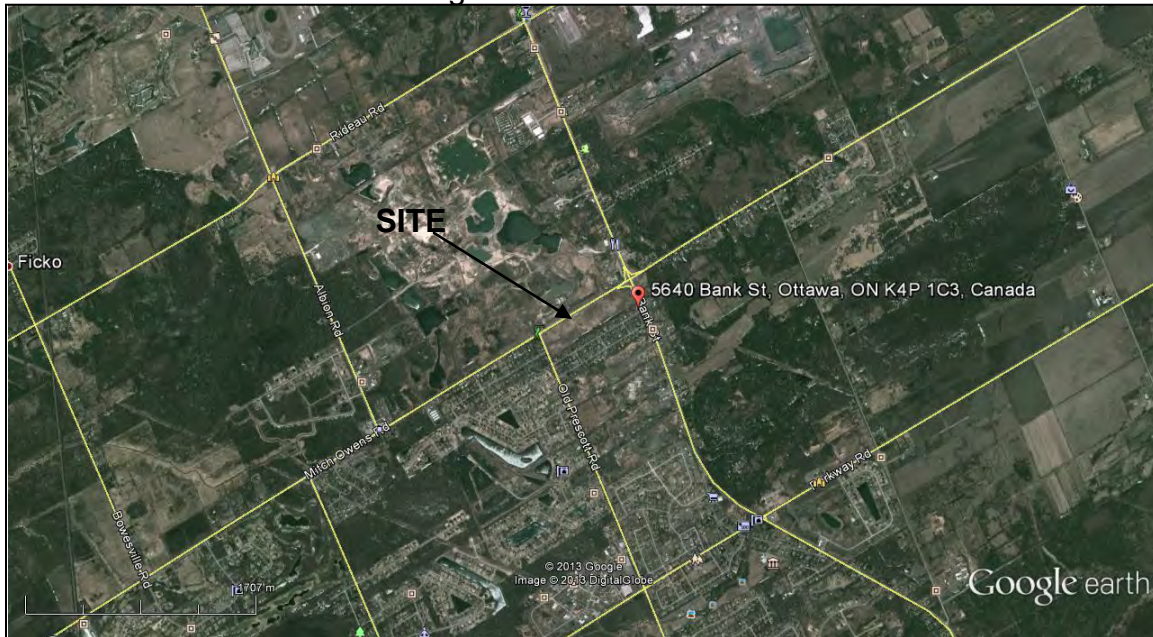
The legal description of the property is *Part of Lot 1, Concession 5, Geographic Township of Osgoode, City of Ottawa*. The Site encompasses three municipal addresses - 5640 Bank Street, 7107 Marco Street, and 7041 Mitch Owens Road.

The subject 13 hectare (32 acre) Site is located on an irregular parcel of land situated at the northern periphery of the Community of Greely, at the southwest corner of the intersection of Bank Street and Mitch Owens Road. The northern portion of the Site has an approximate frontage of 653m on the south side of Mitch Owens Road. The western portion of the Site has an approximate frontage of 200m on the east side of Old Prescott Road. The eastern portion of the Site has an approximate frontage of 150m on the west side of Bank Street. The southern portion of the Site has an approximate frontage of 35m on the north side of Marco Street and 720m backing onto the back of single family residential houses located along Marco Street.

The Site is currently vacant, and was previously utilized as a gravel pit (below water table in the central part of the site). It is understood that much of the gravel pit has been backfilled with a fill derived from pond excavations at a site near Airport Parkway and Hunt Club Road to the north. There are no significant environmental concerns from the current onsite operations. Figure 1 shows the Site location, Figure 2 shows the Site layout, Figure 3 is the Site Plan of Survey.



Figure 1: Site Location



2.2 Land Use

The Site is currently vacant, and was previously utilized as a gravel pit (below water table in the central part of the site). As part of this investigation, BAE reviewed city directories, available fire insurance maps and aerial photographs. The information gathered confirmed that the Site previously operated as an aggregate extraction operation (aggregate pit). Prior to this it was vacant land.

Information concerning the surrounding land use in the vicinity of the subject property was obtained from documented information as well as several site visits. Properties in close proximity to the site are predominantly used as residential and aggregate extraction. Lands to the south and west of the site are in residential use, lands to the north remain in aggregate extractive use, and lands to the east are undeveloped except for a school to the immediate northeast and some scattered commercial properties.

Visual observation of the adjacent properties, to the extent possible, did not reveal the presence of any structures, equipment or materials of concern. There was no evidence of staining, stressed vegetation, odours or environmental concerns currently associated with any of the neighbouring properties.

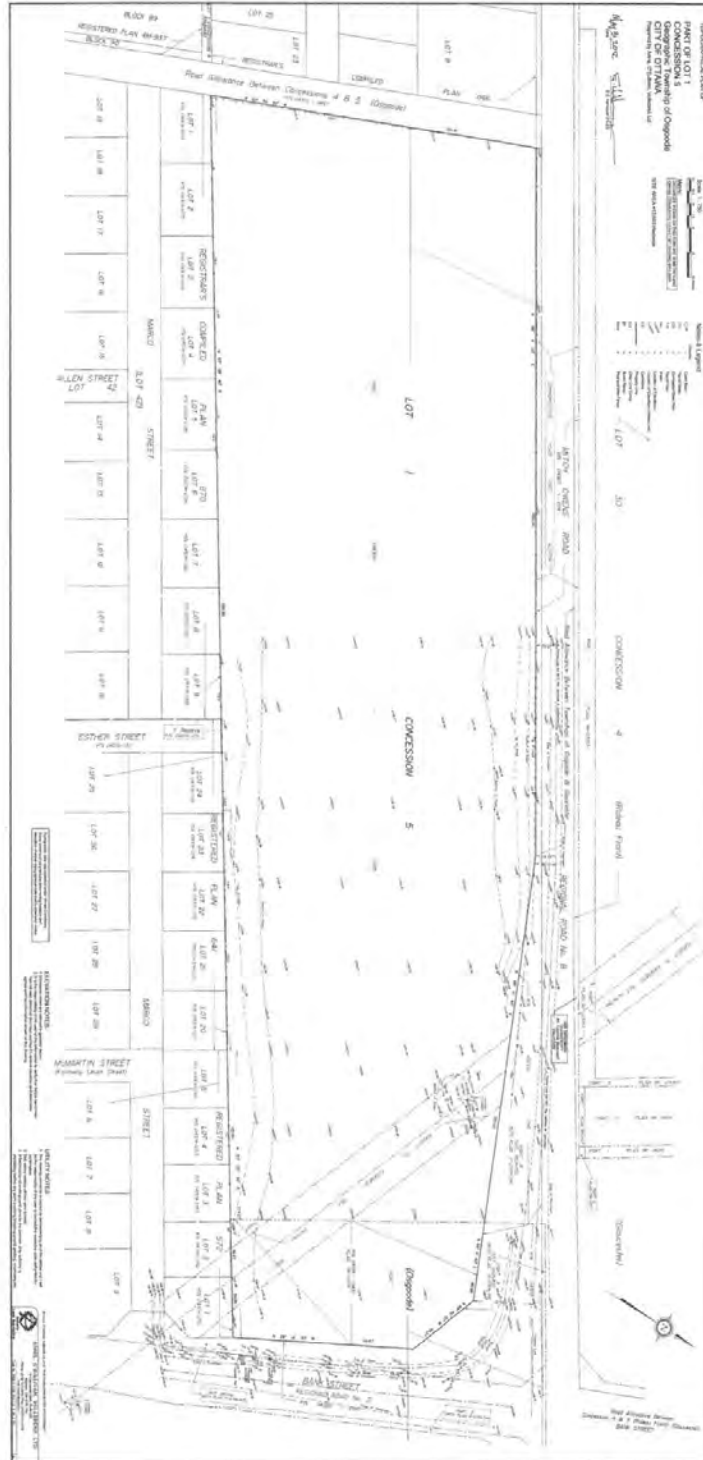


Figure 2: Site Layout





Figure 3: Site Plan of Survey





2.3 Geology and Physiography

The subject lands are located within the North Gower Drumlin Field physiographic region of southern Ontario, a drumlin field occupying much of the southern periphery of the City of Ottawa. According to Ontario Geological Survey Map 2556, the upper soils across the site mainly consist of glaciofluvial ice contact deposits of gravel and sand associated with the mapped abandoned raised beach, with glaciomarine deposits of sand and gravel mapped to the immediate west.

According to local water well records, mainly from wells located at the residential homes to the immediate south and west, the thickness of the undisturbed overburden in the close vicinity of the site is 15 to 27m. The thickest portion of the overburden appears to be along the north-south axis of the mapped abandoned raised beach trending through the centre of the site. The overburden is reported to consist primarily of granular deposits of sand and/or gravel.

2.4 Groundwater and Surface Water

The bedrock is the most commonly utilized source of potable groundwater in the area. Of the 92 reported wells within the same Township lot as the proposed development (i.e. Lot 1, Concession 5, Osgoode), 78 wells (85%) are reported to be completed in the bedrock. The remaining 14 wells are completed in gravel deposits in the lower overburden.

Groundwater is estimated to flow south toward North Castor River which is located approximately 1.5km to the south of the subject property. This information coincides with information taken from aerial photographs, which indicate that, the topography and hence the groundwater flows in the same direction toward this area.

2.5 Other Services

The Site was serviced at the road with hydro, telephone and gas services. Sanitary sewers and municipal water are not available in this area.



3.0 INVESTIGATION AND TESTING

3.1 Subsurface Investigation

The field investigation to determine the engineering characteristics of the subsurface materials included a reconnaissance of the project site, drilling of borings, performing standard penetration tests and obtaining disturbed split-barrel samples.

The drilling consisted of 31 test borings at the locations depicted on the Site Plan Appendix C and D. The onsite drilling was carried out on July 21, 22 and 23, 2013, by Canadian Soil Drilling using a CME 45 mobile mounted drill rig with a 4in diameter, hollow stem auger and split-spoon sampler drill rig with continuous-flight augers.

Borehole locations were selected to maximise property and proposed structure coverage as per the updated site plan, as well as determined by site accessibility. All the boreholes were backfilled upon completion of fieldwork.

The following table is a summary of the Borehole depths and subsurface conditions encountered.

Table 1: Sub-Surface Conditions / Borehole Record

BH#	Depth In Feet	Sub-Surface Conditions	Density AR/BR = Auger Refusal/Boulders/Bedrock	Water Table (Estimate)
1	30	granular with cobble/boulders	medium	22'
2	2	Auger refusal @ 2' boulder/BR	AR@2'	n/a
3	15	0-4 till, 4-12 grey clay, 12-15 grey granular	Soft to 4-15'	8'
4	6	Auger refusal @ 6' boulder/BR	Semi-compact to hard	n/a
5	17	granular with cobble/boulders	Semi-compact	9'
6	25	0-5 till, 5-18 moist clay, 18-25 sand/stone some clay	Soft, BR @ 25'	12
7	27	0-27 gray sandy clay	Soft, BR @ 27'	6-8'
8	35	0-29 gray wet clay, 29-35 granular	Soft to 30'	6-8'
9	40	0-16 wet clay, 16-34 fine sand/silt with clay, 34-40 course silty sand	Soft	8'



10	0	COULD NOT ACCESS WITH DRILL – TOO WET/SOFT		
11	15	0-7 wet clay, 7-15 clay with pebbles/stones, shale BR@15	Soft to 7', stiff 7-15', BR@15	8'
12	40	0-16 wet clay, 16-34 fine sand/silt with clay, 34-40 course silty sand	Soft	8'
13	40	0-16 wet clay, 16-34 fine sand/silt with clay, 34-40 course silty sand	Soft	8'
14	7	0-2 shale cover, 2-7 clay, BR@7	Medium, AR@7	n/a
15	7.5	0-7.5 brown till, AR@7.5	AR@7.5	n/a
16	17.5	0-4 shale cover, 4-10 wet silty clay, 10-17 silty clay with shale pcs.	AR@17.5	5-6'
17	20	0-15 grey clay, 15-20 brown silty clay with shale pebbles	Soft to 15, medium beyond	11'
18	20	0-15 grey clay, 15-20 brown silty clay with shale pebbles	Soft to 15, medium beyond	11'
19	25	0-5 till, 5-18 wet soft clay, 18-25 wet sand/silt/stone with shale pcs.	Soft to 18, medium beyond	8'
20	10	0-7 brown till, 7-10 till with stone	Medium to stiff	n/a
21	25	0-17 wet sandy clay, 17-25 course sand/stone	Soft to medium	12
22	4	0-4 brown to grey compact till	Stiff AR@4	n/a
23	25	0-18 grey clay, 18-25 brown sand/ gravel	Soft to 17, medium beyond	17'
24	10	0-10 granular/cobble/boulder	Medium AR@10	n/a
25	10	0-10 granular/cobble/boulder	Medium	n/a
26	7.5	0-7.5 till	Medium AR@7.5	n/a
27	8	0-8 till	Medium AR@8	n/a
28	9	0-9 granular/cobble/boulder	Medium AR@9	n/a
29	12	0-9 brown till, 9-12 granular/cobble/ boulder	Medium AR@12	n/a
30	6	0-6 granular/cobble/ boulder	Medium AR@6	n/a
31	4	0-4 granular/cobble/ boulder	Medium AR@4	n/a



Soil samples were obtained at selected intervals in the soil test borings. Undisturbed soil samples were obtained in general accordance with ASTM D-1587 (Thin-Walled Tube Sampling of Soils) using a standard split-spoon sampler. A split-spoon sampler is a 5cm O.D. tube that is driven into the soil to be sampled that can be split open lengthways for easy removal and visual inspection of the soil obtained. Disturbed soil samples were obtained in general accordance with ASTM D-1586 (Penetration Test and Split-Barrel Sampling of Soils). All samples were identified according to project number, boring number and depth, encased in polyethylene plastic wrapping to protect against moisture loss, and transported to our laboratory in special containers.

During the sampling procedures, standard penetration tests were performed in the borings in conjunction with the split-barrel sampling. The standard penetration value (N) is defined as the number of blows of a 63.5kg hammer, falling 75cm, required to advance the split-spoon sampler one-foot into the soil (ASTM D-1585). The sampler is lowered to the bottom of the drill hole and the number of blows recorded for each of the three successive increments of six inches penetration. The "N" value is obtained by adding the second and third incremental numbers. The results of the standard penetration test indicate the relative density and comparative consistency of the soils, and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components.

Water level observations were made during the boring operations and the results are noted on the subsurface Table 1. In relatively pervious soils, such as sandy soils, the indicated elevations are considered reliable ground water levels. In relatively impervious soils such as clays and silty clays, the accurate determination of the ground water elevation may not be possible even after several days of observation. Seasonal variations, temperature and recent rainfall conditions may influence the levels of the ground water table and volumes of water will depend on the permeability of the soils.

A field log was prepared for each boring. Each log contained information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as silt, clay, gravel or sand and observations of ground water. It also contained an interpretation of subsurface conditions between samples. Therefore, these logs included both factual and interpretative information. On completion of each borehole, the void was filled in with the existing, removed soil and were all sealed with an impermeable covering.

3.2 Laboratory Testing

Limited laboratory tests were carried out on a number of selected soil samples in order to acquire necessary information with regards to the physical and mechanical properties



of the soil layers and further on to evaluate and determine the parameters required for the calculations. All phases of the laboratory-testing program were performed in general accordance with the applicable ASTM Specifications.

The samples collected will be stored for 30 days from the date of issue of this report, and then disposed of unless otherwise instructed in writing by the client.

4.0 SUBSURFACE CONDITIONS

4.1 Stratigraphy

Detailed descriptions of the geotechnical conditions encountered in the thirty one (31) boreholes are located in Table 1 above. The borehole logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the locations where sampling was conducted.

It should be noted that the soil boundaries indicated on the borehole records are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for purpose of geotechnical design and should not be interpreted as exact planes of geological change.

The initial review of the first seven (7) borehole logs inclusive indicates that the site is generally covered with native overburden overlying approximately 7 to 8 meters of grey clay fill followed by a native deposit of sand and gravel.

Upon review of the thirty one (31) additional boreholes completed at the site, approximately half of the boreholes indicated the deep non native clay layer, with the remaining boreholes showing no signs of non native clay. Appendix D shows the Clay delineation area. Where the clay is located it is as deep as 2 to 8m (7 to 29 ft), however where there is no clay, the soil is desirable, consisting of mostly native gravel, sand, cobble and boulders.

4.2 Topsoil/Overburden

Each borehole indicated a 50mm to 100mm of overburden (topsoil, organics).



4.3 Grey Clay

Below the overburden layer a thick layer of Grey Clay was generally encountered to a depth of approximately 7 to 8 meters. The clay was generally moist, wet, mixed with traces of silt, sand and gravel. The clay had originated just north of the site near the intersection of Airport Parkway and Hunt Club Road, when new retention ponds were constructed, the grey clay was relocated to the subject site and used to fill in the gravel pit.

4.4 Sand and Gravel

Below the clay is the bottom of the gravel pit. The sand and gravel layer has traces of silt and clay. The gravel pit operations did not extend all the way to the Bank Street along the eastern edge. Below the overburden, a thin layer of clay, the sand and gravel, there is a seam of eastern shale bedrock. This extends across the far eastern portion and is located approximately 3.5m below grade.

Detailed description of the type of soil layers encountered during drilling is given in the borehole information, Table 1.

4.5 Groundwater

Groundwater was encountered at observable levels in all but one of the borehole locations. These measurements indicate that the groundwater table at the site is at 3.6m to 6.0m below grade. These may fluctuate with seasonal climatic variations and changes in the land use. Low permeability soils will require several days or longer for groundwater to enter and stabilise in the test borings.

5.0 RECOMMENDATIONS

The recommendations presented in the following sections of this report are based on the information available regarding the proposed construction, the results obtained from our soil test borings and laboratory tests, and our experience with similar projects. Because the test borings represent a very small statistical sampling of subsurface conditions, it is possible that conditions may be encountered during construction that are substantially different from those indicated by the soil test borings. In these instances adjustments to design and construction may be necessary.



This geotechnical report is based on the project information developed by BAE and the assumptions stated in this report. Changes in the proposed location or design of the structures can have significant effects on the conclusions and recommendations of the geotechnical report. BAE should be contacted in the event of such changes.

5.1 Site Preparation

Topsoil and overburden as well as other debris noted at or below the existing ground surface should be removed as part of the site preparation for the proposed construction area. In all new fill and excavation areas, ie; the clay fill area, vegetation, topsoil, roots and other deleterious materials (typically 1.5 to 3cm), deemed unsuitable shall be removed from the proposed construction areas, and replaced with controlled fill. Site clearing, grubbing and stripping will need to be performed only during dry weather conditions. Operation of heavy equipment on the site during wet conditions could result in excessive rutting and mixing of organic debris with the underlying soils especially with low permeability soils like the clays discovered in the drilling.

Due to their physical properties, these types of soils are very sensitive to traffic when allowed to get saturated, as they hold onto the water and will become increasingly difficult to control. **Extreme care** must be taken when exposing these types of soils, both to elements such as freezing and excessive wetting or heavy equipment traffic, especially rubber tire equipment.

5.2 Excavations

Temporary construction slopes should be designed and excavated in strict compliance with the rules and regulations of the Provincial Statute - Occupational Health and Safety Act, R.S.O. 1990, c. O.1, as amended Ontario Regulations 213/91 - Regulations for Construction Projects. This document was prepared to better insure the safety of workers entering trenches or excavations, and requires that all excavations conform to the new OSHA guidelines.

The contractor is solely responsible for protecting excavations by shoring, sloping, benching or other means as required to maintain stability of both the excavation sides and bottom. BAE does not assume any responsibility for construction site safety or the activities of the contractor.

For this site, the overburden soil encountered in our exploratory borings consisted of silty till. We anticipate that OSHA will classify these materials as Type 4 to Type 3. OSHA recommends a maximum slope inclination of 9 Horizontal: 5 Vertical for these



type soils. Excavation construction slopes should be closely observed for signs of mass movement, such as tension cracks near the crest, bulging at the top of the slope, etc.

5.3 Structural Fill (Engineered Fill)

It is recommended that structural fills be constructed as controlled well-compacted engineered fills. Structural engineered fill should be inorganic, low plastic clay, sand, or gravel. Any existing soils with a high organic content (browns) are suitable for reuse as fill in landscaping areas only. It is recommended that only granular fill be used within the building footprint and within 1.5m of the building footprint. The intent of these recommendations is to reduce the potential for consolidation and settlement of new fills.

Laboratory testing should be performed on the fill materials to determine the appropriate moisture-density relationship of the fill being placed. Adjustments to the soil moisture by wetting or drying should be made as needed during fill placement. During grading operations, representative samples of the proposed imported structural fill materials should be periodically checked via laboratory testing. A representative from BAE or approved other, should be on site to monitor excavation and grading operation as well as the suitability of fill materials. Suitable fill material should be placed in thin lifts (lift thickness depends on type of compaction equipment, but in general, lifts of 200mm loose measurements are recommended). The soil should be compacted by the necessary compaction equipment to meet the specified compaction recommendations.

Sheepsfoot rollers may be required to adequately compact fine-grained fill material (silts and clay). If the fill material is granular (sands and gravels) with less than 10% clays and silts, smooth-drum vibratory compactors should be used. In addition, a smooth-drum roller should be provided to “seal” the fill at the end of each workday to reduce the impact of precipitation. In areas undergoing removal of seepage water, the engineered fill should be limited to well-graded sand and gravel or crushed stone.

Within small excavations, such as in utility trenches (less than 60cm in width), around manholes or behind retaining walls, we recommend the use of diesel plate tampers or “jumping jack” compactors to achieve the specified compaction. Loose lift thickness of 100mm is recommended in small area fills.

A qualified field representative should periodically observe fill placement operations and perform field density tests at various locations throughout each lift, including trench backfill, to indicate if the specified compaction is being achieved.

**TABLE 2: STRUCTURAL FILL PLACEMENT GUIDELINES**

Areas of Fill Placement	Compaction Recommendation (ASTM D698-Standard Proctor)	Moisture Content (Percent of Optimum moisture)
Granular cushion beneath Floor Slab and over Footings	98%	As necessary to obtain density
Structural fill supporting Footings	98%	-1 to +3 percent
Structural fill placed within 1.5m beyond the perimeter of the building pad	98%	-1 to +3 percent
Grade-raise fill placed within 30cm of the base of the pavement	98%	-1 to +3 percent
Structural fill placed below the base of the Pavement Soil Subgrade	95%	-1 to +3 percent
Utility Trenches - Within building and pavement areas	98%	-1 to +3 percent
Beneath Landscaped/Grass Areas	92%	As necessary to obtain density

The fill soils should be relatively free of organic materials (less than about two hundredths of a percent by weight) and other deleterious material. In addition, the soils should preferably not contain particle sizes larger than 75mm.

5.4 Foundation Design

Footings should be founded on undisturbed brown or grey sand and gravel with traces of silt and clay found or on engineered fill. Piles and or caissons may also be a feasible option for the deeper clay areas (8m +).

Based on the results of the soil test borings, laboratory testing and our engineering evaluation, it is our opinion that the subsurface conditions where clay fill is present are not suitable for supporting the proposed structure on a conventional shallow foundation. However when the clay is removed and engineered fill is used to backfill these areas, foundations may be constructed as follows: for spread or continuous footings bearing on the natural or engineered fill layers, 150 kPa for an Ultimate Limit State (ULS) and 100



kPa for Serviceability Limit State (SLS) can be used. . The net allowable bearing pressures refer to the bearing pressure at foundation level in excess of the surrounding overburden pressure and do not include footing weight, backfill weight, or slab weight.

Piles or Caissons may be used in the deep clay, areas specifically located in the CR 13 and 14 units, along the south edge, as well as anywhere else on the site that has deep areas of non native clay.

Footings should have minimum dimensions in accordance with the applicable building codes. All footings should be located so that the smallest lateral clear distance between footings will be at least equal to the difference in their bearing elevations. If this distance cannot be maintained, the lower footing should be designed to account for the load imparted by the upper footing. The recommended soil bearing capacity includes a factor of safety of at least 3 against shear failure. It is possible that some soils at the site will have an allowable soil bearing pressure less than the recommended design value. Therefore, foundation bearing surface evaluations should be performed by a BAE representative or acceptable substitute, during footing construction to aid in the identification of such soils and bearing capacities. After the evaluations and any required remedial measures are performed, concrete should be placed as quickly as possible to avoid exposure of the foundation sub-soils to wetting, drying or freezing. If soils in the areas of foundation support are subjected to such conditions, the footings should be re-evaluated.

The frost line in the Ottawa area is 1.2 metres below grade. All foundations in unheated areas, including the footings for retaining walls, should be provided with a minimum of 1.2 metres of soil cover to minimize the potential for frost related movements

When footings or foundations are excavated, a qualified inspector should re-evaluate the soil to ensure stability, and to make recommendations that might include the use of rebar, or widening footings.

Table 3: Factored ULS Bearing Resistance of Engineered Fill

Founding Soil	Footing Width (m)	Footing Depth (m)	Factored ULS Resistance (kPa)
Engineered Fill	1.0	0.6	150
	1.0	1.5	310
	0.6	0.6	130
	0.6	1.5	290



5.5 Floor Slab Subgrade Preparation

The soil subgrade in the areas of concrete slab-on-grade support is often disturbed during foundation and superstructure construction. Additionally, floor slab areas are often disturbed by construction equipment traffic between the time of initial grading and final pavement construction. The subgrade should be excavated to the design depth of the bottom of slab gravels. To prepare the subgrade, the top 20cm of the subgrade should be compacted to a minimum of 98% of the maximum dry density as determined by ASTM D698-91, Standard Proctor Moisture-Density Relationship. The moisture content should also be controlled to -1 to +3% of the optimum.

The final subgrade should be proof-rolled and evaluated by a representative of BAE immediately prior to placement of the engineered fill to detect any localised areas of instability or soft areas. If unstable soils are encountered which cannot be adequately densified in place, such soils should be removed and replaced with well-compacted fill material placed in accordance with the *Structural Fill* section of this report. The subgrade should be graded to a shallower slope than five horizontal to one vertical (5H:1V) prior to receiving general engineered fill material to reduce the effects of differential fill thicknesses. The prepared subgrade should be protected from drying, excessive moisture, and freezing.

5.6 Floor Slab Design

The recommendations provided are based on the assumption that the average net floor slab load will not exceed 750 psf, and that the maximum concentrated net floor slab load will be less than 1500 psf. The recommended bearing capacity of the floor slab is 2000 psf. Should a greater bearing capacity be required, BAE should review the recommendations presented in this report. The granular cushion beneath the floor slab, should be free draining, well graded and compacted by vibration prior to pouring the floor slab. A minimum of 400mm of granular fill should be provided below the slab. The granular fill should be compacted according to the recommendations given in Structural Fills section of this report. The recommended minimum gravel thicknesses are required to promote uniform distribution of floor loads to the subgrade, and to bridge over newly constructed fill areas such as utility trenches. Thicker gravel courses may be required for structural considerations. A vapour barrier should be placed beneath the concrete slab.

The slab-on-grade unit should be allowed to float independently of all load-bearing walls and columns. Floating the floor slab independent from the wall and column loads with movable and/or expansion joints will be critical in minimising the potential cracking, which can occur along, and around the proposed foundation system. In regards to the



wall/floor structural detail, expansion joints and gap spacing are recommended at the wall/floor connection. A half-inch gap for movement between the floor slab and insulation board is recommended along with a bond break that allows independent movement between the floor slab and masonry block wall. A 100mm thick granular cushion is also recommended between the floor slab and top of column pad and wall footings. Resting the floor slab on top of column pads and wall footings is not recommended. Assuming the previously mentioned recommendations are performed, the risk associated with floor slab cracking will be reduced.

5.7 Pavement Subgrade Preparation

Due to the depth of the clay in the parking areas it is possible to bridge the clay and only excavate to a depth that would allow approximately 600 to 800mm of bridging material (in this case preferably rip rap, gabion basket stone, or any stone approximately 100-200mm in size), specified thickness of Granular "B" and Granular "A" and pavement. A few items to keep in mind when designing this structure:

1. The thickness of the granular material must be sufficient to develop acceptable pressure distribution over the wet soils.
2. The backfill material must be able to withstand the wheel load without rutting.
3. The compaction of the backfill material should be in accordance with the Standard Specifications.

The subgrade should be proof rolled with a fully loaded dump truck, scraper, or similar rubber-tired equipment weighing at least 25 tons or a 10-ton vibratory steel drum roller (with vibration off). Do not use vibratory rollers to proofroll materials containing significant amounts (>10%) of fines if the subgrade materials are wet or near groundwater levels, since vibratory rollers tend to wick water to the surface.

A representative of BAE or equivalent qualified person, should observe Proofrolling operations. Unstable and unsuitable soils, which are revealed by proof rolling and which cannot be adequately densified in-place, should be removed under the direction of the BAE representative. It may be necessary to perform selective removal of soft, wet soils and/or stabilise existing soft soils in-place. If required, the methods of stabilisation will typically include incorporating a lift of crushed stone materials or a geosynthetic over the soft soils. The identification of areas that may require undercutting and/or stabilisation should be based on the actual conditions at the time of construction, and will depend on the location of the soft area.

The subgrade should be compacted to a minimum of 98% of the maximum proctor density of ASTM D-698-91, Standard Proctor Moisture-Density Relationship. The



moisture content should also be controlled to -1 to +3% of the optimum. The subgrade should be tested by a representative of BAE and approved for placement of select fill.

5.8 Pavement Design

All of the topsoil and any fill or excessively wet materials within the proposed driveway and parking lot areas should be subexcavated and the areas brought to grade using compacted Granular B. Based on the anticipated traffic loadings, it is recommended that flexible pavements for passenger vehicle parking areas be designed for a maximum Benkelman beam rebound of 2.5 millimetres. Driveways and truck parking areas should be designed for a maximum Benkelman beam rebound of 1.5 millimetres. To achieve these criteria, the pavement structures should consist of the following constructed on a properly prepared engineered fill subgrade:

Table 4: Recommended Pavement Structure Thickness for Surface Parking Areas

Pavement Layer	Compaction Requirements	Computed Pavement Structure	
		Parking Areas (light Duty)	Access Roads (heavy duty)
Asphaltic Concrete	92.0 to 96.5% Maximum relative density	65mm HL3	90mm
OPSS Granular "A" Base	98% SPMDD	150mm	150mm
OPSS Granular "B" Subbase	98% SPMDD	300mm	450mm

The above-noted pavement structures are not intended to support construction traffic. The pavement subgrade should be thoroughly proofrolled with heavy machinery prior to pavement construction to identify any areas requiring remedial work.

The Granular A base and Granular B subbase should be uniformly compacted to at least 98 per cent of standard Proctor maximum dry density. To preserve the integrity of the completed pavement structure, perforated stub drains should be provided at subgrade level at any catchbasin locations; otherwise, grading should direct surface and



subsurface water to perimeter ditches with inverts at least 0.5 metres below subgrade level.

It is recommended that placement of the sheet asphalt be deferred for one year following placement of the binder asphalt to minimise the detrimental effects of potential differential settlement of the service trench backfill.

Surface drainage around the pavement and proper maintenance are also important to long-term performance. Curbs should be backfilled as soon as possible after construction of the pavement. Backfill should be compacted and should be sloped to prevent water from ponding and infiltration under the pavement. All pavement joints should be caulked and any cracks should be quickly patched or sealed to prevent moisture from reaching and softening the subgrade.

5.9 Drainage and Groundwater Considerations

The site should be graded to provide positive drainage to reduce storm water infiltration. A minimum gradient of one percent for asphalt areas should be maintained. A three percent gradient should be maintained for landscaped areas immediately adjacent (within 3m) to the building. In general, water should not be allowed to collect near the surface of the foundation or floor slab areas of the structures during or after construction. If water were allowed to accumulate next to the foundation, it would provide an available source of free water to the expansive soil underlying the foundation. Similarly, surface water drainage patterns or swales must not be altered so that runoff is allowed to collect next to the foundation.

Temporary drainage provisions should be established, as necessary, to minimise water runoff into the construction areas. Since soils generally tend to soften when exposed to free water, provisions should be made to remove seepage water from excavations, should it occur. Also, undercut or excavated areas should be sloped toward one corner to facilitate the collection and removal of rainwater or surface runoff. Adequate protection against sloughing of soils should be provided for workers and inspectors entering the excavations. This protection should meet O.S.H.A. and other applicable building codes.

Ground water seepage was encountered in our borings during drilling, and groundwater should not be encountered during the shallow excavations, but will be found approximately 3.6m below grade. If minor ground water seepage is encountered within the proposed building foundation, utility trenches and grading excavations at the time of construction, especially after periods of heavy precipitation, small quantities of seepage may be handled by conventional sump and pump methods of dewatering.



Steel casing should be on hand during piling operations to prevent seepage and sloughing of the sidewalls. The piles should be concreted immediately following inspection to reduce the potential for sloughing. Some pumping of collected water may be required during underground utility construction.

A permanent dewatering trench with an access well would be a way to minimize water issues on site, especially for long term water management. An ideal location would be moving towards the proposed retention pond, approximately 450mm below grade, ± 100 mm size stones lining the trench. An access well would allow for routine maintenance over the years, as well as emergency access. In addition to the trench, additional sock wrapped drainage tile should be used abundantly under the parking structures, extending outward from the catch basins as well as along all foundation, and retaining wall structures. This will minimise long term undesirable water settlement across the property.

5.10 Earthquake Conditions

The subsoil and groundwater information at this site has been examined in relation to Section 4.1.8.4. of the OBC 2006. The subsoil at the structure location will generally consist of fill. The shallow foundations will be set on the engineered fill. The reported undisturbed N-Values for the soil below the founding levels ranged from 36 to 71.

Based on the subsurface soil conditions encountered during our geotechnical investigations, the Site Class for this site is "C" as per Table 4.1.8.4.A, Site Classification for Seismic Response, OBC 2006.

5.10 Septic and Tile Bed Areas

For the septic and tile bed areas, the clay should be removed and replaced with free draining, engineered fill capable of supporting the septic and tile bed specifications.

6.0 ADDITIONAL SERVICES

The recommendations presented in this report are contingent on BAE observing and/or monitoring:

- Proofrolling and fill Subgrade conditions;
- Backfilling and compaction of excavations;
- Suitability of borrow materials;
- Fill placement and compaction;

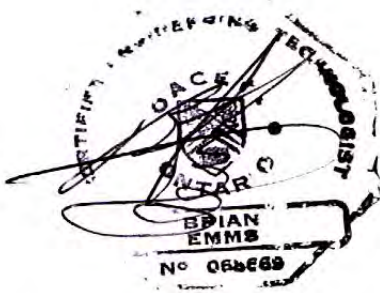


- Foundation subgrades; and
- Compliance with the geotechnical recommendations.

7.0 CLOSURE

We trust that this report will assist you in the design and construction of the proposed project. Should you have any questions, please do not hesitate to contact us. This report was completed by Brian A. Emms, C.E.T. and Sarah Heino, Geotechnologist and reviewed by G. Jan Van Iterson, P. Eng.

Respectfully submitted,
BAE & Associates Environmental Inc.



Brian A. Emms, C.E.T.
Senior Env. Technologist



G. Jan Van Iterson, P. Eng.
Associate



APPENDIX A LIMITATIONS

This report was prepared for the exclusive use of Alium Investments Inc. for the geotechnical aspect of the proposed development described in Section 2. The report may not be relied upon by any other person or entity without the written permission of BAE. This report was prepared in accordance with current, generally accepted geotechnical engineering practices. No other warrantee is provided.

BAE should be allowed the opportunity to review the geotechnical aspects of plans and specifications prior to construction, to allow confirmation of the correct interpretation of the recommendations provided in this report. Foundation, earthworks, underground construction, and pavement construction should be undertaken only with full time monitoring by qualified personnel. BAE can provide these services on request.

The conclusions and recommendations submitted in this report are based upon the data obtained from a limited number of widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction or further investigation. If variations or other latent conditions do become evident, it will be necessary to re-evaluate the recommendations of this report. The recommendations contained herein are not intended to dictate construction methods or sequences. Instead, they are furnished solely to help designers identify potential construction problems related to foundation and earth plans and specifications, based upon findings derived from sampling. Depending upon the final design chosen for the project, the recommendations may also be useful to personnel who observe construction activity.

Potential contractors for the project must evaluate potential construction problems on the basis of their review of the contract documents, their own knowledge of and experience in the local area, and on the basis of similar projects in other localities, taking into account their own proposed methods and procedures.



**APPENDIX B
PROJECT PHOTOGRAPHS**



Area of BH 18 representative of central area of Site, note heavy vegetation



General surface conditions at East side of property, note boulders and heavy vegetation



Looking SE at area of BH 27, start of increased incline to Marco Street



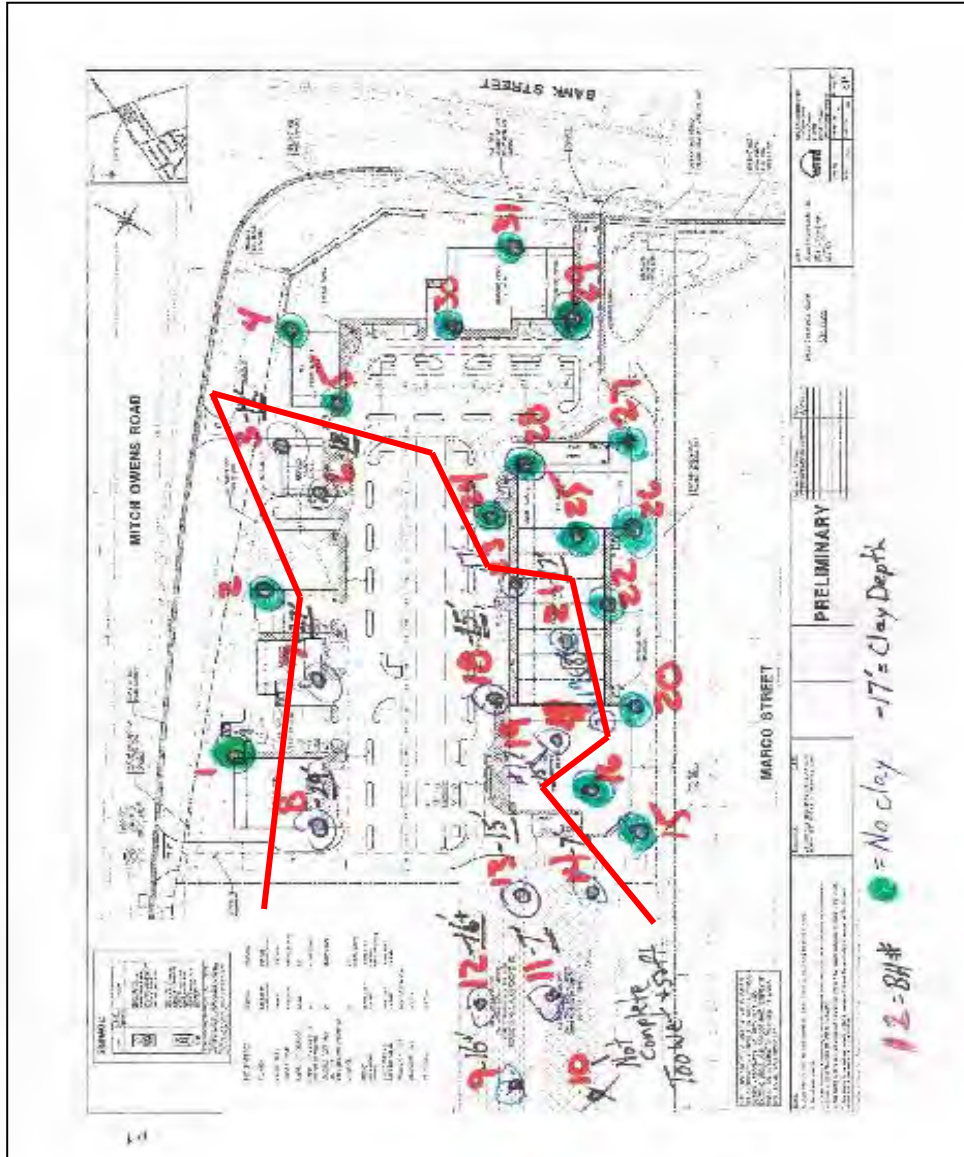
Looking west along bottom of slope and tree line, note incline of slope is parallel with tree tops



**APPENDIX C
BOREHOLE LOCATIONS AND SURFACE ELEVATIONS**



**APPENDIX D
NUMBERED FEILD BOREHOLE LOCATIONS
CLAY DELINEATION**



APPENDIX F

CORRESPONDENCE

January 24, 2014

Mr. Miguel Tremblay, MCIP, RPP
FoTenn Consultants Inc.
223 McLeod Street
Ottawa, ON
K2P 0Z8

Wilson Associates

Consulting Hydrogeologists

Dear Mr. Tremblay:

Re: Hydrogeologic Work Plan for Water Supply
Zoning Amendment Application
5640 Bank St., 7107 Marco St. and 7041 Mitch Owens Rd., Greely
City of Ottawa

As requested by Mark Eplett, the following summarizes the future work plan to address the City's hydrogeologic requirements relating to the completion of the on-site water supply servicing of the proposed commercial development at 5640 Bank St., 7107 Marco St. and 7041 Mitch Owens Rd. in Greely. This work plan follows from the hydrogeologic field work undertaken to date, which is summarized in our last report dated July 18, 2012.

A production well will be drilled under the supervision of a Professional Geoscientist at a location determined to be appropriate for the future development of the site (see below). The following are the specifications of the future production well:

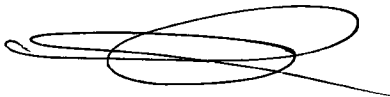
- Drilled production well to be completed to the base of Nepean Sandstone Formation. Based on regional geologic information and local well records for new wells nearby (to the southeast), it appears that the base of the Nepean Formation is at an elevation of about 30 to 40m above sea level (asl). Based on a site elevation of 110m asl, the well will be approximately 70m to 80m (230 to 260 feet) deep, subject to the actual formations encountered. The current three on-site test wells are completed to depths of 55m to 61m, and although completed in the Nepean Formation, do not quite fully penetrate the Formation.
- The production well casing is to be advanced until fully penetrating the overburden and the overlying dolostone of the Oxford Formation, and if present, the interbedded dolostone and sandstone of the March Formation. Based on regional geologic information and local well records, the Nepean Formation is indicated to be about 30m thick. As such, the base of the well casing is anticipated to be set at an elevation of 60 to 70m asl, or a depth of approximately 40 to 50m below grade. The casing will be fully grouted over its entire length, in a manner in accordance with Ontario Regulation 903. The casings of the existing three test wells are set to depths of 18 to 20m, and although exceeding the requirements of Ontario Regulation 903, do not fully isolate the Oxford and March Formations per City requirements.

- A 15.9cm (6 inch nominal) diameter well casing and borehole will be utilized, which is more than sufficient for a 10cm-diameter submersible pump capable of a yield of up to 250L/min. Based on available information, a well yield in the range of 90L/min is anticipated.
- The well site is presently planned to be northeast of the proposed sewage system, immediately adjacent to "CRU 13".
- A 50,000 litre pumping test will be completed on the production well. Based on an anticipated well yield of 90L/min (20 igpm), the pumping test is estimated to be between 9 and 12 hour long, subject to actual safe well yield. Water levels will be observed in the production well and in the three on-site test wells on a continuous basis using submersible pressure transducers (with barometric pressure compensation). Continuous water level observation will commence at least one day prior to the pumping test and extend at least one day after the test conclusion. During the pumping test, water levels in the three on-site shallow monitoring wells will be manually observed on a regular basis.
- The water from the well will be subjected to bacteriological and general chemistry testing, similar to that conducted during the initial round of pumping tests on the three original test wells. Samples will be collected within one hour of the start of the test and again at the test conclusion to confirm water quality stability.
- The three existing on-site test wells will be abandoned in accordance with Ontario Regulation 903, once all testing is concluded to the satisfaction of the City.
- An updated hydrogeologic report specific to the production well construction and testing program will be prepared at the conclusion of field work.

Should there be any questions regarding the above work plan, please feel free to contact this office.

Yours sincerely,

IAN D. WILSON ASSOCIATES LIMITED



Geoffrey Rether, P.Geo.

Jeremy Lighthouse

From: Jeremy Lighthouse [jlighthouse@wmiengineering.ca]
Sent: Thursday, February 06, 2014 3:33 PM
To: jlighthouse@wmiengineering.ca
Subject: FW: 11-183 Greely Commercial Center (Dry Hydrant System)

From: McNaughton, Duncan [mailto:Duncan.McNaughton@ottawa.ca]
Sent: Tuesday, January 28, 2014 2:25 PM
To: jlighthouse@wmiengineering.ca
Cc: tgignac@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)

Yes, 4500L/Min

Duncan A. McNaughton, P.Eng
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From: Jeremy Lighthouse [mailto:jlighthouse@wmiengineering.ca]
Sent: Tuesday, January 28, 2014 14:24
To: McNaughton, Duncan
Cc: tgignac@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)

Duncan,

Ok sounds good. Also, was your number of 500L/min a typo?

Regards,

Jeremy W. Lighthouse, P. Eng.
WMI & Associates Limited
119 Collier Street
Barrie, Ontario L4M 1H5
Office 705-797-2027 Ext 29
Fax 705-797-2028

From: McNaughton, Duncan [mailto:Duncan.McNaughton@ottawa.ca]

2/6/2014

Sent: Tuesday, January 28, 2014 2:19 PM
To: jlighthouse@wmiengineering.ca
Cc: tjignac@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)

Ok,

Wait for the information which I will provide and then model it, that is your only way to know beforehand.

I am awaiting the information from our suppression crews and will forward once I receive.

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From: Jeremy Lighthouse [<mailto:jlighthouse@wmiengineering.ca>]
Sent: Tuesday, January 28, 2014 14:15
To: McNaughton, Duncan
Cc: tjignac@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)

Duncan,

I would prefer to know that the system is going to be sufficient now though as oppose to after it has been built that's all. Do I need to model it and if so then I require the information previously requested, otherwise can you confirm that it is sufficient?

Regards,

Jeremy W. Lighthouse, P. Eng.
WMI & Associates Limited
119 Collier Street
Barrie, Ontario L4M 1H5
Office 705-797-2027 Ext 29
Fax 705-797-2028

From: McNaughton, Duncan [<mailto:Duncan.McNaughton@ottawa.ca>]
Sent: Tuesday, January 28, 2014 2:10 PM
To: jlighthouse@wmiengineering.ca
Cc: tjignac@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)

Jeremy,

2/6/2014

New pipe layout is fine.

OFS will go on site once completed and check for sufficient flow rates for the 4500L/Min. As long as flow rates can provide the 500L/Min it will be passed.

Duncan A. McNaughton, P.Eng
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From: Jeremy Lighthouse [<mailto:jlighthouse@wmiengineering.ca>]
Sent: Tuesday, January 28, 2014 14:05
To: McNaughton, Duncan
Cc: tjignac@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)

Duncan,

Thank you for your quick response and attention. Please note that we are going to move the first section of dry hydrant main extending from the northwest corner of the site in order to avoid pipe conflicts with the other services on-site as well as to clearly show the distinct difference between the three (3) water lines on-site. Please see the attached sketch which illustrates the changes we are proposing.

Could you please confirm that this layout is sufficient from Ottawa Fire's perspective? Also, you mentioned that the Ottawa Fire does the water modelling (i.e. pressure and flow test calculations/checks) for the dry hydrant system to ensure it is sufficiently sized correct based on our layout correct so I do not need to model this part of our system but rather just simply show it as a 200mm dry hydrant main?

Regards,

Jeremy W. Lighthouse, P. Eng.
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Office 705-797-2027 Ext 29
Fax 705-797-2028

From: McNaughton, Duncan [<mailto:Duncan.McNaughton@ottawa.ca>]
Sent: Tuesday, January 28, 2014 1:49 PM
To: jlighthouse@wmiengineering.ca
Cc: tjignac@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)

2/6/2014

Jeremy,

Please proceed with the 200mm fire hydrant service, that is acceptable to Ottawa Fire.

Please proceed on assumption of the 4500L/min flow rate per the dry hydrant installation guide by the OFS.

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From: Jeremy Lighthouse [<mailto:jlighthouse@wmiengineering.ca>]
Sent: Tuesday, January 28, 2014 12:40
To: McNaughton, Duncan
Cc: tjignac@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)

Duncan,

As requested. Please note that I have provided just the governing distances (i.e. furthest ones). Please note that the dry hydrant system is only for the non-sprinklered buildings and that we have ensured that all hydrants are located within the OBC's 90m unobstructed distance to each buildings front door and within 45m of the proposed siamese connections on the sprinklered buildings.

I trust this is sufficient but should you require additional information please do not hesitate to contact me.

Regards,

Jeremy W. Lighthouse, P. Eng.
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Fax 705-797-2028

From: McNaughton, Duncan [<mailto:Duncan.McNaughton@ottawa.ca>]
Sent: Tuesday, January 28, 2014 11:55 AM
To: jlighthouse@wmiengineering.ca
Cc: tjignac@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)

Jeremy,

2/6/2014

Please show distances from the tanks to the Siamese connections or the front doors of buildings without a sprinkler system.

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From: Jeremy Lighthead [<mailto:jlighthead@wmiengineering.ca>]
Sent: Tuesday, January 28, 2014 09:36
To: McNaughton, Duncan
Cc: tjignac@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)

Duncan,

The 200mm diameter Fire Hydrant Service is the one I am referring too. It consists of two (2) fire hydrants and will be a dry hydrant system with concrete tank storage located in the northwest corner of the site. We have no municipal water at this location and two (2) of our tenants require sprinkler systems (CRU 1-3 incl. the future addition and CRU 10). This system will be run off a diesel fire pump while the remainder of the units will simply use the dry hydrant system. We have separated our domestic water supply from both fire protection services.

Should you have any questions please do not hesitate to contact me. Your earliest review would be greatly appreciated.d

Regards,

Jeremy W. Lighthead, P. Eng.
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Barrie, Ontario L4M 1H5
Office 705-797-2027 Ext 29
Fax 705-797-2028

From: McNaughton, Duncan [<mailto:Duncan.McNaughton@ottawa.ca>]
Sent: Tuesday, January 28, 2014 8:30 AM
To: jlighthead@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)

Can you send me a site plan for hydrant set up for my reference.

Duncan A. McNaughton, P.Eng
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101 Centrepointe Drive - 3rd Floor

2/6/2014

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From: Jeremy Lighthouse [<mailto:jlighthouse@wmiengineering.ca>]
Sent: Monday, January 27, 2014 17:48
To: McNaughton, Duncan
Subject: 11-183 Greely Commercial Center (Dry Hydrant System)

Duncan,

I understand that you may have had some previous correspondence with Barry Metz regarding a private sprinkler system (fire pump setup) for our site located at the southwest corner of the intersection of Mitch Owens Road and Bank Street in the Town of Greely? I am the civil engineer for the site and was hoping you could clarify a question I have related to the dry hydrant setup we are proposing for the fire protection associated with all non-sprinklered buildings?

I see based on the City's dry hydrant detail that they require a minimum flow rate of 4500L/min at the furthest hydrant for this type of system. I would like to model my proposed water system and in order to do so I need to know what pressure will be provided at the storage tanks where the pumper truck will be connected (what pressure does the pumper truck put up and at what flow rate) and also what pressure is required at the minimum flow rate of 4500L/min at the furthest hydrant?

Finally based on the OBC and the proposed development which requires in the range of 230,000L of water supply/storage for fire protection purposes, I need a minimum flow rate of 6300L/min as per Table 2 under A.3.2.5.7. Does this mean that the fire department will require 6300L/min at the furthest hydrant or just the 4500L/min as per the dry hydrant detail (see attachment)?

Your earliest response would be greatly appreciated.

Regards,

Jeremy W. Lighthouse, P. Eng.
WMI & Associates Limited
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Fax 705-797-2028

Jeremy Lighthouse

From: Jeremy Lighthouse [jlighthouse@wmiengineering.ca]
Sent: Thursday, February 06, 2014 3:31 PM
To: jlighthouse@wmiengineering.ca
Subject: FW: 11-183 Greely Commercial Center (Dry Hydrant System)

From: McNaughton, Duncan [mailto:Duncan.McNaughton@ottawa.ca]
Sent: Thursday, January 30, 2014 9:42 AM
To: jlighthouse@wmiengineering.ca
Cc: tgignac@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)

Jeremy,

Model for 4500L/min to see what would be needed for pressure at the dry hydrant first.

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Jeremy Lighthouse

From: McNaughton, Duncan [Duncan.McNaughton@ottawa.ca]
Sent: Thursday, January 30, 2014 9:14 AM
To: jlighthouse@wmiengineering.ca
Cc: tgignac@wmiengineering.ca
Subject: FW: 11-183 Greely Commercial Center (Dry Hydrant System)
Importance: High
Attachments: Dry Hydrant SOP.PDF

Jeremy, this is what I was provided.

Hi Duncan,

The certification plate (CAN/ULC-S515-04) on the side of a Class A pump has the following description:

6010 LPM at 1000 Kpa
4200 LPM at 1350 Kpa
3000 LPM at 1700 Kpa

We should be able to draft and supply this flow, however, our Dry Hydrant SOP directs Fire Fighters to pressurize a remote hydrant system to a maximum of 700 Kpa. In reality, during testing, I am getting flows at remote hydrants in the area of 2000 – 3000 LPM.

Does this answer the question?

Tim

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From: McNaughton, Duncan
Sent: Wednesday, January 29, 2014 12:37
To: McNaughton, Duncan; Thompson, David; McNeely, Tim; Burke, Chris
Subject: RE: 11-183 Greely Commercial Center (Dry Hydrant System)
Importance: High

2/6/2014

Hey guys,

Any answers to this??

Duncan A. McNaughton, P.Eng
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From: McNaughton, Duncan
Sent: Tuesday, January 28, 2014 07:33
To: Thompson, David; McNeely, Tim; Burke, Chris
Subject: FW: 11-183 Greely Commercial Center (Dry Hydrant System)

Chiefs,

What is the standard pressure that a Volunteer Station Pumper truck delivers when drafting from a storage tank.

Pressure?

Flow Rate?

Any general info you can give me is great. We will start to include it in our Standard Tank Installation for remote systems.

See below for specific questions posed for this query.

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From: Jeremy Lighthouse [<mailto:jlighthouse@wmiengineering.ca>]
Sent: Monday, January 27, 2014 17:48
To: McNaughton, Duncan
Subject: 11-183 Greely Commercial Center (Dry Hydrant System)

Duncan,

I understand that you may have had some previous correspondence with Barry Metz at regarding a private sprinkler system (fire pump setup) for our site located at the southwest corner of the intersection of Mitch Owens Road and Bank Street in the Town of Greely? I am the civil engineer for the site and was hoping you could clarify a question I have related to the dry hydrant setup we are proposing for the fire protection associated with all non-sprinklered buildings?

I see based on the City's dry hydrant detail that they require a minimum flow rate of 4500L/min at the furthest hydrant for this type of system. I would like to model my proposed water system and in order to do so I need to know what pressure will be provided at the storage tanks where the pumper truck will be connected (what pressure does the pumper truck put up and at what flow rate) and also what pressure is required at the minimum flow rate of 4500L/min at the furthest hydrant?

Finally based on the OBC and the proposed development which requires in the range of 230,000L of water supply/storage for fire protection purposes, I need a minimum flow rate of 6300L/min as per Table 2 under A.3.2.5.7. Does this mean that the fire department will require 6300L/min at the furthest hydrant or just the 4500L/min as per the dry hydrant detail (see attachment)?

Your earliest response would be greatly appreciated.

Regards,

Jeremy W. Lighthouse, P. Eng.
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Jeremy Lighthouse

From: Jeremy Lighthouse [jlighthouse@wmiengineering.ca]
Sent: Thursday, February 06, 2014 3:28 PM
To: jlighthouse@wmiengineering.ca
Subject: FW: 11-183 Greely Commercial Centre - Sprinkler Fire Water Requirements

From: Grieve, Ken - Xylem [mailto:Ken.Grieve@Xylem.com]
Sent: Friday, January 31, 2014 2:48 PM
To: jlighthouse@wmiengineering.ca
Cc: Gasior, Mike - Xylem; tgignac@wmiengineering.ca
Subject: RE: 11-183 Greely Commercial Centre - Sprinkler Fire Water Requirements

Jeremy,

The listed fire pumps are rated at 250 , 500 , 750 USGPM. I would suggest that you would need a 500 gpm unit. Friction loss through the line would have to be calculated to determine the pressure at the pump discharge relative to the pressure required at the furthestmost point. The 500 gpm vertical turbine fire pump boost pressures start at 54 psi, and go up to 250 psi, in increments of 5 psi.

Regards
Ken Grieve
