

Prepared By:



Stormwater Management Report

Mount Forest Subdivision
Township of Wellington North, ON
Avila Investments Ltd.

GMBP File: 318049

Revised: March 2021

TABLE OF CONTENTS

1.	INTRODUCTION AND BACKGROUND	1
2.	EXISTING CONDITIONS AND DRAINAGE.....	2
2.1	Stormwater Management Criteria	4
3.	POST-DEVELOPMENT CONDITIONS AND DRAINAGE	5
3.1	Areas Draining from Subject Property via Proposed SWM Facility	5
3.1.1	Drainage to Proposed SWM Facility.....	5
3.1.2	Proposed SWM Facility.....	7
3.1.3	Drainage from Proposed SWM Facility.....	7
3.2	Areas Draining Uncontrolled from Subject Property	8
3.3	Adjacent External Lands	8
3.4	Modelled Catchment Areas.....	9
4.	QUANTITY CONTROL CRITERIA, PARAMETERS, MODELLING AND DESIGN ANALYSIS.....	10
4.1	Design Rainfall Events	10
4.2	Site Soil Conditions	10
4.2.1	SWM Facility Considerations.....	11
4.3	Existing Catchment Areas	12
4.4	Post-Development Catchment Areas.....	12
4.5	MIDUSS Quantity Control Modelling Results.....	13
4.6	Analysis of Northerly and Southerly Overland Flow Routes	17
4.7	Analysis of SWM Facility's Significant Design Features	18
4.7.1	Forebay Design.....	18
4.7.2	Drawdown Time	18
4.7.3	Active Storage Depth	19
4.7.4	Maintenance and Operation	19
4.8	Analysis of Outlet Channel.....	20
5.	ADDITIONAL CONSIDERATIONS FOR REAR-YARD AREAS ALONG NORTHERLY PROPERTY BOUNDARY.....	21
6.	STORMWATER QUALITY TREATMENT	23
6.1	Thermal Mitigation.....	23
6.2	Total Suspended Solids (TSS) Removal	24
7.	TEMPORARY SEDIMENT AND EROSION CONTROL	24
8.	SUMMARY	25

FIGURES

- Figure No. 1 Site Location Map**
- Figure No. 2 Draft Plan of Subdivision**
- Figure No. 3 Existing Drainage Area Plan**
- Figure No. 4 Existing and Post-Development External Drainage Area Plan**
- Figure No. 5 Post-Development Drainage Area Plan**
- Figure No. 6 Post-Development Major Storm Drainage Area Plan**

APPENDICES

- APPENDIX A: STAGE-STORAGE-DISCHARGE CALCULATIONS**
- APPENDIX B: MTO IDF CURVE LOOKUP RESULTS**
- APPENDIX C: TESTHOLE LOCATIONS AND LOGS**
- APPENDIX D: MIDUSS MODELLING – EXISTING CONDITIONS**
- APPENDIX E: MIDUSS MODELLING – POST-DEVELOPMENT CONDITIONS**
- APPENDIX F: FOREBAY DESIGN CALCULATIONS**
- APPENDIX G: DRAWDOWN TIME CALCULATIONS**
- APPENDIX H: MIDUSS MODELLING – POST-DEVELOPMENT CONDITIONS – MAJOR DESIGN STORM EVENTS**
- APPENDIX I: COOLING TRENCH SIZING CALCULATIONS**

**MOUNT FOREST SUBDIVISION
TOWNSHIP OF WELLINGTON NORTH, ON**

STORMWATER MANAGEMENT REPORT

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1. INTRODUCTION AND BACKGROUND

Avila Investments Ltd. proposes to construct a residential and commercial subdivision on their property located within the southerly part of Mount Forest within the Township of Wellington North (Township), ON. The approximately 31.13 ha, irregularly shaped subject property, is located as shown in Figure No. 1.

For the purposes of this report, Highway No. 6 is assumed to travel in a north-south direction. Therefore, the subject property is located on the northwesterly corner of the intersection of Highway No. 6 and Bentley Street, along the southerly boundary of the Mount Forest settlement area. Agricultural lands are located easterly and southerly of the subject property. The subject property is also bound by former rail lands and the Saugeen River to the west, and residential lands fronting South Water Street to the north.

The Draft Plan of the proposed subdivision is provided as Figure No. 2, and consists generally of the following:

- 231 lots for single detached dwellings (Lots 1-116, 131-245; 231 units; 12.296 ha),
- 30 lots for semi-detached dwellings (Lots 117-130, 246-261; 60 units, 1.672 ha),
- Seven (7) blocks for street townhouse dwellings (Blocks 262-268; 120 units, 3.106 ha),
- Two (2) blocks for commercial development (Blocks 269-270; 2.953 ha),
- One (1) block for park/ open space area (Block 271; 2.574 ha),
- One (1) block for stormwater management (Block 273; 1.722 ha),
- Two (2) blocks for walkways (Blocks 272 & 274; 0.141 ha),
- One (1) block for a hydro substation (Block 286; 0.060 ha), and,
- Approximately 6.615 ha of roadway, road widening/ reserves, and daylight triangles.

An outlet channel is proposed to be constructed from the proposed stormwater management (SWM) facility, located in Block 273, to the Saugeen River via the former rail lands. The proposed outlet channel is designed to convey flows from the proposed SWM facility, and a portion of adjacent external lands, to the Saugeen River.

A Natural Heritage Environmental Impact Assessment (EIA) was previously completed for the subject property by AWS Environmental Consulting Inc. in December 2014. The EIA provides required mitigation measures related to the stormwater management design.

A previously approved Preliminary Servicing and SWM Report was prepared by GM BluePlan Engineering Ltd. (GMBP) in March 2017 (previous GMBP File: 108025), which was submitted in support of Draft Plan Approval for the proposed subdivision.

GMBP has been retained by Avila Investments Ltd. to provide a SWM Report to document the detailed SWM design of the proposed development. This SWM Report is provided to update and supplement the previously approved Preliminary Servicing and SWM Report, to address the stormwater quantity control and quality treatment for site runoff to the satisfaction of the Township, the Saugeen Valley Conservation Authority (SVCA), and the Ministry of the Environment Conservation and Parks (MECP) in support of an Environmental Compliance Approval for the proposed works.

2. EXISTING CONDITIONS AND DRAINAGE

Under existing conditions, the majority of the approximately 31.13 ha subject property is used for agricultural purposes; the site is actively farmed with row crops. The westerly portion of the subject property located adjacent to the Saugeen River and defined by the Saugeen Valley Conservation Authority (SVCA) as 'Core Greenland', consists of a forested, sloped area.

The subject property slopes generally downward from Highway No. 6 to the northerly and westerly property boundaries. The easterly portion of the subject property generally slopes moderately downward with more mild slopes existing throughout the central portion, and a steeper descent within the westerly portion located adjacent to the Saugeen River.

Under existing conditions, runoff draining from the subject property to the northerly property boundary, generally drains as overland flow to the rear of the existing residential properties fronting South Water Street and unopened municipal rights-of-way (ROWs). Runoff draining to the westerly property boundary, generally drains as overland sheet flow directly to the Saugeen River. The westerly and northerly portions of the Highway No. 6 and Bentley ROWs are considered to drain through the subject property.

Portions of the easterly adjacent external lands (lands easterly of Highway No. 6), southerly adjacent external lands (lands southerly of Bentley Street), and westerly adjacent external lands (former rail lands), herein referred to collectively as the 'adjacent external lands', are considered to drain generally to the location of the proposed outlet channel, for existing conditions analysis purposes.

Ultimately, the entirety of the subject property, and the adjacent external lands upstream of the proposed outlet channel, are considered to drain to the Saugeen River under existing conditions. The reach of the Saugeen River downstream of the subject property has been identified as having a "cool water thermal regime" by the previously completed EIA.

The existing drainage conditions of the subject property and adjacent external lands are represented as eight (8) catchment areas as described below and shown in Figures No. 3 and 4:

Catchment 10 – represents the northerly portion of the subject property ultimately draining to the Saugeen River via the adjacent 130 South Water Street Property. Under existing conditions, runoff from Catchment 10 is expected to drain to an existing on-site berm located along a portion of the subject property's northerly boundary. In relation to adjacent properties, the existing on-site berm extends generally from the 250 Harris Street property to the 130 South Water Street property. Runoff draining to the existing on-site berm is directed northerly to a point of discharge within the adjacent 130 South Water Street property. This outlet location is proposed to be generally maintained under post-development conditions. The existing ground cover within the catchment consists generally of row crops/ seeded legumes.

Catchment 11 – represents the portion of the subject property draining to the adjacent 250 Harris Street property. Under existing conditions, runoff from Catchment 11 is expected to drain as overland flow and ultimately outlet to the Saugeen River. The existing ground cover consists generally of row crops/ seeded legumes.

Catchment 12 – represents the portion of the subject property draining to the adjacent unopened Harris Street ROW. Under existing conditions, runoff from Catchment 12 is expected to drain as overland flow and ultimately outlet to the Saugeen River. The existing ground cover consists generally of row crops/ seeded legumes.

Catchment 13 – represents the portion of the subject property draining to the unopened portion of the South Water Street ROW located adjacent to the northerly property boundary. Under existing conditions, runoff from Catchment 13 is expected to drain as overland flow and ultimately outlet to the Saugeen River. The existing ground cover consists generally of row crops/ seeded legumes.

Catchment 14 – represents the remaining portion of the subject property. Under existing conditions, runoff from Catchment 14 is expected to drain as overland flow and ultimately outlet to the Saugeen River; either directly or via the rear-yard area of the adjacent 241 South Water Street property. The existing ground cover consists generally of row crops/ seeded legumes.

Catchment 20 – represents the portion of the adjacent Highway No. 6 and Bentley Street ROWs expected to drain through the subject property to the Saugeen River under existing conditions. The existing pervious ground cover consists generally of grass. The existing impervious ground cover consists generally of the westerly and northerly portions of the Highway No. 6 and Bentley Street roadways, respectively.

Catchment 30 – represents the easterly adjacent external lands located easterly of Highway No. 6. The existing pervious ground cover consists generally of crops, and the existing impervious ground cover consists generally of rooftops, driveways and the easterly portion of the Highway No. 6 roadway. Runoff from Catchment 30 currently appears to drain to a low point located to the east of the Highway No. 6 and Bentley Street intersection. However, there does not appear to be an outlet across Highway No. 6, and it is believed that surface runoff is removed via infiltration or evapotranspiration. Furthermore, the existing topography within Catchment 30 is expected to permit runoff ponding within it to spill northerly to Murphy Street via the 180 Murphy Street property, prior to spilling across Highway No. 6. For conservative consideration, the runoff from Catchment 30 is assumed to drain across Highway No. 6 without impediment, to drain along the southerly roadside ditch of Bentley Street to the location of the proposed outlet channel, and to drain ultimately to the Saugeen River; runoff from Catchment 30 is not considered to drain through the subject property.

Catchment 31 – represents the westerly and southerly adjacent external lands consisting of the former rail lands and lands located southerly of Bentley Street. The existing pervious ground cover consists generally of crops, and the existing impervious ground cover consists generally of rooftops, driveways and the easterly portion of the Highway No. 6 roadway. Under existing conditions, runoff from catchment lands located southerly of Bentley Street is expected to drain generally to and along the southerly roadside ditch of Bentley Street, to a low point located approximately 790 m westerly of the Bentley Street and Highway No. 6 intersection; runoff ponding within this low point is expected to spill ultimately northerly across Bentley Street to the former rail lands. However, it is not easily discernable how, or if, runoff from the former rail lands drains across the ridge formed by the former rail bed located adjacent to Blocks 271 and 273. For conservative consideration, the runoff from Catchment 31 is assumed to drain across the former rail bed without impediment to the location of the proposed outlet channel and drain ultimately to the Saugeen River; runoff from Catchment 31 is not considered to drain through the subject property.

2.1 Stormwater Management Criteria

Based on the existing drainage conditions, the requirements of the Township, SVCA and MECP, and the required mitigation measures outlined in the previously completed EIA, the criteria used to develop the appropriate SWM approach for the proposed development, are as follows:

1. Total post-development peak flow rates draining from the subject property to the Saugeen River are to be attenuated to less than, or equal to, the existing peak flow rates for all of the following design storm event return periods: 2-, 5-, 10-, 25-, 50- and 100-year.
2. In addition, for the 2-, 5-, 10-, 25-, 50-, 100-year design storm events, post-development peak flow rates draining from the subject property, are to be attenuated to less than, or equal to, the existing peak flow rates draining to the following outlet locations within the northerly adjacent lands:
 - A. 130 South Water Street property
 - B. 250 Harris Street property
 - C. Unopened Harris Street ROW
 - D. Unopened portion of the South Water Street ROW
3. The proposed on-site storm sewer system is to convey the runoff associated with a 5-year design storm event, at minimum.
4. Hydrological modelling shall consider a Type II 6-hour SCS rainfall distribution as per the Township's Municipal Servicing Standards (Standards).
5. The SWM design shall demonstrate no negative impacts to water quality or fish habitat within the receiving waters of the Saugeen River:
 - a. An "Enhanced" level of water quality treatment (80% TSS Removal) is to be provided for runoff draining from the proposed development prior to discharging from the subject property.
 - b. The design of the outlet channel, from the proposed SWM facility to the Saugeen River, shall incorporate the design parameters provided in the previously completed EIA. This includes:
 - i. Lining the outlet channel with larger diameter riprap to promote aeration of, and prevent erosion by, conveyed flows.
 - ii. Providing a minimum 1 m of vertical drop at the outlet channel's confluence with the Saugeen River to prevent 'fish access' to the outlet channel. Erosion measures shall be provided to prevent undercutting of the outlet channel or plunge pool creation.
 - iii. Placement of three (3) partially embedded boulders (>0.3 m Ø) at the outlet channel's confluence with the Saugeen River to promote quick 'mixing' of its discharge waters with native river waters.
 - c. The SWM design shall provide thermal controls to reduce thermal impacts due to runoff draining from the developed portions of the subject property prior to discharging to the Saugeen River.

3. POST-DEVELOPMENT CONDITIONS AND DRAINAGE

Under post-development conditions, the impervious level of each drainage catchment within the subject property is calculated generally as a weighted average based on the land uses within them. The impervious levels considered for each land use are described in the following Table 1.

Table 1: Design Impervious Level by Land Use

Land Use	Impervious Level
Single detached lot	50%
Semi-detached lot	55%
Street townhouse blocks	60%
Commercial blocks	90%
On-site roadways, road widening/ reserves, daylight triangles, hydro substation	65%
Walkways	10%
SWM block	Combined area of proposed access road and maximum wetted surface area within proposed SWM facility
Park/ Open Space	Negligible

In addition to the proposed on-site development, Bentley Street is proposed to be reconstructed, from its intersection with Highway No. 6 to approximately 675 m westerly of the same intersection. The existing roadside ditch is proposed to be filled in, and curb and gutter is proposed to be installed along the northerly side of the reconstructed roadway. Along the southerly side of the reconstructed roadway, curb and gutter is proposed from the Highway No. 6 intersection to a point located approximately 150 m westerly of the same intersection. The southerly roadside ditch of Bentley Street is proposed to be cleaned out and re-graded, with existing driveway culverts being replaced, as required; the existing outlet of the southerly roadside ditch is considered to be maintained under post-development conditions.

3.1 Areas Draining from Subject Property via Proposed SWM Facility

3.1.1 Drainage to Proposed SWM Facility

Under post-development conditions, the majority of the subject property, as well as the easterly and northerly portions of the Highway No. 6 and Bentley Street ROWs, respectively, are expected to drain to the proposed SWM facility via a combination of the proposed storm sewer and as overland flow. The storm sewer is proposed to consist of two separate systems: the primary and secondary storm sewer systems.

The proposed **primary storm sewer system** consists mainly of on-site storm sewer installed within the subject property, and a portion of off-site storm sewer installed along Bentley Street, easterly of Street 'A', and Highway No. 6, northerly of Bentley Street. The primary storm sewer system is proposed to include several rear-yard catchbasins along the northerly property boundary. The outlet pipes of these rear-yard catchbasins, are proposed to drain to the trunk storm sewer portion of the primary storm sewer system, located along the proposed on-site roads, and have backflow preventors installed on their downstream end.

The primary storm sewer system is expected to drain most of the developed portions of the proposed subdivision with the exception of relatively small northerly, westerly and southwesterly portions of the subject property. The westerly portion of the Highway No. 6 ROW is considered to drain to the primary storm sewer system. The portion of Bentley Street located easterly of the proposed Street 'A' and proposed to be reconstructed with curb and gutter, is also considered to drain to the primary storm sewer system.

In general, the primary storm sewer system is expected to provide adequate capacity to convey the runoff draining from its tributary lands to the forebay of the proposed SWM facility during a 5-year design storm event, at minimum. The storm sewer leads draining the rear-yard catchbasins to the trunk storm portion of the primary storm sewer system, are designed with sufficient capacity to convey the runoff draining from their respective rear-yard areas during a 100-year design storm event, provided capacity is available with the trunk storm sewer portion.

During design storm events of greater than the 5-year return period, or if the primary storm sewer were to become obstructed, runoff may surcharge in the primary storm sewer system and be conveyed by the proposed on-site roadways to the proposed SWM facility via the northerly overland flow route; proposed grading throughout the subdivision is expected to prevent the flooding of proposed residences in the conveyance of these flows to the SWM facility. The northerly overland flow route, provided by the access road proposed within the SWM block (Block 273), between the SWM facility and Street 'D', is designed to provide adequate capacity to convey the runoff expected to drain from the tributary lands of the primary storm sewer system during a 100-year design storm event. The northerly overland flow route is proposed to discharge to the forebay of the proposed SWM facility at its northeasterly corner. The northerly overland flow route is proposed to be lined with 'turfstone' to provide a driving surface for the access road and protection from the effects of erosion. An analysis of the flow capacity and design flow within the northerly overland flow route is provided in Section 4.6.

The proposed **secondary storm sewer system** consists mainly of off-site storm sewer installed along the northerly side of the reconstructed Bentley Street, and a portion of on-site storm sewer installed within the proposed SWM block.

The secondary storm sewer system is expected to drain the northerly portion of the Bentley Street ROW located westerly of Street 'A', as well as the front-yard areas of the proposed lots adjacent to it (southwesterly portion of subject property). Rear-yard areas of Lots 1 to 4, and 34 to 36, are also considered to drain to the secondary storm sewer system.

In general, the secondary storm sewer system is expected to provide adequate capacity to convey the runoff draining from its tributary lands to the forebay of the proposed SWM facility during a 5-year design storm event, at the minimum.

During design storm events of greater than the 5-year return period, or if the secondary storm sewer were to become obstructed, runoff may surcharge in the secondary storm sewer system and be conveyed along the northerly curb and gutter of the reconstructed Bentley Street roadway to the proposed SWM facility via the southerly overland flow route. The southerly overland flow route is proposed to be constructed as a grassed swale extending from Bentley Street to the southeasterly corner of the proposed SWM facility. The southerly overland flow route is designed to provide adequate capacity to convey the runoff expected to drain from the tributary lands of the secondary storm sewer system during the 100-year design storm event. An analysis of the flow capacity and design flow within the southerly overland flow route is provided in Section 4.6.

Rear-yard areas of Lots 36 to 46 are considered to drain directly to the proposed SWM facility as overland flow under post-development conditions.

3.1.2 Proposed SWM Facility

The SWM facility, designed generally as a wetland-type facility, is proposed to be constructed within Block 273 to provide peak flow rate attenuation and water quality treatment to runoff draining from the proposed development.

The SWM facility is proposed to generally have a 0.3 m-deep permanent pool throughout with 1.3 m-deep sections located near its inlet and outlet. The deeper section at the SWM facility's inlet, immediately downstream of the storm sewer systems' outlets, is designed to serve as a forebay to encourage pollutant removal. At the SWM facility's outlet, the deeper section is provided to serve as a stilling basin to encourage the minimization of re-suspension and discharge of settled pollutants from the SWM facility.

Two berms are proposed to be constructed within the SWM facility that extend into its storage area from opposite sides of the facility in a "serpentine" design. The berms, proposed to extend approximately 0.3 m above the permanent pool elevation, are intended to increase the effective flow path between the SWM facility's inlet and outlet locations under low-flow conditions.

The outlet system of the proposed SWM facility is designed to have three (3) outlets:

- **First Controlled Outlet** – A 200 mm Ø pipe outlet within a new double ditch inlet catchbasin (DDICB; OPSD 705.040). The DDICB's top of grate elevation is proposed to be equal to that of the permanent pool. When runoff ponds within the SWM facility to an elevation above the DDICB's top of grate, runoff is considered to drain from the DDICB via the 200 mm Ø pipe as orifice tube flow to a secondary DDICB.
- **Second Controlled Outlet** – Twin 250 mm Ø pipe outlets within a secondary ditch inlet catchbasin manhole (DICBMH; OPSD 702.040). When the elevation of the ponding runoff within the SWM facility is greater than the secondary DICBMH's top of grate elevation, then discharge from the facility is considered to be governed by the second controlled outlet. Runoff drains via the second controlled outlet as orifice tube flow to the proposed outlet channel.
- **Third Outlet** – A 9 m-wide emergency overflow weir. When the elevation of ponding runoff within the SWM facility is greater than the elevation of the top of the weir, runoff is expected to spill from the SWM facility to the outlet channel via the weir, while continuing to discharge via the second controlled outlet. The emergency overflow weir is designed to convey the expected unattenuated inflows to the SWM facility during a 100-year design storm event.

The stage-storage-discharge calculations for the proposed SWM facility are included as Appendix A. Analysis of the proposed SWM facility's significant design elements, is provided in Section 4.7.

3.1.3 Drainage from Proposed SWM Facility

The outflows from the SWM facility drain to the proposed outlet channel located westerly of the facility. The outlet channel is proposed to span generally from the outlet system of the SWM facility within Block 273, westerly to the adjacent former rail bed lands, and along the northerly side of the existing rail bed to the Saugeen River.

Immediately downstream of the SWM facility, the outlet channel is proposed to have a minimum 15 m-long cooling trench to mitigate the thermal impacts due to the SWM facility's outflows prior to being conveyed to the Saugeen River. The cooling trench consists of a layer of clear stone layer wrapped in geotextile fabric and overlain by rip rap. At the surface, the cooling trench is proposed to be an open-air trapezoidal-shaped channel. Analysis of the cooling trench design is provided in Section 6.2. Downstream of the cooling trench, the outlet channel is proposed to be an open-air trapezoidal-shaped channel lined with rip rap.

The adjacent external lands are considered to drain to the outlet channel downstream of the proposed cooling trench. However, the entire span of the proposed outlet channel is expected to provide adequate capacity to convey the flows draining from the proposed SWM facility and external lands during a 100-year design storm event. During design storm events of greater than the 100-year return period, or should the outlet channel become obstructed, surcharging runoff would spill from the proposed outlet channel, generally along its northerly bank, and be conveyed as overland sheet flow through Block 271 to the Saugeen River.

Further analysis of the proposed outlet channel's design is provided in Section 4.8.

3.2 Areas Draining Uncontrolled from Subject Property

Under post-development conditions, small and isolated areas in the northerly and westerly portions of the subject property are expected to drain from the subject property uncontrolled as piped and overland flow.

The northerly portion of the subject property proposed to drain uncontrolled to the adjacent northerly property (130 South Water Street) under post-development conditions, is reduced in area from existing conditions. This portion of the subject property includes rear-yard areas of Lots 200 to 209. Runoff from this northerly portion is proposed to be collected and conveyed by a new storm sewer lead and swale, located along the rear of the subject lots, that discharges generally to the same outlet location within the adjacent northerly property (130 South Water Street) as under existing conditions. This proposed storm sewer lead is designed with adequate capacity to convey the runoff draining from its tributary lands during a 100-year design storm event, at minimum. Neighbouring property owners were consulted at length during the Draft Plan stage, and the owners of the 130 and 136 South Water Street properties have confirmed a willingness to assist and cooperate by providing the Township with easement rights for the construction and maintenance of a storm lead and overland flow route to municipal roadside ditches located along the southerly side of South Water Street.

The westerly portion of the subject property, including a majority of the park/ open space block (Block 271), and rear-yard areas of Lots 43-52, are also considered to drain ultimately to the Saugeen River as uncontrolled overland flow under post-development conditions.

Along the northerly property boundary, catchbasins proposed within some rear-yard areas have a lower top of grate elevation than that of the structure within the proposed roadway (trunk storm sewer portion) to which its outlet pipe drains. During design storm events greater than the 5-year return period, the flow capacity of the primary storm sewer may be surcharged. To prevent surcharging runoff from spilling from the trunk sewer portion to these rear-yard areas, it is proposed to install backflow preventors on the downstream ends of the outlet pipes of these rear-yard catchbasins.

During conditions where the flow capacity provided by the primary storm sewer system is surcharged, runoff from these rear-yard areas may spill ultimately to adjacent northerly lands. Additional considerations for the drainage of these rear-yard areas during major storm events, considered by this report to be storms greater than the 5-year return period up to, and including, the 100-year design storm event, is provided in Section 5. For conservative sizing purposes, these rear-yard areas are considered to drain to the proposed SWM facility under post-development conditions.

3.3 Adjacent External Lands

Under post-development conditions, the adjacent external lands are not expected to drain via the primary or secondary storm sewer systems and are not expected to drain to the proposed SWM facility either by piped or overland flow.

As it is not apparent that the adjacent external lands, in reality, drain to the location of the proposed outlet channel under the existing conditions or the post-development conditions of the proposed development, the provision of additional capacity within the proposed outlet channel to accommodate the runoff draining from them is considered to be conservative.

Furthermore, the SWM design does not propose drainage works intended to convey the flows from the adjacent external lands to the proposed outlet channel. It is assumed that the conveyance of runoff draining from the adjacent external lands to the proposed outlet channel be the responsibility of the future developer(s) of those lands. The proposed SWM design is not intended to accommodate the conveyance of runoff draining from the adjacent external lands as overland flow along the northerly portion of the reconstructed Bentley Street roadway; it is expected that the overland flow route would be contained to the southerly portion of the Bentley Street ROW.

3.4 Modelled Catchment Areas

The post-development drainage conditions of the subject property and adjacent external lands are represented as nine (9) catchment areas as described below and shown in Figures No. 4 and 5:

Catchment 100 – represents the portion of the subject property expected to drain to the proposed SWM facility mainly via the primary storm sewer system under post-development conditions. In general, this includes the entirety of the proposed development within the subject property with the exception of westerly and northerly portions of the subject property.

Catchment 101 – represents the portion of the subject property expected to drain to the proposed SWM facility via the secondary storm sewer system under post-development conditions. In general, this includes the front-yard areas of lots fronting Bentley Street, westerly of Street 'A', and rear-yard areas of Lots 1 to 4, and 34 to 36.

Catchment 102 – represents the proposed SWM block (Block 273). For conservative design purposes, the entirety of the SWM block is considered to drain to the proposed SWM facility under post-development conditions. The impervious level of this catchment conservatively considers the expected maximum ponding area within the proposed SWM facility as well as the access road proposed along the facility's perimeter.

Catchment 110 – represents the westerly portion of the subject property expected to drain uncontrolled from the subject property, ultimately to the Saugeen River, during all design storm events. In general, this includes the majority of Block 271, and the rear-yard areas of Lots 43 to 54. Runoff from Catchment 110 generally drains from the subject property as overland flow either directly to the Saugeen River, or via the adjacent unopened portion of the South Water Street ROW.

Catchment 111 – represents the northerly portion of the subject property expected to drain uncontrolled from the subject property to the Saugeen River under post-development conditions via the adjacent 130 South Water Street property, during all design storm events. This generally includes the rear-yard area of Lots 200 to 209 and Block 274. The existing berm within this area is proposed to be removed, and swales and a storm sewer lead are proposed to be constructed along the rear-yard boundary of these lots and block. The outlet location of the proposed swales is expected to generally maintain the existing point of discharge from the subject property to the adjacent 130 South Water Street property. From Lots 200 to 209, the only impervious surfaces expected to drain to the proposed swales are the rear halves of their proposed dwellings' rooftops; the impervious level of this catchment is modelled with this consideration.

Catchment 201 – represents the portion of the adjacent Highway No. 6 and Bentley Street ROWs expected to drain to the proposed SWM facility via the primary storm sewer system, under post-development conditions. The impervious level of these lands is expected to be increased from existing conditions due to the driveways and intersections proposed as part of the development.

Catchment 202 – represents the portion of the adjacent Bentley Street ROW expected to drain to the proposed SWM facility via the secondary storm sewer system, under post-development conditions. The impervious level of these lands is expected to be increased from existing conditions due to the driveways proposed as part of the development.

Catchment 300 – represents the easterly adjacent external lands located easterly of Highway No. 6. These lands are expected to be generally maintained from existing conditions (Catchment 30) under post-development conditions. For conservative consideration, the runoff from Catchment 300 is assumed to drain across Highway No. 6 without impediment to the location of the proposed outlet channel and drain ultimately to the Saugeen River; runoff from Catchment 300 is not considered to drain through the subject property.

Catchment 301 – represents the westerly and southerly adjacent external lands consisting of the former rail lands and lands located southerly of Bentley Street. These lands are expected to be generally maintained from existing conditions (Catchment 31) under post-development conditions. For conservative consideration, the runoff from Catchment 301 is assumed to drain across the former rail bed without impediment to the location of the proposed outlet channel and drain ultimately to the Saugeen River; runoff from Catchment 301 is not considered to drain through the subject property.

4. QUANTITY CONTROL CRITERIA, PARAMETERS, MODELLING AND DESIGN ANALYSIS

4.1 Design Rainfall Events

As per the Township's Standards, rainfall within lands under the jurisdiction of the SVCA shall be represented as an SCS Type II rainfall distribution. Furthermore, it is a requirement that the rainfall intensity be based on the Ontario Ministry of Transportation (MTO) Intensity-Duration-Frequency (IDF) curves. The IDF data retrieved from the MTO's online IDF Curve Lookup tool for the subject property's location, is provided as Appendix B, and the corresponding rainfall depths for the modelled 6-hour storm events are summarized in the following Table 2.

Table 2: Design Rainfall Events – Based on MTO IDF Curve Data (2010)

Design Storm Event – Return Frequency	2-Year	5-Year	10-Year	25-Year	50-year	100-Year
Duration (min)	360	360	360	360	360	360
Depth (mm)	40.0	52.8	61.4	72.2	80.1	88.0
Intensity (mm/hr)	29.6	39.1	45.5	53.5	59.4	65.2

4.2 Site Soil Conditions

The soil types within the subject property and the adjacent external southerly and westerly lands, are characterized generally as Listowel silt loam and Teeswater silt loam, as per the Wellington County Soils Map (Ontario Soil Survey Report No. 35) published by the Department of Agriculture. The soil type within the easterly adjacent external lands is characterized generally as Listowel silt loam and Harriston silt loam.

Listowel and Harriston silt loams are known to be generally of the Hydrologic Soil Group (HSG) BC; Teeswater silt loam is generally of the HSG B.

On March 28, 2019, 12 testholes (Boreholes 1 – 12) were excavated across the subject property on March 28, 2019 by CMT Engineering Inc. (CMT). Five (5) additional testholes (Test Pits 1 – 5) were excavated by CMT within the northwesterly portion of the subject property on September 16, 2019. The location and logs of these testholes are provided as Appendix C.

In review of the information provided by the Wellington Soils Map and local testholes, the soils within the subject property and portions of external, adjacent lands, can be generally characterized as an HSG BC soil.

With reference to MTO Design Chart 1.09, the typical SCS Curve Number values for an HSG BC soil given the existing and post-development ground cover within the subject property and external, adjacent lands, are summarized in Table 3 below.

Table 3: SCS Curve Number Values by Ground Cover Type

Ground Cover Type	SCS Curve Number Value
Crop and other improved land*	78
Pasture & other unimproved land	71
Woodlots and forest	65
Impervious surfaces	98
<i>*Lawns considered to be <u>Crop and other improved lands</u></i>	

The pervious SCS Curve Number values used for each of the modelled catchments are generally weighted based on the area of each of the pervious ground cover types within the catchment area.

4.2.1 SWM Facility Considerations

The proposed SWM facility is designed as a wetland-type facility which requires the maintenance of a permanent pool for its intended function. The proposed elevation of the SWM facility's bottom is approximately 410.70 m within its forebay and stilling basin areas, and approximately 411.70 m throughout the remainder.

Of the testholes completed on March 28, 2019 by CMT, Borehole 12 is located centrally within the proposed SWM facility. Its logs indicate that a "sandy silt till" layer exists within the range of the SWM facility's proposed bottom elevations. A sample was obtained from within this layer and analyzed in a "Particle Size Distribution Report"; provided as part of Appendix C. The Particle Size Distribution Report estimated that the sample had a Coefficient of Permeability of less than 1.0×10^{-6} cm/s (or ~ 0.315 m/year).

Therefore, it is anticipated that the existing soils located within the area of the proposed SWM facility are adequate to support the maintenance of a permanent pool given the elevations proposed for the SWM facility's bottom. During construction, should it be discovered that existing soils within the area are not suitable for the maintenance of a permanent pool, the installation of a clay or plastic/ rubber liner may be required.

4.3 Existing Catchment Areas

For existing analysis purposes, the approximately 31.13 ha subject property and approximately 41.65 ha external lands, are modelled as eight (8) drainage catchments; summarized in Table 4 below and shown on Figures No. 3 and 4. The existing conditions MIDUSS computer modelling is attached as Appendix D.

Table 4: Existing Conditions Catchments

Catchment	General Description	Area (ha)	Impervious Level (%)
10	Portion of subject property draining to Saugeen River via the northerly adjacent 130 South Water Street property	1.88	0
11	Portion of subject property draining to Saugeen River via the northerly adjacent 250 Harris Street property	0.77	0
12	Portion of subject property draining to Saugeen River via the northerly adjacent unopened Harris Street ROW	0.41	0
13	Portion of subject property draining to Saugeen River via the northerly adjacent unopened portion of the South Water Street ROW	19.81	0
14	Remaining portion of subject property draining uncontrolled to Saugeen River	8.26	0
20	Portion of Highway No. 6 and Bentley Street ROW lands draining to Saugeen River via subject property	1.44	0
30	External easterly lands (lands east of Highway No. 6)	12.96	4
31	External westerly and southerly Lands (former rail bed lands and lands south of Bentley Street)	27.25	3

The results of the existing conditions routing analysis are summarized in Section 4.5.

4.4 Post-Development Catchment Areas

For post-development analysis purposes, the approximately 31.13 ha subject property and approximately 41.65 ha external lands, are modelled as nine (9) drainage catchments; summarized in Table 5 below and shown on Figures No. 4 and 5. The post-development conditions MIDUSS computer modelling is provided as Appendix E.

Table 5: Post-Development Conditions Catchments

Catchment	General Description	Area (ha)	Impervious Level (%)
100	Portion of subject property draining to Saugeen River via primary storm sewer system and SWM facility	25.39	60
101	Portion of subject property draining to Saugeen River via secondary storm sewer system and SWM facility	0.56	50
102	Proposed SWM block	1.72	70
110	Westerly portion of subject property draining uncontrolled to Saugeen River as overland flow	3.01	10
111	Northerly portion of subject property draining uncontrolled to Saugeen River via the adjacent 130 South Water Street property	0.45	35
201	Portion of Highway No. 6 and Bentley Street ROW lands draining to Saugeen River via primary storm sewer system and SWM facility	1.16	60
202	Portion of Bentley Street ROW lands draining to Saugeen River via secondary storm sewer system and SWM facility	0.28	75
300	External easterly lands (lands east of Highway No. 6)	12.96	4
301	External westerly and southerly Lands (former rail bed lands and lands south of Bentley Street)	27.25	3

The results of the post-development conditions routing analysis are summarized in Section 4.5.

4.5 MIDUSS Quantity Control Modelling Results

MIDUSS modelling software was used to model the existing and post-development conditions runoff draining from the proposed development and the adjacent external lands during the various design storm events. Results from the models are summarized in the following tables, and the modelling is provided for reference in Appendices D and E.

The following Tables 6 and 7 summarize the total peak flow rates discharging to the Saugeen River from the modelled catchments under existing and post-development conditions, respectively.

Table 6: Summary of Peak Flow Rate Results – Existing Conditions

Outlet	Return Storm Frequency (yr)					
	2-year	5-year	10-year	25-year	50-year	100-year
Peak flow rate draining from subject property to Saugeen River via the 130 South Water Street property – <i>Catch. 10</i> (m ³ /s)	0.014	0.031	0.046	0.069	0.088	0.108
Peak flow rate draining from subject property to Saugeen River via the 250 Harris Street property – <i>Catch. 11</i> (m ³ /s)	0.005	0.012	0.017	0.025	0.032	0.040
Peak flow rate draining from subject property to Saugeen River via the unopened Harris Street ROW – <i>Catch. 12</i> (m ³ /s)	0.006	0.012	0.018	0.025	0.031	0.038
Peak flow rate draining from subject property to Saugeen River via the unopened portion of the South Water Street ROW – <i>Catch. 13</i> (m ³ /s)	0.080	0.160	0.230	0.337	0.428	0.530
Peak flow rate draining from the remainder of the subject property to Saugeen River; either directly or via the rear-yard area of the 241 South Water Street property – <i>Catch. 14</i> (m ³ /s)	0.036	0.075	0.112	0.170	0.221	0.277
Peak flow rate draining from portions of the Highway No. 6 and Bentley Street ROWs to the Saugeen River, via the subject property – <i>Catch. 20</i> (m ³ /s)	0.058	0.089	0.113	0.143	0.165	0.188
Total peak flow rate draining to Saugeen River from subject property* – <i>Catch. 10, 11, 12, 13, 14, 20</i> (m³/s)	0.135	0.272	0.393	0.576	0.730	0.898
Peak flow rate draining to Saugeen River from adjacent external lands – <i>Catch. 30, 31</i> (m ³ /s)	0.162	0.342	0.503	0.747	0.958	1.192
Total peak flow rate draining to Saugeen River from modelled catchments* – <i>Catch. 10, 11, 12, 13, 14, 20, 30, 31</i> (m³/s)	0.289	0.604	0.881	1.298	1.655	2.055
* Totaled peak flow rates draining from subject property may not necessarily equal the sum of the peak flow rates draining to each initial outlet due to the timing of peak flow hydrographs within the MIDUSS modelling.						

Table 7: Summary of Peak Flow Rate Results – Post-Development Conditions

Outlet	Return Storm Frequency (yr)					
	2-year	5-year	10-year	25-year	50-year	100-year
Peak flow rate draining to SWM facility via primary storm sewer system – <i>Catch. 100, 201 (m³/s)</i>	1.246	1.837	2.271	2.825	3.270	3.705
Peak flow rate draining to SWM facility via secondary storm sewer system – <i>Catch. 101, 202 (m³/s)</i>	0.043	0.062	0.076	0.093	0.105	0.117
Total peak flow rate draining to SWM facility* – <i>Catch. 100, 101, 102, 201, 202 (m³/s)</i>	1.384	2.030	2.501	3.103	3.583	4.052
Peak flow rate draining from SWM facility – <i>Catch. 100, 101, 102, 201, 202 (m³/s)</i>	0.109	0.126	0.329	0.440	0.457	0.477
Peak flow rate draining uncontrolled from westerly portion of subject property to Saugeen River – <i>Catch. 110 (m³/s)</i>	0.124	0.045	0.069	0.105	0.136	0.169
Peak flow rate draining from northerly portion of subject property to Saugeen River via adjacent northerly property (130 South Water Street) – <i>Catch. 111 (m³/s)</i>	0.014	0.023	0.030	0.039	0.046	0.054
Total peak flow rate draining to Saugeen River from subject property* – <i>Catch. 100, 101, 102, 110, 111, 201, 202 (m³/s)</i>	0.124	0.164	0.356	0.491	0.561	0.634
Peak flow rate draining to Saugeen River from adjacent external lands – <i>Catch. 300, 301 (m³/s)</i>	0.162	0.342	0.503	0.747	0.958	1.192
Total peak flow rate draining to Saugeen River from modelled catchments* – <i>Catch. 100, 101, 102, 110, 111, 201, 202, 300, 301 (m³/s)</i>	0.285	0.492	0.765	1.237	1.471	1.733
* Totaled peak flow rates draining from subject property may not necessarily equal the sum of the peak flow rates draining to each initial outlet due to the timing of peak flow hydrographs within the MIDUSS modelling.						

In comparison of Tables 6 and 7 above, under post-development conditions, the peak flow rates draining from the subject property to the Saugeen River, are expected to be attenuated to less than existing conditions for all modelled design storm events. Furthermore, the total post-development peak flow rates draining from the subject property and the adjacent external lands to the Saugeen River, are expected to be attenuated to less than existing conditions for all modelled design storm events.

Within the northerly portion of the subject property, the post-development peak flow rates draining to the northerly adjacent property (130 South Water Street) are expected to be less than, or equal to, existing conditions for all modelled design storm events.

To provide adequate capacity to convey the unattenuated SWM facility inflows during the 100-year design storm event, the emergency overflow weir (third outlet) is proposed to provide a flow capacity of at least 4.052 m³/s.

Table 8 below summarizes the capacity available at the various stages within the extended proposed SWM facility and provides a comparison to the capacity that is expected to be used during the various design storm events. The Stage-Storage-Discharge Calculations for the proposed SWM facility are provided as Appendix A.

Table 8: Stage-Storage-Discharge Capacities for Proposed SWM Facility

	Available Capacity in SWM Facility Design			Capacity Used During Various Design Storm Events		
	Peak Flow Rate (m ³ /s)	Active Storage Volume (m ³)	Active Storage Elevation (m)	Peak Flow Rate (m ³ /s)	Active Storage Volume (m ³)	Active Storage Elevation (m)
Top of Grate – DDICB of First Controlled Outlet/ Bottom of Active Storage	0	0	412.00	---	---	---
2-year design storm event	---	---	---	0.109	5,483	412.76
5-year design storm event	---	---	---	0.126	8,237	413.08
Top of Grate – DICBMH of Second Controlled Outlet	0.129	8,835	413.15	---	---	---
10-year design storm event	---	---	---	0.329	9,136	413.18
25-year design storm event	---	---	---	0.440	9,986	413.28
50-year design storm event	---	---	---	0.457	11,161	413.40
100-year design storm event	---	---	---	0.477	12,679	413.56
Emergency Overflow Weir (Third Outlet)	0.495	14,108	413.70	---	---	---
Top of Bank	4.720	17,271	414.00	---	---	---

4.6 Analysis of Northerly and Southerly Overland Flow Routes

The proposed northerly and southerly overland flow rates are to convey surcharging runoff from the primary and secondary storm sewer systems, respectively, to the SWM facility. Both overland flow routes are expected to provide adequate capacity to convey the runoff draining from the tributary lands of their respective storm sewer system during the 100-year design storm event. This design condition is intended to provide conveyance of surcharging runoff from the storm sewer systems should they become obstructed.

Therefore, with reference to Table 6, the design flow considered for the northerly and southerly overland flow routes is 3.705 m³/s and 0.117 m³/s, respectively. The proposed geometry, design flow, and the resulting full-flow capacity and velocity of each overland flow route is summarized in Table 9 below. The Manning's 'n' of a turfstone-lined channel is considered to be comparable to that of a rip rap-lined channel.

Table 9: Summary of Proposed Overland Flow Route Designs

Design Parameter	Unit	Northerly Overland Flow Route	Southerly Overland Flow Route
Bottom Width	m	3	0.5
Minimum Depth	m	0.4	0.3
Side Slope	H:V	3:1	3:1
Top Width	m	5.4	2.3
Longitudinal Slope	%	3 – 4.1	5.4
Channel Lining	N/A	Turfstone	150 mm Ø Rip Rap
Manning's n	Unitless	0.035*	0.035*
Design Flow	m ³ /s	3.705	0.117
Minimum Full-Flow Capacity**	m ³ /s	3.757	0.873
Maximum Full-Flow Velocity***	m/s	2.6	2.1
* As provided by MTO Design Chart 2.01 ** Based on minimum longitudinal slope *** Based on maximum longitudinal slope			

As shown in Table 9 above, the proposed northerly and southerly overland flow routes are expected to provide adequate capacity to convey the runoff draining from the tributary lands of their respective storm sewer system, during the 100-year design storm event.

From Section 3.3 of WC-3 of the Highway Drainage Design (HDD) Standards published by the MTO, a nominal stone size of 100 mm Ø and 200 mm Ø, are believed to provide scour and erosion protection for velocities of up to 2.0 m/s and 2.6 m/s, respectively. Therefore, the proposed lining material of each overland flow route is expected to prevent the effects of erosion due to the conveyance of the full-flow velocities.

4.7 Analysis of SWM Facility's Significant Design Features

4.7.1 Forebay Design

A forebay is proposed within the northeasterly corner of the SWM facility to encourage the removal of pollutants from runoff discharging to it. The forebay is proposed to be located immediately downstream of the primary and secondary storm sewer outlets, and the northerly overland flow route. The Stormwater Management Planning and Design (SWMPD) Manual, published by the MECF, provides design element requirements and calculations related to forebay design.

The proposed forebay design is compared with the requirements of the SWMPD Manual in Table 10 below; supporting calculations are provided as Appendix F.

Table 10: Summary of Proposed and Required Forebay Design

Design Parameter	Unit	Required by SWMPD Manual	Provided by Proposed Design
Minimum Depth	m	1	1
Minimum Length to Width Ratio	L:W	2:1	3:1
Minimum Settling Length	m	33.0	57.0
Minimum Dispersion Length*	m	47.9	57.0
Minimum Forebay Deep Zone Width	m	6	11.5
Flow Velocity through Forebay*	m	≤ 0.15	≤ 0.14
* SWMPD Manual requires that the dispersion length be "calculated for the [inlet] pipe design capacity unless the pipe is designed for storms larger than a 10 year return period. In cases where the pipe conveys flows in excess of a 10 year storm, the dispersion length should be calculated for 10 year flows." Calculations conservatively considered the design flow to be equal to the combined flow capacity provided by the storm sewer system outlet pipes.			

As shown in Table 10 above, the proposed forebay design is expected to meet the requirements of the SWMPD Manual.

4.7.2 Drawdown Time

The SWMPD Manual requires a minimum drawdown time (detention time) of 24 hours within the active storage portion of a wetland-type facility. Using the method provided by the SWMPD Manual, a linear regression analysis was completed for the relationship of the proposed SWM facility's pond surface area and pond depth within the portion of the active storage governed by the first controlled outlet. The linear regression analysis is provided as part of Appendix G.

Equation 4.11 of the SWMPD Manual (Section 4.6.2) provides the following calculation to estimate the drawdown time within a SWM facility if the relationship between the pond surface area and pond depth is known (as determined through linear regression):

$$t = \frac{0.66 C_2 h^{1.5} + 2C_3 h^{0.5}}{2.75A_0}$$

Where: t = drawdown time (s)
 A_o = cross-sectional area of orifice = 0.031 m^2
(first controlled outlet = 200 mm Ø)
 h = maximum water elevation above the orifice centroid = 0.96 m
(modelled 2-year design storm event ponding elevation = 412.76 m)
 C_2 = slope coefficient from the area-depth linear regression = 2602.2
(as determined through linear regression)
 C_3 = intercept from the area-depth linear regression = 5661.1
(as determined through linear regression)

From calculation of Equation 4.11 of the SWMPD Manual using the information provided above, it is estimated that the drawdown time for the maximum ponding elevation within the proposed SWM facility, during a 2-year design storm event, is approximately 41 hours (147,104 seconds); greater than the minimum 24-hour drawdown time required by the SWMPD Manual.

4.7.3 Active Storage Depth

The SWMPD Manual, states that “the depth of 1 metre is appropriate as a generic value for most wetland designs, the depth of the extended detention storage should be based on the planting strategy that is chosen for the wetland”. During the 10-year design storm event, the maximum active storage depth within the SWM facility is considered to be approximately 1.18 m (413.18 m – 412.00 m). Since the modelled maximum active storage depth during the 10-year design storm event is not believed to be significantly greater than the recommended generic value, it is reasonable to consider it adequate. Nonetheless, this depth is to be considered in the selection of planting species within the SWM facility.

4.7.4 Maintenance and Operation

Access to the SWM facility is provided from Street ‘D’ via a 3.0 m-wide turfstone-lined lane. Around the perimeter of the SWM facility, a 3.0 m-wide gravel access road is proposed at grades considered adequate for traversing by vehicle. Grassed berms within the SWM facility are also proposed to be 3.0 m wide. The maximum side slope proposed along SWM facility’s banks is 5:1; a 6:1 side slope is proposed for the portion of the bank located adjacent to the SWM facility’s outlet system. The proposed access ways and bank side slope would provide adequate access for maintenance operations within the SWM facility.

The SWM facility’s outlet system is designed to improve the prevention and management of outlet clogging. The risk of the outlet piping clogging is expected to be minimal given that it is proposed to be installed within structures (DDICB and DICBMH) having grated inlets and minimum 0.6 m-deep sumps. As typical of SWM facility maintenance, sediment captured within the structures’ sumps is to be removed periodically. Additionally, the second controlled outlet consists of twin outlet pipes which would further reduce the risk of the outlet system becoming completely clogged. If clogging were to occur, it would therefore be expected to most likely occur at the grate inlets of the DDICB and DICBMH. However, given their relatively large grates (1200 mm x 600 mm), their complete obstruction is considered improbable; ponding within the SWM facility would lower slowly over time. In the extreme case where the grate inlets of both structures (DDICB and DICBMH) were to become completely clogged (zero-flow condition), the proposed elevations of the structures and emergency overflow weir would control the ponding above the preceding clogged structure to a maximum ponding depth of approximately 1.15 m (1.15 m from emergency overflow weir to DICBMH’s lowest grate elevation, and 0.55 m between the lowest grate elevation of the DICBMH and DDICB). Given this relatively shallow depth and the 6:1 side slope of the bank near the outlet system, removal of clogs on the grates by hand (e.g., by raking) should be achievable.

A minor berm is proposed to span between the two main berms of the SWM facility immediately downstream of the forebay area. The elevation of the top of the minor berm is proposed to be equal to that of the permanent pool surface (411.00 m). The minor berm would allow for the isolation of the forebay from the SWM facility's main pond area, should either need to be drained for maintenance operations (e.g. sediment removal), while not encouraging the 'short-circuiting' of flows through the SWM facility during normal operations. Drainage of either area would be achieved through pumping. The 3.0 m-wide access road proposed around the perimeter of the SWM facility provides a staging area for pumping operations, and the maximum 5:1 side slope of the SWM facility's banks allow for access to various ponding elevations.

4.8 Analysis of Outlet Channel

The outlet channel is proposed to convey the outflows of the proposed SWM facility and the runoff draining from adjacent external lands, to the Saugeen River. Runoff draining from the adjacent external lands is considered to drain to the outlet channel downstream of the proposed cooling trench section. Post-development MIDUSS modelling for the 100-year design storm event, provided as part of Appendix E, determined that the design flow within the proposed typical outlet channel section is approximately 1.653 m³/s. Modelling determined that the design flow within the cooling trench section is approximately 0.453 m³/s; the peak flow rate discharging from the SWM facility during the 100-year design storm event.

The proposed geometry, design flow, and the resulting full-flow capacity and velocity of the typical outlet channel cross-section, as well as that of the cooling trench portion, are summarized in Table 11 below.

Table 11: Summary of Proposed Outlet Channel Design

Design Parameter	Unit	Cooling Trench Section	Typical Outlet Channel Section
Bottom Width	m	2	1
Depth	m	0.4	0.5
Side Slope	H:V	5:1	5:1
Top Width	m	6	6
Longitudinal Slope	%	1 – 5	2 – 7.5
Channel Lining	N/A	300 mm Ø Rip Rap	500 mm Ø Rip Rap
Manning's n	Unitless	0.035 – 0.040*	0.035 – 0.040*
Design Flow	m ³ /s	0.453	1.653
Minimum Full-Flow Capacity**	m ³ /s	1.643	2.692
Maximum Full-Flow Velocity***	m/s	2.6	3.4
* As provided by MTO Design Chart 2.01 ** Based on minimum longitudinal slope and Manning's n = 0.040 *** Based on maximum longitudinal slope and Manning's n = 0.035			

As shown in Table 11 above, the proposed outlet channel is expected to provide adequate capacity to convey the runoff draining from the proposed SWM facility and adjacent external land, during the 100-year design storm event. Runoff surcharging from the outlet channel during design storm events of a greater return period, would spill over its northerly bank and be conveyed by existing grades within Blocks 271 and 273, as overland flow, to the Saugeen River; similar to this situation under existing conditions. The existing rail bed located along the southerly side of the proposed outlet channel, is expected to prevent runoff from spilling to the southerly adjacent properties.

The rip rap lining of the outlet channel would promote aeration of, and prevent erosion by, the conveyed flows. From Section 3.3 of WC-3 of the HDD Standards, a nominal stone size of 300 mm Ø and 500 mm Ø, are considered to provide scour and erosion protection for velocities of up to 3.0 m/s and 4.0 m/s, respectively. Therefore, the rip rap diameters proposed within the outlet channel are expected to prevent the effects of erosion due to the conveyance of the full-flow velocities.

The lining of the outlet channel with 500 mm Ø rip rap is proposed to extend to the outlet channel's confluence with the Saugeen River. In doing so, the 500 mm Ø rip rap is expected to promote quick 'mixing' of the outlet channel's discharge with the native river water; supporting the objectives of the previously completed EIA.

5. ADDITIONAL CONSIDERATIONS FOR REAR-YARD AREAS ALONG NORTHERLY PROPERTY BOUNDARY

As discussed in Section 3.2, along the northerly property boundary, catchbasins are proposed within some rear-yard areas as part of the primary storm sewer system. The storm sewer leads draining these rear-yard catchbasins to the trunk storm sewer portion of the primary storm sewer system, are designed with sufficient capacity to convey runoff draining from their respective rear-yard lands during a 100-year design storm event, provided there is capacity available within the trunk storm sewer portion.

For conservative sizing, the design of the proposed SWM facility assumes that these rear-yard areas would drain to the SWM facility during all design storm events up to, and including, the 100-year design storm event. Based on the design of the proposed primary storm sewer system, adequate capacity is expected to be provided to convey runoff draining via these rear-yard catchbasins to the SWM facility as piped flow, during design storm events up to, and including, the 5-year return period, at minimum.

During design storm events greater than the 5-year return period, the primary storm sewer may be surcharged, and adequate capacity may not be available within the trunk storm sewer portion to convey the runoff from the rear-yard catchbasins. In such an event, runoff may spill from these rear-yard areas to northerly adjacent lands. These rear-yard areas constitute a relatively small portion of the subject property's total area and are only considered to drain to the northerly adjacent lands during relatively infrequent major design storm events.

In consideration of this, additional modelling is provided to consider the post-development drainage from the rear-yard areas along the northerly property boundary during major design storm events; included as Appendix H. The catchments included within the additional modelling are shown on Figure No. 6, and catchments of note are described below:

Catchment 120 – represents the portion of the subject property considered to drain uncontrolled to the Saugeen River, via the 130 South Water Street property, during major design storm events. In general, this includes the rear-yard areas of Lots 209 to 213 (expected to drain via the primary storm sewer system during design storm events up to, and including, the 5-year return period, at minimum), in addition to the post-development Catchment 111 (expected to drain uncontrolled during all design storm events).

Catchment 121 – represents the portion of the subject property considered to drain uncontrolled to the Saugeen River, via the 250 Harris Street property, during major design storm events. In general, this includes the rear-yard areas of Lots 149 to 154 and 196 to 200. Catchment 121 is expected to drain via the primary storm sewer system during design storm events up to, and including, the 5-year return period, at minimum.

Catchment 122 – represents the portion of the subject property considered to drain uncontrolled to the Saugeen River, via the unopened Harris Street ROW, during major design storm events. In general, this includes the rear-yard areas of Lots 140 to 144. Catchment 122 is expected to drain via the primary storm sewer system during design storm events up to, and including, the 5-year return period, at minimum.

Catchment 123 – represents the portion of the subject property considered to drain uncontrolled to the Saugeen River, via the unopened portion of the South Water Street ROW, during major design storm events. In general, this includes the rear-yard areas of Lots 53 to 60, and 131 to 136, as well as the rear-yard area of Block 272 (expected to drain via the primary storm sewer system during design storm events up to, and including, the 5-year return period, at minimum), in addition to a portion of the post-development Catchment 110 (expected to drain uncontrolled during all design storm events).

From the lots included within the above-listed catchments, the only impervious surfaces considered to be draining from them, are the rear halves of their proposed dwellings' rooftops. However, the impervious level of these catchments is considered to vary from 35% to 50%. In addition, the entirety of the peak flow rates draining from each of the catchments, is assumed to drain to the northerly adjacent lands. The possible reduction in peak flow rates due to on-site temporary storage, provided by the rear-yard catchbasin structure, its outlet pipe and surface ponding above it (where applicable), was not considered by the modelling. Furthermore, the possible reduction in peak flow rates due to partial drainage of the rear-yard areas via the primary storm sewer system was not considered by the modelling.

Relevant portions of the additional modelling, included as Appendix H, are summarized in Table 12 below.

Table 12: Summary of Peak Flow Rate Results – Post-Development Conditions – Major Design Storm Events

Outlet	Return Storm Frequency (yr)			
	10-year	25-year	50-year	100-year
Peak flow rate draining uncontrolled from subject property to Saugeen River via the 130 South Water Street property – <i>Catch. 120</i> (m ³ /s)	0.045	0.058	0.067	0.077
Peak flow rate draining uncontrolled from subject property to Saugeen River via the 250 Harris Street property – <i>Catch. 121</i> (m ³ /s)	0.017	0.022	0.026	0.030
Peak flow rate draining uncontrolled from subject property to Saugeen River via the unopened Harris Street ROW – <i>Catch. 122</i> (m ³ /s)	0.018	0.022	0.026	0.029
Peak flow rate draining uncontrolled from subject property to Saugeen River via the unopened portion of the South Water Street ROW – <i>Catch. 123</i> (m ³ /s)	0.064	0.082	0.096	0.109
Total peak flow rate draining to Saugeen River from subject property* – <i>Catch. 100A, 101, 102, 120, 121, 122, 123, 124, 201, 202</i> (m³/s)	0.340	0.513	0.582	0.679

Table 12: Summary of Peak Flow Rate Results – Post-Development Conditions – Major Design Storm Events

Outlet	Return Storm Frequency (yr)			
	10-year	25-year	50-year	100-year
Total peak flow rate draining to Saugeen River from modelled catchments* – Catch. 100A, 101, 102, 120, 121, 122, 123, 124, 201, 202 (m³/s) (m³/s)	0.730	1.260	1.498	1.764
* Totaled peak flow rates draining from subject property may not necessarily equal the sum of the peak flow rates draining to each initial outlet due to the timing of peak flow hydrographs within the MIDUSS modelling.				

As shown in Table 12 above, in comparison to Table 6 of Section 4.5, the post-development peak flow rates draining from the subject property to the northerly adjacent lands, the overall post-development peak flow rates draining from the subject property, as well as the total post-development peak flow rates draining from the subject property and adjacent external lands to the Saugeen River, are expected to be less than, or equal to, existing conditions.

Prevention of surcharging runoff spilling to the rear-yard areas from the trunk sewer portion of the primary storm sewer system, is expected to be provided via the installation of backflow preventors on the downstream end of the rear-yard catchbasin outlet pipes.

6. STORMWATER QUALITY TREATMENT

6.1 Thermal Mitigation

Runoff draining from the outlet system of the SWM facility, is proposed to discharge to the surface of the cooling trench. The cooling trench generally consists of a 50 mm Ø clear stone trench, enveloped in geotextile fabric on all sides and bottom, overlain by a layer of rip rap.

The rip rap layer is intended to prevent washout of the clear stone layer by SWM facility outflows. The rip rap layer is also expected to prevent warming of the sub-surface clear stone layer by solar energy. As runoff is discharged from the SWM facility, its velocity is expected to be slowed by the rip rap layer and encouraged to percolate to the clear stone layer below. A relatively mild slope of 1% is proposed at the surface of the rip rap layer to further promote percolation.

As runoff drains downward through the clear stone layer, its thermal energy is expected to be transferred to the surrounding clear stone prior to draining from the trench. The proposed minimum dimensions of the clear stone trench are 15 m-long x 2 m-wide x 0.9 m-deep.

According to the Study Report: Thermal Impacts of Urbanization including Preventative and Mitigation Techniques document, published by Credit Valley Conservation in January 2011, a recommended maximum discharge temperature to a waterbody having a cool-water thermal regime, could be expected to be 22° C. Using cooling trench sizing calculations provided by the same document, the thermal energy reduction provided by the proposed minimum cooling trench dimensions was determined; calculations are provided as Appendix I.

Based on these calculations, the available heat transfer rate within the cooling trench, is approximately 3.8 times greater than that required to reduce an inflow temperature of 31° C, to an outflow temperature of 15° C, assuming an isothermal clear stone temperature of 15 ° C.

Furthermore, as discussed in the previously completed EIA, the proposed outlet channel “can also aid in discharge water thermal regulation, as outflow waters will be shaded during much of the summer season under the semi-closed forest canopy cover before reaching the South Saugeen River”.

6.2 Total Suspended Solids (TSS) Removal

Stormwater quality treatment for runoff discharging from the proposed development is to be provided by the proposed SWM facility, prior to discharging to the proposed outlet channel and, ultimately, the Saugeen River. An approximately 29.11 ha area, having an impervious level of approximately 61%, is considered to drain to the proposed SWM facility under post-development conditions.

The SWMPD Manual recommends that, for wetlands to provide an “Enhanced” level of water quality treatment (80% TSS removal rate), the facility should be sized with sufficient storage volume for 105 m³/ha and 120 m³/s, for a 55% and 70% upstream impervious level, respectively. Of these storage volume requirements, 40 m³/ha is to be provided as active storage.

Therefore, through interpolation due to the impervious level, the proposed wetland should provide a minimum 71 m³/ha, or 2,067 m³, and 40 m³/ha, or 1,165 m³, of permanent and active storage volumes, respectively, to provide the recommended 80% TSS removal rate given its tributary area. The proposed design of the wetland provides approximately 2,565 m³ of permanent storage volume, and approximately 5,483 m³ of active storage at the modelled 2-year ponding level. Therefore, the proposed SWM facility is expected to provide an “Enhanced” level of water quality treatment, prior to discharging to the proposed outlet channel.

The proposed impervious surfaces within the portions of the subject property expected to drain uncontrolled from the subject property, generally consist of rooftop surfaces. Rooftop runoff is generally considered to be ‘clean’ runoff and is not typically associated with conveying significant TSS levels. Furthermore, the rooftop runoff is proposed to be conveyed along, and filtered by, grassed surfaces prior to discharging from the subject property.

Overall, runoff draining from the subject property is expected to be treated to an Enhanced level of water quality treatment prior to discharging to the Saugeen River.

7. TEMPORARY SEDIMENT AND EROSION CONTROL

The SWM facility is proposed to be constructed as part of Phase 1 of the subdivision’s construction, allowing for site runoff to be routed through it, and receive water quality treatment, prior to discharging from the subject property.

Primary sediment control is to be achieved through the installation of heavy-duty silt fence (OPSD 219.130) along the subject property’s boundaries and upstream of retained treed areas as per the remedial tree planting plan. The temporary silt fencing is to be placed prior to any site works and maintained over the duration of the project.

Temporary straw bale flow check dams (OPSD 219.180) are proposed to be installed in rear- and side-yard swales along the northerly portion of the subject property and upstream of storm sewer structures located within landscaped areas. The temporary straw bale flow check dams, installed after initial grading, would slow flow velocities through these swales and promote the settling out of waterborne sediments prior to reaching temporary silt fencing or the proposed SWM facility.

Geotextile (filter cloth) is proposed to be installed beneath the grates of all storm sewer structures to filter sediments from runoff entering the proposed storm sewer systems.

Topsoil stockpiles are to be located away from storm sewer inlets, ditches or road allowances and seeded to prevent erosion. Light-duty silt fence is to be installed around the bases of the stockpiles with perimeter swales draining to temporary settling areas.

Inspection and maintenance of all erosion control measures is proposed to start after installation is complete. They are proposed to be inspected on a weekly basis during active construction or after a rainfall event of 13 mm or greater. Sediment is to be removed when accumulation reaches a maximum of one-half the height of the silt fencing height. Clogged filter materials, such as crushed stone, straw bales or geotextile (filter cloth), is to be replaced as required. Maintenance is to be carried out, within 48 hours, on any part of the features found to need repair. The Contractor shall be responsible for adding and modifying erosion control measures to ensure adequate erosion control, to the satisfaction of the Township.

Erosion control measures are proposed to remain in place until all disturbed ground surfaces have been stabilized either by paving or restoration of vegetative ground cover. Upon removal, sediment accumulated within sediment within erosion control measures is to be removed.

8. SUMMARY

Avila Investments Ltd. proposes to construct a residential and commercial subdivision on their property located within the southerly part of Mount Forest within the Township of Wellington North (Township), ON. As part of the proposed development of the approximately 31.13 ha subject property, two (2) commercial blocks and 411 residential units are planned within the subdivision.

Upon completion of the proposed development;

1. Total post-development peak flow rates draining from the subject property to the Saugeen River are expected to be attenuated to less than the existing peak flow rates for all of the following design storm event return periods: 2-, 5-, 10-, 25-, 50- and 100-year.
2. In addition, for the 2-, 5-, 10-, 25-, 50-, 100-year design storm events, post-development peak flow rates draining from the subject property, are expected to be attenuated to less than, or equal to, the existing peak flow rates draining to the following outlet locations within the northerly adjacent lands:
 - A. 130 South Water Street property
 - B. 250 Harris Street property
 - C. Unopened Harris Street ROW
 - D. Unopened portion of the South Water Street ROW
3. The proposed on-site storm sewer systems draining to the proposed SWM facility, are expected to convey the runoff associated with a 5-year design storm event, at minimum.
4. The proposed SWM facility is expected to provide adequate capacity via its overflow weir to convey the runoff draining to it during the 100-year design storm event; should the outlet system of the SWM facility become obstructed.
5. An "Enhanced" level of water quality treatment (80% TSS Removal) is expected to be provided for runoff draining from the proposed development prior to discharging from the subject property.

6. The design of the proposed outlet channel is expected to:
- a. Provide adequate capacity to convey the runoff draining from the proposed SWM facility and adjacent, external lands during the 100-year design storm event;
 - b. Incorporate design aspects recommended by the previously completed EIA, in support of its objectives; and,
 - c. Provide thermal controls to reduce thermal impacts to runoff draining from the developed portions of the subject property prior to discharging to the Saugeen River, mainly via the installation of a cooling trench.

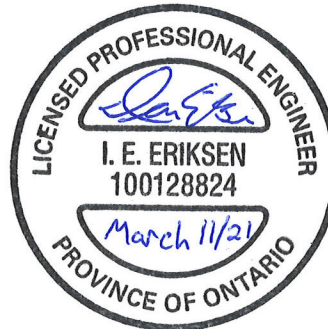
All of which is respectfully submitted,

GM BLUEPLAN ENGINEERING LIMITED

Prepared by:

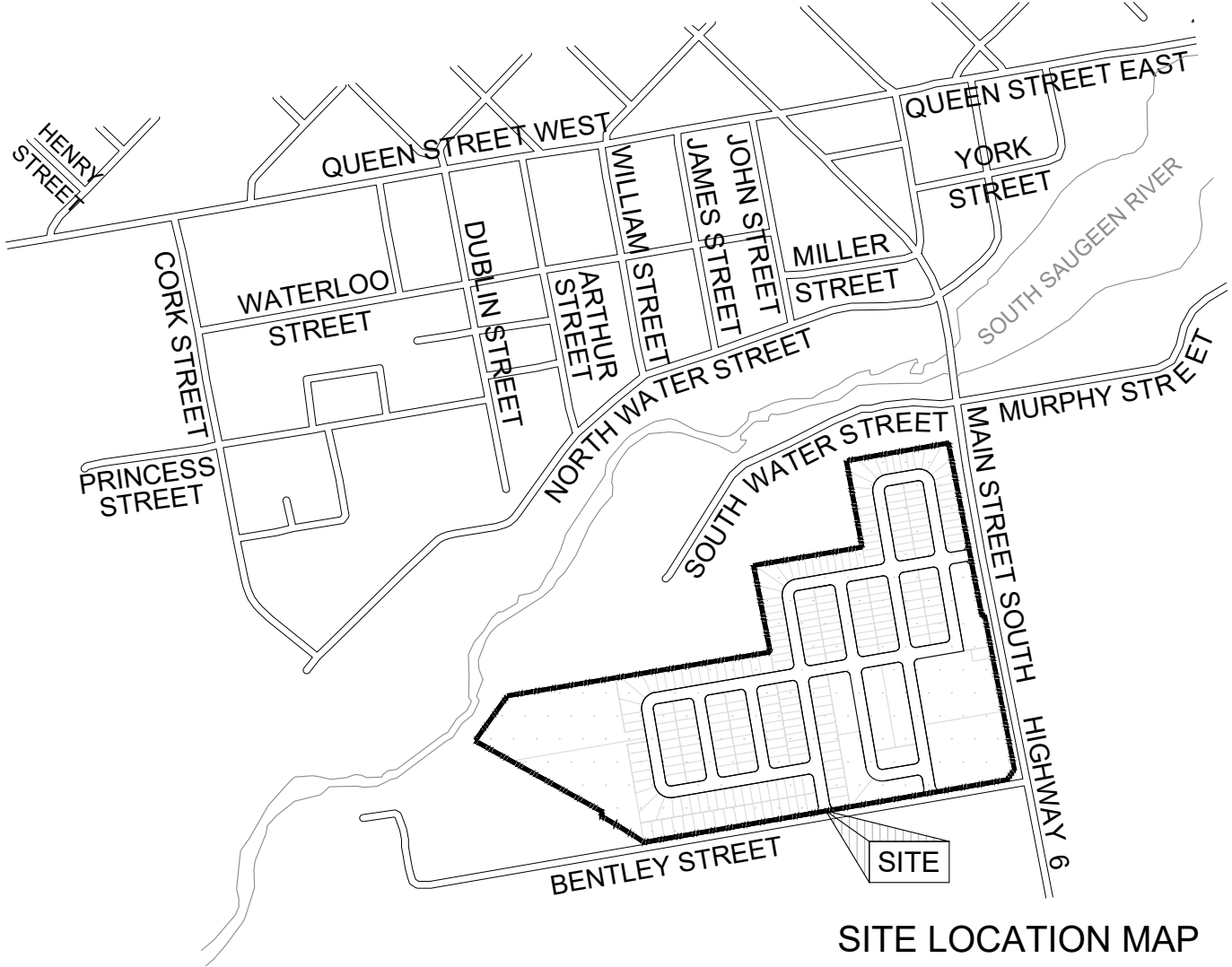
A handwritten signature in blue ink, appearing to read 'Ian Eriksen'.

Ian Eriksen, P.Eng.



FIGURES:

Mount Forest Subdivision
Stormwater
Management Report
Avila Investments Ltd.
Township of Wellington North
Mount Forest

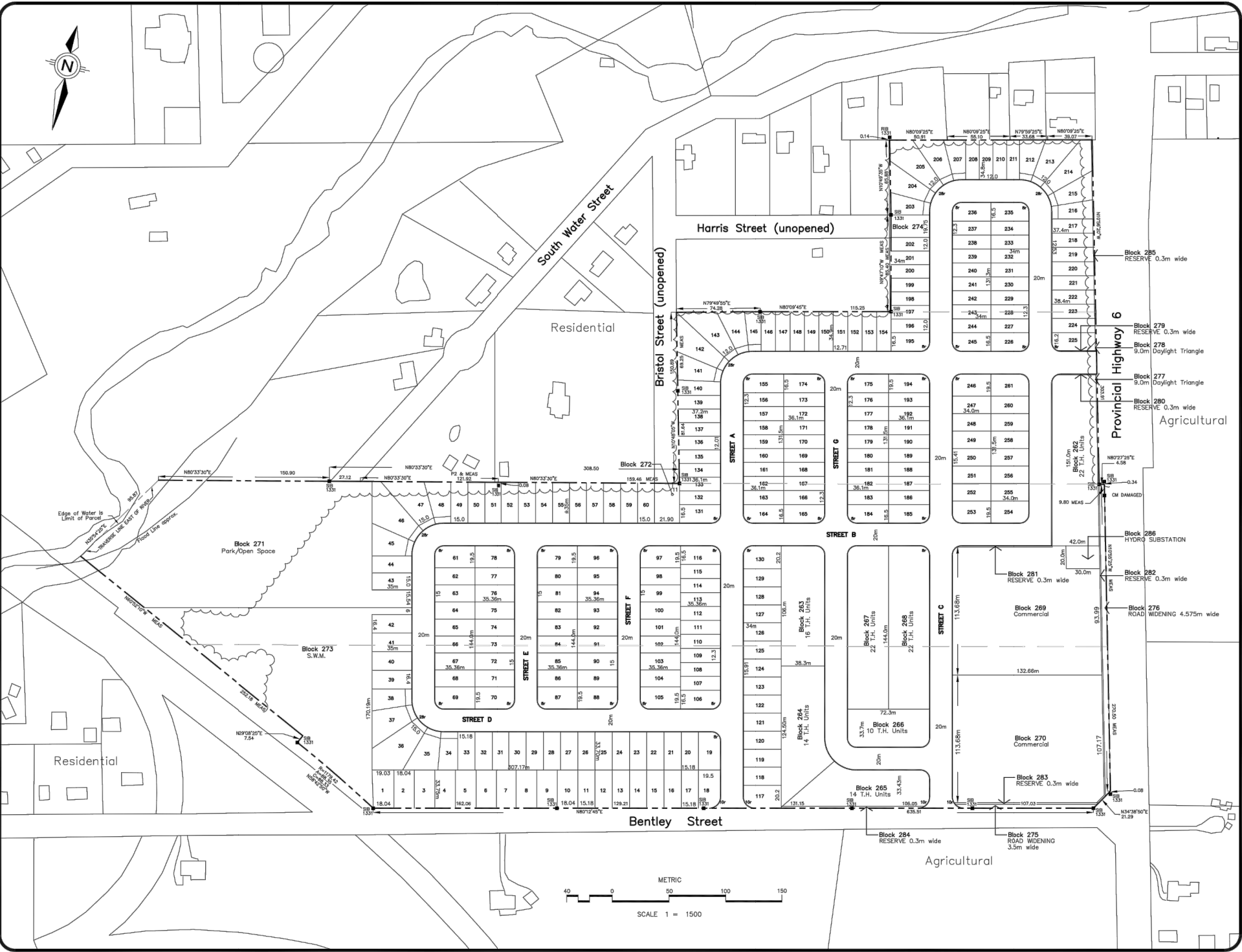


SITE LOCATION MAP

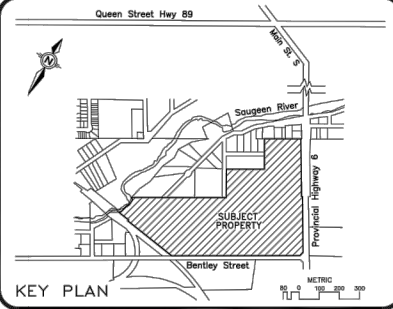
Figure No. 1



Mount Forest Subdivision
Stormwater
Management Report
Avila Investments Ltd.
Township of Wellington North
Mount Forest



DRAFT PLAN OF SUBDIVISION
TOWN OF MOUNT FOREST



Part Parks lots Q & R,
Survey MacDonald's Mount Forest
Part Lot 2, Concession WOSR
Divisions 3 & 4
Geographic Arthur Township
Being Part 1 on Reference Plan 61R-7881
Township of Wellington North
County of Wellington

OWNER'S CERTIFICATE.
I HEREBY AUTHORIZE J.L. COX PLANNING CONSULTANTS INC. TO PREPARE AND SUBMIT THIS DRAFT PLAN
OF SUBDIVISION FOR APPROVAL.
SIGNED: _____ DATE: _____ 2017.
AVILA INVESTMENTS LTD.
SURVEYOR'S CERTIFICATE.
I HEREBY CERTIFY THAT THE DIMENSIONS OF THE LAND TO BE SUBDIVIDED AND THEIR RELATIONSHIP
TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN ON THIS PLAN.
SIGNED: _____ DATE: _____ 2017.
JEFF BUSMAN - VAN HARTEN SURVEYING INC. OLS

DESIGN CRITERIA			
Land Use	Area (ha)	%	Units
Single Detached Residential (Lots 1-116,131-245)	12.296	39.5	231
Semi-Detached Residential (Lots 117-130,246-261)	1.672	5.4	60
Street Townhouse Units (Blocks 262-268)	3.106	10.0	120
Commercial (Blocks 269-270)	2.953	9.5	
Park/Open Space Area (Block 271)	2.574	8.2	
Walkway (Block 272 & 274)	0.144	0.5	
Storm Water Management (Block 273)	1.722	5.5	
Roads (Street A-G)	6.420	20.6	
Widenings/Reserves (Blocks 275, 276 & 279-285)	0.187	0.6	
Daylight Triangles (Blocks 277 & 278)	0.008	—	
Hydro Substation (Block 286)	0.060	0.2	
Total	31.142 ha	100%	411

Information Required Pursuant to
Section 51 (17), of the Planning Act, R.S.O. 1990

A As Shown	E As Shown	I Still Loan
B As Shown	F As Shown	J As Shown
C See Key Plan	G As Shown	K Hydro, Gas, Sewers
D Single Detached Semi-Detached Townhouse and Commercial	H Municipal Piped	L None

J.L. Cox Planning Consultants Inc.
Urban And Rural Planning Services
17 Spencer Crescent,
Guelph, Ontario
N1L 1N1
Tel. (519) 856-5622

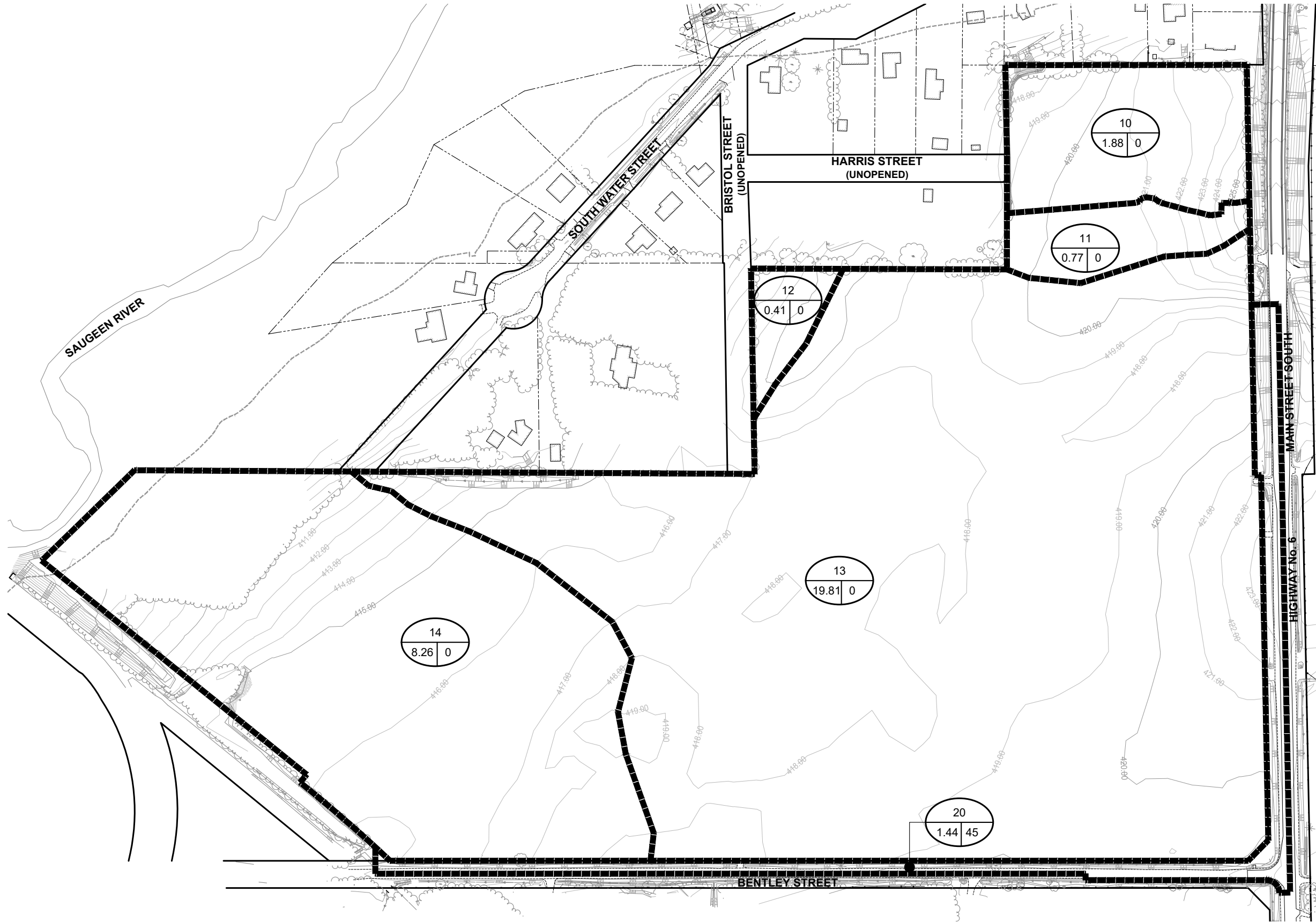
FILE 0740Sub-17.DWG
Project No. 0740
DATE: MARCH 28, 2018
PLOT 1 = 1.5 FOR A1

DRAFT PLAN OF
SUBDIVISION

Figure No. 2



FILE:W:\Listowel\2018\318049 Avila Subdivision Mount Forest\5 Work In Progress\Drafting\SWM Figures\318049 SWM FIGURES.dwg LAYOUT:Figure 3
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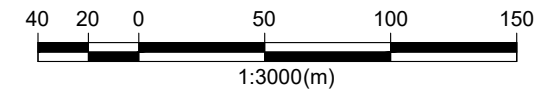


Mount Forest Subdivision
Stormwater
Management Report
Avila Investments Ltd.
Township of Wellington North
Mount Forest



LEGEND

- DRAINAGE AREA BOUNDARY
- CATCHMENT NUMBER
- % IMPERVIOUS
- CATCHMENT AREA IN HECTARES
- ORIGINAL TOPOGRAPHICAL CONTOUR (M.A.S.L.)



EXISTING DRAINAGE
AREA PLAN

Figure No. 3



FILE:W:\Listowel\2018\318049 Avila Subdivision Mount Forest\5 Work In Progress\Drafting\SWM Figures\318049 SWM FIGURES.dwg LAYOUT:Figure 4
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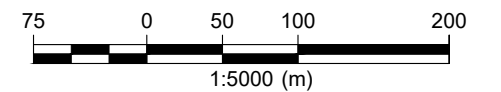


Mount Forest Subdivision
Stormwater
Management Report
Avila Investments Ltd.
Township of Wellington North
Mount Forest



LEGEND

- DRAINAGE AREA BOUNDARY
- CATCHMENT NUMBER (EXISTING / POST-DEVELOPMENT)
30/300
12.96 4
CATCHMENT AREA IN HECTARES
- % IMPERVIOUS
- ORIGINAL TOPOGRAPHICAL CONTOUR (M.A.S.L.)



EXISTING AND
POST-DEVELOPMENT
EXTERNAL DRAINAGE
AREA PLAN

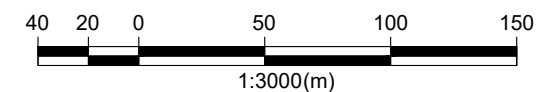
Figure No. 4



318049
January 2020
Scale: 1:5000 | NAD 1983 UTM Zone 17N



The diagram shows a catchment area represented by an oval. A thick black line above the oval is labeled "DRAINAGE AREA BOUNDARY". Inside the oval, the number "100" is at the top, "25.39" is at the bottom left, and "60" is at the bottom right. Arrows point from these numbers to labels on the right: "CATCHMENT NUMBER" for 100, "% IMPERVIOUS" for 60, and "CATCHMENT AREA IN HECTARES" for 25.39. Below the oval, a wavy line is labeled "419.00" and "ORIGINAL TOPOGRAPHICAL CONTOUR (M.A.S.L.)".

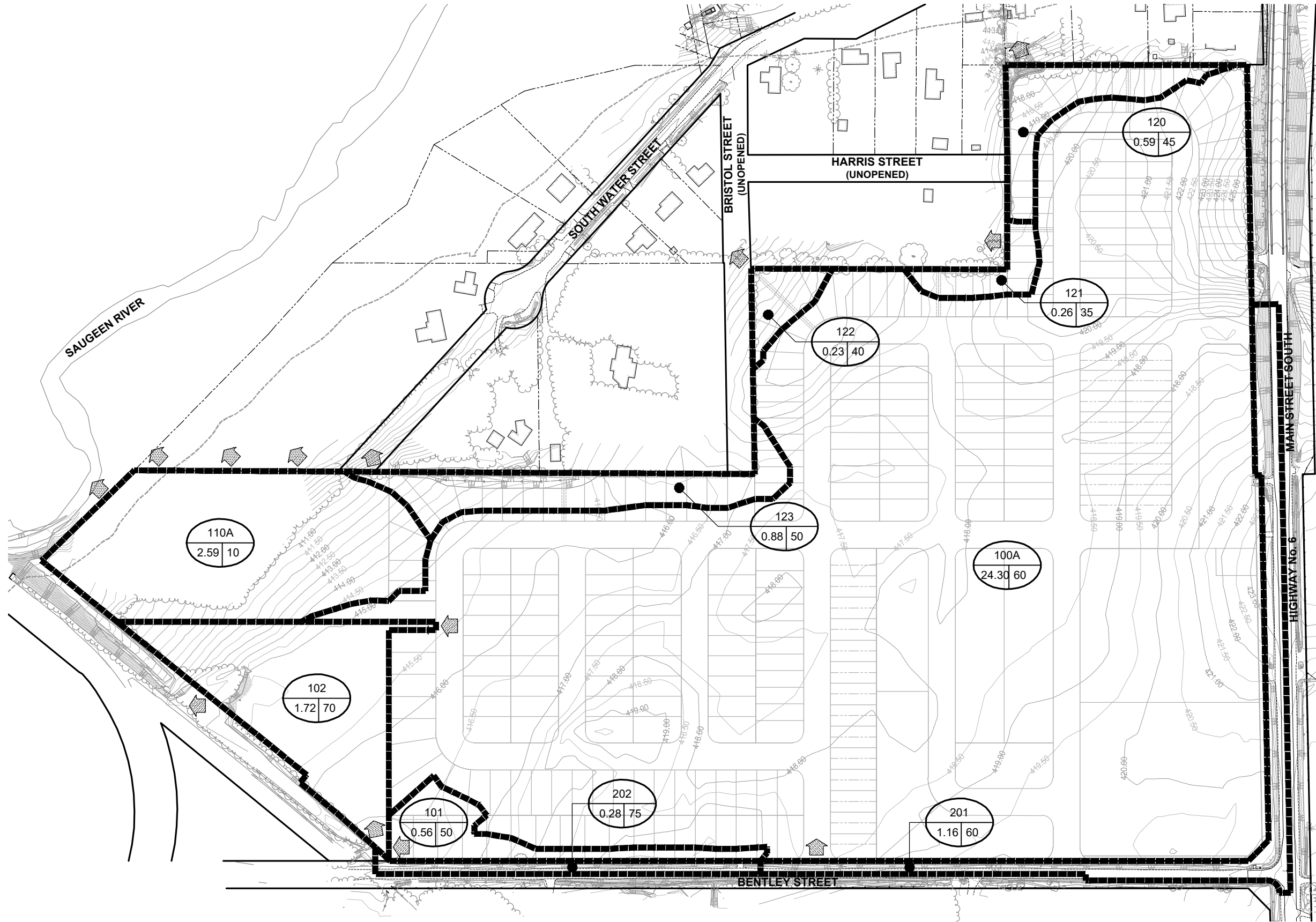


POST- DEVELOPMENT DRAINAGE AREA PLAN

Figure No. 5



FILE W:\Listowel\2018\318049 Avila Subdivision Mount Forest\5 Work In Progress\Drafting\SWM Figures\318049 SWM FIGURES.dwg LAYOUT: Figure 6
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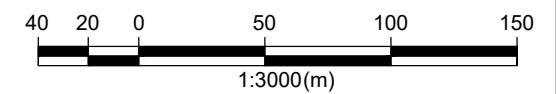


Mount Forest Subdivision
Stormwater
Management Report
Avila Investments Ltd.
Township of Wellington North
Mount Forest



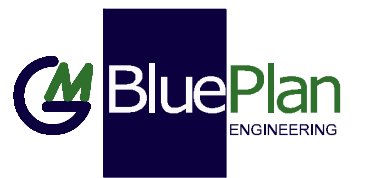
LEGEND

- DRAINAGE AREA BOUNDARY
- CATCHMENT NUMBER
% IMPERVIOUS
CATCHMENT AREA
IN HECTARES
- ORIGINAL TOPOGRAPHICAL
CONTOUR (M.A.S.L.)
- MAJOR STORM OVERLAND
FLOW PATH



POST- DEVELOPMENT
MAJOR STORM
DRAINAGE AREA PLAN

Figure No. 6



APPENDIX A: STAGE-STORAGE-DISCHARGE CALCULATIONS

**MOUNT FOREST SUBDIVISION
TOWNSHIP OF WELLINGTON NORTH
OUR FILE: 318049
FEBRUARY 2020**

SWM FACILITY - BLOCK 273

STORAGE VOLUME CALCULATIONS

ELEVATION	INCR. DEPTH	SURFACE AREA	INCR. STORAGE VOLUME	ACCUM. PERMANENT STORAGE VOLUME	ACCUM. ACTIVE STORAGE VOLUME	
(m)	(m)	(m ²)	(m ³)	(m ³)	(m ³)	
410.70	0.00	0	0	0	0	B/ Forebay and Stilling Basin
410.80	0.10	715	69	69	0	
410.90	0.20	765	74	143	0	
411.00	0.30	817	79	222	0	
411.10	0.40	869	84	306	0	
411.20	0.50	922	90	396	0	
411.30	0.60	975	95	491	0	
411.40	0.70	1030	100	591	0	
411.50	0.80	1086	106	697	0	
411.60	0.90	1142	111	808	0	
411.70	1.00	1200	117	925	0	B/ Pond outside of Forebay and Stilling Basin
411.80	1.10	5320	517	1443	0	
411.90	1.20	5613	547	1989	0	
412.00	1.30	5906	576	2565	0	B/ Active Storage; T/G First Controlled Outlet Structure
412.10	1.40	6200	605	2565	605	
412.20	1.50	6494	635	2565	1240	
412.30	1.60	7316	664	2565	1904	
412.40	1.70	7507	741	2565	2645	
412.50	1.80	7701	760	2565	3406	
412.60	1.90	7898	780	2565	4186	
412.70	2.00	8096	800	2565	4985	
412.80	2.10	8296	820	2565	5805	
412.90	2.20	8497	840	2565	6645	
413.00	2.30	8701	860	2565	7504	T/G Second Contolled Outlet Structure
413.10	2.40	8906	880	2565	8385	
413.15	2.45	9010	451	2565	8835	
413.20	2.50	9114	451	2565	9286	
413.30	2.60	9324	922	2565	10208	
413.40	2.70	9535	943	2565	11151	T/ Weir (Third Outlet) Overflow Overflow Overflow; T/Pond
413.50	2.80	9749	964	2565	12115	
413.60	2.90	9965	986	2565	13101	
413.70	3.00	10183	1007	2565	14108	
413.80	3.10	10405	1029	2565	15137	
413.90	3.20	10670	1054	2565	16191	
414.00	3.30	10964	1080	2565	17271	

FIRST CONTROLLED OUTLET (ORIFICE TUBE)

Orifice Dia. = 200 mm
Orifice Area = 0.031 m²
Coefficient = 0.8
Invert Elev = 411.70 m

THIRD OUTLET (WEIR)

Top of Bank = 414.00 m
Spill Elevation = 413.70 m
H = 0.30 m
2g = 19.612
Length at Base = 9 m
Maximum Side Slopes = 20 :1
Minimum Length at T/ Bank = 21 m
Weir Coefficient = 1.7
Q_{MAX - WEIR} = 4.190 m³/s

SECOND CONTROLLED OUTLET (TWIN ORIFICE TUBES)

Orifice Dia. = 250 mm
Orifice Area = 0.049 m²
Coefficient = 0.8
Invert Elev = 411.55 m

STAGE-STORAGE-DISCHARGE CALCULATIONS

ELEV	STAGE	STORAGE	FIRST OUTLET FLOW	SECOND OUTLET FLOW	THIRD OUTLET FLOW	TOTAL OUTLET FLOW	
(m)	(m)	(m ³)	(m ³ /s)	(m ³ /s)	(m ³ /s)	(m ³ /s)	
412.00	0.00	0	0.000	0.000	0.000	0.000	B/ Active Storage; T/G First Controlled Outlet Structure
412.10	0.10	605	0.061	0.000	0.000	0.061	
412.20	0.20	1240	0.070	0.000	0.000	0.070	
412.30	0.30	1904	0.079	0.000	0.000	0.079	
412.40	0.40	2645	0.086	0.000	0.000	0.086	
412.50	0.50	3406	0.093	0.000	0.000	0.093	
412.60	0.60	4186	0.100	0.000	0.000	0.100	
412.70	0.70	4985	0.106	0.000	0.000	0.106	
412.80	0.80	5805	0.111	0.000	0.000	0.111	
412.90	0.90	6645	0.117	0.000	0.000	0.117	
413.00	1.00	7504	0.122	0.000	0.000	0.122	T/G Second Contolled Outlet Structure
413.10	1.10	8385	0.127	0.000	0.000	0.127	
413.15	1.15	8835	0.129	0.000	0.000	0.129	
413.20	1.20	9286	0.000	0.430	0.000	0.430	
413.30	1.30	10208	0.000	0.443	0.000	0.443	
413.40	1.40	11151	0.000	0.457	0.000	0.457	T/ Weir (Third Outlet) Overflow Overflow Overflow; T/Pond
413.50	1.50	12115	0.000	0.470	0.000	0.470	
413.60	1.60	13101	0.000	0.483	0.000	0.483	
413.70	1.70	14108	0.000	0.495	0.000	0.495	
413.80	1.80	15137	0.000	0.507	0.591	1.098	
413.90	1.90	16191	0.000	0.519	1.977	2.496	
414.00	2.00	17271	0.000	0.530	4.190	4.720	

APPENDIX B: MTO IDF CURVE LOOKUP RESULTS

Active coordinate

43° 58' 15" N, 80° 43' 45" W (43.970833,-80.729167)

Retrieved: Thu, 19 Dec 2019 18:29:40 GMT



Location summary

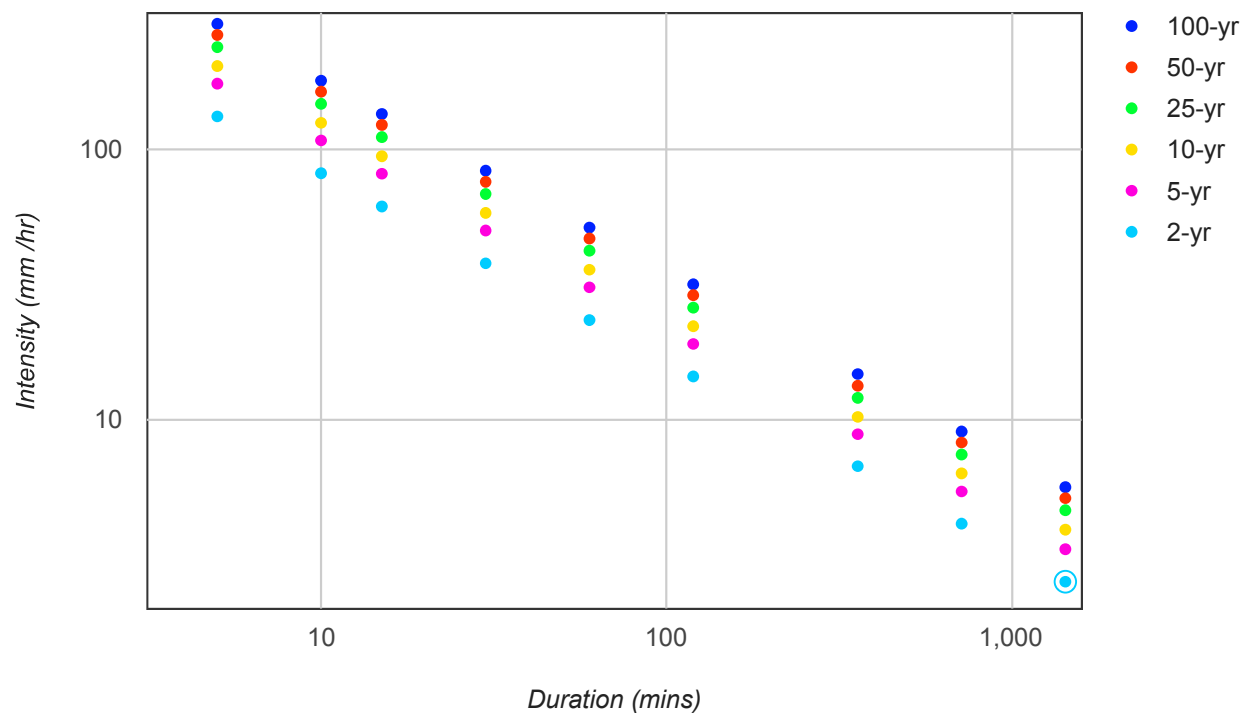
These are the locations in the selection.

IDF Curve: 43° 58' 15" N, 80° 43' 45" W (43.970833,-80.729167)

Results

An IDF curve was found.

Coordinate: 43.970833, -80.729167
IDF curve year: 2010



Coefficient summary

IDF Curve: 43° 58' 15" N, 80° 43' 45" W (43.970833,-80.729167)

Retrieved: Thu, 19 Dec 2019 18:29:40 GMT

Data year: 2010

IDF curve year: 2010

Return period	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
A	23.3	30.8	35.8	42.1	46.7	51.3
B	-0.699	-0.699	-0.699	-0.699	-0.699	-0.699

Statistics

Rainfall intensity (mm hr⁻¹)

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	132.3	81.5	61.4	37.8	23.3	14.4	6.7	4.1	2.5
5-yr	174.9	107.8	81.2	50.0	30.8	19.0	8.8	5.4	3.3
10-yr	203.3	125.3	94.3	58.1	35.8	22.1	10.2	6.3	3.9
25-yr	239.1	147.3	110.9	68.3	42.1	25.9	12.0	7.4	4.6
50-yr	265.3	163.4	123.1	75.8	46.7	28.8	13.3	8.2	5.1
100-yr	291.4	179.5	135.2	83.3	51.3	31.6	14.7	9.0	5.6

Rainfall depth (mm)

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	11.0	13.6	15.4	18.9	23.3	28.7	40.0	49.2	60.6
5-yr	14.6	18.0	20.3	25.0	30.8	37.9	52.8	65.1	80.2
10-yr	16.9	20.9	23.6	29.1	35.8	44.1	61.4	75.6	93.2
25-yr	19.9	24.6	27.7	34.2	42.1	51.9	72.2	88.9	109.6
50-yr	22.1	27.2	30.8	37.9	46.7	57.5	80.1	98.7	121.6
100-yr	24.3	29.9	33.8	41.6	51.3	63.2	88.0	108.4	133.5

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Last Modified: September 2016

APPENDIX C: TESTHOLE LOCATIONS AND LOGS

Provided as part of the Geotechnical Investigation (dated April 15, 2019) and Amendment to Geotechnical Investigation letter (dated October 24, 2019) prepared by CMT Engineering Inc.

NOTES:

Base map provided by J.L. Cox Planning Consultants Inc.

Legend

Borehole - March, 2019

Test Pit - September, 2019

1.	ADDED TEST PITS	OCT 7/19
REVISIONS		

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PROJECT: PROPOSED SUBDIVISION
Highway 6 and Bentley Street
Mount Forest, Ontario

DRAWING TITLE: SITE PLAN SHOWING
BOREHOLE/TEST PIT LOCATIONS

PROJECT NO.:	19-052	DATE:	April 3, 2019
SCALE:	N.T.S.	DRAWING NO.:	1



BOREHOLE 1

Page 1 of 1

Date Drilled: March 28, 2019
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 420.83 m
Logged by: SW

Project No.: 19-052
Project: Residential/Commercial Subdivision
Highway 6 and Bentley Street,
Location: Mount Forest, Ontario

Depth (ft/m)	Sample Type	Recovery (%)	Sample Number	Symbols	SOIL DESCRIPTION	Well Installation	Moisture Content % Wp [---X---] WI 10 20 30 40 50	Pocket Penetrometer kPa 100 200 300 400 SPT (N) Blows/0.3 m 20 40 60 80
ft m								
0 0					Ground Surface (m) 420.83 0.00			
1 1	SS	1			TOPSOIL Very loose, dark brown, silty organic topsoil, moist (185 mm)		6.4	3
2 2					DISTURBED SANDY SILT Very loose, red-brown reworked sandy silt, some clay, trace gravel, trace organics and rootlets, moist			
3 1	SS	2			420.07 0.76		4.7	43
4 4					SAND AND GRAVEL Dense, light brown sand and gravel, moist			
5 5					419.31 1.52			
6 2	SS	3			Becoming compact, trace silt		4.9	25
7 7					418.54 2.29			
8 8	SS	4			Becoming brown, some silt, trace clay, wet		8.5	27
9 9					417.78 3.05			
10 3	SS	5			SILT AND SAND TILL Very dense, brown, silt and sand till, some gravel, trace clay, moist		15.0	50 (3")
11 11								
12 12								
13 4	MC	6					6.3	
14 14								
15 15								
16 5	SS	7						50 (3")
17 17					415.65 5.18	Well dry to bottom March 28, 2019		
18 18					End of Borehole			
19 19								

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BOREHOLE 2

Page 1 of 1

Date Drilled: March 28, 2019
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 417.79 m
Logged by: SW

Project No.: 19-052
Project: Residential/Commercial Subdivision
Highway 6 and Bentley Street,
Location: Mount Forest, Ontario

Depth (ft/m)	Sample Type	Recovery (%)	Sample Number	Symbols	SOIL DESCRIPTION	Well Installation	Moisture Content % Wp [---X---] Wl 10 20 30 40 50	Pocket Penetrometer kPa 100 200 300 400 SPT (N) Blows/0.3 m 20 40 60 80
0					Ground Surface (m) 417.79			
0					TOPSOIL 0.00			
1	SS	1			Very loose, dark brown, silty organic topsoil, moist (360 mm) 417.43 0.36		8.9	2
2					DISTURBED SANDY SILT 417.03 0.76			
3	SS	2			Very loose, brown and dark brown mottled, disturbed sandy silt, trace clay and gravel, trace organics and rootlets, moist		13.8	0
4					SANDY SILT TILL			
5					Very loose, brown sandy silt till, some clay, trace gravel, wet		13.0	3
6	SS	3						
7								
8	SS	4			Dense, light brown, some gravel, trace clay, moist 415.50 2.29		8.2	46
9								
10	SS	5			Becoming very dense 414.74 3.05		8.1	59
11								
12	SS	6			Becoming wet, trace gravel 414.13 3.66		12.3	
13								
14	MC5	7					17.3	80
15								
16	SS	7						
17					End of Borehole 412.61 5.18			
18								
19					Cave at 3.96 m below ground surface. No accumulated groundwater observed upon completion.			
20								
21								

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BOREHOLE 3

Page 1 of 1

Date Drilled: March 28, 2019
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 419.25 m
Logged by: SW

Project No.: 19-052
Project: Residential/Commercial Subdivision
Highway 6 and Bentley Street,
Location: Mount Forest, Ontario

Depth (ft/m)	Sample Type	Recovery (%)	Sample Number	Symbols	SOIL DESCRIPTION	Well Installation	Moisture Content % Wp [---X---] Wl 10 20 30 40 50	Pocket Penetrometer kPa 100 200 300 400 SPT (N) Blows/0.3 m 20 40 60 80
0					Ground Surface (m) 419.25 0.00			
1	SS	1			TOPSOIL Very loose, dark brown, silty organic topsoil, moist (250 mm)			
2								
3	SS	2			DISTURBED SANDY SILT Very loose, brown and dark brown mottled, disturbed sandy silt, trace clay and gravel, trace organics and rootlets, moist			
4								
5					SANDY SILT TILL Compact, light brown, sandy silt till, some clay and gravel, moist			
6	SS	3						
7								
8	SS	4			Becoming very dense, trace clay			
9								
10	SS	5						
11								
12	SS	6						
13								
14	SS	7						
15								
16	SS							
17					End of Borehole	Well dry to bottom March 28, 2019		
18								
19								
20								

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BOREHOLE 4

Page 1 of 1

Date Drilled: March 28, 2019
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 420.11 m
Logged by: SW

Project No.: 19-052
Project: Residential/Commercial Subdivision
Highway 6 and Bentley Street,
Location: Mount Forest, Ontario

Depth (ft/m)	Sample Type	Recovery (%)	Sample Number	Symbols	SOIL DESCRIPTION	Well Installation	Moisture Content % Wp [---X---] Wl 10 20 30 40 50	Pocket Penetrometer kPa 100 200 300 400 SPT (N) Blows/0.3 m 20 40 60 80
0					Ground Surface (m) 420.11 0.00			
1	SS	1			TOPSOIL Very loose, dark brown, silty organic topsoil, moist (220 mm)		9.0	2
2					DISTURBED SANDY SILT Very loose, brown and dark brown mottled, disturbed sandy silt, some clay and gravel, some organics, trace rootlets, moist		7.8	20
3	SS	2						
4					SANDY SILT TILL Compact, brown, sandy silt till, some clay and gravel, very moist		11.0	40
5	SS	3			Becoming dense		8.8	50(3")
6					Becoming very dense, trace clay and gravel, moist		6.1	50(6")
7	SS	4					7.9	
8							6.8	50(3")
9	SS	5						
10								
11	SS	6						
12								
13	SS	7						
14								
15	SS							
16								
17					End of Borehole			
18								
19					Borehole caved at 4.27 m. No accumulated groundwater encountered upon completion.			
20								

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BOREHOLE 5

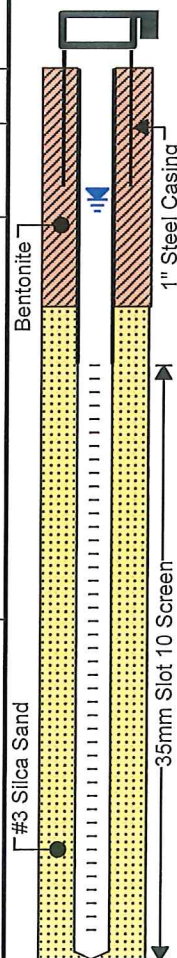
Page 1 of 1

Date Drilled: March 27, 2019
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 418.02 m
Logged by: SW

Project No.: 19-052
Project: Residential/Commercial Subdivision
Highway 6 and Bentley Street,
Location: Mount Forest, Ontario

Depth (ft/m)	Sample Type	Recovery (%)	Sample Number	Symbols	SOIL DESCRIPTION	Well Installation	Moisture Content % Wp [---X---] Wl 10 20 30 40 50	Pocket Penetrometer kPa 100 200 300 400 SPT (N) Blows/0.3 m 20 40 60 80
0					Ground Surface (m) 418.02			
1	SS	1			TOPSOIL Very loose, dark brown, silty organic topsoil, moist (280 mm)			
2					417.74 0.28			
3	SS	2			DISTURBED SANDY SILT Very loose, brown and dark brown mottled, disturbed sandy silt, some clay and gravel, some organics and rootlets, moist			
4					417.26 0.76			
5					SAND Compact, brown sand, trace silt and gravel, wet			
6	SS	3						
7								
8	SS	4						
9								
10					415.20 2.82			
11					SANDY SILT TILL Compact, brown, sandy silt till, some clay and gravel, moist			
12								
13	SS	5						
14								
15					413.45 4.57			
16	SS	6			Becoming very dense			
17					412.84 5.18			
18					End of Borehole			
19								
20								



WL: 417.35 m
(0.67 m below ground surface)
March 28, 2019

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BOREHOLE 6

Page 1 of 1

Date Drilled: March 28, 2019
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 418.38 m
Logged by: SW

Project No.: 19-052
Project: Residential/Commercial Subdivision
Highway 6 and Bentley Street,
Location: Mount Forest, Ontario

Depth (ft/m)	Sample Type	Recovery (%)	Sample Number	Symbols	SOIL DESCRIPTION	Well Installation	Moisture Content % Wp [---X---] Wl 10 20 30 40 50	Pocket Penetrometer kPa 100 200 300 400 SPT (N) Blows/0.3 m 20 40 60 80
0					Ground Surface (m) 418.38 0.00			
1	SS	1			TOPSOIL Loose, dark brown, silty organic topsoil, moist (220 mm)		12.7	6
2					DISTURBED SAND Loose, brown disturbed sand, some gravel and silt, some organics, trace rootlets, moist			
3	SS	2			417.62 0.76			15
4					SAND AND GRAVEL Compact, grey sand and gravel, trace silt, wet			
5								
6	SS	3					10.1	13
7								
8	SS	4			416.09 2.29		9.2	27
9					SANDY SILT TILL Compact, grey, sandy silt till, some clay, trace gravel, wet			
10					415.33 3.05		9.1	7
11	SS	5			Becoming loose			
12								
13	MC5	6					9.6	
14					413.96 4.42			
15					CLAYEY SILT TILL Dense, grey, clayey silt till, some sand and gravel, drier than the plastic limit			
16	SS	7					6.3	43
17					413.20 5.18			
18					End of Borehole			
19					Borehole caved at 1.68 m. No accumulated groundwater encountered upon completion.			
20								

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BOREHOLE 7

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Date Drilled: March 28, 2019
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 417.63 m
Logged by: SW

Project No.: 19-052
Project: Residential/Commercial Subdivision
Highway 6 and Bentley Street,
Location: Mount Forest, Ontario

Depth (ft/m)	Sample Type	Recovery (%)	Sample Number	Symbols	SOIL DESCRIPTION	Well Installation	Moisture Content % Wp [---X---] Wl 10 20 30 40 50	Pocket Penetrometer kPa 100 200 300 400 SPT (N) Blows/0.3 m 20 40 60 80
0					Ground Surface (m) 417.63			
0					TOPSOIL 0.00			
1	SS	1			Very loose, dark brown, silty organic topsoil, moist (360 mm) 417.27		16.5	3
2					DISTURBED SANDY SILT 416.87			
3	SS	2			Loose, grey and brown mottled disturbed sandy silt, some clay and gravel, some organics and rootlets, wet 0.76		5.8	8
4					SAND 416.11			
5					Loose, brown sand, trace silt and gravel, wet 1.52		7.6	56
6	SS	3			SAND AND GRAVEL			
7					Very dense, light brown sand and gravel, trace silt, wet 415.34			
8	SS	4			SANDY SILT TILL 2.29		18.4	21
9					Compact, grey-brown, sandy silt till, some clay and gravel, wet			
10					414.58			
11	SS	5			Becoming dense, moist 3.05		8.0	30
12								
13	MC5	6					7.4	
14								
15								
16	SS	7					8.5	37
17					412.45			
18					End of Borehole 5.18			
19					Borehole caved at 1.09 m. Accumulated groundwater encountered at 0.81 m upon completion.			
20								

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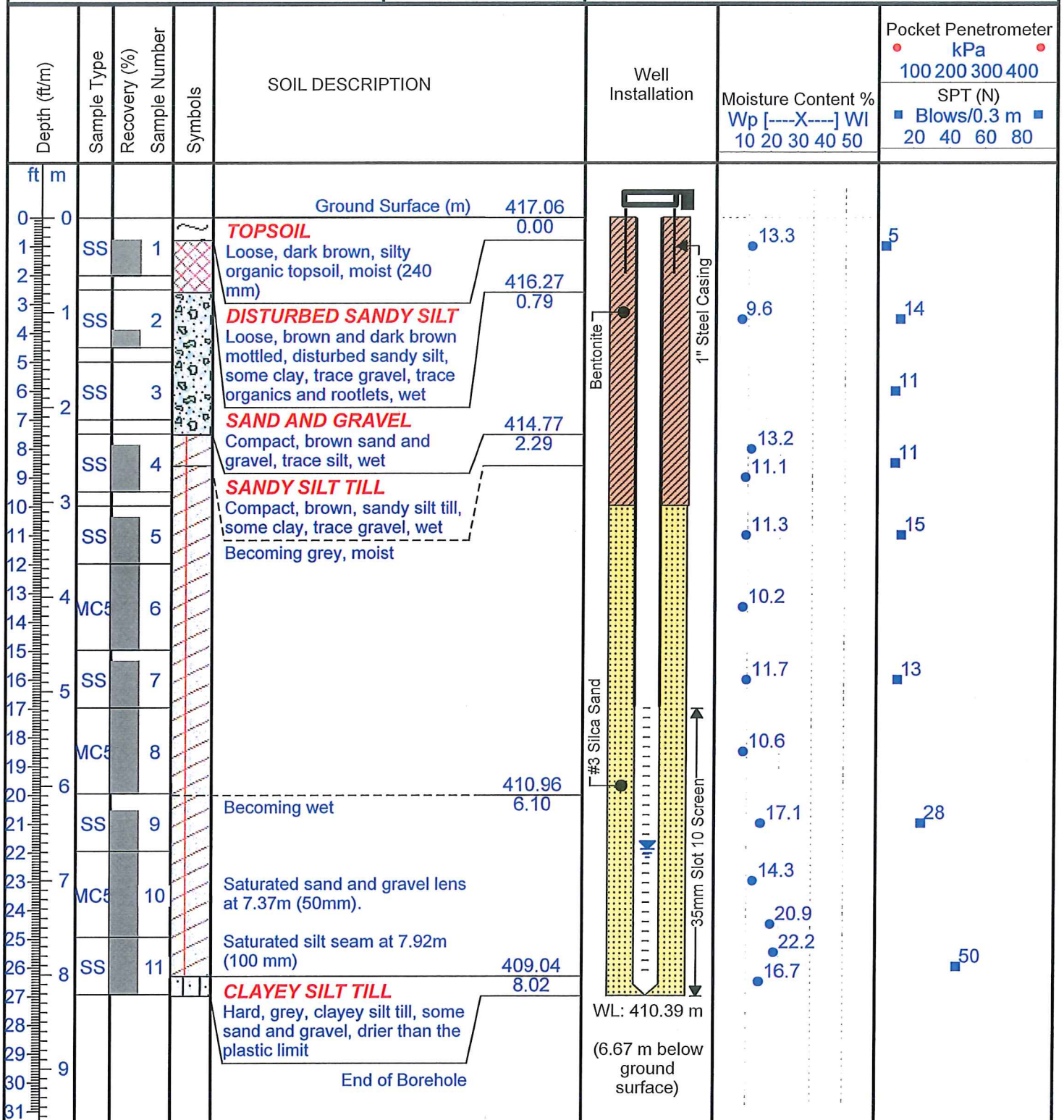
BOREHOLE 8

Page 1 of 1

Date Drilled: March 27, 2019
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 417.06 m
Logged by: SW

Project No.: 19-052
Project: Residential/Commercial Subdivision
Highway 6 and Bentley Street,
Location: Mount Forest, Ontario



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BOREHOLE 9

Page 1 of 1

Date Drilled: **March 27, 2019**
 Rig: **Geoprobe 7822DT**
 Contractor: **CMT Drilling Inc.**
 Drilling Method: **SPT**

Elevation: **417.60 m**
 Logged by: **SW**

Project No.: **19-052**
 Project: **Residential/Commercial Subdivision**
Highway 6 and Bentley Street,
 Location: **Mount Forest, Ontario**

Depth (ft/m)	Sample Type	Recovery (%)	Sample Number	Symbols	SOIL DESCRIPTION	Well Installation	Moisture Content % Wp [---X---] Wl 10 20 30 40 50	Pocket Penetrometer kPa 100 200 300 400 SPT (N) Blows/0.3 m 20 40 60 80
ft m								
0					Ground Surface (m) 417.60			
0					TOPSOIL Very loose, dark brown silty organic topsoil (300mm). 0.00			
1	SS		1		417.30 0.30		18.3	4
2					DISTURBED SANDY SILT Loose, light brown and dark brown mottled disturbed sandy silt, trace clay and gravel, some organics and rootlets, moist 416.84 0.76			
3	SS		2				7.0	31
4					SAND AND GRAVEL Dense, grey and light brown sand and gravel, some silt, trace clay, wet			
5							10.1	43
6	SS		3					
7								
8					Becoming compact 415.31 2.29		8.2	20
9	SS		4					
10								
11	SS		5				15.3	21
12								
13	MC5		6				10.1	
14								
15					413.03 4.57			
16	SS		7		SANDY SILT TILL Very dense, grey, sandy silt till, some clay and gravel, moist		6.8	50(5")
17					412.42 5.18			
18					End of Borehole			
19					Borehole caved at 1.83 m. Accumulated groundwater encountered at 1.52 m upon completion.			
20								

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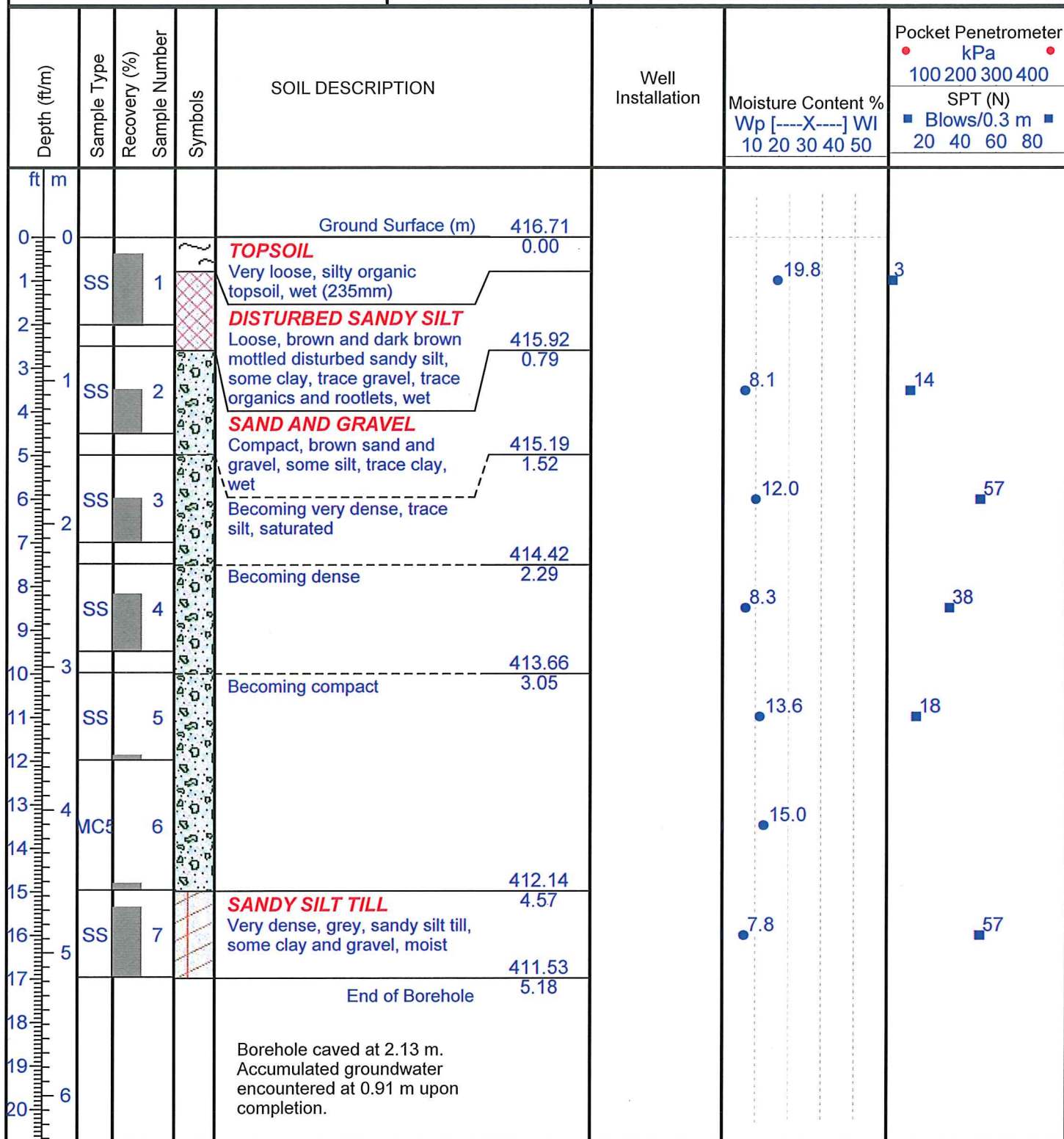
BOREHOLE 10

Page 1 of 1

Date Drilled: March 27, 2019
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 416.71 m
Logged by: SW

Project No.: 19-052
Project: Residential/Commercial Subdivision
Highway 6 and Bentley Street,
Location: Mount Forest, Ontario



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BOREHOLE 11

Page 1 of 1

Date Drilled: March 27, 2019
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 415.66 m
Logged by: SW

Project No.: 19-052
Project: Residential/Commercial Subdivision
Highway 6 and Bentley Street,
Location: Mount Forest, Ontario

Depth (ft/m)	Sample Type	Recovery (%)	Sample Number	Symbols	SOIL DESCRIPTION	Well Installation	Moisture Content % Wp [----X----] Wl 10 20 30 40 50	Pocket Penetrometer kPa 100 200 300 400 SPT (N) Blows/0.3 m 20 40 60 80
0					Ground Surface (m) 415.66			
0					0.00			
1	SS		1		TOPSOIL Loose, dark brown, silty organic topsoil, moist (250 mm)			8
2							8.3	23
3	SS		2		SAND AND GRAVEL Dense, grey and brown sand and gravel, some silt and clay, wet			
4					414.59		9.6	12
5					1.07			
6	SS		3		SANDY SILT TILL Compact, brown, sandy silt till, some clay, trace gravel, moist			
7							8.6	26
8	SS		4		413.07		7.7	30
9					2.59			
10					Becoming dense, grey, some gravel		8.3	
11	SS		5				9.9	41
12								
13	MC5		6				14.1	
14							15.1	50
15	SS		7					
16					410.48		12.7	54
17	SS		8		5.18			
18	MC5		9		CLAYEY SILT TILL Hard, grey clayey silt till, some sand and gravel, drier than the plastic limit			
19								
20	SS		10					
21								
22	SS		10					
23								
24					408.19			
25					7.47			
26					End of Borehole			
27					Borehole caved at 6.93 m below ground surface.			
28					Accumulated groundwater encountered at 6.32 m upon completion.			
29								
30								

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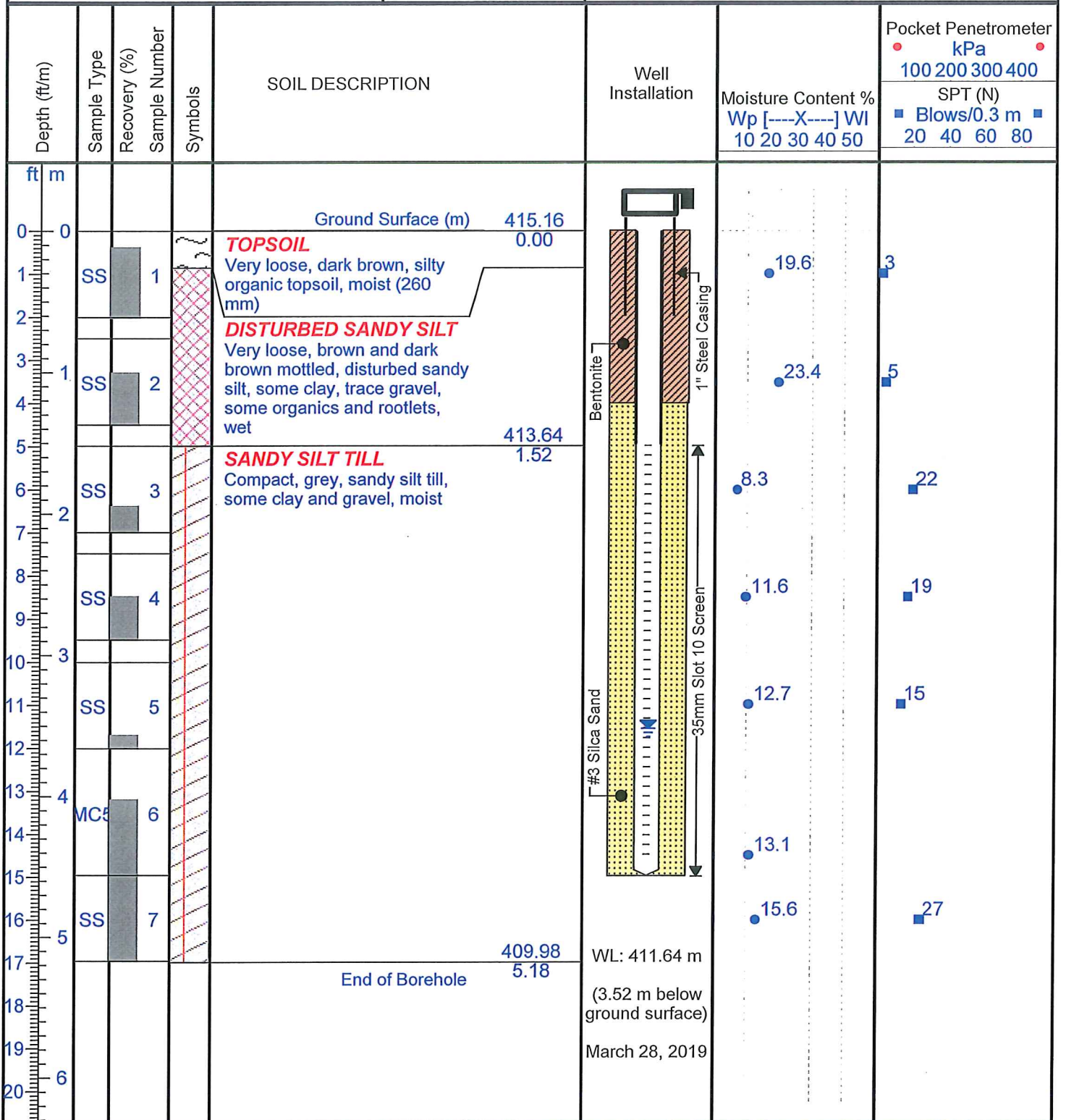
BOREHOLE 12

Page 1 of 1

Date Drilled: March 27, 2019
Rig: Geoprobe 7822DT
Contractor: CMT Drilling Inc.
Drilling Method: SPT

Elevation: 415.16 m
Logged by: SW

Project No.: 19-052
Project: Residential/Commercial Subdivision
Highway 6 and Bentley Street,
Location: Mount Forest, Ontario



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BOREHOLE 13

Page 1 of 1

Date Drilled: March 27, 2019
Rig:
Contractor: CMT Drilling Inc.
Drilling Method: Hand-Dug Hole

Elevation: 419.59
Logged by: SW

Project No.: 19-052
Project: Residential/Commercial Subdivision
Highway 6 and Bentley Street,
Location: Mount Forest, Ontario

Depth (ft/m)	Sample Type	Recovery (%)	Sample Number	Symbols	SOIL DESCRIPTION	Well Installation	Moisture Content % Wp [---X---] Wl 10 20 30 40 50	Pocket Penetrometer kPa 100 200 300 400 SPT (N) Blows/0.3 m 20 40 60 80
0 ft 0 m					Ground Surface (m) 419.59			
					TOPSOIL Very loose, dark brown silty organic topsoil (180mm).			
					419.41 0.18			
1	GS		1		DISTURBED SANDY SILT Loose, light brown and dark brown mottled disturbed sandy silt, trace clay and gravel, some organics and rootlets, moist			
2					418.99 0.60			
					End of Borehole			
3								

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TEST PIT 1

Page 1 of 1

Date Excavated: September 16, 2019

Elevation: 418.26 m

Project No.: 19-052

Project: Residential/Commercial Subdivision

Location: Highway 6 and Bentley Street,
Mount Forest, Ontario

Depth (ft/m)	Sample Type	Sample Number	Symbols	SOIL DESCRIPTION	Moisture Content % Wp [---X---] Wl
					10 20 30 40
0 ft 0 m				Ground Surface (m) 418.26	
				TOPSOIL 0.00 Loose, dark brown, silty organic topsoil, moist	
1				417.91 0.35 SANDY SILT TILL Compact, light brown sandy silt till, some clay and gravel, moist	
2					
3	1 GS	1			10.9
4					
5					
6				416.46 1.80 Becoming wet	
7					
8	GS	2			12.6
9				415.56 2.70 End of Borehole	
10					
11				Test Pit walls stable. No accumulated groundwater observed upon completion.	

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TEST PIT 2

Page 1 of 1

Date Excavated: September 16, 2019

Elevation: 417.65 m

Project No.: 19-052

Project: Residential/Commercial Subdivision

Location: Highway 6 and Bentley Street,
Mount Forest, Ontario

Depth (ft/m)	Sample Type	Sample Number	Symbols	SOIL DESCRIPTION	Moisture Content % Wp [---X---] Wl
0				Ground Surface (m) 417.65	
0				TOPSOIL Loose, dark brown, silty organic topsoil, moist	0.00
1				SAND Compact, red-brown sand, some gravel, moist	0.35
2				SANDY GRAVEL Compact, grey sandy gravel, trace silt and clay, moist	0.75
3	GS	1			5.6
4					
5					
6				SANDY SILT TILL Compact, grey sandy silt till, some clay and gravel, wet	1.80
7					
8	GS	2			11.1
9				End of Borehole 414.95 2.70	
10				Test Pit walls caving from approximately 1.8 m. Groundwater accumulated to about 2.5 m upon completion.	
11					

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TEST PIT 3

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Date Excavated: September 16, 2019

Elevation: 418.46 m

Project No.: 19-052

Project: Residential/Commercial Subdivision

Location: Highway 6 and Bentley Street,
Mount Forest, Ontario

Depth (ft/m)	Sample Type	Sample Number	Symbols	SOIL DESCRIPTION	Moisture Content % Wp [---X---] WI
0				Ground Surface (m) 418.46	
0				TOPSOIL Loose, dark brown, silty organic topsoil, moist	0.00
1					
2				SANDY SILT TILL Compact, brown sandy silt till, some clay and gravel, moist	0.40
3	GS	1			10.5
4					
5					
6				Becoming grey, wet	1.60
7					
8	GS	2			12.7
9				End of Borehole	2.70
10				Test Pit walls stable. No accumulated groundwater observed upon completion.	
11					

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TEST PIT 4

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Date Excavated: September 16, 2019

Elevation: 418.57 m

Project No.: 19-052

Project: Residential/Commercial Subdivision

Location: Highway 6 and Bentley Street,
Mount Forest, Ontario

Depth (ft/m)	Sample Type	Sample Number	Symbols	SOIL DESCRIPTION	Moisture Content % Wp [----X----] Wl
					10 20 30 40
0 ft m				Ground Surface (m) 418.57	
				TOPSOIL Loose, dark brown, silty organic topsoil, moist	0.00
1					
2				SAND Compact, red-brown sand, some silt, trace gravel and clay, moist	0.45
3	1 GS	1			7.2
4					
5				SANDY SILT TILL Compact, brown sandy silt till, some clay and gravel, moist	1.45
6					
7	2 GS	2			10.3
8					
9				End of Borehole	2.50
10	3			Test Pit walls stable. No accumulated groundwater observed upon completion.	
11					

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario NOB 2M0
phone 519-699-5775 fax 519-699-4664
www.cmtinc.net



TEST PIT 5

Page 1 of 1

Date Excavated: September 16, 2019

Elevation: 419.08 m

Project No.: 19-052

Project: Residential/Commercial Subdivision

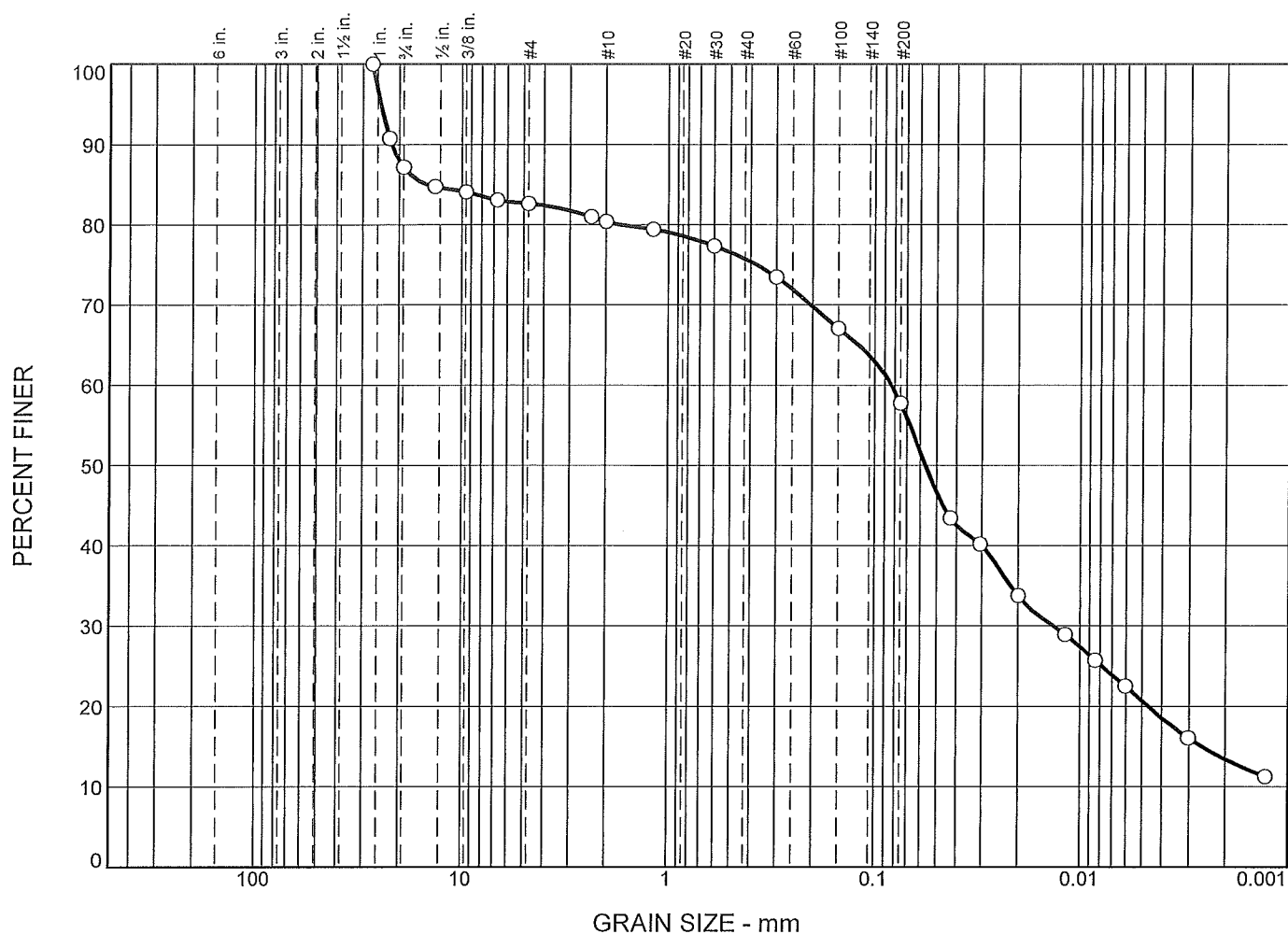
Location: Highway 6 and Bentley Street,
Mount Forest, Ontario

Depth (ft/m)	Sample Type	Sample Number	Symbols	SOIL DESCRIPTION	Moisture Content % Wp [---X---] Wl
0				Ground Surface (m) 419.08	
0				TOPSOIL Loose, dark brown, silty organic topsoil, moist	0.00
1					
2				SANDY SILT TILL Compact, brown sandy silt till, some clay and gravel, moist	0.50
3	1	GS	1		7.7
4					
5					
6					
7	2				
8		GS	2		7.5
9				End of Borehole 416.58	
10					
11				Test Pit walls stable. No accumulated groundwater observed upon completion.	

CMT ENGINEERING INC.
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St. Clements, Ontario NOB 2M0
phone 519-699-5775 fax 519-699-4664
www.cmtinc.net



Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	12.8	4.5	2.3	4.7	18.0	44.3	13.4

SOIL DATA					
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH12	4	2.29-2.90m	sandy silt, some gravel and clay	ML
				Tested by JM of CMT Engineering Inc., April 1, 2019	
				Estimated Coefficient of Permeability: $k < 1.0 \times 10^{-6}$ cm/s	

CMT Engineering Inc.

St. Clements, ON

Client: Avila Investments Ltd.

Project: Proposed Residential/Commercial Subdivision
Highway 6 and Bentley Street, Mount Forest, Ontario

Project No.: 19-052

Figure 6

APPENDIX D:
MIDUSS MODELLING – EXISTING CONDITIONS

```

MIDUSS Output ----->
MIDUSS version Version 2.25 rev. 473"
MIDUSS created Sunday, February 07, 2010"
Units used: ie METRIC"
Job folder: \\os-2012r2\Users_Private\awilkinson\
Documents\MIDUSS\318049"
Output filename: 318049 - Ex 2yr -FEB20.out"
Licensee name: gmbp"
Company
Date & Time last used: 2/20/2020 at 4:56:11 PM"

31 TIME PARAMETERS
5.000 Time Step"
360.000 Max. Storm length"
3600.000 Max. Hydrograph"
32 STORM Mass Curve"
3 Mass Curve"
40.000 Rainfall depth"
360.000 Duration"
41 C:\Program Files (x86)\MIDUSS\SCS_6hr.mrd SCS 6 hour
distributionsssss"
Maximum intensity 29.640 mm/hr"
Total depth 40.000 mm"
6 002hyd Hydrograph extension used in this file"
33 CATCHMENT 10"
1 Triangular SCS"
1 Equal length"
1 SCS method"
10 Catchment 10"
0.000 % Impervious"
1.880 Total Area"
150.000 Flow length"
3.000 Overland Slope"
1.880 Pervious Area"
150.000 Pervious length"
3.000 Pervious slope"
0.000 Impervious Area"
150.000 Impervious length"
3.000 Impervious slope"
0.300 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.258 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.154 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.000 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.014 0.000 0.000 Pervious Impervious Total Area"
Catchment 10

```

```

" Surface Area 1.880 0.000 1.880 hectare"
" Time of concentration 84.509 10.190 84.509 minutes"
" Time to Centroid 307.617 186.581 307.617 minutes"
" Rainfall depth 40.000 40.000 40.000 mm"
" Rainfall volume 752.00 0.00 752.00 c.m"
" Rainfall losses 29.681 5.241 29.681 mm"
" Runoff depth 10.319 34.759 10.319 mm"
" Runoff volume 193.99 0.00 193.99 c.m"
" Runoff coefficient 0.258 0.000 0.258 "
" Maximum flow 0.014 0.000 0.014 c.m/sec"
" HYDROGRAPH Add Runoff "
4 Add Runoff "
0.014 0.014 0.000 0.000"
81 ADD COMMENT=====
1 Lines of comment"
Runoff draining to 130 South Water Street property"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.014 0.014 0.014 0.000"
HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff draining from Subject Property"
Maximum flow 0.014 c.m/sec"
Hydrograph volume 193.991 c.m"
0.014 0.014 0.014"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary"
0.014 0.000 0.014 0.014"
CATCHMENT 11"
1 Triangular SCS"
1 Equal length"
1 SCS method"
11 Catchment 11"
0.000 % Impervious"
0.770 Total Area"
190.000 Flow length"
3.000 Overland Slope"
0.770 Pervious Area"
190.000 Pervious length"
3.000 Pervious slope"
0.000 Impervious Area"
190.000 Impervious length"
3.000 Impervious slope"
0.300 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.258 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.154 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"

```

[illegible]

```

19.810 Pervious Area"
650.000 Pervious length"
2.000 Pervious slope"
0.000 Impervious Area"
650.000 Impervious length"
2.000 Impervious slope"
0.300 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.258 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.000 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.080 0.000 0.006 0.022 c.m/sec"
Catchment 13 Pervious Impervious Total Area "
Surface Area 19.810 0.000 19.810 hectare"
Time of concentration 230.050 27.740 230.049 minutes"
Time to Centroid 474.664 208.232 474.663 minutes"
Rainfall depth 40.000 40.000 40.000 mm"
Rainfall volume 7923.99 0.01 7924.00 c.m"
Rainfall losses 29.680 5.120 29.680 mm"
Runoff depth 10.320 34.880 10.320 mm"
Runoff volume 2044.33 0.01 2044.33 c.m"
Runoff coefficient 0.258 0.000 0.258 c.m/sec"
Maximum flow 0.080 0.000 0.080 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff "
0.080 0.080 0.006 0.022"
81 ADD COMMENT=====
2 Lines of comment"
Runoff draining to unopened portion of South Water Street "
ROW"
40 HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.080 0.080 0.080 0.022"
40 HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff draining from Subject Property"
Maximum flow 0.092 c.m/sec"
Hydrograph volume 2360.079 c.m"
0.080 0.080 0.080 0.092"
40 HYDROGRAPH Start - New Tributary"
2 Start - New Tributary"
0.080 0.000 0.080 0.092"
33 CATCHMENT 14"
1 Triangular SCS"

```

```

1 Equal length"
1 SCS method"
14 Catchment 14"
0.000 % Impervious"
8.260 Total Area"
350.000 Flow length"
3.000 Overland Slope"
8.260 Pervious Area"
350.000 Pervious length"
3.000 Pervious slope"
0.000 Impervious Area"
350.000 Impervious length"
3.000 Impervious slope"
0.300 Pervious Manning 'n'"
75.000 Pervious SCS Curve No."
0.214 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
8.467 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.000 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.036 0.000 0.080 0.092 c.m/sec"
Catchment 14 Pervious Impervious Total Area "
Surface Area 8.260 0.000 8.260 hectare"
Time of concentration 153.160 16.943 153.159 minutes"
Time to Centroid 387.873 194.903 387.872 minutes"
Rainfall depth 40.000 40.000 40.000 mm"
Rainfall volume 3304.00 0.00 3304.00 c.m"
Rainfall losses 31.443 5.149 31.443 mm"
Runoff depth 8.557 34.851 8.557 mm"
Runoff volume 706.80 0.00 706.81 c.m"
Runoff coefficient 0.214 0.000 0.214 c.m/sec"
Maximum flow 0.036 0.000 0.036 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff "
0.036 0.036 0.080 0.092"
81 ADD COMMENT=====
1 Lines of comment"
Runoff draining from remainder of Subject Property"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.036 0.036 0.036 0.092"
40 HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff draining from Subject Property"
Maximum flow 0.127 c.m/sec"
Hydrograph volume 3066.887 c.m"

```

40	40	HYDROGRAPH Start - New Tributary"	0.036	0.036	0.036	0.127"	Runoff draining from Subject Property"	0.135	c.m./sec"
41	41	Maximum flow					Maximum flow	0.135	c.m./sec"
42	42	Hydrograph volume					Hydrograph volume	3371.498	c.m."
43	43	2 Start - New Tributary"	0.036	0.000	0.036	0.127"	HYDROGRAPH Start - New Tributary"	0.058	0.135"
44	44	CATCHMENT 20"					HYDROGRAPH Start - New Tributary"		
45	33	1 Triangular SCS"					2 Start - New Tributary"		
46	46	1 Equal length"					0.058	0.000	0.135"
47	47	1 SCS method"					CATCHMENT 30"		
48	48	20 Catchment 20"					1 Triangular SCS"		
49	49	45.000 % Impervious"					1 Equal length"		
50	50	1.440 Total Area"					1 SCS method"		
51	51	10.000 Flow length"					30 Catchment 30"		
52	52	0.792 Overland Slope"					4.000 % Impervious"		
53	53	10.000 Pervious Area"					12.960 Total Area"		
54	54	2.000 Pervious length"					250.000 Flow length"		
55	55	0.648 Pervious slope"					5.000 Overland Slope"		
56	56	10.000 Impervious Area"					12.442 Pervious Area"		
57	57	2.000 Impervious length"					250.000 Pervious length"		
58	58	0.300 Pervious Manning 'n'"					5.000 Pervious slope"		
59	59	78.000 Pervious SCS Curve No."					Impervious Area"		
60	60	0.258 Pervious Runoff coefficient"					250.000 Impervious length"		
61	61	7.164 Pervious Initial abstraction"					Impervious slope"		
62	62	0.020 Pervious Manning 'n'"					5.000 Pervious slope"		
63	63	98.000 Impervious SCS Curve No."					Impervious Area"		
64	64	0.860 Impervious Runoff coefficient"					250.000 Impervious length"		
65	65	0.100 Impervious Ia/S coefficient"					Impervious slope"		
66	66	0.518 Impervious Initial abstraction"					5.000 Pervious slope"		
67	67	0.058	0.000	0.036	0.127 c.m./sec"		Impervious Area"		
68	68	Catchment 20					250.000 Impervious length"		
69	69	Surface Area					Impervious slope"		
70	70	Time of concentration					5.000 Impervious slope"		
71	71	176.877					0.300 Pervious Manning 'n'"		
72	72	191.693					Pervious SCS Curve No."		
73	73	40.000					Pervious Runoff coefficient"		
74	74	576.00					Pervious Ia/S coefficient"		
75	75	259.20					Pervious Initial abstraction"		
76	76	316.80					Impervious Manning 'n'"		
77	77	29.696					Impervious SCS Curve No."		
78	78	5.586					Impervious Runoff coefficient"		
79	79	34.414					Impervious Ia/S coefficient"		
80	80	21.154					Impervious Initial abstraction"		
81	81	18.846					0.093	0.000	0.135 c.m./sec"
82	82	10.304					Catchment 30		
83	83	223.00					Surface Area		
84	84	304.61					Time of concentration		
85	85	0.529					Time to Centroid		
86	86	0.050					Rainfall depth		
87	87	0.058					Rainfall volume		
88	88	HYDROGRAPH Add Runoff "					Rainfall losses		
89	89	4 Add Runoff "					Rainfall depth		
90	90	0.058	0.058	0.036	0.127"		Runoff volume		
91	91	HYDROGRAPH Copy to Outflow"					Runoff coefficient		
92	92	8 Copy to Outflow"					Maximum flow		
93	93	0.058	0.058	0.058	0.127"		HYDROGRAPH Add Runoff "		
94	94	HYDROGRAPH Combine 1"					4 Add Runoff "		
95	95	6 Combine "					0.058	0.093	0.135"
96	96	1 Node #"					CATCHMENT 31"		
97	97						1 Triangular SCS"		
98	98						1 Equal length"		
99	99								

[illegible]

```

MIDUSS Output ----->
MIDUSS version          Version 2.25 rev. 473"
MIDUSS created          Sunday, February 07, 2010"
Units used:             ie METRIC"
Job folder:             \\os-2012r2\Users_Private\awilkinson\
                        Documents\MIDUSS\318049"
Output filename:        318049 - Ex 5yr - FEB20.out"
Licensee name:          gmbp"
Company
Date & Time last used:  2/20/2020 at 3:30:18 PM"

31  TIME PARAMETERS"
    5.000 Time Step"
    360.000 Max. Storm length"
    3600.000 Max. Hydrograph"
32  STORM Mass Curve"
    3 Mass Curve"
    52.800 Rainfall depth"
    360.000 Duration"
    41 C:\Program Files (x86)\MIDUSS\SCS_6hr.mrd SCS 6 hour
distributionsssss"
    Maximum intensity 39.125 mm/hr"
    Total depth 52.800 mm"
    6 002hyd Hydrograph extension used in this file"
33  CATCHMENT 10"
    1 Triangular SCS"
    1 Equal length"
    1 SCS method"
    10 Catchment 10"
    0.000 % Impervious"
    1.880 Total Area"
    150.000 Flow length"
    3.000 Overland Slope"
    1.880 Pervious Area"
    150.000 Pervious length"
    3.000 Pervious slope"
    0.000 Impervious Area"
    150.000 Impervious length"
    3.000 Impervious slope"
    0.300 Pervious Manning 'n'"
    78.000 Pervious SCS Curve No."
    0.336 Pervious Runoff coefficient"
    0.100 Pervious Ia/S coefficient"
    7.164 Pervious Initial abstraction"
    0.020 Impervious Manning 'n'"
    98.000 Impervious SCS Curve No."
    0.000 Impervious Runoff coefficient"
    0.100 Impervious Ia/S coefficient"
    0.518 Impervious Initial abstraction"
    0.031 0.000 0.000 0.000 c.m/sec"
    Catchment 10 Pervious Impervious Total Area "

```

```

    Surface Area 1.880 0.000 1.880 hectare"
    Time of concentration 67.244 9.047 67.244 minutes"
    Time to Centroid 283.550 183.100 283.550 mm"
    Rainfall depth 52.800 52.800 52.800 c.m"
    Rainfall volume 992.64 0.00 992.64 mm"
    Rainfall losses 35.044 5.447 35.044 mm"
    Runoff depth 17.756 47.353 17.756 mm"
    Runoff volume 333.82 0.00 333.82 c.m"
    Runoff coefficient 0.336 0.000 0.336 "
    Maximum flow 0.031 0.000 0.031 c.m/sec"
    HYDROGRAPH Add Runoff "
    4 Add Runoff " 0.031 0.031 0.000 0.000"
    ADD COMMENT=====
    1 Lines of comment"
    Runoff draining to 130 South Water Street property"
    HYDROGRAPH Copy to Outflow"
    8 Copy to Outflow" 0.031 0.031 0.031 0.000"
    HYDROGRAPH Combine 1"
    6 Combine "
    1 Node #"
    Runoff draining from Subject Property"
    Maximum flow 0.031 c.m/sec"
    Hydrograph volume 333.820 c.m"
    0.031 0.031 0.031"
    HYDROGRAPH Start - New Tributary"
    2 Start - New Tributary" 0.031 0.000 0.031 0.031"
    CATCHMENT 11"
    1 Triangular SCS"
    1 Equal length"
    1 SCS method"
    11 Catchment 11"
    0.000 % Impervious"
    0.770 Total Area"
    190.000 Flow length"
    3.000 Overland Slope"
    0.770 Pervious Area"
    190.000 Pervious length"
    3.000 Pervious slope"
    0.000 Impervious Area"
    190.000 Impervious length"
    3.000 Impervious slope"
    0.300 Pervious Manning 'n'"
    78.000 Pervious SCS Curve No."
    0.336 Pervious Runoff coefficient"
    0.100 Pervious Ia/S coefficient"
    7.164 Pervious Initial abstraction"
    0.020 Impervious Manning 'n'"

```

```

98.000 Impervious SCS Curve No."
0.000 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.012 0.000 0.031 0.000 0.031 c.m/sec"
Catchment 11
Surface Area 0.770 0.000 Impervious Total Area " hectare"
Time of concentration 77.491 10.425 77.491 minutes"
Rainfall depth 52.800 184.807 295.554 minutes"
Rainfall volume 406.56 0.00 406.56 c.m"
Rainfall losses 35.043 5.388 35.043 mm"
Runoff depth 17.757 47.412 17.757 mm"
Runoff volume 136.73 0.00 136.73 c.m"
Runoff coefficient 0.336 0.000 0.336 "
Maximum flow 0.012 0.000 0.012 c.m/sec"
4 Add Runoff "
0.012 0.012 0.031 0.031"
ADD COMMENT=====
1 Lines of comment"
Runoff draining to 250 Harris Street property"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.012 0.012 0.012 0.012 0.031"
HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff draining from Subject Property"
Maximum flow 0.043 c.m/sec"
Hydrograph volume 470.549 c.m"
0.012 0.012 0.043"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary"
0.012 0.000 0.012 0.043"
CATCHMENT 12"
1 Triangular SCS"
1 Equal length"
1 SCS method"
12 Catchment 12"
0.000 % Impervious"
0.410 Total Area"
50.000 Flow length"
6.000 Overland Slope"
0.410 Pervious Area"
50.000 Pervious length"
6.000 Pervious slope"
0.000 Impervious Area"
50.000 Impervious length"
6.000 Impervious slope"

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```

0.300 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.336 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.000 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.012 0.000 0.012 0.043 c.m/sec"
Catchment 12
Surface Area 0.410 0.000 0.410 hectare"
Time of concentration 28.254 3.801 28.254 minutes"
Rainfall depth 52.800 176.728 237.877 mm"
Rainfall volume 216.48 0.00 216.48 c.m"
Rainfall losses 35.052 6.113 35.052 mm"
Runoff depth 17.748 46.687 17.748 mm"
Runoff volume 72.77 0.00 72.77 c.m"
Runoff coefficient 0.336 0.000 0.336 "
Maximum flow 0.012 0.000 0.012 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff "
0.012 0.012 0.012 0.043"
ADD COMMENT=====
1 Lines of comment"
Runoff draining to unopened Harris Street ROW"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.012 0.012 0.012 0.043"
HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff draining from Subject Property"
Maximum flow 0.048 c.m/sec"
Hydrograph volume 543.315 c.m"
0.012 0.012 0.048"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary"
0.012 0.000 0.012 0.048"
CATCHMENT 13"
1 Triangular SCS"
1 Equal length"
1 SCS method"
13 Catchment 13"
0.000 % Impervious"
19.810 Total Area"
650.000 Flow length"
2.000 Overland Slope"

```

```

19.810 Pervious Area"
650.000 Pervious length"
2.000 Pervious slope"
0.000 Impervious Area"
650.000 Impervious length"
2.000 Impervious slope"
0.300 Pervious Manning 'n'"
78.000 Pervious SCS Curve No. "
0.336 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Pervious Manning 'n'"
98.000 Impervious SCS Curve No. "
0.000 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.160 0.000 0.012 0.048 c.m/sec"
Catchment 13 Pervious Impervious Total Area "
Surface Area 19.810 0.000 19.810 hectare"
Time of concentration 183.053 24.627 183.052 minutes"
Time to Centroid 419.207 202.351 419.206 minutes"
Rainfall depth 52.800 52.800 52.800 mm"
Rainfall volume 1.0460 0.0000 1.0460 ha-m"
Rainfall losses 35.042 5.269 35.042 mm"
Runoff depth 17.758 47.531 17.758 mm"
Runoff volume 3517.83 0.336 3517.84 c.m"
Runoff coefficient 0.336 0.000 0.336 "
Maximum flow 0.160 0.160 0.160 c.m/sec"
40 Add Runoff "
0.160 0.160 0.012 0.048"
81 ADD COMMENT=====
2 Lines of comment"
Runoff draining to unopened portion of South Water Street "
ROW"
40 HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.160 0.160 0.160 0.048"
40 HYDROGRAPH Combine 1"
6 Combine "
1 Node #
Runoff draining from Subject Property"
Maximum flow 0.185 c.m/sec"
Hydrograph volume 4061.156 c.m"
0.160 0.160 0.160 0.185"
40 HYDROGRAPH Start - New Tributary"
2 Start - New Tributary"
0.160 0.000 0.160 0.185"
33 CATCHMENT 14"
1 Triangular SCS"
1 Equal length"
1 SCS method"
14 Catchment 14"
0.000 % Impervious"
8.260 Total Area"
350.000 Flow length"
3.000 Overland Slope"
8.260 Pervious Area"
350.000 Pervious length"
3.000 Pervious slope"
0.000 Impervious Area"
350.000 Impervious length"
3.000 Impervious slope"
0.300 Pervious Manning 'n'"
75.000 Pervious SCS Curve No. "
0.289 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
8.467 Pervious Initial abstraction"
0.020 Pervious Manning 'n'"
98.000 Impervious SCS Curve No. "
0.000 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.075 0.000 0.160 0.185 c.m/sec"
Catchment 14 Pervious Impervious Total Area "
Surface Area 8.260 0.000 8.260 hectare"
Time of concentration 119.583 15.041 119.583 minutes"
Time to Centroid 346.667 190.518 346.667 minutes"
Rainfall depth 52.800 52.800 52.800 mm"
Rainfall volume 4361.28 0.00 4361.28 c.m"
Rainfall losses 37.565 5.301 37.565 mm"
Runoff depth 15.235 47.499 15.235 mm"
Runoff volume 1258.43 0.00 1258.44 c.m"
Runoff coefficient 0.289 0.000 0.289 "
Maximum flow 0.075 0.075 0.000 0.075 c.m/sec"
40 HYDROGRAPH Add Runoff "
4 Add Runoff "
0.075 0.075 0.160 0.185"
81 ADD COMMENT=====
1 Lines of comment"
Runoff draining from remainder of Subject Property"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.075 0.075 0.075 0.185"
40 HYDROGRAPH Combine 1"
6 Combine "
1 Node #
Runoff draining from Subject Property"
Maximum flow 0.257 c.m/sec"
Hydrograph volume 5319.602 c.m"

```

[illegible]

	SCS method"	Runoff draining from Subject Property"
1	Catchment 31"	Maximum flow
31	% Impervious "	0.272 c.m/sec"
3.000	Total Area"	Hydrograph volume
27.250	Flow length"	0.188 0.272 c.m"
300.000	Overland Slope"	HYDROGRAPH Copy to Outflow"
1.000	Pervious Area"	8 Copy to Outflow"
26.433	Pervious length"	0.188 0.272 0.272 0.000"
300.000	Pervious slope"	HYDROGRAPH Combine 2"
1.000	Impervious Area"	6 Combine "
0.817	Impervious length"	2 Node #"
300.000	Impervious slope"	Total Runoff to Saugeen River"
1.000	Pervious Manning 'n' "	Maximum flow
0.300	Pervious SCS Curve No. "	Hydrograph volume
73.000	Pervious Ia/S coefficient"	0.188 0.272 0.272
0.260	Pervious Initial abstraction"	START/RE-START TOTALS 1"
0.100	Pervious Manning 'n' "	3 Runoff Totals on EXIT"
9.395	Impervious SCS Curve No. "	Total Catchment area
0.020	Impervious runoff coefficient"	Total Impervious area
98.000	Impervious runoff coefficient"	Total % impervious
0.899	Impervious runoff coefficient"	EXIT"
		hectare"
		1.984 hectare"
		2.726 "

	0.338	Impervious Initial abstraction	0.188	0.198	Pervious	0.272 c.m./sec"	Total Area "
Catchment 31						0.817	27.250
Surface Area					26.433	0.817	27.250
Time of Concentration					158.879	19.065	145.360
Time to Centroid					392.934	195.483	373.842
Rainfall depth					52.800	52.800	52.800
Rainfall volume					1.3956	0.9432	1.4388
Rainfall losses					39.083	5.326	38.071
Runoff depth					13.717	47.474	14.729
Runoff volume					3625.68	388.10	4013.78
Runoff coefficient					0.260	0.899	0.279
Maximum flow					0.178	0.085	0.188

40

4	Add Runoff	0.188	0.342	0.089	0.272"
---	------------	-------	-------	-------	--------

40 HYDROGRAPH Copy to Outflow"

8 Copv to Outflow"

Copy to Section	0.188	0.342	0.342	0.272"

HYDROGRAPH Combine 2"

"6 combine"

Node # "COMPTON"

Total Runoff to Saugeen River"

Maximum flow	0.342	c.m/sec"
Maximum flow	0.342	c.m/sec"

Hydrograph volume 6468.691

	0.188	0.342	0.342"
0.188			
0.342			
0.342"			

40	HYDROGRAPH	Confluence	1"
----	------------	------------	----

7 Confluence "

1 Node #"

" " MIDUSS Output ----->"

" " MIDUSS version Version 2.25 rev. 473"

" " MIDUSS created Sunday, February 07, 2010"

" " Job folder: \\os-2012r2\Users\Private\awilkinson\ie METRIC"

" " Documents\MIDUSS\318049-JAN21"

" " 318049 - Ex 10yr - JAN21.out"

" " gmbp"

" " Output filename:

" " Licensee name:

" " Company

" " Date & Time last used: 1/22/2021 at 8:14:05 PM"

" " 31 TIME PARAMETERS"

" " 5.000 Time Step"

" " 360.000 Max. Storm length"

" " 3600.000 Max. Hydrograph"

" " 32 STORM Mass Curve"

" " 3 Mass Curve"

" " 61.400 Rainfall depth"

" " 360.000 Duration"

" " 41 C:\Program Files (x86)\MIDUSS\SCS_6hr.mnd SCS 6 hour distributionsssss"

" " Maximum intensity 45.497 mm/hr"

" " Total depth 61.400 mm"

" " 6 010hyd Hydrograph extension used in this file"

" " 33 CATCHMENT 10"

" " 1 Triangular SCS"

" " 1 Equal length"

" " 1 SCS method"

" " 10 Catchment 10"

" " 0.000 % Impervious"

" " 1.880 Total Area"

" " 150.000 Flow length"

" " 3.000 Overland Slope"

" " 1.880 Pervious Area"

" " 150.000 Pervious length"

" " 3.000 Pervious slope"

" " 0.000 Impervious Area"

" " 150.000 Impervious length"

" " 3.000 Impervious slope"

" " 0.300 Pervious Manning 'n'"

" " 78.000 Pervious SCS Curve No."

" " 0.380 Pervious Runoff coefficient"

" " 0.100 Pervious Ia/S coefficient"

" " 7.164 Pervious Initial abstraction"

" " 0.020 Pervious Manning 'n'"

" " 98.000 Pervious SCS Curve No."

" " 0.000 Pervious Runoff coefficient"

" " 0.100 Pervious Ia/S coefficient"

" " 0.518 Pervious Initial abstraction"

" " 0.046 0.000 0.000 0.000 c.m/sec"

" " Catchment 10 Pervious 1.880

" " Surface Area Impervious Total Area 1.880 hectare"

" " Time of concentration 60.019 8.490 60.019 minutes"

" " Time to Centroid 272.860 181.378 272.860 minutes"

" " Rainfall depth 61.400 61.400 61.400 mm"

" " Rainfall volume 1154.32 5.514 1154.32 c.m"

" " Rainfall losses 38.037 0.00 38.037 mm"

" " Runoff depth 23.363 55.886 23.363 mm"

" " Runoff volume 439.22 0.00 439.22 c.m"

" " Runoff coefficient 0.380 0.000 0.381 "

" " Maximum flow 0.046 0.000 0.046 c.m/sec"

" " HYDROGRAPH Add Runoff "

" " 4 Add Runoff "

" " 0.046 0.046 0.000 0.000"

" " 81 ADD COMMENT=====

" " 1 Lines of comment"

" " Runoff draining to 130 South Water Street property"

" " HYDROGRAPH Copy to Outflow"

" " 8 Copy to Outflow"

" " 0.046 0.046 0.046 0.000"

" " 40 HYDROGRAPH Combine 1"

" " 6 Combine "

" " 1 Node #"

" " Runoff draining from Subject Property"

" " Maximum flow 0.046 c.m/sec"

" " Hydrograph volume 439.219 c.m"

" " 0.046 0.046 0.046"

" " 40 HYDROGRAPH Start - New Tributary"

" " 2 Start - New Tributary"

" " 0.046 0.000 0.046 0.046"

" " 33 CATCHMENT 11"

" " 1 Triangular SCS"

" " 1 Equal length"

" " 1 SCS method"

" " 11 Catchment 11"

" " 0.000 % Impervious"

" " 0.770 Total Area"

" " 190.000 Flow length"

" " 3.000 Overland Slope"

" " 0.770 Pervious Area"

" " 190.000 Pervious length"

" " 3.000 Pervious slope"

" " 0.000 Impervious Area"

" " 190.000 Impervious length"

" " 3.000 Impervious slope"

" " 0.300 Pervious Manning 'n'"

" " 78.000 Pervious SCS Curve No."

" " 0.381 Pervious Runoff coefficient"

" " 0.100 Pervious Ia/S coefficient"

" " 7.164 Pervious Initial abstraction"

" " 0.020 Pervious Manning 'n'"

" " 98.000 Pervious SCS Curve No."

" " 0.000 Pervious Runoff coefficient"

"	0.100	Pervious Ia/S coefficient"
"	7.164	Pervious Initial abstraction"
"	0.020	Impervious Manning "n"
"	98.000	Impervious SCS Curve No."
"	0.000	Impervious Runoff coefficient"
"	0.100	Impervious Ia/S coefficient"
"	0.518	Impervious Initial abstraction"
"	0.018	0.000
"	Catchment 12	Pervious
"	Surface Area	0.410
"	Time of concentration	25.218
"	Time to Centroid	231.738
"	Rainfall depth	61.400
"	Rainfall volume	251.74
"	Rainfall losses	38.052
"	Runoff depth	23.348
"	Runoff volume	95.73
"	Runoff coefficient	0.380
"	Maximum flow	0.018
"	HYDROGRAPH Add Runoff "	
"	4	Add Runoff "
"	0.018	0.018
"	ADD COMMENT=====	
"	81	Lines of comment"
"	Runoff draining to unopened Harris Street ROW"	
"	40	HYDROGRAPH Copy to Outflow"
"	8	Copy to Outflow"
"	0.018	0.018
"	40	HYDROGRAPH Combine 1"
"	6	Combine "
"	1	Node #"
"	Runoff draining from Subject Property"	
"	Maximum flow	0.072
"	Hydrograph volume	714.854
"	0.018	0.018
"	40	HYDROGRAPH Start - New Tributary"
"	2	Start - New Tributary"
"	0.018	0.000
"	33	CATCHMENT 13"
"	1	Triangular SCS"
"	Equal length"	
"	1	SCS method"
"	13	Catchment 13"
"	0.000	% Impervious"
"	19.810	Total Area"
"	650.000	Flow length"
"	2.000	Overland Slope"
"	19.810	Pervious Area"
"	650.000	Pervious length"
"	2.000	Pervious slope"
"	0.000	Impervious Area"

"	650.000	Impervious length"	"	350.000	Flow length"	"	
"	2.000	Impervious slope"	"	3.000	Overland Slope"	"	
"	0.300	Pervious Manning 'n'"	"	8.260	Pervious Area"	"	
"	78.000	Pervious SCS Curve No. "	"	350.000	Pervious length"	"	
"	0.381	Pervious Runoff coefficient"	"	3.000	Pervious slope"	"	
"	0.100	Pervious Ia/S coefficient"	"	0.000	Impervious Area"	"	
"	7.164	Pervious Initial abstraction"	"	350.000	Impervious length"	"	
"	0.020	Impervious Manning 'n'"	"	3.000	Impervious slope"	"	
"	98.000	Impervious SCS Curve No. "	"	0.300	Pervious Manning 'n'"	"	
"	0.000	Impervious Runoff coefficient"	"	75.000	Pervious SCS Curve No. "	"	
"	0.100	Impervious Ia/S coefficient"	"	0.332	Pervious Runoff coefficient"	"	
"	0.518	Impervious Initial abstraction"	"	0.100	Pervious Ia/S coefficient"	"	
"			"	0.230	0.000	0.072 c.m/sec"	
"		Catchment 13	"		Pervious	Impervious Total Area "	
"	"	Surface Area	"	19.810	0.000	19.810	hectare"
"	"	Time of concentration	"	163.384	23.112	163.384	minutes"
"	"	Time to Centroid	"	395.017	199.475	395.016	minutes"
"	"	Rainfall depth	"	61.400	61.400	61.400	mm"
"	"	Rainfall volume	"	1.2163	0.0000	1.2163	ha-m"
"	"	Rainfall losses	"	38.032	5.345	38.032	mm"
"	"	Runoff depth	"	23.368	56.055	23.368	mm"
"	"	Runoff volume	"	4629.15	0.01	4629.16	c.m"
"	"	Runoff coefficient	"	0.381	0.000	0.381	"
"	"	Maximum flow	"	0.230	0.000	0.230	c.m/sec"
"	40	HYDROGRAPH Add Runoff "	"				
"	4	Add Runoff "	"				
"			"	0.230	0.230	0.018	0.072"
"	81	ADD COMMENT=====	"				
"	2	Lines of comment"	"				
"		Runoff draining to unopened portion of South Water Street "	"				
"		ROW"	"				
"	40	HYDROGRAPH Copy to Outflow"	"				
"	8	Copy to Outflow"	"				
"			"	0.230	0.230	0.230	0.072"
"	40	HYDROGRAPH Combine 1"	"				
"	6	Combine "	"				
"	1	Node #"	"				
"		Runoff draining from Subject Property"	"				
"		Maximum flow	"			0.266	c.m/sec"
"		Hydrograph volume	"			5344.014	c.m"
"			"	0.230	0.230	0.230	0.266"
"	40	HYDROGRAPH Start - New Tributary"	"				
"	2	Start - New Tributary"	"				
"			"	0.230	0.000	0.230	0.266"
"	33	CATCHMENT 14"	"				
"	1	Triangular SCS"	"				
"	1	Equal length"	"				
"	1	SCS method"	"				
"	14	Catchment 14"	"				
"	0.000	% Impervious"	"				
"	8.260	Total Area"	"				

[illegible]

[illegible]

```

31 MIDUSS Output ----->
32 MIDUSS version Version 2.25 rev. 473"
33 MIDUSS created Sunday, February 07, 2010"
34 Units used: ie METRIC"
35 Job folder: \\os-2012r2\Users_Private\awilkinson\
36 Documents\MIDUSS\318049"
37 Output filename: 318049 - Ex 25yr - FEB20.out"
38 License name: gmbp"
39 Date & Time last used: 2/20/2020 at 3:31:17 PM"
40
41 TIME PARAMETERS"
42 5.000 Time Step"
43 360.000 Max. Storm Length"
44 3600.000 Max. Hydrograph"
45
46 32 STORM Mass Curve"
47 3 Mass Curve"
48 72.200 Rainfall depth"
49 360.000 Duration"
50
51 41 C:\Program Files (x86)\MIDUSS\SCS_6hr.mrd SCS 6 hour
52 distributionssss"
53 Maximum intensity 53.500 mm/hr"
54 Total depth 72.200 mm"
55
56 6 025hyd Hydrograph extension used in this file"
57
58 33 CATCHMENT 10"
59 1 Triangular SCS"
60 1 Equal length"
61 1 SCS method"
62 10 Catchment 10"
63 0.000 % Impervious"
64 1.880 Total Area"
65 150.000 Flow length"
66 3.000 Overland Slope"
67 1.880 Pervious Area"
68 150.000 Pervious length"
69 3.000 Pervious slope"
70 0.000 Impervious Area"
71 150.000 Impervious length"
72 3.000 Impervious slope"
73 0.300 Pervious Manning 'n'"
74 78.000 Pervious SCS Curve No."
75 0.429 Pervious Runoff coefficient"
76 0.100 Pervious Ia/S coefficient"
77 7.164 Pervious Initial abstraction"
78 0.020 Impervious Manning 'n'"
79 98.000 Impervious SCS Curve No."
80 0.000 Impervious Runoff coefficient"
81 0.100 Impervious Ia/S coefficient"
82 0.518 Impervious Initial abstraction"
83
84 Catchment 10 Pervious 0.000 0.000
85 Impervious Total Area " 0.000 c.m/sec"

```

```

" Surface Area 1.880 0.000 1.880 hectare"
" Time of concentration 53.487 7.937 53.487 minutes"
" Time to Centroid 262.798 179.798 262.798 minutes"
" Rainfall depth 72.200 72.200 72.200 mm"
" Rainfall volume 1357.36 0.00 1357.36 c.m"
" Rainfall losses 41.261 5.556 41.261 mm"
" Runoff depth 30.939 66.644 30.939 mm"
" Runoff volume 581.66 0.00 581.66 c.m"
" Runoff coefficient 0.429 0.000 0.429 c.m/sec"
" HYDROGRAPH Add Runoff "
" Maximum flow 0.069 0.000 0.069 c.m/sec"
" 4 Add Runoff "
" 0.069 0.069 0.000 0.000"
"
" 81 ADD COMMENT=====
" 1 Lines of comment"
" Runoff draining to 130 South Water Street property"
" HYDROGRAPH Copy to Outflow"
" 8 Copy to Outflow"
" 0.069 0.069 0.069 0.000"
" HYDROGRAPH Combine 1"
" 6 Combine "
" 1 Node #"
" Runoff draining from Subject Property"
" Maximum flow 0.069 c.m/sec"
" Hydrograph volume 581.658 c.m"
" 0.069 0.069 0.069 0.069"
" HYDROGRAPH Start - New Tributary"
" 2 Start - New Tributary"
" 0.069 0.000 0.069 0.069"
" CATCHMENT 11"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 11 Catchment 11"
" 0.000 % Impervious"
" 0.770 Total Area"
" 190.000 Flow length"
" 3.000 Overland Slope"
" 0.770 Pervious Area"
" 190.000 Pervious length"
" 3.000 Pervious slope"
" 0.000 Impervious Area"
" 190.000 Impervious length"
" 3.000 Impervious slope"
" 0.300 Pervious Manning 'n'"
" 78.000 Pervious SCS Curve No."
" 0.429 Pervious Runoff coefficient"
" 0.100 Pervious Ia/S coefficient"
" 7.164 Pervious Initial abstraction"
" 0.020 Impervious Manning 'n'"

```

[illegible]

```

19.810 Pervious Area"
650.000 Pervious length"
2.000 Pervious slope"
0.000 Impervious Area"
650.000 Impervious length"
2.000 Impervious slope"
0.300 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.429 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Pervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.000 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.337 0.000 0.025 0.106 c.m/sec"
Catchment 13 Pervious Impervious Total Area "
Surface Area 19.810 0.000 19.810 hectare"
Time of concentration 145.602 21.606 145.602 minutes"
Time to Centroid 372.569 196.643 372.569 minutes"
Rainfall depth 72.200 72.200 72.200 mm"
Rainfall volume 1.4303 0.0000 1.4303 ha-m"
Rainfall losses 41.254 5.408 41.254 mm"
Runoff depth 30.946 66.792 30.946 mm"
Runoff volume 6130.32 0.01 6130.34 c.m"
Runoff coefficient 0.429 0.000 0.429 "
Maximum flow 0.337 0.000 0.337 c.m/sec"
4 Add Runoff "
0.337 0.337 0.025 0.106"
ADD COMMENT=====
81 Lines of comment"
Runoff draining to unopened portion of South Water Street "
ROW"
40 HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.337 0.337 0.337 0.106"
HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff draining from Subject Property"
Maximum flow 0.388 c.m/sec"
Hydrograph volume 7077.005 c.m"
0.337 0.337 0.337 0.388"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary"
0.337 0.000 0.337 0.388"
CATCHMENT 14"
33 1 Triangular SCS"

```

```

1 Equal length"
1 SCS method"
14 Catchment 14"
0.000 % Impervious"
350.000 Total Area"
3.000 Flow length"
8.260 Overland Slope"
350.000 Pervious Area"
3.000 Pervious length"
0.000 Pervious slope"
350.000 Impervious Area"
3.000 Impervious length"
0.300 Impervious slope"
75.000 Pervious Manning 'n'"
0.379 Pervious SCS Curve No."
0.100 Pervious Runoff coefficient"
8.467 Pervious Ia/S coefficient"
0.020 Pervious Initial abstraction"
98.000 Impervious Manning 'n'"
0.000 Impervious SCS Curve No."
0.100 Impervious Runoff coefficient"
0.518 Impervious Ia/S coefficient"
0.170 0.000 0.337 0.388 c.m/sec"
Catchment 14 Pervious Impervious Total Area "
Surface Area 8.260 0.000 8.260 hectare"
Time of concentration 93.682 13.196 93.681 minutes"
Time to Centroid 312.707 186.249 312.707 minutes"
Rainfall depth 72.200 72.200 72.200 mm"
Rainfall volume 5963.71 0.01 5963.72 c.m"
Rainfall losses 44.830 5.531 44.830 mm"
Runoff depth 27.370 66.669 27.370 mm"
Runoff volume 2260.76 0.01 2260.76 c.m"
Runoff coefficient 0.379 0.000 0.379 "
Maximum flow 0.170 0.000 0.170 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff "
0.170 0.170 0.337 0.388"
ADD COMMENT=====
1 Lines of comment"
Runoff draining from remainder of Subject Property"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.170 0.170 0.170 0.388"
HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff draining from Subject Property"
Maximum flow 0.549 c.m/sec"
Hydrograph volume 9337.761 c.m"

```

```

40 0.170 0.170 0.170 0.549"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary" 0.170 0.170 0.549"
0.170 0.000
33 CATCHMENT 20"
1 Triangular SCS"
1 Equal length"
1 SCS method"
20 Catchment 20"
45.000 % Impervious"
1.440 Total Area"
2.000 Overland Slope"
0.792 Pervious Area"
10.000 Pervious length"
2.000 Pervious slope"
0.648 Impervious Area"
10.000 Impervious length"
2.000 Impervious slope"
0.300 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.427 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.908 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.143 0.000 0.170 0.549 c.m/sec"
Catchment 20 Pervious Impervious Total Area "
Surface Area 0.792 1.440 5.466 hectare"
Time of concentration 11.897 1.765 5.466 minutes"
Rainfall depth 72.200 72.200 186.819 mm"
Rainfall volume 571.82 467.86 1039.68 c.m"
Rainfall losses 41.336 6.644 25.725 mm"
Runoff depth 30.864 65.556 46.475 mm"
Runoff volume 244.45 424.80 669.25 c.m"
Runoff coefficient 0.427 0.908 0.644 "
Maximum flow 0.057 0.093 0.143 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff " 0.143 0.143 0.170 0.549"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow" 0.143 0.143 0.143 0.549"
HYDROGRAPH Combine 1"
6 Combine "
1 Node #"

```

```

40 Runoff draining from Subject Property"
Maximum flow 0.576 c.m/sec"
Hydrograph volume 10007.011 c.m"
0.143 0.143 0.576"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary" 0.143 0.000 0.143 0.576"
0.143 0.000
33 CATCHMENT 30"
1 Triangular SCS"
1 Equal length"
1 SCS method"
30 Catchment 30"
4.000 % Impervious"
12.960 Total Area"
250.000 Flow length"
5.000 Overland Slope"
12.442 Pervious Area"
250.000 Pervious length"
5.000 Pervious slope"
0.518 Impervious Area"
250.000 Impervious length"
5.000 Impervious slope"
0.300 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.429 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.922 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.423 0.000 0.143 0.576 c.m/sec"
Catchment 30 Pervious Impervious Total Area "
Surface Area 12.442 12.960 12.960 hectare"
Time of concentration 62.345 9.251 57.978 minutes"
Time to Centroid 273.359 181.371 265.793 mm"
Rainfall depth 72.200 72.200 72.200 mm"
Rainfall volume 8982.83 374.28 9357.12 c.m"
Rainfall losses 41.258 5.642 39.833 mm"
Runoff depth 30.942 66.558 32.367 mm"
Runoff volume 3849.72 345.04 4194.76 c.m"
Runoff coefficient 0.429 0.922 0.448 "
Maximum flow 0.406 0.076 0.423 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff " 0.423 0.423 0.143 0.576"
CATCHMENT 31"
1 Triangular SCS"
1 Equal length"

```

SCS method"	1	Runoff draining from Subject Property"
31	Maximum flow	0.576 c.m/sec"
3.000	% Impervious"	10007.012 c.m"
27.250	Total Area"	0.420 0.576 0.747 0.000"
300.000	Flow length"	HYDROGRAPH Copy to Outflow"
1.000	Overland Slope"	8 Copy to Outflow"
26.433	Pervious Area"	0.420 0.576 0.576 0.000"
300.000	Pervious length"	HYDROGRAPH Combine 2"
1.000	Pervious slope"	6 Combine "
0.817	Impervious Area"	2 Node #"
300.000	Impervious length"	Total Runoff to Saugeen River"
1.000	Impervious slope"	Maximum flow
0.300	Pervious Manning 'n' "	1.298 c.m/sec"
73.000	Pervious SCS Curve No. "	Hydrograph volume
0.349	Pervious Runoff coefficient"	21398.744 c.m"
0.100	Pervious Ia/S coefficient"	0.420 0.576 0.576 1.298"
9.395	Pervious Initial abstraction"	START/RE-START TOTALS 1"
0.020	Impervious Manning 'n' "	3 Runoff Totals on EXIT"
98.000	Impervious SCS Curve No. "	Total Catchment area
0.925	Impervious Runoff coefficient"	Total Impervious area
		Total % impervious
		EXIT"
		72.780 hectare"
		1.984 hectare"
		2.726"

	0.330 imperial	0.420 imperial	0.423 metric	0.143 metric	0.576 C.m./sec"
Catchment 31					
Surface Area				Pervious	Impervious Total Area "
Time of Concentration				26.433	0.817
Time to Centroid				123.122	27.250
Rainfall depth				348.571	16.726
Rainfall volume				72.200	115.054
Rainfall losses				1.9884	336.595
Runoff depth				0.0590	72.200
Runoff volume				5.448	1.9675
Runoff coefficient				45.789	mm
Runoff coefficient				27.037	mm
Maximum flow				25.163	mm
				66.752	mm
				545.69	C.m."/sec"
				0.925	C.m."/sec"
				0.366	C.m."/sec"
				0.491	C.m."/sec"
				0.120	C.m."/sec"

49

+	ADD	RUNOFF	+	ADD	RUNOFF
0.420	0.747	0.143	0.576"		

12

8. Copy to Outflow"

HYDROGRAPH Combine 2" 0.420 0.747 0.943

of

Node #	Node #
2	2

Maximum flow	0.747	c.m/sec"
0.000	0.000	0.000
0.001	0.001	0.001
0.002	0.002	0.002
0.003	0.003	0.003
0.004	0.004	0.004
0.005	0.005	0.005
0.006	0.006	0.006
0.007	0.007	0.007
0.008	0.008	0.008
0.009	0.009	0.009
0.010	0.010	0.010
0.011	0.011	0.011
0.012	0.012	0.012
0.013	0.013	0.013
0.014	0.014	0.014
0.015	0.015	0.015
0.016	0.016	0.016
0.017	0.017	0.017
0.018	0.018	0.018
0.019	0.019	0.019
0.020	0.020	0.020
0.021	0.021	0.021
0.022	0.022	0.022
0.023	0.023	0.023
0.024	0.024	0.024
0.025	0.025	0.025
0.026	0.026	0.026
0.027	0.027	0.027
0.028	0.028	0.028
0.029	0.029	0.029
0.030	0.030	0.030
0.031	0.031	0.031
0.032	0.032	0.032
0.033	0.033	0.033
0.034	0.034	0.034
0.035	0.035	0.035
0.036	0.036	0.036
0.037	0.037	0.037
0.038	0.038	0.038
0.039	0.039	0.039
0.040	0.040	0.040
0.041	0.041	0.041
0.042	0.042	0.042
0.043	0.043	0.043
0.044	0.044	0.044
0.045	0.045	0.045
0.046	0.046	0.046
0.047	0.047	0.047
0.048	0.048	0.048
0.049	0.049	0.049
0.050	0.050	0.050
0.051	0.051	0.051
0.052	0.052	0.052
0.053	0.053	0.053
0.054	0.054	0.054
0.055	0.055	0.055
0.056	0.056	0.056
0.057	0.057	0.057
0.058	0.058	0.058
0.059	0.059	0.059
0.060	0.060	0.060
0.061	0.061	0.061
0.062	0.062	0.062
0.063	0.063	0.063
0.064	0.064	0.064
0.065	0.065	0.065
0.066	0.066	0.066
0.067	0.067	0.067
0.068	0.068	0.068
0.069	0.069	0.069
0.070	0.070	0.070
0.071	0.071	0.071
0.072	0.072	0.072
0.073	0.073	0.073
0.074	0.074	0.074
0.075	0.075	0.075
0.076	0.076	0.076
0.077	0.077	0.077
0.078	0.078	0.078
0.079	0.079	0.079
0.080	0.080	0.080
0.081	0.081	0.081
0.082	0.082	0.082
0.083	0.083	0.083
0.084	0.084	0.084
0.085	0.085	0.085
0.086	0.086	0.086
0.087	0.087	0.087
0.088	0.088	0.088
0.089	0.089	0.089
0.090	0.090	0.090
0.091	0.091	0.091
0.092	0.092	0.092
0.093	0.093	0.093
0.094	0.094	0.094
0.095	0.095	0.095
0.096	0.096	0.096
0.097	0.097	0.097
0.098	0.098	0.098
0.099	0.099	0.099
0.100	0.100	0.100

	0.420	0.747	0.747"
(8)			

40

7 Confluence "

```

10 MIDUSS Output ----->
11 MIDUSS version Version 2.25 rev. 473"
12 MIDUSS created Sunday, February 07, 2010"
13 Units used: ie METRIC"
14 Job folder: \\os-2012r2\Users_Private\awilkinson\
15 Documents\MIDUSS\318049"
16 Output filename: 318049 - Ex 50yr - FEB20.out"
17 Licensee name: gmbp"
18 Company
19 Date & Time last used: 2/20/2020 at 3:37:26 PM"
20
21 31 TIME PARAMETERS"
22 5.000 Time Step"
23 360.000 Max. Storm length"
24 3600.000 Max. Hydrograph"
25
26 32 STORM Mass Curve"
27 3 Mass Curve"
28 80.100 Rainfall depth"
29 360.000 Duration"
30
31 41 C:\Program Files (x86)\MIDUSS\SCS_6hr.mrd SCS 6 hour
32 distributionssss"
33
34 Maximum intensity 59.354 mm/hr"
35 Total depth 80.100 mm"
36
37 6 050hyd Hydrograph extension used in this file"
38
39 CATCHMENT 10"
40
41 1 Triangular SCS"
42 1 Equal length"
43 1 SCS method"
44
45 10 Catchment 10"
46 % Impervious"
47 0.000
48 1.880 Total Area"
49 150.000 Flow length"
50 3.000 Overland Slope"
51 1.880 Pervious Area"
52 150.000 Pervious length"
53 3.000 Pervious slope"
54 0.000 Impervious Area"
55 150.000 Impervious length"
56 3.000 Impervious slope"
57 0.300 Pervious Manning 'n'"
58 78.000 Pervious SCS Curve No."
59 0.459 Pervious Runoff coefficient"
60 0.100 Pervious Ia/S coefficient"
61 7.164 Pervious Initial abstraction"
62 0.020 Impervious Manning 'n'"
63 98.000 Impervious SCS Curve No."
64 0.000 Impervious Runoff coefficient"
65 0.100 Impervious Ia/S coefficient"
66 0.518 Impervious Initial abstraction"
67
68 0.088 0.000 0.000 Pervious
69 0.000 0.000 0.000 Impervious Total Area"
70
71 Catchment 10

```

```

72
73 Surface Area 1.880 0.000 1.880 hectare"
74 Time of concentration 49.846 7.604 49.845 minutes"
75 Time to Centroid 178.829 256.985 256.985 mm"
76 Rainfall depth 80.100 80.100 80.100 mm"
77 Rainfall volume 1505.88 0.00 1505.88 c.m"
78 Rainfall losses 43.315 5.685 43.315 mm"
79 Runoff depth 36.785 74.415 36.785 mm"
80 Runoff volume 691.55 0.00 691.55 c.m"
81 Runoff coefficient 0.459 0.000 0.459 "
82 Maximum flow 0.088 0.000 0.088 c.m/sec"
83 HYDROGRAPH Add Runoff "
84
85 4 Add Runoff "
86 0.088 0.088 0.000 0.000"
87
88 ADD COMMENT=====
89
90 1 Lines of comment"
91 Runoff draining to 130 South Water Street property"
92 HYDROGRAPH Copy to Outflow"
93
94 8 Copy to Outflow"
95 0.088 0.088 0.088 0.000"
96
97 HYDROGRAPH Combine 1"
98
99 6 Combine "
100
101 1 Node #"
102 Runoff draining from Subject Property"
103 Maximum flow 0.088 c.m/sec"
104 Hydrograph volume 691.550 c.m"
105 0.088 0.088 0.088"
106
107 HYDROGRAPH Start - New Tributary"
108
109 2 Start - New Tributary"
110 0.088 0.000 0.088 0.088"
111
112 CATCHMENT 11"
113
114 1 Triangular SCS"
115 1 Equal length"
116 1 SCS method"
117
118 11 Catchment 11"
119 % Impervious"
120 0.000
121 0.770 Total Area"
122 190.000 Flow length"
123 3.000 Overland Slope"
124 0.770 Pervious Area"
125 190.000 Pervious length"
126 3.000 Pervious slope"
127 0.000 Impervious Area"
128 190.000 Impervious length"
129 3.000 Impervious slope"
130 0.300 Pervious Manning 'n'"
131 78.000 Pervious SCS Curve No."
132 0.459 Pervious Runoff coefficient"
133 0.100 Pervious Ia/S coefficient"
134 7.164 Pervious Initial abstraction"
135 0.020 Impervious Manning 'n'"

```

98.000	Impervious SCS Curve No."	0.300	Pervious Manning 'n'"	0.000	Impervious SCS Curve No."	0.300	Pervious Manning 'n'"	0.000	Impervious SCS Curve No."
0.000	Impervious Runoff coefficient"	78.000	Pervious Runoff coefficient"	0.459	Impervious Runoff coefficient"	78.000	Pervious Runoff coefficient"	0.459	Impervious Runoff coefficient"
0.100	Impervious Ia/S coefficient"	0.100	Pervious Ia/S coefficient"	7.164	Impervious Ia/S coefficient"	0.100	Pervious Ia/S coefficient"	7.164	Impervious Ia/S coefficient"
0.518	Impervious Initial abstraction"	0.032	0.000	0.088	0.088	0.032	0.000	0.088	0.088
	Catchment 11		Pervious		Impervious		Total Area		
	Surface Area	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770
	Time of concentration	57.441	8.763	57.441	57.441	57.441	57.441	57.441	57.441
	Time to Centroid	266.080	180.165	266.080	266.080	266.080	266.080	266.080	266.080
	Rainfall depth	80.100	80.100	80.100	80.100	80.100	80.100	80.100	80.100
	Rainfall volume	616.77	0.00	616.77	0.00	616.77	0.00	616.77	0.00
	Rainfall losses	43.311	5.703	43.311	43.311	43.311	43.311	43.311	43.311
	Rainfall depth	36.789	74.397	36.789	36.789	36.789	36.789	36.789	36.789
	Runoff volume	283.28	0.00	283.28	0.00	283.28	0.00	283.28	0.00
	Runoff coefficient	0.459	0.000	0.459	0.000	0.459	0.000	0.459	0.000
	Maximum flow	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
	HYDROGRAPH Add Runoff "								
40	4 Add Runoff "	0.032	0.032	0.088	0.088				
	ADD COMMENT=====								
" 81	1 Lines of comment"								
	Runoff draining to 250 Harris Street property"								
40	8 Copy to Outflow"	0.032	0.032	0.032	0.088				
	HYDROGRAPH Copy to Outflow"								
40	6 Combine "	0.032	0.032	0.032	0.088				
	Node #"								
	Runoff draining from Subject Property"								
	Maximum flow	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120
	Hydrograph volume	974.828	0.032	0.032	0.120				
40	2 Start - New Tributary"	0.032	0.000	0.032	0.120				
	CATCHMENT 12"								
33	1 Triangular SCS"								
	Equal length"								
	SCS method"								
	Catchment 12"								
	% Impervious"								
	Total Area"								
	Flow length"								
	Overland Slope"								
	Pervious Area"								
	Pervious length"								
	Pervious slope"								
	Impervious Area"								
	Impervious length"								
	Impervious slope"								

	19.810	Pervious Area"		1	Equal length"	
	650.000	Pervious length"		1	SCS method"	
	2.000	Pervious slope"		14	Catchment 14"	
	0.000	Impervious Area"		0.000	% Impervious "	
	650.000	Impervious length"		350.000	Total Area"	
	2.000	Impervious slope"		3.000	Flow Length"	
	0.300	Pervious Manning 'n' "		8.260	Overland Slope"	
	78.000	Pervious SCS Curve No. "		8.260	Pervious Area"	
	0.459	Pervious Runoff coefficient"		350.000	Pervious length"	
	0.100	Pervious Ia/S coefficient"		3.000	Pervious slope"	
	7.164	Pervious Initial abstraction"		0.000	Impervious Area"	
	0.020	Impervious Manning 'n' "		350.000	Impervious length"	
	98.000	Impervious SCS Curve No. "		3.000	Impervious slope"	
	0.000	Impervious Runoff coefficient"		0.300	Pervious Manning 'n' "	
	0.100	Impervious Ia/S coefficient"		75.000	Pervious SCS Curve No. "	
	0.518	Impervious Initial abstraction"		0.410	Pervious Runoff coefficient"	
				0.100	Pervious Ia/S coefficient"	
				8.467	Pervious Initial abstraction"	
				0.020	Impervious Manning 'n' "	
				98.000	Impervious SCS Curve No. "	
				0.100	Impervious Runoff coefficient"	
				0.518	Impervious Ia/S coefficient"	
					Impervious Initial abstraction"	
					0.221	0.000
					0.428	0.491 c.m/sec"
					Impervious Total Area "	
					Surface Area	8.260
					Time of concentration	86.935
					Time to Centroid	303.433
					Rainfall depth	80.100
					Rainfall volume	6616.25
					Rainfall losses	47.272
					Rainfall depth	32.828
					Runoff volume	2711.60
					Runoff coefficient	0.410
					Maximum flow	0.221
					HYDROGRAPH Add Runoff "	
					4	Add Runoff "
					0.428	0.428
					0.136"	0.136"
					ADD COMMENT=====	
					Lines of comment"	
					Runoff draining to unopened portion of South Water Street "	
					ROW"	
					HYDROGRAPH Copy to Outflow"	
					8	Copy to Outflow"
					0.428	0.428
					0.428	0.428
					HYDROGRAPH Combine 1"	
					6	Combine "
					1	Node #"
					Runoff draining from Subject Property"	
					Maximum flow	0.491
					Hydrograph volume	8414.338
					0.428	0.428
					0.428	0.491"
					HYDROGRAPH Start - New Tributary"	
					2	Start - New Tributary"
					0.428	0.000
					0.428	0.428
					0.491"	0.491"
					CATCHMENT 14"	
					1	Triangular SCS"
					Maximum flow	0.695
					Hydrograph volume	11125.945
					c.m/sec"	c.m"

```

40 0.221 0.221 0.221 0.695"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary" 0.221 0.695"
CATCHMENT 20"
1 Triangular SCS"
1 Equal length"
1 SCS method"
20 Catchment 20"
45.000 % Impervious"
1.440 Total Area"
10.000 Flow length"
2.000 Overland Slope"
0.792 Pervious Area"
10.000 Pervious length"
2.000 Pervious slope"
0.648 Impervious Area"
10.000 Impervious length"
2.000 Impervious slope"
0.300 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.458 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.914 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.165 0.000 0.221 0.695 c.m/sec"
Catchment 20 Pervious Impervious Total Area "
Surface Area 0.792 1.440 1.440 hectare"
Time of concentration 11.087 1.691 5.261 minutes"
Rainfall depth 210.564 170.767 185.887 mm"
Rainfall volume 634.39 519.05 1153.44 c.m"
Rainfall losses 43.387 6.867 26.953 mm"
Runoff depth 36.713 73.233 53.147 mm"
Runoff volume 290.77 474.55 765.32 c.m"
Runoff coefficient 0.458 0.914 0.664 "
Maximum flow 0.069 0.104 0.165 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff " 0.165 0.165 0.221 0.695"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow" 0.165 0.165 0.165 0.695"
HYDROGRAPH Combine 1"
6 Combine " 1"
1 Node #"

```

```

40 Runoff draining from Subject Property"
Maximum flow 0.730 c.m/sec"
Hydrograph volume 11891.268 c.m"
0.165 0.165 0.730"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary" 0.165 0.165 0.730"
CATCHMENT 30"
1 Triangular SCS"
1 Equal length"
1 SCS method"
30 Catchment 30"
4.000 % Impervious"
12.960 Total Area"
250.000 Flow length"
5.000 Overland Slope"
12.442 Pervious Area"
250.000 Pervious length"
5.000 Pervious slope"
0.518 Impervious Area"
250.000 Impervious length"
5.000 Impervious slope"
0.300 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.459 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.929 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.541 0.000 0.165 0.730 c.m/sec"
Catchment 30 Pervious Impervious Total Area "
Surface Area 12.442 0.518 12.960 hectare"
Time of concentration 58.101 8.863 54.275 minutes"
Time to Centroid 266.870 180.304 260.144 minutes"
Rainfall depth 80.100 80.100 80.100 mm"
Rainfall volume 0.9966 0.0415 1.0381 ha-m"
Rainfall losses 43.311 5.721 41.808 mm"
Runoff depth 36.789 74.379 38.292 mm"
Runoff volume 4577.12 385.58 4962.70 c.m"
Runoff coefficient 0.459 0.929 0.478 c.m/sec"
Maximum flow 0.521 0.084 0.541 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff " 0.541 0.165 0.730"
CATCHMENT 31"
1 Triangular SCS"
1 Equal length"

```

	SCS method"	Runoff draining from Subject Property"
1	Catchment 31"	Maximum flow 0.730 c.m/sec"
31	% Impervious"	Hydrograph volume 11891.268 c.m"
3.000	Total Area"	0.543 0.730 0.958 0.000"
27.250	Flow length"	HYDROGRAPH Copy to Outflow"
300.000	Overland Slope"	8 Copy to Outflow"
1.000	Pervious Area"	0.543 0.730 0.730 0.000"
26.433	Pervious length"	HYDROGRAPH Combine 2"
300.000	Pervious slope"	6 Combine "
1.000	Impervious Area"	2 Node #"
0.817	Impervious length"	Total Runoff to Saugeen River"
300.000	Impervious slope"	Maximum flow 1.655 c.m/sec"
1.000	Pervious Manning 'n' "	Hydrograph volume 25488.338 c.m"
0.300	Pervious SCS Curve No. "	0.543 0.730 1.655"
73.000	Pervious Runoff coefficient"	START/RE-START TOTALS 1"
0.379	Pervious Ia/S coefficient"	3 Runoff Totals on EXIT"
0.100	Pervious Initial abstraction"	Total Catchment area
9.395	Impervious Manning 'n' "	Total Impervious area
0.020	Impervious SCS Curve No. "	Total % impervious
98.000	Impervious Runoff coefficient"	EXIT"
0.930	Impervious Ia/S coefficient"	
0.100	Impervious Initial abstraction"	
0.518	0.543 0.541 0.165 0.730 c.m/sec"	
	Catchment 31 Pervious Total Area "	
	Surface Area 26.433 0.817 27.250 hectare"	
	Time of concentration 113.922 16.025 107.015 minutes"	
	Time to Centroid 336.623 189.167 326.220 mm"	
	Rainfall depth 80.100 80.100 ha-m"	
	Rainfall volume 2.1172 0.0655 2.1827 mm"	
	Rainfall losses 49.739 5.587 48.414 mm"	
	Runoff depth 30.361 74.513 31.686 c.m"	
	Runoff volume 8025.25 609.15 8634.40 "	
	Runoff coefficient 0.379 0.930 0.396 c.m/sec"	
	Maximum flow HYDROGRAPH Add Runoff "	
	0.543 0.958 0.165 0.730"	
40	4 Add Runoff "	
	HYDROGRAPH Copy to Outflow"	
40	8 Copy to Outflow"	
	0.543 0.958 0.958 0.730"	
40	HYDROGRAPH Combine 2"	
	6 Combine "	
	2 Node #"	
	Total Runoff to Saugeen River"	
	Maximum flow 0.958 c.m/sec"	
	Hydrograph volume 13597.084 c.m"	
	0.543 0.958 0.958 0.958"	
	HYDROGRAPH Confluence 1"	
40	7 Confluence "	
	2 Node #"	
	Total Catchment area	72.780 hectare"
	Total Impervious area	1.984 hectare"
	Total % impervious	2.726"
	EXIT"	

```

30 MIDUSS Output ----->
31 MIDUSS version Version 2.25 rev. 473
32 MIDUSS created Sunday, February 07, 2010
33 Units used: ie METRIC
34 Job folder: \\os-2012r2\Users_Private\awilkinson\
35 Documents\MIDUSS\318049
36 Output filename: 318049 - Ex 100yr - FEB20.out
37 Licensee name: gmbp
38 Date & Time last used: 2/20/2020 at 3:44:12 PM
39
40 TIME PARAMETERS
41 5.000 Time Step
42 360.000 Max. Storm length
43 3600.000 Max. Hydrograph
44 STORM Mass Curve
45 3 Mass Curve
46 88.000 Rainfall depth
47 360.000 Duration
48 41 C:\Program Files (x86)\MIDUSS\SCS_6hr.mrd SCS 6 hour
49 distributionsssss
50 Maximum intensity 65.208 mm/hr
51 Total depth 88.000 mm
52 6 100hyd Hydrograph extension used in this file"
53 CATCHMENT 10"
54 1 Triangular SCS
55 1 Equal length"
56 1 SCS method"
57 10 Catchment 10"
58 % Impervious"
59 0.000
60 1.880 Total Area"
61 150.000 Flow length"
62 3.000 Overland Slope"
63 1.880 Pervious Area"
64 150.000 Pervious length"
65 3.000 Pervious slope"
66 0.000 Impervious Area"
67 150.000 Impervious length"
68 3.000 Impervious slope"
69 0.300 Pervious Manning 'n'"
70 78.000 Pervious SCS Curve No."
71 0.487 Pervious Runoff coefficient"
72 0.100 Pervious Ia/S coefficient"
73 7.154 Pervious Initial abstraction"
74 0.020 Impervious Manning 'n'"
75 98.000 Impervious SCS Curve No."
76 0.000 Impervious Runoff coefficient"
77 0.100 Impervious Ia/S coefficient"
78 0.518 Impervious Initial abstraction"
79 0.108 0.000 0.000 Pervious Impervious Total Area "
80 Catchment 10

```

```

81 Surface Area 1.880 0.000 1.880 hectare"
82 Time of concentration 46.859 7.316 46.858 minutes"
83 Time to Centroid 252.101 177.944 252.101 minutes"
84 Rainfall depth 88.000 0.00 88.000 mm"
85 Rainfall volume 1654.40 0.00 1654.40 c.m"
86 Rainfall losses 45.156 5.864 45.156 mm"
87 Runoff depth 42.844 82.136 42.844 mm"
88 Runoff volume 805.47 0.00 805.48 c.m"
89 Runoff coefficient 0.487 0.000 0.487 "
90 Maximum flow 0.108 0.000 0.108 c.m/sec"
91 HYDROGRAPH Add Runoff "
92 4 Add Runoff "
93 0.108 0.108 0.000 0.000"
94 ADD COMMENT=====
95 1 Lines of comment"
96 Runoff draining to 130 South Water Street property"
97 HYDROGRAPH Copy to Outflow"
98 8 Copy to Outflow"
99 0.108 0.108 0.108 0.000"
100 HYDROGRAPH Combine 1"
101 6 Combine "
102 1 Node #"
103 Runoff draining from Subject Property"
104 Maximum flow 0.108 c.m/sec"
105 Hydrograph volume 805.475 c.m"
106 0.108 0.108 0.108 0.108"
107 HYDROGRAPH Start - New Tributary"
108 2 Start - New Tributary"
109 0.108 0.000 0.108 0.108"
110 CATCHMENT 11"
111 1 Triangular SCS"
112 1 Equal length"
113 1 SCS method"
114 11 Catchment 11"
115 % Impervious"
116 0.000
117 0.770 Total Area"
118 190.000 Flow length"
119 3.000 Overland Slope"
120 0.770 Pervious Area"
121 190.000 Pervious length"
122 3.000 Pervious slope"
123 0.000 Impervious Area"
124 190.000 Impervious length"
125 3.000 Impervious slope"
126 0.300 Pervious Manning 'n'"
127 78.000 Pervious SCS Curve No."
128 0.487 Pervious Runoff coefficient"
129 0.100 Pervious Ia/S coefficient"
130 7.154 Pervious Initial abstraction"
131 0.020 Impervious Manning 'n'"

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98.000 Impervious SCS Curve No."
0.000 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.040 0.000 0.108 0.040 0.000 0.108 c.m/sec"
Catchment 11
Surface Area 0.770 0.000 0.770 hectare"
Time of concentration 53.999 8.430 53.999 minutes"
Time to Centroid 260.676 179.248 260.676 minutes"
Rainfall depth 88.000 88.000 88.000 mm"
Rainfall volume 677.60 0.00 677.60 c.m"
Rainfall losses 45.153 5.729 45.152 mm"
Runoff depth 42.847 82.271 42.848 mm"
Runoff volume 329.93 0.00 329.93 c.m"
Runoff coefficient 0.487 0.000 0.487 "
Maximum flow 0.040 0.000 0.040 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff "
0.040 0.040 0.108 0.108"
ADD COMMENT=====
1 Lines of comment"
Runoff draining to 250 Harris Street property"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.040 0.040 0.040 0.040 0.108"
HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff draining from Subject Property"
Maximum flow 0.148 c.m/sec"
Hydrograph volume 1135.401 c.m"
0.040 0.040 0.040 0.148"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary"
0.040 0.000 0.040 0.148"
CATCHMENT 12"
1 Triangular SCS"
1 Equal length"
1 SCS method"
12 Catchment 12"
0.000 % Impervious"
0.410 Total Area"
50.000 Flow length"
6.000 Overland Slope"
0.410 Pervious Area"
50.000 Pervious length"
6.000 Pervious slope"
0.000 Impervious Area"
50.000 Impervious length"
6.000 Impervious slope"

0.300 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.486 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.000 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.038 0.000 0.040 0.148 c.m/sec"
Catchment 12
Surface Area 0.410 0.000 0.410 hectare"
Time of concentration 19.688 3.074 19.688 minutes"
Time to Centroid 219.449 172.939 219.449 minutes"
Rainfall depth 88.000 88.000 88.000 mm"
Rainfall volume 360.80 0.00 360.80 c.m"
Rainfall losses 45.192 7.225 45.192 mm"
Runoff depth 42.808 80.775 42.808 mm"
Runoff volume 175.51 0.00 175.51 c.m"
Runoff coefficient 0.486 0.000 0.486 "
Maximum flow 0.038 0.000 0.038 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff "
0.038 0.038 0.040 0.148"
ADD COMMENT=====
1 Lines of comment"
Runoff draining to unopened Harris Street ROW"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.038 0.038 0.038 0.148"
HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff draining from Subject Property"
Maximum flow 0.167 c.m/sec"
Hydrograph volume 1310.913 c.m"
0.038 0.038 0.167"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary"
0.038 0.000 0.038 0.167"
CATCHMENT 13"
1 Triangular SCS"
1 Equal length"
1 SCS method"
13 Catchment 13"
0.000 % Impervious"
19.810 Total Area"
650.000 Flow length"
2.000 Overland Slope"

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[illegible]

40	40	0.277	0.277	0.277	0.860"	Runoff draining from Subject Property"
		HYDROGRAPH Start - New Tributary"			Maximum flow	0.898 c.m/sec"
	2	Start - New Tributary"	0.277	0.860"	Hydrograph volume	13844.891 c.m"
		CATCHMENT 20"	0.277	0.000	0.188	0.188 c.m"
33	33	1 Triangular SCS"			HYDROGRAPH Start - New Tributary"	
	1	Equal length"			2	Start - New Tributary"
	1	SCS method"				0.188 0.000 0.188 0.898"
	20	Catchment 20"				
	45.000	% Impervious"				
	1.440	Total Area"				
	10.000	Flow length"				
	2.000	Overland Slope"				
	0.792	Pervious length"				
	10.000	Pervious Area"				
	2.000	Pervious slope"				
	0.648	Impervious Area"				
	10.000	Impervious length"				
	2.000	Impervious slope"				
	0.300	Pervious Manning 'n'"				
	78.000	Pervious SCS Curve No."				
	0.486	Pervious Runoff coefficient"				
	0.100	Pervious Ia/S coefficient"				
	7.164	Pervious Initial abstraction"				
	0.020	Impervious Manning 'n'"				
	98.000	Impervious SCS Curve No."				
	0.919	Impervious Runoff coefficient"				
	0.100	Impervious Ia/S coefficient"				
	0.518	Impervious Initial abstraction"				
		Catchment 20	0.188	0.000	0.277	0.860 c.m/sec"
		Surface Area			Pervious	Impervious Total Area "
		Time to concentration	10.422	0.792	0.648	1.440 hectare "
		Time to Centroid	208.355	1.627	5.078	minutes"
		Rainfall depth	88.000	170.069	185.092	mm"
		Rainfall volume	696.96	570.24	1267.20	c.m"
		Rainfall losses	45.255	7.095	28.083	mm"
		Runoff depth	42.745	80.905	59.917	mm"
		Runoff volume	338.54	524.26	862.80	c.m"
		Runoff coefficient	0.486	0.919	0.681	"
		Maximum flow	0.079	0.114	0.188	c.m/sec"
40	40	HYDROGRAPH Add Runoff "				
	4	Add Runoff "	0.188	0.188	0.277	0.860"
		HYDROGRAPH Copy to Outflow"				
	8	Copy to Outflow"	0.188	0.188	0.188	0.860"
		HYDROGRAPH Combine	1"			
40	40	6 Combine "				
		1 Node #"				

SCS method"	1	Runoff draining from Subject Property"
Catchment 31"	31	Maximum flow
% Impervious"	3.000	0.898
Total Area"	27.250	13844.891
Flow length"	300.000	0.684
Overland Slope"	1.000	0.898
Pervious Area"	26.433	1.192
Pervious length"	300.000	0.898
Pervious slope"	1.000	0.898
Impervious Area"	0.817	0.898
Impervious length"	300.000	0.898
Impervious slope"	1.000	0.898
Pervious Manning 'n'"	0.300	2.055
Pervious SCS Curve No."	73.000	29741.291
Pervious Runoff coefficient"	0.407	0.898
Pervious Ia/S coefficient"	0.100	0.898
Pervious Initial abstraction"	9.395	0.898
Impervious Manning 'n'"	0.020	0.898
Impervious SCS Curve No."	98.000	0.898
Impervious Runoff coefficient"	0.937	0.898
START/RE-START TOTALS 1"	38	START/RE-START TOTALS 1"
Runoff Totals on EXIT"	3	Runoff Totals on EXIT"
Total Catchment area		Total Catchment area
Total Impervious area		Total Impervious area
Total % impervious		Total % impervious
EXIT"	19	EXIT"
hectare"		hectare"
hectare"		hectare"

APPENDIX E:
MIDUSS MODELLING – POST-DEVELOPMENT CONDITIONS

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16 MIDUSS Output ----->
17 MIDUSS version Version 2.25 rev. 473"
18 MIDUSS created Sunday, February 07, 2010"
19 Units used: ie METRIC"
20 Job folder: \\os-2012r2\Users_Private\awilkinson\
21 Documents\WIDUSS\318049"
22 Output filename: 318049 - Post 2yr - FEB20.out"
23 License name: gmbp"
24 Company
25 Date & Time last used: 2/20/2020 at 4:19:21 PM"
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31 TIME PARAMETERS"
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10 Surface Area 10.156 15.234 25.390 hectare"
11 Time of concentration 24.743 3.329 6.922 minutes"
12 Time to Centroid 239.001 178.538 188.684 minutes"
13 Rainfall depth 40.000 40.000 40.000 mm"
14 Rainfall volume 0.4062 0.6094 1.0156 ha-m"
15 Rainfall losses 29.693 5.918 15.428 mm"
16 Runoff depth 10.307 34.082 24.572 mm"
17 Runoff volume 1046.81 5192.04 6238.85 c.m"
18 Runoff coefficient 0.258 0.852 0.614 "
19 Maximum flow 0.174 1.131 1.187 c.m/sec"
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40 HYDROGRAPH Add Runoff "
4 Add Runoff "
0.095 1.246 0.000 0.000"
ADD COMMENT=====
2 Lines of comment"
Area draining to proposed SMM facility via northerly "
overland flow route during major storm events"
CATCHMENT 102"
1 Triangular SCS"
1 Equal length"
1 SCS method"
102 Catchment 102"
70.000 % Impervious"
1.720 Total Area"
5.000 Flow Length"
10.000 Overland Slope"
0.516 Pervious Area"
5.000 Pervious length"
10.000 Pervious slope"
1.204 Impervious Area"
5.000 Impervious length"
10.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.256 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.844 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.095 1.246 0.000 0.000"
Catchment 102 Pervious Impervious Total Area "
Surface Area 0.516 1.204 1.720 hectare"
Time of concentration 6.859 0.923 1.606 minutes"
Rainfall depth 40.000 40.000 40.000 mm"
Rainfall volume 206.40 481.60 688.00 c.m"
Rainfall losses 29.760 6.239 13.295 mm"
Runoff depth 10.240 33.761 26.705 mm"
Runoff volume 52.84 406.49 459.33 c.m"
Runoff coefficient 0.256 0.844 0.668 "
Maximum flow 0.011 0.086 0.095 c.m/sec"
40 HYDROGRAPH Add Runoff "
4 Add Runoff "
0.095 1.342 0.000 0.000"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.095 1.342 1.342 0.000"

```

```

40 HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff to SMM Facility"
Maximum flow 1.342 c.m/sec"
Hydrograph volume 6985.515 c.m"
0.095 1.342 1.342"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary"
0.095 0.000 1.342 1.342"
CATCHMENT 202"
1 Triangular SCS"
1 Equal length"
1 SCS method"
202 Catchment 202"
75.000 % Impervious"
0.280 Total Area"
10.000 Flow Length"
2.000 Overland Slope"
0.070 Pervious Area"
10.000 Pervious length"
2.000 Pervious slope"
0.210 Impervious Area"
10.000 Impervious length"
2.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.258 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.860 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.017 0.000 1.342 1.342 c.m/sec"
Catchment 202 Pervious Impervious Total Area "
Surface Area 0.070 0.210 0.280 hectare"
Time of concentration 16.849 2.267 3.590 minutes"
Time to Centroid 229.911 176.877 181.691 minutes"
Rainfall depth 40.000 40.000 40.000 mm"
Rainfall volume 28.00 84.00 112.00 c.m"
Rainfall losses 29.693 5.586 11.613 mm"
Runoff depth 10.307 34.414 28.387 mm"
Runoff volume 7.21 72.27 79.48 c.m"
Runoff coefficient 0.258 0.860 0.710 "
Maximum flow 0.001 0.016 0.017 c.m/sec"
40 HYDROGRAPH Add Runoff "
4 Add Runoff "
0.017 0.017 0.017 1.342"

```


40 0.026 1.384 0.109 0.000 c.m/sec"
HYDROGRAPH Next link "
5 Next link "
0.026 0.109 0.109 0.000"
33 CATCHMENT 110"
1 Triangular SCS"
1 Equal length"
1 SCS method"
110 Catchment 110"
10.000 % Impervious"
3.010 Total Area"
75.000 Flow length"
7.000 Overland Slope"
2.709 Pervious Area"
75.000 Pervious length"
7.000 Pervious slope"
0.301 Impervious Area"
75.000 Impervious length"
7.000 Impervious slope"
0.300 Pervious Manning 'n'"
70.000 Pervious SCS Curve No."
0.154 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
10.886 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.866 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.024 0.109 0.109 0.000 c.m/sec"
CATCHMENT 110 " Pervious Impervious Total Area "
Surface Area 2.709 0.301 3.010 hectare"
Time of concentration 55.474 5.214 36.108 minutes"
Rainfall depth 40.000 180.413 243.065 mm"
Rainfall volume 1083.60 120.40 1204.00 c.m"
Rainfall losses 33.858 5.344 31.006 mm"
Runoff depth 6.142 34.656 8.994 mm"
Runoff volume 166.40 104.31 270.71 c.m"
Runoff coefficient 0.154 0.866 0.225 "
Maximum flow 0.014 0.023 0.024 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff "
0.024 0.120 0.109 0.000"
33 CATCHMENT 111"
1 Triangular SCS"
1 Equal length"
1 SCS method"
111 Catchment 111"
35.000 % Impervious"

40 0.450 Total Area"
25.000 Flow length"
4.000 Overland Slope"
0.292 Pervious Area"
25.000 Pervious length"
4.000 Pervious slope"
0.157 Impervious Area"
25.000 Impervious length"
4.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.258 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.853 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.014 0.120 0.109 0.000 c.m/sec"
CATCHMENT 111 " Pervious Impervious Total Area "
Surface Area 0.292 0.157 0.450 hectare"
Time of concentration 23.715 3.190 10.571 minutes"
Rainfall depth 40.000 178.321 199.716 mm"
Rainfall volume 117.00 63.00 180.00 c.m"
Rainfall losses 29.685 5.887 21.356 mm"
Runoff depth 10.315 34.113 18.644 mm"
Runoff volume 30.17 53.73 83.90 c.m"
Runoff coefficient 0.258 0.853 0.466 "
Maximum flow 0.005 0.012 0.014 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff "
0.014 0.124 0.109 0.000"
1 Lines of comment"
Runoff draining to 130 South Water Street property"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.014 0.124 0.124 0.000"
HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Total Runoff draining from Subject Property"
Maximum flow 0.124 c.m/sec"
Hydrograph volume 7544.250 c.m"
0.014 0.124 0.124 0.124"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary"
0.014 0.000 0.124 0.124"

[illegible]

40	HYDROGRAPH Copy to Outflow"			
40	8 Copy to Outflow"	0.091	0.124	0.124 0.000"
	HYDROGRAPH Combine "	2"		
	2 Node #"			
	Total Runoff to Saugeen River"			
	Maximum flow	0.285		c.m/sec"
	Hydrograph volume	11281.402		c.m"
	0.091 0.124	0.124		0.285"
38	START/RE-START TOTALS 1"			
	3 Runoff Totals on EXIT"			
	Total Catchment area	72.780		hectare"
	Total Impervious area	19.418		hectare"
	Total % Impervious	26.681"		
19	EXIT"			

```

MIDUSS Output ----->
MIDUSS version          Version 2.25 rev. 473"
MIDUSS created          Sunday, February 07, 2010"
Units used:             ie METRIC"
Job folder:             \\os-2012r2\Users_Private\awilkinson\
                        Documents\MIDUSS\318049"
Output filename:        318049 - Post 5yr - FEB20.out"
Licensee name:          gmbp"
Company
Date & Time last used:  2/20/2020 at 4:23:23 PM"

31  TIME PARAMETERS"
    Time Step"          5.000
    Max. Storm Length"  360.000
    Max. Hydrograph"    3600.000
32  STORM Mass Curve"
    3  Mass Curve"
    52.800  Rainfall depth"
    360.000  Duration"
    41  C:\Program Files (x86)\MIDUSS\SCS_6hr.mrd  SCS 6 hour
distributionsssss"
    Maximum intensity    39.125  mm/hr"
    Total depth          52.800  mm"
    6  00Shyd  Hydrograph extension used in this file"
33  CATCHMENT 100"
    1  Triangular SCS"
    1  Equal length"
    1  SCS method"
    100  Catchment 100"
    60.000  % Impervious"
    25.390  Total Area"
    30.000  Flow length"
    5.000  Overland Slope"
    10.156  Pervious Area"
    30.000  Pervious length"
    5.000  Pervious slope"
    15.234  Impervious Area"
    30.000  Impervious length"
    5.000  Impervious slope"
    0.250  Pervious Manning 'n'"
    78.000  Pervious SCS Curve No."
    0.336  Pervious Runoff coefficient"
    0.100  Pervious Ia/S coefficient"
    7.164  Pervious Initial abstraction"
    0.020  Impervious Manning 'n'"
    98.000  Impervious SCS Curve No."
    0.886  Impervious Runoff coefficient"
    0.100  Impervious Ia/S coefficient"
    0.518  Impervious Initial abstraction"
    1.751  0.000  Pervious
    Catchment 100  Impervious Total Area "

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    Surface Area          10.156          15.234          25.390  hectare"
    Time of concentration  19.688          2.955          6.343  minutes"
    Time to Centroid      227.854          175.754          186.303  minutes"
    Rainfall depth        52.800          52.800          52.800  mm"
    Rainfall volume       0.5362          0.8044          1.3406  ha-m"
    Rainfall losses       35.062          6.224          17.759  mm"
    Runoff depth          17.738          46.576          35.041  mm"
    Runoff volume         1801.46          7095.34          8896.80  c.m"
    Runoff coefficient     0.336          0.882          0.664  "
    Maximum flow          0.353          1.542          1.751  c.m/sec"
    HYDROGRAPH Add Runoff "
4  Add Runoff "          1.751          0.000          0.000"

33  CATCHMENT 201"
    1  Triangular SCS"
    1  Equal length"
    1  SCS method"
    201  Catchment 201"
    60.000  % Impervious"
    1.160  Total Area"
    10.000  Flow length"
    2.000  Overland Slope"
    0.464  Pervious Area"
    10.000  Pervious length"
    2.000  Pervious slope"
    0.696  Impervious Area"
    10.000  Impervious length"
    2.000  Impervious slope"
    0.250  Pervious Manning 'n'"
    78.000  Pervious SCS Curve No."
    0.336  Pervious Runoff coefficient"
    0.100  Pervious Ia/S coefficient"
    7.164  Pervious Initial abstraction"
    0.020  Impervious Manning 'n'"
    98.000  Impervious SCS Curve No."
    0.886  Impervious Runoff coefficient"
    0.100  Impervious Ia/S coefficient"
    0.518  Impervious Initial abstraction"
    0.086  1.751          0.000
    Catchment 201  Pervious
    Surface Area          0.464          0.696          1.160  hectare"
    Time of concentration  13.407          2.012          4.310  minutes"
    Rainfall depth        52.800          52.800          52.800  mm"
    Rainfall volume       244.99          612.48          612.48  c.m"
    Rainfall losses       35.080          6.021          17.645  mm"
    Runoff depth          17.720          46.779          35.155  mm"
    Runoff volume         82.22          325.58          407.80  c.m"
    Runoff coefficient     0.336          0.886          0.666  "
    Maximum flow          0.018          0.872          0.086  c.m/sec"

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40 HYDROGRAPH Add Runoff "
4 Add Runoff " 0.086 1.837 0.000 0.000"
81 ADD COMMENT=====
2 Lines of comment"
Area draining to proposed SWM facility via northerly "
overland flow route during major storm events"
33 CATCHMENT 102"
1 Triangular SCS"
1 Equal length"
1 SCS method"
102 Catchment 102"
70.000 % Impervious"
1.720 Total Area"
5.000 Flow length"
10.000 Overland Slope"
0.516 Pervious Area"
5.000 Pervious length"
10.000 Pervious slope"
1.204 Impervious Area"
5.000 Impervious length"
10.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.334 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.862 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.131 1.837 0.000 0.000 c.m/sec"
Catchment 102 Pervious Impervious Total Area "
Surface Area 0.516 1.204 1.720 hectare"
Time of concentration 5.458 0.819 1.481 minutes"
Rainfall depth 52.800 52.800 52.800 mm"
Rainfall volume 272.45 635.71 908.16 c.m"
Rainfall losses 35.148 7.310 15.661 mm"
Runoff depth 17.652 45.490 37.139 mm"
Runoff volume 91.09 547.70 638.79 c.m"
Runoff coefficient 0.334 0.862 0.703 "
Maximum flow 0.020 0.113 0.131 c.m/sec"
40 HYDROGRAPH Add Runoff "
4 Add Runoff " 0.131 1.967 0.000 0.000"
40 HYDROGRAPH Copy to Outflow"
8 Copy to Outflow" 0.131 1.967 1.967 0.000"

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40 HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff to SWM Facility" 1.967 c.m/sec"
Maximum flow 9943.391 c.m"
Hydrograph volume 0.131 1.967 1.967"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary" 0.131 0.000 1.967 1.967"
CATCHMENT 202"
1 Triangular SCS"
1 Equal length"
1 SCS method"
202 Catchment 202"
75.000 % Impervious"
0.280 Total Area"
10.000 Flow length"
2.000 Overland Slope"
0.070 Pervious Area"
10.000 Pervious length"
2.000 Pervious slope"
0.210 Impervious Area"
10.000 Impervious length"
2.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.336 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.886 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.024 0.000 1.967 1.967 c.m/sec"
Catchment 202 Pervious Impervious Total Area "
Surface Area 0.070 0.210 0.280 hectare"
Time of concentration 13.407 2.012 3.290 minutes"
Time to Centroid 220.458 174.199 179.385 minutes"
Rainfall depth 52.800 52.800 52.800 mm"
Rainfall volume 36.96 110.88 147.84 c.m"
Rainfall losses 35.080 6.021 13.286 mm"
Runoff depth 17.720 46.779 39.514 mm"
Runoff volume 12.40 98.24 110.64 c.m"
Runoff coefficient 0.336 0.886 0.748 "
Maximum flow 0.003 0.022 0.024 c.m/sec"
40 HYDROGRAPH Add Runoff "
4 Add Runoff " 0.024 0.024 1.967 1.967"

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[illegible]

40	0.038	2.030	0.126	0.000	c.m/sec"	
	HYDROGRAPH Next link "					
5	Next link "	0.038	0.126	0.000	0.000"	
33	CATCHMENT 110"					
1	Triangular SCS					
1	Equal length"					
1	SCS method"					
110	Catchment 110"					
10.000	% Impervious"					
3.010	Total Area"					
75.000	Flow length"					
7.000	Overland Slope"					
2.709	Pervious Area"					
75.000	Pervious length"					
7.000	Pervious slope"					
0.301	Impervious Area"					
75.000	Impervious length"					
7.000	Impervious slope"					
0.300	Pervious Manning 'n'"					
70.000	Pervious SCS Curve No."					
0.221	Pervious Runoff coefficient"					
0.100	Pervious Ia/S coefficient"					
10.886	Pervious Initial abstraction"					
0.020	Impervious Manning 'n'"					
98.000	Impervious SCS Curve No."					
0.895	Impervious Runoff coefficient"					
0.100	Impervious Ia/S coefficient"					
0.518	Impervious Initial abstraction"					
	Catchment 110	Pervious	Impervious	Total Area "		
	Surface Area	2.709	0.301	3.010	hectare"	
	Time of concentration	41.572	4.629	30.090	minutes"	
	Rainfall depth	261.082	177.668	235.156	mm"	
	Rainfall volume	52.800	52.800	52.800	c.m"	
	Rainfall losses	1430.35	158.93	1589.28	mm"	
	Runoff depth	41.152	5.522	37.589	mm"	
	Runoff volume	11.648	47.278	15.211	c.m"	
	Runoff coefficient	315.54	142.31	457.85	"	
	Maximum flow	0.221	0.895	0.288	c.m/sec"	
	HYDROGRAPH Add Runoff "					
4	Add Runoff "	0.045	0.126	0.031	0.045	
40						
33	CATCHMENT 111"					
1	Triangular SCS					
1	Equal length"					
1	SCS method"					
111	Catchment 111"					
35.000	% Impervious"					
0.450	Total Area"					
25.000	Flow length"					
4.000	Overland Slope"					
0.292	Pervious Area"					
25.000	Pervious length"					
4.000	Pervious slope"					
0.157	Impervious Area"					
25.000	Impervious length"					
4.000	Impervious slope"					
0.250	Pervious Manning 'n'"					
78.000	Pervious SCS Curve No."					
0.336	Pervious Runoff coefficient"					
0.100	Pervious Ia/S coefficient"					
7.164	Pervious Initial abstraction"					
0.020	Impervious Manning 'n'"					
98.000	Impervious SCS Curve No."					
0.883	Impervious Runoff coefficient"					
0.100	Impervious Ia/S coefficient"					
0.518	Impervious Initial abstraction"					
	Catchment 111	Pervious	Impervious	Total Area "		
	Surface Area	0.292	0.157	0.450	hectare"	
	Time of concentration	18.870	2.832	9.473	minutes"	
	Rainfall depth	226.889	175.474	196.763	mm"	
	Rainfall volume	52.800	52.800	52.800	c.m"	
	Rainfall losses	154.44	83.16	237.60	mm"	
	Runoff depth	35.067	6.194	24.961	mm"	
	Runoff volume	17.733	46.606	27.839	c.m"	
	Runoff coefficient	51.87	73.40	125.27	"	
	Maximum flow	0.336	0.883	0.527	c.m/sec"	
	HYDROGRAPH Add Runoff "					
4	Add Runoff "	0.023	0.164	0.016	0.023	
40						
81	ADD COMMENT=====					
1	Lines of comment"					
	Runoff draining to 130 South Water Street property"					
	HYDROGRAPH Copy to Outflow"					
8	Copy to Outflow"	0.023	0.164	0.000		
40						
40	HYDROGRAPH Combine 1"					
6	Combine "					
1	Node #"					
	Total Runoff draining from Subject Property"					
	Maximum flow	0.164	0.164	c.m/sec"		
	Hydrograph volume	10817.164	0.164	c.m"		
		0.023	0.164	0.164		
	HYDROGRAPH Start - New Tributary"					
2	Start - New Tributary"	0.023	0.000	0.164	0.164"	

40	HYDROGRAPH Copy to Outflow"			
8	Copy to Outflow"	0.188	0.164	0.164
40	HYDROGRAPH Combine 2"			0.000"
6	Combine "			
2	Node #"			
	Total Runoff to Saugeen River"			
	Maximum flow	0.188	0.164	0.492 c.m/sec"
	Hydrograph volume	17285.885		c.m"
		0.188	0.164	0.492"
38	START/RE-START TOTALS 1"			
3	Runoff Totals on EXIT"			
	Total Catchment area			72.780 hectare"
	Total Impervious area			19.418 hectare"
	Total % impervious			26.681"
19	EXIT"			

MIDUSS Output ----->
MIDUSS version Version 2.25 rev. 473
MIDUSS created Sunday, February 07, 2010
Units used: \\os-2012r2\Users\Private\awilkinson\ie METRIC"
Job folder: Documents\MIDUSS\318049-JAN21"
Output filename: 318049 - Post 10yr - JAN21.out
Licensee name: gmbp"
Company
Date & Time last used: 1/22/2021 at 8:21:27 PM
31 TIME PARAMETERS
Time Step 5.000
Max. Storm length 360.000
Max. Hydrograph 3600.000
32 STORM Mass Curve
3 Mass Curve
61.400 Rainfall depth
360.000 Duration
41 C:\Program Files (x86)\MIDUSS\SCS_6hr.mrd SCS 6 hour distributionsssss
Maximum intensity 45.497 mm/hr
Total depth 61.400 mm
6 010hyd Hydrograph extension used in this file"
33 CATCHMENT 100
1 Triangular SCS
1 Equal length
1 SCS method
100 Catchment 100
60.000 % Impervious
25.390 Total Area
30.000 Flow length
5.000 Overland Slope
30.000 Pervious Area
5.000 Pervious slope
15.234 Impervious Area
30.000 Impervious length
5.000 Impervious slope
0.250 Pervious Manning 'n'
78.000 Pervious SCS Curve No."
0.380 Pervious Runoff coefficient
0.100 Pervious Ia/S coefficient
7.164 Pervious Initial abstraction
0.020 Impervious Manning 'n'
98.000 Impervious SCS Curve No."
0.896 Impervious Runoff coefficient
0.100 Impervious Ia/S coefficient
0.518 Impervious Initial abstraction
2.165 0.000
Catchment 100 Pervious
Surface Area 10.156 Impervious Total Area
15.234 25.390 hectare"

" " Time of concentration 17.573 2.773 6.036 minutes"
" " Time to Centroid 222.703 174.406 185.055 minutes"
" " Rainfall depth 61.400 61.400 61.400 mm"
" " Rainfall volume 0.6236 0.9354 1.5589 ha-m"
" " Rainfall losses 38.067 6.406 19.071 mm"
" " Runoff depth 23.333 54.994 42.329 mm"
" " Runoff volume 0.2370 0.8378 1.0747 ha-m"
" " Runoff coefficient 0.380 0.896 0.689 "
" " Maximum flow 1.825 2.165 c.m/sec"
" " HYDROGRAPH Add Runoff "
" " 40
" " 4 Add Runoff "
" " 2.165 2.165 0.000 0.000
" " CATCHMENT 201
" " 1 Triangular SCS
" " 1 Equal length
" " 1 SCS method
" " 201 Catchment 201
" " 60.000 % Impervious
" " 1.160 Total Area
" " 10.000 Flow length
" " 2.000 Overland Slope
" " 0.464 Pervious Area
" " 10.000 Pervious length
" " 2.000 Pervious slope
" " 0.696 Impervious Area
" " 10.000 Impervious length
" " 2.000 Impervious slope
" " 0.250 Pervious Manning 'n'
" " 78.000 Pervious SCS Curve No."
" " 0.379 Pervious Runoff coefficient
" " 0.100 Pervious Ia/S coefficient
" " 7.164 Pervious Initial abstraction
" " 0.020 Impervious Manning 'n'
" " 98.000 Impervious SCS Curve No."
" " 0.897 Impervious Runoff coefficient
" " 0.100 Impervious Ia/S coefficient
" " 0.518 Impervious Initial abstraction
" " 0.105 2.165 0.000 0.000
" " Catchment 201 Pervious
" " Surface Area 0.464 Impervious Total Area
" " Time of concentration 11.966 0.696 1.160 hectare"
" " 1.888 4.105 minutes"
" " Time to Centroid 216.122 172.888 182.399 minutes"
" " Rainfall depth 61.400 61.400 61.400 mm"
" " Rainfall volume 284.90 427.34 712.24 c.m"
" " Rainfall losses 38.100 6.325 19.035 mm"
" " Runoff depth 23.300 55.075 42.365 mm"
" " Runoff volume 108.11 383.32 491.43 c.m"
" " Runoff coefficient 0.379 0.897 0.690 "
" " Maximum flow 0.025 0.085 0.105 c.m/sec"
" " HYDROGRAPH Add Runoff "
" " 40
" " 4 Add Runoff "

"	"	81	0.105	2.271	0.000	0.000"	=====	"
"	"	"	ADD COMMENT=====					
"	"	"	2 Lines of comment"					
"	"	"	Area draining to proposed SWM facility via northerly "					
"	"	"	overland flow route during major storm events"					
"	"	33	CATCHMENT 102"					
"	"	"	1 Triangular SCS"					
"	"	"	1 Equal length"					
"	"	"	1 SCS method"					
"	"	"	102 Catchment 102"					
"	"	"	70.000 % Impervious"					
"	"	"	1.720 Total Area"					
"	"	"	5.000 Flow length"					
"	"	"	10.000 Overland Slope"					
"	"	"	0.516 Pervious Area"					
"	"	"	5.000 Pervious length"					
"	"	"	10.000 Pervious slope"					
"	"	"	1.204 Impervious Area"					
"	"	"	5.000 Impervious length"					
"	"	"	10.000 Impervious slope"					
"	"	"	0.250 Pervious Manning 'n'"					
"	"	"	78.000 Pervious SCS Curve No."					
"	"	"	0.378 Pervious Runoff coefficient"					
"	"	"	0.100 Pervious Ia/S coefficient"					
"	"	"	7.164 Pervious Initial abstraction"					
"	"	"	0.020 Impervious Manning 'n'"					
"	"	"	98.000 Impervious SCS Curve No."					
"	"	"	0.868 Impervious Runoff coefficient"					
"	"	"	0.100 Impervious Ia/S coefficient"					
"	"	"	0.518 Impervious Initial abstraction"					
"	"	"	0.155	2.271	0.000	0.000 c.m/sec"		
"	"	"	Catchment 102	Pervious	0.000	Impervious	Total Area "	
"	"	"	Surface Area	0.516	1.204	1.720	hectare"	
"	"	"	Time of Concentration	4.871	0.769	1.414	minutes"	
"	"	"	Time to Centroid	207.611	173.095	178.526	minutes"	
"	"	"	Rainfall depth	61.400	61.400	61.400	mm"	
"	"	"	Rainfall volume	316.82	739.26	1056.08	c.m"	
"	"	"	Rainfall losses	38.189	8.126	17.145	mm"	
"	"	"	Runoff depth	23.211	53.274	44.255	mm"	
"	"	"	Runoff volume	119.77	641.42	761.18	"	
"	"	"	Runoff coefficient	0.378	0.868	0.721	c.m"	
"	"	"	Maximum flow	0.027	0.131	0.155	c.m/sec"	
"	"	40	HYDROGRAPH Add Runoff "					
"	"	"	4 Add Runoff "	0.155	2.425	0.000	0.000"	
"	"	40	HYDROGRAPH Copy to Outflow"					
"	"	"	8 Copy to Outflow"	0.155	2.425	0.000	0.000"	
"	"	40	HYDROGRAPH Combine 1"					
"	"	"	6 Combine "					
"	"	"	1 Node #"					

"	"	"	Runoff to SWM Facility"					
"	"	"	Maximum flow	2.425	c.m/sec"			
"	"	"	Hydrograph volume	12000.033	c.m"			
"	"	"	0.155	2.425	2.425"			
"	"	40	HYDROGRAPH Start - New Tributary"					
"	"	"	2 Start - New Tributary"	0.155	2.425	2.425"		
"	"	"	0.000	0.000	2.425	2.425"		
"	"	33	CATCHMENT 202"					
"	"	"	1 Triangular SCS"					
"	"	"	1 Equal length"					
"	"	"	1 SCS method"					
"	"	"	202 Catchment 202"					
"	"	"	75.000 % Impervious"					
"	"	"	0.280 Total Area"					
"	"	"	10.000 Flow length"					
"	"	"	2.000 Overland Slope"					
"	"	"	0.070 Pervious Area"					
"	"	"	10.000 Pervious length"					
"	"	"	2.000 Pervious slope"					
"	"	"	0.210 Impervious Area"					
"	"	"	10.000 Impervious length"					
"	"	"	2.000 Impervious slope"					
"	"	"	0.250 Pervious Manning 'n'"					
"	"	"	78.000 Pervious SCS Curve No."					
"	"	"	0.379 Pervious Runoff coefficient"					
"	"	"	0.100 Pervious Ia/S coefficient"					
"	"	"	7.164 Pervious Initial abstraction"					
"	"	"	0.020 Impervious Manning 'n'"					
"	"	"	98.000 Impervious SCS Curve No."					
"	"	"	0.897 Impervious Runoff coefficient"					
"	"	"	0.100 Impervious Ia/S coefficient"					
"	"	"	0.518 Impervious Initial abstraction"					
"	"	"	0.029	0.000	2.425	2.425 c.m/sec"		
"	"	"	Catchment 202	Pervious	0.210	Impervious	Total Area "	
"	"	"	Surface Area	0.070	0.280	0.280	hectare"	
"	"	"	Time of concentration	11.966	1.888	3.134	minutes"	
"	"	"	Time to Centroid	216.122	172.888	178.231	minutes"	
"	"	"	Rainfall depth	61.400	61.400	61.400	mm"	
"	"	"	Rainfall volume	42.98	128.94	171.92	c.m"	
"	"	"	Rainfall losses	38.100	6.325	14.269	mm"	
"	"	"	Runoff depth	23.300	55.075	47.131	mm"	
"	"	"	Runoff volume	16.31	115.66	131.97	c.m"	
"	"	"	Runoff coefficient	0.379	0.897	0.768	"	
"	"	"	Maximum flow	0.004	0.026	0.029	c.m/sec"	
"	"	"	HYDROGRAPH Add Runoff "					
"	"	40	4 Add Runoff "	0.029	0.029	2.425	2.425"	
"	"	"	CATCHMENT 101"					
"	"	33	1 Triangular SCS"					
"	"	"	1 Equal length"					
"	"	"	1 SCS method"					

[illegible]

[illegible]

" 38	START/RE-START TOTALS 1"		
"	3 Runoff Totals on EXIT"		
"	Total Catchment area	72.780	hectare"
"	Total Impervious area	19.418	hectare"
"	Total % impervious	26.681"	
" 19	EXIT"		

```

MIDUSS Output
MIDUSS version Version 2.25 rev. 473
MIDUSS created Sunday, February 07, 2010
Units used: ie METRIC
Job folder: \\os-2012r2\Users_Private\awilkison\Documents\MIDUSS\318049\318049 - Post 25yr - FEB20.out"
gmbp"

Output filename:
Licensee name:
Company
Date & Time last used: 2/20/2020 at 3:52:38 PM

TIME PARAMETERS
31 5.000 Time Step
360.000 Max. Storm length"
3600.000 Max. Hydrograph"
32 STORM Mass Curve"
3 Mass Curve"
72.200 Rainfall depth"
360.000 Duration"
41 C:\Program Files (x86)\MIDUSS\SCS_6hr.mrd SCS 6 hour
distributionsssss"
Maximum intensity 53.500 mm/hr"
Total depth 72.200 mm"
6 025hyd Hydrograph extension used in this file"
CATCHMENT 100"
33 1 Triangular SCS"
1 Equal length"
1 SCS method"
100 % Impervious"
60.000 Catchment 100"
25.390 Total Area"
30.000 Flow length"
5.000 Overland Slope"
10.156 Pervious Area"
30.000 Pervious length"
5.000 Pervious slope"
15.234 Impervious Area"
30.000 Impervious length"
5.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.427 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.910 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
2.696 0.000 0.000 0.000 c.m./sec"
Catchment 100 Pervious Impervious Total Area "

```

40	Surface Area	10.156	15.234	25.390	hectares
	Time of concentration	15.660	2.592	5.709	minutes"
	Time to Centroid	217.777	173.087	183.746	minutes"
	Rainfall depth	72.200	72.200	72.200	mm"
	Rainfall volume	0.7333	1.0999	1.8332	ha-m"
	Rainfall losses	41.335	6.502	20.435	mm"
	Rainfall depth	30.865	65.698	51.765	mm"
	Rainfall volume	0.3135	1.0008	1.3143	ha-m"
	Runoff coefficient	0.427	0.910	0.717	"
	Maximum flow	0.704	2.177	2.696	c.m/sec"
	HYDROGRAPH Add Runoff "				
	4 Add Runoff "	2.696	2.696	0.000	0.000"
33	CATCHMENT 201"				
	1 Triangular SCS"				
	1 Equal length"				
	1 SCS method"				
	201 Catchment 201"				
	60.000 % Impervious"				
	1.160 Total Area"				
	10.000 Flow length"				
	2.000 Overland Slope"				
	0.464 Pervious Area"				
	10.000 Pervious length"				
	2.000 Pervious slope"				
	0.696 Impervious Area"				
	10.000 Impervious length"				
	2.000 Impervious slope"				
	0.250 Pervious Manning 'n'"				
	78.000 Pervious SCS Curve No."				
	0.428 Pervious Runoff coefficient"				
	0.100 Pervious Ia/S coefficient"				
	7.164 Pervious Initial abstraction"				
	0.020 Impervious Manning 'n'"				
	98.000 Impervious SCS Curve No."				
	0.908 Impervious Runoff coefficient"				
	0.100 Impervious Ia/S coefficient"				
	0.518 Impervious Initial abstraction"				
	0.130 2.696 0.000				
	CATCHMENT 201 Pervious				
	Surface Area	0.464	0.696	1.160	hectare"
	Time of concentration	10.664	1.765	3.892	minutes"
	Time to Centroid	211.780	171.579	181.188	minutes"
	Rainfall depth	72.200	72.200	72.200	mm"
	Rainfall volume	335.01	502.51	837.52	c.m"
	Rainfall losses	41.312	6.644	20.512	mm"
	Runoff depth	30.888	65.556	51.688	mm"
	Runoff volume	143.32	456.27	599.59	c.m"
	Runoff coefficient	0.428	0.908	0.716	"
	Maximum flow	0.034	0.100	0.130	c.m/sec"

```

40 HYDROGRAPH Add Runoff "
4 Add Runoff " 0.130 2.825 0.000 0.000"
81 ADD COMMENT=====
2 Lines of comment"
Area draining to proposed SWM facility via northerly "
overland flow route during major storm events"
33 CATCHMENT 102"
1 Triangular SCS"
1 Equal length"
1 SCS method"
102 Catchment 102"
70.000 % Impervious"
1.720 Total Area"
5.000 Flow length"
10.000 Overland Slope"
0.516 Pervious Area"
5.000 Pervious length"
10.000 Pervious slope"
1.204 Impervious Area"
5.000 Impervious length"
10.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.425 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.872 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.186 2.825 0.000 0.000 c.m/sec"
Catchment 102 Pervious Impervious Total Area "
Surface Area 0.516 1.204 1.720 hectare"
Time of concentration 4.341 0.719 1.344 minutes"
Rainfall depth 72.200 72.200 72.200 mm"
Rainfall volume 372.55 869.29 1241.84 c.m"
Rainfall losses 41.548 9.253 18.942 mm"
Runoff depth 30.652 62.947 53.258 mm"
Runoff volume 158.16 757.88 916.04 c.m"
Runoff coefficient 0.425 0.872 0.738 "
Maximum flow 0.036 0.154 0.186 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff " 0.186 3.010 0.000 0.000"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow" 0.186 3.010 3.010 0.000"

```

```

40 HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff to SWM Facility" 3.010 c.m/sec"
Maximum flow 14658.656 c.m"
Hydrograph volume 0.186 3.010 3.010 c.m"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary" 0.186 0.000 3.010 3.010"
CATCHMENT 202"
1 Triangular SCS"
1 Equal length"
1 SCS method"
202 Catchment 202"
75.000 % Impervious"
0.280 Total Area"
10.000 Flow length"
2.000 Overland Slope"
0.070 Pervious Area"
10.000 Pervious length"
2.000 Pervious slope"
0.210 Impervious Area"
10.000 Impervious length"
2.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.428 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.908 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.034 0.000 3.010 3.010 c.m/sec"
Catchment 202 Pervious Impervious Total Area "
Surface Area 0.070 0.210 0.280 hectare"
Time of concentration 10.664 1.765 2.973 minutes"
Time to Centroid 211.780 171.579 177.036 minutes"
Rainfall depth 72.200 72.200 72.200 mm"
Rainfall volume 50.54 151.62 202.16 c.m"
Rainfall losses 41.312 6.644 15.311 mm"
Runoff depth 30.888 65.556 56.889 mm"
Runoff volume 21.62 137.67 159.29 c.m"
Runoff coefficient 0.428 0.908 0.788 "
Maximum flow 0.005 0.030 0.034 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff " 0.034 0.034 3.010 3.010"

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.. 33 40 81 40 40

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33 40 0.058 3.103 0.440 0.000 c.m/sec"
HYDROGRAPH Next Link "
5 Next link " 0.058 0.440 0.440 0.000"
CATCHMENT 110"
1 Triangular SCS"
1 Equal length"
1 SCS method"
110 Catchment 110"
10.000 % Impervious"
3.010 Total Area"
75.000 Flow length"
7.000 Overland Slope"
2.709 Pervious Area"
75.000 Pervious length"
7.000 Pervious slope"
0.301 Impervious Area"
75.000 Impervious length"
7.000 Impervious slope"
0.300 Pervious Manning 'n'"
70.000 Pervious SCS Curve No."
0.306 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
10.886 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.915 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.105 0.440 0.440 0.000 c.m/sec"
CATCHMENT 110 Impervious Total Area "
Surface Area 0.301 3.010 hectare"
Time of concentration 31.641 24.759 minutes"
Time to Centroid 243.689 174.995 minutes"
Rainfall depth 72.200 72.200 mm"
Rainfall volume 1955.90 217.32 c.m"
Rainfall losses 50.121 6.131 45.722 mm"
Runoff depth 22.079 66.069 26.478 mm"
Runoff volume 598.13 198.87 797.00 c.m"
Runoff coefficient 0.306 0.915 0.367 c.m/sec"
Maximum flow 0.091 0.043 0.105 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff " 0.105 0.440 0.440 0.000"
CATCHMENT 111"
1 Triangular SCS"
1 Equal length"
1 SCS method"
111 Catchment 111"
35.000 % Impervious"

```

```

33 40 0.450 Total Area"
25.000 Flow length"
4.000 Overland Slope"
0.292 Pervious Area"
25.000 Pervious length"
4.000 Pervious slope"
0.157 Impervious Area"
25.000 Impervious length"
4.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.428 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.912 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.039 0.482 0.440 0.000 c.m/sec"
CATCHMENT 111 Impervious Total Area "
Surface Area 0.292 0.157 hectare"
Time of concentration 15.009 2.485 8.316 minutes"
Time to Centroid 217.021 173.028 193.509 minutes"
Rainfall depth 72.200 72.200 mm"
Rainfall volume 211.18 113.71 324.90 c.m"
Rainfall losses 41.319 6.365 29.086 mm"
Runoff depth 30.881 65.835 43.114 mm"
Runoff volume 90.33 103.69 194.02 c.m"
Runoff coefficient 0.428 0.912 0.597 c.m/sec"
Maximum flow 0.020 0.023 0.039 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff " 0.039 0.491 0.440 0.000"
ADD COMMENT=====
1 Lines of comment"
Runoff draining to 130 South Water Street property"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.039 0.491 0.491 0.000"
HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Total Runoff draining from Subject Property"
Maximum flow 0.491 c.m/sec"
Hydrograph volume 16081.256 c.m"
0.039 0.491 0.491
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary" 0.039 0.000 0.491 0.491"

```


40	HYDROGRAPH Copy to Outflow"			
8	Copy to Outflow"	0.420	0.491	0.000"
40	HYDROGRAPH Combine 2"			
6	Combine "			
2	Node #"			
	Total Runoff to Saugeen River"			
	Maximum flow	1.237		c.m/sec"
	Hydrograph volume	27473.014		c.m"
		0.420	0.491	1.237"
38	START/RE-START TOTALS 1"			
3	Runoff Totals on EXIT"			
	Total Catchment area		72.780	hectare"
	Total Impervious area		19.418	hectare"
	Total % impervious		26.681"	
19	EXIT"			

```

10 MIDUSS Output ----->
11 MIDUSS version Version 2.25 rev. 473"
12 MIDUSS created Sunday, February 07, 2010"
13 Units used: ie METRIC"
14 Job folder: \\os-2012r2\Users_Private\awilkinson\
15 Documents\MIDUSS\318049"
16 Output filename: 318049 - Post 50yr - FEB20.out"
17 Licensee name: gmbp"
18 Company
19 Date & Time last used: 2/20/2020 at 4:26:28 PM"
20
21 TIME PARAMETERS"
22 31 5.000 Time Step"
23 360.000 Max. Storm Length"
24 3600.000 Max. Hydrograph"
25
26 STORM Mass Curve"
27 32 80.100 Rainfall depth"
28 360.000 Duration"
29
30 41 C:\Program Files (x86)\MIDUSS\SCS_6hr.mrd SCS 6 hour
31 distributionssss"
32 Maximum intensity 59.354 mm/hr"
33 Total depth 80.100 mm"
34 6 050hyd Hydrograph extension used in this file"
35
36 CATCHMENT 100"
37 1 Triangular SCS"
38 1 Equal length"
39 1 SCS method"
40 100 Catchment 100"
41 % Impervious"
42 60.000 Total Area"
43 10.000 Flow length"
44 2.000 Overland Slope"
45 0.464 Pervious Area"
46 10.000 Pervious length"
47 2.000 Pervious slope"
48 0.696 Impervious Area"
49 10.000 Impervious length"
50 2.000 Impervious slope"
51 0.250 Pervious Manning 'n'"
52 78.000 Pervious SCS Curve No."
53 0.457 Pervious Runoff coefficient"
54 0.100 Pervious Ia/S coefficient"
55 7.164 Pervious Initial abstraction"
56 0.020 Impervious Manning 'n'"
57 98.000 Impervious SCS Curve No."
58 0.914 Impervious Runoff coefficient"
59 0.100 Impervious Ia/S coefficient"
60 0.518 Impervious Initial abstraction"
61
62 Catchment 100 Pervious 0.000 0.000 c.m/sec"
63 Impervious Total Area "
64 3.123 0.000 0.000 c.m/sec"
65
66 CATCHMENT 201"
67 1 Triangular SCS"
68 1 Equal length"
69 1 SCS method"
70 201 Catchment 201"
71 % Impervious"
72 60.000 Total Area"
73 10.000 Flow length"
74 2.000 Overland Slope"
75 0.464 Pervious Area"
76 10.000 Pervious length"
77 2.000 Pervious slope"
78 0.696 Impervious Area"
79 10.000 Impervious length"
80 2.000 Impervious slope"
81 0.250 Pervious Manning 'n'"
82 78.000 Pervious SCS Curve No."
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86 0.020 Impervious Manning 'n'"
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92 Catchment 201 Pervious 0.000 0.000 c.m/sec"
93 Impervious Total Area "
94 3.123 0.000 0.000 c.m/sec"
95
96 Surface Area 10.156 15.234 25.390 hectare"
97 Time of concentration 14.594 2.484 5.508 minutes"
98 Time to Centroid 214.818 172.432 183.016 minutes"
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103 Runoff volume 0.3731 1.1211 1.4942 ha-m"
104 Runoff coefficient 0.459 0.919 0.735 "
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106
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108 4 Add Runoff " 3.123 3.123 0.000 0.000"
109
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112 1 Equal length"
113 1 SCS method"
114 201 Catchment 201"
115 % Impervious"
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117 10.000 Flow length"
118 2.000 Overland Slope"
119 0.464 Pervious Area"
120 10.000 Pervious length"
121 2.000 Pervious slope"
122 0.696 Impervious Area"
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709 Impervious Total Area "
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40 HYDROGRAPH Add Runoff "
4 Add Runoff "
0.148 3.270 0.000 0.000"
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81 ADD COMMENT=====
2 Lines of comment"
Area draining to proposed SWM facility via northerly "
overland flow route during major storm events"
CATCHMENT 102"
33 1 Triangular SCS"
1 Equal length"
1 SCS method"
102 Catchment 102"
% Impervious"
70.000 Total Area"
1.720 Flow length"
5.000 Overland Slope"
10.000 Pervious Area"
0.516 Pervious length"
5.000 Pervious slope"
10.000 Impervious Area"
1.204 Impervious length"
5.000 Impervious slope"
10.000 Pervious Manning 'n'"
0.250 Pervious SCS Curve No."
78.000 Pervious Runoff coefficient"
0.453 Pervious Ia/S coefficient"
0.100 Pervious Initial abstraction"
7.164 Impervious Manning 'n'"
0.020 Impervious SCS Curve No."
98.000 Impervious Runoff coefficient"
0.873 Impervious Ia/S coefficient"
0.100 Impervious Initial abstraction"
0.518 Impervious Initial abstraction"
0.209 3.270 0.000 0.000 c.m/sec"
CATCHMENT 102"
Surface Area 1.204 1.720 Impervious Total Area "
Time of concentration 4.046 0.688 1.299 hectares"
Rainfall depth 80.100 171.510 177.149 minutes"
Rainfall volume 413.32 964.40 1377.72 mm"
Rainfall losses 43.826 10.144 20.248 mm"
Runoff depth 36.274 69.956 59.852 mm"
Runoff volume 187.17 842.27 1029.45 c.m"
Runoff coefficient 0.453 0.873 0.747 "
Maximum flow 0.043 0.170 0.209 c.m/sec"
40 HYDROGRAPH Add Runoff "
4 Add Runoff "
0.209 3.478 0.000 0.000"
8 HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.209 3.478 3.478 0.000"

```

```

40 HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff to SWM Facility"
Maximum flow 3.478 c.m/sec"
Hydrograph volume 16651.113 c.m"
0.209 3.478 3.478
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary"
0.209 0.000 3.478 3.478"
CATCHMENT 202"
1 Triangular SCS"
1 Equal length"
1 SCS method"
202 Catchment 202"
% Impervious"
75.000 Total Area"
10.000 Flow length"
2.000 Overland Slope"
0.070 Pervious Area"
10.000 Pervious length"
2.000 Pervious slope"
0.210 Impervious Area"
10.000 Impervious length"
2.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.457 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.914 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.039 0.000 3.478 3.478 c.m/sec"
CATCHMENT 202"
Surface Area 0.070 0.210 Impervious Total Area "
Time of concentration 9.938 1.691 2.869 hectares"
Time to Centroid 209.314 170.767 176.272 minutes"
Rainfall depth 80.100 80.100 80.100 mm"
Rainfall volume 56.07 168.21 224.28 c.m"
Rainfall losses 43.500 6.867 16.025 mm"
Runoff depth 36.600 73.233 64.075 mm"
Runoff volume 25.62 153.79 179.41 c.m"
Runoff coefficient 0.457 0.914 0.800 "
Maximum flow 0.006 0.034 0.039 c.m/sec"
40 HYDROGRAPH Add Runoff "
4 Add Runoff "
0.039 0.039 3.478 3.478"

```

[illegible]

[illegible]


```

40 HYDROGRAPH Copy to Outflow"
40 8 Copy to Outflow"
40 0.543 0.561 0.561 0.000"
40 HYDROGRAPH Combine 2"
40 6 Combine "
40 2 Node #"
40 Total Runoff to Saugeen River"
40 Maximum flow 1.471 c.m/sec"
40 Hydrograph volume 31906.010 c.m"
40 0.543 0.561 0.561 1.471"
38 START/RE-START TOTALS 1"
38 3 Runoff Totals on EXIT"
38 Total Catchment area 72.780 hectare"
38 Total Impervious area 19.418 hectare"
38 Total % impervious 26.681"
38 EXIT"
38 " 19

```

```

" " MIDUSS Output ----->
" " MIDUSS version Version 2.25 rev. 473"
" " MIDUSS created Sunday, February 07, 2010"
" " Units used: ie METRIC"
" " Job folder: \\os-2012r2\Users_Private\awilkinson\
" " Documents\MIDUSS\318049"
" " Output filename: 318049 - Post 100yr - FEB20.out"
" " License name: gmbp"
" " Company "
" " Date & Time last used: 2/20/2020 at 6:50:57 PM"
" 31 TIME PARAMETERS"
" " 5.000 Time Step"
" " 360.000 Max. Storm length"
" " 3600.000 Max. Hydrograph"
" 32 STORM Mass Curve"
" " 3 Mass Curve"
" " 88.000 Rainfall depth"
" " 360.000 Duration"
" " 41 C:\Program Files (x86)\MIDUSS\SCS_6hr.mrd SCS 6 hour
distributionssss"
" " Maximum intensity 65.208 mm/hr"
" " Total depth 88.000 mm"
" 33 CATCHMENT 100"
" " 6 100hyd Hydrograph extension used in this file"
" " 1 Triangular SCS"
" " 1 Equal length"
" " 1 SCS method"
" " 100 Catchment 100"
" " 60.000 % Impervious"
" " 25.390 Total Area"
" " 30.000 Flow length"
" " 5.000 Overland Slope"
" " 10.156 Pervious Area"
" " 30.000 Pervious length"
" " 5.000 Pervious slope"
" " 15.234 Impervious Area"
" " 30.000 Impervious length"
" " 5.000 Impervious slope"
" " 0.250 Pervious Manning 'n'"
" " 78.000 Pervious SCS Curve No."
" " 0.486 Pervious Runoff coefficient"
" " 0.100 Pervious Ia/S coefficient"
" " 7.164 Pervious Initial abstraction"
" " 0.020 Impervious Manning 'n'"
" " 98.000 Impervious SCS Curve No."
" " 0.919 Impervious Runoff coefficient"
" " 0.100 Impervious Ia/S coefficient"
" " 0.518 Impervious Initial abstraction"
" " 3.540 0.000 Pervious Impervious Total Area "
" " Catchment 100 0.000 c.m/sec"

```

```

" 40 HYDROGRAPH Add Runoff "
" " Surface Area 10.156 15.234 25.390 hectare"
" " Time of concentration 13.720 2.390 5.329 minutes"
" " Time to Centroid 212.273 171.850 182.337 minutes"
" " Rainfall depth 88.000 88.000 88.000 mm"
" " Rainfall volume 0.8937 1.3406 2.2343 ha-m"
" " Rainfall losses 45.217 6.584 22.037 mm"
" " Runoff depth 42.783 81.416 65.963 mm"
" " Runoff volume 0.4345 1.2403 1.6748 ha-m"
" " Runoff coefficient 0.486 0.925 0.750 "
" " Maximum flow 1.015 2.688 3.540 c.m/sec"
" 33 CATCHMENT 201"
" " 1 Triangular SCS"
" " 1 Equal length"
" " 1 SCS method"
" " 201 Catchment 201"
" " 60.000 % Impervious"
" " 1.160 Total Area"
" " 10.000 Flow length"
" " 2.000 Overland Slope"
" " 0.464 Pervious Area"
" " 10.000 Pervious length"
" " 2.000 Pervious slope"
" " 0.696 Impervious Area"
" " 10.000 Impervious length"
" " 2.000 Impervious slope"
" " 0.250 Pervious Manning 'n'"
" " 78.000 Pervious SCS Curve No."
" " 0.484 Pervious Runoff coefficient"
" " 0.100 Pervious Ia/S coefficient"
" " 7.164 Pervious Initial abstraction"
" " 0.020 Impervious Manning 'n'"
" " 98.000 Impervious SCS Curve No."
" " 0.919 Impervious Runoff coefficient"
" " 0.100 Impervious Ia/S coefficient"
" " 0.518 Impervious Initial abstraction"
" " 0.165 3.540 0.000 c.m/sec"
" " Catchment 201 Pervious Impervious Total Area "
" " Surface Area 0.464 0.696 1.160 hectare"
" " Time of concentration 9.342 1.627 3.631 minutes"
" " Time to Centroid 207.151 170.069 179.703 minutes"
" " Rainfall depth 88.000 88.000 88.000 mm"
" " Rainfall volume 408.32 612.48 1020.80 c.m"
" " Rainfall losses 45.407 7.095 22.420 mm"
" " Runoff depth 42.593 80.905 65.580 mm"
" " Runoff volume 197.63 563.10 760.73 c.m"
" " Runoff coefficient 0.484 0.919 0.745 "
" " Maximum flow 0.046 0.122 0.165 c.m/sec"

```

```

40 HYDROGRAPH Add Runoff "
4 Add Runoff " 0.165 3.705 0.000 0.000"
81 ADD COMMENT=====
Lines of comment"
Area draining to proposed SWM facility via northerly "
overland flow route during major storm events"
33 CATCHMENT 102"
1 Triangular SCS"
1 Equal length"
1 SCS method"
102 Catchment 102"
70.000 % Impervious"
1.720 Total Area"
5.000 Flow length"
10.000 Overland Slope"
0.516 Pervious Area"
5.000 Pervious length"
10.000 Pervious slope"
1.204 Impervious Area"
5.000 Impervious length"
10.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.478 Pervious Runoff coefficient"
7.164 Pervious Ia/S coefficient"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.874 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.232 3.705 0.000 0.000 c.m/sec"
Catchment 102 Pervious Impervious Total Area "
Surface Area 0.516 1.204 1.720 hectare"
Time of concentration 3.803 0.662 1.259 minutes"
Time to Centroid 200.855 170.992 176.665 minutes"
Rainfall depth 88.000 88.000 88.000 mm"
Rainfall volume 454.08 1059.52 1513.60 c.m"
Rainfall losses 45.917 11.084 21.534 mm"
Runoff depth 42.083 76.916 66.466 mm"
Runoff volume 217.15 926.07 1143.22 c.m"
Runoff coefficient 0.478 0.874 0.755 "
Maximum flow 0.049 0.186 0.232 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff " 0.232 3.934 0.000 0.000"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow" 0.232 3.934 3.934 0.000"

```

```

40 HYDROGRAPH Combine 1"
6 Combine "
1 Node #"
Runoff to SWM Facility" 3.934 c.m/sec"
Hydrograph volume 18651.918 c.m"
0.232 3.934 3.934"
HYDROGRAPH Start - New Tributary"
2 Start - New Tributary" 0.232 0.000 3.934 3.934"
CATCHMENT 202"
1 Triangular SCS"
1 Equal length"
1 SCS method"
202 Catchment 202"
75.000 % Impervious"
0.280 Total Area"
10.000 Flow length"
2.000 Overland Slope"
0.070 Pervious Area"
10.000 Pervious length"
2.000 Pervious slope"
0.210 Impervious Area"
10.000 Impervious length"
2.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.484 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.919 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.043 0.000 3.934 3.934 c.m/sec"
Catchment 202 Pervious Impervious Total Area "
Surface Area 0.070 0.210 0.280 hectare"
Time of concentration 9.342 1.627 2.779 minutes"
Time to Centroid 207.150 170.069 175.605 minutes"
Rainfall depth 88.000 88.000 88.000 mm"
Rainfall volume 61.600 184.80 246.40 c.m"
Rainfall losses 45.407 7.095 16.673 mm"
Runoff depth 42.593 80.905 71.327 mm"
Runoff volume 29.82 169.90 199.72 c.m"
Runoff coefficient 0.484 0.919 0.811 "
Maximum flow 0.007 0.037 0.043 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff " 0.043 0.043 3.934 3.934"

```

[illegible]

```

" 47      0.074      4.052      0.477      0.000 c.m/sec"
FILE_O Write/Save Channel Flow - from SWM Facility.100hyd"
2 1=rainfall; 2=write/save"
2 1=rainfall; 2=hydrograph"
3 1=runoff; 2=inflow; 3=outflow; 4=junction"
Channel Flow - from SWM Facility.100hyd"
Outflow hydrograph saved to be used at end of modelling to determine
design flow within outlet channel"
Total volume      19186.260      c.m"
Maximum flow      0.477      c.m/sec"
" 40      0.074      4.052      0.477      0.000 c.m/sec"
HYDROGRAPH Next link "
5 Next link "
" 33      0.074      0.477      0.477      0.000"
CATCHMENT 110"
1 Triangular SCS"
1 Equal length"
1 SCS method"
110 Catchment 110"
10.000 % Impervious"
3.010 Total Area"
75.000 Flow length"
7.000 Overland Slope"
2.709 Pervious Area"
75.000 Pervious length"
7.000 Pervious slope"
0.301 Impervious Area"
75.000 Impervious length"
7.000 Impervious slope"
0.300 Pervious Manning 'n'"
70.000 Pervious SCS Curve No."
0.363 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
10.886 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.920 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
" 40      0.169      0.477      0.477      0.000 c.m/sec"
CATCHMENT 110"
Surface Area      2.709      0.301      0.301      3.010      hectare"
Time of concentration      27.126      3.743      21.991      21.991      minutes"
Time to Centroid      234.966      173.654      221.502      221.502      minutes"
Rainfall depth      88.000      88.000      88.000      88.000      mm"
Rainfall volume      2383.92      264.88      2648.80      2648.80      c.m"
Rainfall losses      56.049      7.082      51.152      51.152      mm"
Runoff depth      80.918      80.918      36.848      36.848      mm"
Runoff volume      243.56      1109.12      1109.12      1109.12      c.m"
Runoff coefficient      0.363      0.363      0.920      0.920      c.m/sec"

```

```

" 40      0.074      0.477      0.477      0.000 c.m/sec"
Maximum flow      0.477      c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff "
" 33      0.169      0.607      0.477      0.000"
CATCHMENT 111"
1 Triangular SCS"
1 Equal length"
1 SCS method"
111 Catchment 111"
35.000 % Impervious"
0.450 Total Area"
25.000 Flow length"
4.000 Overland Slope"
0.292 Pervious Area"
25.000 Pervious length"
4.000 Pervious slope"
0.157 Impervious Area"
25.000 Impervious length"
4.000 Impervious slope"
0.250 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.486 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.926 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
" 40      0.054      0.607      0.477      0.000 c.m/sec"
CATCHMENT 111"
Surface Area      13.149      0.292      0.157      0.157      hectare"
Time of concentration      13.149      2.290      7.648      7.648      minutes"
Time to Centroid      211.671      88.000      171.724      171.724      minutes"
Rainfall depth      88.000      88.000      88.000      88.000      mm"
Rainfall volume      257.40      138.50      396.00      396.00      c.m"
Rainfall losses      45.272      6.511      31.706      31.706      mm"
Runoff depth      42.728      124.98      81.489      81.489      mm"
Runoff volume      124.98      128.34      253.32      253.32      c.m"
Runoff coefficient      0.486      0.926      0.640      0.640      c.m/sec"
Maximum flow      0.029      0.028      0.054      0.054      c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff "
" 81      0.054      0.634      0.477      0.000"
ADD COMMENT=====
1 Lines of comment"
Runoff draining to 130 South Water Street property"
HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
" 40      0.054      0.634      0.634      0.000"

```

```

40 HYDROGRAPH Combine 1"
6 Combine "
1 Node #
Total Runoff draining from Subject Property"
Maximum flow 0.634 c.m/sec"
Hydrograph volume 20548.713 c.m"
0.054 0.634 0.634 0.634"
40 HYDROGRAPH Start - New Tributary"
2 Start - New Tributary"
0.054 0.000 0.634 0.634"
33 CATCHMENT 300"
1 Triangular SCS"
1 Equal length"
1 SCS method"
300 Catchment 300"
4.000 % Impervious"
12.960 Total Area"
250.000 Flow length"
5.000 Overland Slope"
12.442 Pervious Area"
250.000 Pervious length"
5.000 Pervious slope"
0.518 Impervious Area"
250.000 Impervious length"
5.000 Impervious slope"
0.300 Pervious Manning 'n'"
78.000 Pervious SCS Curve No."
0.487 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
7.164 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.935 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.664 0.000 0.634 0.634 c.m/sec"
Catchment 300 Pervious Impervious Total Area "
Surface Area 12.442 0.518 12.960 hectare"
Time of concentration 54.619 8.527 51.205 minutes"
Time to Centroid 261.418 179.354 255.340 minutes"
Rainfall depth 88.000 88.000 88.000 mm"
Rainfall volume 1.0949 0.0456 1.1405 ha-m"
Rainfall losses 45.150 5.738 43.574 mm"
Runoff depth 42.850 82.262 44.426 mm"
Runoff volume 5331.21 426.45 5757.66 c.m"
Runoff coefficient 0.487 0.935 0.505 c.m/sec"
Maximum flow 0.641 0.092 0.664 c.m"
HYDROGRAPH Add Runoff "
4 Add Runoff " 0.664 0.564 0.634 0.634"

33 CATCHMENT 301"
1 Triangular SCS"
1 Equal length"
1 SCS method"
301 Catchment 301"
3.000 % Impervious"
27.250 Total Area"
300.000 Flow length"
1.000 Overland Slope"
26.433 Pervious Area"
300.000 Pervious length"
1.000 Pervious slope"
0.817 Impervious Area"
300.000 Impervious length"
1.000 Impervious slope"
0.300 Pervious Manning 'n'"
73.000 Pervious SCS Curve No."
0.407 Pervious Runoff coefficient"
0.100 Pervious Ia/S coefficient"
9.395 Pervious Initial abstraction"
0.020 Impervious Manning 'n'"
98.000 Impervious SCS Curve No."
0.937 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
0.684 0.664 0.634 0.634 c.m/sec"
Catchment 301 Pervious Impervious Total Area "
Surface Area 26.433 0.817 27.250 hectare"
Time of concentration 106.452 15.417 100.399 minutes"
Time to Centroid 326.734 187.931 317.505 minutes"
Rainfall depth 88.000 88.000 88.000 mm"
Rainfall volume 2.3261 0.0719 2.3980 ha-m"
Rainfall losses 52.193 5.536 50.794 mm"
Runoff depth 35.807 82.464 37.206 mm"
Runoff volume 0.9465 0.0674 1.0139 ha-m"
Runoff coefficient 0.407 0.937 0.423 c.m/sec"
Maximum flow 0.656 0.145 0.684 c.m/sec"
HYDROGRAPH Add Runoff "
4 Add Runoff " 0.684 1.192 0.634 0.634"

40 HYDROGRAPH Copy to Outflow"
8 Copy to Outflow"
0.684 1.192 1.192 0.634"
47 FILE_O Write/Save Channel Flow - from External Lands.100hyd"
2 1=read/open; 2=write/save"
2 1=rainfall; 2=hydrograph"
3 1=runoff; 2=Inflow; 3=outflow; 4=Junction"
Channel Flow - from External Lands.100hyd"
Outflow hydrograph saved to be used at end of modelling to determine
design flow within outlet channel"

```

"	3	1=runoff; 2=inflow; 3=outflow; 4=junction"			
"		Channel Flow - from External Lands,100hyd"			
"		Outflow hydrograph saved to be used at end of modelling to determine			
"		design flow within outlet channel"			
"		Total volume	15896.393	c.m"	
"		Maximum flow	1.192	c.m/sec"	
"		0.684	0.634	1.192	0.477 c.m/sec"
"	40	HYDROGRAPH Combine	1"		
"		6 Combine "			
"		1 Node #"			
"		Outlet Channel Design Flow"			
"		Maximum flow	1.653	c.m/sec"	
"		Hydrograph volume	35082.676	c.m"	
"		0.684	0.634	1.192	1.653"
"	38	START/RE-START TOTALS 1"			
"		3 Runoff Totals on EXIT"			
"		Total Catchment area			72.780 hectare"
"		Total Impervious area			19.418 hectare"
"		Total % impervious			26.681"
"		EXIT"			
"	19				

"	Total volume	15896.393	c.m"
"	Maximum flow	1.192	c.m/sec"
"	0.684	1.192	0.634 c.m/sec"
"	HYDROGRAPH Combine	2"	
"	6 Combine "		
"	2 Node #"		
"	Total Runoff to Saugeen River"		
"	Maximum flow	1.192	c.m/sec"
"	Hydrograph volume	15896.393	c.m"
"	0.684	1.192	1.192"
"	HYDROGRAPH Start - New Tributary"		
"	2 Start - New Tributary"		
"	0.684	0.000	1.192
"	HYDROGRAPH Confluence	1"	
"	7 Confluence "		
"	1 Node #"		
"	Total Runoff draining from Subject Property"		
"	Maximum flow	0.634	c.m/sec"
"	Hydrograph volume	20548.711	c.m"
"	0.684	0.634	1.192
"	HYDROGRAPH Copy to Outflow"		0.000"
"	8 Copy to Outflow"		
"	0.684	0.634	0.000"
"	HYDROGRAPH Combine	2"	
"	6 Combine "		
"	2 Node #"		
"	Total Runoff to Saugeen River"		
"	Maximum flow	1.733	c.m/sec"
"	Hydrograph volume	36445.113	c.m"
"	0.684	0.634	1.733"
"	FILE_O Read/Open Channel Flow - from SWM Facility.100hyd"		
"	1 1=read/open; 2=write/save"		
"	2 1=rainfall; 2=hydrograph"		
"	3 1=runoff; 2=inflow; 3=outflow; 4=junction"		
"	Channel Flow - from SWM Facility.100hyd"		
"	Outflow hydrograph saved to be used at end of modelling to determine		
"	design flow within outlet channel"		
"	Total volume	19186.260	c.m"
"	Maximum flow	0.477	c.m/sec"
"	0.684	0.477	1.733 c.m/sec"
"	HYDROGRAPH Combine	1"	
"	6 Combine "		
"	1 Node #"		
"	Outlet Channel Design Flow"		
"	Maximum flow	0.477	c.m/sec"
"	Hydrograph volume	19186.260	c.m"
"	0.684	0.634	0.477
"	FILE_O Read/Open Channel Flow - from External Lands.100hyd"		
"	1 1=read/open; 2=write/save"		
"	2 1=rainfall; 2=hydrograph"		

APPENDIX F: FOREBAY DESIGN CALCULATIONS

**MOUNT FOREST SUBDIVISION
TOWNSHIP OF WELLINGTON NORTH
OUR FILE: 318049
JANUARY 2021**

FOREBAY DESIGN CALCULATIONS

DESIGN PARAMETERS

Average Forebay Length (at bottom)	=	57.0	m	(Dist)
Forebay Top Width	=	17.5	m	
Forebay Depth	=	1.0	m	(d)
Active Forebay Bottom Width	=	11.5	m	
Approximate Permanent Forebay Pool Volume	=	827	m ³	
Length to Width Ratio	≈	3 : 1		(r)
2 Year Design Storm Event Peak Outflow from SWM Facility	=	0.109	m ³ /s	(Q _p)
Capacity of 1350 mm Ø @ 0.3%	=	2.923	m ³ /s	
Capacity of 300 mm Ø @ 0.5%	=	0.068	m ³ /s	
Total Inlet Flow Rate	=	2.991	m ³ /s	(Q _i)
Desired Forebay Velocity (recommended)	=	0.5	m/s	(V _f)
Desired Settling Velocity (recommended)	=	0.0003	m/s	(V _s)

SETTLING LENGTH

$$\text{Dist}_1 = ((r \times Q_p) / V_s)^{0.5} = 33.0 \text{ m}$$

Proposed forebay length exceeds the required settling length of 33.0 m

DISPERSION LENGTH

$$\text{Dist}_2 = (8 \times Q_i) / (d \times V_f) = 47.9 \text{ m}$$

Proposed forebay length exceeds the required dispersion length of 47.9 m

MINIMUM FOREBAY DEEP ZONE WIDTH

$$\text{Width} = \text{Dist}_2 / 8 = 6.0 \text{ m}$$

Proposed forebay deep zone bottom width exceeds the required deep zone bottom width

FLOW VELOCITY THROUGH FOREBAY

Cross-Sectional Area of Forebay	=	15	m ²	
Cross-sectional Area of Forebay (with Permanent Pool)	=	22	m ²	(A)
Q _i	=	2.991	m ³ /s	(Q ₅)
Velocity	=	Q ₅ / A	=	0.14 m/s

The average flow velocity through the forebay is less than the allowable velocity of 0.15 m/s

APPENDIX G: DRAWDOWN TIME CALCULATIONS

**MOUNT FOREST SUBDIVISION
TOWNSHIP OF WELLINGTON NORTH
OUR FILE: 318049
FEBRUARY 2020**

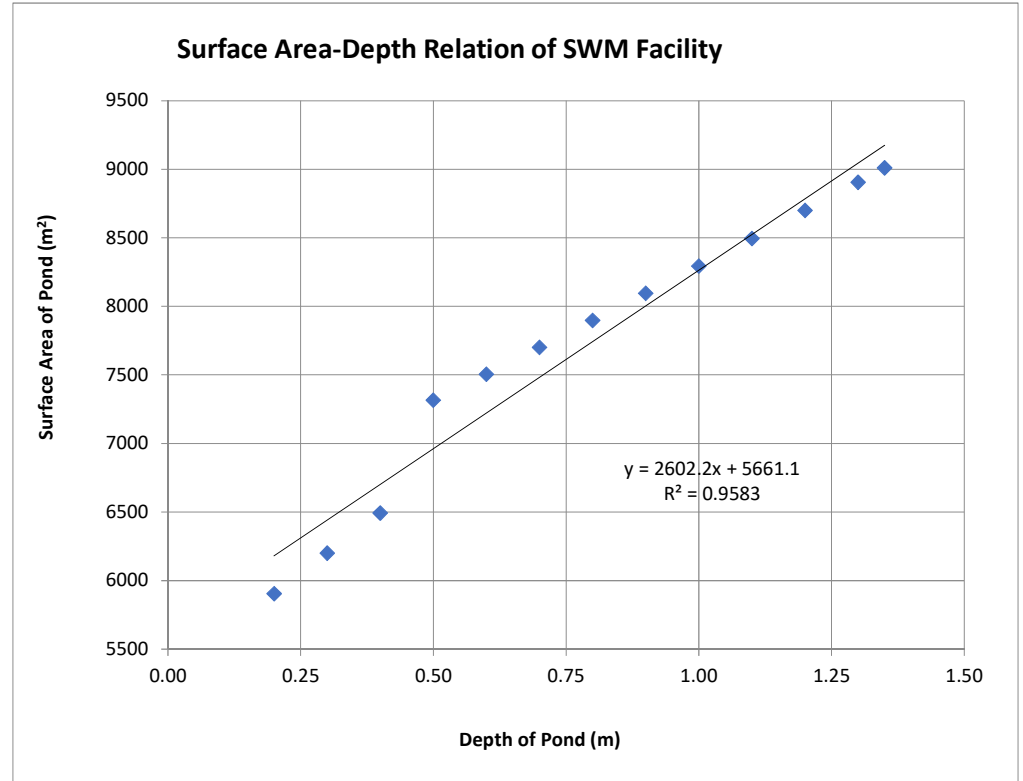
MINIMUM DRAWDOWN TIME CALCULATIONS

	Elevation (m)	Height of Water above Centroid of First Orifice Outlet (m)	Surface Area (m ²)
Podding Stages Governed by First Controlled Outlet	412.00	0.20	5906
	412.10	0.30	6200
	412.20	0.40	6494
	412.30	0.50	7316
	412.40	0.60	7507
	412.50	0.70	7701
	412.60	0.80	7898
	412.70	0.90	8096
	412.80	1.00	8296
	412.90	1.10	8497
	413.00	1.20	8701
	413.10	1.30	8906
	413.15	1.35	9010

Orifice Diameter 200 mm
Orifice Area 0.03142 m²
Orifice Inv. 411.70 m
Orifice Centroid 411.80 m

Results of Linear Regression

C2 2602.2 (for Eq. 4.11)
C3 5661.1 (for Eq. 4.11)



Using Eq. 4.11 from MECP's Stormwater Management Planning and Design Manual

Design Storm Event	Max. Water Elevation Within Pond (m)	Max. Water Elevation above the Orifice Centroid (m)	Drawdown Time (s)	Drawdown Time (h)
2 year	412.76	0.96	147,104	41

APPENDIX H:
MIDUSS MODELLING – POST-DEVELOPMENT CONDITIONS –
MAJOR DESIGN STORM EVENTS

"	101	Catchment 101 "
"	50.000	% Impervious"
"	0.560	Total Area"
"	10.000	Flow Length"
"	4.000	Overland Slope"
"	0.280	Pervious Area"
"	10.000	Pervious length"
"	4.000	Pervious slope"
"	0.280	Impervious Area"
"	10.000	Impervious length"
"	4.000	Impervious slope"
"	0.250	Pervious Manning 'n'"
"	78.000	Pervious SCS Curve No."
"	0.378	Pervious Runoff coefficient"
"	0.100	Pervious Ia/S coefficient"
"	7.164	Pervious Initial abstraction"
"	0.020	Impervious Manning 'n'"
"	98.000	Impervious SCS Curve No."
"	0.895	Impervious Runoff coefficient"
"	0.100	Impervious Ia/S coefficient"
"	0.518	Impervious Initial abstraction"
"		0.047 0.029 2.332
"		Catchment 101 Pervious 2.332 c.m/sec"
"		Surface Area 0.280 0.280 0.560
"		Time of concentration 9.720 1.534 3.967
"		Time to Centroid 213.538 171.797 184.204
"		Rainfall depth 61.400 61.400 61.400
"		Rainfall volume 171.92 171.92 343.84
"		Rainfall losses 38.165 6.464 22.315
"		Runoff depth 23.235 54.936 39.085
"		Runoff volume 65.06 153.82 218.88
"		Runoff coefficient 0.378 0.895 0.637
"		Maximum flow 0.015 0.034 0.047
"	40	HYDROGRAPH Add Runoff " 2.332 c.m/sec"
"		4 Add Runoff " 0.047 0.076 2.332 2.332"
"	81	ADD COMMENT=====
"	2	Lines of comment"
"		Area draining to proposed SWM facility via southerly "
"		overland flow route during major storm events"
"	40	HYDROGRAPH Copy to Outflow"
"		8 Copy to Outflow"
"		0.047 0.076 0.076 2.332"
"	40	HYDROGRAPH Combine 1"
"		6 Combine "
"	1	Node #"
"		Runoff to SWM Facility"
"		Maximum flow 2.408 c.m/sec"
"		Hydrograph volume 11889.490 c.m"
"		0.047 0.076 0.076 2.408"
"	40	HYDROGRAPH Start - New Tributary"

[illegible]

" " Hydrograph volume 12629.330 c.m" " " 0.045 0.045 0.325" " 40 HYDROGRAPH Start - New Tributary" " " 2 Start - New Tributary" 0.045 0.045 0.325" " 33 CATCHMENT 121" " " 1 Triangular SCS" " " 1 Equal length" 121 121 121 " " 1 SCS method" 35.000 % Impervious" " " 25.000 Total Area" 0.260 Flow length" " " 25.000 Overland Slope" 5.000 Pervious Area" 0.169 Pervious length" 25.000 Pervious slope" 3.000 Pervious Area" 0.091 Impervious length" 25.000 Impervious slope" 3.000 Pervious Manning 'n'" 0.250 Pervious SCS Curve No." 78.000 Pervious Runoff coefficient" 0.380 Pervious Ia/S coefficient" 0.100 Pervious Initial abstraction" 7.164 Pervious Manning 'n'" 0.020 Impervious SCS Curve No." 98.000 Impervious Runoff coefficient" 0.895 Impervious Ia/S coefficient" 0.100 Impervious Initial abstraction" 0.518 0.017 0.000 0.045 0.325 c.m/sec" " " Catchment 121 Pervious Impervious Total Area " " Surface Area 0.169 0.091 0.260 hectare" " Time of concentration 18.361 2.898 9.715 minutes" " Time to Centroid 223.639 174.617 196.228 minutes" " Rainfall depth 61.400 61.400 61.400 mm" " Rainfall volume 103.77 55.87 159.64 c.m" " Rainfall losses 38.068 6.443 26.999 mm" " Runoff depth 23.332 54.957 34.401 mm" " Runoff volume 39.43 50.01 89.44 c.m" " Runoff coefficient 0.380 0.895 0.560 c.m/sec" " 40 Maximum flow 0.008 0.011 0.017 " " HYDROGRAPH Add Runoff " " 4 Add Runoff " 0.017 0.017 0.045 0.325" " 81 ADD COMMENT===== " " 1 Lines of comment" " " Runoff draining to 250 Harris Street property" " 40 HYDROGRAPH Copy to Outflow" " " 8 Copy to Outflow" 0.017 0.017 0.017 0.325" "

" 40 HYDROGRAPH Combine 1" " " 6 Combine " " " 1 Node #" " " Total Runoff draining from Subject Property" " " Maximum flow 0.327 c.m/sec" " " Hydrograph volume 12718.771 c.m" " " 0.017 0.017 0.327" " 40 HYDROGRAPH Start - New Tributary" " " 2 Start - New Tributary" 0.017 0.000 0.327" " 33 CATCHMENT 122" " " 1 Triangular SCS" " " 1 Equal length" 122 122 122 " " 1 SCS method" 40.000 % Impervious" " " 0.230 Total Area" 15.000 Flow length" " " 5.000 Overland Slope" 0.138 Pervious Area" 15.000 Pervious length" 6.000 Pervious slope" 0.092 Impervious Area" 15.000 Impervious length" 6.000 Impervious slope" 0.250 Pervious Manning 'n'" 78.000 Pervious SCS Curve No." 0.380 Pervious Runoff coefficient" 0.100 Pervious Ia/S coefficient" 7.164 Pervious Initial abstraction" 0.020 Impervious Manning 'n'" 98.000 Impervious SCS Curve No." 0.896 Impervious Runoff coefficient" 0.100 Impervious Ia/S coefficient" 0.518 Impervious Initial abstraction" 0.018 0.000 0.017 0.327 c.m/sec" " " Catchment 122 Pervious Impervious Total Area " " Surface Area 0.138 0.092 0.230 hectare" " Time of concentration 10.977 1.732 5.326 minutes" " Time to Centroid 214.878 172.432 188.932 minutes" " Rainfall depth 61.400 61.400 61.400 mm" " Rainfall volume 84.73 56.49 141.22 c.m" " Rainfall losses 38.076 6.385 25.400 mm" " Runoff depth 23.324 55.015 36.000 mm" " Runoff volume 32.19 50.61 82.80 c.m" " Runoff coefficient 0.380 0.896 0.586 " " Maximum flow 0.008 0.011 0.018 c.m/sec" " 40 HYDROGRAPH Add Runoff " " 4 Add Runoff " 0.018 0.018 0.017 0.327" " 81 ADD COMMENT===== "

[illegible]

"	Rainfall depth	61.400	61.400	61.400	mm"
"	Rainfall volume	7639.14	318.30	7957.44	c.m"
"	Rainfall losses	38.034	5.621	36.738	mm"
"	Runoff depth	23.366	55.779	24.662	mm"
"	Runoff volume	2907.08	289.16	3196.24	c.m"
"	Runoff coefficient	0.381	0.908	0.402	"
"	Maximum flow	0.274	0.064	0.288	c.m/sec"
"	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "	0.288	0.288	0.064	0.340"
"	CATCHMENT 301"				
"	1 Triangular SCS"				
"	1 Equal length"				
"	1 SCS method"				
"	301 Catchment 301"				
"	3.000 % Impervious"				
"	27.250 Total Area"				
"	300.000 Flow length"				
"	1.000 Overland Slope"				
"	26.433 Pervious Area"				
"	300.000 Pervious length"				
"	1.000 Pervious slope"				
"	0.817 Impervious Area"				
"	300.000 Impervious length"				
"	1.000 Impervious slope"				
"	0.300 Pervious Manning 'n'."				
"	73.000 Pervious SCS Curve No."				
"	0.302 Pervious Runoff coefficient"				
"	0.100 Pervious Ia/S coefficient"				
"	9.395 Pervious Initial abstraction"				
"	0.020 Impervious Manning 'n'."				
"	98.000 Impervious SCS Curve No."				
"	0.913 Impervious Runoff coefficient"				
"	0.100 Impervious Ia/S coefficient"				
"	0.518 Impervious Initial abstraction"				
"	0.279 0.288 0.064 0.340 c.m/sec"				
"	Catchment 301	Pervious	Impervious	Total Area	"
"	Surface Area	26.433	0.817	27.250	hectare"
"	Time of concentration	139.893	17.893	129.456	minutes"
"	Time to Centroid	369.731	193.018	354.613	minutes"
"	Rainfall depth	61.400	61.400	61.400	mm"
"	Rainfall volume	1.6230	0.0502	1.6732	ha-m"
"	Rainfall losses	42.870	5.348	41.744	mm"
"	Runoff depth	18.530	56.052	19.656	mm"
"	Runoff volume	4898.02	458.23	5356.25	c.m"
"	Runoff coefficient	0.302	0.913	0.320	"
"	Maximum flow	0.265	0.101	0.279	c.m/sec"
"	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "	0.279	0.503	0.064	0.340"
"	HYDROGRAPH Copy to Outflow"				
"	0.279				

"	Time of concentration	15.660	2.592	5.709	minutes"
"	Time to Centroid	217.777	173.087	183.745	minutes"
"	Rainfall depth	72.200	72.200	72.200	mm"
"	Rainfall volume	0.7018	1.0527	1.7545	ha-m"
"	Rainfall losses	41.335	6.502	20.435	mm"
"	Runoff depth	30.865	65.698	51.765	mm"
"	Runoff volume	0.3000	0.9579	1.2579	ha-m"
"	Runoff coefficient	0.427	0.910	0.717	"
"	Maximum flow	0.673	2.084	2.580	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "	2.580	2.580	0.000	0.000"
" 33	CATCHMENT 201"				
"	1 Triangular SCS"				
"	1 Equal length"				
"	1 SCS method"				
"	201 Catchment 201"				
"	60.000 % Impervious"				
"	1.160 Total Area"				
"	10.000 Flow length"				
"	2.000 Overland Slope"				
"	0.464 Pervious Area"				
"	10.000 Pervious length"				
"	2.000 Pervious slope"				
"	0.696 Impervious Area"				
"	10.000 Impervious length"				
"	2.000 Impervious slope"				
"	0.250 Pervious Manning 'n'"				
"	78.000 Pervious SCS Curve No."				
"	0.428 Pervious Runoff coefficient"				
"	0.100 Pervious Ia/S coefficient"				
"	7.164 Pervious Initial abstraction"				
"	0.020 Impervious Manning 'n'"				
"	98.000 Impervious SCS Curve No."				
"	0.908 Impervious Runoff coefficient"				
"	0.100 Impervious Ia/S coefficient"				
"	0.518 Impervious Initial abstraction"				
"	0.130 201 Pervious	0.000	0.000	0.000 c.m/sec"	
"	Catchment 201				
"	Surface Area	0.464	0.696	1.160	hectare"
"	Time of concentration	10.664	1.765	3.892	minutes"
"	Time to Centroid	211.780	171.579	181.188	minutes"
"	Rainfall depth	72.200	72.200	72.200	mm"
"	Rainfall volume	335.01	502.51	837.52	c.m"
"	Rainfall losses	41.312	6.644	20.512	mm"
"	Runoff depth	30.888	65.556	51.688	mm"
"	Runoff volume	143.32	456.27	599.59	c.m"
"	Runoff coefficient	0.428	0.908	0.716	"
"	Maximum flow	0.034	0.100	0.130	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				

```

" 81      ADD COMMENT=====0.130      2.710      0.000      0.000"
"
" 2 Lines of comment"
" Area draining to proposed SWM facility via northerly "
" overland flow route during major storm events"
" 33      CATCHMENT 102"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 102 Catchment 102"
" 70.000 % Impervious"
" 1.720 Total Area"
" 5.000 Flow length"
" 10.000 Overland Slope"
" 0.516 Pervious Area"
" 5.000 Pervious length"
" 10.000 Pervious slope"
" 1.204 Impervious Area"
" 5.000 Impervious length"
" 10.000 Impervious slope"
" 0.250 Pervious Manning 'n'"
" 78.000 Pervious SCS Curve No."
" 0.425 Pervious Runoff coefficient"
" 0.100 Pervious Ia/S coefficient"
" 7.164 Pervious Initial abstraction"
" 0.020 Impervious Manning 'n'"
" 98.000 Impervious SCS Curve No."
" 0.872 Impervious Runoff coefficient"
" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"
" 0.186 0.000 2.710 0.000 0.000 c.m/sec"
" Catchment 102 Pervious Impervious Total Area "
" Surface Area 0.516 1.204 1.720 hectare"
" Time of Concentration 4.341 0.719 1.344 minutes"
" Time to Centroid 204.330 172.106 177.670 minutes"
" Rainfall depth 72.200 72.200 72.200 mm"
" Rainfall volume 372.55 869.29 1241.84 c.m"
" Rainfall losses 41.548 9.253 18.942 mm"
" Runoff depth 30.652 62.947 53.258 mm"
" Runoff volume 158.16 757.88 916.04 c.m"
" Runoff coefficient 0.425 0.872 0.738 "
" Maximum flow 0.036 0.154 0.186 c.m/sec"
" 40 HYDROGRAPH Add Runoff "
" 4 Add Runoff "
" 0.186 2.895 0.000 0.000"
" HYDROGRAPH Copy to Outflow"
" 8 Copy to Outflow"
" 0.186 2.895 2.895 0.000"
" HYDROGRAPH Combine 1"
" 6 Combine "
" 1 Node #"

```

```

" Runoff to SWM Facility"
" Maximum flow 2.895 c.m/sec"
" Hydrograph volume 14094.419 c.m"
" 2.895"
" 40 HYDROGRAPH Start - New Tributary"
" 2 Start - New Tributary"
" 0.186 0.000 2.895 2.895"
" CATCHMENT 202"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 202 Catchment 202"
" 75.000 % Impervious"
" 0.280 Total Area"
" 10.000 Flow length"
" 2.000 Overland Slope"
" 0.070 Pervious Area"
" 10.000 Pervious length"
" 2.000 Pervious slope"
" 0.210 Impervious Area"
" 10.000 Impervious length"
" 2.000 Impervious slope"
" 0.250 Pervious Manning 'n'"
" 78.000 Pervious SCS Curve No."
" 0.428 Pervious Runoff coefficient"
" 0.100 Pervious Ia/S coefficient"
" 7.164 Pervious Initial abstraction"
" 0.020 Impervious Manning 'n'"
" 98.000 Impervious SCS Curve No."
" 0.908 Impervious Runoff coefficient"
" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"
" 0.034 0.000 2.895 2.895 c.m/sec"
" Catchment 202 Pervious Impervious Total Area "
" Surface Area 0.070 0.210 0.280 hectare"
" Time of concentration 10.664 1.765 2.973 minutes"
" Time to Centroid 211.780 171.579 177.036 minutes"
" Rainfall depth 72.200 72.200 72.200 mm"
" Rainfall volume 50.54 151.62 202.16 c.m"
" Rainfall losses 41.312 6.644 15.311 mm"
" Runoff depth 30.888 65.556 56.889 mm"
" Runoff volume 21.62 137.67 159.29 c.m"
" Runoff coefficient 0.428 0.908 0.788 "
" Maximum flow 0.005 0.030 0.034 c.m/sec"
" 40 HYDROGRAPH Add Runoff "
" 4 Add Runoff "
" 0.034 0.034 2.895 2.895"
" CATCHMENT 101"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"

```

[illegible]

" " 1 Equal length" " 33
" " 1 SCS method" " 1
" " 1101 Catchment 110A" " 1
" " 10.000 % Impervious" " 1
" " 2.590 Total Area" " 120
" " 100.000 Flow length" " 45.000
" " 7.000 Overland Slope" " 0.590
" " 2.331 Pervious Area" " 20.000
" " 100.000 Pervious length" " 4.000
" " 7.000 Pervious slope" " 0.324
" " 0.259 Impervious Area" " 20.000
" " 100.000 Impervious length" " 4.000
" " 7.000 Impervious slope" " 0.265
" " 0.300 Pervious Manning 'n'" " 20.000
" " 70.000 Pervious SCS Curve No." " 4.000
" " 0.306 Pervious Runoff coefficient" " 0.250
" " 0.100 Pervious Ia/S coefficient" " 78.000
" " 0.020 Pervious Initial abstraction" " 0.427
" " 98.000 Impervious Manning 'n'" " 7.164
" " 0.920 Impervious SCS Curve No." " 0.020
" " 0.100 Impervious Runoff coefficient" " 98.000
" " 0.518 Impervious Ia/S coefficient" " 0.913
" " 0.082 Impervious Initial abstraction" " 0.100
" " 0.082 0.436 0.000 c.m/sec" " 0.518
" " Catchment 1101 Pervious Impervious Total Area "
" " Surface Area 2.331 0.259 2.590 hectare "
" " Time of Concentration 37.602 4.826 29.391 minutes "
" " Rainfall depth 72.200 175.903 231.891 mm "
" " Rainfall volume 1682.98 72.200 1869.98 c.m "
" " Rainfall losses 50.117 5.761 45.681 mm "
" " Runoff depth 22.083 66.439 26.519 mm "
" " Runoff volume 514.75 172.08 686.83 c.m "
" " Runoff coefficient 0.306 0.920 0.367 "
" " Maximum flow 0.070 0.037 0.082 c.m/sec "
" " 40 HYDROGRAPH Add Runoff " " 40
" " 4 Add Runoff " " 40
" " 0.082 0.471 0.436 0.000 "
" " HYDROGRAPH Copy to Outflow" " " 40
" " 8 Copy to Outflow" " 0.082 0.471 0.471 0.000 "
" " 40 HYDROGRAPH Combine 1" " " 40
" " 6 Combine " " " 40
" " 1 Node # " " " 40
" " Total Runoff draining from Subject Property" " " 40
" " Maximum flow 0.471 c.m/sec "
" " Hydrograph volume 15211.832 c.m "
" " 0.082 0.471 0.471 0.471 "
" " 40 HYDROGRAPH Start - New Tributary" " " 40
" " 2 Start - New Tributary" " " 40
" " 0.082 0.000 0.471 0.471 "

" " 33 CATCHMENT 120" " 33
" " 1 Triangular SCS" " 1
" " 1 Equal length" " 1
" " 1 SCS method" " 1
" " 120 Catchment 120" " 1
" " 45.000 % Impervious" " 1
" " 0.590 Total Area" " 1
" " 20.000 Flow length" " 1
" " 4.000 Overland Slope" " 1
" " 0.324 Pervious Area" " 1
" " 20.000 Pervious length" " 1
" " 4.000 Pervious slope" " 1
" " 0.265 Impervious Area" " 1
" " 20.000 Impervious length" " 1
" " 4.000 Impervious slope" " 1
" " 0.250 Pervious Manning 'n'" " 1
" " 78.000 Pervious SCS Curve No." " 1
" " 0.427 Pervious Runoff coefficient" " 1
" " 0.100 Pervious Ia/S coefficient" " 1
" " 7.164 Pervious Initial abstraction" " 1
" " 0.020 Impervious Manning 'n'" " 1
" " 98.000 Impervious SCS Curve No." " 1
" " 0.913 Impervious Runoff coefficient" " 1
" " 0.100 Impervious Ia/S coefficient" " 1
" " 0.518 Impervious Initial abstraction" " 1
" " 0.058 0.000 0.471 0.471 c.m/sec" " 1
" " Catchment 120 Pervious Impervious Total Area "
" " Surface Area 0.324 0.265 0.590 hectare "
" " Time of concentration 13.129 2.173 6.159 minutes "
" " Time to Centroid 214.767 172.611 187.948 mm "
" " Rainfall depth 72.200 72.200 72.200 mm "
" " Rainfall volume 234.29 191.69 425.98 c.m "
" " Rainfall losses 41.342 6.253 25.552 mm "
" " Runoff depth 30.858 65.947 46.648 mm "
" " Runoff volume 100.13 175.09 275.22 c.m "
" " Runoff coefficient 0.427 0.913 0.646 "
" " Maximum flow 0.023 0.038 0.058 c.m/sec "
" " 40 HYDROGRAPH Add Runoff " " 40
" " 4 Add Runoff " " 40
" " 0.058 0.058 0.471 0.471 "
" " 81 ADD COMMENT===== " 81
" " 1 Lines of comment" " 1
" " Runoff draining to 130 South Water Street property" " 1
" " 40 HYDROGRAPH Copy to Outflow" " 40
" " 8 Copy to Outflow" " 8
" " 0.058 0.058 0.058 0.471 "
" " 40 HYDROGRAPH Combine 1" " 40
" " 6 Combine " " 40
" " 1 Node # " " 40
" " Total Runoff draining from Subject Property" " 40
" " Maximum flow 0.484 c.m/sec "

" " Hydrograph volume 15487.054 c.m"
" 0.058 0.058 0.058 0.484"
" 40 HYDROGRAPH Start - New Tributary"
" 2 Start - New Tributary" 0.058 0.058 0.484"
" 33 CATCHMENT 121"
" 1 Triangular SCS"
" 1 Equal length"
" 121 Catchment 121"
" 35.000 % Impervious"
" 0.260 Total Area"
" 25.000 Flow length"
" 5.000 Overland Slope"
" 0.169 Pervious Area"
" 25.000 Pervious length"
" 3.000 Pervious slope"
" 0.091 Impervious Area"
" 25.000 Impervious length"
" 3.000 Impervious slope"
" 0.250 Pervious Manning 'n'"
" 78.000 Pervious SCS Curve No."
" 0.428 Pervious Runoff coefficient"
" 0.100 Pervious Ia/S coefficient"
" 7.164 Pervious Initial abstraction"
" 0.020 Impervious Manning 'n'"
" 98.000 Impervious SCS Curve No."
" 0.908 Impervious Runoff coefficient"
" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"
" 0.022 0.000 0.058 0.484 c.m/sec"
" Catchment 121 Pervious Impervious Total Area "
" Surface Area 0.169 0.091 0.260 hectare"
" Time of concentration 16.362 2.709 9.081 minutes"
" Time to Centroid 218.577 173.319 194.440 minutes"
" Rainfall depth 72.200 72.200 72.200 mm"
" Rainfall volume 122.02 65.70 187.72 c.m"
" Rainfall losses 41.296 6.612 29.157 mm"
" Runoff depth 30.904 65.588 43.043 mm"
" Runoff volume 52.23 59.69 111.91 c.m"
" Runoff coefficient 0.428 0.908 0.596 c.m/sec"
" Maximum flow 0.012 0.013 0.022 c.m/sec"
" 40 HYDROGRAPH Add Runoff "
" 4 Add Runoff "
" 81 ADD COMMENT=====
" 1 Lines of comment"
" 40 HYDROGRAPH Copy to Outflow"
" 8 Copy to Outflow" 0.022 0.022 0.022 0.484"

" 40 HYDROGRAPH Combine 1"
" 6 Combine "
" 1 Node #"
" Total Runoff draining from Subject Property"
" Maximum flow 0.489 c.m/sec"
" Hydrograph volume 15598.964 c.m"
" 0.022 0.022 0.022 0.489"
" 40 HYDROGRAPH Start - New Tributary"
" 2 Start - New Tributary" 0.022 0.000 0.022 0.489"
" 33 CATCHMENT 122"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 122 Catchment 122"
" 40.000 % Impervious"
" 0.230 Total Area"
" 15.000 Flow length"
" 5.000 Overland Slope"
" 0.138 Pervious Area"
" 15.000 Pervious length"
" 6.000 Pervious slope"
" 0.092 Impervious Area"
" 15.000 Impervious length"
" 6.000 Impervious slope"
" 0.250 Pervious Manning 'n'"
" 78.000 Pervious SCS Curve No."
" 0.426 Pervious Runoff coefficient"
" 0.100 Pervious Ia/S coefficient"
" 7.164 Pervious Initial abstraction"
" 0.020 Impervious Manning 'n'"
" 98.000 Impervious SCS Curve No."
" 0.907 Impervious Runoff coefficient"
" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"
" 0.022 0.000 0.022 0.489 c.m/sec"
" Catchment 122 Pervious Impervious Total Area "
" Surface Area 0.138 0.092 0.230 hectare"
" Time of concentration 9.782 1.619 4.994 minutes"
" Time to Centroid 210.844 171.099 187.528 minutes"
" Rainfall depth 72.200 72.200 72.200 mm"
" Rainfall volume 99.64 66.42 166.06 c.m"
" Rainfall losses 41.435 6.709 27.545 mm"
" Runoff depth 30.765 65.491 44.655 mm"
" Runoff volume 42.46 60.25 102.71 c.m"
" Runoff coefficient 0.426 0.907 0.618 c.m/sec"
" Maximum flow 0.010 0.013 0.022 c.m/sec"
" 40 HYDROGRAPH Add Runoff "
" 4 Add Runoff "
" 81 ADD COMMENT=====
" 0.022 0.022 0.022 0.489"

[illegible]

"	Rainfall depth	72.200	72.200	72.200	mm"	"	8	Copy to Outflow"	"	0.420	0.747	0.747	0.513"
"	Rainfall volume	8982.83	374.28	374.28	c.m"	"		HYDROGRAPH	Combine	2"			
"	Rainfall losses	41.258	5.642	39.833	mm"	"	40	6	Combine "				
"	Runoff depth	30.942	66.558	32.367	mm"	"		2	Node #"				
"	Runoff volume	3849.72	345.04	4194.76	c.m"	"			Total Runoff to Saugeen River"				
"	Runoff coefficient	0.922	0.448	0.448	"	"			Maximum flow	0.747	0.747	c.m/sec"	
"	Maximum flow	0.429	0.076	0.423	c.m/sec"	"			Hydrograph volume	11391.764	0.747	0.747"	
"	HYDROGRAPH Add Runoff "					"			0.420	0.747	0.747	0.747"	
"	4	Add Runoff "	0.423	0.082	0.513"	"	40	2	Start - New Tributary"				
"	CATCHMENT 301"					"			HYDROGRAPH Start - New Tributary"				
"	1	Triangular SCS"				"			0.420	0.000	0.747	0.747"	
"	1	Equal length"				"	40	7	Confluence "	1"			
"	1	SCS method"				"			HYDROGRAPH	Confluence			
"	301	Catchment 301"				"		1	Node #"				
"	3.000	% Impervious"				"			Total Runoff draining from Subject Property"				
"	27.250	Total Area"				"			Maximum flow	0.513	0.513	c.m/sec"	
"	300.000	Flow length"				"			Hydrograph volume	16125.340	0.747	0.000"	
"	1.000	Overland Slope"				"	40		HYDROGRAPH Copy to Outflow"				
"	26.433	Pervious Area"				"		8	Copy to Outflow"	0.420	0.513	0.747	0.000"
"	300.000	Pervious length"				"			0.420	0.513	0.513	0.000"	
"	1.000	Pervious slope"				"			HYDROGRAPH	Combine	2"		
"	0.817	Impervious Area"				"	40	6	Combine "				
"	300.000	Impervious length"				"		2	Node #"				
"	1.000	Impervious slope"				"			Total Runoff to Saugeen River"				
"	0.300	Pervious Manning 'n'"				"			Maximum flow	1.260	1.260	c.m/sec"	
"	73.000	Pervious SCS Curve No."				"			Hydrograph volume	27517.086	0.513	1.260"	
"	0.349	Pervious Runoff coefficient"				"			0.420	0.513	0.513	1.260"	
"	0.100	Pervious Ia/S coefficient"				"			START/RE-START TOTALS 1"				
"	9.395	Pervious Initial abstraction"				"	38	3	Runoff Totals on EXIT"				
"	0.020	Impervious Manning 'n'"				"			Total Catchment area				
"	98.000	Impervious SCS Curve No."				"			Total Impervious area				
"	0.925	Impervious Runoff coefficient"				"			Total % impervious				
"	0.100	Impervious Ia/S coefficient"				"			EXIT"				
"	0.518	Impervious Initial abstraction"				"	19						
"		0.420	0.423	0.082	0.513 c.m/sec"	"							
"	Catchment 301	Pervious	Impervious	Total Area	"								
"	Surface Area	26.433	0.817	27.250	hectare"	"							
"	Time of concentration	123.122	16.726	115.054	minutes"	"							
"	Time to Centroid	348.571	190.614	336.595	minutes"	"							
"	Rainfall depth	72.200	72.200	72.200	mm"	"							
"	Rainfall volume	1.9084	0.0590	1.9675	ha-m"	"							
"	Rainfall losses	47.037	5.448	45.789	mm"	"							
"	Runoff depth	25.163	66.752	26.411	mm"	"							
"	Runoff volume	6651.31	545.69	7197.00	c.m"	"							
"	Runoff coefficient	0.349	0.925	0.366	"	"							
"	Maximum flow	0.401	0.120	0.420	c.m/sec"	"							
"	HYDROGRAPH Add Runoff "					"							
"	4	Add Runoff "	0.420	0.747	0.513"	"							
"						"							
"	HYDROGRAPH Copy to Outflow"					"	40						

"	Time of concentration	14.594	2.484	5.508	minutes"
"	Time to Centroid	214.818	172.432	183.016	minutes"
"	Rainfall depth	80.100	80.100	80.100	mm"
"	Rainfall volume	0.7786	1.1679	1.9464	ha-m"
"	Rainfall losses	43.360	6.509	21.249	mm"
"	Runoff depth	36.740	73.591	58.851	mm"
"	Runoff volume	0.3571	1.0730	1.4301	ha-m"
"	Runoff coefficient	0.459	0.919	0.735	"
"	Maximum flow	0.810	2.329	2.989	c.m/sec"
40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "	2.989	2.989	0.000	0.000"
33	CATCHMENT 201"				
"	1 Triangular SCS"				
"	1 Equal length"	1			
"	1 SCS method"				
"	201 Catchment 201"				
"	60.000 % Impervious"				
"	1.160 Total Area"				
"	10.000 Flow length"				
"	2.000 Overland Slope"				
"	0.464 Pervious Area"				
"	10.000 Pervious length"				
"	2.000 Pervious slope"				
"	0.696 Impervious Area"				
"	10.000 Impervious length"				
"	2.000 Impervious slope"				
"	0.250 Pervious Manning 'n'"				
"	78.000 Pervious SCS Curve No."				
"	0.457 Pervious Runoff coefficient"				
"	0.100 Pervious Ia/S coefficient"				
"	7.164 Pervious Initial abstraction"				
"	0.020 Impervious Manning 'n'"				
"	98.000 Impervious SCS Curve No."				
"	0.914 Impervious Runoff coefficient"				
"	0.100 Impervious Ia/S coefficient"				
"	0.518 Impervious Initial abstraction"				
"	0.148 2.989 0.000				
"	Catchment 201		Pervious	0.000	0.000 c.m/sec"
"	Surface Area	0.464	0.696	1.160	hectare"
"	Time of concentration	9.938	1.691	3.752	minutes"
"	Time to Centroid	209.314	170.767	180.401	minutes"
"	Rainfall depth	80.100	80.100	80.100	mm"
"	Rainfall volume	371.66	557.50	929.16	c.m"
"	Rainfall losses	43.500	6.867	21.520	mm"
"	Runoff depth	36.600	73.233	58.580	mm"
"	Runoff volume	169.82	509.70	679.53	c.m"
"	Runoff coefficient	0.457	0.914	0.731	"
"	Maximum flow	0.040	0.111	0.148	c.m/sec"
40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				

" 81 ADD COMMENT=====0.148 3.136 0.000 0.000"

" 2 Lines of comment"

" Area draining to proposed SWM facility via northerly "

" overland flow route during major storm events"

" 33 CATCHMENT 102"

" 1 Triangular SCS"

" 1 Equal length"

" 1 SCS method"

" 102 Catchment 102 "

" % Impervious"

" 70.000 Total Area"

" 1.720 Flow length"

" 5.000 Overland Slope"

" 10.000 Pervious Area"

" 0.516 Pervious length"

" 5.000 Pervious slope"

" 10.000 Pervious Area"

" 1.204 Impervious length"

" 5.000 Impervious slope"

" 10.000 Pervious Manning 'n'"

" 0.250 Pervious SCS Curve No."

" 78.000 Pervious Runoff coefficient"

" 0.453 Pervious Ia/S coefficient"

" 0.100 Pervious Initial abstraction"

" 7.164 Pervious Manning 'n'"

" 0.020 Impervious SCS Curve No."

" 98.000 Impervious Runoff coefficient"

" 0.873 Impervious Ia/S coefficient"

" 0.100 Impervious Initial abstraction"

" 0.518 Impervious Initial abstraction"

" 0.209 3.136 0.000 0.000 c.m/sec"

" Catchment 102 Pervious Impervious Total Area "

" Surface Area 0.516 1.204 1.720 hectare"

" Time of Concentration 4.046 0.688 1.299 minutes"

" Time to Centroid 202.525 171.510 177.149 minutes"

" Rainfall depth 80.100 80.100 80.100 mm"

" Rainfall volume 413.32 964.40 1377.72 c.m"

" Rainfall losses 43.826 10.144 20.248 mm"

" Runoff depth 36.274 69.956 59.852 mm"

" Runoff volume 187.17 842.27 1029.45 c.m"

" Runoff coefficient 0.453 0.873 0.747 "

" Maximum flow 0.043 0.170 0.209 c.m/sec"

" 40 HYDROGRAPH Add Runoff "

" 4 Add Runoff "

" 0.209 3.343 0.000 0.000"

" HYDROGRAPH Copy to Outflow"

" 8 Copy to Outflow"

" 0.209 3.343 3.343 0.000"

" 40 HYDROGRAPH Combine 1"

" 6 Combine "

" 1 Node #"

" Runoff to SWM Facility"

" Maximum flow 3.343 c.m/sec"

" Hydrograph volume 16009.651 c.m"

" 0.209 3.343 3.343"

" 40 HYDROGRAPH Start - New Tributary"

" 2 Start - New Tributary"

" 0.209 0.000 3.343 3.343"

" 33 CATCHMENT 202"

" 1 Triangular SCS"

" 1 Equal length"

" 1 SCS method"

" 202 Catchment 202"

" % Impervious"

" 75.000 Total Area"

" 0.280 Flow length"

" 10.000 Overland Slope"

" 2.000 Pervious Area"

" 0.070 Pervious length"

" 10.000 Pervious slope"

" 2.000 Impervious Area"

" 0.210 Impervious length"

" 10.000 Impervious slope"

" 2.000 Pervious Manning 'n'"

" 0.250 Pervious SCS Curve No."

" 78.000 Pervious Runoff coefficient"

" 0.457 Pervious Ia/S coefficient"

" 0.100 Pervious Initial abstraction"

" 7.164 Pervious Manning 'n'"

" 0.020 Impervious SCS Curve No."

" 98.000 Impervious Runoff coefficient"

" 0.914 Impervious Ia/S coefficient"

" 0.100 Impervious Initial abstraction"

" 0.518 Impervious Initial abstraction"

" 0.039 0.000 3.343 3.343 c.m/sec"

" Catchment 202 Pervious Impervious Total Area "

" Surface Area 0.070 0.210 0.280 hectare"

" Time of concentration 9.938 1.691 2.869 minutes"

" Time to Centroid 209.314 170.767 176.272 minutes"

" Rainfall depth 80.100 80.100 80.100 mm"

" Rainfall volume 56.07 168.21 224.28 c.m"

" Rainfall losses 43.500 6.867 16.025 mm"

" Runoff depth 36.600 73.233 64.075 mm"

" Runoff volume 25.62 153.79 179.41 c.m"

" Runoff coefficient 0.457 0.914 0.800 "

" Maximum flow 0.006 0.034 0.039 c.m/sec"

" 40 HYDROGRAPH Add Runoff "

" 4 Add Runoff "

" 0.039 0.039 3.343 3.343"

" 33 CATCHMENT 101"

" 1 Triangular SCS"

" 1 Equal length"

" 1 SCS method"

[illegible]

" " Hydrograph volume 17632.188 c.m"
" 0.067 0.067 0.067 0.539"
" 40 HYDROGRAPH Start - New Tributary"
" 2 Start - New Tributary"
" 0.067 0.067 0.067 0.539"
" 33 CATCHMENT 121"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 121 Catchment 121"
" 35.000 % Impervious"
" 0.260 Total Area"
" 25.000 Flow length"
" 5.000 Overland Slope"
" 0.169 Pervious Area"
" 25.000 Pervious length"
" 3.000 Pervious slope"
" 0.091 Impervious Area"
" 25.000 Impervious length"
" 3.000 Impervious slope"
" 0.250 Pervious Manning 'n'"
" 78.000 Pervious SCS Curve No."
" 0.458 Pervious Runoff coefficient"
" 0.100 Pervious Ia/S coefficient"
" 7.164 Pervious Initial abstraction"
" 0.020 Impervious Manning 'n'"
" 98.000 Impervious SCS Curve No."
" 0.917 Impervious Runoff coefficient"
" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"
" 0.026 0.000 0.067 0.539 c.m/sec"
" Catchment 121 Pervious Impervious Total Area "
" Surface Area 0.169 0.260 hectare"
" Time of concentration 15.249 2.595 8.686 minutes"
" Time to Centroid 215.615 172.497 193.252 minutes"
" Rainfall depth 80.100 80.100 80.100 mm"
" Rainfall volume 135.37 72.89 208.26 c.m"
" Rainfall losses 43.406 6.671 30.549 mm"
" Runoff depth 36.694 73.429 49.551 mm"
" Runoff volume 62.01 66.82 128.83 c.m"
" Runoff coefficient 0.458 0.917 0.619 "
" Maximum flow 0.014 0.014 0.026 c.m/sec"
" 40 HYDROGRAPH Add Runoff "
" 4 Add Runoff "
" 0.026 0.026 0.067 0.539"
" 81 ADD COMMENT=====
" 1 Lines of comment"
" Runoff draining to 250 Harris Street property"
" 40 HYDROGRAPH Copy to Outflow"
" 8 Copy to Outflow"
" 0.026 0.026 0.026 0.539"

" 40 HYDROGRAPH Combine 1"
" 6 Combine "
" 1 Node #"
" Total Runoff draining from Subject Property"
" Maximum flow 0.546 c.m/sec"
" Hydrograph volume 17761.021 c.m"
" 0.026 0.026 0.026 0.546"
" 40 HYDROGRAPH Start - New Tributary"
" 2 Start - New Tributary"
" 0.026 0.000 0.026 0.546"
" 33 CATCHMENT 122"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 122 Catchment 122"
" 40.000 % Impervious"
" 0.230 Total Area"
" 15.000 Flow length"
" 5.000 Overland Slope"
" 0.138 Pervious Area"
" 15.000 Pervious length"
" 6.000 Pervious slope"
" 0.092 Impervious Area"
" 15.000 Impervious length"
" 6.000 Impervious slope"
" 0.250 Pervious Manning 'n'"
" 78.000 Pervious SCS Curve No."
" 0.457 Pervious Runoff coefficient"
" 0.100 Pervious Ia/S coefficient"
" 7.164 Pervious Initial abstraction"
" 0.020 Impervious Manning 'n'"
" 98.000 Impervious SCS Curve No."
" 0.913 Impervious Runoff coefficient"
" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"
" 0.026 0.000 0.026 0.546 c.m/sec"
" Catchment 122 Pervious Impervious Total Area "
" Surface Area 0.138 0.092 0.230 hectare"
" Time of concentration 9.116 1.551 4.794 minutes"
" Time to Centroid 208.328 170.342 186.623 minutes"
" Rainfall depth 80.100 80.100 80.100 mm"
" Rainfall volume 110.54 73.69 184.23 c.m"
" Rainfall losses 43.516 6.940 28.886 mm"
" Runoff depth 36.584 73.160 51.214 mm"
" Runoff volume 50.49 67.31 117.79 c.m"
" Runoff coefficient 0.457 0.913 0.639 "
" Maximum flow 0.012 0.015 0.026 c.m/sec"
" 40 HYDROGRAPH Add Runoff "
" 4 Add Runoff "
" 0.026 0.026 0.026 0.546"
" 81 ADD COMMENT=====

[illegible]

"	Time of concentration	13.720	2.390	5.329	minutes"
"	Time to Centroid	212.273	171.850	182.337	minutes"
"	Rainfall depth	88.000	88.000	88.000	mm"
"	Rainfall volume	0.8554	1.2830	1.2830	ha-m"
"	Rainfall losses	45.217	6.584	22.037	mm"
"	Runoff depth	42.783	81.416	65.963	mm"
"	Runoff volume	0.4159	1.1870	1.6029	ha-m"
"	Runoff coefficient	0.486	0.925	0.750	"
"	Maximum flow	0.972	2.573	3.388	c.m/Sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "	3.388	3.388	0.000	0.000"
" 33	CATCHMENT 201"				
"	1 Triangular SCS"				
"	1 Equal length"	1			
"	1 SCS method"				
"	201 Catchment 201"				
"	60.000 % Impervious"				
"	1.160 Total Area"				
"	10.000 Flow length"				
"	2.000 Overland Slope"				
"	0.464 Pervious Area"				
"	10.000 Pervious length"				
"	2.000 Pervious slope"				
"	0.696 Impervious Area"				
"	10.000 Impervious length"				
"	2.000 Impervious slope"				
"	0.250 Pervious Manning 'n' "				
"	78.000 Pervious SCS Curve No. "				
"	0.484 Pervious Runoff coefficient"				
"	0.100 Pervious Ia/5 coefficient"				
"	7.164 Pervious Initial abstraction"				
"	0.020 Impervious Manning 'n' "				
"	98.000 Impervious SCS Curve No. "				
"	0.919 Impervious Runoff coefficient"				
"	0.100 Impervious Ia/5 coefficient"				
"	0.518 Impervious Initial abstraction"				
"	0.165 Pervious	3.388	0.000	0.000 c.m/sec"	
"	Catchment 201			Impervious Total Area "	
"	Surface Area	0.464	0.696	1.160	hectare"
"	Time of concentration	9.342	1.627	3.631	minutes"
"	Time to Centroid	207.151	179.069	179.703	minutes"
"	Rainfall depth	88.000	88.000	88.000	mm"
"	Rainfall volume	408.32	612.48	1020.80	c.m"
"	Rainfall losses	45.407	7.095	22.420	mm"
"	Runoff depth	42.593	80.905	65.580	mm"
"	Runoff volume	197.63	563.10	760.73	c.m"
"	Runoff coefficient	0.484	0.919	0.745	"
"	Maximum flow	0.046	0.122	0.165	c.m/Sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				

" 81 ADD COMMENT=====0.165 3.553 0.000 0.000"
" 2 Lines of comment"
" Area draining to proposed SWM facility via northerly "
" overland flow route during major storm events"
" 33 CATCHMENT 102"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 102 Catchment 102"
" 70.000 % Impervious"
" 1.720 Total Area"
" 5.000 Flow length"
" 10.000 Overland Slope"
" 0.516 Pervious Area"
" 5.000 Pervious length"
" 10.000 Pervious slope"
" 1.204 Impervious Area"
" 5.000 Impervious length"
" 10.000 Impervious slope"
" 0.250 Pervious Manning 'n'"
" 78.000 Pervious SCS Curve No."
" 0.478 Pervious Runoff coefficient"
" 0.100 Pervious Ia/S coefficient"
" 7.164 Pervious Initial abstraction"
" 0.020 Impervious Manning 'n'"
" 98.000 Impervious SCS Curve No."
" 0.874 Impervious Runoff coefficient"
" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"
" 0.232 3.553 0.000 0.000 c.m/sec"
" Catchment 102 Pervious Impervious Total Area "
" Surface Area 0.516 1.204 1.720 hectare"
" Time of Concentration 3.803 0.662 1.259 minutes"
" Time to Centroid 200.855 170.992 176.665 minutes"
" Rainfall depth 88.000 88.000 88.000 mm"
" Rainfall volume 454.08 1059.52 1513.60 c.m"
" Rainfall losses 45.917 11.084 21.534 mm"
" Runoff depth 42.083 76.916 66.466 mm"
" Runoff volume 217.15 926.07 1143.22 c.m"
" Runoff coefficient 0.478 0.874 0.755 "
" Maximum flow 0.049 0.186 0.232 c.m/sec"
" 40 HYDROGRAPH Add Runoff "
" 4 Add Runoff "
" 0.232 3.783 0.000 0.000"
" HYDROGRAPH Copy to Outflow"
" 8 Copy to Outflow"
" 0.232 3.783 3.783 0.000"
" 40 HYDROGRAPH Combine 1"
" 6 Combine "
" 1 Node #"

" Runoff to SWM Facility"
" Maximum flow 3.783 c.m/sec"
" Hydrograph volume 17932.928 c.m"
" 3.783"
" 40 HYDROGRAPH Start - New Tributary"
" 2 Start - New Tributary"
" 0.232 0.000 3.783 3.783"
" CATCHMENT 202"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 202 Catchment 202"
" 75.000 % Impervious"
" 0.280 Total Area"
" 10.000 Flow length"
" 2.000 Overland Slope"
" 0.070 Pervious Area"
" 10.000 Pervious length"
" 2.000 Pervious slope"
" 0.210 Impervious Area"
" 10.000 Impervious length"
" 2.000 Impervious slope"
" 0.250 Pervious Manning 'n'"
" 78.000 Pervious SCS Curve No."
" 0.484 Pervious Runoff coefficient"
" 0.100 Pervious Ia/S coefficient"
" 7.164 Pervious Initial abstraction"
" 0.020 Impervious Manning 'n'"
" 98.000 Impervious SCS Curve No."
" 0.919 Impervious Runoff coefficient"
" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"
" 0.043 0.000 3.783 3.783 c.m/sec"
" Catchment 202 Pervious Impervious Total Area "
" Surface Area 0.070 0.210 0.280 hectare"
" Time of concentration 9.342 1.627 2.779 minutes"
" Time to Centroid 207.150 170.069 175.605 minutes"
" Rainfall depth 88.000 88.000 88.000 mm"
" Rainfall volume 61.60 184.80 246.40 c.m"
" Rainfall losses 45.407 7.095 16.673 mm"
" Runoff depth 42.593 80.905 71.327 mm"
" Runoff volume 29.82 169.90 199.72 c.m"
" Runoff coefficient 0.484 0.919 0.811 "
" Maximum flow 0.007 0.037 0.043 c.m/sec"
" 40 HYDROGRAPH Add Runoff "
" 4 Add Runoff "
" 0.043 0.043 3.783 3.783"
" CATCHMENT 101"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"

[illegible]

" " Hydrograph volume 19795.621 c.m"
" 0.077 0.077 0.077 0.600"
" 40 HYDROGRAPH Start - New Tributary"
" 2 Start - New Tributary" 0.077 0.077 0.600"
" 33 CATCHMENT 121"
" 1 Triangular SCS"
" 1 Equal length"
" 121 Catchment 121"
" 35.000 % Impervious"
" 0.260 Total Area"
" 25.000 Flow length"
" 5.000 Overland Slope"
" 0.169 Pervious Area"
" 25.000 Pervious length"
" 3.000 Pervious slope"
" 0.091 Impervious Area"
" 25.000 Impervious length"
" 3.000 Impervious slope"
" 0.250 Pervious Manning 'n'"
" 78.000 Pervious SCS Curve No."
" 0.486 Pervious Runoff coefficient"
" 0.100 Pervious Ia/S coefficient"
" 7.164 Pervious Initial abstraction"
" 0.020 Impervious Manning 'n'"
" 98.000 Impervious SCS Curve No."
" 0.924 Impervious Runoff coefficient"
" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"
" 0.030 0.000 0.077 0.600 c.m/sec"
" Catchment 121 Pervious Impervious Total Area "
" Surface Area 0.169 0.091 0.260 hectare"
" Time of concentration 14.335 2.497 8.348 minutes"
" Time to Centroid 213.024 171.936 192.245 minutes"
" Rainfall depth 88.000 88.000 88.000 mm"
" Rainfall volume 148.72 80.08 228.80 c.m"
" Rainfall losses 45.195 6.665 31.709 mm"
" Runoff depth 42.805 81.335 56.291 mm"
" Runoff volume 72.34 74.02 146.36 c.m"
" Runoff coefficient 0.486 0.924 0.640 "
" Maximum flow 0.017 0.016 0.030 c.m/sec"
" 40 HYDROGRAPH Add Runoff "
" 4 Add Runoff "
" 81 ADD COMMENT=====
" 1 Lines of comment"
" 40 HYDROGRAPH Copy to Outflow"
" 8 Copy to Outflow" 0.030 0.030 0.030 0.600"

" 40 HYDROGRAPH Combine 1"
" 6 Combine "
" 1 Node #"
" Total Runoff draining from Subject Property"
" Maximum flow 0.615 c.m/sec"
" Hydrograph volume 19941.979 c.m"
" 0.030 0.030 0.030 0.615"
" 40 HYDROGRAPH Start - New Tributary"
" 2 Start - New Tributary" 0.030 0.000 0.030 0.615"
" 33 CATCHMENT 122"
" 1 Triangular SCS"
" 1 Equal length"
" 1 SCS method"
" 122 Catchment 122"
" 40.000 % Impervious"
" 0.230 Total Area"
" 15.000 Flow length"
" 5.000 Overland Slope"
" 0.138 Pervious Area"
" 15.000 Pervious length"
" 6.000 Pervious slope"
" 0.092 Impervious Area"
" 15.000 Impervious length"
" 6.000 Impervious slope"
" 0.250 Pervious Manning 'n'"
" 78.000 Pervious SCS Curve No."
" 0.486 Pervious Runoff coefficient"
" 0.100 Pervious Ia/S coefficient"
" 7.164 Pervious Initial abstraction"
" 0.020 Impervious Manning 'n'"
" 98.000 Impervious SCS Curve No."
" 0.919 Impervious Runoff coefficient"
" 0.100 Impervious Ia/S coefficient"
" 0.518 Impervious Initial abstraction"
" 0.029 0.000 0.030 0.615 c.m/sec"
" Catchment 122 Pervious Impervious Total Area "
" Surface Area 0.138 0.092 0.230 hectare"
" Time of concentration 8.570 1.493 4.623 minutes"
" Time to Centroid 206.079 169.778 185.834 minutes"
" Rainfall depth 88.000 88.000 88.000 mm"
" Rainfall volume 121.44 80.96 202.40 c.m"
" Rainfall losses 45.254 7.156 30.015 mm"
" Runoff depth 42.746 80.844 57.985 mm"
" Runoff volume 58.99 74.38 133.37 c.m"
" Runoff coefficient 0.486 0.919 0.659 "
" Maximum flow 0.013 0.016 0.029 c.m/sec"
" 40 HYDROGRAPH Add Runoff "
" 4 Add Runoff "
" 81 ADD COMMENT=====
" 0.029 0.029 0.030 0.615"

[illegible]

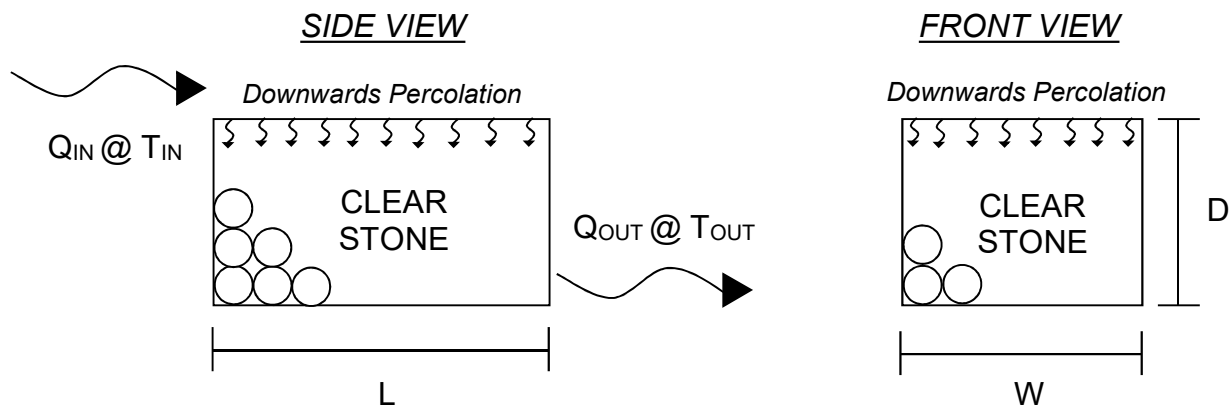
APPENDIX I: COOLING TRENCH SIZING CALCULATIONS

COOLING TRENCH CALCULATIONS

Assumptions:

- Solid media (clear stone) in trench is isothermal (i.e. at a constant temperature) and spherical
- Temperature of fluid moving through trench is constant and is approximated as the average inlet and outlet temperature
- Thermal conductivity of clear stone is comparable to that of granite
- A temperature of 273.15 K is equivalent to 0°C

Schematic:



Design Variables – Temperatures and Flows:

Q = design flow rate through cooling trench
= peak outflow from SWM facility during 2-year design storm event
= 0.109 m³/s

T_{IN} = temperature of inflow
= 31°C
= 303 K

T_{OUT} = temperature of outflow
= 15°C
= 288 K

T_{AVG} = average temperature of inflow and outflow
= 23°C
= 296 K

T_{STONE} = average temperature of clear stone
= 15°C
= 288 K

Design Variables – Geometry of Cooling Trench:

- L = length of clear stone within cooling trench of cooling trench
= 15 m
- W = width of clear stone layer within cooling trench
= 2 m
- D = depth of clear stone layer within cooling trench
= 0.9 m
- Dia. = diameter of clear stone within cooling trench
= 50 mm
= 0.050 m

Design Variables – Physical/ Thermophysical Properties of Fluid (Water):

	Source
ρ = fluid density = 998 kg/m ³ for water at 293 K	[1]
ν = kinematic viscosity = 1.005 x 10 ⁻⁶ for water at 293 K	[1]
C_p = specific heat of fluid = 4,181 kJ/kg•K for water at 295 K	[2]
Pr_f = Prandtl number of fluid = 6.62 for water at 295 K	[2]
K = thermal conductivity of solid media = 2.79 W/m•K for granite	[2]

Sources:

[1] F. M. White, *Fluid Mechanics*, 5th ed. Boston, MA: McGraw-Hill, 2003.

[2] T. L. Bergman, A. S. Lavine, F. P. Incropera, and D. P. DeWitt, *Fundamentals of Heat and Mass Transfer*, 7th ed. Hoboken, NJ: John Wiley & Sons, 2011.

Analysis:**Required Heat Transfer Rate**

Calculate the required heat transfer rate (q_r) using the following equation:

$$q_r = \dot{m} C_p \Delta T \quad \text{Eq. 1}$$

$$q_r = Q \rho C_p (T_{IN} - T_{OUT})$$

$$q_r = \left(0.109 \frac{\text{m}^3}{\text{s}}\right) \left(998 \frac{\text{kg}}{\text{m}^3}\right) \left(4,181 \frac{\text{J}}{\text{kg} \cdot \text{K}}\right) (303 \text{ K} - 288 \text{ K})$$

$$q_r = 6,822,263 \text{ J/s}$$

$$q_r = 6,822,263 \text{ W}$$

Where:

$\dot{m}$ = mass flow rate (kg/s)

Therefore, the heat transfer rate required to reduce the temperature of water to 294 K (21°C) from 314 K (41°C), given the design flow rate of 0.109 m³/s, is approximately 9,096,351 W.

Available Heat Transfer Rate

Calculate the available heat transfer rate (q_a) using the following equation:

$$q_a = h_s A_s (T_{AVG} - T_{STONE}) \quad \text{Eq. 2}$$

Where:

h_s = convective heat transfer coefficient for clear stone $\left(\frac{\text{W}}{\text{m}^2 \cdot \text{K}}\right)$

A_s = surface area of clean stone particles (m²)

Step 1

Approximate the available surface area of the clear stone within the cooling trench using the following equation:

A_s = surface area of one particle • total estimated number of particles

$$A_s = (\pi \cdot \text{Dia.}^2) \left(\frac{L}{\text{Dia.}} \cdot \frac{W}{\text{Dia.}} \cdot \frac{H}{\text{Dia.}} \right) \quad \text{Eq. 3}$$

$$A_s = \pi \cdot \frac{L \cdot W \cdot D}{\text{Dia.}}$$

$$A_s = \pi \cdot \frac{15 \text{ m} \cdot 2 \text{ m} \cdot 0.9 \text{ m}}{0.050 \text{ m}}$$

$$A_s = 1,696 \text{ m}^2$$

Therefore, the total available surface area of the clear stone particles is approximated as 1,696 m².

Step 2

Estimate the convective heat transfer coefficient of the clear stone particles using the equation:

$$h_s = \left(0.97 + 0.68 \left(\frac{V \cdot \text{Dia.}}{\nu} \right)^{0.5} \right) \frac{K \cdot \text{Pr}_f^{0.3}}{\text{Dia.}} \quad \text{Eq. 4}$$

Note: The equation used to estimate the heat transfer coefficient (h_s) utilizes Kramer's Correlation for flow of liquids past spheres, for which $1 < Re < 2000$.

Where:

V = velocity of fluid through trench (m/s)

Calculate V using the following equation:

$$V = \frac{Q}{A_{\text{flow}}} \quad \text{Eq. 5}$$

Where:

A_{flow} = available flow area through trench (m²)

Calculate A_{flow} using the following equation:

$A_{\text{flow}} = \text{cross-sectional area of trench} - \text{cross-sectional area of particles}$

$A_{\text{flow}} = \text{section area} - \text{cross-sectional area of single sphere} \cdot \text{est. number of spheres in section}$

$$A_{\text{flow}} = (L \cdot W) - \left(\frac{\pi \cdot \text{Dia.}^2}{4} \right) \left(\frac{L}{\text{Dia.}} \cdot \frac{W}{\text{Dia.}} \right) \quad \text{Eq. 6}$$

$$A_{\text{flow}} = L \cdot W \left(1 - \frac{\pi}{4} \right)$$

Substitute equation for A_{flow} (Eq. 6) into the equation for V (Eq. 5) and solve:

$$V = \frac{Q}{L \cdot W \left(1 - \frac{\pi}{4} \right)} \quad \text{Eq. 7}$$

$$V = \frac{0.109 \frac{\text{m}^3}{\text{s}}}{(15 \text{ m} \cdot 2 \text{ m}) \left(1 - \frac{\pi}{4} \right)}$$

$$V = 0.017 \frac{\text{m}^2}{\text{s}}$$

Therefore, the velocity of fluid through the trench is approximately $0.017 \frac{\text{m}^2}{\text{s}}$
(Confirm Reynolds Number; $Re = 845$)

Step 3

Solve Eq. 4 using the results of Eq. 7

$$h_s = \left(0.97 + 0.68 \left(\frac{V \cdot \text{Dia.}}{\nu} \right)^{0.5} \right) \frac{K \cdot \text{Pr}_f^{0.3}}{\text{Dia.}} \quad \text{Eq. 4}$$

$$h_s = \left(0.97 + 0.68 \left(\frac{0.017 \frac{\text{m}^2}{\text{s}} \cdot 0.050 \text{ m}}{1.005 \times 10^{-6} \frac{\text{m}^3}{\text{s}}} \right)^{0.5} \right) \frac{2.79 \frac{\text{W}}{\text{m} \cdot \text{K}} \cdot 6.62^{0.3}}{0.050 \text{ m}}$$

$$h_s = 2,041 \frac{\text{W}}{\text{m}^2 \cdot \text{K}}$$

Therefore, the heat transfer coefficient (h_s) for clean stone particles is approximately $2,041 \frac{\text{W}}{\text{m}^2 \cdot \text{K}}$

Calculate the available heat transfer rate (q_a) using the following equation:

$$q_a = h_s A_s (T_{\text{AVG}} - T_{\text{STONE}}) \quad \text{Eq. 2}$$

$$q_a = \left(2,041 \frac{\text{W}}{\text{m}^2 \cdot \text{K}} \right) (1,696 \text{ m}^2) (296 \text{ K} - 288 \text{ K})$$

$$q_a = 27,692,288 \text{ J/s}$$

$$q_a = 27,692,288 \text{ W}$$

Therefore, the heat transfer rate available to reduce the temperature of water to 294 K (21°C) from 314 K (41°C), given the design flow rate of 0.109 m³/s, is approximately 27,692,288 W.

Factor of Safety (FS)

$$FS = \frac{q_a}{q_r} \quad \text{Eq. 8}$$

$$FS = \frac{27,692,288 \text{ w}}{9,096,351 \text{ w}}$$

$$FS = 3.8$$

Conclusion:

Since the available heat transfer rate of approximately 27,692,288 W is greater than the required transfer rate of approximately 9,096,351 W, it is expected that a cooling trench having the proposed dimensions and clear stone diameter, has the ability to reduce the temperature of inflows to 294 K (21°C) from 314 K (41°C), for a design flow of approximately 0.109 m³/s.