UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

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*File: 25010*

# FUNCTIONAL SERVICING REPORT

## 116 Four Mile Creek Road, Niagara-On-The-Lake
## August 2025

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## INTRODUCTION

Upper Canada Consultants has been retained to undertake and provide a Functional Servicing Report to address the servicing needs and requirements as part of a Site Plan Application for the proposed development. The project site is located at the above noted address, situated on the west side of Four Mile Creek Road (Regional Road 100), north of Creekside Drive. The development site has historically been the location of the 'Orchard Glen' grocer business on the north portion of the site, with the south portion remaining vacant agricultural lands.

The proposed development site is approximately 0.74 hectares and shall consist of a 4-storey, 77-unit residential apartment building and will include associated parking lot, concrete curb, catch basins, storm sewers, sanitary service, and a water service.

The objectives of this study are as follows:

1. Identify domestic and fire protection water service needs for the site;
2. Identify sanitary servicing needs for the site; and,
3. Identify stormwater management needs for the site.

## WATER SERVICING

There is an existing 200mm diameter municipal watermain located on the west side of Four Mile Creek Road (Regional Road 100) fronting the subject property. It is proposed to construct a 200mm diameter service to provide both domestic water supply and fire protection for the proposed development apartment building.

The nearest fire hydrant in proximity to the site is located approximately 18m north of the northeast corner of the site on the west side of Four Mile Creek Road (Regional Road 100). Due to the size of the proposed building, it is expected internal fire suppression systems will be required. The building will be designed to incorporate a fire department connection within 45m of the existing hydrant on Four Mile Creek Road per Ontario Building Code requirements.

Per the sanitary calculations outlined further in this report, the proposed development will result in a total population of 123 persons at 1.6 persons/apartment utilized by the City's external modelling consultant. Per the 2021 Regional Water Master Servicing Plan Update, 240 L/cap/day

is attributed as the average daily demand. Therefore, the average, maximum day, and peak hour domestic requirements will be 29,520L/cap/day, 81,180L/cap/day, and 121,918L/cap/day respectively with peaking factors of 2.75 and 4.13.

The buildings' internal Sprinkler System Engineer will provide the minimum flow calculations and requirements necessary to provide adequate fire protection for the proposed buildings as part of future building permit submissions. However, a subsequent calculation has been conducted and included in Appendix A to determine the minimum fire flow requirement for the proposed development per the Fire Underwriters Survey (2020) with the known construction techniques for this building at this time. The calculation utilizes factor such as the type of construction, combustibility of contents and proximity to adjacent structures to determine the minimum fire flow amount required to provide adequate fire protection. The calculation has determined that a minimum flow rate of 100.0L/s is expected to be required at a pressure of 20psi (140kPa) under fire flow conditions.

A hydrant flow test was conducted by Niagara Regional Fire Protection at the existing hydrant fronting the site on Mountain Road with the results with further calculations included in Appendix A. A flow calculation has determined that the hydrant will provide approximately 129.5L/s at fire flow conditions of 20psi. Therefore, the existing municipal watermain system will have adequate capacity to provide minimum fire flow per the Fire Underwriters Survey for the proposed development.

Lastly, a calculation has been conducted determining that due to the relatively low pressures within the existing watermain system fronting the site, pressures will drop to below 40 PSI (275KPa) within the top floors of the building. Through conversations with Town staff, it is expected that modifications to the existing municipal watermain system will be required in order to increase pressures to desirable levels in the system.

## SANITARY SERVICING

The proposed apartment building development will outlet to the existing municipal 200mm diameter municipal sanitary sewer located on Four Mile Creek Road (Regional Road 100) fronting the site. It is proposed to connect to an existing sanitary manhole with a 200mm diameter sanitary service to provide service for the apartment block.

An analysis of the peak sanitary flows from the development site has been conducted and included in Appendix B for both existing and future conditions. The analysis has concluded that the existing property contributed a peak sanitary outflow of 0.69L/s utilizing a commercial flow rate of 28 $m^3$/gross hectare/day per the MECP Design Criteria (2023). Utilizing a population density of 1.6 persons per apartment unit, the proposed development will discharge a total peak sanitary flow of **1.75 L/s** to the existing sanitary system – an increase of 1.06 L/s. the increase in flow will occupy 2.4% of the capacity of the existing sanitary sewer fronting the property. It is expected that the downstream municipal sanitary sewer system will have sufficient capacity for the proposed development site.

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## STORMWATER MANAGEMENT PLAN

As part of the site development, the following is a summary of the stormwater management plan.

The criteria provided by the Town of Niagara-on-the-Lake and Region of Niagara for this development includes the requirement to control future development stormwater flows to allowable levels from this site for up to and including the 100-year design storm event. It is also required to improve stormwater quality levels to MECP Normal Protection (70% TSS removal) levels prior to discharge to the existing storm sewer on Four Mile Creek Road (Regional Road 100).

### Existing Conditions

There is an existing ditch inlet at the northeast corner of the site. Under existing conditions, stormwater from the majority of the site is conveyed to on-site catch basins that discharges directly to the existing ditch inlet. The ditch inlet catches additional flows from the westerly roadside ditch and then directs stormwater via a 600mm diameter culvert to a manhole at the intersection of Four Mile Creek Road (Regional Road 100) and David Secord Drive. The storm sewer conveys flows easterly to a 3.0x1.8m concrete box culvert as part of Four Mile Creek passing below David Secord Drive.

The delineated drainage areas for the existing site conditions can be found on Figure 1 in Appendix C. The areas consist of the proposed development site, as well as the adjacent lands the convey stormwater into the proposed development site. Drainage Area EX10 consists mainly of the adjacent #82 Four Mile Creek Road property and has been attributed a Runoff Coefficient of 0.20 based on its' mainly undeveloped land use. Drainage Area EX20 consists mainly of the proposed development site. A Weighted Runoff Coefficient of 0.51 has been calculated as part of the Weighted Impervious Calculations included in Appendix D.

### Proposed Conditions

Figure 2 in Appendix C outlines the delineated drainage areas as part of the proposed Stormwater Management Plan for future development conditions.

Drainage Area A10 will remain identical to Drainage Area EX10. Stormwater flows from this area will be captured within an on-site catch basin and conveyed to Manhole #6 at the northeast corner of the site prior to discharging to the existing municipal storm sewer system. No quantity controls will be provided for stormwater flows from this drainage area. Drainage Area A20 will consist of stormwater flows from the frontage of the site that will be directed straight to the Four Mile Creek Road road allowance. No stormwater peak flow quantity controls will be provided for these drainage areas.

Drainage Area A21 will consist of the majority of the proposed development. Flows from this area will be captured within an on-site stormwater management system prior to discharge from the property. As the calculated Runoff Coefficent for this area has been calculated at an increased

0.77, peak stormwater flows will increase and peak flow quantity controls will be required to restrict stormwater flows to allowable levels prior to discharge from the site.

**Quantity Analysis**

Using the Modified Rational Method, the existing and allowable peak stormwater flow rates have been determined for the proposed development during the 5-. And 100-year design storm events using the Town of Niagara-on-the-Lake IDF curves. All Modified Rational Method calculations have been included in Appendix D.

**Table 1. Peak Stormwater Flows**

| Design Storm Event | Existing Conditions | Future Conditions | | |
|---|---|---|---|---|
| | Drainage Area EX20 | Drainage Area A20 | Drainage Area A21 | A21 Allowable Peak Flow |
| 5 Year | 95.5 | 3.4 | 129.0 | 92.1 |
| 100 Year | 153.3 | 5.5 | 207.1 | ~~147.7~~ |
| *Note: Peak outflow from A21 during 100 year event is 100.4L/s as discussed below* | | | | |

As stated previously, stormwater flows from Drainage Areas EX10 and A10 will not change as a result of the Stormwater Management Plan and have therefore been left out of the following calculations.

The combined peak stormwater flows from Drainage Areas A20 and A21 will increase from existing conditions as a result of the proposed development, therefore as previously concluded, peak stormwater quantity controls will be required prior to discharge from the site. For this development, a Weir Wall will be constructed in STM MH 5 that will include a 200mm diameter orifice to restrict peak stormwater flows from Drainage Area A21.

During the 5 year event stormwater flows will be restricted to less than maximum allowable levels (92.1L/s) as outlined in Table 1. However, during storm events greater than the 5 year design storm, it will not be possible to provide the extreme overland flow route from the parking lot to the road allowance due to the grade of the site as well as the existing adjacent properties.

Therefore, peak 100 year flows from the development will be restricted to allowable 5 year levels from the site plus an additional 15% due to surcharged capabilities (92.1L/s + 15 %) for a total of 100.4L/s. As drainage area A20 will be discharging 5.5L/s uncontrolled to the roadside ditch, Drainage Area A21 will have an allowable outflow of **100.4L/s** during the 100 year design storm event. As a result of this strategy, stormwater flows will inherently be significantly reduced from existing conditions during the 100 year design storm event.

For this development, a 200mm diameter orifice will be placed at the base of weir wall elevation of 126.42m within STM MH 6. The weir wall will be constructed with a top elevation of 128.00m – less than the lowest catch basin rim elevation of 128.15m. Therefore, during storm events greater

than the 100 year event, stormwater flows will crest over the weir wall and discharge unrestricted into the downstream storm sewer system. The on-site underground storm sewer system will provide a minimum storage volume of 47.3m$^3$ up to the top of weir wall elevation of 128.00m for stormwater flows backing up in the system.

Table 2 below outlines the future peak flows and volumes to be experienced within the proposed stormwater management system during the 5 and 100 year storm events.

**Table 2. Stormwater Management Facility Characteristics**

| Design Storm Event | Maximum Allowable Outflow (L/s) | Provided Outflow (L/s) | Minimum Required Storage (m$^3$) | Provided Volume (m$^3$) | Maximum Elevation (m) |
|---|---|---|---|---|---|
| 5 Year | 92.1 | 62.3 | 28.3 | 29.3 | 127.11 |
| 100 Year | 100.4 | 96.9 | 46.9 | 47.2 | 127.90 |

As shown in Table 2 above, stormwater flows during the 100 year event will remain below the top of weir wall elevation of 128.00m and below the lowest CB Rim elevation of 128.15m. A Stage-Storage-Discharge Calculation Sheet has been included in this submission in Appendix D.

Table 3 outlines a total peak stormwater flow comparison under existing and future conditions for the modelled drainage areas during 5 and 100 year design storm events. The existing conditions are the total peak flows from Drainage Areas EX10 and EX20 while the future conditions represent the total peak flows from Drainage Areas A10, A20 and A21.

**Table 3. Total Peak Flow Comparison**

| Design Storm Event | Existing Conditions | Future Conditions |
|---|---|---|
| 5 Year | 141.6 L/s | 227.3 L/s |
| 100 Year | 111.8 L/s | 176.5 L/s |

Therefore, peak stormwater flows discharging from the site will be significantly reduced during all modelled storm events.

**Downstream Municipal Storm Sewer Analysis**

Stormwater flows discharging to the existing municipal storm sewer system were sized to ensure sufficient capacity is available downstream of the development during the modelled storm events.

A 600mm diameter CSP culvert currently conveys flows from the ditch inlet at the northeast corner of the property to the existing manhole at the intersection of David Secord Drive. Stormwater

flows at the manhole converge with flows from a second 600mm diameter storm sewer discharging stormwater flows to the north side of the existing manhole from the Apricot Glen Phase 1 SWM Facility at a slope of 0.37%. Per the original Apricot Glen Estates SWM Report, the SWM Facility discharges flows at a rate of approximately 159L/s during the 5 year design storm event, and 352L/s during the 100 year design storm event. The 600mm diameter connecting storm sewer from the manhole at David Secord Drive to the Four Mile Creek Box Culvert was constructed at a slope of 5.2%.

The storm sewer analysis has determined that the municipal storm sewer system downstream of the site will have adequate capacity to accommodate stormwater flows from the site for up to and including the 5 year design storm event. Stormwater flows will occupy approximately 25% of the capacity of the downstream 600mm diameter storm sewers during the 5 year storm event.

**Quality Analysis**

It is required by the Town of Niagara-on-the-Lake to provide stormwater quality enhancements to an Enhanced (80% TSS removal) Protection standard prior to discharge from the site. For this development, a Hydroworks HD4 Oil/Grit Separator located in STM MH X will provide the necessary quality enhancements for the parking lot area. As both the rooftop area of the building can be considered a non-significant source of TSS, stormwater from this area will bypass the OGS.

The contributing drainage area to the quality enhancement device is approximately 0.45 hectares with an impervious coverage of approximately 100%. The modelling for a Hydroworks unit has indicated that a HD4 will provide approximately 90.8% TSS overall removal and capture 99.9% of stormwater flows. Therefore, the Hydroworks HD4 is proposed for this development. Output calculations for the quality assessment can be found in Appendix E.

## MAINTENANCE OF STORMWATER MANAGEMENT FACILITY

The function of the proposed stormwater quality protection facility, a stormwater oil/grit separator, will require maintenance on an annual basis. The following is a summary of the maintenance activities required.

Regular inspections of the stormwater Maintenance Hole (MH) oil/grit interceptor will indicate whether maintenance is required or not. They should be made after every significant storm during the first two years of operation to ensure that it is functioning properly. This will translate into an average of six inspections per year.
Points of regular inspections are as follows:

a) Is there sediment in the separator sump? The level of sediment can be measured from the surface without entry into the oil/grit separator via a dipstick tube equipped with a ball valve (Sludge Judge) or with a graduated pole with a flat plate attached to the bottom.

b) Is there oil in the separator sump? This can be checked from the surface by inserting a dipstick in the 150mm vent tube. The presence of oil is usually indicated by an oily sheen,

frothing or unusual colouring. The separator should be cleaned in the event of a major spill contamination.

c) Is there debris or trash at the inlet weir and drop pipe? This can be observed from the surface without entry into the separator. Clogging at the inlet drop pipe will cause stormwater to bypass the sedimentation section and continue downstream without treatment.

d) Completion of the Inspection Report (a sample report is included in Appendix E for reference purposes). These reports will provide details about the operation and maintenance requirements for this type of stormwater quality device. After an evaluation period (usually 2 years) this information will be used to maximize efficiency and minimize the costs of operation and maintenance for the maintenance hole oil/grit separator.

Typically, stormwater MH oil/grit separators are cleaned out using vacuum pumping. No entry into the unit is required for maintenance. Cleaning should occur annually or whenever the accumulation reaches sediment storage specified by the manufacturer and after any major spills have occurred. Oil levels greater than 2.5 centimeters should be removed immediately by a licensed waste management firm.

Generally, the sediment removed from the separator will not be contaminated to the point that it would be classified as hazardous waste. However, the sediment should be tested to determine the disposal options. The Ministry of Environment, Conservation and Parks publishes sediment disposal guidelines which should be consulted for up-to-date information pertaining to the exact parameters and acceptable levels for the various disposal options. The preferred option is an off-site disposal, arranged by a licensed waste management firm.

The future owners of a Hydroworks facility are provided with an Owner's Manual upon installation, which explains the function, maintenance requirements and procedures for the facility with extensive use It is recommended to follow the manufacturers instructions to allow the oil/grit separator to perform as intended. A Sample Oil/Grit Separator Inspection Report has been included in Appendix E.

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## CONCLUSIONS AND RECOMMENDATIONS

Therefore, based on the above comments and design calculations provided for this site, the following summarizes the servicing for this site.

1. The existing 200mm diameter municipal watermain will have sufficient capacity to provide both domestic and fire protection water supply.

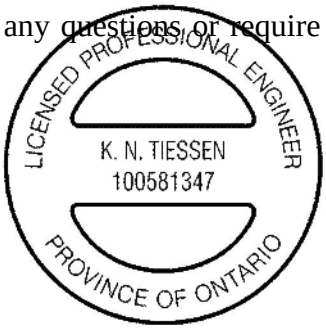
2. The existing 200mm diameter municipal sanitary sewer on Four Mile Creek Road will have adequate capacity for the proposed residential development.

3. Stormwater quantity controls will be provided to allowable conditions up to and including the 100-year design storm event.

4. Stormwater quality protection will be provided to Enhanced Protection (80% TSS removal) levels by a Hydroworks HD4 Oil/Grit Separator prior to discharge from the site.

Based on the above and the accompanying calculations, there exists adequate municipal servicing for this development. We trust the above comments and enclosed calculations are satisfactory for approval. If you have any questions or require additional information, please do not hesitate to contact our office.

Yours very truly,




Kurt Tiessen, P.Eng.
August 29, 2025
Encl.

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# APPENDICES

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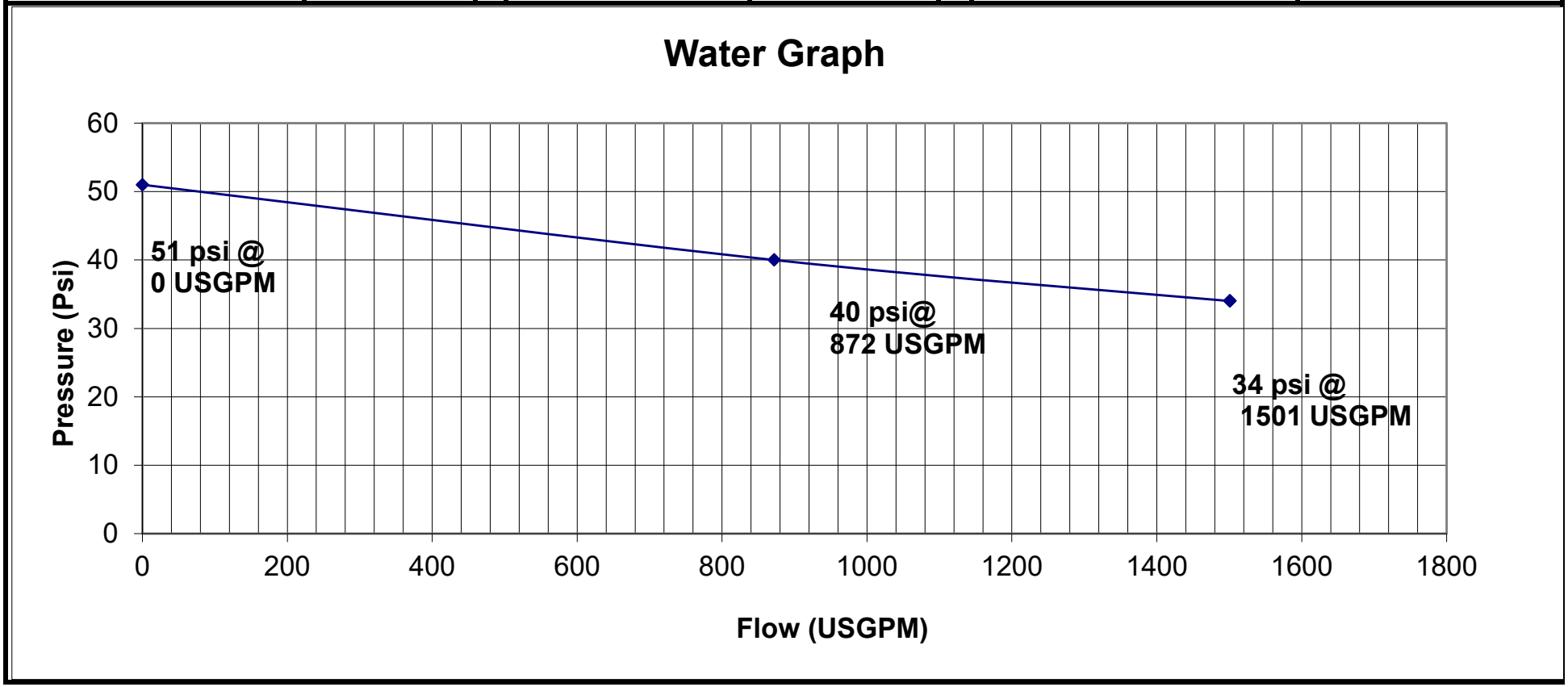
# APPENDIX A

**Hydrant Flow Test Results – Niagara Regional Fire Protection**
**Hydrant Fire Flow Calculation Sheet**
**Fire Underwriters Survey – Minimum Required Fire Flow Calculation Sheet**

| NIAGARA REGIONAL FIRE PROTECTION INC. | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Flow Test Location: 126 Four Mile Creek Rd.** | | | | | | | |
| **Static Pressure (Psi)** | | | **Pitot Reading 1** | 27 | | **# of Outlets Flowed 1** | 1 |
| | 51 | | **Outlet Size 1** | 2.5 | | **# of Outlets Flowed 2** | 2 |
| **Residual Pressure 1 (Psi)** | | | **Pitot Reading 2** | 20 | | **# of Outlets Flowed 3** | 2 |
| | 40 | | **Outlet Size 2** | 2.5 | | **Graph Data:** | |
| **Residual Pressure 2 (Psi)** | | | **Pitot Reading 3** | 20 | | **Pressure Values (y-axis)** | **Flow Values (x-axis)** |
| | 34 | | **Outlet Size 3** | 2.5 | | 51 | 0 |
| **Residual Pressure 3 (Psi)** | | | **Flow 1 Calculated** | | | 40 | 872 |
| | 34 | | | 871.9 | | 34 | 1501 |
| Extrapolated to 20psi residual 2076 GPM | | | **Flow 2 Calculated** | | | 34 | 1501 |
| Color code Blue | | | | 1500.8 | | **Date & Time of Test :** | **Aug. 8/2025** |
| **Coefficient value** | | | **Flow 3 Calculated** | | | | **8:00 AM** |
| | 0.9 | | | 1500.8 | | **Performed by:** | Mike & Callum |



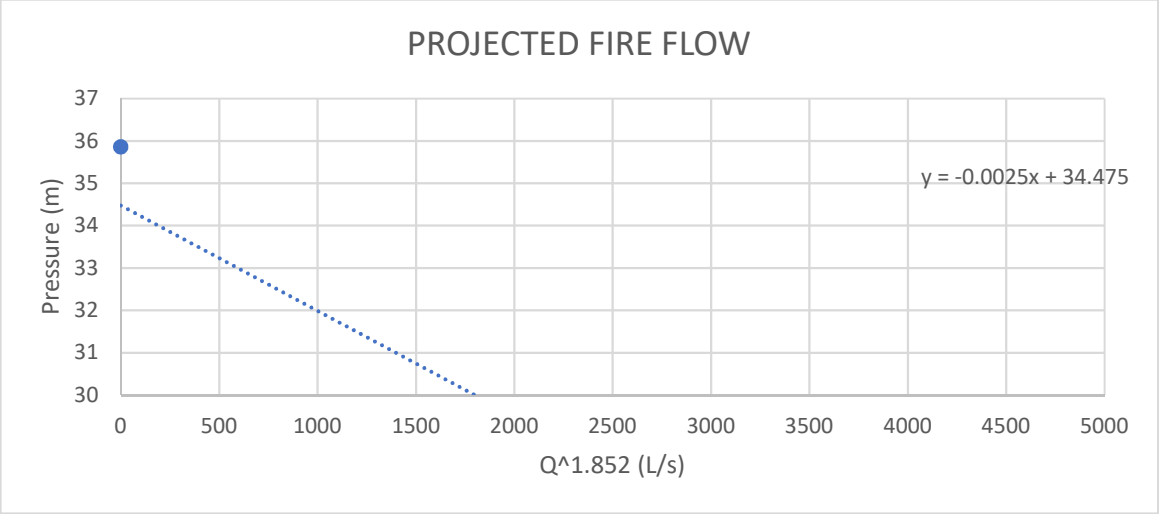
# FIRE FLOW CALCULATION SHEET

**Project:** 116 Four Mile Creek Road Apartment (Pine Mansion #4)
**Project Number:** 25010
**Date:** August 5, 2025
**Prepared By:** Kurt Tiessen, P.Eng.

**Flow Test Provided by:** Niagara Regional Fire Protection
**Data of Test:** August 8, 2025
**Hydrant Location:** #126 Four Mile Creek Road

**FLOW TEST RESULTS**

| TEST | PRESSURE (psi) | FLOW RATE (USGPM) | FLOW RATE (L/s) | $Q^{1.852}$ | PRESSURE (m) |
|---|---|---|---|---|---|
| **STATIC** | 51 | 0 | 0 | 0 | 35.86 |
| **RESIDUAL 1** | 40 | 871.9 | 55.01 | 1672.13 | 28.13 |
| **RESIDUAL 2** | 34 | 1500.8 | 94.69 | 4571.69 | 23.91 |




**FIRE FLOW FORMULA (y = ax + b)**

a = -0.0025
b = 34.475

**FIRE FLOW AT A SPECIFIED PRESSURE**

Pressure = 20 psi
Pressure = 14.064 m
$Q^{1.852}$ = 8164.40
**Flow, Q = 129.50 L/s**
Flow, Q = 2052.62 USGPM

**PRESSURE AT SPECIFIED FIRE FLOW**

Flow (Q) = 0 L/s
$Q^{1.852}$ 0.00
Pressure = 34.48 m
Pressure = 49.03 psi

**Hazen-Williams Equation (1.852)

## Fire Underwriters Survey

### Water Supply for Public Fire Protection (2020) Calculations

**116 Four Mile Creek Road**

| | | | |
|---|---|---|---|
| Required Fire Flow in Litres per Minute | F= | 6,000 | (L/m) |
| | | 100.00 | (L/s) |
| | | 1,585 | (USgmp) |
| Type of Construction | | | |
| Non-Combustible Construction (unprotected metal structural components, masonry o | C= | 0.80 | |
| Total Floor Area in square metres | A= | 3486 | (m2) |
| Includes Largest Floor + 25% of floors above and below (2324 + 2 x 25%) | | | |
| Total Number of Floors | | 1 | |
| 2. Combustibility of Contents *(may not reduce fire flow demand below 2,000 L/min)* | | | |
| Limited Combustible | = | -15% | |
| 3. Sprinkler Systems | | | |
| Is there a complete automatic sprinkler protection system per NFPA (Yes/No). | Yes | -30% | |
| Water supply standard for both system and fire department hose lines (Yes/No). | Yes | -10% | |
| Is system fully monitored (Yes/No). | Yes | -10% | |
| Total Sprinker Reduction to Overall Fire Flow Demand | | -50% | |
| 4. Spacial Separation of Neighbouring Structures (within 45 metres) | | | |
| Location of Building: | | | |
| 116 Four Mile Creek Road | | | |
| Distance to Nearest Building to the North | 28.1 m | 10% | |
| Distance to Nearest Building to the South | 6.0 m | 20% | |
| Distance to Nearest Building to the East | 40.0 m | 0% | |
| Distance to Nearest Building to the West | 22.0 m | 10% | |
| Total Spacial Separation to Adjacent Structures | | 40% | |
| Additions | | | |
| Is roof wood shingles or shakes (Yes/No). | No | | |

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# APPENDIX B

## Sanitary Sewer Calculations

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**3-30 HANNOVER DRIVE**
**ST.CATHARINES, ONTARIO**
**L2W 1A3**

**DESIGN FLOWS**

RESIDENTIAL: 255 LITRES/PERSON/DAY (AVERAGE DAILY FLOW)
COMMERCIAL: 28 $m^3$/GROSS HA/DAY
INFILTRATION RATE: 0.286 L / s / ha (M.O.E FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 L / s / ha)
POPULATION DENSITY: 1.6 PERSONS / UNIT

**SEWER DESIGN**

PIPE ROUGHNESS: 0.013 FOR MANNING'S EQUATION
PIPE SIZES: 1.016 IMPERIAL EQUIVALENT FACTOR
PERCENT FULL: TOTAL PEAK FLOW / CAPACITY

**MUNICIPALITY:** TOWN OF NIAGARA ON THE LAKE
**PROJECT :** PINEWOOD MANSIONS IV
**PROJECT NO:** 25010

**SANITARY SEWER DESIGN SHEET**

Peaking Factor= $M = 1 + \frac{14}{4 + P^{0.5}}$ Where P = design population in thousands

| LOCATION | | | AREA | | POPULATION | | | | ACCUMULATED PEAK FLOW | | | | DESIGN FLOW | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Location and Description** | **From M.H** | **To M.H.** | **Increment (hectares)** | **Accumulated (hectares)** | **Number of Units** | **Population Density (persons/unit)** | **Population Increment** | **Total Population Served** | **Peaking Factor** | **Flow (L/s)** | **Infiltration Flow L/s** | **Total Peak Flow (L/s)** | **Pipe Diameter (mm)** | **Pipe Length (m)** | **Pipe Slope (%)** | **Full Flow Velocity (m/s)** | **Full Flow Capacity (L/s)** | **Percent Full** |
| ***EXISTING CONDITIONS*** | | | | | | | | | | | | | | | | | | |
| 116 FOUR MILE CREEK RD | | SEWER | 0.74 | 0.74 | | 28 $m^3$/ha/day | | | 2.00 | 0.48 | 0.21 | 0.69 | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| ***FUTURE CONDITIONS*** | | | | | | | | | | | | | | | | | | |
| PROP DEVELOPMENT | STUB | PROP MH | 0.74 | 0.74 | 77 | 1.6 | 123 | 123 | 4.22 | 1.53 | 0.21 | 1.75 | 150 | 10.0 | 1.00 | 0.87 | 15.89 | 11.0% |
| | PROP MH | SEWER | | 0.74 | | | | 123 | 4.22 | 1.53 | 0.21 | 1.75 | 150 | 19.1 | 6.00 | 2.13 | 38.92 | 4.5% |
| EX SEWER | EX MH | EX MH | | 0.74 | | | | 123 | 4.22 | 1.53 | 0.21 | 1.75 | 200 | 78.3 | 1.63 | 1.35 | 43.68 | 4.0% |

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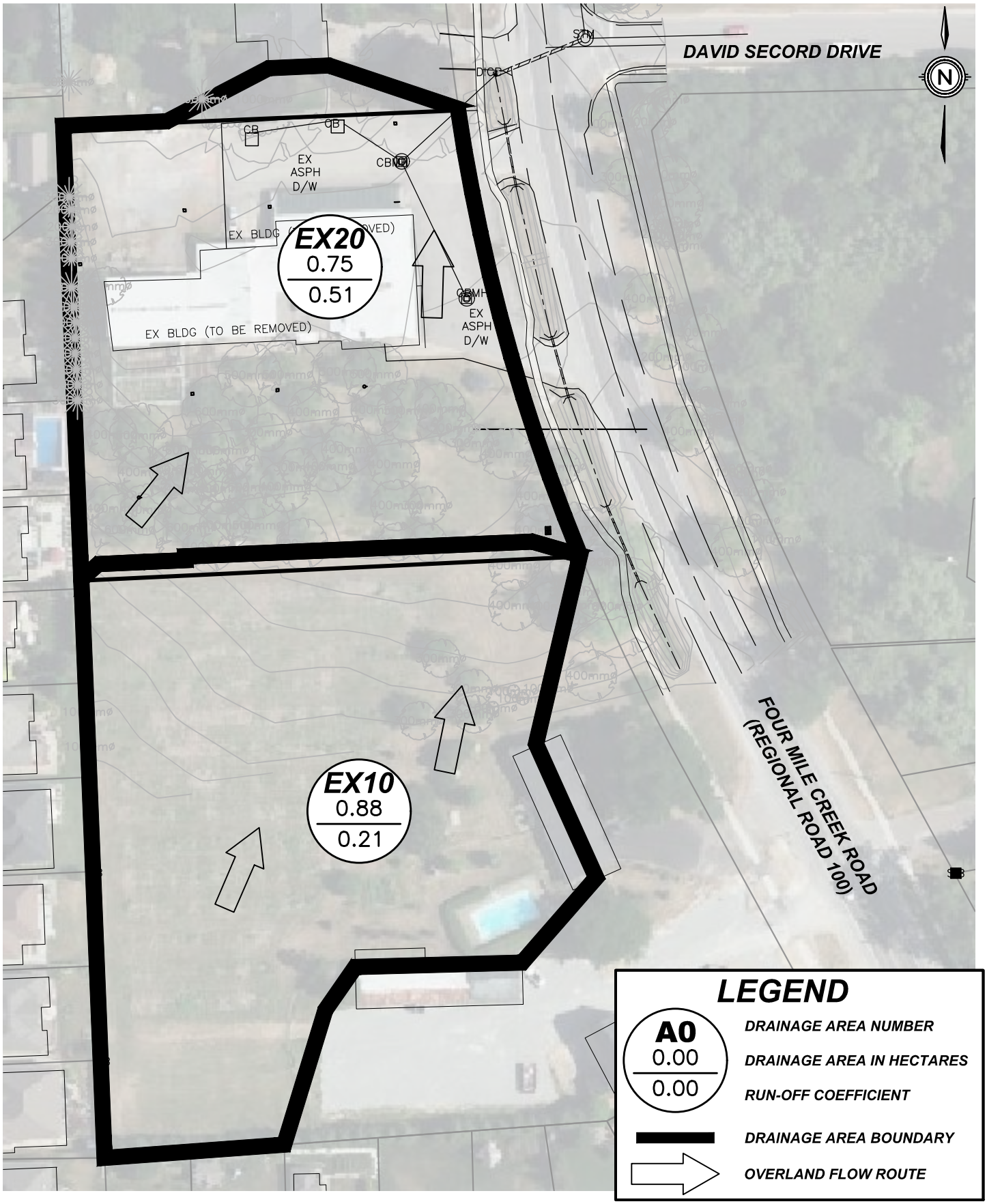
# APPENDIX C

**Figure 1 – Existing Overall Storm Drainage Area Plan**
**Figure 2 – Proposed Overall Storm Drainage Area Plan**

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# PINEWOOD MANSION IV

TOWN OF NIAGARA-ON-THE-LAKE

## EXISTING OVERALL STORM DRAINAGE AREA PLAN

| | |
|---|---|
| DATE | 2025–08–12 |
| SCALE | 1:1,000 m |
| REF No. | 25010 |
| DWG No. | FIGURE 1 |

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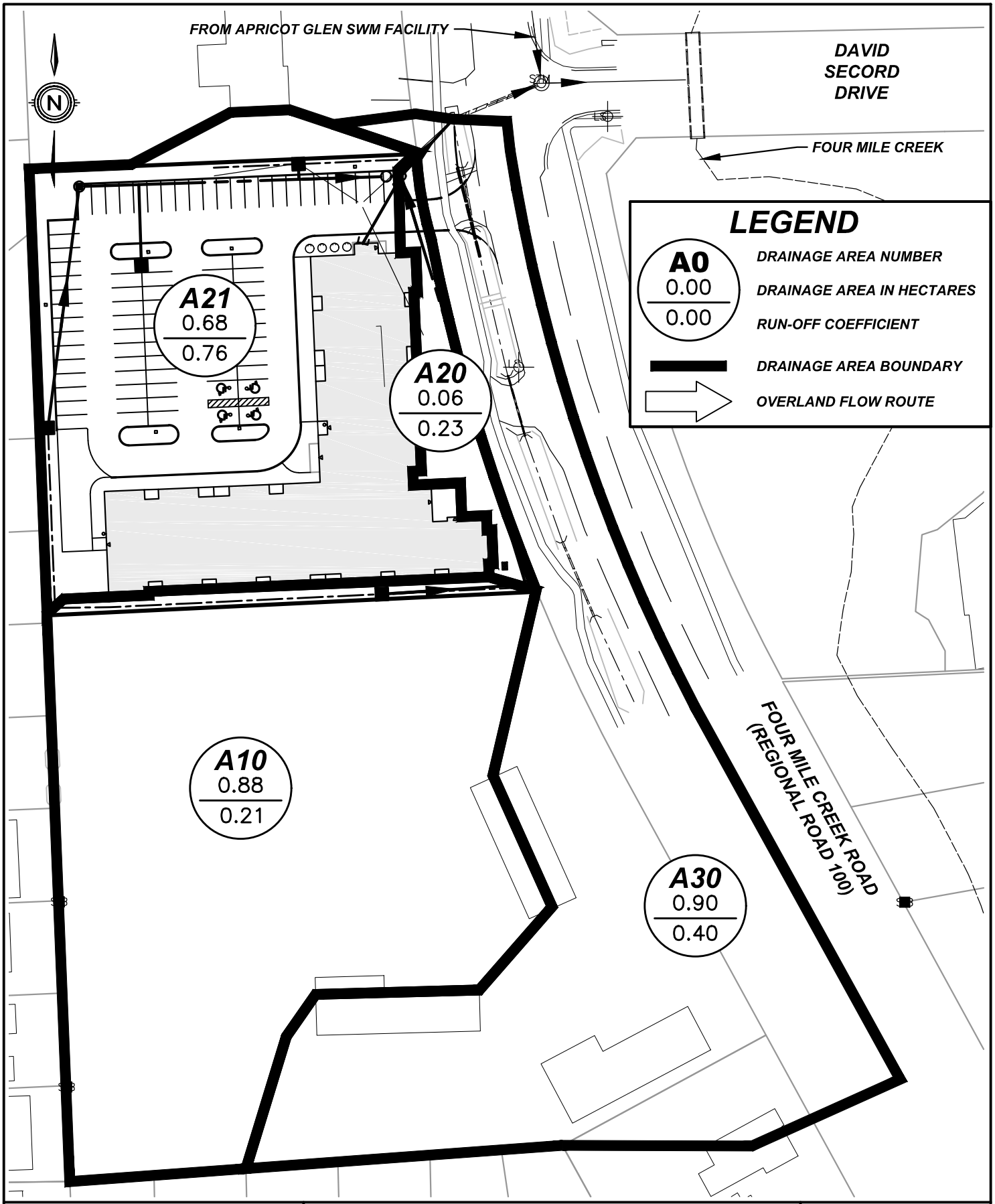


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# PINEWOOD MANSION IV

TOWN OF NIAGARA-ON-THE-LAKE

## PROPOSED OVERALL STORM DRAINAGE AREA PLAN

| | |
|---|---|
| DATE | 2025-08-12 |
| SCALE | 1:1,000 m |
| REF No. | 25010 |
| DWG No. | FIGURE 2 |

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# APPENDIX D

**Weighted Imperviousness Calculation Sheet**
**Modified Rational Method Calculation Sheet – 5 Year Peak Flows and Volumes**
**Modified Rational Method Calculation Sheet – 100 Year Peak Flows and Volumes**
**Stage-Storage-Discharge Calculation Sheet**
**Storm Sewer Calculation Sheet – 5 Year**

# Weighted Imperviousness Percentage Calculation Worksheet

| | |
|---|---|
| Project Name: | 116 Four Mile Creek Road - Pine Mansions IV |
| Project Number: | 25010 |
| Date: | August 2025 |
| Person: | K. Tiessen, P.Eng. |

**EX20 - EXISTING CONDITIONS**

| | *Footprint* | *Runoff Coefficient* | *Effective Impervious Area* |
|---|---|---|---|
| Buildings/Asphalt | 2808.7 $m^2$ | 0.90 | 2527.8 $m^2$ |
| Granular Parking Lot | 781.1 $m^2$ | 0.70 | 546.8 $m^2$ |
| Landscape/Greenspace | 3912.8 $m^2$ | 0.20 | 782.6 $m^2$ |
| **TOTAL CATCHMENT IMPERVIOUS AREAS** | | | 3,857 $m^2$ |
| **TOTAL CATCHMENT AREA** | | | 7,503 $m^2$ |
| | | **EFFECTIVE RUNOFF COEFFICIENT** | **0.51** |
| | | **EFFECTIVE WEIGHTED IMPERVIOUSNESS** | **44.9** % |

**EX10/A10 - FUTURE CONDITIONS**

| | *Footprint* | *Runoff Coefficient* | *Effective Impervious Area* |
|---|---|---|---|
| Concrete Patio/Building Rooftop | 99.5 $m^2$ | 0.90 | 89.6 $m^2$ |
| Landscape/Greenspace | 8711.2 $m^2$ | 0.20 | 1742.2 $m^2$ |
| **TOTAL CATCHMENT IMPERVIOUS AREAS** | | | 1,832 $m^2$ |
| **TOTAL CATCHMENT AREA** | | | 8,811 $m^2$ |
| | | **EFFECTIVE RUNOFF COEFFICIENT** | **0.21** |
| | | **EFFECTIVE WEIGHTED IMPERVIOUSNESS** | **1.1** % |

**A20 - FUTURE CONDITIONS**

| | *Footprint* | *Runoff Coefficient* | *Effective Impervious Area* |
|---|---|---|---|
| Asphalt Parking Lot | 30.9 $m^2$ | 0.90 | 27.8 $m^2$ |
| Landscape/Greenspace | 596.2 $m^2$ | 0.20 | 119.2 $m^2$ |
| **TOTAL CATCHMENT IMPERVIOUS AREAS** | | | 147 $m^2$ |
| **TOTAL CATCHMENT AREA** | | | 627 $m^2$ |
| | | **EFFECTIVE RUNOFF COEFFICIENT** | **0.23** |
| | | **EFFECTIVE WEIGHTED IMPERVIOUSNESS** | **4.9** % |

**A21 - FUTURE CONDITIONS**

| | *Footprint* | *Runoff Coefficient* | *Effective Impervious Area* |
|---|---|---|---|
| Asphalt Parking Lot/Building Rooftop | 5508.9 $m^2$ | 0.90 | 4958.0 $m^2$ |
| Landscape/Greenspace | 1336.6 $m^2$ | 0.20 | 267.3 $m^2$ |
| **TOTAL CATCHMENT IMPERVIOUS AREAS** | | | 5,225 $m^2$ |
| **TOTAL CATCHMENT AREA** | | | 6,846 $m^2$ |
| | | **EFFECTIVE RUNOFF COEFFICIENT** | **0.76** |
| | | **EFFECTIVE WEIGHTED IMPERVIOUSNESS** | **80.5** % |

# PEAK STORMWATER FLOW CALCULATIONS

*5 YEAR DESIGN STORM EVENT*

**PROJECT: 116 FOUR MILE CREEK ROAD, TOWN OF NIAGARA-ON-THE-LAKE**

| LOCATION | | | | | | TIME OF FLOW | | STORMWATER ANALYSIS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESCRIPTION | FROM M.H. | TO M.H. | PIPE LENGTH (m) | INCREMENT AREA (hectares) | TOTAL AREA (hectares) | TO UPPER END (min) | IN SECTION (min) | RUNOFF COEFF | SECTION A X R | ACCUMLD A x R | RAINFALL INTENSITY (mm/hr) | PEAK FLOW (L/s) |
| **EXISTING CONDITIONS** | | | | | | | | | | | | |
| EX10 - External Southerly Lands | SITE | OUTLET | | 0.88 | 0.88 | 10.00 | 0.00 | 0.21 | 0.185 | 0.185 | 89.884 | 46.1 |
| EX20 - Existing Property | SITE | OUTLET | | 0.75 | 0.75 | 10.00 | 0.00 | 0.51 | 0.383 | 0.383 | 89.884 | 95.5 |
| | | | | | | | | | | | | **141.6** |
| **FUTURE CONDITIONS** | | | | | | | | | | | | |
| A10 - Uncontrolled (Ext South Lands) | SITE | OUTLET | | 0.88 | 0.88 | 10.00 | 0.00 | 0.21 | 0.185 | 0.185 | 89.884 | 46.1 |
| A20 - Uncontrolled (Creek Rd Frontage) | SITE | OUTLET | | 0.06 | 0.06 | 10.00 | 0.00 | 0.23 | 0.014 | 0.014 | 89.884 | 3.4 |
| A21 - Controlled (Internal Site) | SITE | OUTLET | | 0.68 | 0.68 | 10.00 | 0.00 | 0.76 | 0.517 | 0.517 | 89.884 | 129.0 |
| | | | | | | | | | | | | 178.6 |
| A21 ALLOWABLE PEAK OUTFLOW | | | | | | | | | | | | 92.1 |
| PROVIDED OUTFLOW | | | | | | | | | | | | **62.3** |


**DESIGN BY:** **UPPER CANADA CONSULTANTS**
**30 HANNOVER DRIVE, UNIT 3**
**ST. CATHARINES, ON L2W 1A3**
**DESIGN BY:** **K.TIESSEN, P.ENG**
**DATE:** **AUGUST 2025**


**RAINFALL PARAMETERS:**

Time to Upper End = 10 min.

Town of Niagara-on-the-Lake - 5 Year IDF C

a = 664.00 mm/hr

b = 4.70 minutes

c = 0.74

# Modified Rational Method (MRM) Required Storage Volume

| | |
|---|---|
| Project: | 116 Four Mile Creek Road - Pine Mansions IV |
| Project No: | 25010 |
| Date: | August 2025 |
| Design By: | K.Tiessen, P.Eng. |
| Description: | STORMWATER MANAGEMENT PLAN |

Storm Event: **Town of Niagara-on-the-Lake - 5 Year IDF Curve**

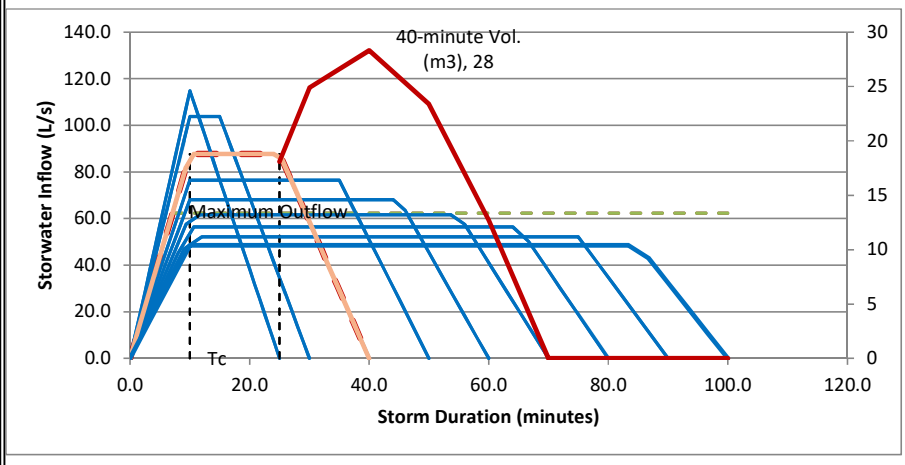
| | | |
|---|---|---|
| a = | 664.00 | mm/hr |
| b = | 4.70 | minutes |
| c = | 0.74 | |

| | | | |
|---|---|---|---|
| Critical Storm Duration: | 40.00 | minutes | Tail Multiplier (x1-11.5 |
| Tc From Design: | 10.00 | minutes | |
| Storm Tail Time: | 25.00 | minutes | |
| Accumulated Area x R (Ha): | 0.517 | | <-- Area x Runoff Coefficient (Sewer Design Sheet) |
| Peak Rainfall Intensity: | 61.09 | mm/hr | |
| Peak Inflow at Tc: | 87.70 | L/s | |
| Maximum Release Rate: | 62.30 | | <-- Outlet Full Flow Capacity (Design Sheet) |
| Time When Outlet Exceeded: | 7.10 | | |

| Time (min) | Intensity (mm/hr) | Inflow (L/s) | Outflow (L/s) | Interval Volume (m3) | Total Required Volume (m3) |
|---|---|---|---|---|---|
| 0.0 | 0.00 | 0.00 | 62.30 | -3.7 | 0.0 |
| 1.3 | 8.15 | 11.69 | 62.30 | -4.0 | 0.0 |
| 2.7 | 16.29 | 23.39 | 62.30 | -3.1 | 0.0 |
| 4.0 | 24.44 | 35.08 | 62.30 | -2.2 | 0.0 |
| 5.3 | 32.58 | 46.78 | 62.30 | -1.2 | 0.0 |
| 6.7 | 40.73 | 58.47 | 62.30 | -0.3 | 0.0 |
| 8.0 | 48.88 | 70.16 | 62.30 | 0.6 | 0.6 |
| 9.3 | 57.02 | 81.86 | 62.30 | 1.6 | 2.2 |
| 10.7 | 61.09 | 87.70 | 62.30 | 2.0 | 4.2 |
| 12.0 | 61.09 | 87.70 | 62.30 | 2.0 | 6.3 |
| 13.3 | 61.09 | 87.70 | 62.30 | 2.0 | 8.3 |
| 14.7 | 61.09 | 87.70 | 62.30 | 2.0 | 10.3 |
| 16.0 | 61.09 | 87.70 | 62.30 | 2.0 | 12.4 |
| 17.3 | 61.09 | 87.70 | 62.30 | 2.0 | 14.4 |
| 18.7 | 61.09 | 87.70 | 62.30 | 2.0 | 16.4 |
| 20.0 | 61.09 | 87.70 | 62.30 | 2.0 | 18.5 |
| 21.3 | 61.09 | 87.70 | 62.30 | 2.0 | 20.5 |
| 22.7 | 61.09 | 87.70 | 62.30 | 2.0 | 22.5 |
| 24.0 | 61.09 | 87.70 | 62.30 | 2.0 | 24.5 |
| 25.3 | 59.74 | 85.76 | 62.30 | 1.9 | 26.4 |
| 26.7 | 54.31 | 77.96 | 62.30 | 1.3 | 27.7 |
| 28.0 | 48.88 | 70.16 | 62.30 | 0.6 | 28.3 |
| 29.3 | 43.44 | 62.37 | 62.30 | 0.0 | ***28.3*** |
| 30.7 | 38.01 | 54.57 | 62.30 | -0.6 | 27.7 |
| 32.0 | 32.58 | 46.78 | 62.30 | -1.2 | 26.5 |
| 33.3 | 27.15 | 38.98 | 62.30 | -1.9 | 24.6 |
| 34.7 | 21.72 | 31.18 | 62.30 | -2.5 | 22.1 |
| 36.0 | 16.29 | 23.39 | 62.30 | -3.1 | 19.0 |
| 37.3 | 10.86 | 15.59 | 62.30 | -3.7 | 15.2 |
| 38.7 | 5.43 | 7.80 | 62.30 | -4.4 | 10.9 |
| 40.0 | 0.00 | 0.00 | 62.30 | -5.0 | 5.9 |

**Variable Storm Duration Storage Requirements**

| *Duration* | *Max Storage* | *Duration* | *Max Storage* | *Duration* | *Max Storage* |
|---|---|---|---|---|---|
| 25 Min | 18.1 m3 | 50 Min | 23.4 m3 | 80 Min | 0.0 m3 |
| 30 Min | 24.9 m3 | 60 Min | 12.7 m3 | 90 Min | 0.0 m3 |
| 40 Min | **28.3 m3** | 70 Min | 0.0 m3 | 100 Min | 0.0 m3 |



# PEAK STORMWATER FLOW CALCULATIONS

*100 YEAR DESIGN STORM EVENT*

**PROJECT: 116 FOUR MILE CREEK ROAD, TOWN OF NIAGARA-ON-THE-LAKE**

| | LOCATION | | | | | TIME OF FLOW | | STORMWATER ANALYSIS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DESCRIPTION** | **FROM M.H.** | **TO M.H.** | **PIPE LENGTH (m)** | **INCREMENT AREA (hectares)** | **TOTAL AREA (hectares)** | **TO UPPER END (min)** | **IN SECTION (min)** | **RUNOFF COEFF** | **SECTION A X R** | **ACCUMLD A x R** | **RAINFALL INTENSITY (mm/hr)** | **PEAK FLOW (L/s)** |
| **EXISTING CONDITIONS** | | | | | | | | | | | | |
| EX10 - External Southerly Lands | SITE | OUTLET | | 0.88 | 0.88 | 10.00 | 0.00 | 0.210 | 0.185 | 0.185 | 144.260 | 74.1 |
| EX20 - Existing Property | SITE | OUTLET | | 0.75 | 0.75 | 10.00 | 0.00 | 0.510 | 0.383 | 0.383 | 144.260 | 153.3 |
| | | | | | | | | | | | | **227.3** |
| **FUTURE CONDITIONS** | | | | | | | | | | | | |
| A10 - Uncontrolled (Ext South Lands) | SITE | OUTLET | | 0.88 | 0.88 | 10.00 | 0.00 | 0.210 | 0.185 | 0.185 | 144.260 | 74.1 |
| A20 - Uncontrolled (Creek Rd Frontage) | SITE | OUTLET | | 0.06 | 0.06 | 10.00 | 0.00 | 0.230 | 0.014 | 0.014 | 144.260 | 5.5 |
| A21 - Controlled (Internal Site) | SITE | OUTLET | | 0.68 | 0.68 | 10.00 | 0.00 | 0.760 | 0.517 | 0.517 | 144.260 | 207.1 |
| | | | | | | | | | | | | 286.7 |
| A21 ALLOWABLE PEAK OUTFLOW | | | | | | | | | | | | 147.7 |
| | | | | | | | ALLOWABLE 5 YEAR FLOW (92.1L/s) + 15% - A20 | | | | | 100.4 |
| PROVIDED OUTFLOW | | | | | | | | | | | | **96.9** |

**DESIGN BY:** **UPPER CANADA CONSULTANTS**
**30 HANNOVER DRIVE, UNIT 3**
**ST. CATHARINES, ON L2W 1A3**
**DESIGN BY:** **K.TIESSEN, P.ENG**
**DATE:** **AUGUST 2025**

**RAINFALL PARAMETERS:**
Time to Upper End = 10 min.
Town of Niagara-on-the-Lake - 100 Year ID

a = 980.00 mm/hr
b = 3.70 minutes
c = 0.73

# Modified Rational Method (MRM) Required Storage Volume

| | |
|---|---|
| Project: | 116 Four Mile Creek Road - Pine Mansions IV |
| Project No: | 25010 |
| Date: | August 2025 |
| Design By: | K.Tiessen, P.Eng. |
| Description: | STORMWATER MANAGEMENT PLAN |

Storm Event: **Town of Niagara-on-the-Lake - 100 Year IDF Curve**

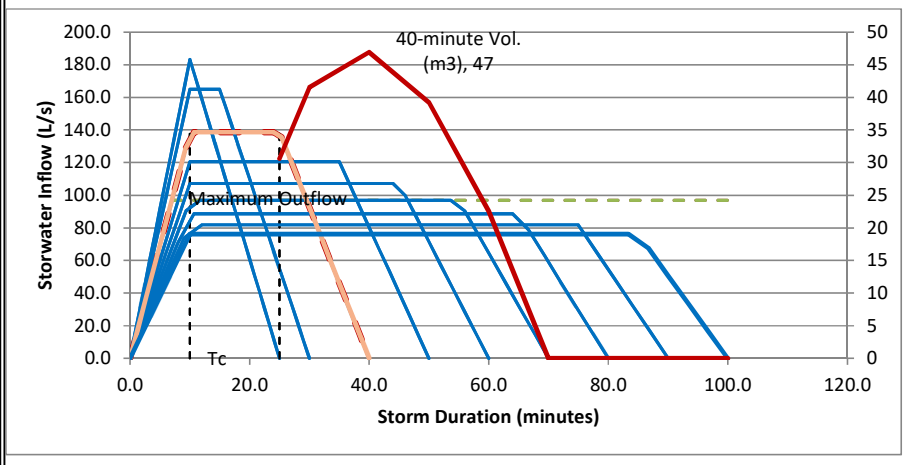
| | | |
|---|---|---|
| a = | 980.00 | mm/hr |
| b = | 3.70 | minutes |
| c = | 0.73 | |

| | | |
|---|---|---|
| Critical Storm Duration: | 40.00 minutes | Tail Multiplier (x1-11.5 |
| Tc From Design: | 10.00 minutes | |
| Storm Tail Time: | 25.00 minutes | |
| Accumulated Area x R (Ha): | 0.517 | <-- Area x Runoff Coefficient (Sewer Design Sheet) |
| Peak Rainfall Intensity: | 96.59 mm/hr | |
| Peak Inflow at Tc: | 138.65 L/s | |
| Maximum Release Rate: | 96.90 | <-- Outlet Full Flow Capacity (Design Sheet) |
| Time When Outlet Exceeded: | 6.99 | |

| Time (min) | Intensity (mm/hr) | Inflow (L/s) | Outflow (L/s) | Interval Volume (m3) | Total Required Volume (m3) |
|---|---|---|---|---|---|
| 0.0 | 0.00 | 0.00 | 96.90 | -5.8 | 0.0 |
| 1.3 | 12.88 | 18.49 | 96.90 | -6.3 | 0.0 |
| 2.7 | 25.76 | 36.97 | 96.90 | -4.8 | 0.0 |
| 4.0 | 38.63 | 55.46 | 96.90 | -3.3 | 0.0 |
| 5.3 | 51.51 | 73.95 | 96.90 | -1.8 | 0.0 |
| 6.7 | 64.39 | 92.44 | 96.90 | -0.4 | 0.0 |
| 8.0 | 77.27 | 110.92 | 96.90 | 1.1 | 1.1 |
| 9.3 | 90.15 | 129.41 | 96.90 | 2.6 | 3.7 |
| 10.7 | 96.59 | 138.65 | 96.90 | 3.3 | 7.1 |
| 12.0 | 96.59 | 138.65 | 96.90 | 3.3 | 10.4 |
| 13.3 | 96.59 | 138.65 | 96.90 | 3.3 | 13.7 |
| 14.7 | 96.59 | 138.65 | 96.90 | 3.3 | 17.1 |
| 16.0 | 96.59 | 138.65 | 96.90 | 3.3 | 20.4 |
| 17.3 | 96.59 | 138.65 | 96.90 | 3.3 | 23.8 |
| 18.7 | 96.59 | 138.65 | 96.90 | 3.3 | 27.1 |
| 20.0 | 96.59 | 138.65 | 96.90 | 3.3 | 30.4 |
| 21.3 | 96.59 | 138.65 | 96.90 | 3.3 | 33.8 |
| 22.7 | 96.59 | 138.65 | 96.90 | 3.3 | 37.1 |
| 24.0 | 96.59 | 138.65 | 96.90 | 3.3 | 40.5 |
| 25.3 | 94.44 | 135.57 | 96.90 | 3.1 | 43.6 |
| 26.7 | 85.85 | 123.25 | 96.90 | 2.1 | 45.7 |
| 28.0 | 77.27 | 110.92 | 96.90 | 1.1 | 46.8 |
| 29.3 | 68.68 | 98.60 | 96.90 | 0.1 | ***46.9*** |
| 30.7 | 60.10 | 86.27 | 96.90 | -0.9 | 46.1 |
| 32.0 | 51.51 | 73.95 | 96.90 | -1.8 | 44.2 |
| 33.3 | 42.93 | 61.62 | 96.90 | -2.8 | 41.4 |
| 34.7 | 34.34 | 49.30 | 96.90 | -3.8 | 37.6 |
| 36.0 | 25.76 | 36.97 | 96.90 | -4.8 | 32.8 |
| 37.3 | 17.17 | 24.65 | 96.90 | -5.8 | 27.0 |
| 38.7 | 8.59 | 12.32 | 96.90 | -6.8 | 20.3 |
| 40.0 | 0.00 | 0.00 | 96.90 | -7.8 | 12.5 |

**Variable Storm Duration Storage Requirements**

| *Duration* | *Max Storage* | *Duration* | *Max Storage* | *Duration* | *Max Storage* |
|---|---|---|---|---|---|
| 25 Min | 30.6 m3 | 50 Min | 39.2 m3 | 80 Min | 0.0 m3 |
| 30 Min | 41.5 m3 | 60 Min | 22.5 m3 | 90 Min | 0.0 m3 |
| 40 Min | **46.9 m3** | 70 Min | 0.0 m3 | 100 Min | 0.0 m3 |



# Stage Storage Discharge Calculation Sheet

**Project Name:** 116 Four Mile Creek Road - Pine Mansion IV
**Project No.:** 25010
**Date:** August 2025

| | | MH 4 TO MH 5 | | MH 5 TO MH 6 | | CB 3 TO SEWER | | CB 2 TO SEWER | | TOTAL STORAGE VOLUME | Base Orifice | Slot Weir | Total Outflow |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Controlling Rim Elev:** | **128.15** | PIPE | MH 4 | PIPE | MH 5 | PIPE | CB 3 | PIPE | CB 2 | | | | |
| **Invert:** | | 126.55 | 126.55 | 126.46 | 126.46 | 126.95 | 126.95 | 127.45 | 127.45 | | Dia (m) = 0.200 | | |
| **Pipe Diameter:** | | 0.914 | | 0.450 | | 0.200 | | 0.250 | | | Cd = 0.60 | Width (m) = 1.500 | |
| **Structure/Pipe Length:** | | 60.70 | 1800 | 3.00 | 1800 | 3.00 | 600x600mm | 14.70 | 600x600mm | | Invert (m) = 126.42 | Invert (m) = 128.00 | |
| | | | | | | | | | | | | | **DISCHARGE** |
| Elevation (m) | | ($m^3$) | ($m^3$) | ($m^3$) | ($m^3$) | ($m^3$) | ($m^3$) | ($m^3$) | ($m^3$) | Total ($m^3$) | Orifice ($m^3/s$) | Slot Weir ($m^3/s$) | (L/s) |
| 128.20 | | 39.83 | 2.67 | 0.48 | 2.90 | 0.09 | 0.45 | 0.72 | 0.27 | 47.4 | 0.107 | 0.247 | 354.0 |
| 128.15 | | 39.83 | 2.67 | 0.48 | 2.90 | 0.09 | 0.43 | 0.72 | 0.25 | 47.4 | 0.106 | 0.160 | 265.9 |
| 128.05 | | 39.83 | 2.67 | 0.48 | 2.90 | 0.09 | 0.40 | 0.72 | 0.22 | 47.3 | 0.102 | 0.031 | 133.0 |
| 128.00 | | 39.83 | 2.67 | 0.48 | 2.90 | 0.09 | 0.38 | 0.72 | 0.20 | 47.3 | 0.100 | - | 100.4 |
| 127.96 | | 39.83 | 2.67 | 0.48 | 2.90 | 0.09 | 0.36 | 0.72 | 0.18 | 47.2 | 0.099 | - | 99.0 |
| **127.90** | **100 Yr** | **39.83** | **2.67** | **0.48** | **2.90** | **0.09** | **0.34** | **0.72** | **0.16** | **47.2** | **0.097** | **-** | **96.9** |
| 127.80 | | 39.83 | 2.67 | 0.48 | 2.90 | 0.09 | 0.31 | 0.72 | 0.13 | 47.1 | 0.093 | - | 93.2 |
| 127.70 | | 39.83 | 2.67 | 0.48 | 2.90 | 0.09 | 0.27 | 0.72 | 0.09 | 47.1 | 0.089 | - | 89.4 |
| 127.60 | | 39.83 | 2.67 | 0.48 | 2.90 | 0.09 | 0.23 | 0.45 | 0.05 | 46.7 | 0.085 | - | 85.4 |
| 127.50 | | 39.83 | 2.42 | 0.48 | 2.65 | 0.09 | 0.20 | 0.10 | 0.02 | 45.8 | 0.081 | - | 81.2 |
| 127.40 | | 38.60 | 2.16 | 0.48 | 2.39 | 0.09 | 0.16 | - | - | 43.9 | 0.077 | - | 76.8 |
| 127.30 | | 34.97 | 1.91 | 0.48 | 2.14 | 0.09 | 0.13 | - | - | 39.7 | 0.072 | - | 72.2 |
| 127.20 | | 30.29 | 1.65 | 0.48 | 1.88 | 0.09 | 0.09 | - | - | 34.5 | 0.067 | - | 67.2 |
| **127.11** | **5 YR** | **25.58** | **1.43** | **0.48** | **1.65** | **0.08** | **0.06** | **-** | **-** | **29.3** | **0.062** | **-** | **62.3** |
| 127.10 | | 25.04 | 1.40 | 0.48 | 1.63 | 0.08 | 0.05 | - | - | 28.7 | 0.062 | - | 61.7 |
| 127.00 | | 19.52 | 1.15 | 0.48 | 1.37 | 0.02 | 0.02 | - | - | 22.6 | 0.056 | - | 55.8 |
| 126.90 | | 14.03 | 0.89 | 0.47 | 1.12 | - | - | - | - | 16.5 | 0.049 | - | 49.2 |
| 126.80 | | 8.83 | 0.64 | 0.39 | 0.87 | - | - | - | - | 10.7 | 0.041 | - | 41.5 |
| 126.70 | | 4.27 | 0.38 | 0.26 | 0.61 | - | - | - | - | 5.5 | 0.032 | - | 32.0 |
| 126.60 | | 0.85 | 0.13 | 0.13 | 0.36 | - | - | - | - | 1.5 | 0.022 | - | 21.9 |
| 126.50 | | - | - | 0.02 | 0.10 | - | - | - | - | 0.1 | 0.005 | - | 5.3 |
| 126.42 | | - | - | - | - | - | - | - | - | 0.0 | - | - | 0.0 |

**UPPER CANADA CONSULTANTS**
**3-30 HANNOVER DRIVE**
**ST. CATHARINES, ON L2W 1A3**

# STORM SEWER DESIGN

**MUNICIPALITY:** TOWN OF NIAGARA-ON-THE-LAKE — A = 664.00 mm/hr — 5 YEAR DESIGN IDF
**PROJECT:** PINE MANSIONS IV — B = 4.70 minutes — PIPE ROUGHNESS = 0.013
**UCC PROJECT NO.:** 25010 — C = 0.744 — PIPE CONVERSION FACTOR = 1.016

| DESCRIPTION | | | STORMWATER ANALYSIS | | | | | | | | | | STORM SEWER DESIGN | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LOCATION | FROM MH | TO MH | AREA (ha) | ACCUMLTD AREA (ha) | RUNOFF COEFFICNT | A*R | ACCUMLTD A*R | T of C (min.) | PIPE TIME (min.) | T of C (sum) | INTENSITY (mm/hr) | FLOW (L/s) | LENGTH (m) | DIAMETER (mm) | SLOPE (%) | CAPACITY (L/s) | VELOCITY (m/s) | PERCENT FULL |
| A1 - SNOW STORAGE | CB 1 | DCBMH 4 | 0.05 | 0.05 | 0.80 | 0.040 | 0.040 | 10.00 | 0.46 | 10.46 | 89.9 | 10.0 | 48.1 | 250 | 2.0 | 87.77 | 1.7 | 11.4% |
| A2 - PARKING LOT | CB 2 | SEWER | 0.17 | 0.17 | 0.90 | 0.153 | 0.153 | 10.00 | 0.13 | 10.13 | 89.9 | 38.2 | 14.7 | 250 | 2.5 | 98.13 | 1.9 | 38.9% |
| A3 - REAR YARD | CB 3 | SEWER | 0.04 | 0.04 | 0.40 | 0.016 | 0.016 | 10.00 | 0.03 | 10.03 | 89.9 | 4.0 | 3.0 | 200 | 2.0 | 48.41 | 1.5 | 8.3% |
| A4 - PARKING LOT | DCBMH 4 | MH 5 | 0.18 | 0.44 | 0.90 | 0.162 | 0.371 | 10.46 | 1.11 | 11.58 | 87.8 | 90.5 | 60.7 | 900 | 0.1 | 597.46 | 0.9 | 15.2% |
| | MH 5 | MH 6 | | 0.44 | | | 0.371 | 11.58 | 0.04 | 11.61 | 83.3 | 85.9 | 3.0 | 450 | 0.5 | 210.40 | 1.3 | 40.8% |
| A5 - ROOFTOP | STUB | MH 6 | 0.24 | 0.24 | 0.90 | 0.216 | 0.216 | 10.00 | 0.15 | 10.15 | 89.9 | 53.9 | 15.4 | 250 | 2.0 | 87.77 | 1.7 | 61.4% |
| | | | | *0.68* | | | | | | | 64 L/s DURING 5 YR EVENT | | | | | | | |
| SITE QUANTITY OUTLET | | MH 6 | | | | | | 11.61 | | | | 64.0 | | | | | | |
| A6 - EXTERNAL LANDS | CB 7 | MH 8 | 0.90 | 0.90 | 0.21 | 0.189 | 0.189 | 10.00 | 0.31 | 10.31 | 89.9 | 47.2 | 28.5 | 250 | 1.6 | 78.50 | 1.5 | 60.1% |
| | MH 8 | MH 6 | | 0.90 | | | 0.189 | 10.31 | 0.94 | 11.24 | 88.5 | 46.5 | 84.4 | 250 | 1.5 | 76.01 | 1.5 | 61.1% |
| | MH 6 | EX DI | | 1.58 | | | 0.189 | 11.61 | 0.20 | 11.81 | 83.2 | 107.7 | 15.2 | 450 | 0.5 | 210.40 | 1.3 | 51.2% |
| A20 - SITE FRONTAGE | | DITCH | 0.06 | 0.06 | 0.23 | 0.014 | 0.014 | | | | | | | | | | | |
| A30 - FOUR MILE CREEK ROAD | EX DI | EX MH | 0.88 | 2.52 | 0.40 | 0.352 | 0.555 | 11.81 | 0.08 | 11.89 | 82.4 | 191.0 | 18.8 | 600 | 3.2 | 1146.32 | 3.9 | 16.7% |
| | | | | | | | | | APRICOT GLEN SWM FACILITY - 159L/s DURING 5 YR EVENT | | | | | | | | | |
| APRICOT GLEN SWM FACILITY | EX MH | EX MH | | 15.00 | | | | | | | | 159.0 | 41.0 | 600 | 0.37 | 389.79 | 1.3 | 40.8% |
| | EX MH | DSD CULVERT | | 17.52 | | | 0.555 | 11.89 | 0.05 | 11.94 | 82.1 | 349.6 | 14.4 | 600 | 5.3 | 1475.26 | 5.1 | 23.7% |

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

# APPENDIX E

**Hydroworks OGS Calculation Output File**
**OGS Sample Inspection Report**

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

```
          ************************************************
          *      Storm Water Management Sizing Model     *
          *               Hydroworks, LLC                *
          *                Version 4.4                   *
          *                                              *
          *        Continuous Simulation Program         *
          *             Based on SWMM 4.4H               *
          *             Hydroworks, LLC                  *
          *              Graham Bryant                   *
          *               2003 - 2021                    *
          ************************************************
                          Developed by
          ************************************************
          *              Hydroworks, LLC                 *
          *            Metcalf & Eddy, Inc.              *
          *           University of Florida              *
          *       Water Resources Engineers, Inc.        *
          *      (Now Camp Dresser & McKee, Inc.)        *
          *              Modified SWMM 4.4               *
          ************************************************
                   Distributed and Maintained by
          ************************************************
          *                                              *
          *               Hydroworks, LLC                *
          *                888-290-7900                  *
          *             www.hydroworks.com               *
          *                                              *
          ************************************************
          ************************************************
          *     If any problems occur executing this     *
          *     model, contact Mr. Graham Bryant at      *
          *     Hydroworks, LLC by phone at 888-290-7900 *
          *     or by e-mail: support@hydroworks.com     *
          ************************************************
          ************************************************
          *     This model is based on EPA SWMM 4.4      *
          *  "Nature is full of infinite causes which    *
          *   have never occurred in experience" da Vinci *
          ************************************************
          ************************************************
          * Entry made to the Rain Block                 *
          * Created by the University of Florida - 1988  *
          * Updated by Oregon State University, March 2000 *
          ************************************************
          Pinewood Mansions 4
          NOTL

         HydroDome Simulation

       ########################################
       #  Precipitation Block Input Commands  #
       ########################################
      Station Name.........................  St. Catherines A
      Station Location.....................  Ontario
      Station, ISTA........................    7287
      Beginning date, IYBEG (Yr/Mo/Dy)......  1971/ 1/ 1
      Ending date, IYEND (Yr/Mo/Dy).........  2005/12/31
      Minimum interevent time, MIT..........     1
      Number of ranked storms, NPTS.........    10
      NWS format, IFORM (See text)..........     1
      Print storm summary, ISUM (O-No 1-Yes)     0
      Print all rainfall, IYEAR (O-No 1-Yes)     0
      Save storm event data on NSCRAT(1)....     0
      (IFILE =0 -Do not save, =1 -Save data)
      IDECID 0 - Create interface file
             1 - Create file and analyze
             2 - Synoptic analysis..........     2
      Plotting position parameter, A........  0.40

     Storm event statistics, NOSTAT........  1100

      KODEA (from optional group B0)........     2
       = 0, Do not include NCDC cumulative values.
       = 1, Average NCDC cumulative values.
       = 2, Use NCDC cumulative value as inst. rain.

      KODEPR (from optional group B0).......     0
       Print NCDC special codes in event summary:
       = 0, only on days with events.
       = 1, on all days with codes present.
       Codes: A = accumulated value, I = incomplete value,
              M = missing value,     O = other code present

*******************************************************
*  Precipitation output created using the Rain block   *
*  Number of precipitation stations...        1        *
*******************************************************

Location Station Number
-------- --------------
       1.     7287

TATION ID ON PRECIP. DATA INPUT FILE = 7287
REQUESTED STATION ID =     7287  CHECK TO BE SURE THEY MATCH.
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
Note, 15-min. data are being processed, but hourly
print-out, summaries, and statistics are based on
hourly totals only.  Data placed on interface file
are at correct 15-min. intervals.
```

```
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

##################################################
# Entry made to the Runoff Block, last updated by #
# Oregon State University, and Camp, Dresser and  #
# McKee, Inc., March 2002.                        #
##################################################
# "And wherever water goes, amoebae go along for  #
#  the ride"                    Tom Robbins       #
##################################################

                Pinewood Mansions 4
                 NOTL

Snowmelt parameter - ISNOW.....................          0
Number of rain gages - NRGAG...................          1
Horton infiltration equation used - INFILM.....          2
Maximum infiltration volume is limited to RMAXINF input on  subcatchment lines.
Infiltration volume regenerates during  non rainfall periods.
Quality is simulated - KWALTY..................          1
IVAP is negative.  Evaporation will be set to zero
    during time steps with rainfall.
Read evaporation data on line(s) F1 (F2) - IVAP..          1
Hour of day at start of storm - NHR............          1
Minute of hour at start of storm - NMN.........          1
Time TZERO at start of storm (hours)...........      1.017
Use Metric units for I/O - METRIC..............          1
 ===> Ft-sec units used in all internal computations
unoff input print control...                             0
Runoff graph plot control....                            1
Runoff output print control..                            0
Print headers every 50 lines - NOHEAD (0=yes, 1=no)      0
Print land use load percentages -LANDUPR (0=no, 1=yes)   0
Limit number of groundwater convergence messages to 10000 (if simulated)
Month, day, year of start of storm is:             1/ 1/1971
Wet time step length (seconds).......                  300.
Dry time step length (seconds).......                  900.
Wet/Dry time step length (seconds)...                  450.
Simulation length is.....                     20051231.0 Yr/Mo/Dy
Percent of impervious area with zero detention depth    25.0
Horton infiltration model being used
Rate for regeneration of infiltration = REGEN * DECAY
DECAY is read in for each subcatchment
REGEN = ........................................   0.01000
*********************************************************
*   Processed Precipitation will be read from file      *
*********************************************************

  ##############################
  #        Data Group F1       #
  # Evaporation Rate (mm/day) #
  ##############################

 JAN.  FEB.  MAR.  APR.  MAY   JUN.  JUL.  AUG.  SEP.  OCT.  NOV.  DEC.
 ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----
 0.00  0.00  0.00  2.54  2.54  3.81  3.81  3.81  2.54  2.54  0.00  0.00

*********************************************************
*         C H A N N E L  A N D  P I P E  D A T A         *
*********************************************************

Input   NAMEG:     Drains                          Invert  L Side   R Side  Intial     Max  Mann-   Full
equen  Channel      to      Channel  Width  Length   Slope   Slope    Slope   Depth    Depth   ings   Flow
umber    ID #      NGTO:     Type     (m)    (m)    (m/m)   (m/m)    (m/m)     (m)      (m)   "N"   (cms)
-----  ------------------ -------- ------ -------   ------- -------- -------- ------- ------- -----  -----
  1        201        200   Dummy     0.0     0.0    0.0000   0.0000  0.0000     0.0     0.0  0.0000 0.00E+00

 ***************************************************
 *          S U B C A T C H M E N T  D A T A       *
 ***************************************************

*NOTE. SEE LATER TABLE FOR OPTIONAL SUBCATCHMENT PARAMETERS*
      SUBCATCH-  CHANNEL      WIDTH    AREA  PERCENT    SLOPE    RESISTANCE  FACTOR    DEPRES. STORAGE(MM) INFILTRATION   DECAY RATE GAGE
MAXIMUM
       MENT NO.  OR INLET       (M)    (HA)  IMPERV.    (M/M)     IMPERV.     PERV.   IMPERV.     PERV.      RATE(MM/HR)    (1/SEC)    NO.
VOLUME
                                                                                                          MAXIMUM MINIMUM
(MM)
 ---  --------   -------- --------- --------  -----   -------    -------  --------    ------    ------     ----   -------  -------  ------ --
-----
  1        300        200     67.08     0.45 100.00    0.0200      0.015     0.250     0.510     5.080    63.50   10.16    0.00055     1
101.60000

TOTAL NUMBER OF SUBCATCHMENTS...              1
TOTAL TRIBUTARY AREA (HECTARES).           0.45
IMPERVIOUS AREA (HECTARES)......           0.45
PERVIOUS AREA (HECTARES)........           0.00
TOTAL WIDTH (METERS)............          67.08
PERCENT IMPERVIOUSNESS.........          100.00


*********************************************************
*      U P S T R E A M   S T O R A G E  D A T A         *
*********************************************************

     Storage        Flow
      (m3)         (m3/s)
```

```
         0.       0.000
        54.       0.100

*****************************************************
*     G R O U N D W A T E R   I N P U T   D A T A   *
*****************************************************


    SUB-     CHANNEL     ========== E L E V A T I O N S ========  =========== F L O W   C O N S T A N T S ============
    CATCH        OR      GROUND  BOTTOM   STAGE     BC      TW       A1         B1        A2         B2        A3
    NUMBER     INLET       (M)     (M)     (M)     (M)     (M) (MM/HR-M^B1)         (MM/HR-M^B2)          (MM/HR-M^2)
    ------     -----     -------  ------  ------  ------  ------ -----------  ------- -----------  ------- -----------
         0       602        3.05    0.00    0.00    0.61    0.61   3.484E-04    2.600   0.000E+00    1.000    0.00E+00

*****************************************************
* G R O U N D W A T E R   I N P U T   D A T A (CONTINUED) *
*****************************************************

               S O I L   P R O P E R T I E S
                     SATURATED                                        PERCOLATION     E T  P A R A M E T E R S
          SUBCAT.      HYDRAULIC  WILTING  FIELD   INITIAL     MAX. DEEP   PARAMETERS        DEPTH  FRACTION OF ET
          NO.   POROSITY CONDUCTIVITY  POINT  CAPACITY MOISTURE  PERCOLATION   HCO    PCO        OF ET  TO UPPER ZONE
                          (mm/hr)                               (mm/hr)                          (m)
        ----   ------     -------    ------  ------   ------    ----------  ------  ------     ------      ------
           0    .4000     127.000     .1500   .3000    .3000     5.080E-02   10.00    4.57       4.27       0.350


*****************************************************
*    Arrangement of Subcatchments and Channel/Pipes     *
*****************************************************
* See second subcatchment output table for connectivity *
* of subcatchment to subcatchment flows.                *
*****************************************************
   Channel
   or Pipe
       201     No Tributary Channel/Pipes
               No Tributary Subareas.....

    INLET
       200     Tributary Channel/Pipes...        201
               Tributary Subareas........        300

*****************************************************
* Hydrographs will be stored for the following   1 INLETS *
*****************************************************
          200

#####################################################
#              Quality Simulation                   #
#####################################################
#      General Quality Control Data Groups          #
#####################################################

 Description                          Variable       Value
 -----------                          --------       -----
 Number of quality constituents.....    NQS.......         1
 Number of land uses................  JLAND.......         1
 Standard catchbasin volume.........  CBVOL.......      1.22 cubic meters
 Erosion is not simulated.........    IROS........         0
 DRY DAYS PRIOR TO START OF STORM... DRYDAY.......      3.00 DAYS
 DRY DAYS REQUIRED TO RECHARGE
 CATCHBASIN CONCENTRATION TO
 INITIAL VALUES..................... DRYBSN.......      5.00 DAYS
 DUST AND DIRT
 STREET SWEEPING EFFICIENCY......... REFFDD.......     0.300
 DAY OF YEAR ON WHICH STREET
 SWEEPING BEGINS.................... KLNBGN.......       120
 DAY OF YEAR ON WHICH STREET
 SWEEPING ENDS...................... KLNEND.......       270

###########################################
#     Land use data on data group J2      #
###########################################

                                                      LIMITING                          CLEANING  AVAIL.    DAYS SINCE
AND USE   BUILDUP EQUATION TYPE   FUNCTIONAL DEPENDENCE OF   BUILDUP    BUILDUP  BUILDUP  INTERVAL  FACTOR      LAST
LNAME)           (METHOD)        BUILDUP PARAMETER(JACGUT)  (DDLIM)    (DDPOW)  (DDFACT)  (CLFREQ)  (AVSWP)    (DSLCL)
-------   --------------------   -------------------------  --------   -------  --------  --------  -------    ---------
Urban De  EXPONENTIAL(1)                 AREA(1)           2.802E+01     0.500    67.250    30.000     0.300    30.000

###############################################
#     Constituent data on data group J3      #
###############################################

                             Total Su
                             --------
Constituent units........      mg/l
Type of units............          0
KALC.....................          2
Type of buildup calc.....    EXPONENTIAL(2)
KWASH....................          0
Type of washoff calc.....  POWER EXPONEN.(0)
KACGUT...................          1
Dependence of buildup....        AREA(1)
LINKUP...................          0
```

```
Linkage to snowmelt......   NO SNOW LINKAGE
Buildup param 1 (QFACT1).          28.020
Buildup param 2 (QFACT2).           0.500
Buildup param 3 (QFACT3).          67.250
Buildup param 4 (QFACT4).           0.000
Buildup param 5 (QFACT5).           0.000
Washoff power (WASHPO)...           1.100
Washoff coef. (RCOEF)....           0.086
Init catchb conc (CBFACT)         100.000
Precip. conc. (CONCRN)...           0.000
Street sweep effic (REFF)           0.300
Remove fraction (REMOVE).           0.000
1st order QDECAY, 1/day..           0.000
Land use number.........               1

************************************************
* Constant Groundwater Quality Concentration(s) *
************************************************

 Total Susp has a concentration of..    0.0000   mg/l

************************************************
* REMOVAL FRACTIONS FOR SELECTED CHANNEL/PIPES *
* FROM J7 LINES                                *
************************************************

  CHANNEL/   CONSTITUENT
     PIPE Total Susp
----------  --------
       201     0.000

******************************************************
*     Subcatchment surface quality on data group L1 *
******************************************************

                            Total   Number   Input
                     Land    Gutter     of    Loading
              Land    Use    Length   Catch-  load/ha
         No.  Usage   No.      Km     Basins  Total Su
       ------ -------- ----  -------- --------  -------
   1       300 Urban De  1         0.13     2.00  0.0E+00
   Totals (Loads in kg or other)    0.13     2.00  0.0E+00

    **********************
    *    DATA GROUP M1    *
    **********************


TOTAL NUMBER OF PRINTED GUTTERS/INLETS...NPRNT..        1
NUMBER OF TIME STEPS BETWEEN PRINTINGS..INTERV..        0
STARTING AND STOPPING PRINTOUT DATES............        0        0


    **********************
    *    DATA GROUP M3    *
    **********************

CHANNEL/INLET PRINT DATA GROUPS......       -200

===> WARNING !! STORAGE UNIT IS FLOODING.  EXCESS VOLUME CONVEYED AS DISCHARGE

          ****************************************
          * Rainfall from Nat. Weather Serv. file  *
          * in units of hundredths of an inch      *
          ****************************************

         Pinewood Mansions 4
         NOTL



Rainfall Station    St. Catherines A
State/Province      Ontario

Rainfall Depth Summary (mm)

Year     Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec    Total

1971.     31.    0.    0.    0.    0.    0.  126.   93.   52.   60.   29.    0.    391.
1972.      0.    0.    0.   47.   65.  100.   39.  115.   63.   90.    1.    0.    521.
1973.      0.    0.    0.  103.   77.   71.   53.   29.   63.  139.    0.    0.    534.
1974.      0.    0.    0.   67.  105.   62.   50.   31.   74.   37.  110.    0.    536.
1975.      0.    0.    0.    0.    0.   94.   78.   76.   73.   56.   59.    6.    442.
1976.      0.    0.    0.  119.  136.   87.  101.   60.   72.   73.   13.    1.    662.
1977.      0.    0.    0.   94.   29.   69.   57.  150.  230.   71.    0.    1.    701.
1978.      0.    0.    0.   72.   43.   72.   43.   86.  156.   95.    0.    0.    567.
1979.      0.    0.    0.   84.   92.   33.   91.   88.   84.  129.   71.    0.    673.
1980.      0.    0.    0.   81.   39.  122.   60.   32.   79.   96.   45.    0.    554.
1981.      0.    0.    0.   91.   71.  106.  122.   61.  123.   91.   84.    0.    749.
1982.      0.    0.    0.   28.   65.   97.   36.   66.   82.   25.  143.    0.    544.
1983.      0.    0.    0.   78.  100.   65.   55.  106.   75.  122.   92.    0.    694.
1984.      0.    0.    0.   31.  113.  136.   19.   51.  144.   24.   44.    0.    562.
1985.      0.    0.   67.   32.   52.   64.   40.   94.   42.  109.    0.    1.    501.
1986.      0.    0.    0.   93.  113.   60.   85.   83.   98.   80.   43.   65.    719.
1987.      0.    2.   11.   77.   42.   80.  122.   97.   99.   71.   94.   34.    730.
1988.      0.    0.   41.   71.   42.   21.  110.   82.   70.   68.   75.    5.    585.
```

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1989. | 0. | 0. | 13. | 63. | 137. | 108. | 36. | 45. | 89. | 73. | 84. | 0. | 647. |
| 1990. | 0. | 2. | 38. | 99. | 124. | 44. | 68. | 95. | 56. | 112. | 96. | 0. | 735. |
| 1991. | 0. | 0. | 86. | 124. | 67. | 31. | 85. | 57. | 79. | 64. | 61. | 28. | 682. |
| 1992. | 0. | 0. | 29. | 127. | 56. | 92. | 185. | 116. | 77. | 47. | 103. | 38. | 869. |
| 1993. | 3. | 0. | 7. | 83. | 56. | 86. | 32. | 61. | 71. | 92. | 80. | 38. | 610. |
| 1994. | 0. | 0. | 44. | 88. | 105. | 124. | 48. | 77. | 117. | 15. | 0. | 15. | 633. |
| 1995. | 112. | 23. | 16. | 48. | 37. | 60. | 123. | 66. | 8. | 137. | 94. | 0. | 724. |
| 1998. | 0. | 0. | 0. | 0. | 51. | 54. | 64. | 29. | 9. | 0. | 1. | 0. | 207. |
| 1999. | 0. | 0. | 0. | 79. | 59. | 35. | 61. | 58. | 116. | 78. | 0. | 0. | 487. |
| 2000. | 0. | 0. | 0. | 123. | 134. | 216. | 51. | 0. | 0. | 0. | 10. | 0. | 534. |
| 2001. | 0. | 0. | 0. | 56. | 88. | 45. | 25. | 30. | 81. | 129. | 0. | 0. | 454. |
| 2002. | 0. | 0. | 0. | 73. | 104. | 64. | 53. | 49. | 52. | 65. | 8. | 0. | 468. |
| 2003. | 0. | 0. | 0. | 10. | 163. | 77. | 81. | 64. | 67. | 73. | 2. | 0. | 537. |
| 2004. | 0. | 0. | 0. | 131. | 126. | 99. | 115. | 40. | 88. | 17. | 0. | 0. | 616. |
| 2005. | 0. | 0. | 0. | 38. | 42. | 78. | 53. | 120. | 112. | 0. | 0. | 0. | 443. |

Total Rainfall Depth for Simulation Period 19310. (mm)

Rainfall Intensity Analysis (mm/hr)

| (mm/hr) | (#) | (%) | (mm) | (%) |
|---|---|---|---|---|
| 2.50 | 21481 | 74.6 | 6454. | 33.4 |
| 5.00 | 3585 | 12.4 | 3088. | 16.0 |
| 7.50 | 1973 | 6.8 | 2886. | 14.9 |
| 10.00 | 575 | 2.0 | 1233. | 6.4 |
| 12.50 | 389 | 1.4 | 1070. | 5.5 |
| 15.00 | 194 | 0.7 | 660. | 3.4 |
| 17.50 | 210 | 0.7 | 846. | 4.4 |
| 20.00 | 66 | 0.2 | 306. | 1.6 |
| 22.50 | 92 | 0.3 | 487. | 2.5 |
| 25.00 | 39 | 0.1 | 232. | 1.2 |
| 27.50 | 37 | 0.1 | 246. | 1.3 |
| 30.00 | 34 | 0.1 | 245. | 1.3 |
| 32.50 | 29 | 0.1 | 228. | 1.2 |
| 35.00 | 5 | 0.0 | 42. | 0.2 |
| 37.50 | 10 | 0.0 | 90. | 0.5 |
| 40.00 | 10 | 0.0 | 97. | 0.5 |
| 42.50 | 12 | 0.0 | 124. | 0.6 |
| 45.00 | 9 | 0.0 | 99. | 0.5 |
| 47.50 | 1 | 0.0 | 12. | 0.1 |
| 50.00 | 3 | 0.0 | 37. | 0.2 |
| >50.00 | 49 | 0.2 | 829. | 4.3 |

Total # of Intensities 28803

Daily Rainfall Depth Analysis (mm)

| (mm) | (#) | (%) | (mm) | (%) |
|---|---|---|---|---|
| 2.50 | 1077 | 38.9 | 1247. | 6.5 |
| 5.00 | 507 | 18.3 | 1850. | 9.6 |
| 7.50 | 326 | 11.8 | 2006. | 10.4 |
| 10.00 | 226 | 8.2 | 1958. | 10.1 |
| 12.50 | 150 | 5.4 | 1672. | 8.7 |
| 15.00 | 111 | 4.0 | 1495. | 7.7 |
| 17.50 | 100 | 3.6 | 1620. | 8.4 |
| 20.00 | 67 | 2.4 | 1260. | 6.5 |
| 22.50 | 45 | 1.6 | 958. | 5.0 |
| 25.00 | 37 | 1.3 | 881. | 4.6 |
| 27.50 | 23 | 0.8 | 609. | 3.2 |
| 30.00 | 20 | 0.7 | 575. | 3.0 |
| 32.50 | 20 | 0.7 | 631. | 3.3 |
| 35.00 | 12 | 0.4 | 405. | 2.1 |
| 37.50 | 8 | 0.3 | 290. | 1.5 |
| 40.00 | 9 | 0.3 | 350. | 1.8 |
| 42.50 | 4 | 0.1 | 165. | 0.9 |
| 45.00 | 4 | 0.1 | 173. | 0.9 |
| 47.50 | 2 | 0.1 | 91. | 0.5 |
| 50.00 | 4 | 0.1 | 192. | 1.0 |
| >50.00 | 15 | 0.5 | 882. | 4.6 |

Total # Days with Rain 2767

```
**********************************************
*      End of time step DO-loop in Runoff      *
**********************************************
Final Date (Mo/Day/Year)   =                  1/ 1/2006
Total number of time steps =                    2056427
Final Julian Date  =                            2006001
Final time of day  =                                 3. seconds.
Final time of day  =                               0.00   hours.
Final running time =                          306816.0000   hours.
Final running time =                           12784.0000    days.

**************************************************
*     Extrapolation Summary for Watersheds       *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of OVERLND Calls      *
**************************************************

 Subcatch   # Steps   # Calls  Subcatch   # Steps   # Calls  Subcatch   # Steps   # Calls
 --------   -------   -------  --------   -------   -------  --------   -------   -------
      300   6221598   1586270

**************************************************
*     Extrapolation Summary for Channel/Pipes    *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of GUTNR Calls        *
```

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

Chan/Pipe   # Steps   # Calls Chan/Pipe   # Steps   # Calls Chan/Pipe   # Steps   # Calls
 --------   -------   -------  --------   -------   -------  --------   -------   -------
      201         0         0

*********************************************
*       Continuity Check for Surface Water   *
*********************************************
                                                          Millimeters over
                                                cubic meters  Total Basin
Total Precipitation (Rain plus Snow)                 86681.     19263.
Total Infiltration                                       0.         0.
Total Evaporation                                     8916.      1981.
Surface Runoff from Watersheds                       78475.     17439.
Total Water remaining in Surface Storage                 0.         0.
Infiltration over the Pervious Area...                   0.         0.
                    --------
Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
Water remaining in Snow Cover.....                   87392.     19421.
Total Precipitation + Initial Storage.               86681.     19263.

The error in continuity is calculated as
************************************
* Precipitation + Initial Snow Cover  *
*      - Infiltration -               *
*Evaporation - Snow removal -         *
*Surface Runoff from Watersheds -     *
*Water in Surface Storage -           *
*Water remaining in Snow Cover        *
*-----------------------------------*
* Precipitation + Initial Snow Cover  *
************************************
Error.................................       -0.820 Percent

*********************************************
*       Continuity Check for Channel/Pipes   *
*********************************************
                                                          Millimeters over
                                                cubic meters  Total Basin
Initial Channel/Pipe Storage.............                0.         0.
Final Channel/Pipe Storage...............                0.         0.
Surface Runoff from Watersheds...........            78475.     17439.
Baseflow.................................                0.
Groundwater Subsurface Inflow............                0.         0.
Evaporation Loss from Channels...........                0.         0.
Channel/Pipe/Inlet Outflow...............            78475.     17439.
Initial Storage + Inflow.................            78475.     17439.
Final Storage + Outflow..................            78475.     17439.
*********************************************
* Final Storage + Outflow + Evaporation  - *
* Watershed Runoff - Groundwater Inflow  - *
*     Initial Channel/Pipe Storage         *
*     ---------------------------------    *
*  Final Storage + Outflow  + Evaporation  *
*********************************************
Error.....................................      0.000 Percent

*************************************************
*     Continuity Check for Subsurface Water       *
*************************************************
                                                 Millimeters over
                                       cubic meters  Subsurface Basin

Total Infiltration                                0.         0.
Total Upper Zone ET                               0.         0.
Total Lower Zone ET                               0.         0.
Total Groundwater flow                            0.         0.
Total Deep percolation                            0.         0.
Initial Subsurface Storage                     4115.       914.
Final Subsurface Storage                       4115.       914.
Upper Zone ET over Pervious Area                  0.         0.
Lower Zone ET over Pervious Area                  0.         0.


*****************************************
* Infiltration + Initial Storage - Final *
* Storage - Upper and Lower Zone ET -    *
* Groundwater Flow - Deep Percolation    *
* -------------------------------------- *
*     Infiltration + Initial Storage     *
*****************************************
Error ....................................     0.000 Percent
```

**SUMMARY STATISTICS FOR SUBCATCHMENTS**

| SUBCATCHMENT NO. | GUTTER OR INLET NO. | AREA (HA) | PERCENT IMPER. | TOTAL SIMULATED RAINFALL (MM) | PERVIOUS AREA RUNOFF DEPTH (MM) | PERVIOUS AREA TOTAL LOSSES (MM) | PERVIOUS AREA PEAK RUNOFF RATE (CMS) | IMPERVIOUS AREA RUNOFF DEPTH (MM) | IMPERVIOUS AREA PEAK RUNOFF RATE (CMS) | TOTAL SUBCATCHMENT AREA RUNOFF DEPTH (MM) | TOTAL SUBCATCHMENT AREA PEAK RUNOFF RATE (CMS) | TOTAL SUBCATCHMENT AREA PEAK UNIT RUNOFF (MM/HR) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 300 | 200 | 0.45 | 100.01 | 9262.47 | 0.000 | 0.000 | 0.00017 | 436.135 | 0.245 | 17436.135 | 0.245 | 197.644 |

*** NOTE *** IMPERVIOUS AREA STATISTICS AGGREGATE IMPERVIOUS AREAS WITH AND WITHOUT DEPRESSION STORAGE

SUMMARY STATISTICS FOR CHANNEL/PIPES

| CHANNEL NUMBER | FULL FLOW (CMS) | FULL VELOCITY (M/S) | FULL DEPTH (M) | MAXIMUM COMPUTED INFLOW (CMS) | MAXIMUM COMPUTED OUTFLOW (CMS) | MAXIMUM COMPUTED DEPTH (M) | MAXIMUM COMPUTED VELOCITY (M/S) | TIME OF OCCURRENCE DAY | TIME OF OCCURRENCE HR. | LENGTH OF SURCHARGE (HOUR) | MAXIMUM SURCHARGE VOLUME (CU-M) | RATIO OF MAX. TO FULL FLOW | RATIO OF MAX. DEPTH TO FULL DEPTH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 201 | | | | 0.00 | | | | 1/ 0/1900 | 0.00 | | | | |
| 200 | | | | 0.25 | | | | 8/14/1972 | 14.25 | | | | |

TOTAL NUMBER OF CHANNELS/PIPES = 2

** NOTE *** THE MAXIMUM FLOWS AND DEPTHS ARE CALCULATED AT THE END OF THE TIME INTERVAL

```
##########################################################
#             Runoff Quality Summary Page                #
# If NDIM = 0 Units for:   loads    mass rates           #
#             METRIC = 1    lb        lb/sec             #
#             METRIC = 2    kg        kg/sec             #
# If NDIM = 1 Loads are in units of quantity             #
#             and mass rates are quantity/sec            #
# If NDIM = 2 loads are in units of concentration        #
#             times volume and mass rates have units     #
#             of concentration times volume/second       #
##########################################################

Total Su NDIM =  0
METRIC =  2
                          Total Su
                          --------
Inputs
------
 1. INITIAL SURFACE LOAD........       10.
 2. TOTAL SURFACE BUILDUP.......     9115.
 3. INITIAL CATCHBASIN LOAD.....        0.
 4. TOTAL CATCHBASIN LOAD.......        0.
 5. TOTAL CATCHBASIN AND
    SURFACE BUILDUP (2+4).......     9115.

Remaining Loads
---------------
 6. LOAD REMAINING ON SURFACE...        3.
 7. REMAINING IN CATCHBASINS....        0.
 8. REMAINING IN CHANNEL/PIPES..        0.

Removals
--------
 9. STREET SWEEPING REMOVAL.....      647.
10. NET SURFACE BUILDUP (2-9)...     8469.
11. SURFACE WASHOFF.............     8464.
12. CATCHBASIN WASHOFF..........        0.
13. TOTAL WASHOFF (11+12).......     8464.
14. LOAD FROM OTHER CONSTITUENTS        0.
15. PRECIPITATION LOAD..........        0.
15a.SUM SURFACE LOAD (13+14+15).     8464.
16. TOTAL GROUNDWATER LOAD......        0.
16a.TOTAL I/I LOAD..............        0.
17. NET SUBCATCHMENT LOAD
    (15a-15b-15c-15d+16+16a)....     8464.
>>Removal in channel/pipes (17a, 17b):
17a.REMOVE BY BMP FRACTION......        0.
17b.REMOVE BY 1st ORDER DECAY...        0.
18. TOTAL LOAD TO INLETS........     8464.
19. FLOW WT'D AVE.CONCENTRATION  mg/l
    (INLET LOAD/TOTAL FLOW).....      108.

Percentages
-----------
20. STREET SWEEPING (9/2).......        7.
21. SURFACE WASHOFF (11/2)......       93.
22. NET SURFACE WASHOFF(11/10)..      100.
23. WASHOFF/SUBCAT LOAD(11/17)..      100.
24. SURFACE WASHOFF/INLET LOAD
    (11/18).....................      100.
25. CATCHBASIN WASHOFF/
    SUBCATCHMENT LOAD (12/17)...        0.
26. CATCHBASIN WASHOFF/
    INLET LOAD (12/18)..........        0.
27. OTHER CONSTITUENT LOAD/
    SUBCATCHMENT LOAD (14/17)...        0.
28. INSOLUBLE FRACTION/
    INLET LOAD (14/18)..........        0.
29. PRECIPITATION/
    SUBCATCHMENT LOAD (15/17)...        0.
30. PRECIPITATION/
    INLET LOAD (15/18)..........        0.
31. GROUNDWATER LOAD/
    SUBCATCHMENT LOAD (16/17)...        0.
32. GROUNDWATER LOAD/
    INLET LOAD (16/18)..........        0.
32a.INFILTRATION/INFLOW LOAD/
    SUBCATCHMENT LOAD (16a/17)..        0.
32b.INFILTRATION/INFLOW LOAD/
    INLET LOAD (16a/18).........        0.
32c.CH/PIPE BMP FRACTION REMOVAL/
    SUBCATCHMENT LOAD (17a/17)..        0.
32d.CH/PIPE 1st ORDER DECAY REMOVAL/
```

```
    SUBCATCHMENT LOAD (17b/17)..        0.
33. INLET LOAD SUMMATION ERROR
    (18+8+6a+17a+17b-17)/17.....        0.

CAUTION. Due to method of quality routing (Users Manual, Appendix IX)
quality routing through channel/pipes is sensitive to the time step.
Large "Inlet Load Summation Errors" may result.
These can be reduced by adjusting the time step(s).
Note: surface accumulation during dry time steps at end of simulation is
not included in totals.  Buildup is only performed at beginning of
wet steps or for street cleaning.

*****************************************************
*           TSS Particle Size Distribution          *
*****************************************************
   Diameter    %     Specific    Settling Velocity   Critical Peclet
     (um)            Gravity        (m/s)               Number

      20.    20.0      2.65         0.000267           0.093400
      60.    20.0      2.65         0.002319           0.170600
     150.    20.0      2.65         0.012234           0.297500
     400.    20.0      2.65         0.047806           0.524584
    2000.    20.0      2.65         0.180097           1.431405

*****************************************************
*                                                   *
*              Summary of TSS Removal               *
*                                                   *
*****************************************************

TSS Removal based on Lab Performance Curve

 Model      Low Q Treated  High Q Treated     Runoff Treated        TSS Removed
   #           (cms)          (cms)               (%)                 (%)

 Unavailabl   0.106          0.106               99.9                85.4
 HD 4         0.106          0.106               99.9                90.8
 HD 5         0.106          0.106               99.9                94.2
 HD 6         0.106          0.106               99.9                96.4
 HD 7         0.106          0.106               99.9                97.7
 HD 8         0.106          0.106               99.9                98.6
 HD 10        0.106          0.106               99.9                99.5
 HD 12        0.106          0.106               99.9                99.8

*****************************************************
*                                                   *
*  Summary of Annual Flow Treatmnet & TSS Removal   *
*                                                   *
*****************************************************

 HD 4
 Year       Flow Vol       Flow Treated     TSS In     TSS Rem      TSS Out     TSS Byp     Flow Treated     TSS Removal
              (m3)           (m3)           (kg)       (kg)         (kg)        (kg)          (%)              (%)
 1971.         8049.          8049.          166.       148.          19.          0.         100.0            88.7
 1972.        10214.          9945.          225.       203.          22.          1.          97.4            90.2
 1973.        10456.         10456.          239.       216.          23.          0.         100.0            90.4
 1974.        10654.         10654.          257.       239.          18.          0.         100.0            93.1
 1975.         9034.          9034.          217.       195.          23.          0.         100.0            89.6
 1976.        13443.         13443.          272.       247.          25.          0.         100.0            91.0
 1977.        14384.         14384.          258.       225.          33.          0.         100.0            87.2
 1978.        11533.         11533.          250.       223.          27.          0.         100.0            89.4
 1979.        13760.         13760.          283.       258.          25.          0.         100.0            91.1
 1980.        11099.         11099.          273.       248.          25.          0.         100.0            90.9
 1981.        15318.         15318.          299.       276.          23.          0.         100.0            92.4
 1982.        10808.         10808.          247.       228.          19.          0.         100.0            92.2
 1983.        14260.         14260.          313.       285.          28.          0.         100.0            91.0
 1984.        11474.         11474.          240.       217.          23.          0.         100.0            90.4
 1985.        10009.         10009.          242.       221.          22.          0.         100.0            91.0
 1986.        14597.         14597.          327.       300.          27.          0.         100.0            91.7
 1987.        15071.         15071.          326.       300.          26.          0.         100.0            91.9
 1988.        11999.         11999.          275.       254.          21.          0.         100.0            92.2
 1989.        13287.         13287.          261.       242.          18.          0.         100.0            92.9
 1990.        15085.         15085.          335.       312.          24.          0.         100.0            93.0
 1991.        14125.         14125.          313.       287.          26.          0.         100.0            91.7
 1992.        17965.         17965.          353.       317.          36.          0.         100.0            89.9
 1993.        12215.         12215.          315.       293.          22.          0.         100.0            93.1
 1994.        13008.         13008.          251.       225.          26.          0.         100.0            89.6
 1995.        15198.         15198.          298.       267.          31.          0.         100.0            89.7
 1998.         3935.          3935.          123.       111.          13.          0.         100.0            89.8
 1999.         9621.          9621.          238.       212.          25.          0.         100.0            89.4
 2000.        11104.         11104.          196.       170.          26.          0.         100.0            86.9
 2001.         8778.          8778.          195.       183.          12.          0.         100.0            93.9
 2002.         9165.          9165.          228.       210.          18.          0.         100.0            92.1
 2003.        10424.         10424.          231.       207.          25.          0.         100.0            89.3
 2004.        12463.         12463.          233.       209.          24.          0.         100.0            89.9
 2005.         8966.          8966.          178.       154.          24.          0.         100.0            86.5

 HD 5
 Year       Flow Vol       Flow Treated     TSS In     TSS Rem      TSS Out     TSS Byp     Flow Treated     TSS Removal
              (m3)           (m3)           (kg)       (kg)         (kg)        (kg)          (%)              (%)

 1971.         8049.          8049.          166.       153.          13.          0.         100.0            92.1
 1972.        10214.          9945.          225.       209.          16.          1.          97.4            92.9
 1973.        10456.         10456.          239.       225.          14.          0.         100.0            94.2
 1974.        10654.         10654.          257.       246.          11.          0.         100.0            95.9
 1975.         9034.          9034.          217.       204.          14.          0.         100.0            93.7
 1976.        13443.         13443.          272.       258.          14.          0.         100.0            95.0
```

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1977. | 14384. | 14384. | 258. | 236. | 22. | 0. | 100.0 | 91.7 |
| 1978. | 11533. | 11533. | 250. | 232. | 17. | 0. | 100.0 | 93.0 |
| 1979. | 13760. | 13760. | 283. | 267. | 16. | 0. | 100.0 | 94.2 |
| 1980. | 11099. | 11099. | 273. | 256. | 17. | 0. | 100.0 | 93.9 |
| 1981. | 15318. | 15318. | 299. | 287. | 13. | 0. | 100.0 | 95.7 |
| 1982. | 10808. | 10808. | 247. | 237. | 11. | 0. | 100.0 | 95.7 |
| 1983. | 14260. | 14260. | 313. | 295. | 19. | 0. | 100.0 | 94.1 |
| 1984. | 11474. | 11474. | 240. | 225. | 15. | 0. | 100.0 | 93.7 |
| 1985. | 10009. | 10009. | 242. | 230. | 12. | 0. | 100.0 | 95.0 |
| 1986. | 14597. | 14597. | 327. | 312. | 15. | 0. | 100.0 | 95.3 |
| 1987. | 15071. | 15071. | 326. | 309. | 17. | 0. | 100.0 | 94.7 |
| 1988. | 11999. | 11999. | 275. | 261. | 14. | 0. | 100.0 | 95.0 |
| 1989. | 13287. | 13287. | 261. | 251. | 10. | 0. | 100.0 | 96.3 |
| 1990. | 15085. | 15085. | 335. | 322. | 13. | 0. | 100.0 | 96.1 |
| 1991. | 14125. | 14125. | 313. | 298. | 15. | 0. | 100.0 | 95.1 |
| 1992. | 17965. | 17965. | 353. | 331. | 22. | 0. | 100.0 | 93.7 |
| 1993. | 12215. | 12215. | 315. | 301. | 14. | 0. | 100.0 | 95.7 |
| 1994. | 13008. | 13008. | 251. | 233. | 18. | 0. | 100.0 | 92.9 |
| 1995. | 15198. | 15198. | 298. | 277. | 21. | 0. | 100.0 | 92.9 |
| 1998. | 3935. | 3935. | 123. | 115. | 8. | 0. | 100.0 | 93.6 |
| 1999. | 9621. | 9621. | 238. | 222. | 16. | 0. | 100.0 | 93.3 |
| 2000. | 11104. | 11104. | 196. | 178. | 18. | 0. | 100.0 | 90.9 |
| 2001. | 8778. | 8778. | 195. | 188. | 7. | 0. | 100.0 | 96.5 |
| 2002. | 9165. | 9165. | 228. | 217. | 11. | 0. | 100.0 | 95.1 |
| 2003. | 10424. | 10424. | 231. | 215. | 16. | 0. | 100.0 | 93.1 |
| 2004. | 12463. | 12463. | 233. | 218. | 15. | 0. | 100.0 | 93.6 |
| 2005. | 8966. | 8966. | 178. | 162. | 17. | 0. | 100.0 | 90.6 |

```
**************************************************
*                                                *
*      Summary of Toronto Rainfall Intensities   *
*                                                *
**************************************************
```

| Rainfall Intensity (mm/h) | Flow (L/s) | Percentage % |
|---|---|---|
| 1.50 | 1.8 | 31.1 |
| 2.25 | 2.7 | 11.2 |
| 3.00 | 3.6 | 8.2 |
| 3.75 | 4.5 | 6.0 |
| 4.75 | 5.6 | 6.9 |
| 5.75 | 6.8 | 5.0 |
| 8.00 | 9.5 | 7.9 |
| 10.00 | 11.9 | 4.4 |
| 15.50 | 18.4 | 7.7 |
| 23.25 | 27.6 | 11.4 |

```
**************************************************
*  Summary of Quantity and Quality Results at    *
*  Location        200  INFlow in cms.           *
*  Values are instantaneous at indicated time step *
**************************************************

  Pinewood Mansions 4
 NOTL

     Date     Time        Flow   Total Su
 Mo/Da/Year  Hr:Min       cum/s  mg/l
 ----------  -------    -------  --------
Flow wtd means.....        0.001      108.
Flow wtd std devs..        0.003      122.
Maximum value......        0.245     1338.
Minimum value......        0.000        0.
Total loads........       78301.     8458.
                        Cub-Met  KILOGRAM

===> Runoff simulation ended normally.

===> SWMM 4.4    simulation ended normally.
     Always check output file for possible warning messages.

**************************************************
*       SWMM 4.4    Simulation Date and Time Summary  *
**************************************************
* Starting Date... August     14, 2025               *
*          Time...          11:58: 0.578             *
*   Ending Date... August     14, 2025               *
*          Time...          11:58: 3.120             *
*  Elapsed Time...               0.042 minutes.      *
*  Elapsed Time...               2.542 seconds.      *
**************************************************
```

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

**SAMPLE INSPECTION REPORT**

---

**Owner:**

**Location:**

**Manhole Oil/Grit Separator:**

**Type of Inspection** ☐ Monthly ☐ Annually ☐ Special

**Inlet/Outlet Information**

| | Inlet | | Outlet | |
|---|---|---|---|---|
| Clear of Debris | ☐ Yes | ☐ No | ☐ Yes | ☐ No |
| Build Up of Sediment | ☐ Yes | ☐ No | ☐ Yes | ☐ No |

Action Taken:

**Sediment Tank Information**

A. Manhole Sump Depth: ± m from cover rim (to be as-constructed verified)

B. Measurement from Rim to Sediment Level: m

C. Depth of Sediment: m (A - B)

Note: If the measured depth of sediment is greater than **200mm** then sediment removal is required.

**Presence of Contaminants**

| | | | | |
|---|---|---|---|---|
| Oil | ☐ Yes | ☐ No | Depth | m |
| Foam | ☐ Yes | ☐ No | Depth | m |

Action Taken:

**Name of Regulatory Agency** Telephone No.:

Transaction No.:

**Name of Licensed Waste Management Collector** Telephone No.:

Transaction No.:

Owner Notification ☐ Yes ☐ No Other:

Time: Date:

Name of Inspector:

Signed: Date: