FUNCTIONAL SERVICING REPORT FOR

Kettle Creek Subdivision
37719 Lake Line
Port Stanley ON

Submitted: February 2021
Revised: July 2021

Strathroy Turf Farms Inc.

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SBM-18-0530

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1 INTRODUCTION

This Functional Servicing Report (report) has been prepared by Strik Baldinelli Moniz Ltd (SBM) to address the requirements of the Municipality of Central Elgin for this proposed development located at 37719 Lake Line, Port Stanley, Ontario (Subject Site).

This report is intended to represent a component of the overall site design submission and should be read in conjunction with all other submitted documents.

The proposed subject site is 12.8 ha in area and is bordered by the Lake Line Right-of-way (R.O.W.) to the north and east, Kettle Creek Golf and County Club, and a Public School to the south, and River Road R.O.W. to the west. It is our understanding that the proposed development is to include approximately 79 single family residential units, 9 semi-detached units (totalling 97 dwellings) with 6 additional blocks allotted for open space and walkways. The following report, along with the Site Engineering Drawings 1-19, provided separately, have been prepared to address the municipality's requirements for the subject site.

The work has been executed following the most recent Municipality of Central Elgin Infrastructure Design Guidelines and Construction Standards (IDGCS) 2004, per the discussions and request during the subdivision consultation meeting on (December 3, 2019), The City of St Thomas Design Guidelines Manual (DGM) 2020, Ministry of the Environment, Conservation and Parks (MECP) Design Guidelines for Drinking-Water Systems, 2008 (DGDWS), MECP Design Guidelines for Stormwater Management Planning and Design Manual (SWMP&DM), and Ministry of Transportation Drainage Management Manual (MTO DMM).

1.1 Existing (Pre-Development) Conditions

Under pre-development conditions, the subject site is an open field consisting of an existing creek (open channel portion of the Marr Drain) located adjacent to the southeast boundary line, within the subject site property. Additionally, there is an existing municipal drain located within the property, as well as, an existing building, and silo located on the west side of the property. As shown on the Existing Conditions, Removals, and Sediment & Erosion Control Plan Sheet 3, by SBM provided separately, the entire site drains to the southeast of the property, towards the existing open channel portion of the Marr Drain. The pre-development runoff coefficient (C) for the site is calculated to be 0.22.

1.2 Proposed (Post-Development) Conditions

Post-development conditions were obtained from Engineering Drawings by SBM, provided separately (see Master Servicing Plan, Sheet 4). Under the post-development conditions, the site will be comprised of 79 single detached dwelling units, 9 semi-detached units with 6 additional blocks allotted for open space and walkways. As per the municipality's IDGCS for single family/semi-detached dwellings, the runoff coefficient (C) for single family residential ranges from 0.35 - 0.75. Therefore, 0.5 was used for the post-development runoff coefficient for both the single-family and semi-detached residential dwellings on this site. When also considering the imperviousness of the R.O.W. which was calculated to be 0.57, the composite runoff coefficient for both the single-family/semi-detached dwellings and the right of way is 0.52 as shown in stormwater management (SWM) calculations provided in Appendix F.

2 SANITARY SERVICING

According to the Carlow Road watermain replacement – Phase 1 drawing, dated February 2012, and provided in Appendix A, there is an existing 200 mm diameter combined sewer in the Carlow Road R.O.W., that is directed to an existing pumping station that ultimately pumps the flows up Lake Line and discharges into the treatment facility on Scotch Line. According to the Master Servicing Plan Sheet 4 of the engineering drawings, provided separately, the site's sanitary sewer is proposed to extend southeast through the existing Kettle Creek Golf and Country Club lands (same ownership as development), then extend easterly through the existing arena located southeast of the proposed site, and ultimately discharging into the existing 200mm diameter combined sewer in the Carlow Road R.O.W. The 200 mm diameter combined sewer currently does not have enough capacity from the proposed connection to the existing pumping station for the proposed flows, therefore the existing 200 mm diameter combined sewer downstream of the proposed sanitary sewer connection in the Carlow Road R.O.W. will be replaced with a 375 mm diameter and 450 mm diameter sewer to convey existing and proposed sanitary flows to the pumping station. The existing pumping station has been confirmed by the Municipality to have sufficient capacity for the additional flows.

The site was divided into eighteen (18) sanitary catchments areas (A201 to S218). Four (4) external catchment areas (EX201 to EX204) which are currently discharging sanitary flows to the existing 200 mm diameter combined sewer in the Carlow Road R.O.W. were also included in the Sanitary Design Sheet as shown on the Sanitary Catchment Areas Plan, Sheet 7, provided separately. The population for each sanitary catchment was calculated using the low-density population of 3.5 people per unit, as per Municipality's IDGCS. The sanitary peak flow was calculated by multiplying population in each sanitary catchment area by the average usage of 400 litres per day per capita. The sanitary peak design flow for the entire site area was calculated by adding residential peak flow and the infiltration allowance of 0.20 litres per second per hectare. These calculations are provided in the Sanitary Design Sheet, Sheet 8, provided separately.

The sanitary design sheet shows that the proposed sanitary sewers at the proposed slopes have sufficient capacity to convey the subject site's proposed sanitary peak design flow of 8.33 L/s to the sanitary sewer in the Carlow Road R.O.W., and ultimately to the existing pumping station. Refer to the Sanitary catchment Areas Plan and Sanitary Design Sheet on Sheets 7 and 8 respectively, provided separately.

Additional to the values calculated from the above, the storm portion of the existing 200 mm combined sewer (EX 203) was accounted for with approximately 0.08 ha tributary to the existing catch basin on the SAMH 27 to SAMH 15 pipe section, this was calculated assuming a time of concentration of 20.0 minutes (inlet time according to Municipality of Central Elgin) and runoff coefficient 'C' of 0.7 to add approximately 8 L/s to catchment EX202 under the 2-year design storm.

The storm portion of the existing 200 mm diameter combined sewer north of SAMH 15 has been estimated with a catchment area of 0.78 ha of storm drainage that is tributary to the existing 200 mm diameter combined sewer north of SAMH 15 based on the catch basins in Carlow Road R.O.W. north of SAMH 15. The storm flows were calculated assuming a time of concentration of 22.9 minutes (approximately 175 m from top of assumed catchment, limited at 1 m/s adjustment from 20.0 minutes) and runoff coefficient 'C' of 0.7 to add approximately 74 L/s to catchment EX203 under the 2-year design storm.

The existing 200 mm diameter combined sewer north of SAMH 15 was calculated to have a capacity of 46.3 L/s and an estimated design flow of 75.4 L/s. Therefore, in a conservative scenario, the 200 mm diameter combined

sewer north of SAMH 15 is assumed not to meet the existing capacity requirements. To compensate for the non-compliance, it is assumed that the excess flows under the 2-year design storm from Catchment EX203 will flow overland from the catch basins north of SAMH 15 to the catch basins within EX202 (south of SAMH15). Therefore, the difference between the design flow of 75.4 L/s and the assumed pipe capacity of 46.3 L/s were added to Catchment EX202 to ensure sufficient capacity has been provided in the combined sewer. The section of pipes between SAMH 26, SAMH 27, and SAMH 15 has been upsized to 375mm at @ 0.15% and 450mm @ 0.16% respectively to accommodate these flows. Under existing conditions, the excess flows that are not currently captured (in the conservative scenario) continue to flow overland to the south and ultimately outlet at the Marr Drain crossing of the Carlow Road R.O.W.

Based on the above assumption, adequate capacity has been provided in the combined sewer upgrade in the Carlow Road R.O.W. during the 2-year storm event and the overall design. Please see design sheet #8 in the drawings.

3 WATER SERVICING

According to scan showing the existing watermain information in the Lake Line R.O.W., provided in Appendix B, there is currently a 200mm diameter watermain in the Lake Line R.O.W., available to service the subject site. A 200 mm watermain is proposed to be connected to the existing 200 mm diameter watermain in the Lake Line R.O.W. The subject site is proposed to be serviced by a 150 mm diameter watermain connected to the proposed 200 mm diameter watermain connected to the 200 mm watermain in the Lake Line R.O.W.

The hydraulic grade line (HGL) for the watermain connection was calculated by adding the residual pressure (for each demand scenario) to the estimated elevation of watermain connection at Lake Line R.O.W., based on hydrant flow test done on January 18, 2021, and water demand calculations provided in Appendix B. These conditions were applied to review the available water supply in the analysis.

Hydraulic demand calculations were considered with the normal water usage of residential occupancy as per the municipality's IDGCS Section 5 and MECP DGDWS Section 3. The design parameters are presented in the Section 3.1 below.

3.1 Design Criteria

The design parameters outlined below are based on the Municipality's water design standards found in Section 5 of the IDGCS, dated June 2004, The City of St Thomas DGM, and Section 3 of the MECP DGDWS:

- An average demand of 400 L/person per day
- Low density residential of 3.5 persons per unit
- Minimum water pressures to be maintained in the distribution system of:
    - Minimum of 140 kPa (20 psi) at maximum day demand flow plus fire flow
    - Minimum of 275 kPa (40 psi) at maximum hourly demand flow
    - Minimum of 275 kPa (40 psi) at average day demand flow
- Maximum residual pressure in the distribution system should not exceed 700 kPa (100 psi)
- Peaking factors of 3.6 for maximum day and 5.4 for maximum hour
- Minimum 150mm diameter watermain size for systems designed to provide fire protection according to the City of St Thomas DGM.

- 1.5 m/s and 3 m/s maximum velocity during maximum hour domestic flow and fire flow conditions respectively (based on MECP DGDWS)
- Hazen Williams C factor of 100 for 150 mm and 110 for 200 mm diameter watermain according to section 5.4 of IDGCS

3.2 Design Software

The modeling software, EPANET V2, was used to calculate the hydraulic loads and aging of the system. In this case, the network consists of pipes, nodes (pipe junctions), and sources. EPANET calculates the flow rate and velocity of water in each pipe and the pressure at each node based on the total head at the connection points (source) and design demands assigned to select nodes. The network map with nodes and links (Water Distribution System Layout) is provided in Appendix C.

3.3 Design Assumption

The EPANET watermain maximum day plus fire flow conditions model was designed with a conservative approach analyzing only the most conservative scenario hydrant (Node H4) located furthest from the watermain source (Node 1). The assumption to this design was that the point furthest from the sources will produce the lowest pressure in the watermain during maximum day plus fire demand scenario. If the most conservative hydrant meets the pressure conditions, then the other proposed hydrants that are located closer to the source (Node 1) will have sufficient pressure.

3.4 Domestic Water Demand

Hydraulic demand calculations were considered with the normal water usage of residential occupancy as per municipality's IDGCS, Section 5, presented in the section 3.1 above. An average daily water demand for selected nodes was determined based on the number of units for each node, the low density residential (3.5 persons per unit), and the average day domestic (residential) demand per capita (400 L/person per day). Maximum day and maximum hour flows were determined by multiplying the average daily flow by the established peaking factors. The water demand calculations are provided in Appendix B.

3.5 Fire Flow Demand

Hydrant maximum separation of 150m in accordance with the municipality's IDGCS was used in the design. The proposed site servicing plan attached separately shows that the seven (7) hydrants proposed for the site are sufficient.

The fire-fighting demand was calculated in accordance with the Water Supply for Public Fire Protection (Fire Underwriters Survey). Refer to fire flow calculation in Appendix B for detailed information. The design parameters of the conceptual building area of 300 m^2 per dwelling (single family dwelling), wood-frame construction, and combustible fire hazard contents. Fire flow + max day flow rate of about 4,626 L/min was calculated. The calculations must be verified after flow tests to confirm available firefighting flow.

3.6 Project Design Results

The detailed EPANET results tables for average day, maximum hour, and maximum day plus fire flow demand scenarios are presented in Appendices D and E, respectively. The EPANET V2 modeling software output results

(Appendices D and E) show that the proposed water distribution system is in compliance with the municipality's IDGCS requirements for water supply, pressure in the system and MECP DGDWS requirements for velocities in the system.

The average day demand flow results presented in Appendix D show that the proposed water distribution system has a maximum pressure of 70.55 m (100.3 psi or 691.7 kPa) at Node J2, which is marginally less than 700 kPa as specified by MECP DGDWS. To address quality concerns, current standards dictate that water shall not remain unused in the watermain for more than 72 hours under average day demand. The results show that the maximum age of water in the watermain is 34.55 hours at Node J3, which is less than the 72 hours requirement.

The maximum hourly flow results presented in Appendix D show that the minimum pressure in the system is 65.48 m (93.1 psi or 642.0 kPa) at Node H1, which is greater than 275 kPa (40 psi) required by the Municipality's IDGCS. The maximum velocity during the maximum hour demand is 0.27 m/s at Link 1, which is less than the maximum velocity under maximum hourly flow scenario of 1.5 m/s required by MECP DGDWS.

The maximum day flow plus fire flow demand were calculated for the most conservative hydrant (Node H4). Result presented in Appendix E shows that the lowest pressure in the system is 28.22 m or 276.7 kPa (40.1 psi) at Node H4, which is higher than minimum required pressure of 140 kPa (20 psi) during maximum day demand plus fire flow as per the IDGCS. The maximum velocity in the system during the maximum day plus fire-flow demand is 2.45 m/s at Link 1, which is less than the maximum velocity of 3 m/s required by MECP DGDWS.

The maximum day plus fire flow scenario was modelled to determine the maximum flow that could be drawn from most conservative scenario hydrant at minimum of 20 psi throughout the proposed development. Result presented in Appendix E shows the most conservative scenario hydrant (Node H4) could provide a flow of 5,659.2 L/min (1,495.0 GPM) at 20psi. The above confirms that the other hydrants in the site will have a flow greater than 5,659.2 L/min (1,495.0 GPM) at 20psi. A proposed fire hydrant colour class table per NFPA 291 has been included in Table 1 for consideration. As these results are computed through modelling (EPANET V2), flow tests should be completed once the lands have been developed to confirm the hydrant colour coding that should be applied.

Hydrant	Flowrate @ 20 psi	Class	Colour
Hydrant Node H4	5,659.2 L/min (1,495.0 GPM)	Class AA	Light Blue

Table 1: Hydrant Colour Class Table

4 STORM SERVICING AND STORMWATER MANAGEMENT

4.1 Storm Servicing

Under pre-development conditions, there are no existing storm sewers on site. According to the Marr Drain plan and details by Spriet Associates, dated May 23, 1991, provided in Appendix F, the Marr Drain passes through the subject site and advances southeast of the subject site towards the open-channel portion of the Marr Drain. Under post-development conditions, a storm sewer system will be installed to collect and convey minor runoff (2-year storm) from the subject site to a proposed stormwater management (SWM) dry pond located southeast of the subject site. Minor storm (5-year) and major storm (100-year) runoff flows will be conveyed to the proposed SWM pond by site grading. The portion of the Marr Drain located within the site will be removed and

relocated to the servicing easement behind lots 47-53. The proposed SWM dry pond will discharge flows to the downstream open channel portion of the Marr Drain.

The site was divided into twenty-four storm catchments areas (A201 to A222, U201, and U202). The proposed site collects flows from external areas and discharges to the open channel portion of the Marr Drain located southeast of the site. Therefore, external areas (Ext201 to Ext203) will discharge minor and major storm flows through the site's storm sewer system and overland flow route, see Storm Catchment Areas Plan Sheet 5 provided separately. The storm sewer design sheet (Sheet 6 provided separately) shows that the proposed storm sewers at the proposed sizes and slopes have sufficient capacity to convey the proposed sites and external lands' minor flows (2-year storm) to the proposed SWM dry pond.

The major flows from the subject site and external lands will be safely conveyed by site grading to the overland flow routes (Blocks 91, 92 and 93) and discharge to the SWM dry pond. See Subdivision Grading Plan Sheets 10A – 10C provided separately. For the storm servicing drawings and additional information, refer to the Site Master Servicing Plan (Sheet 4), Storm Sewer Catchment Area Plan & Design Sheet (Sheets 5 and 6), and Site Grading Plan (Sheet 10A-10C), provided separately.

4.2 Stormwater Management

4.2.1. Rainfall Information

SBM compared the Chicago distribution derived from the IDF values found in the City of St Thomas Design Standard to the City of London Chicago distribution. Comparison showed that the Chicago distribution derived from the IDF values found in the City of St Thomas Design Standard, produced half the rainfall as City of London Chicago distribution, which does not seem appropriate due to the proximity of the 2 cities.

The Chicago distribution on Table 2 was derived from the Intensity-Duration-Frequency (IDF) Parameters obtained from Environment and Climate Change Canada Rain Gauge Information dated 27th of February 2019 for The St Thomas WPCP ID ON_6137362 (Table 2b) from 1926 - 2007 provided in Appendix F, which shows similar rainfall to the City of London.

The Intensity from Table 2b of the above rain gauge information was inputted in Miduss IDF Curve Fit tools (as shown in Miduss IDF to Chicago Conversion) to produce the Chicago Distribution parameters. The St Thomas WPCP Chicago Rainfall Distribution Parameters are shown in Table 2 below:

Return Period (Years)	Parameters		
	a	b	c
2	737.970	7.382	0.8035
5	1009.820	7.472	0.8055
10	1178.220	7.382	0.8049
25	1398.350	7.382	0.8048
50	1497.170	6.876	0.7978
100	1634.380	6.798	0.7954

Table 2: St Thomas WPCP Chicago Distribution from MIDUSS IDF Curve Fit Tools

As storm data for the St Thomas WPCP ID ON_6137362 was limited to the 100-year storm, the 250-year storm from the City of London was additionally analyzed to understand how the system preformed under more severe storm events. Rainfall intensity duration frequency (IDF) storm parameters for the City of London 250-year event were obtained from the City of London 2019 Design Specifications and Requirements Manual and are based on the Environment and Climate Change Canada February 2019 IDF update.

The City of London 250-year event Rainfall Distribution Parameters are shown in Table 3 below:

Return Period (Years)	Parameters		
	a	b	c
250 (City of London)	3048.220	10.030	0.8880

Table 3: City of London Rainfall Distribution Parameters

Hyetographs for the 2 to 250-year rainfall events were created using the MTO DMM and provided in Appendix F. The time and intensity values obtained from the hyetographs were inputted into the stormwater management model.

4.2.2. EPASWMM5.1 Pre-Development Modelling

Environmental Protection Agency Storm Water Management Model version 5.1 (EPASWMM5.1) software was used for stormwater quantity modelling. Under pre-development conditions, the site was shown as three (3) catchment areas. External area Ext101 was also modelled to discharge flows to the open channel portion of the Marr Drain. These areas are shown on Sheet 3 of the engineering drawings provided separately. The sub-catchment parameters are shown in the pre-development sub-catchment parameter table (Table 1) of the SWM calculation provided in Appendix F.

From the sub-catchment parameter table, the flow length is the approximate distance from the highest to the lowest point of a sub-catchment. The percent impervious was obtained by converting the runoff coefficient value for each sub-catchment. The manning's n coefficient and depression storage values were obtained from the Storm Water Management Model User's Manual Version 5.1 (SWMMUM), and the CN numbers were obtained from A.4 of Storm Water Management Model User's Manual Version 5.1 with an average hydrologic soil group of C for the entire site as confirmed by EXP geotechnical engineers via email dated July 5, 2021. The sub-catchment parameters were inputted into the EPASWMM5.1 pre-development condition model.

The existing condition model contains 1 outfall, matching the existing condition runoff outlet resulting from the existing site topography. The peak runoff from the outfall for each rainfall event is tabulated in Table 3 of the SWM calculations provided in Appendix F.

The EPASWMM5.1 pre-development model layout provided in Appendix G shows the sub-catchment and the associated outlet and outfall. The modelling results for each rainfall event are also provided in Appendix G.

4.2.3. EPASWMM5.1 Post-Development Modelling

EPASWMM5.1 modelling software was used to quantify post-development runoff into the SWM dry pond and orifice flow controls were used to discharge to the open channel portion of the Marr Drain located southeast of the site to match pre-development flow rates. This model was used to verify that post-development flow rates and volumes did not exceed the allowable values for all outlets, and to calculate the required SWM dry pond storage and restricted flow rates. The post-development model was produced according to the Storm Catchment Area Plans by SBM Sheet 5, which were also used for the catchment area identification numbers. As previously mentioned, the stormwater management quantity objective for the site is to attenuate the post-development flows to the pre-development levels. Catchment parameters have been provided in Table 2 of the SWM calculation provided in Appendix F.

The EPASWMM5.1 post-development model layout provided in Appendix H shows each sub-catchment and the associated outlet and outfall. The post-development modelling results for each rainfall event are also provided in Appendix H.

The minor (5-Year Storm) and major (100-Year Storm) flows will be discharged through the two orifices located within the SWM dry pond outlet structure. The orifices have been designed to restrict the 5 to 100-year post-development flows to the pre-development levels. A weir has been provided to outlet excess runoff during major storm event (greater than the 100-year storm). A minimum 0.3m freeboard has been provided between the weir elevation and the lowest elevation between the SWM pond and the abutting Lots. As shown in the Table 3 of the SWM Calculations, sufficient storage is provided in the proposed SWM dry pond to meet the SWM objectives for this site. As shown on the engineering drawings provided separately, road accesses to the pond are proposed for cleaning and maintenance of the pond.

A homeowner information package has been provided in Appendix F of this brief to explain to homeowners that altering of the proposed grading and swales as well as blocking proposed rear yard catch basins (RYCB's) could cause serious flooding.

4.3 Quality Control

It is proposed to install an Oil and Grit Separator (OGS) CDS 4030 upstream of the SWM dry pond to provide at least 70% TSS removal for the subject site in accordance with Table 3.2 of the MECP SWMP&DM for a "normal" protection level. See Appendix F for all details and calculations for the CDS 4030 Stormwater Treatment Unit. Stormwater Treatment Unit Operation & Maintenance Manual is provided in Appendix F. OGS inspection and maintenance schedule is recommended to be maintained by the Contractor during construction and by the owner after construction as it is the owner's responsibility to maintain these devices in accordance with current standards and policies.

5 SEDIMENT AND EROSION CONTROL MEASURES

Complementary to the site servicing and grading design for the site, sediment and erosion control details and notes have been included with the Site Engineering design. This should alleviate the off-site migration of sediments by incorporation of various best management practices and control measures. Such controls may include but are not limited to silt fencing, silt sacks for inlet grate protection (catch basins, and catch basin maintenance holes), tree preservation fencing and erosion control blanket treatment of significant fill/cut slopes. Suitable precautions should be undertaken in maintaining and monitoring these controls during the construction phase. The control measures to be implemented on site should include:

- Protect all exposed surfaces and control all runoff during construction;
- Sediment and erosion control measures to be removed at completion of project (following completion of base asphalt and sod);
- Maintain erosion control measures during construction;
- All collected sediment to be disposed of at an approved location;
- Minimize area disturbed during construction;
- All dewatering to be disposed of in an approved sedimentation basin;
- Protect all catch basins, maintenance holes and pipe ends from sediment intrusion with geotextile fabric (Terrafix 270R), silt sacks, or approved equal;
- Keep all sumps clean during construction;
- Prevent wind-blown dust;
- Straw bales to be used in localized areas as directed by the engineer during construction for works which are in or adjacent to flood lines, fill lines and hazardous slopes;
- Straw bales to be terminated by rounding bales to contain and filter runoff;
- Contractor to supply sediment erosion control measures and emergency plan (including emergency contacts) in case of SEC measures failure, extreme weather conditions, or spills. Any spills are to be reported to the MECP at 1-866-6638477 toll free;
- Sediment and Erosion Control measures shall be repaired without delay by the owner's contractor as instructed by the contract administrator/engineer at no expense to the owner
- On-site sediment and erosion control measures are to be reviewed and modified to meet the changing site;
- Sediment and Erosion Control measures are to be inspected weekly or following significant rainfall events;
- Obtain approval from the governing Conservation Authority prior to construction for works which are in, or adjacent to flood lines, fill lines and hazardous slopes; and
- All of the above notes and any sediment and erosion control measures are at the minimum to be in accordance with the ministry of natural resources guidelines on sediment and erosion control for urban construction sites.
- Sediment and erosion control measures to be removed at completion of project (following completion of base asphalt and sod).

The above noted items have also been placed on the Engineering Drawing Sheet 3 under the Sediment & Erosion Control Measures for reference on-site. Sediment trap capacity calculations have been provided in Appendix I to show the capacity of proposed sediment traps to accept dewatering as well as surface stormwater with potential sediment load.

6 LIMITATIONS

This report was prepared by Strik, Baldinelli, Moniz Ltd. for Strathroy Turf farms Inc. and the Corporation of the Municipality of Central Elgin. Use of this report by any third party, or any reliance upon its findings, is solely the responsibility of that party. Strik, Baldinelli, Moniz Ltd. accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions undertaken as a result of this report. Third party use of this report, without the express written consent of the Consultant, denies any claims, whether in contract, tort, and/or any other cause of action in law, against the Consultant.

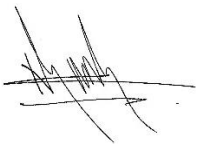
All findings and conclusions presented in this report are based on site conditions as they appeared during the period of the investigation. This report is not intended to be exhaustive in scope, or to imply a risk-free facility. It should be recognized that the passage of time may alter the designs, opinions, conclusions, and/or recommendations provided herein.
The design was limited to the documents referenced herein and on the SBM drawings provided separately. SBM Ltd. accepts no responsibility for the accuracy of the information provided by others. All designs, opinions, conclusions, and/or recommendations presented in this report are based on the information available at the time of the review.

7 CLOSURE

We trust this report meets your satisfaction and current needs. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Respectfully submitted,

Strik, Baldinelli, Moniz Ltd.
Planning • Civil • Structural • Mechanical • Electrical

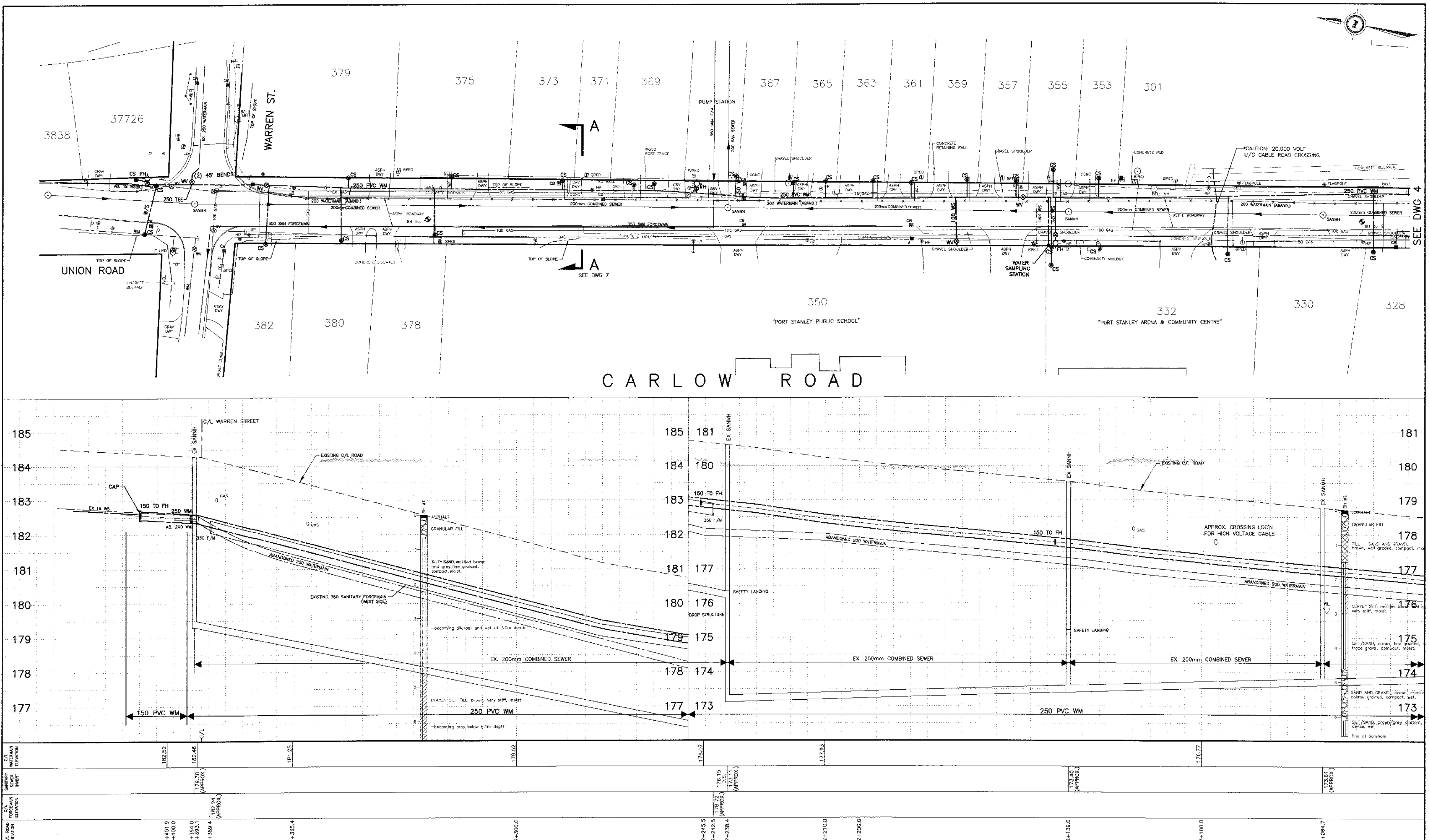


Nelson Guiot, P.Eng. Associate II
Eng. IV, Civil Department Manager

Kurtis Caron, EIT
Civil Engineer in Training II

APPENDIX A

Carlow Road Watermain Replacement As-Constructed Drawing – Phase 1 Drawing



EXISTING SERVICES	DRAWING #, SOURCE	DATE	AS CONSTRUCTED SERVICES	COMPLETION

DETAILS	
DESIGN	PAM
DRAWN BY	SGS
CHECKED	DOC
APPROVED	PAM
DATE	JUL/10

No.	REVISIONS	DATE	CONSULTANT
1	SUBMITTED FOR REVIEW	14/SEP/10	AECOM
2	ISSUED FOR TENDER	21/SEP/10	AECOM
3	ISSUED FOR TENDER	16/FEB/11	AECOM
4	AS CONSTRUCTED	FEB/2012	AECOM

AECOM

London, Ontario 519.673.0510

ENGINEER'S STAMP

The Corporation of the Municipality of Central Elgin

SCALE
HORZ 1:500
VERT 1:50

TITLE
CARLOW ROAD WATERMAIN REPLACEMENT – PHASE 1
MUNICIPALITY OF CENTRAL ELGIN

CARLOW ROAD

STA 2+050 TO 2+430

PROJECT No. 60157539

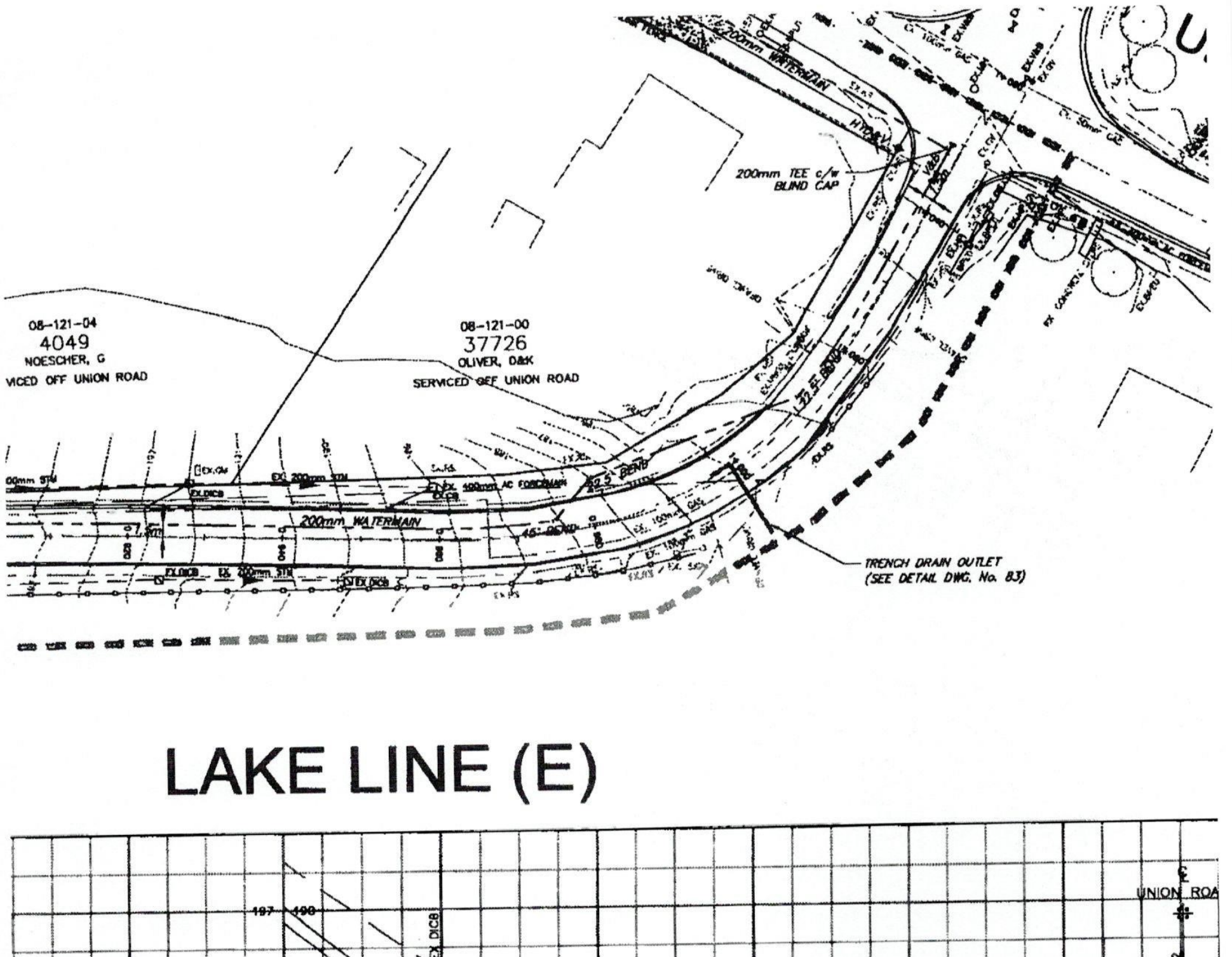
SHEET No. 3

PLAN FILE No.

APPENDIX B

Scan Showing Watermain Information in The Lake Line R.O.W
Hydrant Flow Test
Water Demand Calculations (Average Day, Max. Hour and Max. Day plus Fire flow)
Average Day and Max. Hour HGL Calculations
Fire Flow Calculation

LAKE LINE (E)


08-121-04
4049
NOESCHER, G
VICED OFF UNION ROAD
08-121-00
37726
OLIVER, D&K
SERVICED OFF UNION ROAD
200mm WATERMAIN
200mm TEE c/w BLIND CAP
EX DICB
EX 200mm STM
EX 400mm AC FORCEMAIN
22.5° BEND
45° BEND
TRENCH DRAIN OUTLET
(SEE DETAIL DWG. No. 83)
EX GROUND @ ℄ ROAD
UNION ROA
EX 400mm AC FORCEMAIN
EX 90° BEND
200x150mm TEE
c/w BLIND CAP

Central Elgin (Port Stanley) Hydrant Flow Test Report

Date: 18-Jan-21 Time: 11;12 AM Operator: Lucas/Hodder

Test Hydrant Information:

Number: 1 Elevation: n/a

N.F.P.A. Colour Code: BLUE Location: 3830 Union Road

STATIC PRESSURE: 90 psi Hyd# 1

RESIDUAL PRESSURE: 76 psi

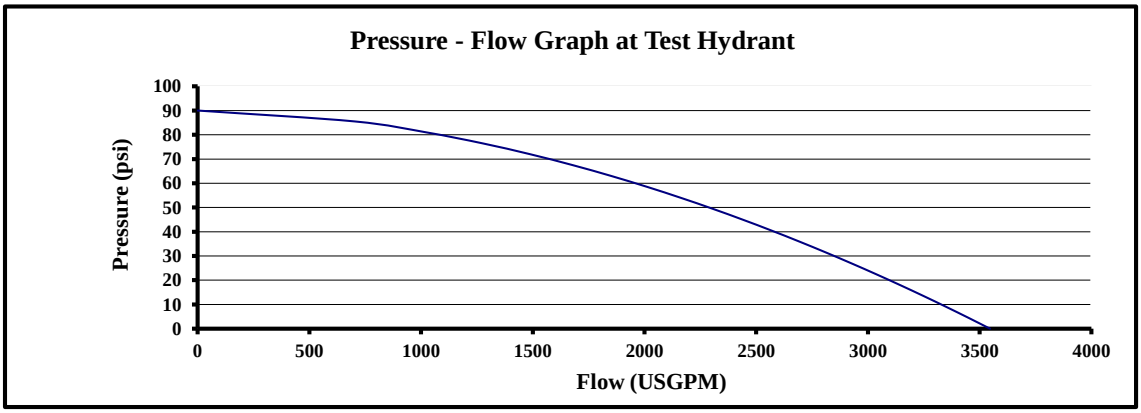
HPR S/N: 1199

Flow Hydrants Information:

Hydrant No.	HPR No.	Outlet Dia. (in.)	Coefficient (~0.9)	Pitot Gauge Reading (psi)	Flow (USGPM)
#1	n/a	2.5	0.9	60	1298
				Total Flow (USGPM)	1298

Available Flow At Test Hydrant at 20 psi 3096 USGPM 2559 IGPM

Available Flow At Test Hydrant at 10 psi 3328 USGPM 2750 IGPM



Comments/Discrepencies/Diagram:

Fire Hydrant is located at northeast corner of Carlow Road & Warren Street

*NOTE: Graph updated by SBM to show Flow on X axis and Pressure on Y axis.

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(519) 659-1144

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KITCHENER LOCATION
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Kitchener, ON N2R 0L3
P: 519-725-8093

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sbm@sbmltd.ca

DOMESTIC WATER DEMAND CALCULATION

	For data entry
	Calculated, not for data entry

DATE:	July 13, 2021
JOB No.:	SBM-18-0530

Client:	**Strathroy Turf Farms Ltd.**
Project:	**Kettle Creek Subdivision**
Location:	**37719 Lake Line, Port Stanley, Ontario**

Values as per MECP Design Guidelines for Drinking Water System (DGDWS) and Central Elgin Infrastructure Design Guidelines and Construction Standards (IDGCS)

Avg. Residential Day Demand = 400 L/D/cap =	0.00462963	L/s/cap	As per Chapter 5.2.2 of IDGCS
Max. Day Peaking Factor =	3.6		As per Table 3-3 of MECP DGDWS
Max. Hour Peaking Factor =	5.4		As per Table 3-3 of MECP DGDWS
Residential Population Density =	3.5	ppl/unit	As per Chapter 4.2.1 A of IDGCS

Note: Peaking Factors from MECP DGDWS was used as per Section 5.2.2 of IDGCS

Domestic Water Demand

Node	Units	Population	Avg. Day (L/s)	Max. Hour (L/s)	Max. Day (L/s)
1 - Source 1	0	0	0.000	0.000	0.000
2 - Units 46-53	8	28	0.130	0.700	0.467
3 - Units 1-9 & 54-61	17	60	0.275	1.488	0.992
4 - Units 10-17 & 62-65	12	42	0.194	1.050	0.700
5 - Unit 18-23 & 66-70	11	39	0.178	0.963	0.642
6 - Units 24-28 & 71-72	7	25	0.113	0.613	0.408
7 - Units 29-36 & 86-88	11	39	0.178	0.963	0.642
8 - Units 37-45	9	32	0.146	0.788	0.525
9 - Units 78-81 (Semi-Detached) & 82-85	12	42	0.194	1.050	0.700
10 - Units 73-77 (Semi-Detached)	10	35	0.162	0.875	0.583
TOTAL:	97	340	1.572	8.488	5.658

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Average Day and Max Hour HGL

	For data entry
	Calculated, not for data entry

DATE:	July 13, 2021
JOB N0.:	SBM-18-0530

Client:	**Strathroy Turf Farms Ltd.**
Project:	**Kettle Creek Subdivision**
Location:	**37719 Lake Line, Port Stanley, Ontario**

Average Day Demand (L/s) = 1.57
Average Day Demand (L/min) = 94.31

Max Hour Demand (L/s) = 8.49
Max Hour Demand (L/min) = 509.25

Average Day Pressures

	90.00	*psi (620.53 kPa) =	**0**	*L/min (0 USGPM)
Provided Supply Flow Rate @	**20.00**	*psi (137.9 kPa) =	**11719.6**	*L/min (3096 USGPM)
Using linear interpolation, residual pressure at required flow=	**89.44**	psi (616.64 kPa) =	**94**	L/min (25 USGPM)

Pressure @ Average Day Demand = 89.44 psi
Pressure @ Average Day Demand = 62.90 m head of water

Approximate Watermain Elevation @ Node 1 (Lake Line) Connection: 186.39 m

Approximate HGL Elevation @ Node 1 (Lake Line) Connection: 249.29 m

Max Hour Pressures

	90.00	*psi (620.53 kPa) =	**0**	*L/min (0 USGPM)
Provided Supply Flow Rate @	**20.00**	*psi (137.9 kPa) =	**11720**	*L/min (3096 USGPM)
Using linear interpolation, residual pressure at required flow=	**86.96**	psi (599.56 kPa) =	**509**	L/min (135 USGPM)

Pressure @ Max Hour Demand = 86.96 psi
Pressure @ Max Hour Demand = 61.15 m head of water

Approximate Watermain Elevation @ Node 1 (Lake Line) Connection: 186.39 m

Approximate HGL Elevation @ Node 1 (Lake Line) Connection: 247.54 m

*Refer to the Provided Hydrant Flow Tests by Hetek Solutions Inc. Dated January 18, 2021

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Kitchener, ON N2R 0L3
P: 519-725-8093

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sbm@sbmltd.ca

Water Supply for Public Fire Protection (Fire Underwriters Survey)

	For data entry
	Calculated, not for data entry

DATE:	July 13, 2021
JOB N0.:	SBM-18-0530

Client:	**Strathroy Turf Farms Ltd.**
Project:	**Kettle Creek Subdivision**
Location:	**37719 Lake Line, Port Stanley, Ontario**

$$F = 220 \times C \times \sqrt{A}$$

Type of Construction:	**Wood-Frame**		**1.5**
Fire Hazard of Contents:	**Combustible**		**1.00**
Total Floor Area, m^2 :			**300.00**
Sprinklered:	**No**		**1.0**
Separation, Side 1:	**0 to 3m**	25%	
Separation, Side 2:	**0 to 3m**	25%	
Separation, Side 3:	**20.1 to 30m**	15%	
Separation, Side 4:	**20.1 to 30m**	15%	
Sum of Separation Coefficients (Shall Not Exceed 75%:)			**75%**

F, L/min (Shall not exceed 45,000 L/min or be less than 2,000 L/min)=	**4287**	**L/min**
Maximum Day Demand=	**339**	**L/min**
Required Supply Flow Rate, L/min =	4626	

Provided Supply Flow Rate @	**90.00**	psi* =	**0**	L/min*
	20.00	psi* =	**11720.0**	L/min*
Using linear interpolation, residual pressure at hydrant =	**62.37**	@	**4626**	L/min

Pressure @ Max Hour Demand = 62.37 psi
Pressure @ Max Hour Demand = 43.86 m head of water

Approximate Watermain Elevation @ Node 1 (Lake Line) Connection: 186.39

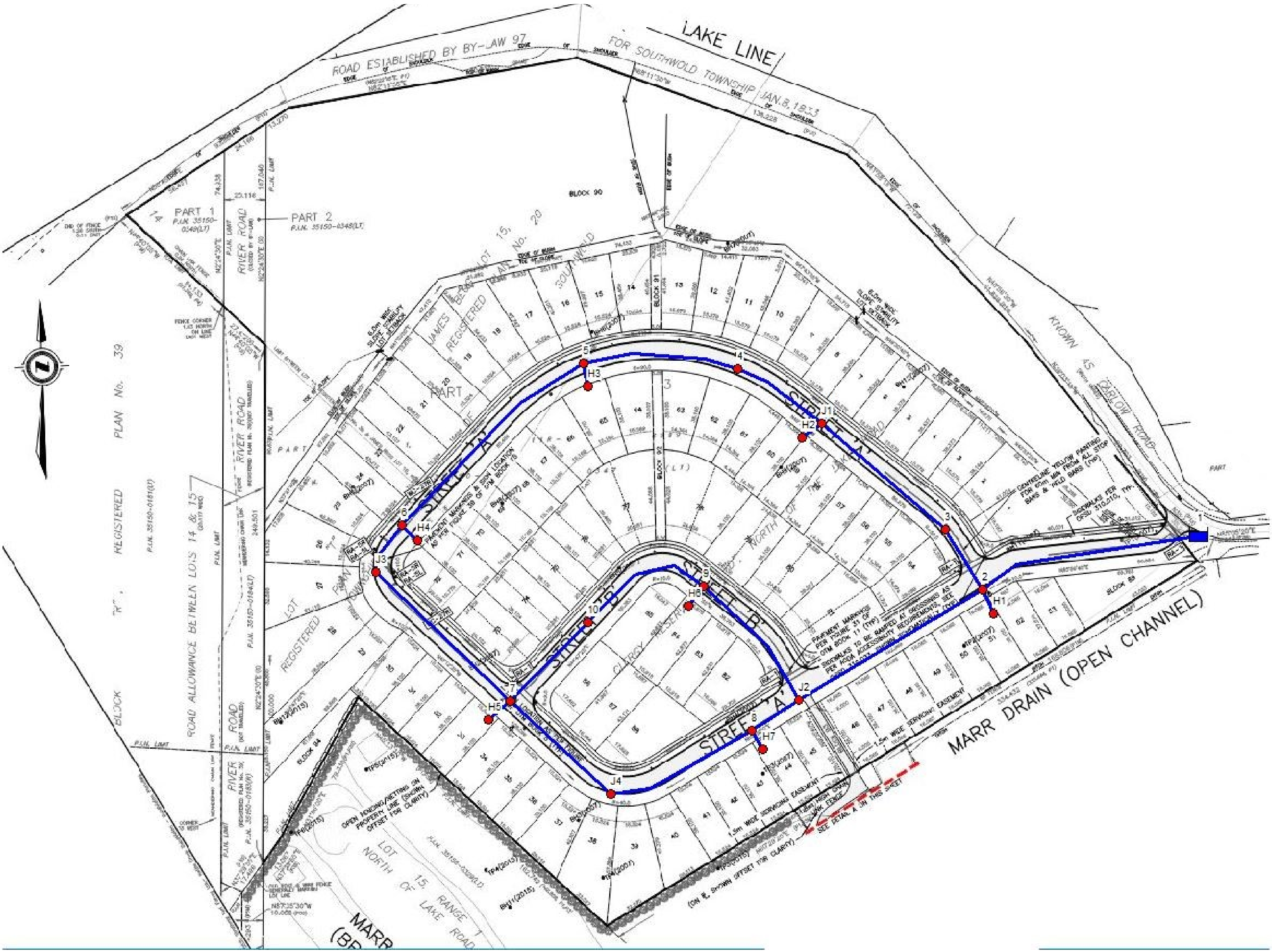
Approximate HGL Elevation @ Node 1 (Lake Line) Connection: 230.25

*Refer to the Provided Hydrant Flow Tests by Hetek Solution Dated January 18, 2021

APPENDIX C

Water Distribution System Layout

WATER DISTRIBUTION SYSTEM LAYOUT



APPENDIX D

EPANET V2 Documentation - Average Day and Maximum Hour Demand Results

```
**************************************************************************
*                            E P A N E T                                 *
*                     Hydraulic and Water Quality                        *
*                     Analysis for Pipe Networks                         *
*                          Version 2.0                                   *
**************************************************************************
```

Input File: Averageday.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
2	2	J2	101.62	150
3	J2	8	21.87	150
4	8	J4	61.73	150
5	J4	7	79.58	150
6	7	J3	87.89	150
8	J3	6	101.07	150
9	6	5	118.84	150
10	5	4	63.37	150
11	4	J1	47.68	150
12	J1	3	70.44	150
13	3	2	45.63	150
14	J2	9	74.34	150
16	2	H1	5	150
17	J1	H2	5	150
18	5	H3	5	150
19	6	H4	5	150
20	7	H5	5	150
21	9	H6	5	150
22	8	H7	5	150
23	9	10	60.24	150
24	10	7	59.48	150
1	1	2	119.51	200

Node Results:

Node ID	Demand LPS	Head m	Pressure m	Quality hours
2	0.13	249.29	67.53	0.66
3	0.28	249.28	68.41	0.96
4	0.19	249.28	69.81	2.20
5	0.18	249.28	69.90	3.32
H3	0.00	249.28	69.82	72.00
J1	0.00	249.28	69.57	1.70
H2	0.00	249.28	69.48	72.00
H1	0.00	249.29	67.31	72.00
8	0.15	249.28	70.44	1.68

FF

Node Results: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality hours
H7	0.00	249.28	70.35	72.00
J2	0.00	249.28	70.55	1.38
9	0.19	249.28	70.36	2.47
H6	0.00	249.28	70.27	72.00
7	0.18	249.28	69.91	4.93
H5	0.00	249.28	69.81	72.00
6	0.11	249.28	69.31	16.90

H4	0.00	249.28	69.22	72.00	
J4	0.00	249.28	70.12	3.10	
J3	0.00	249.28	69.47	34.55	
10	0.16	249.28	70.27	6.42	
1	-1.57	249.29	0.00	0.00	Reservoir

Link Results:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
2	0.69	0.04	0.03	Open
3	0.36	0.02	0.01	Open
4	0.21	0.01	0.00	Open
5	0.21	0.01	0.00	Open
6	0.01	0.00	0.00	Open
8	0.01	0.00	0.00	Open
9	-0.10	0.01	0.00	Open
10	-0.28	0.02	0.01	Open
11	-0.47	0.03	0.01	Open
12	-0.47	0.03	0.02	Open
13	-0.75	0.04	0.04	Open
14	0.34	0.02	0.01	Open
16	0.00	0.00	0.00	Open
17	0.00	0.00	0.00	Open
18	0.00	0.00	0.00	Open
19	0.00	0.00	0.00	Open
20	0.00	0.00	0.00	Open
21	0.00	0.00	0.00	Open
22	0.00	0.00	0.00	Open
23	0.14	0.01	0.00	Open
24	-0.02	0.00	0.00	Open
1	1.57	0.05	0.03	Open

```
**************************************************************************
*                            E P A N E T                                 *
*                     Hydraulic and Water Quality                        *
*                     Analysis for Pipe Networks                         *
*                          Version 2.0                                   *
**************************************************************************
```

Input File: Maximum Hour.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
2	2	J2	101.62	150
3	J2	8	21.87	150
4	8	J4	61.73	150
5	J4	7	79.58	150
6	7	J3	87.89	150
8	J3	6	101.07	150
9	6	5	118.84	150
10	5	4	63.37	150
11	4	J1	47.68	150
12	J1	3	70.44	150
13	3	2	45.63	150
14	J2	9	74.34	150
16	2	H1	5	150
17	J1	H2	5	150
18	5	H3	5	150
19	6	H4	5	150
20	7	H5	5	150
21	9	H6	5	150
22	8	H7	5	150
23	9	10	60.24	150
24	10	7	59.48	150
1	1	2	119.51	200

Node Results:

Node ID	Demand LPS	Head m	Pressure m	Quality hours
2	0.70	247.46	65.70	0.12
3	1.49	247.43	66.56	0.21
4	1.05	247.39	67.92	0.43
5	0.96	247.38	68.00	0.64
H3	0.00	247.38	67.92	72.00
J1	0.00	247.40	67.69	0.34
H2	0.00	247.40	67.60	72.00
H1	0.00	247.46	65.48	72.00
8	0.79	247.39	68.55	0.34

FF

Node Results: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality hours
H7	0.00	247.39	68.46	72.00
J2	0.00	247.39	68.66	0.26
9	1.05	247.38	68.46	0.46
H6	0.00	247.38	68.37	72.00
7	0.96	247.38	68.01	0.94
H5	0.00	247.38	67.91	72.00
6	0.61	247.38	67.41	3.16

H4	0.00	247.38	67.32	72.00	
J4	0.00	247.38	68.22	0.60	
J3	0.00	247.38	67.57	6.43	
10	0.87	247.38	68.37	1.19	
1	-8.48	247.54	0.00	0.00	Reservoir

Link Results:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
2	3.75	0.21	0.70	Open
3	1.94	0.11	0.21	Open
4	1.15	0.07	0.08	Open
5	1.15	0.07	0.08	Open
6	0.08	0.00	0.00	Open
8	0.08	0.00	0.00	Open
9	-0.53	0.03	0.02	Open
10	-1.49	0.08	0.13	Open
11	-2.54	0.14	0.34	Open
12	-2.54	0.14	0.34	Open
13	-4.03	0.23	0.80	Open
14	1.81	0.10	0.18	Open
16	0.00	0.00	0.00	Open
17	0.00	0.00	0.00	Open
18	0.00	0.00	0.00	Open
19	0.00	0.00	0.00	Open
20	0.00	0.00	0.00	Open
21	0.00	0.00	0.00	Open
22	0.00	0.00	0.00	Open
23	0.76	0.04	0.04	Open
24	-0.11	0.01	0.00	Open
1	8.48	0.27	0.65	Open

APPENDIX E

EPANET V2 Documentation - Maximum Day Plus Fire Demand Results
Maximum Day Plus Fire Demand @ 20psi

```
**************************************************************************
*                            E P A N E T                                 *
*                     Hydraulic and Water Quality                        *
*                     Analysis for Pipe Networks                         *
*                          Version 2.0                                   *
**************************************************************************
```

Input File: Maximum Day + Fire Flow @ 20psi.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
2	2	J2	101.62	150
3	J2	8	21.87	150
4	8	J4	61.73	150
5	J4	7	79.58	150
6	7	J3	87.89	150
8	J3	6	101.07	150
9	6	5	118.84	150
10	5	4	63.37	150
11	4	J1	47.68	150
12	J1	3	70.44	150
13	3	2	45.63	150
14	J2	9	74.34	150
16	2	H1	5	150
17	J1	H2	5	150
18	5	H3	5	150
19	6	H4	5	150
20	7	H5	5	150
21	9	H6	5	150
22	8	H7	5	150
23	9	10	60.24	150
24	10	7	59.48	150
1	1	2	119.51	200

Node Results:

Node ID	Demand LPS	Head m	Pressure m	Quality hours
2	0.47	222.71	40.95	0.08
3	0.99	218.92	38.05	0.17
4	0.70	209.47	30.00	0.33
5	0.64	204.53	25.15	0.42
H3	0.00	204.53	25.07	72.00
J1	0.00	213.28	33.57	0.25
H2	0.00	213.28	33.48	72.00
H1	0.00	222.71	40.73	72.00
8	0.53	213.55	34.71	0.25

FF

Node Results: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality hours
H7	0.00	213.55	34.62	72.00
J2	0.00	214.10	35.37	0.17
9	0.70	212.49	33.57	0.25
H6	0.00	212.49	33.48	72.00
7	0.64	210.09	30.72	0.42
H5	0.00	210.09	30.62	72.00
6	0.41	195.50	15.53	0.54

H4	94.32	194.13	14.07	0.63	
J4	0.00	212.04	32.88	0.33	
J3	0.00	203.31	23.50	0.50	
10	0.58	211.26	32.25	0.33	
1	-99.97	230.25	0.00	0.00	Reservoir

Link Results:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
2	50.02	2.83	84.74	Open
3	26.08	1.48	25.37	Open
4	25.55	1.45	24.43	Open
5	25.55	1.45	24.43	Open
6	47.57	2.69	77.22	Open
8	47.57	2.69	77.22	Open
9	-47.16	2.67	75.98	Open
10	-47.80	2.70	77.90	Open
11	-48.50	2.74	80.02	Open
12	-48.50	2.74	80.02	Open
13	-49.49	2.80	83.07	Open
14	23.94	1.35	21.65	Open
16	0.00	0.00	0.00	Open
17	0.00	0.00	0.00	Open
18	0.00	0.00	0.00	Open
19	94.32	5.34	274.32	Open
20	0.00	0.00	0.00	Open
21	0.00	0.00	0.00	Open
22	0.00	0.00	0.00	Open
23	23.24	1.32	20.49	Open
24	22.66	1.28	19.55	Open
1	99.97	3.18	63.07	Open

```
*************************************************************************
*                            E P A N E T                                *
*                     Hydraulic and Water Quality                       *
*                     Analysis for Pipe Networks                        *
*                          Version 2.0                                  *
*************************************************************************
```

Input File: Maximum Day + Fire Flow.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
2	2	J2	101.62	150
3	J2	8	21.87	150
4	8	J4	61.73	150
5	J4	7	79.58	150
6	7	J3	87.89	150
8	J3	6	101.07	150
9	6	5	118.84	150
10	5	4	63.37	150
11	4	J1	47.68	150
12	J1	3	70.44	150
13	3	2	45.63	150
14	J2	9	74.34	150
16	2	H1	5	150
17	J1	H2	5	150
18	5	H3	5	150
19	6	H4	5	150
20	7	H5	5	150
21	9	H6	5	150
22	8	H7	5	150
23	9	10	60.24	150
24	10	7	59.48	150
1	1	2	119.51	200

Node Results:

Node ID	Demand LPS	Head m	Pressure m	Quality hours
2	0.47	225.59	43.83	0.08
3	0.99	223.25	42.38	0.17
4	0.70	217.49	38.02	0.33
5	0.64	214.51	35.13	0.42
H3	0.00	214.51	35.05	72.00
J1	0.00	219.82	40.11	0.25
H2	0.00	219.82	40.02	72.00
H1	0.00	225.59	43.61	72.00
8	0.53	219.94	41.10	0.25

FF

Node Results: (continued)

Node ID	Demand LPS	Head m	Pressure m	Quality hours
H7	0.00	219.94	41.01	72.00
J2	0.00	220.28	41.55	0.17
9	0.70	219.29	40.37	0.25
H6	0.00	219.29	40.28	72.00
7	0.64	217.84	38.47	0.42
H5	0.00	217.84	38.37	72.00
6	0.41	209.10	29.13	0.54

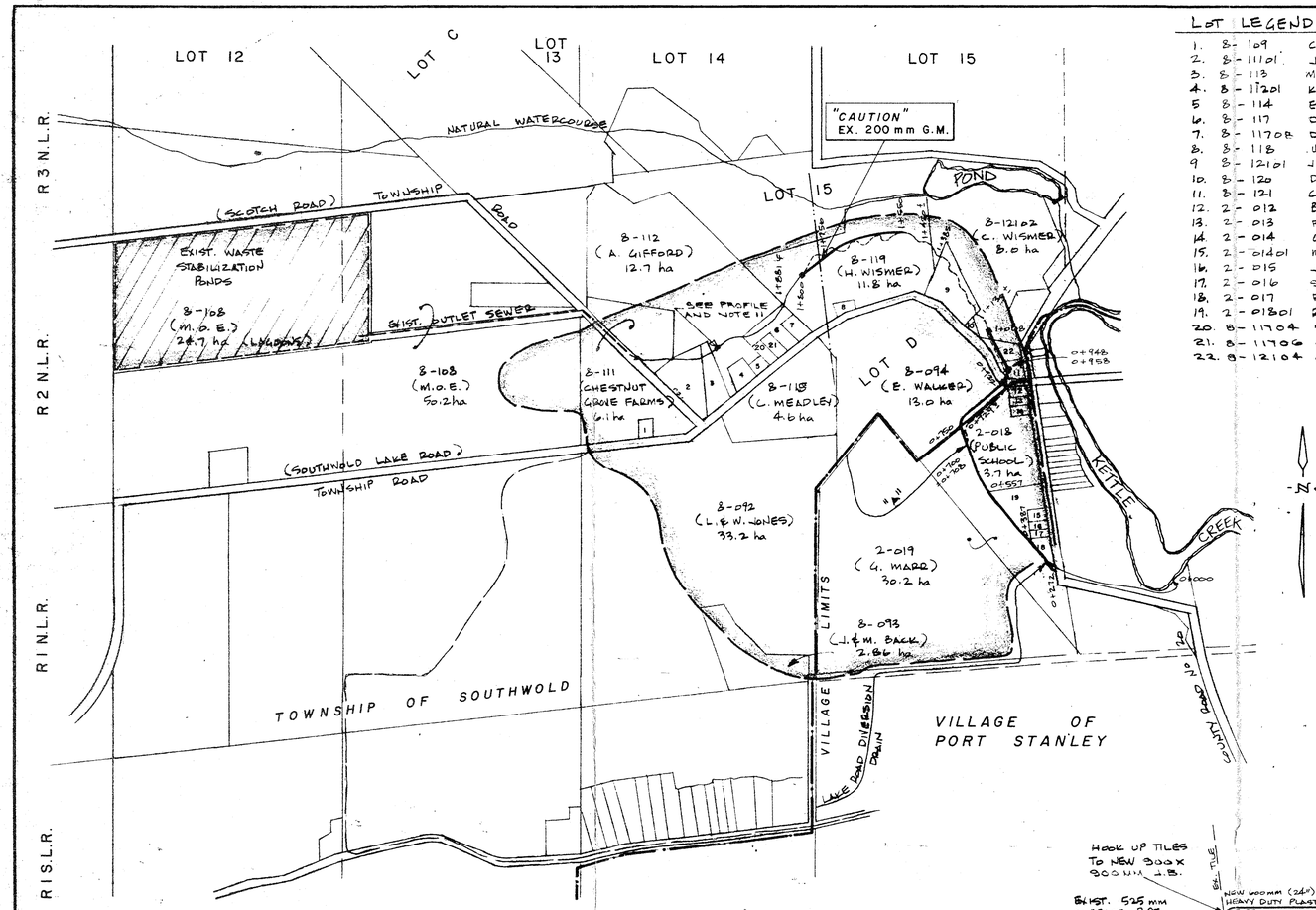
H4	71.45	208.28	28.22	0.63	
J4	0.00	219.02	39.86	0.33	
J3	0.00	213.77	33.96	0.50	
10	0.58	218.54	39.53	0.33	
1	-77.10	230.25	0.00	0.00	Reservoir

Link Results:

Link ID	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
2	38.53	2.18	52.25	Open
3	20.06	1.14	15.61	Open
4	19.54	1.11	14.86	Open
5	19.54	1.11	14.86	Open
6	36.08	2.04	46.27	Open
8	36.08	2.04	46.27	Open
9	-35.78	2.02	45.56	Open
10	-36.42	2.06	47.08	Open
11	-37.12	2.10	48.77	Open
12	-37.12	2.10	48.77	Open
13	-38.11	2.16	51.20	Open
14	18.46	1.04	13.38	Open
16	0.00	0.00	0.00	Open
17	0.00	0.00	0.00	Open
18	0.00	0.00	0.00	Open
19	71.45	4.04	164.02	Open
20	0.00	0.00	0.00	Open
21	0.00	0.00	0.00	Open
22	0.00	0.00	0.00	Open
23	17.76	1.01	12.46	Open
24	17.18	0.97	11.71	Open
1	77.10	2.45	38.98	Open

APPENDIX F

Marr Drain Plan and Details by Spriet Associates
Marr Drain Profiles Drawing
SWM Calculations
Environment and Climate Change Canada Rain Gauge Information for St Thomas WPCP ID ON_6137362
IDF to Chicago Conversion Using MIDUSS
Chicago Hyetograph Creation
Staged Storage Volume Calculations
OGS CDS 4030 Stormwater Treatment Unit
Stormwater Treatment Unit Operation & Maintenance Manual
Homeowner Information Package



PLAN

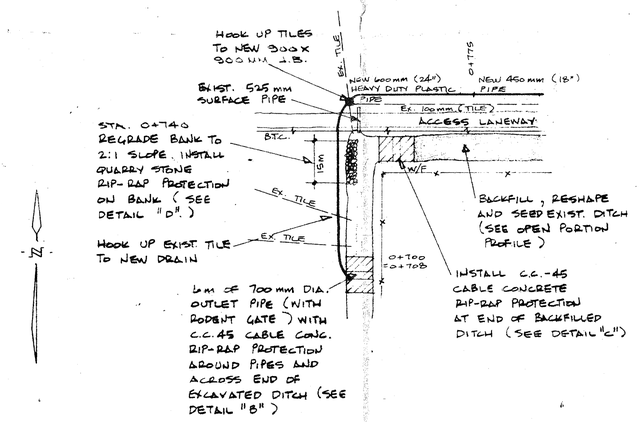
SCALE 1:7500

LOT LEGEND

1.	B-109	C. & P. MINOR	0.14 ha
2.	B-11101	J. & C. JOHNSON	1.20 ha
3.	B-113	M. GIFFORD	0.69 ha
4.	B-11201	K. GIFFORD	0.31 ha
5	B-114	E. BEATTIE	0.13 ha
6.	B-117	D. GILBERT	8.71 ha
7.	B-11708	D & R PEARN	0.20 ha
8.	B-118	UNION GAS LTD.	0.10 ha
9	B-12101	J. & G. HURST	1.40 ha
10.	B-120	D. & M. ZANITZ	0.20 ha
11.	B-121	C. SCIDMORE	0.25 ha
12.	2-012	B. & G. STORMES	0.09 ha
13.	2-013	R. & M. SMITH	0.09 ha
14.	2-014	G. & S. ELLIOTT	0.09 ha
15.	2-01801	M. & D. MACKINNON	0.14 ha
16.	2-015	J. MCCARTHY	0.09 ha
17.	2-016	S. & V. MCTAGGART	0.09 ha
18.	2-017	R. WALLS	0.24 ha
19.	2-01801	RECREATION CENTRE	1.10 ha
20.	B-11704	B. FRANK	0.20 ha
21.	B-11706	G. HINSCHBERGER	0.20 ha
22.	B-12104	G. NOESCHER	0.35 ha

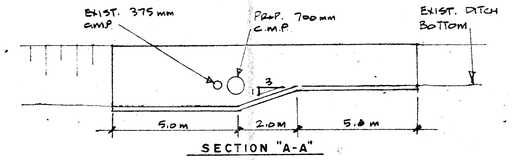
GENERAL NOTES

1. OUR SPECIFICATIONS DATED JANUARY 1983 APPLY TO THIS PROJECT.
2. ALL OWNERS OF LANDS WHERE THE DRAIN IS TO BE CONSTRUCTED SHALL MAKE AN ACCESS ROUTE AVAILABLE FROM THE NEAREST ROAD ALLOWANCE TO THE DRAIN LOCATION. THE AVERAGE WIDTH OF THIS ROUTE SHALL NOT EXCEED 8 METERS.
3. THE WORKING WIDTH AVAILABLE TO THE CONTRACTOR TO CONSTRUCT THE DRAIN AND CONJECTIONS CONSISTS OF THOSE LANDS IMMEDIATELY ADJACENT TO THE COURSE OF THE DRAIN AND CONJECTIONS AND SHALL NOT EXCEED AN AVERAGE WIDTH OF 15 METERS FOR TILING AND 15 METERS FOR BACKFILLING AND REGRADING.
4. CATCHBASINS TO BE CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH OUR SPECIFICATIONS. EXACT LOCATION AND ELEVATION OF CATCHBASINS TO BE CONFIRMED BY ENGINEER OR DRAINAGE SUPERINTENDENT PRIOR TO CONSTRUCTION.
5. ALL TREES, BRUSH SCRUB ETC. TO BE CLEARED IN ACCORDANCE WITH OUR SPECIFICATIONS. ALL TREES AND BRUSH TO BE REMOVED FROM BACKFILLED DITCH.
6. ALL QUARRY STONE TO RANGE IN SIZE FROM 100 mm TO 300 mm EVENLY DISTRIBUTED AND PLACED TO A 300 mm THICKNESS ON AN APPROVED GEOTEXTILE.
7. EXACT LOCATION OF NEW CLOSED DRAINS TO BE CONFIRMED BY ENGINEER OR DRAINAGE SUPERINTENDENT PRIOR TO CONSTRUCTION.
8. BACKFILLED DITCHES AND REGRADED DITCH BANKS TO BE HYDRO SEEDED AND MULCHED AT A RATE OF 65 kg/ha WITH THE FOLLOWING GRASS SEED MIXTURE:
   - CREEPING RED FESCUE 40%
   - KENTUCKY BLUE GRASS 20%
   - RED TOP 10%
   - TIMOTHY 20%
   - LADINO 10%
9. CABLE CONCRETE TO BE C.C. - 45 AS MANUFACTURED BY WEST LORNE PRECAST AND TO BE INSTALLED WITH GEOTEXTILE ATTACHED TO UNDERSIDE IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.
10. CONTRACTOR TO NOTIFY UNION GAS CO. 72 HRS. PRIOR TO CROSSING GAS LINE.
11. CONTRACTOR TO SUPPLY & INSTALL QUARRY STONE RIP-RAP WITH FILTER BLANKET ON GIFFORD PROPERTY STA 2+930

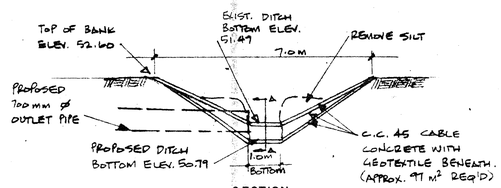


DETAIL "A"

N.T.S.



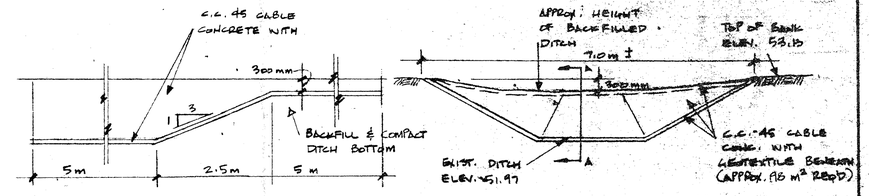
SECTION "A-A"



SECTION

STA 0+708±

DETAIL "B" N.T.S.

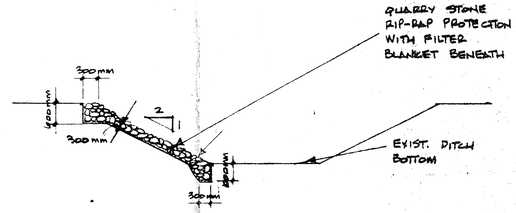


SECTION "A-A" SECTION

STA 0+750±

DETAIL "C"

N.T.S.



DETAIL "D"

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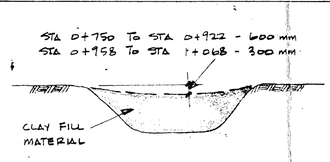


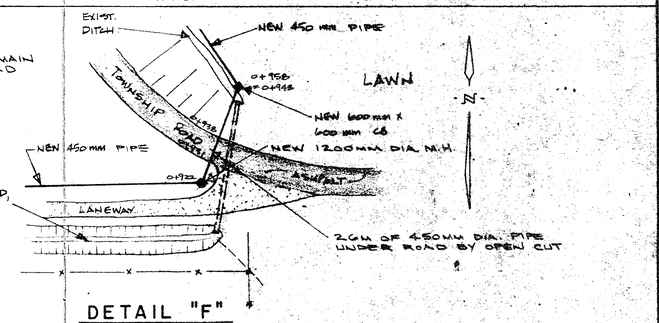
NOTES

1. EXIST. DITCH TO BE BACKFILLED USING IMPORTED CLAY FILL MATERIAL (APPROX. 1600 m³ LOOSE FILL REQ'D) DITCH TO BE BACKFILLED AND COMPACTED WITH DOZER IN APPROXIMATELY 150 mm LAYERS.
2. IMPORTED TOPSOIL TO BE LEVELLED OVER CLAY FILL MATERIAL TO A THICKNESS OF 50 mm (APPROX. 110 m³ REQ'D)
3. BACKFILLED DITCH TO BE HYDRO SEEDED AND MULCHED WITH AN APPROVED GRASS SEED MIXTURE AT A RATE OF 84 kg/ha [75 lbs/ac (APPROX. 1600 m² SEEDING REQ'D)]

TYPICAL BACKFILLED DITCH SECTION

DETAIL "E"

N.T.S.

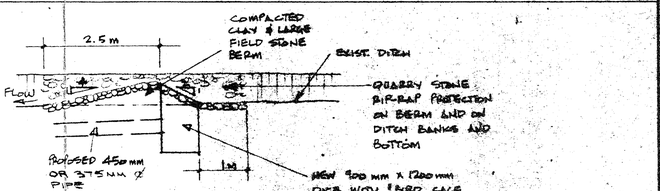


DETAIL "F"

N.T.S.

NOTES

1. BERM TO BE CONSTRUCTED WITH IMPORTED CLAY FILL MATERIAL MIXED WITH LARGE FIELD STONE TO A 50% - 50% RATIO.
2. ENDS OF BERM TO BE 150 mm LOWER THAN ELEV. AT DICB. LOCATION



STA 1+068 & STA 1+800

DETAIL "G"

N.T.S.

J. R. SPRIET — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

MARR DRAIN

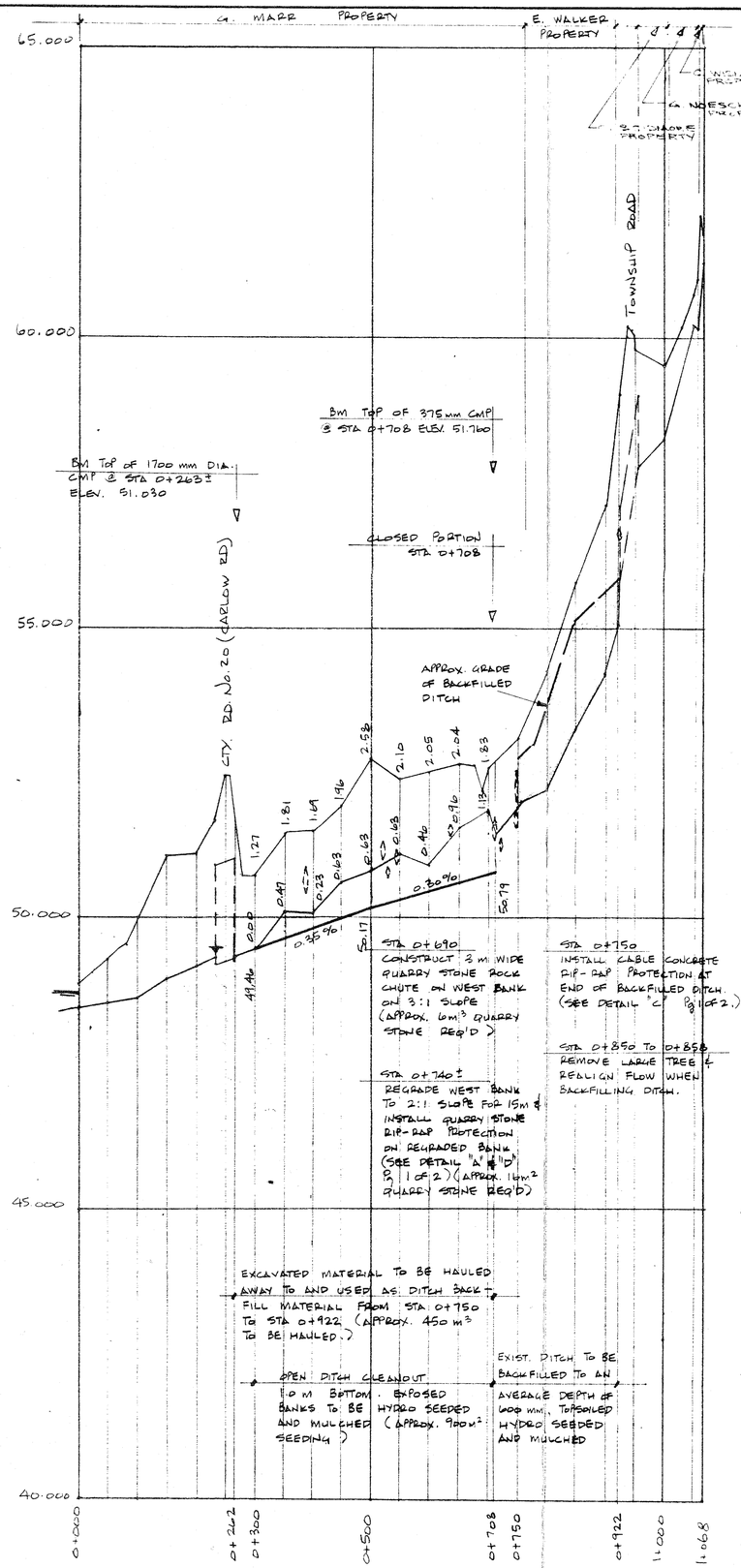
VILLAGE OF PORT STANLEY

Scale: AS SHOWN	Approved By: F.B. D-142,146	JOB NO. 87086	Drawn By: MD, AD
Date: MAY 23, 1991			Revised:

PLAN & DETAILS

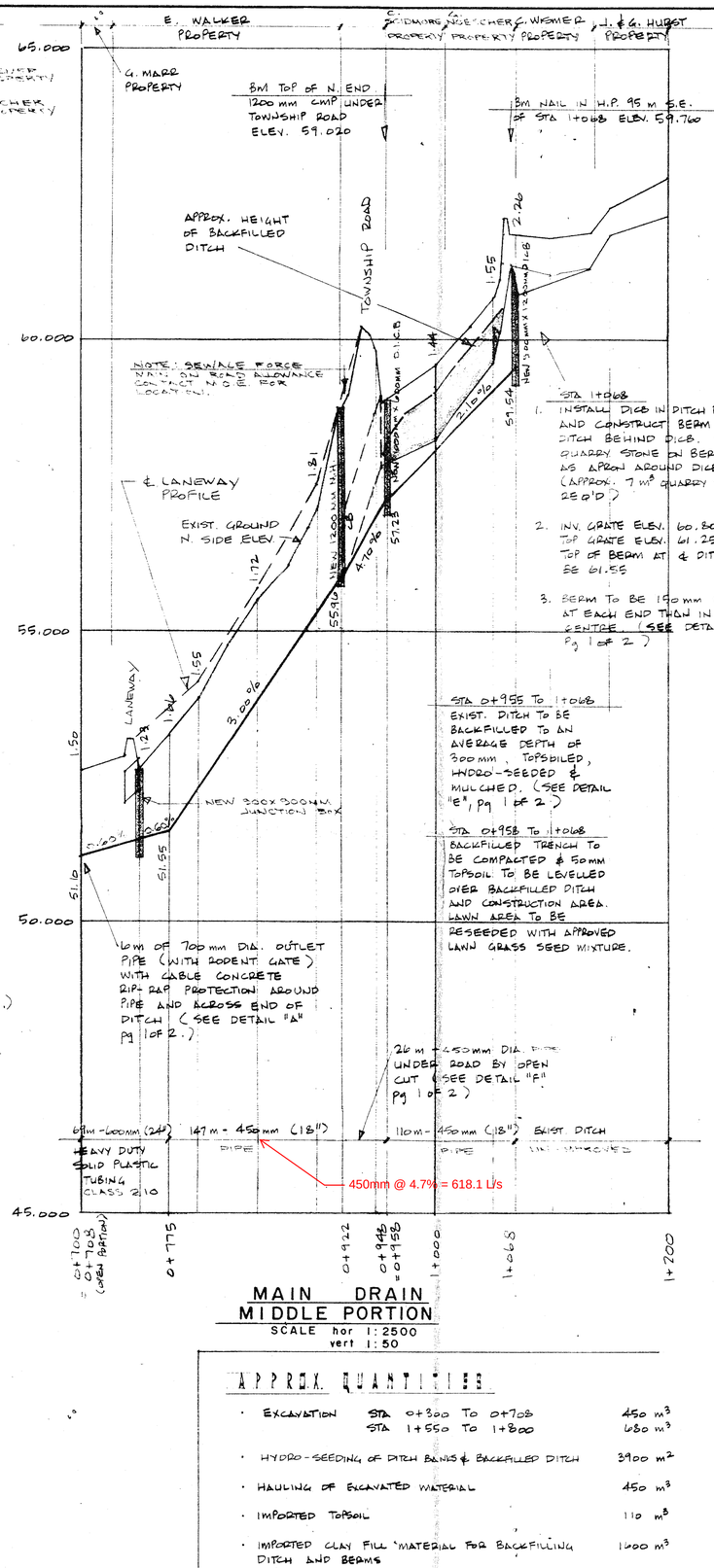
SPRIET ASSOCIATES CONSULTING ENGINEERS — LONDON SUDBURY

Drawing Number 1 of 2



MAIN DRAIN OPEN PORTION

SCALE hor 1:5000
vert 1:50

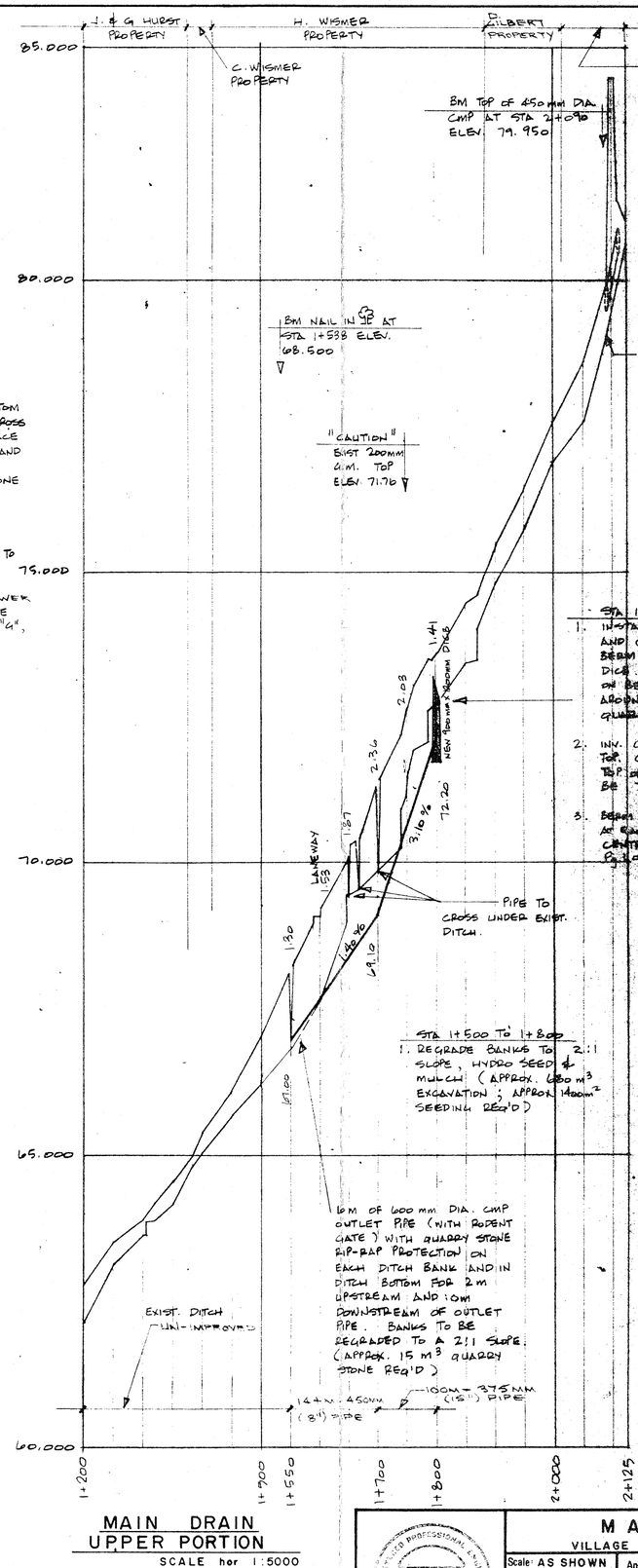


MAIN DRAIN MIDDLE PORTION

SCALE hor 1:2500
vert 1:50

APPROX. QUANTITIES

• EXCAVATION	STA 0+300 TO 0+708	450 m³
	STA 1+550 TO 1+800	680 m³
• HYDRO-SEEDING OF DITCH BANKS & BACKFILLED DITCH		3900 m²
• HAULING OF EXCAVATED MATERIAL		450 m³
• IMPORTED TOPSOIL		110 m³
• IMPORTED CLAY FILL MATERIAL FOR BACKFILLING DITCH AND BERMS		1600 m³
• QUARRY STONE RIP-RAP PROTECTION		56 m³
• FILTER BLANKET		170 m²
• CABLE CONCRETE C.C.-45 (INCLUDING GEOTEXTILE)		195 m²



MAIN DRAIN UPPER PORTION

SCALE hor 1:5000
vert 1:50

NOTE
UNLESS OTHERWISE NOTED ALL 375MM AND 450 MM PIPE TO BE ULTRA-RIB P.V.C. STORM SEWER PIPE

J.R. SPRIET PROFESSIONAL ENGINEER PROVINCE OF ONTARIO

MARR DRAIN
VILLAGE OF PORT STANLEY

Scale: AS SHOWN	Approved By:	JOB NO. 87086	Drawn By: M.D., A.D.
Date: MAY 23, 1991	F.B. D-142,146		Revised:

PROFILES

SPRIET ASSOCIATES CONSULTING ENGINEERS — LONDON SUDBURY

Drawing Number 2 of 2

STRIK BALDINELLI MONIZ
PLANNING · CIVIL · STRUCTURAL · MECHANICAL · ELECTRICAL

LONDON LOCATION
1599 Adelaide St. N., Units 301 & 203
London, ON N5X 4E8
P: 519-471-6667

KITCHENER LOCATION
1415 Huron Rd., Unit 225
Kitchener, ON N2R 0L3
P: 519-725-8093

www.sbmltd.ca

sbm@sbmltd.ca

SWM Calculations

DATE: July 13, 2021
JOB No.: SBM-18-0530

Client: Strathroy Turf Farms Ltd.
Project: Kettle Creek Subdivision
Location: 37719 Lake Line, Port Stanley, Ontario

ST THOMAS WPCP CHICAGO RAINFALL DISTRIBUTION PARAMETERS*

Return Period (years)	A,B,C Parameters A	B	C
2	737.970	7.382	0.8035
5	1009.820	7.472	0.8055
10	1178.220	7.382	0.8049
25	1398.350	7.382	0.8048
50	1497.170	6.876	0.7978
100	1634.380	6.798	0.7954

Note: Chicago Rainfall Distribution Parameters were derived from the IDF Parameters obtained from Environment and Climate Change Canada Rain Gauge Information dated 27th of February 2019 for The St Thomas WPCP ID ON_6137362 (Table 2b) from 1926 - 2007 provided in Appendix F. The Intensity from Table 2b was inputted in Midsus IDF Curve Fit tools to produce the Chicago Distribution parameters. Rainfall intensity duration frequency (IDF) storm parameters for the City of London 250-year event were obtained from the City of London 2019 Design Specifications and Requirements Manual and are based on the Environment and Climate Change Canada February 2019 IDF update.

CITY OF LONDON RAINFALL DISTRIBUTION PARAMETERS*

Return Period (years)	A,B,C Parameters A	B	C
250	3048.220	10.030	0.8880

*Intensity i=A/(t+B)^C (mm/hr)
Post development flows to be kept at 2-100-year pre development levels

PRE-DEVELOPMENT CONDITIONS

PRE-DEVELOPMENT AREA FOR ENTIRE SITE

	Area (m^2)	C	A*C
EXT101 (R.O.W.)	4905.95	0.9	4415.3586
A101 (Slope)	64793.87	0.2	12958.773
A102 (Field)	88940.46	0.21	18506.5914
A103 (Golf Course)	8398.24	0.2	1679.6482
Total Site Area:	167038.52		37560.3712
C_{ave} = ∑(A*C)/∑(A) =	0.22		

POST-DEVELOPMENT CONDITIONS

CALCULATE SUBDIVISION RUNOFF CO-EFFICIENT (R.O.W. AND RESIDENTIAL LOTS)

R.O.W. - Street A	Area (Per 1m W.)	C	A*C (per m of R.O.W.)
Total	20.0		
Pavement	8.08	0.9	7.272
Curb & Gutter (0.44m per side)	0.88	0.9	0.792
Sidewalk (1.5m on one side)	1.50	0.9	1.35
Grass	9.54	0.2	1.908
Total	20.0		11.3
C_{ave} = ∑(A*C)/∑(A) =	0.57		

Composite Runoff Coefficient (R.O.W. and Residential Lots Combined)

	Area (m^2)	C	A*C
R.O.W. - Street A	20266.30	0.57	11472.75243
Single Family/Semi-Detached Lots	67321.40	0.50	33660.7
Total	87587.70		45133.45243
	0.52	calculated	
	0.52	used for design	

3.3.5 Runoff Coefficients

The value of runoff coefficient R, is to be taken from the following:

Asphalt or Concrete Surfaces	0.9
Roof Areas	0.9
Single Family Residential	0.35 to 0.75
Semi-Detached Residential	0.40 to 0.75
Apartments	0.50 to 0.70
Light industrial	0.50 to 0.80
Heavy industrial	0.60 to 0.90
Neighbourhood Commercial	0.50 to 0.70
Playgrounds	0.2
Parks	0.2

* Refer to Design Guidelines of the Municipality of Central Elgin Infrastructure Design Guidelines and Construction Standards

POST-DEVELOPMENT AREA FOR ENTIRE SITE (See DWG)

A201 (Slope) Ext 203 (Slope)	64740.87	0.20	12948.1732
A202-A221 (Development)	83532.88	0.52	43437.09864
EXT201 EXT202 (Lake Line R.O.W.)	4960.35	0.90	4464.3141
A222 (SWM Pond)	6099.30	0.32	1951.77504
U201	929.29	0.20	185.8578
U202	4462.38	0.52	2320.43552
	164725.06		65307.6543
	0.40		

TABLE 1: PRE-DEVELOPMENT SUBCATCHMENT PARAMETERS

Catchment Area	Total Area (m2)	Total Area (ha)	Land Use 1 Runoff Coefficient 0.20	Land Use 2 Runoff Coefficient 0.32	Land Use 3 Runoff Coefficient 0.52	Land Use 4 Runoff Coefficient 0.90	Land Use 5 Runoff Coefficient 0.70	Weighted C Value	[4] Flow Length (m)	Width (m)	% Slope	% Impervious	[3]N- Imperv	[3] N- Perv	[3] Distore - Imperv (mm)	[3] Distore - Perv (mm)	[1] SCS Curve Numbers
Pre Development																	
A101 (Slope)	64793.865	6.479	64793.865					0.20	84	771	30	0.00	0.011	0.4	2	7.5	70
A102 (Field)	88940.457	8.894	87503.457				1437.000	0.21	195	456	3	1.15	0.011	0.2	2	3.8	74
A103 (Natural Area/Golf Course)	8398.241	0.840	8398.241					0.20	144	58	3	0.00	0.011	0.2	2	3.8	74
EXT101 (R.O.W.)	4905.954	0.491				4905.954		0.90	8	613	2	100.00	0.011	0.2	2	3.8	98

TABLE 2: POST-DEVELOPMENT SUBCATCHMENT PARAMETERS

Catchment Area	Total Area (m2)	Total Area (ha)	Land Use 1 Runoff Coefficient 0.20	Land Use 2 Runoff Coefficient 0.32	Land Use 3 Runoff Coefficient 0.52	Land Use 4 Runoff Coefficient 0.90	Land Use 5 Runoff Coefficient 0.70	Weighted C Value	Flow Length (m)	Width (m)	% Slope	% Impervious	[3]N- Imperv	[3] N- Perv	[3] Distore - Imperv (mm)	[3] Distore - Perv (mm)	[1] Pervious CN
Post Development																	
A201 (Slope)	42597.228	4.260	42597.228					0.20	115	370	30	0.00	0.011	0.4	2	7.5	70
A202	4994.591	0.499			4994.591			0.52	68	73	2	45.71	0.011	0.2	2	3.8	90
A203	8076.397	0.808			8076.397			0.52	66	134	2	45.71	0.011	0.2	2	3.8	90
A204	4670.840	0.467			4670.840			0.52	53	89	2	45.71	0.011	0.2	2	3.8	90
A205	2766.500	0.277			2766.500			0.52	55	55	2	45.71	0.011	0.2	2	3.8	90
A206	13569.860	1.357			13569.860			0.52	50	271	2	45.71	0.011	0.2	2	3.8	90
A207	3590.660	0.359			3590.660			0.52	57	63	2	45.71	0.011	0.2	2	3.8	90
A208	1988.570	0.199			1988.570			0.52	51	39	2	45.71	0.011	0.2	2	3.8	90
A209	8459.380	0.846			8459.380			0.52	80	106	2	45.71	0.011	0.2	2	3.8	90
A210	3472.440	0.347			3472.440			0.52	47	74	2	45.71	0.011	0.2	2	3.8	90
A211	2350.335	0.235			2350.335			0.52	48	49	2	45.71	0.011	0.2	2	3.8	90
A212	1689.250	0.169			1689.250			0.52	52	32	2	45.71	0.011	0.2	2	3.8	90
A213	1601.004	0.160			1601.004			0.52	47	34	2	45.71	0.011	0.2	2	3.8	90
A214	5029.240	0.503			5029.240			0.52	53	95	2	45.71	0.011	0.2	2	3.8	90
A215	2544.754	0.254			2544.754			0.52	52	49	2	45.71	0.011	0.2	2	3.8	90
A216	6359.951	0.636			6359.951			0.52	52	123	2	45.71	0.011	0.2	2	3.8	90
A217	2193.177	0.219			2193.177			0.52	52	42	2	45.71	0.011	0.2	2	3.8	90
A218	1870.553	0.187			1870.553			0.52	48	39	2	45.71	0.011	0.2	2	3.8	90
A219	2933.515	0.293			2933.515			0.52	48	61	2	45.71	0.011	0.2	2	3.8	90
A220	2211.934	0.221			2211.934			0.52	15	147	3	45.71	0.011	0.2	2	3.8	90
A221	3159.931	0.316			3159.931			0.52	18	176	2	45.71	0.011	0.2	2	3.8	90
A222 (SWM Dry Pond)	6099.297	0.610		6099.297				0.32	30	204	8	17.14	0.011	0.2	2	3.8	74
U201	929.289	0.093	929.289					0.20	20	46	3	0.00	0.011	0.2	2	3.8	74
U202	4462.376	0.446			4462.376			0.52	30	149	6	45.71	0.011	0.2	2	3.8	90
EXT201 (R.O.W.)	4044.511	0.404				4044.511		0.90	8	506	2	100.00	0.011	0.2	2	3.8	98
EXT202 (R.O.W.)	915.838	0.092				915.838		0.90	8	114	2	100.00	0.011	0.2	2	3.8	98
EXT203 (Slope)	22143.638	2.214	22143.638					0.20	150	148	30	0.00	0.011	0.4	2	7.5	70

Average Hydrological Soil Group of C for the site (Communication from Geotechnical engineers EXP dated 2021-07-05)
(1) Values from A.4 of Storm Water Management Model User's Manual Version 5.1
(2) Values from A.6 of Storm Water Management Model User's Manual Version 5.1
(3) Values from A.5 of Storm Water Management Model User's Manual Version 5.1
(4) Sample Calculation to Convert from C to % Impervious: % Impervious = x
C = x(0.9) + (1-x)0.2 (ie. weighted C value)
therefore 0.7x = C - 0.2
x = (C-0.2)/0.7

TABLE 3: Result Summary from EPA SWMM5.1 Modelling

Design Storm Event	Existing Conditions Peak Runoff for Entire Site (m^3/s)	Proposed Conditions Peak Discharge - 205mm Orifice (m^3/s) (Lower Orifice)	Proposed Conditions Peak Discharge - 600mm Orifice (m^3/s) (Higher Orifice)	Proposed Conditions Peak Discharge - Weir (m^3/s)	Proposed Conditions Peak Uncontrolled Flow U201 (m^3/s)	Proposed Conditions Peak Uncontrolled Flow U202 (m^3/s)	Proposed Conditions Total Peak Discharge (m^3/s)	Dry-Basin Total Storage Volume(m^3)	Dry-Basin Peak Ponding Elev. (m)	Dry-Basin Peak Ponding Depth. (m)
5-Year	0.27	0.081	0.080	0.00	0.001	0.101	0.263	1,070	177.89	0.82
10-Year	0.36	0.086	0.143	0.00	0.003	0.129	0.361	1,357	177.98	0.91
25-Year	0.52	0.092	0.237	0.00	0.005	0.167	0.501	1,750	178.09	1.02
50-Year	0.68	0.096	0.312	0.00	0.007	0.198	0.613	2,042	178.17	1.10
100-Year	0.83	0.100	0.396	0.00	0.010	0.227	0.733	2,359	178.26	1.19
250-Year (City of London)	1.20	0.102	0.446	0.00	0.015	0.281	0.844	2,426	178.31	1.24

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Short Duration Rainfall Intensity-Duration-Frequency Data
Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée

Gumbel - Method of moments/Méthode des moments

2019/02/27

==========

ST THOMAS WPCP ON 6137362
(composite)
Latitude: 42 46'N Longitude: 81 13'W Elevation/Altitude: 209 m

Years/Années : 1926 - 2007 # Years/Années : 75

==========

****

Table 1 : Annual Maximum (mm)/Maximum annuel (mm)

****

Year / Année	5 min	10 min	15 min	30 min	1 h	2 h	6 h	12 h	24 h
1926	8.1	11.9	16.3	24.9	41.1	56.4	75.7	80.3	104.4
1927	7.1	9.4	10.2	15.5	18.3	29.7	40.9	46.2	56.6
1929	9.7	15.0	18.3	21.1	38.4	38.4	38.4	38.4	40.9
1930	8.1	16.0	18.3	24.4	29.0	35.6	49.5	50.3	51.6
1931	8.4	10.7	16.0	20.6	23.1	23.4	33.8	37.1	37.1
1932	7.1	9.9	12.2	22.6	39.4	59.4	64.3	65.3	65.5
1933	10.2	11.2	11.2	11.7	12.2	14.7	24.9	24.9	27.4
1934	7.1	8.4	10.4	12.2	15.2	16.0	25.9	27.2	27.2
1935	14.0	26.4	32.8	49.8	60.2	63.2	63.2	63.2	63.2
1936	6.3	11.4	12.2	14.2	19.0	20.3	30.2	32.8	32.8
1937	8.9	17.8	25.1	37.8	43.9	49.8	54.9	56.9	74.4
1938	10.7	14.0	15.0	17.0	17.8	24.9	46.0	47.5	47.5
1939	6.9	11.7	17.5	21.1	21.6	22.1	27.9	30.0	30.5
1940	6.6	12.4	18.3	25.4	33.5	35.3	38.9	50.5	72.9
1941	8.6	13.2	17.0	27.4	37.8	38.1	38.1	41.4	50.5
1942	15.0	20.3	22.6	23.6	32.0	41.7	47.2	52.8	54.9
1943	7.6	12.2	15.2	20.6	25.9	26.4	40.6	48.8	50.3
1944	8.1	14.5	17.3	21.8	26.4	26.7	33.5	33.5	33.5
1945	9.1	12.2	13.0	18.0	20.1	30.7	47.2	55.4	75.4
1946	9.4	15.0	16.8	17.8	24.6	24.9	27.9	36.3	42.2
1947	9.4	18.3	21.8	29.0	31.7	33.0	40.9	44.2	56.6

1948	10.2	14.7	19.6	19.8	19.8	19.8	26.7	28.2	39.1
1949	6.3	9.9	12.2	14.0	14.2	21.8	33.3	33.5	35.1
1952	8.1	13.7	15.5	23.9	33.0	38.6	44.2	71.4	76.7
1953	5.1	7.9	9.4	16.5	20.6	23.9	25.4	31.0	40.6
1954	5.3	8.9	10.9	16.0	16.3	25.1	33.8	47.2	69.3
1955	6.9	9.9	10.7	12.4	16.0	20.1	33.0	45.5	54.1
1956	10.7	14.7	19.3	23.1	38.1	41.4	51.3	57.7	60.7
1957	12.4	18.5	21.8	24.6	30.7	34.5	42.2	42.7	42.9
1958	6.9	9.7	10.9	18.5	21.1	28.7	36.3	36.3	36.8
1959	9.1	14.7	18.8	25.1	27.4	31.2	35.6	35.8	35.8
1960	8.9	16.0	17.3	21.6	27.4	27.7	31.5	38.6	46.2
1961	12.7	16.0	18.0	20.1	22.6	27.4	31.7	31.7	31.7
1962	12.2	15.7	18.8	18.8	20.8	21.3	36.6	42.7	48.0
1963	4.8	5.8	8.6	10.9	20.6	26.4	29.7	36.1	41.7
1964	11.9	15.0	16.8	23.1	37.1	67.3	86.4	86.9	86.9
1965	5.6	7.6	9.1	12.2	19.3	25.1	31.0	44.2	56.6
1967	6.3	9.4	13.2	23.6	38.1	58.4	66.8	76.2	78.5
1968	11.4	17.8	20.3	25.4	35.8	44.7	86.6	101.6	104.6
1969	29.2	30.5	38.1	45.0	48.5	49.5	49.5	49.5	52.6
1970	5.3	5.8	6.9	11.4	13.5	15.5	29.7	29.7	36.1
1971	10.4	12.7	14.7	22.4	22.4	22.4	26.7	26.7	30.2
1972	5.1	10.2	11.7	15.5	15.5	25.4	27.2	31.7	40.4
1973	6.1	7.4	7.4	8.9	10.2	14.0	23.6	28.4	33.8
1974	6.1	7.4	9.9	11.2	14.5	20.6	25.1	26.9	26.9
1975	10.9	21.8	27.2	35.8	39.4	61.0	66.8	75.9	79.0
1976	20.3	21.6	23.4	25.1	25.4	27.7	49.0	51.6	51.6
1977	11.7	17.3	20.3	22.6	22.6	30.5	45.0	46.0	48.8
1978	9.0	11.4	13.6	16.0	18.7	21.6	32.0	34.4	41.0
1979	5.0	5.8	6.6	8.6	14.0	17.2	27.0	42.8	51.8
1980	8.9	12.3	12.7	16.0	25.1	31.7	34.9	52.9	73.0
1981	-99.9	-99.9	-99.9	-99.9	34.0	36.9	49.2	66.8	73.9
1982	8.5	13.1	16.1	21.2	29.3	30.0	55.6	65.4	68.0
1983	10.7	13.9	18.0	30.6	42.8	50.1	82.2	99.4	108.7
1984	8.6	13.0	14.7	29.4	40.6	64.7	92.1	95.3	124.3
1985	6.5	10.2	14.9	18.4	27.6	34.6	34.8	47.4	52.8
1986	8.9	10.2	13.1	23.9	25.2	37.9	45.1	49.4	50.4
1987	6.1	8.1	8.6	16.3	23.0	27.8	39.4	51.6	51.8
1988	8.9	12.1	13.9	26.9	33.7	40.8	50.4	52.2	52.6
1989	6.1	7.7	9.3	15.4	25.7	26.2	27.2	27.2	27.4
1990	10.3	16.3	21.2	36.4	51.1	56.2	56.7	56.7	76.9
1991	6.1	10.4	13.2	21.4	25.6	27.6	36.9	44.0	46.0
1992	8.4	12.0	17.2	21.2	28.8	30.7	32.2	39.1	52.2
1993	4.0	4.4	5.8	9.0	12.8	13.4	27.5	29.0	34.4
1994	10.3	12.0	12.7	18.4	27.4	31.5	48.6	52.2	52.2
1995	8.1	11.3	12.1	17.4	20.6	31.4	60.0	69.5	72.0
1996	12.1	15.8	18.3	19.1	19.1	24.3	25.3	44.4	52.0
1997	11.4	12.3	16.4	27.2	30.7	31.3	43.4	43.4	46.7
1998	11.7	20.7	29.2	41.5	43.0	43.0	43.0	52.2	56.3
1999	8.5	12.2	16.2	23.0	24.2	25.8	32.9	36.6	36.6
2000	8.5	12.5	16.4	27.8	31.5	44.8	47.5	53.4	58.4

2001	6.1	10.7	11.9	21.4	24.5	24.5	34.8	38.6	40.4
2002	8.4	11.1	14.4	18.8	21.2	23.9	23.9	25.2	34.4
2003	8.1	14.4	16.3	20.6	32.9	38.0	38.4	38.4	38.4
2004	10.2	14.3	15.8	16.9	26.0	26.0	34.7	35.9	45.0
2005	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	66.6
2007	5.4	7.7	9.7	13.7	14.7	15.7	19.5	-99.9	-99.9
# Yrs. Années	75	75	75	75	76	76	76	75	76
Mean Moyenne	8.9	12.9	15.7	21.3	27.1	32.5	41.7	47.5	53.5
Std. Dev. Écart-type	3.6	4.6	5.8	7.9	10.0	13.0	15.9	17.4	20.1
Skew. Dissymétrie	2.86	1.13	1.23	1.22	0.77	1.00	1.37	1.26	1.26
Kurtosis	16.47	5.64	5.92	5.49	3.64	3.50	4.77	4.61	4.93

*-99.9 Indicates Missing Data/Données manquantes

Warning: annual maximum amount greater than 100-yr return period amount
Avertissement : la quantité maximale annuelle excède la quantité pour une période de retour de 100 ans

Year/Année	Duration/Durée	Data/Données	100-yr/ans
1935	30 min	49.8	46.1
1935	1 h	60.2	58.5
1969	5 min	29.2	20.2
1969	10 min	30.5	27.3
1969	15 min	38.1	33.8
1976	5 min	20.3	20.2
1984	6 h	92.1	91.6
1984	24 h	124.3	116.4

****

Table 2a : Return Period Rainfall Amounts (mm)
Quantité de pluie (mm) par période de retour

****

Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	8.4	11.5	13.6	16.3	18.3	20.2	75
10 min	12.2	16.2	18.9	22.3	24.8	27.3	75
15 min	14.7	19.8	23.2	27.5	30.6	33.8	75
30 min	20.0	27.0	31.6	37.5	41.8	46.1	75
1 h	25.4	34.3	40.1	47.6	53.1	58.5	76
2 h	30.3	41.8	49.4	59.0	66.1	73.1	76
6 h	39.1	53.1	62.4	74.2	82.9	91.6	76
12 h	44.6	60.0	70.2	83.0	92.6	102.1	75
24 h	50.2	67.9	79.7	94.5	105.5	116.4	76

****

Table 2b :

Return Period Rainfall Rates (mm/h) - 95% Confidence limits
Intensité de la pluie (mm/h) par période de retour - Limites de confiance de 95%

****

Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	100.3	138.4	163.7	195.6	219.3	242.8	75
	+/- 9.0	+/- 15.1	+/- 20.4	+/- 27.5	+/- 32.9	+/- 38.3	75
10 min	73.0	97.2	113.3	133.6	148.7	163.6	75
	+/- 5.7	+/- 9.6	+/- 13.0	+/- 17.5	+/- 20.9	+/- 24.4	75
15 min	59.0	79.4	92.8	109.9	122.6	135.1	75
	+/- 4.8	+/- 8.1	+/- 10.9	+/- 14.7	+/- 17.6	+/- 20.5	75
30 min	40.1	54.0	63.3	75.0	83.6	92.2	75
	+/- 3.3	+/- 5.5	+/- 7.5	+/- 10.1	+/- 12.0	+/- 14.0	75
1 h	25.4	34.3	40.1	47.6	53.1	58.5	76
	+/- 2.1	+/- 3.5	+/- 4.7	+/- 6.3	+/- 7.6	+/- 8.9	76
2 h	15.2	20.9	24.7	29.5	33.0	36.6	76
	+/- 1.3	+/- 2.3	+/- 3.0	+/- 4.1	+/- 4.9	+/- 5.7	76
6 h	6.5	8.9	10.4	12.4	13.8	15.3	76
	+/- 0.5	+/- 0.9	+/- 1.2	+/- 1.7	+/- 2.0	+/- 2.3	76
12 h	3.7	5.0	5.8	6.9	7.7	8.5	75
	+/- 0.3	+/- 0.5	+/- 0.7	+/- 0.9	+/- 1.1	+/- 1.3	75
24 h	2.1	2.8	3.3	3.9	4.4	4.9	76
	+/- 0.2	+/- 0.3	+/- 0.4	+/- 0.5	+/- 0.6	+/- 0.7	76

****

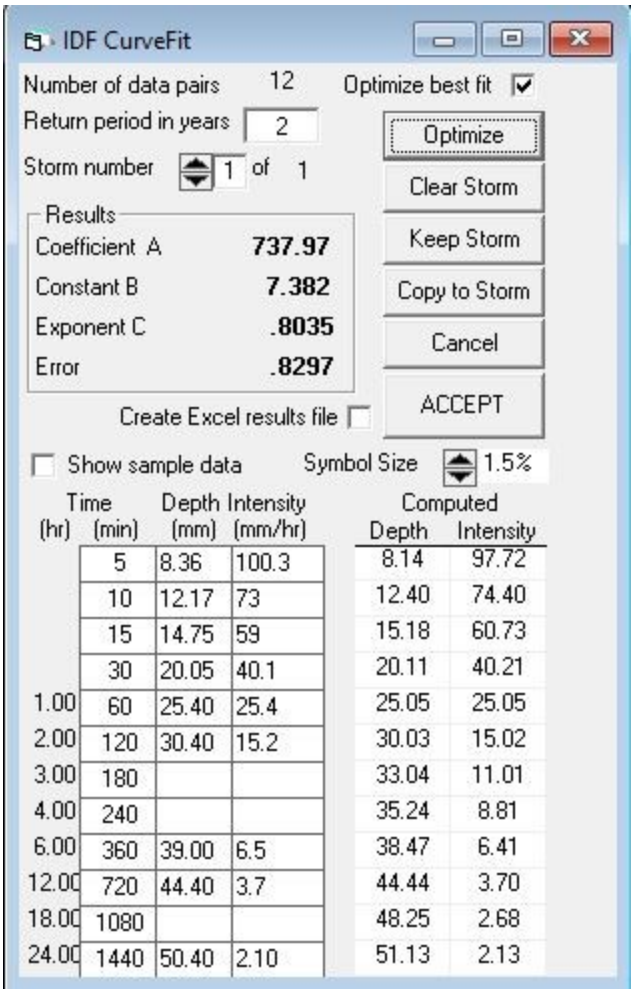
Table 3 : Interpolation Equation / Équation d'interpolation: R = A*T^B

R = Interpolated Rainfall rate (mm/h)/Intensité interpolée de la pluie (mm/h)
RR = Rainfall rate (mm/h) / Intensité de la pluie (mm/h)
T = Rainfall duration (h) / Durée de la pluie (h)

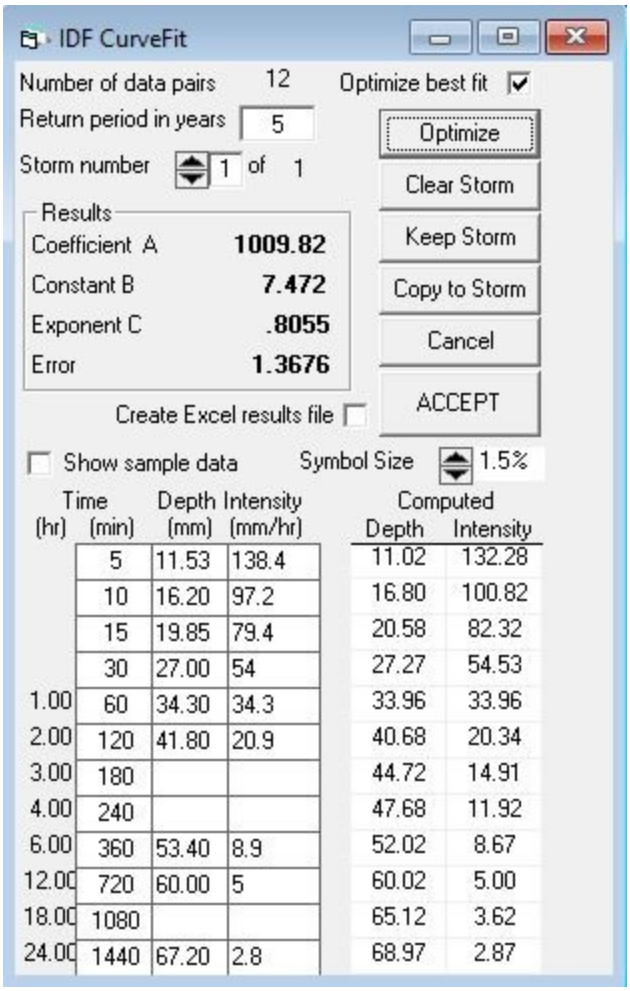
****

Statistics/Statistiques	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans
Mean of RR/Moyenne de RR	36.1	49.0	57.5	68.3	76.2	84.2
Std. Dev. /Écart-type (RR)	34.7	47.4	55.8	66.3	74.2	82.0
Std. Error/Erreur-type	8.9	11.3	12.9	14.9	16.4	17.8
Coefficient (A)	21.9	29.7	34.8	41.3	46.2	50.9
Exponent/Exposant (B)	-0.694	-0.694	-0.694	-0.694	-0.694	-0.694
Mean % Error/% erreur moyenne	9.9	10.0	10.0	10.0	10.1	10.1

2-YEAR IDF TO CHICAGO CONVERSION USING MIDUSS

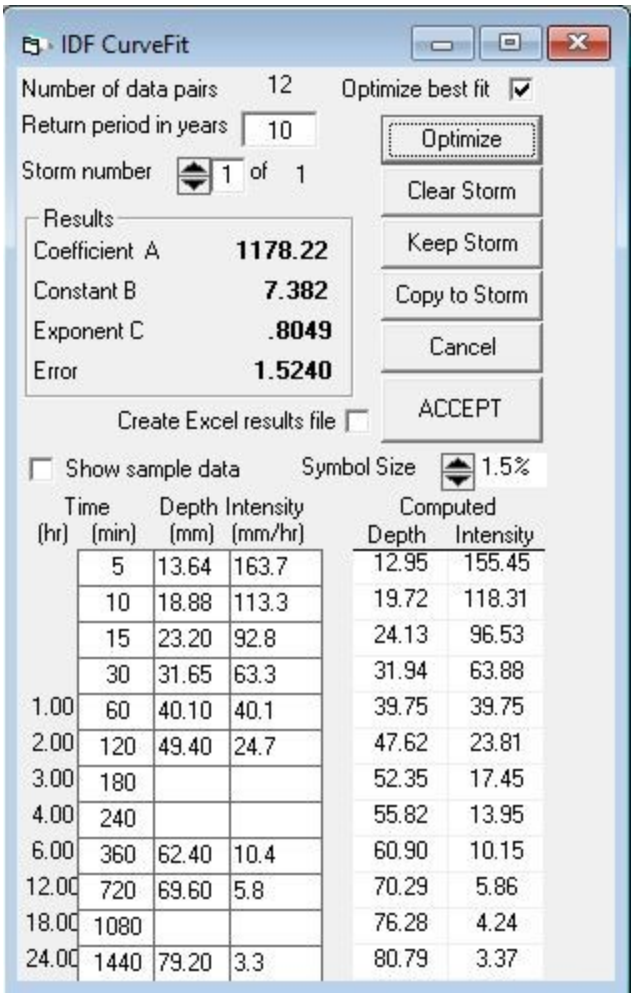


5-YEAR IDF TO CHICAGO CONVERSION USING MIDUSS

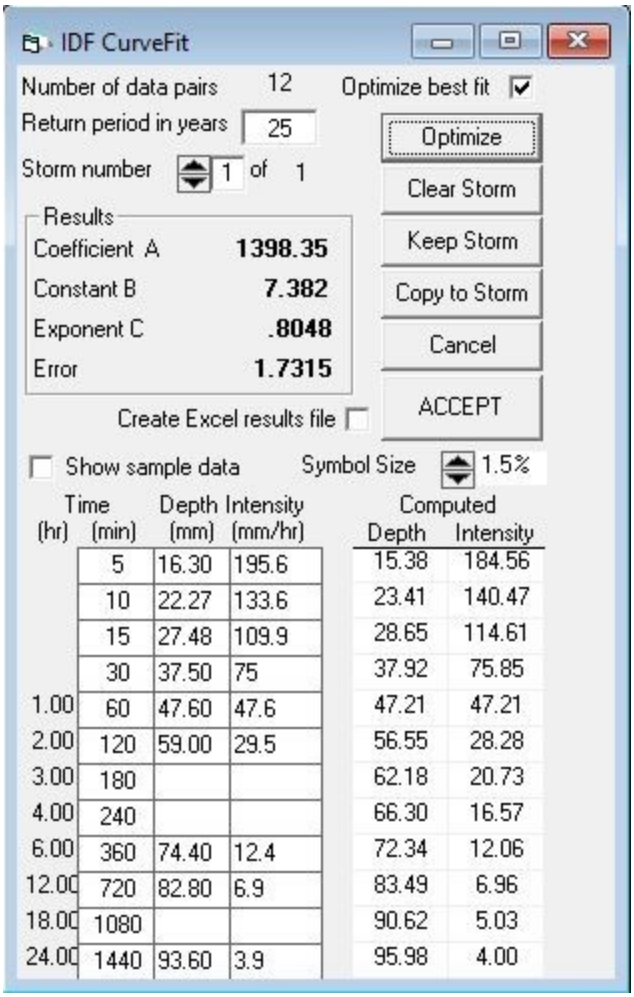


Time (hr)	Time (min)	Depth (mm)	Intensity (mm/hr)	Computed Depth	Computed Intensity
	5	11.53	138.4	11.02	132.28
	10	16.20	97.2	16.80	100.82
	15	19.85	79.4	20.58	82.32
	30	27.00	54	27.27	54.53
1.00	60	34.30	34.3	33.96	33.96
2.00	120	41.80	20.9	40.68	20.34
3.00	180			44.72	14.91
4.00	240			47.68	11.92
6.00	360	53.40	8.9	52.02	8.67
12.00	720	60.00	5	60.02	5.00
18.00	1080			65.12	3.62
24.00	1440	67.20	2.8	68.97	2.87

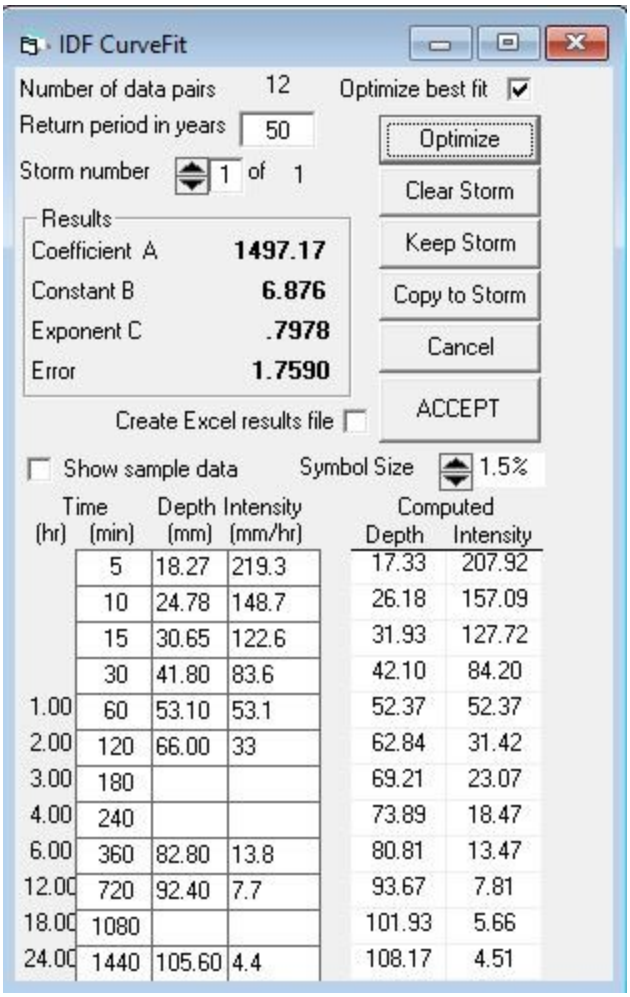
10-YEAR IDF TO CHICAGO CONVERSION USING MIDUSS



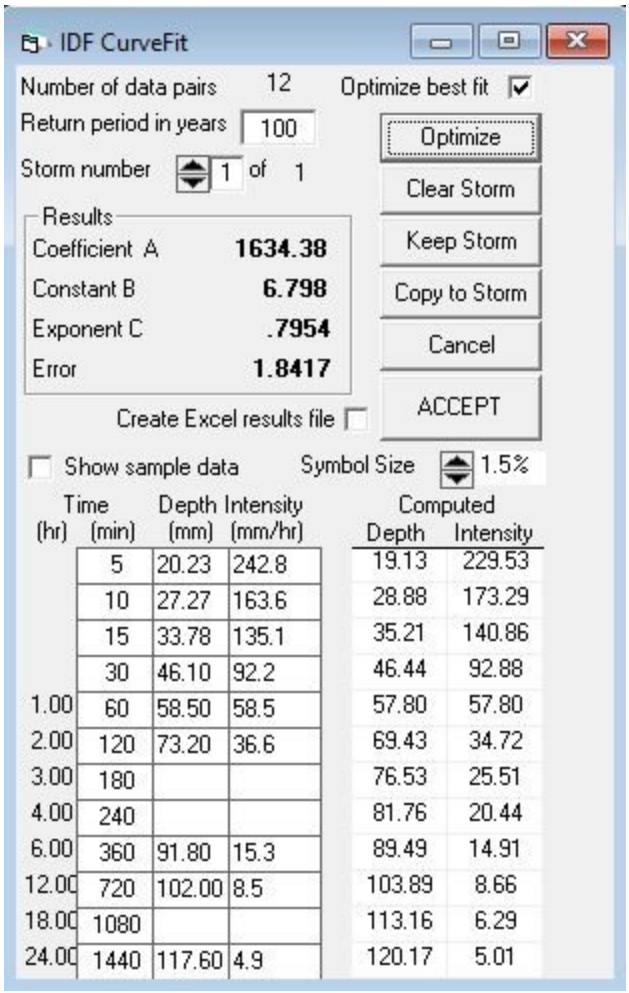
25-YEAR IDF TO CHICAGO CONVERSION USING MIDUSS



50-YEAR IDF TO CHICAGO CONVERSION USING MIDUSS



100-YEAR IDF TO CHICAGO CONVERSION USING MIDUSS



Time (hr)	Time (min)	Depth (mm)	Intensity (mm/hr)	Computed Depth	Computed Intensity
	5	20.23	242.8	19.13	229.53
	10	27.27	163.6	28.88	173.29
	15	33.78	135.1	35.21	140.86
	30	46.10	92.2	46.44	92.88
1.00	60	58.50	58.5	57.80	57.80
2.00	120	73.20	36.6	69.43	34.72
3.00	180			76.53	25.51
4.00	240			81.76	20.44
6.00	360	91.80	15.3	89.49	14.91
12.00	720	102.00	8.5	103.89	8.66
18.00	1080			113.16	6.29
24.00	1440	117.60	4.9	120.17	5.01

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CHICAGO HYETOGRAPH CREATION

DATE:	July 13, 2021
JOB No.:	SBM-18-0530

Client:	**Strathroy Turf Farms Ltd.**
Project:	**Kettle Creek Subdivision**
Location:	**37719 Lake Line, Port Stanley, Ontario**

ST THOMAS WPCP CHICAGO RAINFALL DISTRIBUTION PARAMETERS*

Return Period (years)	A,B,C Parameters A	B	C
2	737.970	7.382	0.8035
5	1009.820	7.472	0.8055
10	1178.220	7.382	0.8049
25	1398.350	7.382	0.8048
50	1497.170	6.876	0.7978
100	1634.380	6.798	0.7954

*Intensity i=A/(t+B)^C (mm/hr)

Starting Time= 0:00
Time Step= 0:01

r= 0.38	MTO DMM Section 8, Page 14
t_d= 1	
t_d * r= 0.38	
t_d * (1-r)= 0.62	
i_p= 133.70	peak rainfall intensity, mm/h
t_b= 68.4	time before the peak intensity, min
t_a= 111.6	time after the peak intensity, min

$$i_p = \frac{A}{(\Delta t + B)^c} = \text{peak rainfall intensity}$$

Before the peak:

$$i_b = \frac{A[((1-c)t_b/r) + B]}{[t_b/r + B]^{1+c}}$$

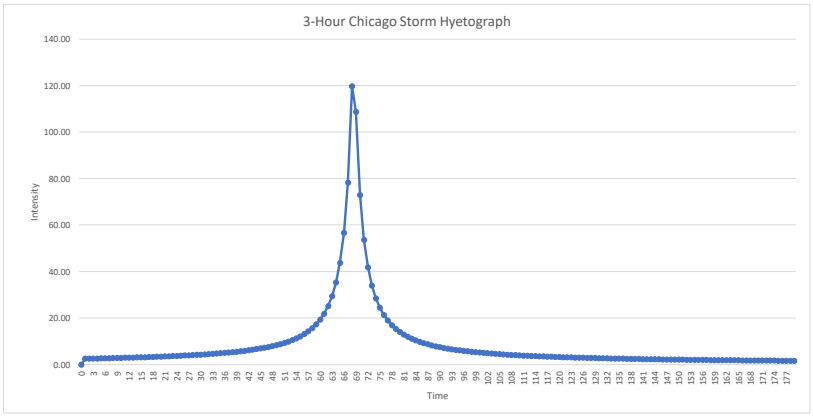
After the peak:

$$i_a = \frac{A[((1-c)t_a/(1-r)) + B]}{[t_a/(1-r) + B]^{1+c}}$$

Return Period (Years)	A,B,C Parameters A	B	C
2	737.970	7.382	0.804

2-Year Hyetograph

t_b OR t_a	Time (min)	Time (h:m)	Intensity
68.40	0	0:00	0.00
67.40	1	0:01	2.55
66.40	2	0:02	2.58
65.40	3	0:03	2.62
64.40	4	0:04	2.65
63.40	5	0:05	2.69
62.40	6	0:06	2.73
61.40	7	0:07	2.77
60.40	8	0:08	2.81
59.40	9	0:09	2.86
58.40	10	0:10	2.90
57.40	11	0:11	2.95
56.40	12	0:12	3.00
55.40	13	0:13	3.05
54.40	14	0:14	3.10
53.40	15	0:15	3.15
52.40	16	0:16	3.21
51.40	17	0:17	3.26
50.40	18	0:18	3.32
49.40	19	0:19	3.39
48.40	20	0:20	3.45
47.40	21	0:21	3.52
46.40	22	0:22	3.59
45.40	23	0:23	3.67
44.40	24	0:24	3.74
43.40	25	0:25	3.82
42.40	26	0:26	3.91
41.40	27	0:27	4.00
40.40	28	0:28	4.09
39.40	29	0:29	4.19
38.40	30	0:30	4.29
37.40	31	0:31	4.40
36.40	32	0:32	4.52
35.40	33	0:33	4.64
34.40	34	0:34	4.77
33.40	35	0:35	4.91
32.40	36	0:36	5.05
31.40	37	0:37	5.21
30.40	38	0:38	5.37
29.40	39	0:39	5.55
28.40	40	0:40	5.74
27.40	41	0:41	5.95
26.40	42	0:42	6.17
25.40	43	0:43	6.41
24.40	44	0:44	6.67
23.40	45	0:45	6.95
22.40	46	0:46	7.25
21.40	47	0:47	7.59
20.40	48	0:48	7.96
19.40	49	0:49	8.37
18.40	50	0:50	8.83
17.40	51	0:51	9.33
16.40	52	0:52	9.91
15.40	53	0:53	10.55
14.40	54	0:54	11.29
13.40	55	0:55	12.14
12.40	56	0:56	13.13
11.40	57	0:57	14.28
10.40	58	0:58	15.66
9.40	59	0:59	17.32
8.40	60	1:00	19.35
7.40	61	1:01	21.89
6.40	62	1:02	25.15



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5.40	63	1:03	29.45
4.40	64	1:04	35.34
3.40	65	1:05	43.79
2.40	66	1:06	56.72
1.40	67	1:07	78.34
0.40	68	1:08	119.69
0.60	69	1:09	108.77
1.60	70	1:10	72.96
2.60	71	1:11	53.63
3.60	72	1:12	41.83
4.60	73	1:13	34.00
5.60	74	1:14	28.49
6.60	75	1:15	24.43
7.60	76	1:16	21.34
8.60	77	1:17	18.91
9.60	78	1:18	16.96
10.60	79	1:19	15.36
11.60	80	1:20	14.04
12.60	81	1:21	12.92
13.60	82	1:22	11.96
14.60	83	1:23	11.14
15.60	84	1:24	10.42
16.60	85	1:25	9.79
17.60	86	1:26	9.23
18.60	87	1:27	8.73
19.60	88	1:28	8.28
20.60	89	1:29	7.88
21.60	90	1:30	7.52
22.60	91	1:31	7.19
23.60	92	1:32	6.89
24.60	93	1:33	6.61
25.60	94	1:34	6.36
26.60	95	1:35	6.12
27.60	96	1:36	5.91
28.60	97	1:37	5.70
29.60	98	1:38	5.52
30.60	99	1:39	5.34
31.60	100	1:40	5.18
32.60	101	1:41	5.02
33.60	102	1:42	4.88
34.60	103	1:43	4.74
35.60	104	1:44	4.62
36.60	105	1:45	4.49
37.60	106	1:46	4.38
38.60	107	1:47	4.27
39.60	108	1:48	4.17
40.60	109	1:49	4.07
41.60	110	1:50	3.98
42.60	111	1:51	3.89
43.60	112	1:52	3.81
44.60	113	1:53	3.73
45.60	114	1:54	3.65
46.60	115	1:55	3.58
47.60	116	1:56	3.51
48.60	117	1:57	3.44
49.60	118	1:58	3.37
50.60	119	1:59	3.31
51.60	120	2:00	3.25
52.60	121	2:01	3.20
53.60	122	2:02	3.14
54.60	123	2:03	3.09
55.60	124	2:04	3.04
56.60	125	2:05	2.99
57.60	126	2:06	2.94
58.60	127	2:07	2.89
59.60	128	2:08	2.85
60.60	129	2:09	2.81
61.60	130	2:10	2.76
62.60	131	2:11	2.72
63.60	132	2:12	2.68
64.60	133	2:13	2.65
65.60	134	2:14	2.61
66.60	135	2:15	2.57
67.60	136	2:16	2.54
68.60	137	2:17	2.51
69.60	138	2:18	2.47
70.60	139	2:19	2.44
71.60	140	2:20	2.41
72.60	141	2:21	2.38
73.60	142	2:22	2.35
74.60	143	2:23	2.32
75.60	144	2:24	2.30
76.60	145	2:25	2.27
77.60	146	2:26	2.24
78.60	147	2:27	2.22
79.60	148	2:28	2.19
80.60	149	2:29	2.17
81.60	150	2:30	2.14
82.60	151	2:31	2.12
83.60	152	2:32	2.10
84.60	153	2:33	2.08
85.60	154	2:34	2.05
86.60	155	2:35	2.03
87.60	156	2:36	2.01
88.60	157	2:37	1.99
89.60	158	2:38	1.97
90.60	159	2:39	1.95
91.60	160	2:40	1.93
92.60	161	2:41	1.92
93.60	162	2:42	1.90
94.60	163	2:43	1.88
95.60	164	2:44	1.86
96.60	165	2:45	1.85
97.60	166	2:46	1.83
98.60	167	2:47	1.81
99.60	168	2:48	1.80

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100.60	169	2:49	1.78
101.60	170	2:50	1.77
102.60	171	2:51	1.75
103.60	172	2:52	1.74
104.60	173	2:53	1.72
105.60	174	2:54	1.71
106.60	175	2:55	1.69
107.60	176	2:56	1.68
108.60	177	2:57	1.67
109.60	178	2:58	1.65
110.60	179	2:59	1.64
111.60	180	3:00	1.63

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CHICAGO HYETOGRAPH CREATION

DATE:	July 13, 2021
JOB No.:	SBM-18-0530

Client:	**Strathroy Turf Farms Ltd.**
Project:	**Kettle Creek Subdivision**
Location:	**37719 Lake Line, Port Stanley, Ontario**

ST THOMAS WPCP CHICAGO RAINFALL DISTRIBUTION PARAMETERS*

Return Period (years)	A,B,C Parameters A	B	C
2	737.970	7.382	0.8035
5	1009.820	7.472	0.8055
10	1178.220	7.382	0.8049
25	1398.350	7.382	0.8048
50	1497.170	6.876	0.7978
100	1634.380	6.798	0.7954

*Intensity i=A/(t+B)^C (mm/hr)

Starting Time= 0:00
Time Step= 0:01

r= 0.38 MTO DMM Section 8, Page 14

t_d= 1

t_d * r= 0.38

t_d * (1-r)= 0.62

i_p= 180.61 peak rainfall intensity, mm/h

t_b= 68.4 time before the peak intensity, min

t_a= 111.6 time after the peak intensity, min

$$i_p = \frac{A}{(\Delta t + B)^c} = \text{peak rainfall intensity}$$

Before the peak:

$$i_b = \frac{A[((1-c)t_b/r) + B]}{[t_b/r + B]^{1+c}}$$

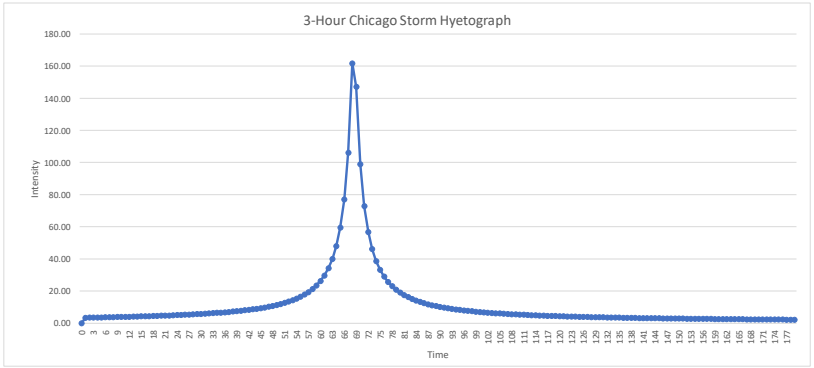
After the peak:

$$i_a = \frac{A[((1-c)t_a/(1-r)) + B]}{[t_a/(1-r) + B]^{1+c}}$$

Return Period (Years)	A,B,C Parameters A	B	C
5	1009.820	7.472	0.806

5-Year Hyetograph

t_b OR t_a	Time (min)	Time (h:m)	Intensity
68.40	0	0:00	0.00
67.40	1	0:01	3.42
66.40	2	0:02	3.47
65.40	3	0:03	3.52
64.40	4	0:04	3.57
63.40	5	0:05	3.62
62.40	6	0:06	3.67
61.40	7	0:07	3.73
60.40	8	0:08	3.78
59.40	9	0:09	3.84
58.40	10	0:10	3.90
57.40	11	0:11	3.97
56.40	12	0:12	4.03
55.40	13	0:13	4.10
54.40	14	0:14	4.17
53.40	15	0:15	4.24
52.40	16	0:16	4.32
51.40	17	0:17	4.39
50.40	18	0:18	4.48
49.40	19	0:19	4.56
48.40	20	0:20	4.65
47.40	21	0:21	4.74
46.40	22	0:22	4.84
45.40	23	0:23	4.94
44.40	24	0:24	5.04
43.40	25	0:25	5.15
42.40	26	0:26	5.27
41.40	27	0:27	5.39
40.40	28	0:28	5.51
39.40	29	0:29	5.65
38.40	30	0:30	5.79
37.40	31	0:31	5.94
36.40	32	0:32	6.09
35.40	33	0:33	6.26
34.40	34	0:34	6.43
33.40	35	0:35	6.62
32.40	36	0:36	6.82
31.40	37	0:37	7.03
30.40	38	0:38	7.25
29.40	39	0:39	7.49
28.40	40	0:40	7.75
27.40	41	0:41	8.03
26.40	42	0:42	8.33
25.40	43	0:43	8.65
24.40	44	0:44	9.00
23.40	45	0:45	9.39
22.40	46	0:46	9.80
21.40	47	0:47	10.26
20.40	48	0:48	10.76
19.40	49	0:49	11.32
18.40	50	0:50	11.94
17.40	51	0:51	12.63
16.40	52	0:52	13.41
15.40	53	0:53	14.29
14.40	54	0:54	15.29
13.40	55	0:55	16.45
12.40	56	0:56	17.79
11.40	57	0:57	19.36
10.40	58	0:58	21.24
9.40	59	0:59	23.49
8.40	60	1:00	26.26
7.40	61	1:01	29.72
6.40	62	1:02	34.15



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5.40	63	1:03	40.00
4.40	64	1:04	48.00
3.40	65	1:05	59.47
2.40	66	1:06	76.99
1.40	67	1:07	106.21
0.40	68	1:08	161.84
0.60	69	1:09	147.18
1.60	70	1:10	98.95
2.60	71	1:11	72.80
3.60	72	1:12	56.80
4.60	73	1:13	46.17
5.60	74	1:14	38.68
6.60	75	1:15	33.17
7.60	76	1:16	28.96
8.60	77	1:17	25.66
9.60	78	1:18	23.00
10.60	79	1:19	20.83
11.60	80	1:20	19.03
12.60	81	1:21	17.50
13.60	82	1:22	16.20
14.60	83	1:23	15.08
15.60	84	1:24	14.10
16.60	85	1:25	13.25
17.60	86	1:26	12.49
18.60	87	1:27	11.81
19.60	88	1:28	11.21
20.60	89	1:29	10.66
21.60	90	1:30	10.17
22.60	91	1:31	9.72
23.60	92	1:32	9.31
24.60	93	1:33	8.93
25.60	94	1:34	8.59
26.60	95	1:35	8.27
27.60	96	1:36	7.97
28.60	97	1:37	7.70
29.60	98	1:38	7.44
30.60	99	1:39	7.21
31.60	100	1:40	6.98
32.60	101	1:41	6.78
33.60	102	1:42	6.58
34.60	103	1:43	6.40
35.60	104	1:44	6.22
36.60	105	1:45	6.06
37.60	106	1:46	5.91
38.60	107	1:47	5.76
39.60	108	1:48	5.62
40.60	109	1:49	5.49
41.60	110	1:50	5.36
42.60	111	1:51	5.24
43.60	112	1:52	5.13
44.60	113	1:53	5.02
45.60	114	1:54	4.92
46.60	115	1:55	4.82
47.60	116	1:56	4.72
48.60	117	1:57	4.63
49.60	118	1:58	4.54
50.60	119	1:59	4.46
51.60	120	2:00	4.38
52.60	121	2:01	4.30
53.60	122	2:02	4.23
54.60	123	2:03	4.15
55.60	124	2:04	4.09
56.60	125	2:05	4.02
57.60	126	2:06	3.95
58.60	127	2:07	3.89
59.60	128	2:08	3.83
60.60	129	2:09	3.77
61.60	130	2:10	3.72
62.60	131	2:11	3.66
63.60	132	2:12	3.61
64.60	133	2:13	3.56
65.60	134	2:14	3.51
66.60	135	2:15	3.46
67.60	136	2:16	3.41
68.60	137	2:17	3.37
69.60	138	2:18	3.33
70.60	139	2:19	3.28
71.60	140	2:20	3.24
72.60	141	2:21	3.20
73.60	142	2:22	3.16
74.60	143	2:23	3.12
75.60	144	2:24	3.09
76.60	145	2:25	3.05
77.60	146	2:26	3.01
78.60	147	2:27	2.98
79.60	148	2:28	2.95
80.60	149	2:29	2.91
81.60	150	2:30	2.88
82.60	151	2:31	2.85
83.60	152	2:32	2.82
84.60	153	2:33	2.79
85.60	154	2:34	2.76
86.60	155	2:35	2.73
87.60	156	2:36	2.70
88.60	157	2:37	2.68
89.60	158	2:38	2.65
90.60	159	2:39	2.62
91.60	160	2:40	2.60
92.60	161	2:41	2.57
93.60	162	2:42	2.55
94.60	163	2:43	2.52
95.60	164	2:44	2.50
96.60	165	2:45	2.48
97.60	166	2:46	2.46
98.60	167	2:47	2.43
99.60	168	2:48	2.41

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100.60	169	2:49	2.39
101.60	170	2:50	2.37
102.60	171	2:51	2.35
103.60	172	2:52	2.33
104.60	173	2:53	2.31
105.60	174	2:54	2.29
106.60	175	2:55	2.27
107.60	176	2:56	2.25
108.60	177	2:57	2.24
109.60	178	2:58	2.22
110.60	179	2:59	2.20
111.60	180	3:00	2.18

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CHICAGO HYETOGRAPH CREATION

DATE:	July 13, 2021
JOB No.:	SBM-18-0530

Client:	**Strathroy Turf Farms Ltd.**
Project:	**Kettle Creek Subdivision**
Location:	**37719 Lake Line, Port Stanley, Ontario**

ST THOMAS WPCP CHICAGO RAINFALL DISTRIBUTION PARAMETERS*

Return Period (years)	A,B,C Parameters A	B	C
2	737.970	7.382	0.8035
5	1009.820	7.472	0.8055
10	1178.220	7.382	0.8049
25	1398.350	7.382	0.8048
50	1497.170	6.876	0.7978
100	1634.380	6.798	0.7954

*Intensity i=A/(t+B)^C (mm/hr)

Starting Time= 0:00
Time Step= 0:01
r= 0.38 MTO DMM Section 8, Page 14
t_d= 1
t_d * r= 0.38
t_d * (1-r)= 0.62
i_p= 212.83 peak rainfall intensity, mm/h
t_b= 68.4 time before the peak intensity, min
t_a= 111.6 time after the peak intensity, min

$$i_p = \frac{A}{(\Delta t + B)^c} = \text{peak rainfall intensity}$$

Before the peak:

$$i_b = \frac{A[((1-c)t_b/r) + B]}{[t_b/r + B]^{1+c}}$$

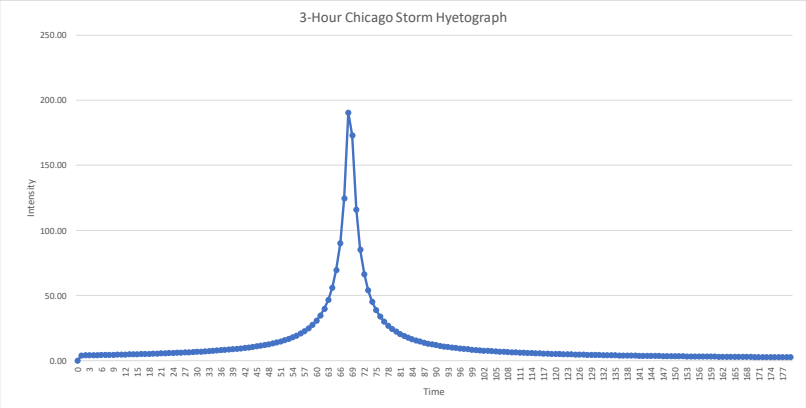
After the peak:

$$i_a = \frac{A[((1-c)t_a/(1-r)) + B]}{[t_a/(1-r) + B]^{1+c}}$$

Return Period (Years)	A,B,C Parameters A	B	C
10	1178.220	7.382	0.805

10-Year Hyetograph

t_b OR t_a	Time (min)	Time (h:m)	Intensity
68.40	0	0:00	0.00
67.40	1	0:01	4.01
66.40	2	0:02	4.07
65.40	3	0:03	4.12
64.40	4	0:04	4.18
63.40	5	0:05	4.24
62.40	6	0:06	4.30
61.40	7	0:07	4.37
60.40	8	0:08	4.43
59.40	9	0:09	4.50
58.40	10	0:10	4.57
57.40	11	0:11	4.65
56.40	12	0:12	4.72
55.40	13	0:13	4.80
54.40	14	0:14	4.88
53.40	15	0:15	4.97
52.40	16	0:16	5.06
51.40	17	0:17	5.15
50.40	18	0:18	5.24
49.40	19	0:19	5.34
48.40	20	0:20	5.44
47.40	21	0:21	5.55
46.40	22	0:22	5.66
45.40	23	0:23	5.78
44.40	24	0:24	5.90
43.40	25	0:25	6.03
42.40	26	0:26	6.17
41.40	27	0:27	6.31
40.40	28	0:28	6.45
39.40	29	0:29	6.61
38.40	30	0:30	6.77
37.40	31	0:31	6.95
36.40	32	0:32	7.13
35.40	33	0:33	7.32
34.40	34	0:34	7.53
33.40	35	0:35	7.75
32.40	36	0:36	7.98
31.40	37	0:37	8.22
30.40	38	0:38	8.49
29.40	39	0:39	8.77
28.40	40	0:40	9.07
27.40	41	0:41	9.39
26.40	42	0:42	9.74
25.40	43	0:43	10.12
24.40	44	0:44	10.53
23.40	45	0:45	10.98
22.40	46	0:46	11.46
21.40	47	0:47	12.00
20.40	48	0:48	12.58
19.40	49	0:49	13.23
18.40	50	0:50	13.96
17.40	51	0:51	14.76
16.40	52	0:52	15.67
15.40	53	0:53	16.70
14.40	54	0:54	17.87
13.40	55	0:55	19.22
12.40	56	0:56	20.78
11.40	57	0:57	22.62
10.40	58	0:58	24.80
9.40	59	0:59	27.44
8.40	60	1:00	30.67
7.40	61	1:01	34.71
6.40	62	1:02	39.89



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5.40	63	1:03	46.73
4.40	64	1:04	56.10
3.40	65	1:05	69.55
2.40	66	1:06	90.14
1.40	67	1:07	124.58
0.40	68	1:08	190.49
0.60	69	1:09	173.08
1.60	70	1:10	116.01
2.60	71	1:11	85.21
3.60	72	1:12	66.42
4.60	73	1:13	53.96
5.60	74	1:14	45.20
6.60	75	1:15	38.74
7.60	76	1:16	33.82
8.60	77	1:17	29.96
9.60	78	1:18	26.87
10.60	79	1:19	24.33
11.60	80	1:20	22.23
12.60	81	1:21	20.45
13.60	82	1:22	18.93
14.60	83	1:23	17.62
15.60	84	1:24	16.48
16.60	85	1:25	15.48
17.60	86	1:26	14.59
18.60	87	1:27	13.80
19.60	88	1:28	13.10
20.60	89	1:29	12.46
21.60	90	1:30	11.89
22.60	91	1:31	11.36
23.60	92	1:32	10.88
24.60	93	1:33	10.45
25.60	94	1:34	10.04
26.60	95	1:35	9.67
27.60	96	1:36	9.33
28.60	97	1:37	9.01
29.60	98	1:38	8.71
30.60	99	1:39	8.43
31.60	100	1:40	8.17
32.60	101	1:41	7.93
33.60	102	1:42	7.70
34.60	103	1:43	7.49
35.60	104	1:44	7.28
36.60	105	1:45	7.09
37.60	106	1:46	6.91
38.60	107	1:47	6.74
39.60	108	1:48	6.58
40.60	109	1:49	6.42
41.60	110	1:50	6.28
42.60	111	1:51	6.14
43.60	112	1:52	6.01
44.60	113	1:53	5.88
45.60	114	1:54	5.76
46.60	115	1:55	5.64
47.60	116	1:56	5.53
48.60	117	1:57	5.42
49.60	118	1:58	5.32
50.60	119	1:59	5.22
51.60	120	2:00	5.13
52.60	121	2:01	5.04
53.60	122	2:02	4.95
54.60	123	2:03	4.87
55.60	124	2:04	4.79
56.60	125	2:05	4.71
57.60	126	2:06	4.63
58.60	127	2:07	4.56
59.60	128	2:08	4.49
60.60	129	2:09	4.42
61.60	130	2:10	4.36
62.60	131	2:11	4.29
63.60	132	2:12	4.23
64.60	133	2:13	4.17
65.60	134	2:14	4.11
66.60	135	2:15	4.06
67.60	136	2:16	4.00
68.60	137	2:17	3.95
69.60	138	2:18	3.90
70.60	139	2:19	3.85
71.60	140	2:20	3.80
72.60	141	2:21	3.75
73.60	142	2:22	3.70
74.60	143	2:23	3.66
75.60	144	2:24	3.62
76.60	145	2:25	3.57
77.60	146	2:26	3.53
78.60	147	2:27	3.49
79.60	148	2:28	3.45
80.60	149	2:29	3.41
81.60	150	2:30	3.38
82.60	151	2:31	3.34
83.60	152	2:32	3.30
84.60	153	2:33	3.27
85.60	154	2:34	3.24
86.60	155	2:35	3.20
87.60	156	2:36	3.17
88.60	157	2:37	3.14
89.60	158	2:38	3.11
90.60	159	2:39	3.08
91.60	160	2:40	3.05
92.60	161	2:41	3.02
93.60	162	2:42	2.99
94.60	163	2:43	2.96
95.60	164	2:44	2.93
96.60	165	2:45	2.91
97.60	166	2:46	2.88
98.60	167	2:47	2.85
99.60	168	2:48	2.83

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100.60	169	2:49	2.80
101.60	170	2:50	2.78
102.60	171	2:51	2.76
103.60	172	2:52	2.73
104.60	173	2:53	2.71
105.60	174	2:54	2.69
106.60	175	2:55	2.67
107.60	176	2:56	2.64
108.60	177	2:57	2.62
109.60	178	2:58	2.60
110.60	179	2:59	2.58
111.60	180	3:00	2.56

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CHICAGO HYETOGRAPH CREATION

DATE:	July 13, 2021
JOB No.:	SBM-18-0530

Client:	**Strathroy Turf Farms Ltd.**
Project:	**Kettle Creek Subdivision**
Location:	**37719 Lake Line, Port Stanley, Ontario**

ST THOMAS WPCP CHICAGO RAINFALL DISTRIBUTION PARAMETERS*

Return Period (years)	A,B,C Parameters A	B	C
2	737.970	7.382	0.8035
5	1009.820	7.472	0.8055
10	1178.220	7.382	0.8049
25	1398.350	7.382	0.8048
50	1497.170	6.876	0.7978
100	1634.380	6.798	0.7954

*Intensity i=A/(t+B)^C (mm/hr)

$$i_p = \frac{A}{(\Delta t + B)^c} = \text{peak rainfall intensity}$$

Before the peak:

$$i_b = \frac{A[((1-c)t_b/r) + B]}{[t_b/r + B]^{1+c}}$$

After the peak:

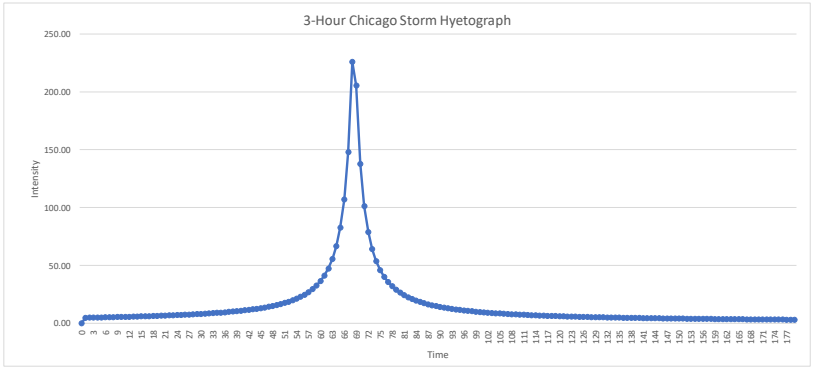
$$i_a = \frac{A[((1-c)t_a/(1-r)) + B]}{[t_a/(1-r) + B]^{1+c}}$$

Starting Time= 0:00
Time Step= 0:01
r= 0.38 MTO DMM Section 8, Page 14
t_d= 1
t_d * r= 0.38
t_d * (1-r)= 0.62
i_p= 252.64 peak rainfall intensity, mm/h
t_b= 68.4 time before the peak intensity, min
t_a= 111.6 time after the peak intensity, min

Return Period (Years)	A,B,C Parameters A	B	C
25	1398.350	7.382	0.805

25-Year Hyetograph

t_b OR t_a	Time (min)	Time (h:m)	Intensity
68.40	0	0:00	0.00
67.40	1	0:01	4.77
66.40	2	0:02	4.83
65.40	3	0:03	4.90
64.40	4	0:04	4.97
63.40	5	0:05	5.04
62.40	6	0:06	5.11
61.40	7	0:07	5.19
60.40	8	0:08	5.27
59.40	9	0:09	5.35
58.40	10	0:10	5.43
57.40	11	0:11	5.52
56.40	12	0:12	5.61
55.40	13	0:13	5.70
54.40	14	0:14	5.80
53.40	15	0:15	5.90
52.40	16	0:16	6.01
51.40	17	0:17	6.11
50.40	18	0:18	6.23
49.40	19	0:19	6.34
48.40	20	0:20	6.47
47.40	21	0:21	6.59
46.40	22	0:22	6.73
45.40	23	0:23	6.87
44.40	24	0:24	7.01
43.40	25	0:25	7.16
42.40	26	0:26	7.32
41.40	27	0:27	7.49
40.40	28	0:28	7.67
39.40	29	0:29	7.85
38.40	30	0:30	8.05
37.40	31	0:31	8.25
36.40	32	0:32	8.47
35.40	33	0:33	8.70
34.40	34	0:34	8.94
33.40	35	0:35	9.20
32.40	36	0:36	9.47
31.40	37	0:37	9.77
30.40	38	0:38	10.08
29.40	39	0:39	10.41
28.40	40	0:40	10.77
27.40	41	0:41	11.16
26.40	42	0:42	11.57
25.40	43	0:43	12.02
24.40	44	0:44	12.51
23.40	45	0:45	13.04
22.40	46	0:46	13.61
21.40	47	0:47	14.25
20.40	48	0:48	14.95
19.40	49	0:49	15.72
18.40	50	0:50	16.57
17.40	51	0:51	17.53
16.40	52	0:52	18.61
15.40	53	0:53	19.83
14.40	54	0:54	21.22
13.40	55	0:55	22.82
12.40	56	0:56	24.68
11.40	57	0:57	26.86
10.40	58	0:58	29.45
9.40	59	0:59	32.58
8.40	60	1:00	36.42
7.40	61	1:01	41.22
6.40	62	1:02	47.37



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5.40	63	1:03	55.49
4.40	64	1:04	66.61
3.40	65	1:05	82.58
2.40	66	1:06	107.01
1.40	67	1:07	147.90
0.40	68	1:08	226.13
0.60	69	1:09	205.47
1.60	70	1:10	137.72
2.60	71	1:11	101.17
3.60	72	1:12	78.86
4.60	73	1:13	64.07
5.60	74	1:14	53.66
6.60	75	1:15	46.00
7.60	76	1:16	40.16
8.60	77	1:17	35.58
9.60	78	1:18	31.90
10.60	79	1:19	28.90
11.60	80	1:20	26.39
12.60	81	1:21	24.28
13.60	82	1:22	22.48
14.60	83	1:23	20.93
15.60	84	1:24	19.57
16.60	85	1:25	18.38
17.60	86	1:26	17.33
18.60	87	1:27	16.40
19.60	88	1:28	15.56
20.60	89	1:29	14.80
21.60	90	1:30	14.12
22.60	91	1:31	13.49
23.60	92	1:32	12.93
24.60	93	1:33	12.41
25.60	94	1:34	11.93
26.60	95	1:35	11.49
27.60	96	1:36	11.08
28.60	97	1:37	10.70
29.60	98	1:38	10.34
30.60	99	1:39	10.02
31.60	100	1:40	9.71
32.60	101	1:41	9.42
33.60	102	1:42	9.15
34.60	103	1:43	8.89
35.60	104	1:44	8.65
36.60	105	1:45	8.43
37.60	106	1:46	8.21
38.60	107	1:47	8.01
39.60	108	1:48	7.81
40.60	109	1:49	7.63
41.60	110	1:50	7.46
42.60	111	1:51	7.29
43.60	112	1:52	7.13
44.60	113	1:53	6.98
45.60	114	1:54	6.84
46.60	115	1:55	6.70
47.60	116	1:56	6.57
48.60	117	1:57	6.44
49.60	118	1:58	6.32
50.60	119	1:59	6.20
51.60	120	2:00	6.09
52.60	121	2:01	5.98
53.60	122	2:02	5.88
54.60	123	2:03	5.78
55.60	124	2:04	5.69
56.60	125	2:05	5.59
57.60	126	2:06	5.50
58.60	127	2:07	5.42
59.60	128	2:08	5.33
60.60	129	2:09	5.25
61.60	130	2:10	5.17
62.60	131	2:11	5.10
63.60	132	2:12	5.02
64.60	133	2:13	4.95
65.60	134	2:14	4.89
66.60	135	2:15	4.82
67.60	136	2:16	4.75
68.60	137	2:17	4.69
69.60	138	2:18	4.63
70.60	139	2:19	4.57
71.60	140	2:20	4.51
72.60	141	2:21	4.46
73.60	142	2:22	4.40
74.60	143	2:23	4.35
75.60	144	2:24	4.30
76.60	145	2:25	4.25
77.60	146	2:26	4.20
78.60	147	2:27	4.15
79.60	148	2:28	4.10
80.60	149	2:29	4.06
81.60	150	2:30	4.01
82.60	151	2:31	3.97
83.60	152	2:32	3.93
84.60	153	2:33	3.88
85.60	154	2:34	3.84
86.60	155	2:35	3.80
87.60	156	2:36	3.77
88.60	157	2:37	3.73
89.60	158	2:38	3.69
90.60	159	2:39	3.65
91.60	160	2:40	3.62
92.60	161	2:41	3.58
93.60	162	2:42	3.55
94.60	163	2:43	3.52
95.60	164	2:44	3.48
96.60	165	2:45	3.45
97.60	166	2:46	3.42
98.60	167	2:47	3.39
99.60	168	2:48	3.36

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100.60	169	2:49	3.33
101.60	170	2:50	3.30
102.60	171	2:51	3.27
103.60	172	2:52	3.25
104.60	173	2:53	3.22
105.60	174	2:54	3.19
106.60	175	2:55	3.17
107.60	176	2:56	3.14
108.60	177	2:57	3.11
109.60	178	2:58	3.09
110.60	179	2:59	3.07
111.60	180	3:00	3.04

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CHICAGO HYETOGRAPH CREATION

DATE:	July 13, 2021
JOB No.:	SBM-18-0530

Client:	**Strathroy Turf Farms Ltd.**
Project:	**Kettle Creek Subdivision**
Location:	**37719 Lake Line, Port Stanley, Ontario**

ST THOMAS WPCP CHICAGO RAINFALL DISTRIBUTION PARAMETERS*

Return Period (years)	A,B,C Parameters		
	A	B	C
2	737.970	7.382	0.8035
5	1009.820	7.472	0.8055
10	1178.220	7.382	0.8049
25	1398.350	7.382	0.8048
50	1497.170	6.876	0.7978
100	1634.380	6.798	0.7954

*Intensity i=A/(t+B)^C (mm/hr)

Starting Time= 0:00
Time Step= 0:01
r= 0.38 MTO DMM Section 8, Page 14
t_d= 1
t_d * r= 0.38
t_d * (1-r)= 0.62
i_p= 288.53 peak rainfall intensity, mm/h
t_b= 68.4 time before the peak intensity, min
t_a= 111.6 time after the peak intensity, min

$$i_p = \frac{A}{(\Delta t + B)^c} = \text{peak rainfall intensity}$$

Before the peak:

$$i_b = \frac{A[((1-c)t_b/r) + B]}{[t_b/r + B]^{1+c}}$$

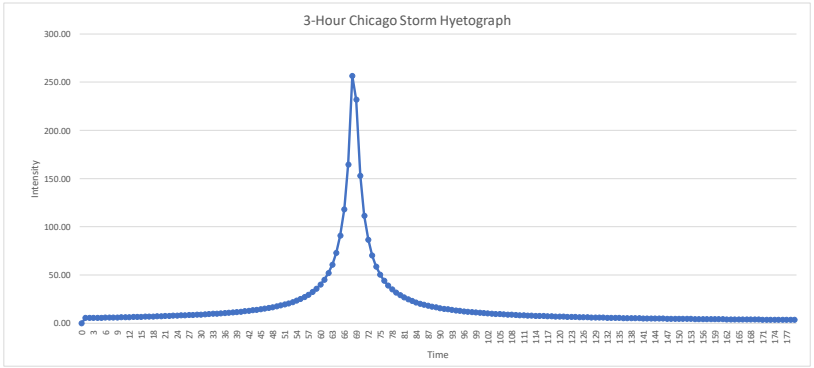
After the peak:

$$i_a = \frac{A[((1-c)t_a/(1-r)) + B]}{[t_a/(1-r) + B]^{1+c}}$$

Return Period (Years)	A,B,C Parameters		
	A	B	C
50	1497.170	6.876	0.798

50-Year Hyetograph

t_b OR t_a	Time (min)	Time (h:m)	Intensity
68.40	0	0:00	0.00
67.40	1	0:01	5.41
66.40	2	0:02	5.48
65.40	3	0:03	5.56
64.40	4	0:04	5.64
63.40	5	0:05	5.72
62.40	6	0:06	5.80
61.40	7	0:07	5.88
60.40	8	0:08	5.97
59.40	9	0:09	6.06
58.40	10	0:10	6.15
57.40	11	0:11	6.25
56.40	12	0:12	6.35
55.40	13	0:13	6.46
54.40	14	0:14	6.56
53.40	15	0:15	6.67
52.40	16	0:16	6.79
51.40	17	0:17	6.91
50.40	18	0:18	7.04
49.40	19	0:19	7.17
48.40	20	0:20	7.30
47.40	21	0:21	7.44
46.40	22	0:22	7.59
45.40	23	0:23	7.74
44.40	24	0:24	7.90
43.40	25	0:25	8.07
42.40	26	0:26	8.25
41.40	27	0:27	8.43
40.40	28	0:28	8.63
39.40	29	0:29	8.83
38.40	30	0:30	9.04
37.40	31	0:31	9.27
36.40	32	0:32	9.51
35.40	33	0:33	9.76
34.40	34	0:34	10.03
33.40	35	0:35	10.31
32.40	36	0:36	10.61
31.40	37	0:37	10.94
30.40	38	0:38	11.28
29.40	39	0:39	11.64
28.40	40	0:40	12.04
27.40	41	0:41	12.46
26.40	42	0:42	12.91
25.40	43	0:43	13.40
24.40	44	0:44	13.93
23.40	45	0:45	14.51
22.40	46	0:46	15.14
21.40	47	0:47	15.83
20.40	48	0:48	16.60
19.40	49	0:49	17.44
18.40	50	0:50	18.37
17.40	51	0:51	19.41
16.40	52	0:52	20.58
15.40	53	0:53	21.91
14.40	54	0:54	23.42
13.40	55	0:55	25.16
12.40	56	0:56	27.18
11.40	57	0:57	29.55
10.40	58	0:58	32.37
9.40	59	0:59	35.77
8.40	60	1:00	39.95
7.40	61	1:01	45.18
6.40	62	1:02	51.90



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5.40	63	1:03	60.81
4.40	64	1:04	73.06
3.40	65	1:05	90.77
2.40	66	1:06	118.17
1.40	67	1:07	164.79
0.40	68	1:08	256.61
0.60	69	1:09	232.04
1.60	70	1:10	153.10
2.60	71	1:11	111.58
3.60	72	1:12	86.63
4.60	73	1:13	70.26
5.60	74	1:14	58.81
6.60	75	1:15	50.41
7.60	76	1:16	44.03
8.60	77	1:17	39.04
9.60	78	1:18	35.04
10.60	79	1:19	31.77
11.60	80	1:20	29.05
12.60	81	1:21	26.75
13.60	82	1:22	24.79
14.60	83	1:23	23.10
15.60	84	1:24	21.63
16.60	85	1:25	20.34
17.60	86	1:26	19.19
18.60	87	1:27	18.17
19.60	88	1:28	17.26
20.60	89	1:29	16.44
21.60	90	1:30	15.69
22.60	91	1:31	15.01
23.60	92	1:32	14.39
24.60	93	1:33	13.82
25.60	94	1:34	13.30
26.60	95	1:35	12.82
27.60	96	1:36	12.37
28.60	97	1:37	11.96
29.60	98	1:38	11.57
30.60	99	1:39	11.21
31.60	100	1:40	10.87
32.60	101	1:41	10.55
33.60	102	1:42	10.26
34.60	103	1:43	9.97
35.60	104	1:44	9.71
36.60	105	1:45	9.46
37.60	106	1:46	9.22
38.60	107	1:47	9.00
39.60	108	1:48	8.79
40.60	109	1:49	8.59
41.60	110	1:50	8.39
42.60	111	1:51	8.21
43.60	112	1:52	8.04
44.60	113	1:53	7.87
45.60	114	1:54	7.71
46.60	115	1:55	7.56
47.60	116	1:56	7.41
48.60	117	1:57	7.27
49.60	118	1:58	7.14
50.60	119	1:59	7.01
51.60	120	2:00	6.89
52.60	121	2:01	6.77
53.60	122	2:02	6.65
54.60	123	2:03	6.54
55.60	124	2:04	6.43
56.60	125	2:05	6.33
57.60	126	2:06	6.23
58.60	127	2:07	6.14
59.60	128	2:08	6.04
60.60	129	2:09	5.95
61.60	130	2:10	5.87
62.60	131	2:11	5.78
63.60	132	2:12	5.70
64.60	133	2:13	5.62
65.60	134	2:14	5.54
66.60	135	2:15	5.47
67.60	136	2:16	5.40
68.60	137	2:17	5.33
69.60	138	2:18	5.26
70.60	139	2:19	5.19
71.60	140	2:20	5.13
72.60	141	2:21	5.07
73.60	142	2:22	5.01
74.60	143	2:23	4.95
75.60	144	2:24	4.89
76.60	145	2:25	4.83
77.60	146	2:26	4.78
78.60	147	2:27	4.72
79.60	148	2:28	4.67
80.60	149	2:29	4.62
81.60	150	2:30	4.57
82.60	151	2:31	4.52
83.60	152	2:32	4.47
84.60	153	2:33	4.43
85.60	154	2:34	4.38
86.60	155	2:35	4.34
87.60	156	2:36	4.29
88.60	157	2:37	4.25
89.60	158	2:38	4.21
90.60	159	2:39	4.17
91.60	160	2:40	4.13
92.60	161	2:41	4.09
93.60	162	2:42	4.05
94.60	163	2:43	4.02
95.60	164	2:44	3.98
96.60	165	2:45	3.94
97.60	166	2:46	3.91
98.60	167	2:47	3.87
99.60	168	2:48	3.84

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100.60	169	2:49	3.81
101.60	170	2:50	3.77
102.60	171	2:51	3.74
103.60	172	2:52	3.71
104.60	173	2:53	3.68
105.60	174	2:54	3.65
106.60	175	2:55	3.62
107.60	176	2:56	3.59
108.60	177	2:57	3.56
109.60	178	2:58	3.54
110.60	179	2:59	3.51
111.60	180	3:00	3.48

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CHICAGO HYETOGRAPH CREATION

DATE:	July 13, 2021
JOB No.:	SBM-18-0530

Client:	**Strathroy Turf Farms Ltd.**
Project:	**Kettle Creek Subdivision**
Location:	**37719 Lake Line, Port Stanley, Ontario**

ST THOMAS WPCP CHICAGO RAINFALL DISTRIBUTION PARAMETERS*

Return Period (years)	A,B,C Parameters A	B	C
2	737.970	7.382	0.8035
5	1009.820	7.472	0.8055
10	1178.220	7.382	0.8049
25	1398.350	7.382	0.8048
50	1497.170	6.876	0.7978
100	1634.380	6.798	0.7954

*Intensity i=A/(t+B)^C (mm/hr)

Starting Time= 0:00
Time Step= 0:01
r= 0.38 MTO DMM Section 8, Page 14
t_d= 1
t_d * r= 0.38
t_d * (1-r)= 0.62
i_p= 319.06 peak rainfall intensity, mm/h
t_b= 68.4 time before the peak intensity, min
t_a= 111.6 time after the peak intensity, min

$$i_p = \frac{A}{(\Delta t + B)^c} = \text{peak rainfall intensity}$$

Before the peak:

$$i_b = \frac{A[((1-c)t_b/r) + B]}{[t_b/r + B]^{1+c}}$$

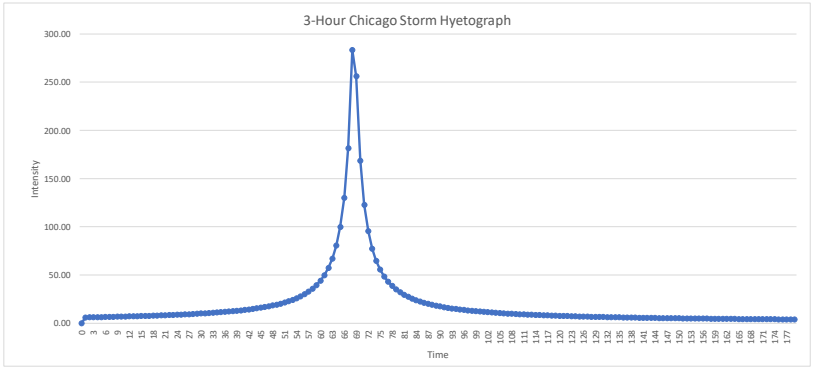
After the peak:

$$i_a = \frac{A[((1-c)t_a/(1-r)) + B]}{[t_a/(1-r) + B]^{1+c}}$$

Return Period (Years)	A,B,C Parameters A	B	C
100	1634.380	6.798	0.795

100-Year Hyetograph

t_b OR t_a	Time (min)	Time (h:m)	Intensity
68.40	0	0:00	0.00
67.40	1	0:01	6.04
66.40	2	0:02	6.12
65.40	3	0:03	6.20
64.40	4	0:04	6.29
63.40	5	0:05	6.37
62.40	6	0:06	6.46
61.40	7	0:07	6.56
60.40	8	0:08	6.66
59.40	9	0:09	6.76
58.40	10	0:10	6.86
57.40	11	0:11	6.97
56.40	12	0:12	7.08
55.40	13	0:13	7.19
54.40	14	0:14	7.31
53.40	15	0:15	7.43
52.40	16	0:16	7.56
51.40	17	0:17	7.70
50.40	18	0:18	7.83
49.40	19	0:19	7.98
48.40	20	0:20	8.13
47.40	21	0:21	8.28
46.40	22	0:22	8.45
45.40	23	0:23	8.62
44.40	24	0:24	8.80
43.40	25	0:25	8.98
42.40	26	0:26	9.18
41.40	27	0:27	9.38
40.40	28	0:28	9.60
39.40	29	0:29	9.82
38.40	30	0:30	10.06
37.40	31	0:31	10.31
36.40	32	0:32	10.57
35.40	33	0:33	10.85
34.40	34	0:34	11.15
33.40	35	0:35	11.46
32.40	36	0:36	11.79
31.40	37	0:37	12.15
30.40	38	0:38	12.53
29.40	39	0:39	12.93
28.40	40	0:40	13.36
27.40	41	0:41	13.83
26.40	42	0:42	14.33
25.40	43	0:43	14.87
24.40	44	0:44	15.46
23.40	45	0:45	16.10
22.40	46	0:46	16.79
21.40	47	0:47	17.55
20.40	48	0:48	18.39
19.40	49	0:49	19.32
18.40	50	0:50	20.34
17.40	51	0:51	21.49
16.40	52	0:52	22.78
15.40	53	0:53	24.24
14.40	54	0:54	25.91
13.40	55	0:55	27.82
12.40	56	0:56	30.04
11.40	57	0:57	32.65
10.40	58	0:58	35.75
9.40	59	0:59	39.49
8.40	60	1:00	44.08
7.40	61	1:01	49.83
6.40	62	1:02	57.22



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5.40	63	1:03	67.01
4.40	64	1:04	80.48
3.40	65	1:05	99.98
2.40	66	1:06	130.18
1.40	67	1:07	181.67
0.40	68	1:08	283.51
0.60	69	1:09	256.21
1.60	70	1:10	168.75
2.60	71	1:11	122.91
3.60	72	1:12	95.43
4.60	73	1:13	77.40
5.60	74	1:14	64.81
6.60	75	1:15	55.58
7.60	76	1:16	48.57
8.60	77	1:17	43.08
9.60	78	1:18	38.68
10.60	79	1:19	35.08
11.60	80	1:20	32.09
12.60	81	1:21	29.57
13.60	82	1:22	27.42
14.60	83	1:23	25.56
15.60	84	1:24	23.94
16.60	85	1:25	22.51
17.60	86	1:26	21.25
18.60	87	1:27	20.13
19.60	88	1:28	19.12
20.60	89	1:29	18.22
21.60	90	1:30	17.39
22.60	91	1:31	16.65
23.60	92	1:32	15.96
24.60	93	1:33	15.34
25.60	94	1:34	14.76
26.60	95	1:35	14.23
27.60	96	1:36	13.73
28.60	97	1:37	13.27
29.60	98	1:38	12.85
30.60	99	1:39	12.45
31.60	100	1:40	12.07
32.60	101	1:41	11.73
33.60	102	1:42	11.40
34.60	103	1:43	11.09
35.60	104	1:44	10.79
36.60	105	1:45	10.52
37.60	106	1:46	10.26
38.60	107	1:47	10.01
39.60	108	1:48	9.78
40.60	109	1:49	9.55
41.60	110	1:50	9.34
42.60	111	1:51	9.14
43.60	112	1:52	8.94
44.60	113	1:53	8.76
45.60	114	1:54	8.58
46.60	115	1:55	8.41
47.60	116	1:56	8.25
48.60	117	1:57	8.10
49.60	118	1:58	7.95
50.60	119	1:59	7.81
51.60	120	2:00	7.67
52.60	121	2:01	7.54
53.60	122	2:02	7.41
54.60	123	2:03	7.29
55.60	124	2:04	7.17
56.60	125	2:05	7.05
57.60	126	2:06	6.94
58.60	127	2:07	6.84
59.60	128	2:08	6.74
60.60	129	2:09	6.64
61.60	130	2:10	6.54
62.60	131	2:11	6.45
63.60	132	2:12	6.36
64.60	133	2:13	6.27
65.60	134	2:14	6.18
66.60	135	2:15	6.10
67.60	136	2:16	6.02
68.60	137	2:17	5.94
69.60	138	2:18	5.87
70.60	139	2:19	5.79
71.60	140	2:20	5.72
72.60	141	2:21	5.65
73.60	142	2:22	5.58
74.60	143	2:23	5.52
75.60	144	2:24	5.45
76.60	145	2:25	5.39
77.60	146	2:26	5.33
78.60	147	2:27	5.27
79.60	148	2:28	5.21
80.60	149	2:29	5.16
81.60	150	2:30	5.10
82.60	151	2:31	5.05
83.60	152	2:32	4.99
84.60	153	2:33	4.94
85.60	154	2:34	4.89
86.60	155	2:35	4.84
87.60	156	2:36	4.79
88.60	157	2:37	4.75
89.60	158	2:38	4.70
90.60	159	2:39	4.66
91.60	160	2:40	4.61
92.60	161	2:41	4.57
93.60	162	2:42	4.53
94.60	163	2:43	4.49
95.60	164	2:44	4.44
96.60	165	2:45	4.40
97.60	166	2:46	4.37
98.60	167	2:47	4.33
99.60	168	2:48	4.29

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100.60	169	2:49	4.25
101.60	170	2:50	4.22
102.60	171	2:51	4.18
103.60	172	2:52	4.15
104.60	173	2:53	4.11
105.60	174	2:54	4.08
106.60	175	2:55	4.05
107.60	176	2:56	4.01
108.60	177	2:57	3.98
109.60	178	2:58	3.95
110.60	179	2:59	3.92
111.60	180	3:00	3.89

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CHICAGO HYETOGRAPH CREATION

DATE:	July 13, 2021
JOB No.:	SBM-18-0530

Client:	**Strathroy Turf Farms Ltd.**
Project:	**Kettle Creek Subdivision**
Location:	**37719 Lake Line, Port Stanley, Ontario**

CITY OF LONDON RAINFALL DISTRIBUTION PARAMETERS*

Return Period (years)	A,B,C Parameters A	B	C
250	3048.220	10.030	0.888

*Intensity i=A/(t+B)^C (mm/hr)

Starting Time= 0:00
Time Step= 0:01

r= 0.38 MTO DMM Section 8, Page 14
t_c= 1
t_d * r= 0.38
t_d * (1-r)= 0.62
i_p= 361.61 peak rainfall intensity, mm/h
t_b= 68.4 time before the peak intensity, min
t_a= 111.6 time after the peak intensity, min

$$i_p = \frac{A}{(\Delta t + B)^c} = \text{peak rainfall intensity}$$

Before the peak:

$$i_b = \frac{A[(1-c)t_b/r) + B]}{[t_b/r + B]^{1+c}}$$

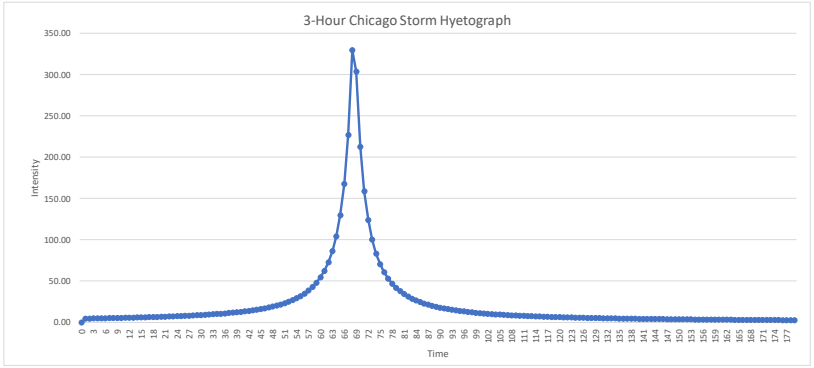
After the peak:

$$i_a = \frac{A[(1-c)t_a/(1-r)) + B]}{[t_a/(1-r) + B]^{1+c}}$$

Return Period (Years)	A,B,C Parameters A	B	C
250	3048.220	10.030	0.888

250-Year Hyetograph

t_b OR t_a	Time (min)	Time (h:m)	Intensity
68.40	0	0:00	0.00
67.40	1	0:01	4.66
66.40	2	0:02	4.74
65.40	3	0:03	4.82
64.40	4	0:04	4.91
63.40	5	0:05	5.00
62.40	6	0:06	5.09
61.40	7	0:07	5.18
60.40	8	0:08	5.28
59.40	9	0:09	5.38
58.40	10	0:10	5.48
57.40	11	0:11	5.59
56.40	12	0:12	5.71
55.40	13	0:13	5.82
54.40	14	0:14	5.95
53.40	15	0:15	6.08
52.40	16	0:16	6.21
51.40	17	0:17	6.35
50.40	18	0:18	6.50
49.40	19	0:19	6.65
48.40	20	0:20	6.81
47.40	21	0:21	6.98
46.40	22	0:22	7.15
45.40	23	0:23	7.34
44.40	24	0:24	7.53
43.40	25	0:25	7.73
42.40	26	0:26	7.95
41.40	27	0:27	8.18
40.40	28	0:28	8.42
39.40	29	0:29	8.67
38.40	30	0:30	8.94
37.40	31	0:31	9.22
36.40	32	0:32	9.52
35.40	33	0:33	9.85
34.40	34	0:34	10.19
33.40	35	0:35	10.56
32.40	36	0:36	10.95
31.40	37	0:37	11.37
30.40	38	0:38	11.82
29.40	39	0:39	12.31
28.40	40	0:40	12.83
27.40	41	0:41	13.40
26.40	42	0:42	14.02
25.40	43	0:43	14.69
24.40	44	0:44	15.43
23.40	45	0:45	16.23
22.40	46	0:46	17.12
21.40	47	0:47	18.10
20.40	48	0:48	19.18
19.40	49	0:49	20.39
18.40	50	0:50	21.75
17.40	51	0:51	23.27
16.40	52	0:52	24.99
15.40	53	0:53	26.96
14.40	54	0:54	29.22
13.40	55	0:55	31.84
12.40	56	0:56	34.90
11.40	57	0:57	38.51
10.40	58	0:58	42.82
9.40	59	0:59	48.03
8.40	60	1:00	54.45
7.40	61	1:01	62.47
6.40	62	1:02	72.72
5.40	63	1:03	86.16
4.40	64	1:04	104.32
3.40	65	1:05	129.84
2.40	66	1:06	167.51
1.40	67	1:07	226.92



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0.40	68	1:08	329.71
0.60	69	1:09	303.81
1.60	70	1:10	212.54
2.60	71	1:11	158.64
3.60	72	1:12	123.96
4.60	73	1:13	100.21
5.60	74	1:14	83.15
6.60	75	1:15	70.45
7.60	76	1:16	60.71
8.60	77	1:17	53.05
9.60	78	1:18	46.91
10.60	79	1:19	41.89
11.60	80	1:20	37.73
12.60	81	1:21	34.24
13.60	82	1:22	31.28
14.60	83	1:23	28.74
15.60	84	1:24	26.55
16.60	85	1:25	24.63
17.60	86	1:26	22.95
18.60	87	1:27	21.46
19.60	88	1:28	20.14
20.60	89	1:29	18.96
21.60	90	1:30	17.89
22.60	91	1:31	16.94
23.60	92	1:32	16.07
24.60	93	1:33	15.28
25.60	94	1:34	14.56
26.60	95	1:35	13.89
27.60	96	1:36	13.29
28.60	97	1:37	12.73
29.60	98	1:38	12.21
30.60	99	1:39	11.73
31.60	100	1:40	11.28
32.60	101	1:41	10.87
33.60	102	1:42	10.48
34.60	103	1:43	10.12
35.60	104	1:44	9.78
36.60	105	1:45	9.46
37.60	106	1:46	9.16
38.60	107	1:47	8.88
39.60	108	1:48	8.62
40.60	109	1:49	8.37
41.60	110	1:50	8.13
42.60	111	1:51	7.91
43.60	112	1:52	7.69
44.60	113	1:53	7.49
45.60	114	1:54	7.30
46.60	115	1:55	7.12
47.60	116	1:56	6.94
48.60	117	1:57	6.78
49.60	118	1:58	6.62
50.60	119	1:59	6.47
51.60	120	2:00	6.32
52.60	121	2:01	6.18
53.60	122	2:02	6.05
54.60	123	2:03	5.92
55.60	124	2:04	5.80
56.60	125	2:05	5.68
57.60	126	2:06	5.57
58.60	127	2:07	5.46
59.60	128	2:08	5.36
60.60	129	2:09	5.26
61.60	130	2:10	5.16
62.60	131	2:11	5.07
63.60	132	2:12	4.98
64.60	133	2:13	4.89
65.60	134	2:14	4.81
66.60	135	2:15	4.73
67.60	136	2:16	4.65
68.60	137	2:17	4.57
69.60	138	2:18	4.50
70.60	139	2:19	4.43
71.60	140	2:20	4.36
72.60	141	2:21	4.29
73.60	142	2:22	4.23
74.60	143	2:23	4.16
75.60	144	2:24	4.10
76.60	145	2:25	4.04
77.60	146	2:26	3.99
78.60	147	2:27	3.93
79.60	148	2:28	3.88
80.60	149	2:29	3.82
81.60	150	2:30	3.77
82.60	151	2:31	3.72
83.60	152	2:32	3.67
84.60	153	2:33	3.62
85.60	154	2:34	3.58
86.60	155	2:35	3.53
87.60	156	2:36	3.49
88.60	157	2:37	3.45
89.60	158	2:38	3.41
90.60	159	2:39	3.36
91.60	160	2:40	3.32
92.60	161	2:41	3.29
93.60	162	2:42	3.25
94.60	163	2:43	3.21
95.60	164	2:44	3.17
96.60	165	2:45	3.14
97.60	166	2:46	3.10
98.60	167	2:47	3.07
99.60	168	2:48	3.04
100.60	169	2:49	3.01
101.60	170	2:50	2.97
102.60	171	2:51	2.94
103.60	172	2:52	2.91
104.60	173	2:53	2.88

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105.60	174	2:54	2.85
106.60	175	2:55	2.82
107.60	176	2:56	2.80
108.60	177	2:57	2.77
109.60	178	2:58	2.74
110.60	179	2:59	2.72
111.60	180	3:00	2.69

STAGED STORAGE VOLUME CALCULATIONS							
ELEV	AREA (sq. m)	STEP DEPTH (m)	AVG END INC. VOL. (cu. m)	AVG END TOTAL VOL. (cu. m)	CONIC INC. VOL. (cu. m)	CONIC TOTAL VOL. (cu. m)	DEPTH (m)
177.07	0	N/A	N/A	0	N/A	0	0
177.08	3.06	0.01	0.02	0.02	0.01	0.01	0.01
177.09	8.17	0.01	0.06	0.07	0.05	0.06	0.02
177.1	13.04	0.01	0.11	0.18	0.11	0.17	0.03
177.11	17.45	0.01	0.15	0.33	0.15	0.32	0.04
177.12	23.11	0.01	0.2	0.53	0.2	0.52	0.05
177.13	30.72	0.01	0.27	0.8	0.27	0.79	0.06
177.14	40.1	0.01	0.35	1.16	0.35	1.14	0.07
177.15	51.27	0.01	0.46	1.61	0.46	1.6	0.08
177.16	64.25	0.01	0.58	2.19	0.58	2.18	0.09
177.17	79.05	0.01	0.72	2.91	0.72	2.89	0.1
177.18	95.69	0.01	0.87	3.78	0.87	3.76	0.11
177.19	114.17	0.01	1.05	4.83	1.05	4.81	0.12
177.2	134.47	0.01	1.24	6.07	1.24	6.05	0.13
177.21	156.61	0.01	1.46	7.53	1.45	7.51	0.14
177.22	180.55	0.01	1.69	9.21	1.68	9.19	0.15
177.23	206.3	0.01	1.93	11.15	1.93	11.13	0.16
177.24	232.69	0.01	2.19	13.34	2.19	13.32	0.17
177.25	260	0.01	2.46	15.81	2.46	15.78	0.18
177.26	288.04	0.01	2.74	18.55	2.74	18.52	0.19
177.27	316.9	0.01	3.02	21.57	3.02	21.54	0.2
177.28	346.49	0.01	3.32	24.89	3.32	24.86	0.21
177.29	376.84	0.01	3.62	28.51	3.62	28.48	0.22
177.3	408.03	0.01	3.92	32.43	3.92	32.4	0.23
177.31	440.34	0.01	4.24	36.67	4.24	36.64	0.24
177.32	473.88	0.01	4.57	41.24	4.57	41.21	0.25
177.33	508.64	0.01	4.91	46.16	4.91	46.12	0.26
177.34	544.58	0.01	5.27	51.42	5.27	51.39	0.27
177.35	581.73	0.01	5.63	57.05	5.63	57.02	0.28
177.36	620.07	0.01	6.01	63.06	6.01	63.02	0.29
177.37	659.61	0.01	6.4	69.46	6.4	69.42	0.3
177.38	700.28	0.01	6.8	76.26	6.8	76.22	0.31
177.39	742.25	0.01	7.21	83.47	7.21	83.43	0.32
177.4	785.41	0.01	7.64	91.11	7.64	91.07	0.33
177.41	829.72	0.01	8.08	99.19	8.07	99.14	0.34
177.42	875.23	0.01	8.52	107.71	8.52	107.67	0.35
177.43	921.94	0.01	8.99	116.7	8.98	116.65	0.36
177.44	969.83	0.01	9.46	126.16	9.46	126.11	0.37
177.45	1018.94	0.01	9.94	136.1	9.94	136.05	0.38
177.46	1068.83	0.01	10.44	146.54	10.44	146.49	0.39
177.47	1119.16	0.01	10.94	157.48	10.94	157.43	0.4
177.48	1169.85	0.01	11.45	168.92	11.44	168.87	0.41
177.49	1220.84	0.01	11.95	180.88	11.95	180.83	0.42
177.5	1272.19	0.01	12.47	193.34	12.46	193.29	0.43
177.51	1323.87	0.01	12.98	206.32	12.98	206.27	0.44
177.52	1375.68	0.01	13.5	219.82	13.5	219.77	0.45
177.53	1427.64	0.01	14.02	233.84	14.02	233.78	0.46
177.54	1480.09	0.01	14.54	248.38	14.54	248.32	0.47
177.55	1532.98	0.01	15.07	263.44	15.06	263.39	0.48
177.56	1586.35	0.01	15.6	279.04	15.6	278.98	0.49
177.57	1640.13	0.01	16.13	295.17	16.13	295.11	0.5
177.58	1694.11	0.01	16.67	311.84	16.67	311.78	0.51
177.59	1748.25	0.01	17.21	329.05	17.21	329	0.52
177.6	1802.33	0.01	17.75	346.81	17.75	346.75	0.53
177.61	1855.69	0.01	18.29	365.1	18.29	365.04	0.54
177.62	1908.16	0.01	18.82	383.92	18.82	383.86	0.55
177.63	1959.8	0.01	19.34	403.26	19.34	403.19	0.56
177.64	2010.57	0.01	19.85	423.11	19.85	423.05	0.57
177.65	2060.55	0.01	20.36	443.46	20.36	443.4	0.58
177.66	2109.71	0.01	20.85	464.31	20.85	464.25	0.59
177.67	2158.04	0.01	21.34	485.65	21.34	485.59	0.6
177.68	2205.62	0.01	21.82	507.47	21.82	507.41	0.61
177.69	2252.46	0.01	22.29	529.76	22.29	529.7	0.62
177.7	2298.42	0.01	22.75	552.52	22.75	552.45	0.63
177.71	2343.62	0.01	23.21	575.73	23.21	575.66	0.64
177.72	2387.98	0.01	23.66	599.38	23.66	599.32	0.65
177.73	2431.53	0.01	24.1	623.48	24.1	623.42	0.66
177.74	2474.31	0.01	24.53	648.01	24.53	647.95	0.67
177.75	2516.31	0.01	24.95	672.96	24.95	672.9	0.68
177.76	2557.68	0.01	25.37	698.33	25.37	698.27	0.69
177.77	2598.7	0.01	25.78	724.12	25.78	724.05	0.7
177.78	2639.35	0.01	26.19	750.31	26.19	750.24	0.71
177.79	2679.58	0.01	26.59	776.9	26.59	776.83	0.72
177.8	2719.51	0.01	27	803.9	27	803.83	0.73
177.81	2758.91	0.01	27.39	831.29	27.39	831.22	0.74
177.82	2798.11	0.01	27.79	859.07	27.78	859.01	0.75
177.83	2837.29	0.01	28.18	887.25	28.18	887.18	0.76
177.84	2876.49	0.01	28.57	915.82	28.57	915.75	0.77
177.85	2915.79	0.01	28.96	944.78	28.96	944.71	0.78
177.86	2955.1	0.01	29.35	974.14	29.35	974.07	0.79
177.87	2993.3	0.01	29.74	1003.88	29.74	1003.81	0.8
177.88	3029.8	0.01	30.12	1033.99	30.12	1033.92	0.81
177.89	3067.13	0.01	30.48	1064.48	30.48	1064.41	0.82
177.9	3103.18	0.01	30.85	1095.33	30.85	1095.26	0.83
177.91	3135.3	0.01	31.19	1126.52	31.19	1126.45	0.84

177.92	3166.68	0.01	31.51	1158.03	31.51	1157.96	0.85
177.93	3197.34	0.01	31.82	1189.85	31.82	1189.78	0.86
177.94	3227.22	0.01	32.12	1221.97	32.12	1221.9	0.87
177.95	3256.45	0.01	32.42	1254.39	32.42	1254.32	0.88
177.96	3284.85	0.01	32.71	1287.1	32.71	1287.03	0.89
177.97	3312.57	0.01	32.99	1320.09	32.99	1320.02	0.9
177.98	3339.84	0.01	33.26	1353.35	33.26	1353.28	0.91
177.99	3366.09	0.01	33.53	1386.88	33.53	1386.81	0.92
178	3391.67	0.01	33.79	1420.67	33.79	1420.6	0.93
178.01	3416.64	0.01	34.04	1454.71	34.04	1454.64	0.94
178.02	3441.04	0.01	34.29	1489	34.29	1488.93	0.95
178.03	3464.76	0.01	34.53	1523.53	34.53	1523.46	0.96
178.04	3488.08	0.01	34.76	1558.29	34.76	1558.22	0.97
178.05	3510.94	0.01	35	1593.29	35	1593.21	0.98
178.06	3533.64	0.01	35.22	1628.51	35.22	1628.44	0.99
178.07	3556.33	0.01	35.45	1663.96	35.45	1663.89	1
178.08	3579.22	0.01	35.68	1699.64	35.68	1699.56	1.01
178.09	3601.98	0.01	35.91	1735.54	35.91	1735.47	1.02
178.1	3623.51	0.01	36.13	1771.67	36.13	1771.6	1.03
178.11	3644.66	0.01	36.34	1808.01	36.34	1807.94	1.04
178.12	3665.32	0.01	36.55	1844.56	36.55	1844.49	1.05
178.13	3683.11	0.01	36.74	1881.3	36.74	1881.23	1.06
178.14	3700.58	0.01	36.92	1918.22	36.92	1918.15	1.07
178.15	3718.15	0.01	37.09	1955.31	37.09	1955.24	1.08
178.16	3735.43	0.01	37.27	1992.58	37.27	1992.51	1.09
178.17	3752.82	0.01	37.44	2030.02	37.44	2029.95	1.1
178.18	3769.98	0.01	37.61	2067.64	37.61	2067.57	1.11
178.19	3787.29	0.01	37.79	2105.42	37.79	2105.35	1.12
178.2	3804.41	0.01	37.96	2143.38	37.96	2143.31	1.13
178.21	3821.73	0.01	38.13	2181.51	38.13	2181.44	1.14
178.22	3838.93	0.01	38.3	2219.82	38.3	2219.74	1.15
178.23	3856.34	0.01	38.48	2258.29	38.48	2258.22	1.16
178.24	3873.69	0.01	38.65	2296.94	38.65	2296.87	1.17
178.25	3891.11	0.01	38.82	2335.77	38.82	2335.7	1.18
178.26	3908.62	0.01	39	2374.77	39	2374.69	1.19
178.27	3926.25	0.01	39.17	2413.94	39.17	2413.87	1.2
178.28	3943.95	0.01	39.35	2453.29	39.35	2453.22	1.21
178.29	3960.39	0.01	39.52	2492.81	39.52	2492.74	1.22
178.3	3973.12	0.01	39.67	2532.48	39.67	2532.41	1.23
178.31	3985.18	0.01	39.79	2572.27	39.79	2572.2	1.24
178.32	3997.27	0.01	39.91	2612.18	39.91	2612.11	1.25
178.33	4009.4	0.01	40.03	2652.22	40.03	2652.15	1.26
178.34	4021.46	0.01	40.15	2692.37	40.15	2692.3	1.27
178.35	4033.83	0.01	40.28	2732.65	40.28	2732.58	1.28
178.36	4046.61	0.01	40.4	2773.05	40.4	2772.98	1.29
178.37	4059.64	0.01	40.53	2813.58	40.53	2813.51	1.3
178.38	4072.93	0.01	40.66	2854.24	40.66	2854.17	1.31
178.39	4086.5	0.01	40.8	2895.04	40.8	2894.97	1.32
178.4	4100.34	0.01	40.93	2935.98	40.93	2935.9	1.33
178.41	4114.45	0.01	41.07	2977.05	41.07	2976.98	1.34
178.42	4128.83	0.01	41.22	3018.27	41.22	3018.19	1.35
178.43	4143.48	0.01	41.36	3059.63	41.36	3059.56	1.36
178.44	4158.41	0.01	41.51	3101.14	41.51	3101.07	1.37
178.45	4173.61	0.01	41.66	3142.8	41.66	3142.73	1.38
178.46	4189.08	0.01	41.81	3184.61	41.81	3184.54	1.39
178.47	4204.82	0.01	41.97	3226.58	41.97	3226.51	1.4
178.48	4220.81	0.01	42.13	3268.71	42.13	3268.64	1.41
178.49	4237.08	0.01	42.29	3311	42.29	3310.93	1.42
178.5	4253.65	0.01	42.45	3353.45	42.45	3353.38	1.43
178.51	4270.52	0.01	42.62	3396.07	42.62	3396	1.44
178.52	4287.63	0.01	42.79	3438.86	42.79	3438.79	1.45
178.53	4304.97	0.01	42.96	3481.83	42.96	3481.75	1.46
178.54	4322.36	0.01	43.14	3524.96	43.14	3524.89	1.47
178.55	4338.22	0.01	43.3	3568.27	43.3	3568.19	1.48
178.56	4352.95	0.01	43.46	3611.72	43.46	3611.65	1.49
178.57	4366.94	0.01	43.6	3655.32	43.6	3655.25	1.5
178.58	4380.19	0.01	43.74	3699.06	43.74	3698.98	1.51
178.59	4393.01	0.01	43.87	3742.92	43.87	3742.85	1.52
178.6	4405.8	0.01	43.99	3786.92	43.99	3786.84	1.53
178.61	4418.61	0.01	44.12	3831.04	44.12	3830.97	1.54
178.62	4431.45	0.01	44.25	3875.29	44.25	3875.22	1.55
178.63	4444.27	0.01	44.38	3919.67	44.38	3919.6	1.56

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD
BASED ON A FINE PARTICLE SIZE DISTRIBUTION

Project Name: 37719 Lake Line
Location: Port Stanley, ON
OGS #: 1-Revision 1

Engineer: **Strik Baldinelli Moniz**
Contact: Kurtis Caron, EIT II
Report Date: 19-Jul-21

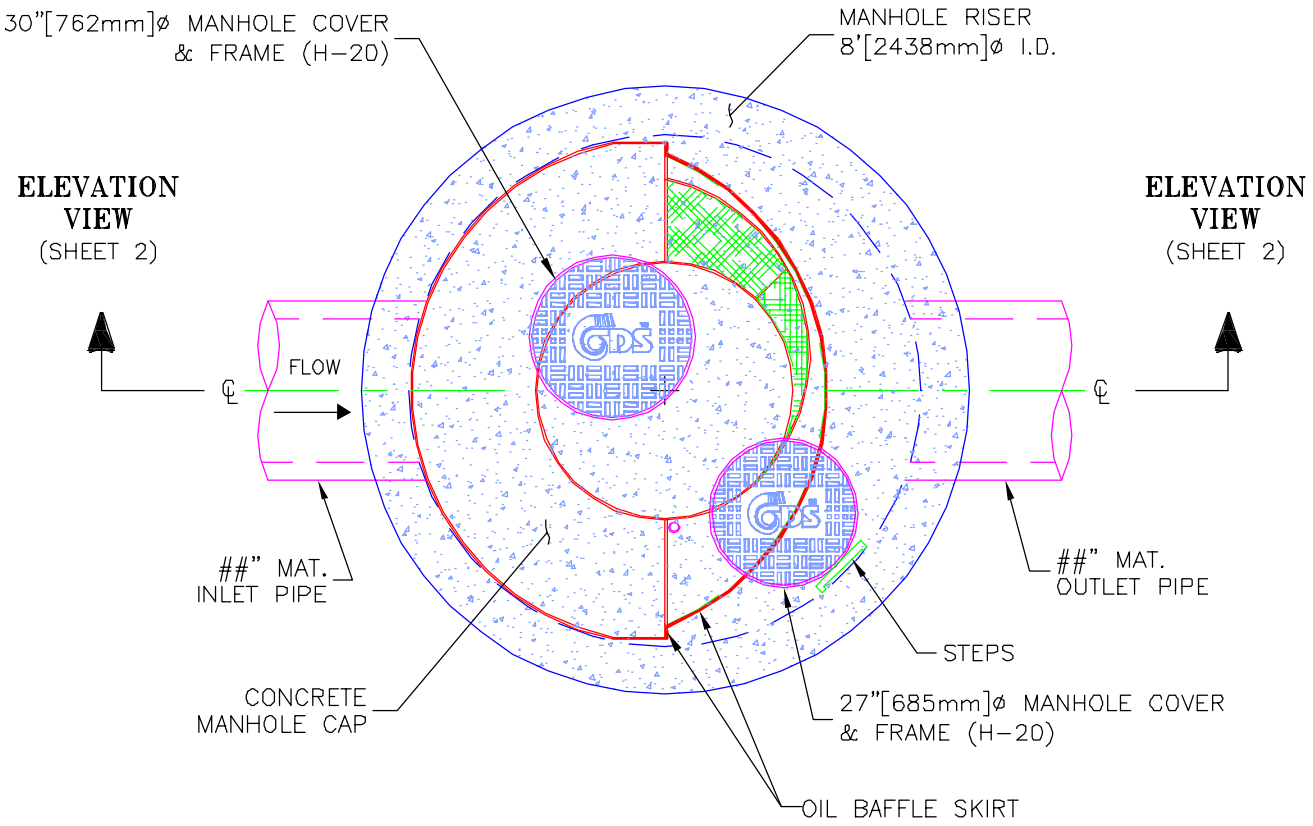
Area	15.520	ha	**Rainfall Station #**	195	
Weighted C	0.40		**Particle Size Distribution**	FINE	
CDS Model	4030		**CDS Treatment Capacity**	127	l/s

Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
1.0	10.3%	20.1%	17.3	17.3	13.5	95.0	9.7
1.5	9.7%	29.7%	25.9	25.9	20.3	93.0	9.0
2.0	8.9%	38.6%	34.5	34.5	27.1	91.1	8.1
2.5	7.7%	46.2%	43.1	43.1	33.9	89.2	6.8
3.0	6.5%	52.7%	51.8	51.8	40.6	87.2	5.6
3.5	4.2%	56.9%	60.4	60.4	47.4	85.3	3.6
4.0	4.7%	61.6%	69.0	69.0	54.2	83.3	3.9
4.5	3.9%	65.4%	77.7	77.7	60.9	81.4	3.1
5.0	3.4%	68.8%	86.3	86.3	67.7	79.4	2.7
6.0	4.7%	73.6%	103.5	103.5	81.3	75.6	3.6
7.0	4.6%	78.2%	120.8	120.8	94.8	71.7	3.3
8.0	3.5%	81.7%	138.1	127.4	100.0	64.8	2.3
9.0	2.3%	84.0%	155.3	127.4	100.0	57.6	1.3
10.0	2.6%	86.6%	172.6	127.4	100.0	51.8	1.3
15.0	6.7%	93.3%	258.9	127.4	100.0	34.6	2.3
20.0	2.7%	96.0%	345.2	127.4	100.0	25.9	0.7
25.0	1.7%	97.7%	431.5	127.4	100.0	20.7	0.4
30.0	1.3%	99.0%	517.7	127.4	100.0	17.3	0.2
35.0	0.6%	99.6%	604.0	127.4	100.0	14.8	0.1
40.0	0.3%	99.8%	690.3	127.4	100.0	13.0	0.0
45.0	0.0%	99.8%	776.6	127.4	100.0	11.5	0.0
50.0	0.2%	100.0%	862.9	127.4	100.0	10.4	0.0
							77.6
						Removal Efficiency Adjustment[2] =	6.5%
						Predicted Net Annual Load Removal Efficiency =	**71.1%**
						Predicted Annual Rainfall Treated =	**90.3%**

1 - Based on 44 years of hourly rainfall data from Canadian Station 6144475, London ON
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.
3 - CDS Efficiency based on testing conducted at the University of Central Florida
4 - CDS design flowrate and scaling based on standard manufacturer model & product specifications

OR APPROVED EQUIVALENT**

PLAN VIEW



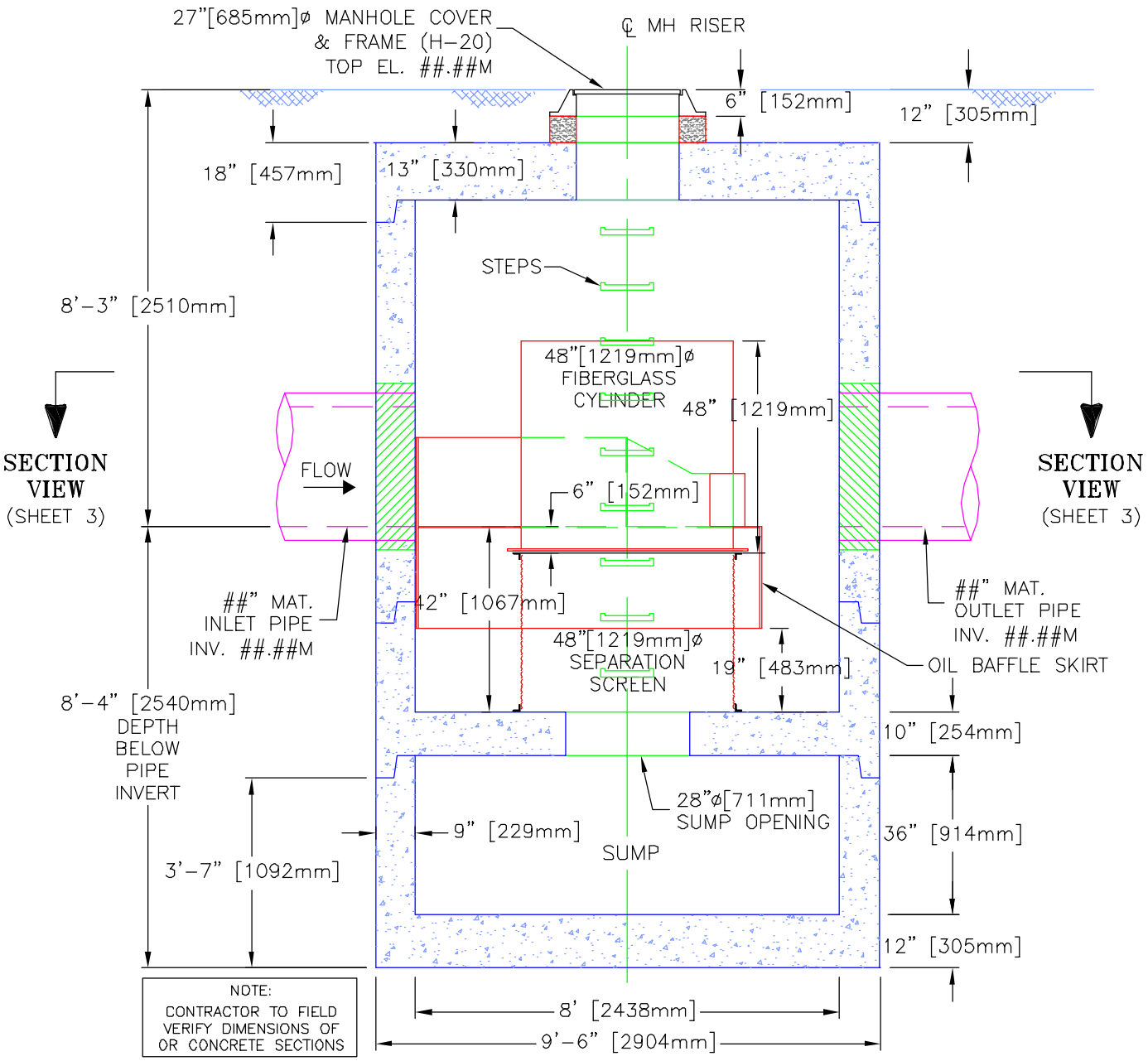
CDS MODEL PMSU40_30m, 4.5 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS	PROJECT NAME CITY, STATE	JOB# XX-##-###	SCALE 1" = 3'
		DATE ##/##/##	SHEET 1
		DRAWN INITIALS	
		APPROV.	

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

OR APPROVED EQUIVALENT**

ELEVATION VIEW



CDS MODEL PMSU40_30m, 4.5 CFS TREATMENT CAPACITY STORM WATER TREATMENT UNIT

CONTECH STORMWATER SOLUTIONS	PROJECT NAME CITY, STATE	JOB# XX-##-###	SCALE 1" = 3'
		DATE ##/##/##	SHEET 2
		DRAWN INITIALS	
		APPROV.	

Echelon Environmental 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577
CONTECH Stormwater Solutions Inc. 930 Woodcock Road, Suite 101, Orlando, Florida 32803 Tel: (800) 848-9955

OR APPROVED EQUIVALENT**

STORMWATER TREATMENT UNIT OPERATION & MAINTENANCE MANUAL

PROJECT NAME
CITY, ON
CDS JOB #

ECHELON ENVIRONMENTAL

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

OR APPROVED EQUIVALENT**

OPERATIONS AND MAINTENANCE GUIDELINES FOR CDS® UNIT MODEL PMSU

(Continuous Deflective Separation Unit)

PROJECT NAME

1. INTRODUCTION

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

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

2. OPERATION OVERVIEW

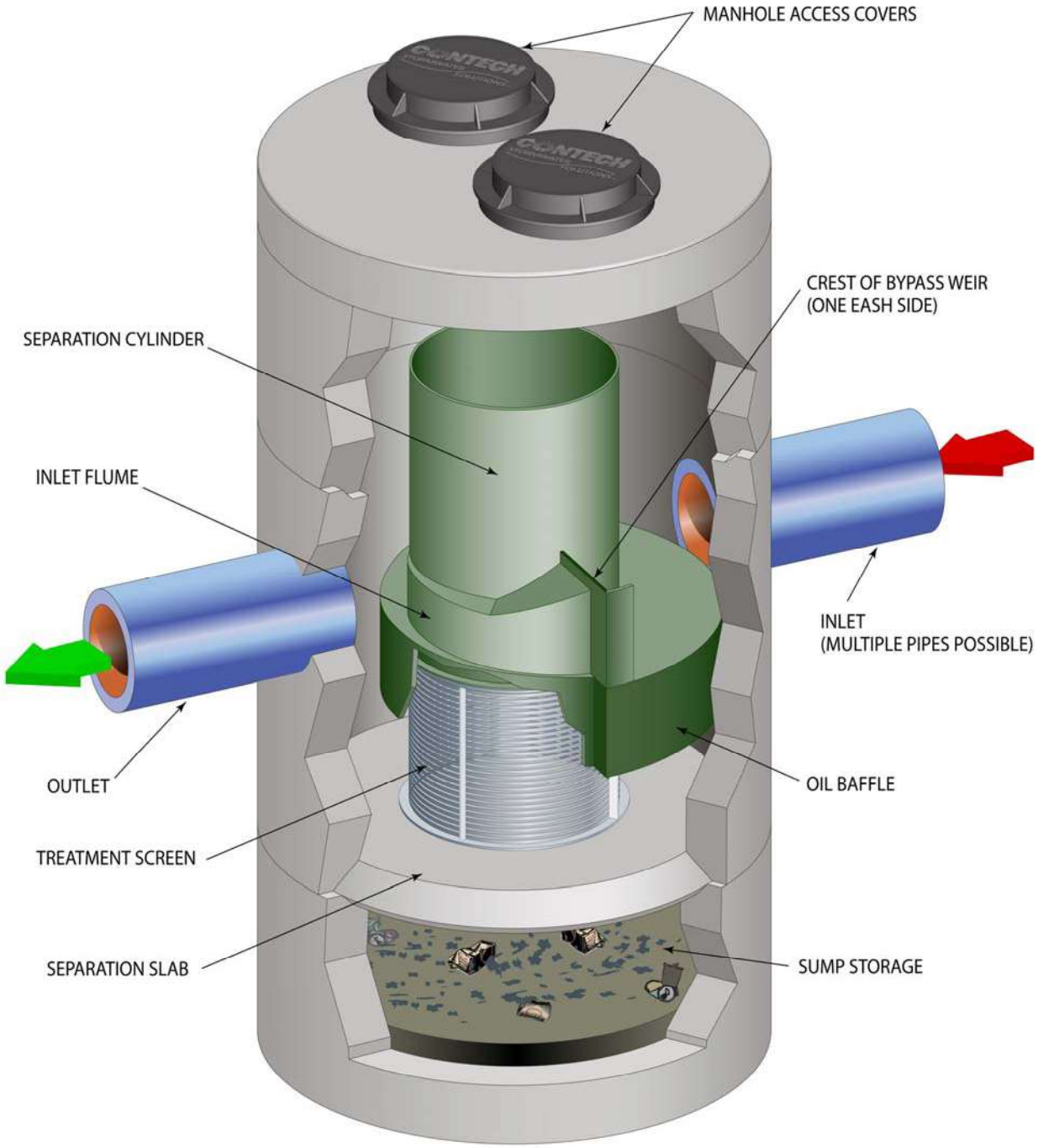
The CDS® unit is a non-mechanical hydraulically driven technology that will function any time there is flow in the storm drainage system. Stormwater enters the CDS® System (Figure 1) where the bypass weir guides the flow into the unit’s separation chamber and pollutants are removed from the flow. All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

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

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

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

Figure One: In-Line CDS® Systems



3. INSPECTION OVERVIEW

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

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

IMPORTANT - CONFINED SPACE

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

4. MAINTENANCE

Contech Engineered Solutions recommends the following:

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

ECHELON ENVIRONMENTAL CDS CONTECH ENGINEERED SOLUTIONS

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

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

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

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

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

CLEANOUT AND DISPOSAL

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

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

5. OPTIONAL FEATURES

USE OF SORBENTS FOR ENHANCED OIL CAPTURE

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

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

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

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

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

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

VECTOR CONTROL

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

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

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

6. RECORDS OF OPERATION AND MAINTENANCE

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

APPENDIX A

CDS® UNIT RECORD OF

OPERATIONS & MAINTENANCE

OR APPROVED EQUIVALENT**

CDS® UNIT RECORD OF OPERATION & MAINTENANCE

OWNER _____

ADDRESS _____

OWNER REPRESENTATIVE _____ **PHONE** _____

CDS® INSTALLATION:

MODEL DESIGNATION _____ DATE _____
SITE LOCATION _____
DEPTH FROM COVER TO BOTTOM OF SUMP (SUMP INVERT) _____
VOLUME OF SUMP _____ CUBIC METERS

INSPECTIONS:

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

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

OBSERVATIONS OF FUNCTION: _____

_____

_____

_____

CLEANOUT:

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

SCREEN MAINTENANCE:
Note is Power Washing Performed: _____

CERTIFICATION: _____ **TITLE:** _____

DATE: _____

APPENDIX B

CDS® UNIT

INSPECTION CHECKLIST

OR APPROVED EQUIVALENT**

Date: _____

INSPECTION CHECKLIST

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

MAINTENANCE CHECKLIST

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

OR APPROVED EQUIVALENT**

APPENDIX C

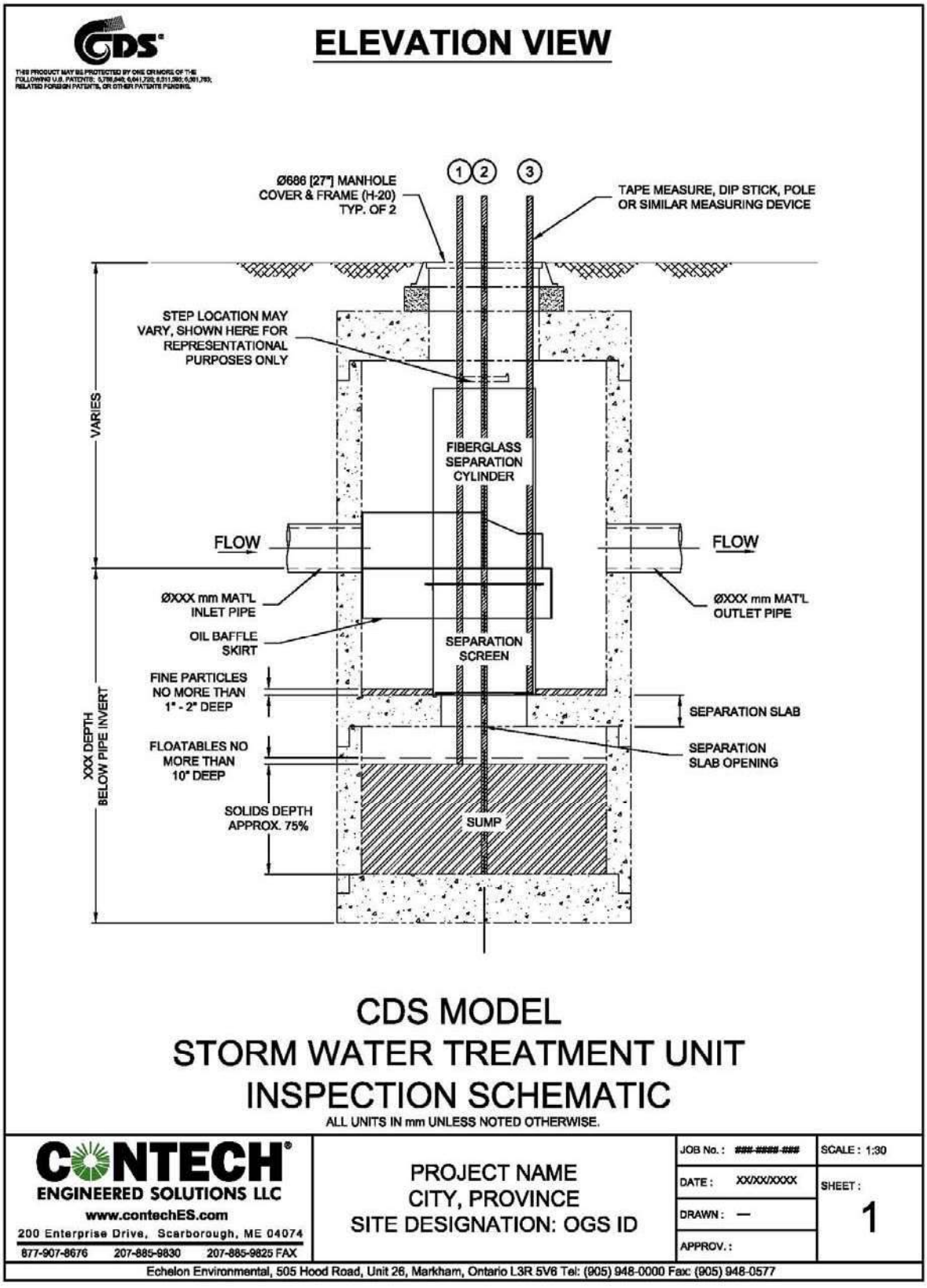
INSPECTION SCHEMATIC

OR APPROVED EQUIVALENT**

ECHELON ENVIRONMENTAL

CDS

CONTECH ENGINEERED SOLUTIONS



OR APPROVED EQUIVALENT**

APPENDIX D

CLEANOUT SCHEMATIC

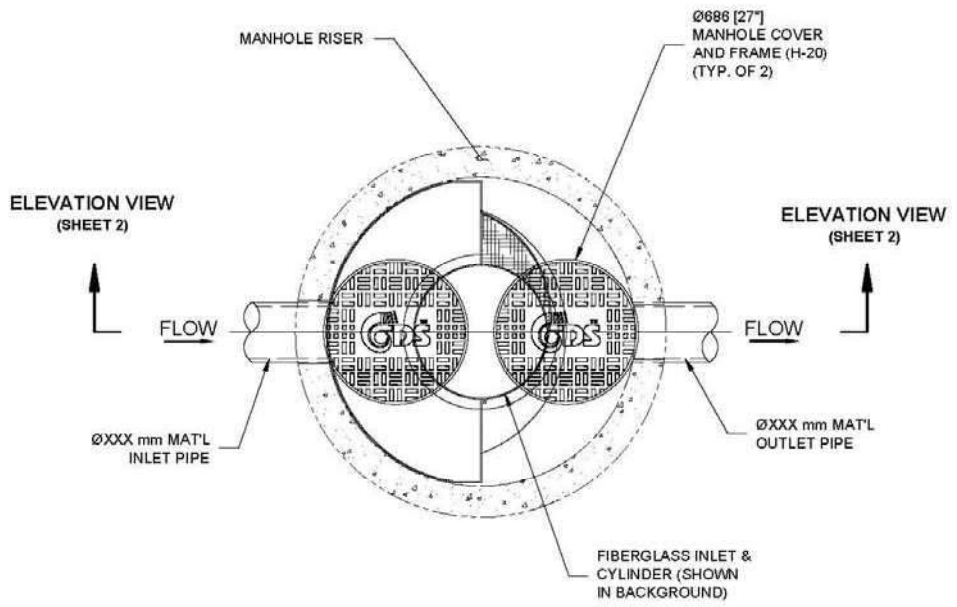
OR APPROVED EQUIVALENT**

ECHELON ENVIRONMENTAL

CONTECH ENGINEERED SOLUTIONS

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,759,640; 6,641,720; 6,511,595; 6,561,733; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

PLAN VIEW



CDS MODEL
STORM WATER TREATMENT UNIT
CLEANOUT SCHEMATIC

ALL UNITS IN mm UNLESS NOTED OTHERWISE.

CONTECH ENGINEERED SOLUTIONS LLC
www.contechES.com
200 Enterprise Drive, Scarborough, ME 04074
877-907-8676 207-885-9830 207-885-9825 FAX

PROJECT NAME
CITY, PROVINCE
SITE DESIGNATION: OGS ID

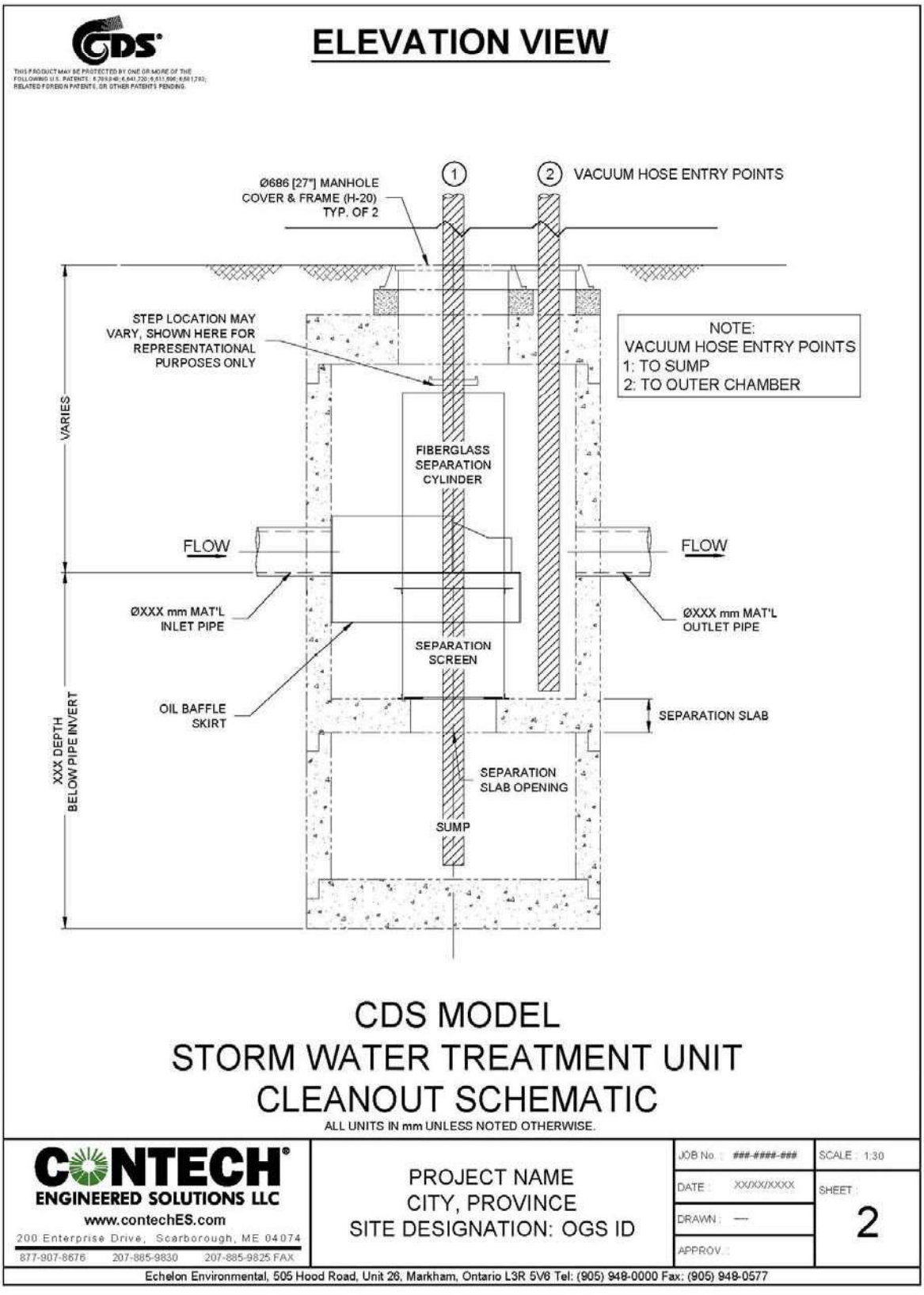
JOB No.: ###-####-###	SCALE: 1:30
DATE: XX/XX/XXXX	SHEET: 1
DRAWN: ---	
APPROV.:	

Echelon Environmental, 505 Hood Road, Unit 26, Markham, Ontario L3R 5V6 Tel: (905) 948-0000 Fax: (905) 948-0577

OR APPROVED EQUIVALENT**

ECHELON ENVIRONMENTAL

CONTECH ENGINEERED SOLUTIONS



Lot Grading & Drainage

Homeowners' Information Package

All drainage from your lot makes its way to the Marr Drain and ultimately Lake Erie through groundwater, a system grassed side/rear yard swales, road ditches, catchbasins/catchbasin maintenance holes, storm sewer pipes (stormwater collection system), and open watercourses. Engineering on your lot has been done to retain natural drainage characteristics as much as possible. Some of the measures on your lot are:

- Construction of side and rear yard grassed swales to convey your lot runoff to catchbasin/catchbasin maintenance holes, storm sewer system, and ultimately to the Marr Drain and ultimately Lake Erie. The side/rear yard grassed swales and overland flow swales will provide polishing and pre-treatment of the storm water (improve storm water quality).
- In addition, measures such as temporary silt fencing and sediment protection at catchbasins/catchbasin maintenance holes, are to be undertaken during construction to reduce erosion, sedimentation and water quality impacts on the receiving system.

These measures assist in reducing the detrimental impact that the development may otherwise have on storm water quality and quantity of the receiving system.

What can you do to help?

The provision of the above noted measures alone does not solve the problem forever. The measures noted above must be maintained and the residents of each lot must practice preventative measures. The following is a non-inclusive list of homeowner obligations to keep the storm water drainage functioning properly:

1. Retain the grades on the property in compliance with the approved lot grading plan issued at the time of your home construction.
2. Prevent the storage of items or construction of shed in the rear yard in the area of the rear yard swales and catch basins/catchbasin maintenance holes.
3. When building decks and patios, consider wooden decking as opposed to harder impermeable surfaces to minimize the amount of paved surfaces.
4. Prevent oil and fluid spills or leaks from motor vehicles.
5. Avoid pesticide use, particularly before major storm events and/or consider using organic alternatives to pesticides and fertilizers. This will help with water quality issues.
6. Prevent the entry of debris or pollutants of any kind from entering stormwater collection system.
7. Remove sediment and debris from the rear yard storm swales and catchbasin/catchbasin maintenance holes.
   and
8. Remember that your side/rear yard grassed swales are designed to temporarily retain and pond runoff water during <u>and</u> after rainfall events.

Use of the above practices and being aware of the purpose of these systems will help keep and improve water quality in the Marr Drain and ultimately Lake Erie.

Telephone Numbers:

Municipality of Central Elgin
519-631-4860
www.centralelgin.org

Kettle Creek Conservation Authority
519-631-1270
www.kettlecreekconservation.on.ca

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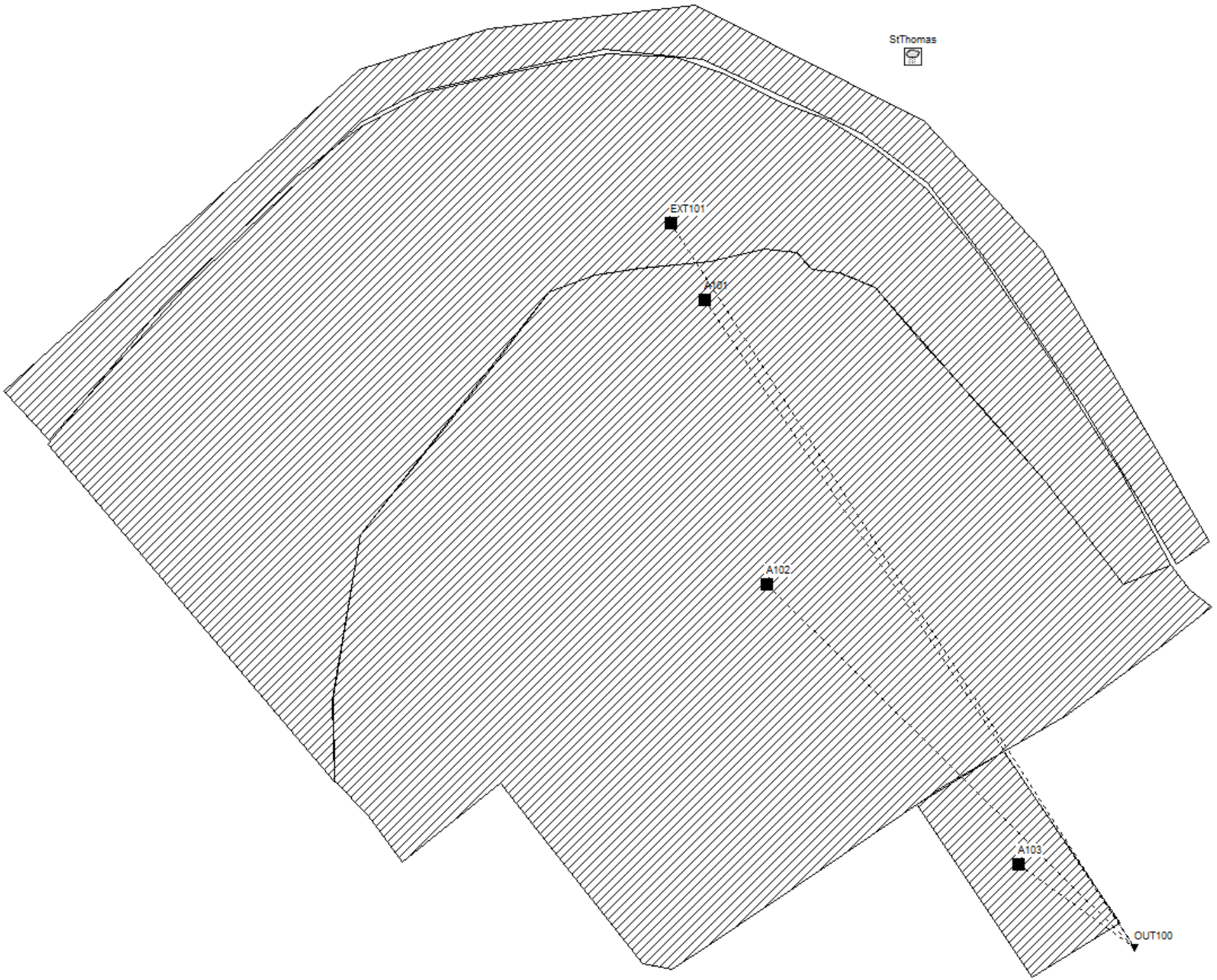
APPENDIX G

EPASWMM5.1 Pre-Development Conditions Layout
EPASWMM5.1 Pre-Development Modelling Results

PRE-DEVELOPMENT CONDITIONS LAYOUT



EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

SBM-18-0530 Kettle Creek Pre-Development Results 5 Year Storm

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... NO
  Water Quality ..... NO
Infiltration Method ..... CURVE_NUMBER
Surcharge Method ..... EXTRAN
Starting Date 01/01/2015 00:00:00
Ending Date 01/02/2015 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:01:00
Dry Time Step 00:01:00

**********	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**********	---------	-------
Total Precipitation	0.598	35.777
Evaporation Loss	0.000	0.000
Infiltration Loss	0.517	30.955
Surface Runoff	0.059	3.560
Final Storage	0.021	1.263
Continuity Error (%)	-0.004	

**********	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
**********	---------	---------
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.059	0.595
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.059	0.595
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Subcatchment Runoff Summary
****

	Total Precip	Total Runon	Total Evap	Total Infil	Imperv Runoff	Perv Runoff	Total Runoff	Total Runoff	Peak Runoff	Runoff Coeff

Subcatchment	mm	mm	mm	mm	mm	mm	mm	10^6 ltr	CMS	
A101	35.78	0.00	0.00	34.07	0.00	0.45	0.45	0.03	0.01	0.013
A102	35.78	0.00	0.00	30.44	0.39	3.68	4.07	0.36	0.05	0.114
EXT101	35.78	0.00	0.00	0.00	34.31	0.00	34.31	0.17	0.21	0.959
A103	35.78	0.00	0.00	30.43	0.00	4.09	4.09	0.03	0.00	0.114

Analysis begun on: Tue Jul 13 15:50:54 2021
Analysis ended on: Tue Jul 13 15:50:54 2021
Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

SBM-18-0530 Kettle Creek Pre-Development Results 10 Year Storm

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... NO
  Water Quality ..... NO
Infiltration Method ..... CURVE_NUMBER
Surcharge Method ..... EXTRAN
Starting Date 01/01/2015 00:00:00
Ending Date 01/02/2015 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:01:00
Dry Time Step 00:01:00

**********	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**********	---------	-------
Total Precipitation	0.700	41.892
Evaporation Loss	0.000	0.000
Infiltration Loss	0.575	34.403
Surface Runoff	0.104	6.228
Final Storage	0.021	1.263
Continuity Error (%)	-0.004	

**********	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
**********	---------	---------
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.104	1.040
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.104	1.040
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Subcatchment Runoff Summary
****

	Total Precip	Total Runon	Total Evap	Total Infil	Imperv Runoff	Perv Runoff	Total Runoff	Total Runoff	Peak Runoff	Runoff Coeff

Subcatchment	mm	mm	mm	mm	mm	mm	mm	10^6 ltr	CMS	
A101	41.89	0.00	0.00	37.88	0.00	2.76	2.76	0.18	0.03	0.066
A102	41.89	0.00	0.00	33.83	0.46	6.34	6.80	0.61	0.07	0.162
EXT101	41.89	0.00	0.00	0.00	40.43	0.00	40.43	0.20	0.25	0.965
A103	41.89	0.00	0.00	33.75	0.00	6.89	6.89	0.06	0.01	0.164

Analysis begun on: Tue Jul 13 15:51:30 2021
Analysis ended on: Tue Jul 13 15:51:30 2021
Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

SBM-18-0530 Kettle Creek Pre-Development Results 25 Year Storm

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... NO
  Water Quality ..... NO
Infiltration Method ..... CURVE_NUMBER
Surcharge Method ..... EXTRAN
Starting Date 01/01/2015 00:00:00
Ending Date 01/02/2015 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:01:00
Dry Time Step 00:01:00

**********	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**********	---------	-------
Total Precipitation	0.831	49.745
Evaporation Loss	0.000	0.000
Infiltration Loss	0.638	38.209
Surface Runoff	0.171	10.264
Final Storage	0.021	1.274
Continuity Error (%)	-0.005	

**********	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
**********	---------	---------
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.171	1.715
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.171	1.715
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Subcatchment Runoff Summary
****

	Total Precip	Total Runon	Total Evap	Total Infil	Imperv Runoff	Perv Runoff	Total Runoff	Total Runoff	Peak Runoff	Runoff Coeff

Subcatchment	mm	mm	mm	mm	mm	mm	mm	10^6 ltr	CMS	
A101	49.75	0.00	0.00	42.00	0.00	6.48	6.48	0.42	0.08	0.130
A102	49.75	0.00	0.00	37.63	0.56	10.30	10.85	0.97	0.13	0.218
EXT101	49.75	0.00	0.00	0.00	48.29	0.00	48.29	0.24	0.30	0.971
A103	49.75	0.00	0.00	37.50	0.00	10.99	10.99	0.09	0.01	0.221

Analysis begun on: Tue Jul 13 15:52:17 2021
Analysis ended on: Tue Jul 13 15:52:17 2021
Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

SBM-18-0530 Kettle Creek Pre-Development Results 50 Year Storm

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... NO
  Water Quality ..... NO
Infiltration Method ..... CURVE_NUMBER
Surcharge Method ..... EXTRAN
Starting Date 01/01/2015 00:00:00
Ending Date 01/02/2015 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:01:00
Dry Time Step 00:01:00

**********	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**********	---------	-------
Total Precipitation	0.926	55.420
Evaporation Loss	0.000	0.000
Infiltration Loss	0.680	40.721
Surface Runoff	0.224	13.435
Final Storage	0.021	1.267
Continuity Error (%)	-0.006	

**********	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
**********	---------	---------
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.224	2.244
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.224	2.244
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Subcatchment Runoff Summary
****

	Total Precip	Total Runon	Total Evap	Total Infil	Imperv Runoff	Perv Runoff	Total Runoff	Total Runoff	Peak Runoff	Runoff Coeff

Subcatchment	mm	mm	mm	mm	mm	mm	mm	10^6 ltr	CMS	
A101	55.42	0.00	0.00	44.72	0.00	9.44	9.44	0.61	0.12	0.170
A102	55.42	0.00	0.00	40.13	0.62	13.42	14.04	1.25	0.18	0.253
EXT101	55.42	0.00	0.00	0.00	53.97	0.00	53.97	0.26	0.34	0.974
A103	55.42	0.00	0.00	39.95	0.00	14.20	14.20	0.12	0.02	0.256

Analysis begun on: Tue Jul 13 15:52:36 2021
Analysis ended on: Tue Jul 13 15:52:36 2021
Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

SBM-18-0530 Kettle Creek Pre-Development Results 100 Year Storm

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... NO
  Water Quality ..... NO
Infiltration Method ..... CURVE_NUMBER
Surcharge Method ..... EXTRAN
Starting Date 01/01/2015 00:00:00
Ending Date 01/02/2015 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:01:00
Dry Time Step 00:01:00

**********	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**********	---------	-------
Total Precipitation	1.024	61.315
Evaporation Loss	0.000	0.000
Infiltration Loss	0.720	43.097
Surface Runoff	0.283	16.955
Final Storage	0.021	1.267
Continuity Error (%)	-0.007	

**********	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
**********	---------	---------
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.283	2.832
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.283	2.832
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Subcatchment Runoff Summary
****

	Total Precip	Total Runon	Total Evap	Total Infil	Imperv Runoff	Perv Runoff	Total Runoff	Total Runoff	Peak Runoff	Runoff Coeff

Subcatchment	mm	mm	mm	mm	mm	mm	mm	10^6 ltr	CMS	
A101	61.32	0.00	0.00	47.34	0.00	12.73	12.73	0.82	0.18	0.208
A102	61.32	0.00	0.00	42.46	0.69	16.90	17.59	1.56	0.24	0.287
EXT101	61.32	0.00	0.00	0.00	59.87	0.00	59.87	0.29	0.38	0.976
A103	61.32	0.00	0.00	42.29	0.00	17.78	17.78	0.15	0.03	0.290

Analysis begun on: Tue Jul 13 15:52:52 2021
Analysis ended on: Tue Jul 13 15:52:52 2021
Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

SBM-18-0530 Kettle Creek Pre-Development Results 250 Year Storm

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... NO
  Water Quality ..... NO
Infiltration Method ..... CURVE_NUMBER
Surcharge Method ..... EXTRAN
Starting Date 01/01/2015 00:00:00
Ending Date 01/02/2015 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:01:00
Dry Time Step 00:01:00

**********	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**********	---------	-------
Total Precipitation	1.137	68.042
Evaporation Loss	0.000	0.000
Infiltration Loss	0.751	44.962
Surface Runoff	0.364	21.812
Final Storage	0.021	1.274
Continuity Error (%)	-0.010	

**********	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
**********	---------	---------
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.364	3.644
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.364	3.644
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Subcatchment Runoff Summary
****

	Total Precip	Total Runon	Total Evap	Total Infil	Imperv Runoff	Perv Runoff	Total Runoff	Total Runoff	Peak Runoff	Runoff Coeff

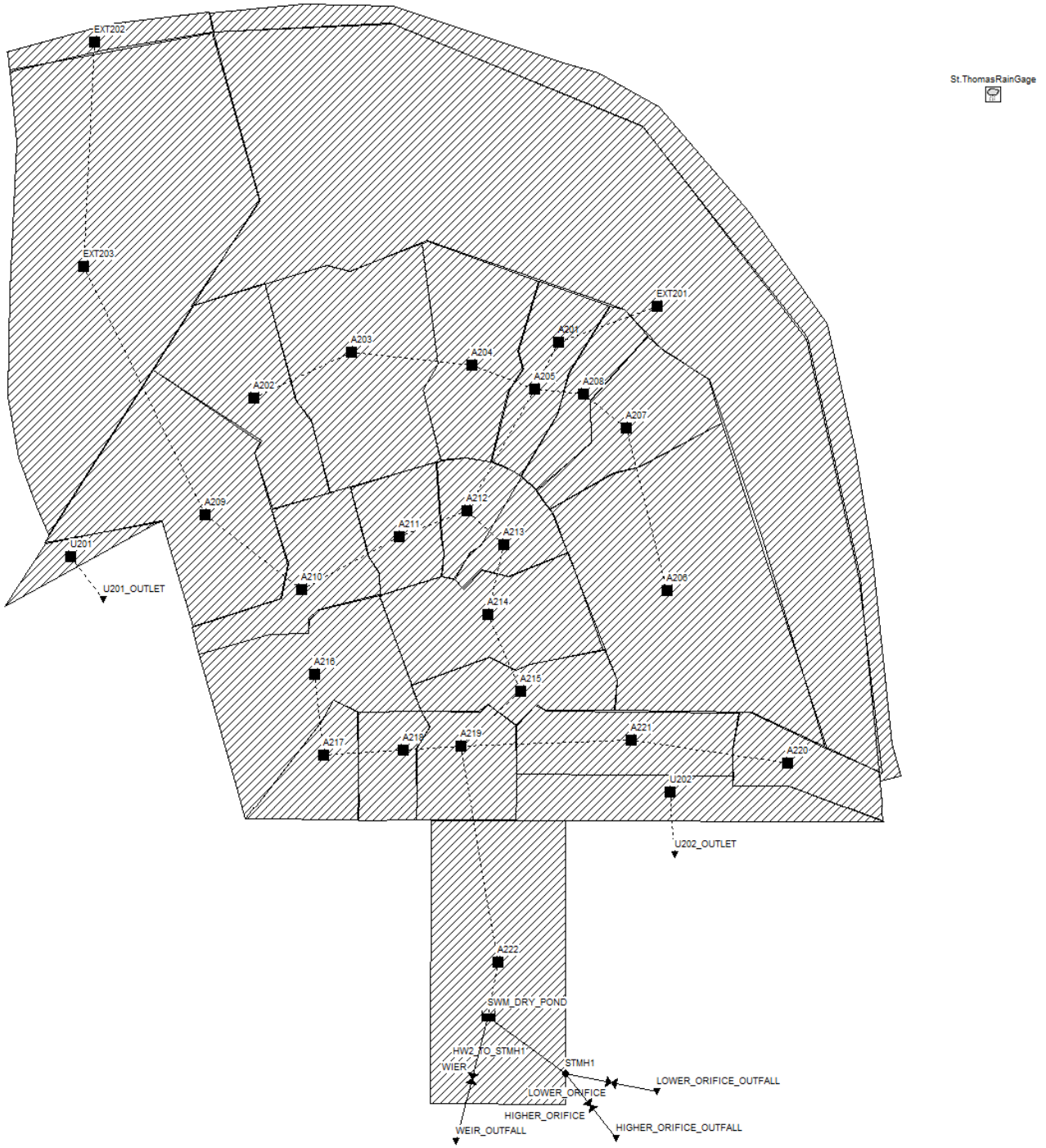
Subcatchment	mm	mm	mm	mm	mm	mm	mm	10^6 ltr	CMS	
A101	68.04	0.00	0.00	49.68	0.00	17.10	17.10	1.11	0.34	0.251
A102	68.04	0.00	0.00	44.09	0.77	21.92	22.68	2.02	0.38	0.333
EXT101	68.04	0.00	0.00	0.00	66.59	0.00	66.59	0.33	0.44	0.979
A103	68.04	0.00	0.00	44.02	0.00	22.77	22.77	0.19	0.04	0.335

Analysis begun on: Tue Jul 13 15:53:11 2021
Analysis ended on: Tue Jul 13 15:53:11 2021
Total elapsed time: < 1 sec

APPENDIX H

EPASWMM5.1 Post-Development Conditions Layout
EPASWMM5.1 Post-Development Modelling Results

POST-DEVELOPMENT CONDITIONS LAYOUT



```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------

SBM-18-0530 Kettle Creek Post-Development Results 5 Year Storm


*****************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*****************************************************

***************
Analysis Options
***************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 12/11/2020 00:00:00
Ending Date .............. 12/11/2020 03:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:01:00
Dry Time Step ............ 00:01:00
Routing Time Step ........ 30.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.001500 m


*************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
*************************     ---------       -------
Total Precipitation ......         0.589        35.741
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.265        16.076
Surface Runoff ...........         0.198        12.031
Final Storage ............         0.125         7.560
Continuity Error (%) .....         0.205


*************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
*************************     ---------     ----------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.198         1.977
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.095         0.954
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.102         1.017
Continuity Error (%) .....         0.317
```

```
    ************************
    Highest Continuity Errors
    ************************
    Node STMH1 (1.21%)


    ***************************
    Time-Step Critical Elements
    ***************************
    Link HW2_TO_STMH1 (99.78%)


    *******************************
    Highest Flow Instability Indexes
    *******************************
    All links are stable.


    ************************
    Routing Time Step Summary
    ************************
    Minimum Time Step           :     0.52 sec
    Average Time Step           :     3.89 sec
    Maximum Time Step           :    30.00 sec
    Percent in Steady State     :     0.00
    Average Iterations per Step :     2.00
    Percent Not Converging      :     0.00
    Time Step Frequencies       :
       30.000 - 13.228 sec      :     3.93 %
       13.228 -  5.833 sec      :     9.55 %
        5.833 -  2.572 sec      :    41.89 %
        2.572 -  1.134 sec      :    44.60 %
        1.134 -  0.500 sec      :     0.04 %


    ***************************
    Subcatchment Runoff Summary
    ***************************

    ---------------------------------------------------------------------------------------------------------------
                             Total      Total      Total      Total     Imperv      Perv     Total      Total     Peak  Runoff
                            Precip      Runon      Evap      Infil     Runoff    Runoff    Runoff     Runoff   Runoff   Coeff
    Subcatchment                mm         mm         mm         mm         mm        mm        mm   10^6 ltr      CMS
    ---------------------------------------------------------------------------------------------------------------
    A201                     35.74       3.24       0.00      26.91       0.00      2.43      2.43       0.10     0.02   0.062
    A202                     35.74       0.00       0.00       8.56      15.53      7.59     23.11       0.12     0.10   0.647
    A203                     35.74      14.25       0.00       8.56      22.01     15.02     37.02       0.30     0.21   0.741
    A204                     35.74      63.94       0.00       8.56      44.63     41.16     85.79       0.40     0.22   0.861
    A205                     35.74     337.46       0.00       8.56     169.25    185.40    354.65       0.98     0.41   0.950
    A206                     35.74       0.00       0.00       8.56      15.55      7.84     23.39       0.32     0.27   0.655
    A207                     35.74      88.28       0.00       8.56      55.73     54.00    109.73       0.39     0.25   0.885
    A208                     35.74     197.59       0.00       8.56     105.57    112.14    217.71       0.43     0.23   0.933
    A209                     35.74       2.30       0.00       8.56      16.48      8.18     24.66       0.21     0.16   0.648
    A210                     35.74      59.94       0.00       8.56      42.78     38.77     81.54       0.28     0.17   0.852
    A211                     35.74     120.07       0.00       8.56      70.16     70.45    140.61       0.33     0.17   0.902
    A212                     35.74     774.54       0.00       8.56     368.70    418.49    787.19       1.33     0.55   0.972
    A213                     35.74     828.96       0.00       8.56     393.62    448.24    841.86       1.35     0.54   0.974
    A214                     35.74     266.96       0.00       8.56     137.04    147.50    284.54       1.43     0.52   0.940
    A215                     35.74     561.68       0.00       8.56     271.50    304.33    575.83       1.46     0.52   0.964
    A216                     35.74       0.00       0.00       8.56      15.55      7.82     23.37       0.15     0.13   0.654
    A217                     35.74      67.75       0.00       8.56      46.39     43.29     89.68       0.20     0.13   0.867
    A218                     35.74     104.83       0.00       8.56      63.29     62.96    126.25       0.24     0.12   0.898
    A219                     35.74     621.58       0.00       8.56     298.92    337.10    636.02       1.86     0.61   0.968
    A220                     35.74       0.00       0.00       8.56      15.61      8.38     24.00       0.05     0.05   0.671
    A221                     35.74      16.76       0.00       8.56      23.25     17.25     40.50       0.13     0.11   0.771
    A222                     35.74     304.56       0.00      21.15      58.04    248.46    306.50       1.87     0.60   0.901
    EXT201                   35.74       0.00       0.00       0.00      34.15      0.00     34.15       0.14     0.17   0.955
    EXT202                   35.74       0.00       0.00       0.00      34.15      0.00     34.15       0.03     0.04   0.955
    EXT203                   35.74       1.42       0.00      26.91       0.00      0.89      0.89       0.02     0.01   0.024
```

U201	35.74	0.00	0.00	25.52	0.00	5.50	5.50	0.01	0.00	0.154
U202	35.74	0.00	0.00	8.56	15.61	8.34	23.95	0.11	0.10	0.670

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
STMH1	JUNCTION	0.65	0.84	177.89	0 02:23	0.84
U201_OUTLET	OUTFALL	0.00	0.00	184.50	0 00:00	0.00
LOWER_ORIFICE_OUTFALL	OUTFALL	0.00	0.00	177.02	0 00:00	0.00
HIGHER_ORIFICE_OUTFALL	OUTFALL	0.00	0.00	177.02	0 00:00	0.00
WEIR_OUTFALL	OUTFALL	0.00	0.00	178.35	0 00:00	0.00
U202_OUTLET	OUTFALL	0.00	0.00	179.30	0 00:00	0.00
SWM_DRY_POND	STORAGE	0.64	0.82	177.89	0 02:23	0.82

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
STMH1	JUNCTION	0.000	0.162	0 02:22	0	0.853	1.226
U201_OUTLET	OUTFALL	0.001	0.001	0 01:26	0.0051	0.0051	0.000
LOWER_ORIFICE_OUTFALL	OUTFALL	0.000	0.081	0 02:23	0	0.508	0.000
HIGHER_ORIFICE_OUTFALL	OUTFALL	0.000	0.080	0 02:23	0	0.335	0.000
WEIR_OUTFALL	OUTFALL	0.000	0.000	0 00:00	0	0	0.000 ltr
U202_OUTLET	OUTFALL	0.101	0.101	0 01:10	0.107	0.107	0.000
SWM_DRY_POND	STORAGE	0.601	0.601	0 01:29	1.87	1.87	0.209

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
SWM_DRY_POND	0.747	19	0	0	1.070	27	0 02:23	0.162

****
Outfall Loading Summary

****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
U201_OUTLET	84.98	0.001	0.001	0.005
LOWER_ORIFICE_OUTFALL	99.60	0.066	0.081	0.508
HIGHER_ORIFICE_OUTFALL	72.13	0.065	0.080	0.335
WEIR_OUTFALL	0.00	0.000	0.000	0.000
U202_OUTLET	99.86	0.010	0.101	0.107
System	71.31	0.141	0.166	0.954

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	Time of Max Occurrence hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
HW2_TO_STMH1	CONDUIT	0.162	0	02:22	0.29	0.11	0.69
LOWER_ORIFICE	ORIFICE	0.081	0	02:23			1.00
HIGHER_ORIFICE	ORIFICE	0.080	0	02:23			0.32
WIER	WEIR	0.000	0	00:00			0.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
HW2_TO_STMH1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Tue Jul 13 15:45:49 2021
Analysis ended on: Tue Jul 13 15:45:49 2021
Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

SBM-18-0530 Kettle Creek Pre-Development Results 10 Year Storm

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Infiltration Method ..... CURVE_NUMBER
Flow Routing Method ..... DYNWAVE
Surcharge Method ..... EXTRAN
Starting Date 12/11/2020 00:00:00
Ending Date 12/11/2020 03:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:01:00
Dry Time Step 00:01:00
Routing Time Step ..... 30.00 sec
Variable Time Step ..... YES
Maximum Trials 8
Number of Threads 1
Head Tolerance ..... 0.001500 m

**************************   Volume   Depth
Runoff Quantity Continuity   hectare-m   mm
**************************   ---------   -------
Total Precipitation 0.689   41.849
Evaporation Loss 0.000   0.000
Infiltration Loss 0.293   17.804
Surface Runoff 0.259   15.737
Final Storage 0.135   8.206
Continuity Error (%) 0.242

**************************   Volume   Volume
Flow Routing Continuity   hectare-m   10^6 ltr
**************************   ---------   ---------
Dry Weather Inflow 0.000   0.000
Wet Weather Inflow 0.259   2.586
Groundwater Inflow 0.000   0.000
RDII Inflow 0.000   0.000
External Inflow 0.000   0.000
External Outflow 0.132   1.322
Flooding Loss 0.000   0.000
Evaporation Loss 0.000   0.000
Exfiltration Loss 0.000   0.000
Initial Stored Volume 0.000   0.000
Final Stored Volume 0.125   1.255
Continuity Error (%) 0.364

```
**************************
Highest Continuity Errors
**************************
Node STMH1 (1.16%)


***************************
Time-Step Critical Elements
***************************
Link HW2_TO_STMH1 (99.80%)


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :     0.25 sec
Average Time Step           :     3.54 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :    -0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00
Time Step Frequencies       :
   30.000 - 13.228 sec      :     3.18 %
   13.228 -  5.833 sec      :     9.18 %
    5.833 -  2.572 sec      :    20.00 %
    2.572 -  1.134 sec      :    67.64 %
    1.134 -  0.500 sec      :     0.00 %


***************************
Subcatchment Runoff Summary
***************************

-----------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total      Imperv       Perv      Total       Total      Peak  Runoff
                         Precip      Runon       Evap      Infil      Runoff     Runoff     Runoff      Runoff    Runoff   Coeff
Subcatchment                 mm         mm         mm         mm         mm         mm         mm    10^6 ltr       CMS
-----------------------------------------------------------------------------------------------------------------------
A201                      41.85       3.81       0.00      30.23       0.00       5.26       5.26        0.22      0.04   0.115
A202                      41.85       0.00       0.00       9.15      18.31      10.19      28.50        0.14      0.12   0.681
A203                      41.85      17.57       0.00       9.15      26.30      19.40      45.70        0.37      0.26   0.769
A204                      41.85      78.93       0.00       9.15      54.26      51.80     106.06        0.50      0.28   0.878
A205                      41.85     451.77       0.00       9.15     224.21     249.16     473.37        1.31      0.54   0.959
A206                      41.85       0.00       0.00       9.15      18.34      10.47      28.81        0.39      0.33   0.688
A207                      41.85     108.71       0.00       9.15      67.83      67.56     135.39        0.49      0.32   0.899
A208                      41.85     243.83       0.00       9.15     129.47     139.61     269.07        0.54      0.29   0.942
A209                      41.85       7.83       0.00       9.15      21.73      13.22      34.95        0.30      0.19   0.704
A210                      41.85      84.91       0.00       9.15      56.90      54.21     111.11        0.39      0.22   0.877
A211                      41.85     163.53       0.00       9.15      92.72      95.69     188.41        0.44      0.21   0.917
A212                      41.85    1034.80       0.00       9.15     490.32     560.50    1050.82        1.78      0.73   0.976
A213                      41.85    1106.54       0.00       9.15     523.18     599.71    1122.89        1.80      0.72   0.978
A214                      41.85     356.06       0.00       9.15     180.46     197.45     377.91        1.90      0.70   0.950
A215                      41.85     745.99       0.00       9.15     358.42     405.42     763.84        1.94      0.69   0.970
A216                      41.85       0.00       0.00       9.15      18.33      10.44      28.78        0.18      0.16   0.688
A217                      41.85      83.44       0.00       9.15      56.33      54.32     110.65        0.24      0.16   0.883
A218                      41.85     129.36       0.00       9.15      77.27      78.75     156.01        0.29      0.16   0.911
A219                      41.85     812.97       0.00       9.15     389.10     442.20     831.30        2.44      0.82   0.972
A220                      41.85       0.00       0.00       9.15      18.40      11.07      29.47        0.07      0.07   0.704
A221                      41.85      20.58       0.00       9.15      27.79      21.98      49.77        0.16      0.14   0.797
A222                      41.85     398.06       0.00      23.61      75.11     327.01     402.12        2.45      0.80   0.914
EXT201                    41.85       0.00       0.00       0.00      40.25       0.00      40.25        0.16      0.21   0.962
EXT202                    41.85       0.00       0.00       0.00      40.25       0.00      40.25        0.04      0.05   0.962
EXT203                    41.85       1.67       0.00      30.23       0.00       3.02       3.02        0.07      0.01   0.069
```

U201	41.85	0.00	0.00	28.49	0.00	8.51	8.51	0.01	0.00	0.203
U202	41.85	0.00	0.00	9.15	18.40	11.02	29.42	0.13	0.13	0.703

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
STMH1	JUNCTION	0.73	0.93	177.98	0 02:18	0.93
U201_OUTLET	OUTFALL	0.00	0.00	184.50	0 00:00	0.00
LOWER_ORIFICE_OUTFALL	OUTFALL	0.00	0.00	177.02	0 00:00	0.00
HIGHER_ORIFICE_OUTFALL	OUTFALL	0.00	0.00	177.02	0 00:00	0.00
WEIR_OUTFALL	OUTFALL	0.00	0.00	178.35	0 00:00	0.00
U202_OUTLET	OUTFALL	0.00	0.00	179.30	0 00:00	0.00
SWM_DRY_POND	STORAGE	0.72	0.91	177.98	0 02:18	0.91

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
STMH1	JUNCTION	0.000	0.229	0 02:17	0	1.2	1.173
U201_OUTLET	OUTFALL	0.003	0.003	0 01:20	0.00789	0.00789	0.000
LOWER_ORIFICE_OUTFALL	OUTFALL	0.000	0.086	0 02:18	0	0.545	0.000
HIGHER_ORIFICE_OUTFALL	OUTFALL	0.000	0.143	0 02:18	0	0.638	0.000
WEIR_OUTFALL	OUTFALL	0.000	0.000	0 00:00	0	0	0.000 ltr
U202_OUTLET	OUTFALL	0.129	0.129	0 01:10	0.131	0.131	0.000
SWM_DRY_POND	STORAGE	0.803	0.803	0 01:27	2.45	2.45	0.176

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
SWM_DRY_POND	0.971	25	0	0	1.357	35	0 02:18	0.229

****
Outfall Loading Summary

****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
U201_OUTLET	86.07	0.001	0.003	0.008
LOWER_ORIFICE_OUTFALL	99.67	0.071	0.086	0.545
HIGHER_ORIFICE_OUTFALL	76.64	0.117	0.143	0.638
WEIR_OUTFALL	0.00	0.000	0.000	0.000
U202_OUTLET	99.87	0.011	0.129	0.131
System	72.45	0.201	0.235	1.322

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
HW2_TO_STMH1	CONDUIT	0.229	0	02:17	0.28	0.15	0.77
LOWER_ORIFICE	ORIFICE	0.086	0	02:18			1.00
HIGHER_ORIFICE	ORIFICE	0.143	0	02:18			0.47
WIER	WEIR	0.000	0	00:00			0.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
HW2_TO_STMH1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Tue Jul 13 15:46:07 2021
Analysis ended on: Tue Jul 13 15:46:07 2021
Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

SBM-18-0530 Kettle Creek Pre-Development Results 25 Year Storm

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Infiltration Method ..... CURVE_NUMBER
Flow Routing Method ..... DYNWAVE
Surcharge Method ..... EXTRAN
Starting Date 12/11/2020 00:00:00
Ending Date 12/11/2020 03:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:01:00
Dry Time Step 00:01:00
Routing Time Step ..... 30.00 sec
Variable Time Step ..... YES
Maximum Trials 8
Number of Threads 1
Head Tolerance ..... 0.001500 m

**************************   Volume   Depth
Runoff Quantity Continuity   hectare-m   mm
**************************   ---------   -------
Total Precipitation 0.819   49.695
Evaporation Loss 0.000   0.000
Infiltration Loss 0.326   19.790
Surface Runoff 0.345   20.934
Final Storage 0.146   8.838
Continuity Error (%) 0.267

**************************   Volume   Volume
Flow Routing Continuity   hectare-m   10^6 ltr
**************************   ---------   ----------
Dry Weather Inflow 0.000   0.000
Wet Weather Inflow 0.344   3.440
Groundwater Inflow 0.000   0.000
RDII Inflow 0.000   0.000
External Inflow 0.000   0.000
External Outflow 0.187   1.872
Flooding Loss 0.000   0.000
Evaporation Loss 0.000   0.000
Exfiltration Loss 0.000   0.000
Initial Stored Volume 0.000   0.000
Final Stored Volume 0.156   1.555
Continuity Error (%) 0.386

```
**************************
Highest Continuity Errors
**************************
Node STMH1 (1.06%)


***************************
Time-Step Critical Elements
***************************
Link HW2_TO_STMH1 (99.83%)


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :     0.76 sec
Average Time Step           :     3.11 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00
Time Step Frequencies       :
   30.000 - 13.228 sec      :     2.48 %
   13.228 -  5.833 sec      :     8.32 %
    5.833 -  2.572 sec      :    13.48 %
    2.572 -  1.134 sec      :    75.69 %
    1.134 -  0.500 sec      :     0.03 %


***************************
Subcatchment Runoff Summary
***************************

-----------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv       Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff     Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                 mm         mm         mm         mm         mm         mm         mm  10^6 ltr      CMS
-----------------------------------------------------------------------------------------------------------------------
A201                      49.69       4.56       0.00      34.12       0.00       9.46       9.46      0.40     0.09   0.174
A202                      49.69       0.00       0.00       9.77      21.88      13.69      35.57      0.18     0.15   0.716
A203                      49.69      21.93       0.00       9.77      31.87      25.23      57.10      0.46     0.33   0.797
A204                      49.69      98.62       0.00       9.77      66.82      65.87     132.70      0.62     0.37   0.895
A205                      49.69     609.38       0.00       9.77     299.77     337.33     637.10      1.76     0.73   0.967
A206                      49.69       0.00       0.00       9.77      21.91      13.99      35.90      0.49     0.42   0.722
A207                      49.69     135.51       0.00       9.77      83.64      85.44     169.08      0.61     0.41   0.913
A208                      49.69     304.53       0.00       9.77     160.76     175.77     336.53      0.67     0.39   0.950
A209                      49.69      17.01       0.00       9.77      29.46      21.20      50.66      0.43     0.24   0.759
A210                      49.69     123.06       0.00       9.77      77.86      77.78     155.64      0.54     0.28   0.901
A211                      49.69     229.04       0.00       9.77     126.16     133.86     260.02      0.61     0.28   0.933
A212                      49.69    1401.83       0.00       9.77     661.55     761.38    1422.94      2.40     0.98   0.980
A213                      49.69    1498.61       0.00       9.77     705.86     814.24    1520.10      2.43     0.97   0.982
A214                      49.69     482.09       0.00       9.77     241.56     268.33     509.90      2.56     0.95   0.959
A215                      49.69    1006.67       0.00       9.77     481.05     548.86    1029.90      2.62     0.94   0.975
A216                      49.69       0.00       0.00       9.77      21.91      13.96      35.87      0.23     0.20   0.722
A217                      49.69     104.02       0.00       9.77      69.30      68.87     138.17      0.30     0.21   0.899
A218                      49.69     161.55       0.00       9.77      95.54      99.56     195.10      0.36     0.21   0.924
A219                      49.69    1080.99       0.00       9.77     515.09     589.76    1104.85      3.24     1.11   0.977
A220                      49.69       0.00       0.00       9.77      21.99      14.65      36.64      0.08     0.08   0.737
A221                      49.69      25.59       0.00       9.77      33.66      28.26      61.91      0.20     0.19   0.822
A222                      49.69     529.11       0.00      26.45      98.92     437.64     536.56      3.27     1.10   0.927
EXT201                    49.69       0.00       0.00       0.00      48.09       0.00      48.09      0.19     0.25   0.968
EXT202                    49.69       0.00       0.00       0.00      48.09       0.00      48.09      0.04     0.06   0.968
EXT203                    49.69       2.00       0.00      34.12       0.00       6.54       6.54      0.14     0.03   0.127
```

U201	49.69	0.00	0.00	31.92	0.00	12.77	12.77	0.01	0.01	0.257
U202	49.69	0.00	0.00	9.77	21.98	14.60	36.58	0.16	0.17	0.736

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
STMH1	JUNCTION	0.84	1.04	178.09	0 02:12	1.04
U201_OUTLET	OUTFALL	0.00	0.00	184.50	0 00:00	0.00
LOWER_ORIFICE_OUTFALL	OUTFALL	0.00	0.00	177.02	0 00:00	0.00
HIGHER_ORIFICE_OUTFALL	OUTFALL	0.00	0.00	177.02	0 00:00	0.00
WEIR_OUTFALL	OUTFALL	0.00	0.00	178.35	0 00:00	0.00
U202_OUTLET	OUTFALL	0.00	0.00	179.30	0 00:00	0.00
SWM_DRY_POND	STORAGE	0.82	1.02	178.09	0 02:12	1.02

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
STMH1	JUNCTION	0.000	0.329	0 02:11	0	1.72	1.070
U201_OUTLET	OUTFALL	0.005	0.005	0 01:17	0.0118	0.0118	0.000
LOWER_ORIFICE_OUTFALL	OUTFALL	0.000	0.092	0 02:12	0	0.589	0.000
HIGHER_ORIFICE_OUTFALL	OUTFALL	0.000	0.237	0 02:12	0	1.11	0.000
WEIR_OUTFALL	OUTFALL	0.000	0.000	0 00:00	0	0	0.000 ltr
U202_OUTLET	OUTFALL	0.167	0.167	0 01:10	0.163	0.163	0.000
SWM_DRY_POND	STORAGE	1.100	1.100	0 01:26	3.27	3.27	0.146

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
SWM_DRY_POND	1.285	33	0	0	1.750	45	0 02:12	0.329

****
Outfall Loading Summary

****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
U201_OUTLET	87.27	0.002	0.005	0.012
LOWER_ORIFICE_OUTFALL	99.74	0.077	0.092	0.589
HIGHER_ORIFICE_OUTFALL	80.48	0.196	0.237	1.108
WEIR_OUTFALL	0.00	0.000	0.000	0.000
U202_OUTLET	99.88	0.014	0.167	0.163
System	73.48	0.288	0.336	1.872

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
HW2_TO_STMH1	CONDUIT	0.329	0	02:11	0.32	0.22	0.86
LOWER_ORIFICE	ORIFICE	0.092	0	02:12			1.00
HIGHER_ORIFICE	ORIFICE	0.237	0	02:12			0.66
WIER	WEIR	0.000	0	00:00			0.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
HW2_TO_STMH1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.02	0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Tue Jul 13 15:47:10 2021
Analysis ended on: Tue Jul 13 15:47:10 2021
Total elapsed time: < 1 sec

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------

SBM-18-0530 Kettle Creek Pre-Development Results 50 Year Storm


*****************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*****************************************************

***************
Analysis Options
***************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 12/11/2020 00:00:00
Ending Date .............. 12/11/2020 03:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:01:00
Dry Time Step ............ 00:01:00
Routing Time Step ........ 30.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.001500 m


*************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
*************************     ---------       -------
Total Precipitation ......         0.912        55.362
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.347        21.087
Surface Runoff ...........         0.409        24.860
Final Storage ............         0.153         9.260
Continuity Error (%) .....         0.280


*************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.409         4.085
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.230         2.304
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.177         1.766
Continuity Error (%) .....         0.387
```

```
**************************
Time-Step Critical Elements
**************************
Link HW2_TO_STMH1 (99.85%)


******************************
Highest Flow Instability Indexes
******************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     1.33 sec
Average Time Step           :     2.77 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :    -0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00
Time Step Frequencies       :
   30.000 - 13.228 sec      :     2.00 %
   13.228 -  5.833 sec      :     7.52 %
    5.833 -  2.572 sec      :    11.03 %
    2.572 -  1.134 sec      :    79.45 %
    1.134 -  0.500 sec      :     0.00 %


**************************
Subcatchment Runoff Summary
**************************

---------------------------------------------------------------------------------------------------------------------
                         Total      Total      Total      Total     Imperv       Perv      Total       Total     Peak  Runoff
                        Precip      Runon       Evap      Infil    Runoff     Runoff     Runoff     Runoff   Runoff   Coeff
Subcatchment                mm         mm         mm         mm        mm         mm         mm   10^6 ltr      CMS
---------------------------------------------------------------------------------------------------------------------
A201                     55.36       5.09       0.00      36.70      0.00      12.75      12.75       0.54     0.13   0.211
A202                     55.36       0.00       0.00      10.15     24.46      16.27      40.74       0.20     0.17   0.736
A203                     55.36      25.12       0.00      10.15     35.90      29.52      65.43       0.53     0.39   0.813
A204                     55.36     113.01       0.00      10.15     75.97      76.18     152.15       0.71     0.43   0.904
A205                     55.36     728.01       0.00      10.15    356.53     403.70     760.23       2.11     0.90   0.970
A206                     55.36       0.00       0.00      10.15     24.50      16.60      41.09       0.56     0.50   0.742
A207                     55.36     155.10       0.00      10.15     95.17      98.53     193.70       0.70     0.49   0.920
A208                     55.36     348.87       0.00      10.15    183.59     202.20     385.79       0.77     0.46   0.954
A209                     55.36      24.49       0.00      10.15     35.43      27.58      63.01       0.53     0.28   0.789
A210                     55.36     153.07       0.00      10.15     94.13      96.29     190.42       0.66     0.33   0.914
A211                     55.36     280.24       0.00      10.15    152.10     163.71     315.82       0.74     0.33   0.941
A212                     55.36    1680.58       0.00      10.15    791.48     914.07    1705.55       2.88     1.19   0.982
A213                     55.36    1796.39       0.00      10.15    844.50     977.31    1821.81       2.91     1.18   0.984
A214                     55.36     577.82       0.00      10.15    287.85     322.23     610.08       3.07     1.16   0.964
A215                     55.36    1204.55       0.00      10.15    574.02     657.85    1231.86       3.13     1.15   0.978
A216                     55.36       0.00       0.00      10.15     24.50      16.57      41.06       0.26     0.23   0.742
A217                     55.36     119.06       0.00      10.15     78.75      79.53     158.28       0.35     0.24   0.907
A218                     55.36     185.07       0.00      10.15    108.86     114.79     223.65       0.42     0.25   0.930
A219                     55.36    1283.36       0.00      10.15    610.12     701.26    1311.39       3.84     1.35   0.980
A220                     55.36       0.00       0.00      10.15     24.58      17.31      41.88       0.09     0.10   0.757
A221                     55.36      29.25       0.00      10.15     37.92      32.88      70.80       0.22     0.22   0.837
A222                     55.36     628.07       0.00      28.31    116.85     521.39     638.24       3.89     1.33   0.934
EXT201                   55.36       0.00       0.00       0.00     53.75       0.00      53.75       0.22     0.28   0.971
EXT202                   55.36       0.00       0.00       0.00     53.75       0.00      53.75       0.05     0.06   0.971
EXT203                   55.36       2.23       0.00      36.70      0.00       9.41       9.41       0.21     0.04   0.163
U201                     55.36       0.00       0.00      34.17      0.00      16.07      16.07       0.01     0.01   0.290
U202                     55.36       0.00       0.00      10.15     24.57      17.25      41.82       0.19     0.20   0.755


******************
Node Depth Summary
```

```
******************

--------------------------------------------------------------------------------
                                 Average  Maximum  Maximum  Time of Max    Reported
                                   Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type         Meters   Meters   Meters  days hr:min      Meters
--------------------------------------------------------------------------------
STMH1                JUNCTION       0.91     1.12   178.17     0  02:09        1.12
U201_OUTLET          OUTFALL        0.00     0.00   184.50     0  00:00        0.00
LOWER_ORIFICE_OUTFALL OUTFALL       0.00     0.00   177.02     0  00:00        0.00
HIGHER_ORIFICE_OUTFALL OUTFALL      0.00     0.00   177.02     0  00:00        0.00
WEIR_OUTFALL         OUTFALL        0.00     0.00   178.35     0  00:00        0.00
U202_OUTLET          OUTFALL        0.00     0.00   179.30     0  00:00        0.00
SWM_DRY_POND         STORAGE        0.90     1.10   178.17     0  02:09        1.10


*******************
Node Inflow Summary
*******************

-------------------------------------------------------------------------------------------------
                                 Maximum  Maximum                  Lateral       Total        Flow
                                 Lateral    Total  Time of Max      Inflow      Inflow     Balance
                                  Inflow   Inflow   Occurrence      Volume      Volume       Error
Node                 Type           CMS      CMS  days hr:min    10^6 ltr    10^6 ltr     Percent
-------------------------------------------------------------------------------------------------
STMH1                JUNCTION     0.000    0.407     0  02:08           0        2.12       0.995
U201_OUTLET          OUTFALL      0.007    0.007     0  01:15      0.0149      0.0149       0.000
LOWER_ORIFICE_OUTFALL OUTFALL     0.000    0.096     0  02:09           0       0.619       0.000
HIGHER_ORIFICE_OUTFALL OUTFALL    0.000    0.312     0  02:09           0        1.48       0.000
WEIR_OUTFALL         OUTFALL      0.000    0.000     0  00:00           0           0       0.000 ltr
U202_OUTLET          OUTFALL      0.198    0.198     0  01:10       0.186       0.186       0.000
SWM_DRY_POND         STORAGE      1.334    1.334     0  01:26        3.88        3.88       0.130


**********************
Node Surcharge Summary
**********************

No nodes were surcharged.


**********************
Node Flooding Summary
**********************

No nodes were flooded.


**********************
Storage Volume Summary
**********************

-------------------------------------------------------------------------------------------------
                        Average     Avg  Evap Exfil       Maximum     Max    Time of Max    Maximum
                         Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt     Occurrence    Outflow
Storage Unit           1000 m3    Full  Loss  Loss      1000 m3    Full    days hr:min        CMS
-------------------------------------------------------------------------------------------------
SWM_DRY_POND             1.530      39     0     0         2.042      52       0  02:09      0.407


**********************
Outfall Loading Summary
**********************

-----------------------------------------------------------
                        Flow       Avg       Max       Total
                        Freq      Flow      Flow      Volume
Outfall Node            Pcnt       CMS       CMS    10^6 ltr
```

U201_OUTLET	88.41	0.002	0.007	0.015
LOWER_ORIFICE_OUTFALL	99.79	0.081	0.096	0.619
HIGHER_ORIFICE_OUTFALL	82.89	0.259	0.312	1.484
WEIR_OUTFALL	0.00	0.000	0.000	0.000
U202_OUTLET	99.90	0.015	0.198	0.186
System	74.20	0.358	0.416	2.304

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
HW2_TO_STMH1	CONDUIT	0.407	0	02:08	0.37	0.27	0.93
LOWER_ORIFICE	ORIFICE	0.096	0	02:09			1.00
HIGHER_ORIFICE	ORIFICE	0.312	0	02:09			0.79
WIER	WEIR	0.000	0	00:00			0.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
HW2_TO_STMH1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Tue Jul 13 15:47:29 2021
Analysis ended on: Tue Jul 13 15:47:30 2021
Total elapsed time: 00:00:01

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

SBM-18-0530 Kettle Creek Pre-Development Results 100 Year Storm

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Infiltration Method ..... CURVE_NUMBER
Flow Routing Method ..... DYNWAVE
Surcharge Method ..... EXTRAN
Starting Date 12/11/2020 00:00:00
Ending Date 12/11/2020 03:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:01:00
Dry Time Step 00:01:00
Routing Time Step ..... 30.00 sec
Variable Time Step ..... YES
Maximum Trials 8
Number of Threads 1
Head Tolerance ..... 0.001500 m

**************************   Volume   Depth
Runoff Quantity Continuity   hectare-m   mm
**************************   ---------   -------
Total Precipitation 1.009   61.250
Evaporation Loss 0.000   0.000
Infiltration Loss 0.368   22.329
Surface Runoff 0.479   29.104
Final Storage 0.159   9.642
Continuity Error (%) 0.288

**************************   Volume   Volume
Flow Routing Continuity   hectare-m   10^6 ltr
**************************   ---------   ---------
Dry Weather Inflow 0.000   0.000
Wet Weather Inflow 0.478   4.783
Groundwater Inflow 0.000   0.000
RDII Inflow 0.000   0.000
External Inflow 0.000   0.000
External Outflow 0.279   2.786
Flooding Loss 0.000   0.000
Evaporation Loss 0.000   0.000
Exfiltration Loss 0.000   0.000
Initial Stored Volume 0.000   0.000
Final Stored Volume 0.198   1.979
Continuity Error (%) 0.379

```
**************************
Time-Step Critical Elements
**************************
Link HW2_TO_STMH1 (99.89%)


******************************
Highest Flow Instability Indexes
******************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.68 sec
Average Time Step           :     2.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00
Time Step Frequencies       :
   30.000 - 13.228 sec      :     1.33 %
   13.228 -  5.833 sec      :     5.40 %
    5.833 -  2.572 sec      :     7.64 %
    2.572 -  1.134 sec      :    49.08 %
    1.134 -  0.500 sec      :    36.55 %


**************************
Subcatchment Runoff Summary
**************************

---------------------------------------------------------------------------------------------------------------------
                         Total      Total      Total      Total     Imperv       Perv      Total       Total     Peak   Runoff
                        Precip      Runon       Evap      Infil     Runoff     Runoff     Runoff     Runoff   Runoff   Coeff
Subcatchment                mm         mm         mm         mm         mm         mm         mm  10^6 ltr      CMS
---------------------------------------------------------------------------------------------------------------------
A201                     61.25       5.65       0.00      39.20       0.00      16.40      16.40       0.70     0.19   0.245
A202                     61.25       0.00       0.00      10.49      27.15      19.03      46.17       0.23     0.20   0.754
A203                     61.25      28.47       0.00      10.49      40.12      34.07      74.19       0.60     0.45   0.827
A204                     61.25     128.16       0.00      10.49      85.57      87.07     172.64       0.81     0.50   0.911
A205                     61.25     855.67       0.00      10.49     417.53     475.21     892.74       2.47     1.09   0.974
A206                     61.25       0.00       0.00      10.49      27.18      19.37      46.55       0.63     0.57   0.760
A207                     61.25     175.69       0.00      10.49     107.26     112.34     219.60       0.79     0.57   0.927
A208                     61.25     395.53       0.00      10.49     207.59     230.08     437.67       0.87     0.53   0.958
A209                     61.25      32.93       0.00      10.49      41.95      34.67      76.62       0.65     0.32   0.814
A210                     61.25     186.17       0.00      10.49     111.91     116.69     228.60       0.79     0.38   0.924
A211                     61.25     336.48       0.00      10.49     180.46     196.53     376.99       0.89     0.38   0.948
A212                     61.25    1982.20       0.00      10.49     931.97    1079.48    2011.46       3.40     1.43   0.984
A213                     61.25    2118.80       0.00      10.49     994.51    1154.05    2148.55       3.44     1.42   0.986
A214                     61.25     681.52       0.00      10.49     337.90     380.69     718.58       3.61     1.40   0.967
A215                     61.25    1418.94       0.00      10.49     674.65     776.07    1450.72       3.68     1.39   0.980
A216                     61.25       0.00       0.00      10.49      27.18      19.34      46.52       0.30     0.26   0.759
A217                     61.25     134.88       0.00      10.49      88.66      90.79     179.45       0.39     0.28   0.915
A218                     61.25     209.82       0.00      10.49     122.85     130.86     253.71       0.47     0.29   0.936
A219                     61.25    1501.86       0.00      10.49     712.63     821.78    1534.41       4.50     1.62   0.982
A220                     61.25       0.00       0.00      10.49      27.27      20.12      47.39       0.10     0.12   0.774
A221                     61.25      33.10       0.00      10.49      42.36      37.77      80.13       0.25     0.25   0.849
A222                     61.25     734.96       0.00      30.10     136.18     612.08     748.26       4.56     1.60   0.940
EXT201                   61.25       0.00       0.00       0.00      59.63       0.00      59.63       0.24     0.31   0.974
EXT202                   61.25       0.00       0.00       0.00      59.63       0.00      59.63       0.05     0.07   0.974
EXT203                   61.25       2.48       0.00      39.20       0.00      12.65      12.65       0.28     0.06   0.198
U201                     61.25       0.00       0.00      36.32       0.00      19.68      19.68       0.02     0.01   0.321
U202                     61.25       0.00       0.00      10.49      27.26      20.07      47.33       0.21     0.23   0.773


******************
Node Depth Summary
```

```
******************

--------------------------------------------------------------------------------
                                 Average  Maximum  Maximum  Time of Max    Reported
                                   Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type         Meters   Meters   Meters  days hr:min      Meters
--------------------------------------------------------------------------------
STMH1                JUNCTION       1.03     1.20   178.25     0  02:06        1.20
U201_OUTLET          OUTFALL        0.00     0.00   184.50     0  00:00        0.00
LOWER_ORIFICE_OUTFALL OUTFALL       0.00     0.00   177.02     0  00:00        0.00
HIGHER_ORIFICE_OUTFALL OUTFALL      0.00     0.00   177.02     0  00:00        0.00
WEIR_OUTFALL         OUTFALL        0.00     0.00   178.35     0  00:00        0.00
U202_OUTLET          OUTFALL        0.00     0.00   179.30     0  00:00        0.00
SWM_DRY_POND         STORAGE        1.01     1.19   178.26     0  02:06        1.19


*******************
Node Inflow Summary
*******************

-------------------------------------------------------------------------------------------------
                                 Maximum  Maximum                  Lateral       Total        Flow
                                 Lateral    Total  Time of Max      Inflow      Inflow     Balance
                                  Inflow   Inflow   Occurrence      Volume      Volume       Error
Node                 Type           CMS      CMS  days hr:min    10^6 ltr    10^6 ltr     Percent
-------------------------------------------------------------------------------------------------
STMH1                JUNCTION     0.000    0.496     0  02:06           0        2.58       0.916
U201_OUTLET          OUTFALL      0.010    0.010     0  01:14      0.0183      0.0183       0.000
LOWER_ORIFICE_OUTFALL OUTFALL     0.000    0.100     0  02:06           0       0.649       0.000
HIGHER_ORIFICE_OUTFALL OUTFALL    0.000    0.396     0  02:06           0        1.91       0.000
WEIR_OUTFALL         OUTFALL      0.000    0.000     0  00:00           0           0       0.000 ltr
U202_OUTLET          OUTFALL      0.227    0.227     0  01:10       0.211       0.211       0.000
SWM_DRY_POND         STORAGE      1.600    1.600     0  01:25        4.55        4.55       0.116


**********************
Node Surcharge Summary
**********************

No nodes were surcharged.


*********************
Node Flooding Summary
*********************

No nodes were flooded.


**********************
Storage Volume Summary
**********************

-------------------------------------------------------------------------------------------------
                        Average     Avg  Evap Exfil       Maximum     Max    Time of Max    Maximum
                         Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt     Occurrence    Outflow
Storage Unit           1000 m3    Full  Loss  Loss       1000 m3    Full    days hr:min        CMS
-------------------------------------------------------------------------------------------------
SWM_DRY_POND             1.896      48     0     0         2.359      60       0  02:06      0.496


**********************
Outfall Loading Summary
**********************

-----------------------------------------------------------
                        Flow       Avg       Max       Total
                        Freq      Flow      Flow      Volume
Outfall Node            Pcnt       CMS       CMS    10^6 ltr
```

U201_OUTLET	91.48	0.002	0.010	0.018
LOWER_ORIFICE_OUTFALL	99.87	0.088	0.100	0.649
HIGHER_ORIFICE_OUTFALL	87.78	0.342	0.396	1.908
WEIR_OUTFALL	0.00	0.000	0.000	0.000
U202_OUTLET	99.93	0.015	0.227	0.211
System	75.81	0.448	0.506	2.786

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
HW2_TO_STMH1	CONDUIT	0.496	0	02:06	0.44	0.32	0.99
LOWER_ORIFICE	ORIFICE	0.100	0	02:06			1.00
HIGHER_ORIFICE	ORIFICE	0.396	0	02:06			0.92
WIER	WEIR	0.000	0	00:00			0.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
HW2_TO_STMH1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Tue Jul 13 15:47:47 2021
Analysis ended on: Tue Jul 13 15:47:47 2021
Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

SBM-18-0530 Kettle Creek Pre-Development Results 250 Year Storm

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Infiltration Method ..... CURVE_NUMBER
Flow Routing Method ..... DYNWAVE
Surcharge Method ..... EXTRAN
Starting Date 12/11/2020 00:00:00
Ending Date 12/11/2020 03:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:01:00
Dry Time Step 00:01:00
Routing Time Step ..... 30.00 sec
Variable Time Step ..... YES
Maximum Trials 8
Number of Threads 1
Head Tolerance ..... 0.001500 m

**************************   Volume   Depth
Runoff Quantity Continuity   hectare-m   mm
**************************   ---------   -------
Total Precipitation 1.121   68.042
Evaporation Loss 0.000   0.000
Infiltration Loss 0.389   23.645
Surface Runoff 0.577   35.016
Final Storage 0.152   9.251
Continuity Error (%) 0.191

**************************   Volume   Volume
Flow Routing Continuity   hectare-m   10^6 ltr
**************************   ---------   ---------
Dry Weather Inflow 0.000   0.000
Wet Weather Inflow 0.576   5.758
Groundwater Inflow 0.000   0.000
RDII Inflow 0.000   0.000
External Inflow 0.000   0.000
External Outflow 0.304   3.040
Flooding Loss 0.043   0.429
Evaporation Loss 0.000   0.000
Exfiltration Loss 0.000   0.000
Initial Stored Volume 0.000   0.000
Final Stored Volume 0.198   1.977
Continuity Error (%) 5.416

```
**************************
Highest Continuity Errors
**************************
Node STMH1 (8.34%)


***************************
Time-Step Critical Elements
***************************
Link HW2_TO_STMH1 (99.72%)


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


************************
Routing Time Step Summary
************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     1.50 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :    -0.00
Average Iterations per Step :     2.01
Percent Not Converging      :     0.00
Time Step Frequencies       :
   30.000 - 13.228 sec      :     1.38 %
   13.228 -  5.833 sec      :     3.76 %
    5.833 -  2.572 sec      :     4.82 %
    2.572 -  1.134 sec      :    24.79 %
    1.134 -  0.500 sec      :    65.25 %


***************************
Subcatchment Runoff Summary
***************************

-----------------------------------------------------------------------------------------------------------------------
                          Total      Total      Total      Total     Imperv       Perv      Total       Total     Peak  Runoff
                         Precip      Runon       Evap      Infil     Runoff     Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment                 mm         mm         mm         mm         mm         mm         mm   10^6 ltr      CMS
-----------------------------------------------------------------------------------------------------------------------
A201                      68.04       6.30       0.00      41.87       0.00      21.44      21.44        0.91     0.31   0.288
A202                      68.04       0.00       0.00      10.83      30.29      22.59      52.88        0.26     0.24   0.777
A203                      68.04      32.62       0.00      10.83      45.16      39.95      85.11        0.69     0.56   0.845
A204                      68.04     147.09       0.00      10.83      97.39     101.13     198.51        0.93     0.65   0.923
A205                      68.04    1024.46       0.00      10.83     497.88     571.20    1069.08        2.96     1.52   0.979
A206                      68.04       0.00       0.00      10.83      30.32      22.90      53.22        0.72     0.70   0.782
A207                      68.04     200.98       0.00      10.83     121.99     129.96     251.96        0.90     0.72   0.937
A208                      68.04     454.05       0.00      10.83     237.53     265.96     503.49        1.00     0.70   0.964
A209                      68.04      44.95       0.00      10.83      50.58      44.71      95.29        0.81     0.40   0.843
A210                      68.04     231.75       0.00      10.83     135.88     145.04     280.92        0.97     0.48   0.937
A211                      68.04     413.83       0.00      10.83     218.96     242.22     461.18        1.08     0.50   0.957
A212                      68.04    2389.03       0.00      10.83    1121.15    1305.12    2426.26        4.10     1.98   0.987
A213                      68.04    2557.72       0.00      10.83    1198.33    1397.01    2595.33        4.15     1.97   0.988
A214                      68.04     823.88       0.00      10.83     406.15     462.02     868.17        4.37     1.95   0.973
A215                      68.04    1715.65       0.00      10.83     813.46     941.50    1754.96        4.46     1.94   0.984
A216                      68.04       0.00       0.00      10.83      30.32      22.88      53.19        0.34     0.33   0.782
A217                      68.04     154.32       0.00      10.83     100.71     105.14     205.85        0.45     0.36   0.926
A218                      68.04     240.82       0.00      10.83     140.19     151.57     291.75        0.55     0.38   0.945
A219                      68.04    1802.52       0.00      10.83     853.25     989.36    1842.61        5.40     2.23   0.985
A220                      68.04       0.00       0.00      10.83      30.38      23.58      53.96        0.12     0.14   0.793
A221                      68.04      37.70       0.00      10.83      47.59      43.78      91.37        0.29     0.31   0.864
A222                      68.04     883.23       0.00      31.99     162.76     739.60     902.36        5.50     2.20   0.949
EXT201                    68.04       0.00       0.00       0.00      66.45       0.00      66.45        0.27     0.36   0.977
EXT202                    68.04       0.00       0.00       0.00      66.45       0.00      66.45        0.06     0.08   0.977
EXT203                    68.04       2.76       0.00      41.87       0.00      17.24      17.24        0.38     0.11   0.243
```

U201		68.04	0.00	0.00	38.61	0.00	24.39	24.39	0.02	0.02	0.359
U202		68.04	0.00	0.00	10.83	30.38	23.53	53.90	0.24	0.28	0.792

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
STMH1	JUNCTION	1.09	1.24	178.30	0 01:36	1.25
U201_OUTLET	OUTFALL	0.00	0.00	184.50	0 00:00	0.00
LOWER_ORIFICE_OUTFALL	OUTFALL	0.00	0.00	177.02	0 00:00	0.00
HIGHER_ORIFICE_OUTFALL	OUTFALL	0.00	0.00	177.02	0 00:00	0.00
WEIR_OUTFALL	OUTFALL	0.00	0.00	178.35	0 00:00	0.00
U202_OUTLET	OUTFALL	0.00	0.00	179.30	0 00:00	0.00
SWM_DRY_POND	STORAGE	1.08	1.20	178.27	0 01:41	1.20

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
STMH1	JUNCTION	0.000	4.956	0 01:43	0	3.5	9.093
U201_OUTLET	OUTFALL	0.015	0.015	0 01:13	0.0226	0.0226	0.000
LOWER_ORIFICE_OUTFALL	OUTFALL	0.000	0.102	0 01:36	0	0.657	0.000
HIGHER_ORIFICE_OUTFALL	OUTFALL	0.000	0.446	0 01:36	0	2.12	0.000
WEIR_OUTFALL	OUTFALL	0.000	0.000	0 00:00	0	0	0.000 ltr
U202_OUTLET	OUTFALL	0.281	0.281	0 01:10	0.24	0.24	0.000
SWM_DRY_POND	STORAGE	2.202	2.202	0 01:24	5.5	5.5	0.564

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
STMH1	JUNCTION	0.18	0.000	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CMS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 ltr	Maximum Ponded Depth Meters
STMH1	0.18	2.787	0 01:43	0.702	0.000

****

Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
SWM_DRY_POND	2.084	53	0	0	2.426	62	0 01:41	4.956

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
U201_OUTLET	94.00	0.002	0.015	0.023
LOWER_ORIFICE_OUTFALL	99.87	0.092	0.102	0.657
HIGHER_ORIFICE_OUTFALL	91.51	0.377	0.446	2.120
WEIR_OUTFALL	0.00	0.000	0.000	0.000
U202_OUTLET	99.94	0.015	0.281	0.240
System	77.07	0.486	0.571	3.040

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
HW2_TO_STMH1	CONDUIT	4.956	0 01:43	4.39	3.25	1.00
LOWER_ORIFICE	ORIFICE	0.102	0 01:36			1.00
HIGHER_ORIFICE	ORIFICE	0.446	0 01:36			1.00
WIER	WEIR	0.000	0 00:00			0.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
HW2_TO_STMH1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
HW2_TO_STMH1	0.01	0.01	0.67	0.10	0.01

Analysis begun on: Tue Jul 13 15:50:09 2021

```
277     Analysis ended on:  Tue Jul 13 15:50:10 2021
278     Total elapsed time: 00:00:01
```