



S. LLEWELLYN & ASSOCIATES LIMITED  
CONSULTING ENGINEERS



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## **1.0 INTRODUCTION AND BACKGROUND**

### **1.1 OVERVIEW**

S. Llewellyn & Associates Limited has been retained by Hi Rise Development Advisors Inc to provide consulting engineering services for the proposed development at 43-51 King Street East in the City of Hamilton (see Figure 1.0 for location plan). This report will outline the functional servicing strategy for the proposed development.

The proposed development consists of constructing a two tower (25 and 34 storeys) mixed use condominium building containing approximately 528 units. The ground level will house commercial units and parking spaces and the upper levels will contain residential units. The proposed site will also include an underground parking structure and roof top amenity areas.

This Functional Servicing Report will provide detailed information of the proposed servicing scheme for this development. Please refer to the preliminary site engineering plans prepared by S. Llewellyn and Associates Limited and the site plan prepared by Graziani & Corazza Architects Inc. for additional information.

### **1.2 BACKGROUND INFORMATION**

The following documents were referenced in the preparation of this report:

- Ref. 1: MOE Stormwater Management Practices Planning and Design Manual (Ministry of Environment, March 2003)
- Ref. 2: Engineering Guidelines for Servicing Land under Development Applications (City of Hamilton, December 2012)
- Ref. 3: City of Hamilton Criteria and Guidelines for Stormwater Management Infrastructure (September 2007)
- Ref. 4: City of Hamilton Storm Drainage Policy (2004)
- Ref. 5: Erosion & Sediment Control Guidelines for Urban Construction (December 2006)



**Figure 1.0 – Location Plan**

## 2.0 STORMWATER MANAGEMENT

The following stormwater management (SWM) criteria will be applied to the site, in accordance with the criteria stated in the City of Hamilton's memorandum dated December 9, 2016:

### **Quantity Control**

The stormwater discharge rate from the proposed site shall be controlled to the 2-year pre-development condition discharge rate for all storm events up to and including the 100-year event.

### **Quality Control**

No quality control will be required since the entire proposed site is roof top (clean water) runoff.

### **Erosion Control**

Erosion and sediment control measures will be implemented in accordance with the standards of the City of Hamilton.

## 2.1 EXISTING CONDITIONS

In the existing condition, the site consists of a vacant 2-storey building and an asphalt parking lot. The site is bound by King William Street to the north, existing commercial buildings to the east, King Street to the south and Hughson Street North to the west. The existing site drains to the existing 375mm $\varnothing$  combined sewer along both King William Street as well as the existing 375mm $\varnothing$  combined sewer along Hughson Street North.

One catchment area, Catchment 101, has been identified in the existing condition. Catchment 101 represents the existing condition discharge for the entire site. See Table 2.1 below and the Existing Condition Drainage Area Plan in Appendix A for details.

Catchment ID	Description	Area (ha)	Percent Impervious	Run-off Coefficient
101	Entire Site	0.39	100%	0.93

An analysis was performed on Catchment 101 using the SWMHYMO hydrologic modeling program developed by J.F. Sabourin & Associates for the 2-year to 100-year City of Hamilton Mount Hope design storms. A summary of the results can be found in the Table 2.2 and detailed SWMHYMO input/output information can be found in Appendix B.

Storm Event	Catchment 101 Discharge (m <sup>3</sup> /s)
2-Yr Event	0.080
5-Yr Event	0.111
10-Yr Event	0.132
25-Yr Event	0.157
50-Yr Event	0.177
100-Yr Event	0.196

## 2.2 PROPOSED CONDITIONS

It is proposed to develop the site by constructing a two tower (25 and 34 storeys) mixed use condominium building with an underground parking structure and roof top amenity areas. The proposed site will be serviced by a private storm sewer system designed and constructed in accordance with the standards and specifications of the City of Hamilton.

One catchment area, Catchment 201, has been identified in the proposed condition. Catchment 201 represents drainage that is captured from the roof areas which will outlet via the proposed 375mm $\varnothing$  private storm sewer and discharge to the existing 375mm $\varnothing$  combined sewer along Hughson Street North. See Table 2.3 below and the Proposed Condition Drainage Area Plan in Appendix A for details.

Catchment ID	Description	Area (ha)	Percent Impervious	Run-off Coefficient
201	Uncontrolled to Carling Street	0.39	100%	0.95

An analysis was performed on the Proposed Condition site using the SWMHYMO hydrologic modeling program to determine the uncontrolled post-development flows. A summary of the results can be found in Table 2.4 and detailed SWMHYMO input/output information can be found in Appendix B.

Storm Event	Catchment 201 Discharge (m <sup>3</sup> /s)
2-Yr Event	0.080
5-Yr Event	0.111
10-Yr Event	0.132
25-Yr Event	0.157
50-Yr Event	0.177
100-Yr Event	0.196

### **Water Quantity Control**

It is proposed to apply quantity control measures to the runoff from Catchment 201 by means of a 165mmØ orifice plate to restrict discharge from the site to 0.080m<sup>3</sup>/s at the east invert of MH1. See the Preliminary Grading & Servicing Plan for orifice location.

With the installation of on-site quantity control measures for Catchment 201, it will be required to provide stormwater storage during storm events. Roof top storage could not be implemented for this development as the roof top amenity areas consume the majority of the roofs area. To provide the required storage, it is proposed to install a stormwater storage tank within the proposed underground parking structure. It is determined that a 2.0m-high watertight tank will be cast into the foundation wall of the building that will provide 111m<sup>3</sup> of storage which will accommodate the stormwater storage required during the 100-year event.

Preliminary details of the proposed storage tank can be found in the Preliminary Grading & Servicing Plan. The stage-storage-discharge characteristics can be seen in Table 2.5 below and Appendix A for details.

Storm Event	Underground Storage (m <sup>3</sup> )	Discharge (m <sup>3</sup> /s)
93.25 (Bottom of Tank)	0	0
93.75 (0.5m Depth)	28	0.0389
94.25 (1.0m Depth)	56	0.0559
94.75 (1.5m Depth)	83	0.0688
95.25 (Top of Tank)	111	0.0797

An analysis was performed on the Proposed Condition site using the SWMHYMO hydrologic modeling program to determine the required volume of stormwater storage required during the 2-year to 100-year City of Hamilton Mount Hope design storms. A summary of the results can be found in Table 2.6 and detailed SWMHYMO input/output information can be found in Appendix B.

Storm Event	Uncontrolled Discharge (m <sup>3</sup> /s)	Controlled Discharge (m <sup>3</sup> /s)	Allowable Discharge* (m <sup>3</sup> /s)	Required Storage (m <sup>3</sup> )
2-Yr	0.080	0.044	0.080	36.8
5-Yr	0.111	0.055	0.080	54.8
10-Yr	0.132	0.061	0.080	67.6
25-Yr	0.157	0.069	0.080	84.1
50-Yr	0.177	0.074	0.080	96.6
100-Yr	0.196	0.079	0.080	109.4

This analysis determined the following:

- The proposed condition discharge rates will not exceed the existing condition 2-year discharge rate of 0.080m<sup>3</sup>/s during the 2-year to 100-year design storms, with the installation of an orifice plate at the east invert of MH1.
- 109.4m<sup>3</sup> of stormwater storage is required during the 100-year event, which can be accommodated by the proposed storage tank having a volume of 111m<sup>3</sup>.

#### **Water Quality Control**

No stormwater quality control is required since the entire proposed site is roof top (clean water) runoff.

## **2.3 SEDIMENT AND EROSION CONTROL**

In order to minimize erosion during the grading and site servicing period of construction, the following measures will be implemented:

- Install silt fencing along the outer boundary of the site to ensure that sediment does not migrate to the adjacent properties;
- Install sediment control (silt sacks) in the proposed catchbasins as well as the nearby existing catchbasins to ensure that no untreated runoff enters the existing conveyance system
- Stabilize all disturbed or landscaped areas with hydro seeding/sodding to minimize the opportunity for erosion.

To ensure and document the effectiveness of the erosion and sediment control structures, an appropriate inspection and maintenance program is necessary. The program will include the following activities:

- Inspection of the erosion and sediment controls (e.g. silt fences, sediment traps, outlets, vegetation, etc.) with follow up reports to the governing municipality; and
- The developer and/or his contractor shall be responsible for any costs incurred during the remediation of problem areas.

Details of the proposed erosion & sediment control measures will be provided on the Erosion and Sediment Control Plans, which will be provided upon detailed design for Site Plan Approval.

## **3.0 SANITARY SEWER SERVICING**

### **3.1 EXISTING CONDITIONS**

The site is located at the corner of King Street East and Hughson Street North with an existing 375mm $\varnothing$  combined sewer located along Hughson Street North and an existing 375mm $\varnothing$  combined sewer located along King William Street.

### **3.2 SANITARY DEMAND**

The proposed development consists of a two tower (25 and 34 storeys) mixed use condominium building containing, 3 retail units and approximately 528 residential units. Wastewater generation for the site was calculated based on Table 8.2.1.3.A - Residential Occupancies and Table 8.2.1.3.B – Other Occupancies of the 2012 Ontario Plumbing Code.

Table 3.1 summarizes the sanitary sewer discharge rates from the proposed site. Sanitary discharge calculations will be confirmed upon completion of the Wastewater



Generation Assessment, which will be prepared as part of the Site Plan Approval process.

<b>Table 3.1 – Proposed Sanitary Sewer Discharge</b>	
Occupancy Type:	
One-Bedroom Units (2 Persons)	275 l/person/unit/day x 2 persons x 316 units <b>= 173,800 l/day.</b>
Two-Bedroom Units (3 Persons)	275 l/person/unit/day x 3 persons x 212 units <b>= 174,900 l/day.</b>
Retail	5 l/1.0m <sup>2</sup> /day x 1,460 m <sup>2</sup> = <b>7,300 l/day</b>
<b>Waste Generated (l/day):</b>	<b>356,000</b>
<b>Total Wastewater Estimate (l/s):</b>	<b>4.12</b>

Based on the above, the estimate of sanitary demand for the two tower (25 and 34 storeys) mixed use condominium building is:

$$4.12 \text{ L/s} = 0.00412 \text{ m}^3/\text{s}$$

### 3.3 PROPOSED SANITARY SERVICING AND CAPACITY ANALYSIS

The proposed mixed use condominium building will be serviced by a 200mm $\varnothing$  sanitary sewer, designed and constructed in accordance with City of Hamilton standards. Drainage from this sewer will discharge to the existing 375mm $\varnothing$  combined sewer adjacent to the site along Hughson Street North.

The minimum grade of the proposed 200mm $\varnothing$  sanitary sewer will be 1.0%. At this minimum grade, the proposed sanitary sewer will have a capacity of 0.033 m<sup>3</sup>/s (33 l/s). Therefore, the proposed 200mm $\varnothing$  sanitary sewer at 1.0% grade is adequately sized to service the proposed development.

## 4.0 DOMESTIC AND FIRE WATER SUPPLY SERVICING

### 4.1 EXISTING CONDITIONS

The existing municipal water distribution system consists of a 200mm $\varnothing$  watermain located along Hughson Street North and a 150mm $\varnothing$  watermain located along King William Street. Three existing fire hydrants are located within 15m of the proposed condominium building and are located on Hughson Street North and King William Street.

### 4.2 DOMESTIC WATER DEMAND

The following is an estimate of the water usage for the existing building. Water usage for the site was calculated based on the "Fixture Unit Method" as per Table 7.6.3.2.A. forming part of sentences 7.6.3.1(1) to (3) and 7.6.3.4.(2), (3) and (5) of the 2012 Ontario Building Code. See Table 4.1 for fixture unit (FU) calculations.

<b>Table 4.1 – Proposed Domestic Water Demand Fixture Unit Calculations Condominium Units</b>				
Component	No. of Fixtures/Unit	FU/ Fixture	No. of Units	Total FU
Lavatory (8.3L/min or less per head) (Private)*	1 2	0.7	316 212	221.2 296.8
Shower Head (9.5L/min or less per head) (Private)*	1 2	1.4	316 212	442.4 593.6
Water Closet (6 LPF or less with flush tank) (Private)*	1 2	2.2	316 212	695.2 932.8
Sink (kitchen, domestic, 8.3 L/min or less)*	1	1.4	528	739.2
Dishwasher (domestic)*	1	1.4	528	739.2
Clothes Washer (3.5 kg)*	1	1.4	528	739.2
<b>Total FU:</b>				<b>5399.6</b>
<b>Proposed Domestic Water Demand Fixture Unit Calculations Retail Units</b>				
Component	No. of Fixtures	FU/ Fixture	Total FU	
Lavatory (8.3L/min or less per head) (Private)*	4	0.7	2.8	
Water Closet (6 LPF or less with flush tank) (Private)*	4	2.2	8.8	
<b>Total FU:</b>				<b>11.6</b>

\*Number of fixtures are assumed and will be confirmed during the site approval process

$$5411.2\text{FU} = 543 \text{ IGPM (41.17 L/s)}$$

#### 4.3 FIRE FLOW DEMAND

Fire flow demands for development are governed by a number of guidelines and criteria, such as the Water Supply for Public Fire Protection (Fire Underwriters Survey, 1999), Ontario Building Code (OBC), and various codes and standards published by the National Fire Protection Association (NFPA).

At this stage of development, it is understood that the proposed two tower (25 and 34 storeys) mixed use building will be constructed of fire-resistive construction (C=0.6), with limited combustible occupancy (-15% correction) and a fully supervised sprinkler system (-50% correction).

The resulting required flow rate as determined in accordance with the Fire Underwriters Survey – 1999 Water Supply for Public Fire Protection, as specified by the City of Hamilton is **13,000 l/min (217 l/s)**. Refer to the Fire Flow Demand Requirements in Appendix C for calculations and details.

The following hydrant flow tests for the public fire hydrants in closest proximity to the proposed development has been analysed to determine if the municipal system adjacent to the subject site is adequate to provide the required fire flow, with a minimum pressure

of 20 psi. Table 4.2 below summarized the hydrant flow tests, provided by the City of Hamilton's Hansen System.

<b>Table 4.2 - Hydrant Flow Test Data</b>	
Hydrant ID	HA16H054
Location	HUGHSON ST N
Test Date (mm/dd/yyyy)	20-08-2015 6:00:31 AM
Static Pressure	74 psi
Residual Pressure During Test Flow	73 psi
Test Flow Rate	970 IGPM (73 l/s)
Theoretical Flow @ 20 psi	<b>8,361 IGPM (633 l/s)</b>
Hydrant ID	HA16H067
Location	HUGHSON ST N
Test Date (mm/dd/yyyy)	20-08-2015 7:54:05 AM
Static Pressure	70 psi
Residual Pressure During Test Flow	70 psi
Test Flow Rate	960 IGPM (70 l/s)
Theoretical Flow @ 20 psi	<b>N/A</b>
Hydrant ID	HA16H066
Location	KING WILLIAM ST
Test Date (mm/dd/yyyy)	26-08-2015 7:17:04 AM
Static Pressure	71 psi
Residual Pressure During Test Flow	70 psi
Test Flow Rate	1,060 IGPM (80 l/s)
Theoretical Flow @ 20 psi	<b>8,859 IGPM (671 l/s)</b>

Based on the above hydrant flow test data, the theoretical maximum available flow rate are **633 & 671 l/s at 20 psi**. Based on the complete gross floor area of the two tower (25 and 34 storeys) mixed use condominium building, the maximum required fire flow is **217 l/s**. Therefore, the water distribution system has adequate pressure and capacity to service the proposed development.

#### **4.4 PROPOSED WATER SERVICING AND ANALYSIS**

Proposed water servicing for the site consists of connecting a 200mmØ water service off of the existing 200mmØ adjacent to the site on Hughson Street North. The proposed 200mmØ water service will provide domestic and fire water service for the proposed mixed use condominium building. Water services for the site are to be designed and constructed in accordance with City of Hamilton standards.

## 5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided herein, it is concluded that the proposed development of 43-51 King Street East can be constructed to meet the requirements of the City of Hamilton. Therefore, it is recommended that:

- The development be graded and serviced in accordance with the Preliminary Grading & Servicing Plan prepared by S. Llewellyn & Associates Limited;
- A 165mmØ orifice plate be installed as per the Preliminary Grading & Servicing Plan and this report to provide adequate quantity control;
- An underground storage tank of approximately 111m<sup>3</sup> be incorporated into the underground parking garage of the proposed development as per the Preliminary Grading & Servicing Plan and this report to provide adequate stormwater storage during storm events;
- Erosion and sediment controls be installed as described in this report to meet City of Hamilton requirements;
- The proposed sanitary and water servicing system be installed as per the Preliminary Site Servicing Plan and this report to adequately service the proposed development.

We trust the information enclosed herein is satisfactory. Should you have any questions please do not hesitate to contact our office.

Prepared by:

**S. LLEWELLYN & ASSOCIATES LIMITED**



M. Colosimo, Dipl. T.



S. Frankovich, P.Eng.

---

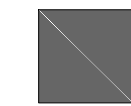
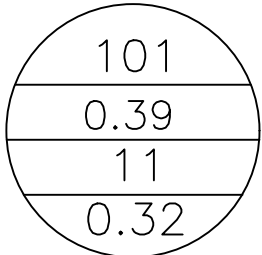
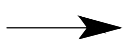
**APPENDIX A**

**STORMWATER MANAGEMENT INFORMATION**

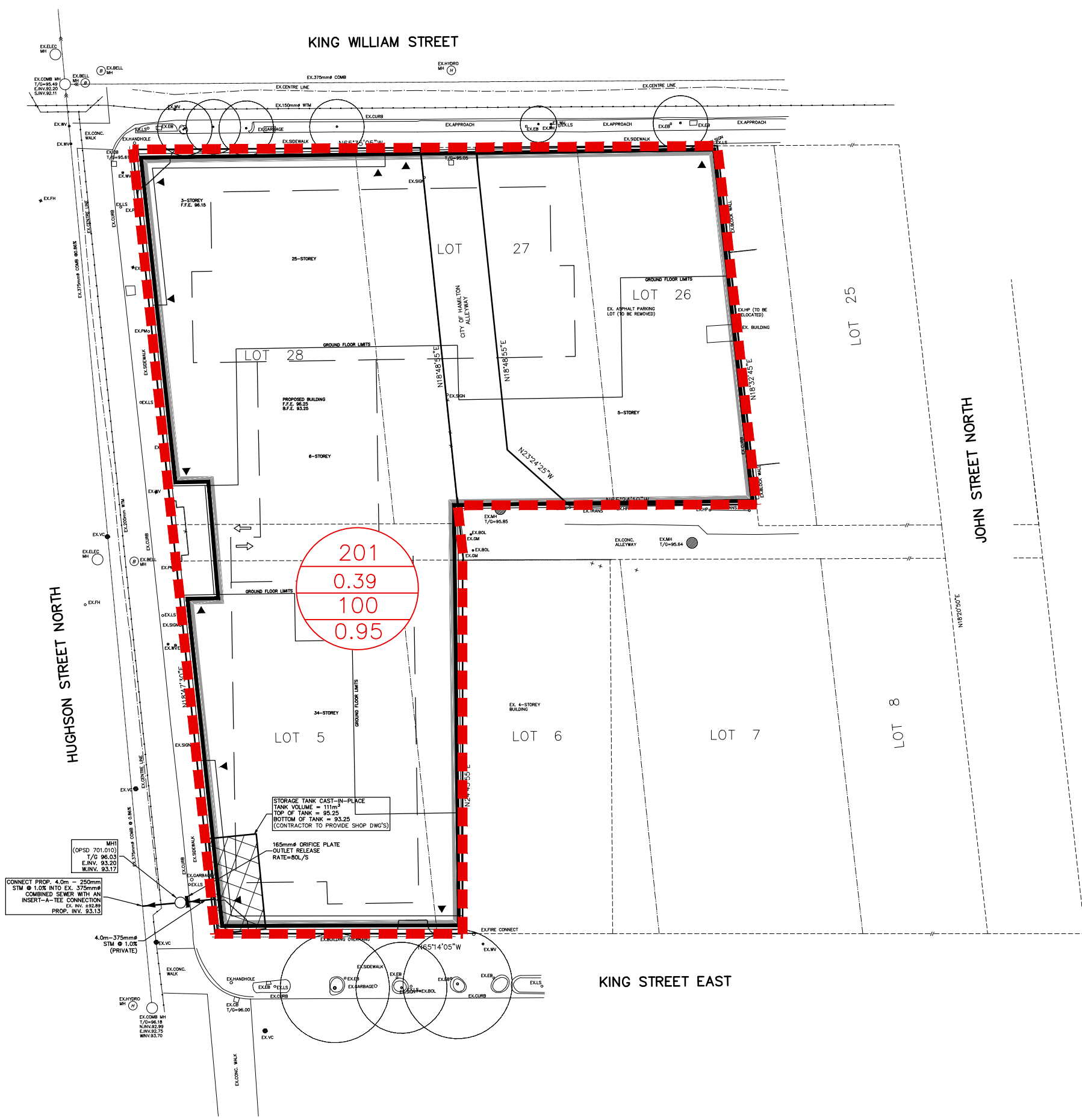
---



**LEGEND**

	PERVIOUS AREA
	DRAINAGE AREA I.D. DRAINAGE AREA (ha) PERCENT IMPERVIOUS RUNOFF COEFFICIENT
	DIRECTION OF SHEET FLOW

**FIGURE 1.0**  
**PRE-DEVELOPMENT STORM**  
**DRAINAGE AREA PLAN**  
 SCALE: 1:500  
 PROJECT: 43-51 KING STREET EAST  
 PROJECT No.: 17018



201
0.39
100
0.95

**LEGEND**

- PERVIOUS AREA
- DRAINAGE AREA I.D.  
DRAINAGE AREA (ha)  
PERCENT IMPERVIOUS  
RUNOFF COEFFICIENT
- DIRECTION OF SHEET FLOW

**FIGURE 2.0**  
**POST-DEVELOPMENT STORM**  
**DRAINAGE AREA PLAN**  
 SCALE: 1:500

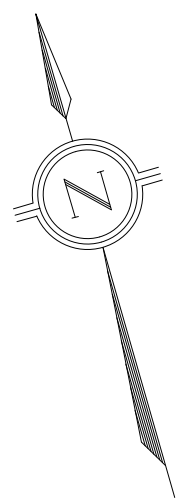
PROJECT: 43-51 KING STREET EAST  
 PROJECT No.: 17018



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## STAGE-STORAGE-DISCHARGE CALCULATIONS

### Outlet Device No. 1 (Quantity)

Type:	Orifice Plate
Diameter (mm)	165
Area (m <sup>2</sup> )	0.02138
Invert Elev. (m)	93.20
C/L Elev. (m)	93.28
Disch. Coeff. (C <sub>d</sub> )	0.6
Discharge (Q) =	$C_d A (2 g H)^{0.5}$
Number of Orifices:	1

	Elevation m	SWM Pond Volumes				Outlet No. 1		
		Area m <sup>2</sup>	Incremental Volume m <sup>3</sup>	Cumulative Volume m <sup>3</sup>	Total Active Storage Volume m <sup>3</sup>	H m	Discharge m <sup>3</sup> /s	Total Discharge m <sup>3</sup> /s
Orifice Invert	93.20				<b>0</b>	0.000	0.0000	<b>0.0000</b>
Bottom of Tank	93.25	0	0	0	<b>0</b>	0.000	0.0000	<b>0.0000</b>
0.5m Depth	93.75	56	28	28	<b>28</b>	0.468	0.0389	<b>0.0389</b>
1.0m Depth	94.25	56	28	56	<b>56</b>	0.968	0.0559	<b>0.0559</b>
1.5m Depth	94.75	56	28	83	<b>83</b>	1.468	0.0688	<b>0.0688</b>
Top of Tank	95.25	56	28	111	<b>111</b>	1.968	0.0797	<b>0.0797</b>



---

**APPENDIX B**

**SWMHYMO INPUT/OUTPUT INFORMATION**

---

2 Metric units

```

*#*****|
*# Project Name: 43-51 KING STREET EAST
*#           HAMILTON, ONTARIO
*# JOB NUMBER : 17018
*#   Date     : APRIL 2017
*#   Revised  :
*#   Company  : S. LLEWELLYN AND ASSOCIATES LTD.
*#   File     : 17018.DAT
*#*****|

```

```

*
START           TZERO=[0.0],  METOUT=[2],  NSTORM=[1],  NRUN=[002]
                MTH4002.stm

```

```

*
READ STORM      STORM_FILENAME "STORM.001"

```

```

*#*****|
*#
*#           PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#           =====
*#

```

```

*#*****|
*# CATCHMENT 101 - EXISTING CONDITION (OUTLETS TO JAMES STREET NORTH)
*

```

```

CALIB STANDHYD  ID=[1], NHYD=["101"], DT=[1](min), AREA=[0.39](ha),
                XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
                SCS curve number CN=[75],
                Pervious  surfaces: IAper=[8.47](mm), SLPP=[0.1](%),
                                   LGP=[0.1](m), MNP=[0.25], SCP=[0](min),
                Impervious surfaces: IAimp=[1](mm), SLPI=[1.7](%),
                                   LGI=[22](m), MNI=[0.015], SCI=[0](min),
                RAINFALL=[ , , , , ](mm/hr) , END=-1

```

```

*#*****|
*#
*#           POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#           =====
*#

```

```

*#*****|
*# CATCHMENT 201 - PROPOSED CONDITION (CONTROLLED DISCHARGE TO JAMES ST NORTH)
*

```

```

CALIB STANDHYD  ID=[2], NHYD=["201"], DT=[1](min), AREA=[0.39](ha),
                XIMP=[0.99], TIMP=[0.99], DWF=[0](cms), LOSS=[2],
                SCS curve number CN=[75],
                Pervious  surfaces: IAper=[8.47](mm), SLPP=[0.1](%),
                                   LGP=[0.1](m), MNP=[0.250], SCP=[0](min)
                Impervious surfaces: IAimp=[1.0](mm), SLPI=[2.0](%),
                                   LGI=[15](m), MNI=[0.015], SCI=[0](min),
                RAINFALL=[ , , , , ](mm/hr) , END=-1

```

```

*%-----|-----|
ROUTE RESERVOIR IDout=[3],  NHYD=["201"],  IDin=[2],
                RDT=[1](min),

```

TABLE of ( OUTFLOW-STORAGE ) values  
(cms) - (ha-m)

0.0	0.0
0.0389	0.0028
0.0559	0.0056
0.0688	0.0083
0.0797	0.0111
-1	-1 (max twenty pts)

```

                IDovf=[4], NHYDovf=["OVF"]

```

```

*%-----|-----|
* RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)

```

\*  
START                   TZERO=[0.0],   METOUT=[2],   NSTORM=[1],   NRUN=[005]  
                          MTH4005.stm

\*  
START                   TZERO=[0.0],   METOUT=[2],   NSTORM=[1],   NRUN=[010]  
                          MTH4010.stm

\*  
START                   TZERO=[0.0],   METOUT=[2],   NSTORM=[1],   NRUN=[025]  
                          MTH4025.stm

\*  
START                   TZERO=[0.0],   METOUT=[2],   NSTORM=[1],   NRUN=[050]  
                          MTH4050.stm

\*  
START                   TZERO=[0.0],   METOUT=[2],   NSTORM=[1],   NRUN=[100]  
                          MTH4100.stm

\*  
\*%-----|-----|  
FINISH



```

*****
*
005:0002
*
| READ STORM | Filename: 5-YR MT. HOPE (A=1049.5 B=8 C=0.803)
| Ptotal= 50.14 mm | Comments: 5-YR MT. HOPE (A=1049.5 B=8 C=0.803)
*
  TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
  hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
  .17 3.196 | 1.17 28.027 | 2.17 8.084 | 3.17 3.885
  .33 3.691 | 1.33 103.038 | 2.33 6.801 | 3.33 3.593
  .50 4.393 | 1.50 36.919 | 2.50 5.885 | 3.50 3.344
  .67 5.470 | 1.67 19.516 | 2.67 5.198 | 3.67 3.130
  .83 7.347 | 1.83 13.211 | 2.83 4.664 | 3.83 2.945
  1.00 11.470 | 2.00 10.009 | 3.00 4.236 | 4.00 2.782

```

```

005:0003
*
*****
*#
*# PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#
*#
*# *****
*# CATCHMENT 101 - EXISTING CONDITION (OUTLETS TO JAMES STREET NORTH)
*#

```

```

| CALIB STANDHYD | Area (ha)= .39
| 01:101 DT= 1.00 | Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00
*
  IMPERVIOUS PERVIOUS (i)
  Surface Area (ha)= .39 .00
  Dep. Storage (mm)= 1.00 8.47
  Average Slope (%)= 1.70 .10
  Length (m)= 22.00 .10
  Mannings n = .015 .250
*
  Max.eff.Inten.(mm/hr)= 103.04 32.37
  over (min) 1.00 2.00
  Storage Coeff. (min)= .95 (ii) 1.69 (ii)
  Unit Hyd. Tpeak (min)= 1.00 2.00
  Unit Hyd. peak (cms)= 1.11 .62
*
  PEAK FLOW (cms)= .11 .00 .111 (iii)
  TIME TO PEAK (hrs)= 1.33 1.33 1.333
  RUNOFF VOLUME (mm)= 49.14 13.74 48.785
  TOTAL RAINFALL (mm)= 50.14 50.14 50.139
  RUNOFF COEFFICIENT = .98 .27 .973
*
  (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
  CN* = 75.0 Ia = Dep. Storage (Above)
  (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
  THAN THE STORAGE COEFFICIENT.
  (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

```

005:0004
*
*****
*#
*# POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#
*#
*# *****
*# CATCHMENT 201 - PROPOSED CONDITION (CONTROLLED DISCHARGE TO JAMES ST NORTH)
*#

```

```

| CALIB STANDHYD | Area (ha)= .39
| 02:201 DT= 1.00 | Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00
*
  IMPERVIOUS PERVIOUS (i)
  Surface Area (ha)= .39 .00
  Dep. Storage (mm)= 1.00 8.47
  Average Slope (%)= 2.00 .10
  Length (m)= 15.00 .10
  Mannings n = .015 .250
*
  Max.eff.Inten.(mm/hr)= 103.04 33.56
  over (min) 1.00 2.00
  Storage Coeff. (min)= .72 (ii) 1.45 (ii)
  Unit Hyd. Tpeak (min)= 1.00 1.00
  Unit Hyd. peak (cms)= 1.28 .85
*
  PEAK FLOW (cms)= .11 .00 .111 (iii)
  TIME TO PEAK (hrs)= 1.33 1.33 1.333
  RUNOFF VOLUME (mm)= 49.14 13.74 48.785
  TOTAL RAINFALL (mm)= 50.14 50.14 50.139
  RUNOFF COEFFICIENT = .98 .27 .973
*
  (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
  CN* = 75.0 Ia = Dep. Storage (Above)
  (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
  THAN THE STORAGE COEFFICIENT.
  (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

```

005:0005
*
*****
*#
*# POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#
*#
*# *****
*# CATCHMENT 201 - PROPOSED CONDITION (CONTROLLED DISCHARGE TO JAMES ST NORTH)
*#
  Requested routing time step = 1.0 min.
  ===== OUTFLOW STORAGE TABLE =====
  OUTFLOW STORAGE | OUTFLOW STORAGE
  (cms) (ha.m.) | (cms) (ha.m.)
  .000 .000E+00 | .069 .830E+02
  .039 .280E+02 | .080 .111E+01
  .056 .560E+02 | .000 .000E+00
*
  ROUTING RESULTS AREA QPEAK TPEAK R.V.
  (ha) (cms) (hrs) (mm)
  INFLOW >02: (201 ) .39 .111 1.333 48.785
  OUTFLOW<03: (201 ) .39 .055 1.350 48.785
  OVERFLOW<04: (OVF ) .00 .000 .000 .000
*
  TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
  CUMULATIVE TIME OF OVERFLOWS (hours) = .00
  PERCENTAGE OF TIME OVERFLOWING (%) = .00

```

```

PEAK FLOW REDUCTION [Qout/Qin](%)= 49.749
TIME SHIFT OF PEAK FLOW (min)= 1.00
MAXIMUM STORAGE USED (ha.m.)= 5482E-02

```

```

005:0006
*
* RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
*
005:0002
*
** END OF RUN : 9

```

```

| START | Project dir.: T:\PROJECTS\17018\SWMHYMO\
| Rainfall dir.: T:\PROJECTS\17018\SWMHYMO\
*
TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 010
NSTORM= 1
# 1-MTH4010.stm

```

```

010:0002
*
*****
*# Project Name: 43-51 KING STREET EAST
*# HAMILTON, ONTARIO
*# JOB NUMBER : 17018
*# Date : APRIL 2017
*# Revised :
*# Company : S. LLEWELLYN AND ASSOCIATES LTD.
*# File : 17018.DAT
*#

```

```

010:0002
*
| READ STORM | Filename: 10-YR MT. HOPE (A=1343.7 B=9 C=0.814)
| Ptotal= 60.22 mm | Comments: 10-YR MT. HOPE (A=1343.7 B=9 C=0.814)
*
  TIME RAIN | TIME RAIN | TIME RAIN | TIME RAIN
  hrs mm/hr | hrs mm/hr | hrs mm/hr | hrs mm/hr
  .17 3.725 | 1.17 34.487 | 2.17 9.714 | 3.17 4.557
  .33 4.322 | 1.33 122.292 | 2.33 8.126 | 3.33 4.203
  .50 5.173 | 1.50 45.465 | 2.50 6.998 | 3.50 3.903
  .67 6.489 | 1.67 23.981 | 2.67 6.156 | 3.67 3.646
  .83 8.802 | 1.83 16.104 | 2.83 5.503 | 3.83 3.423
  1.00 13.931 | 2.00 12.108 | 3.00 4.982 | 4.00 3.228

```

```

010:0003
*
*****
*#
*# PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#
*#
*# *****
*# CATCHMENT 101 - EXISTING CONDITION (OUTLETS TO JAMES STREET NORTH)
*#

```

```

| CALIB STANDHYD | Area (ha)= .39
| 01:101 DT= 1.00 | Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00
*
  IMPERVIOUS PERVIOUS (i)
  Surface Area (ha)= .39 .00
  Dep. Storage (mm)= 1.00 8.47
  Average Slope (%)= 1.70 .10
  Length (m)= 22.00 .10
  Mannings n = .015 .250
*
  Max.eff.Inten.(mm/hr)= 122.29 46.21
  over (min) 1.00 2.00
  Storage Coeff. (min)= .88 (ii) 1.53 (ii)
  Unit Hyd. Tpeak (min)= 1.00 2.00
  Unit Hyd. peak (cms)= 1.15 .66
*
  PEAK FLOW (cms)= .13 .00 .132 (iii)
  TIME TO PEAK (hrs)= 1.33 1.33 1.333
  RUNOFF VOLUME (mm)= 59.22 19.63 58.823
  TOTAL RAINFALL (mm)= 60.22 60.22 60.219
  RUNOFF COEFFICIENT = .98 .33 .977
*
  (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
  CN* = 75.0 Ia = Dep. Storage (Above)
  (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
  THAN THE STORAGE COEFFICIENT.
  (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

```

010:0004
*
*****
*#
*# POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#
*#
*# *****
*# CATCHMENT 201 - PROPOSED CONDITION (CONTROLLED DISCHARGE TO JAMES ST NORTH)
*#

```

```

| CALIB STANDHYD | Area (ha)= .39
| 02:201 DT= 1.00 | Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00
*
  IMPERVIOUS PERVIOUS (i)
  Surface Area (ha)= .39 .00
  Dep. Storage (mm)= 1.00 8.47
  Average Slope (%)= 2.00 .10
  Length (m)= 15.00 .10
  Mannings n = .015 .250
*
  Max.eff.Inten.(mm/hr)= 122.29 47.65
  over (min) 1.00 1.00
  Storage Coeff. (min)= .67 (ii) 1.31 (ii)
  Unit Hyd. Tpeak (min)= 1.00 1.00

```

```

Unit Hyd. peak (cms)=      1.32      .91
PEAK FLOW (cms)=          .13      .00
TIME TO PEAK (hrs)=       1.33      1.33
RUNOFF VOLUME (mm)=       59.22     19.63
TOTAL RAINFALL (mm)=     60.22     60.22
RUNOFF COEFFICIENT =      .98      .33
*TOTALS*
                          .132 (iii)
(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 75.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
    THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

010:0005

```

ROUTE RESERVOIR
IN>02:(201 )
OUT<03:(201 )
Requested routing time step = 1.0 min.
===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE OUTFLOW STORAGE
(cms) (ha.m.) (cms) (ha.m.)
.000 .0000E+00 .069 .8300E-02
.039 .2800E-02 .080 .1110E-01
.056 .5600E-02 .000 .0000E+00
ROUTING RESULTS AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW >02: (201 ) .39 .132 1.333 58.823
OUTFLOW<03: (201 ) .39 .061 1.350 58.823
OVERFLOW<04: (OVF ) .00 .000 .000 .000
TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
CUMULATIVE TIME OF OVERFLOWS (hours)= .00
PERCENTAGE OF TIME OVERFLOWING (%)= .00
PEAK FLOW REDUCTION [Qout/Qin](%)= 46.609
TIME SHIFT OF PEAK FLOW (min)= 1.00
MAXIMUM STORAGE USED (ha.m.)=.6761E-02

```

010:0006

\* RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)

010:0002

010:0002

\*\* END OF RUN : 24

```

START Project dir.: T:\PROJECTS\17018\SWMHYMO\
Rainfall dir.: T:\PROJECTS\17018\SWMHYMO\
TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 025
NSTORM= 1
# 1=MTH4025.stm

```

025:0002

```

Project Name: 43-51 KING STREET EAST
Project NUMBER : 17018
Date : APRIL 2017
Revised :
Company : S. LLEWELLYN AND ASSOCIATES LTD.
File : 17018.DAT

```

025:0002

```

READ STORM Filename: 25-YR MT. HOPE (A=1719.5 B=10 C=0.823)
Ptotal= 73.09 mm Comments: 25-YR MT. HOPE (A=1719.5 B=10 C=0.823)
TIME RAIN TIME RAIN TIME RAIN TIME RAIN
hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr
.17 4.422 1.17 42.745 2.17 11.847 3.17 5.440
.33 5.152 1.33 146.101 2.33 9.863 3.33 5.006
.50 6.198 1.50 56.322 2.50 8.458 3.50 4.639
.67 7.827 1.67 29.752 2.67 7.413 3.67 4.326
.83 10.708 1.83 19.870 2.83 6.605 3.83 4.055
1.00 17.140 2.00 14.849 3.00 5.963 4.00 3.818

```

025:0003

```

PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
=====

```

\* CATCHMENT 101 - EXISTING CONDITION (OUTLETS TO JAMES STREET NORTH)

```

CALIB STANDHYD Area (ha)= .39
01:101 DT= 1.00 Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00

```

```

Surface Area (ha)= .39 .00
Dep. Storage (mm)= 1.00 8.47
Average Slope (%)= 1.70 .10
Length (m)= 22.00 .10
Mannings n = .015 .250
Max.eff.Inten.(mm/hr)= 146.10 66.94
over (min) 1.00 1.00
Storage Coeff. (min)= .82 (ii) 1.38 (ii)

```

```

Unit Hyd. Tpeak (min)= 1.00 1.00
Unit Hyd. peak (cms)= 1.20 .88
*TOTALS*
PEAK FLOW (cms)= .16 .00 .157 (iii)
TIME TO PEAK (hrs)= 1.33 1.33 1.333
RUNOFF VOLUME (mm)= 72.09 27.97 71.645
TOTAL RAINFALL (mm)= 73.09 73.09 73.086
RUNOFF COEFFICIENT = .99 .38 .980
(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 75.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
    THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

025:0004

```

POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
=====
CATCHMENT 201 - PROPOSED CONDITION (CONTROLLED DISCHARGE TO JAMES ST NORTH)

```

```

CALIB STANDHYD Area (ha)= .39
02:201 DT= 1.00 Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00

```

```

IMPERVIOUS PERVIOUS (i)
Surface Area (ha)= .39 .00
Dep. Storage (mm)= 1.00 8.47
Average Slope (%)= 2.00 .10
Length (m)= 15.00 .10
Mannings n = .015 .250
Max.eff.Inten.(mm/hr)= 146.10 66.94
over (min) 1.00 1.00
Storage Coeff. (min)= .62 (ii) 1.18 (ii)
Unit Hyd. Tpeak (min)= 1.00 1.00
Unit Hyd. peak (cms)= 1.36 .97
*TOTALS*
PEAK FLOW (cms)= .16 .00 .157 (iii)
TIME TO PEAK (hrs)= 1.32 1.33 1.333
RUNOFF VOLUME (mm)= 72.09 27.97 71.645
TOTAL RAINFALL (mm)= 73.09 73.09 73.086
RUNOFF COEFFICIENT = .99 .38 .980

```

```

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 75.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
    THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

025:0005

```

ROUTE RESERVOIR
IN>02:(201 )
OUT<03:(201 )
Requested routing time step = 1.0 min.
===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE OUTFLOW STORAGE
(cms) (ha.m.) (cms) (ha.m.)
.000 .0000E+00 .069 .8300E-02
.039 .2800E-02 .080 .1110E-01
.056 .5600E-02 .000 .0000E+00
ROUTING RESULTS AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW >02: (201 ) .39 .157 1.333 71.645
OUTFLOW<03: (201 ) .39 .069 1.367 71.645
OVERFLOW<04: (OVF ) .00 .000 .000 .000
TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
CUMULATIVE TIME OF OVERFLOWS (hours)= .00
PERCENTAGE OF TIME OVERFLOWING (%)= .00
PEAK FLOW REDUCTION [Qout/Qin](%)= 43.938
TIME SHIFT OF PEAK FLOW (min)= 2.00
MAXIMUM STORAGE USED (ha.m.)=.8405E-02

```

025:0002

```

Project Name: 43-51 KING STREET EAST
Project NUMBER : 17018
Date : APRIL 2017
Revised :
Company : S. LLEWELLYN AND ASSOCIATES LTD.
File : 17018.DAT

```

025:0002

```

READ STORM Filename: 25-YR MT. HOPE (A=1719.5 B=10 C=0.823)
Ptotal= 73.09 mm Comments: 25-YR MT. HOPE (A=1719.5 B=10 C=0.823)
TIME RAIN TIME RAIN TIME RAIN TIME RAIN
hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/hr
.17 4.422 1.17 42.745 2.17 11.847 3.17 5.440
.33 5.152 1.33 146.101 2.33 9.863 3.33 5.006
.50 6.198 1.50 56.322 2.50 8.458 3.50 4.639
.67 7.827 1.67 29.752 2.67 7.413 3.67 4.326
.83 10.708 1.83 19.870 2.83 6.605 3.83 4.055
1.00 17.140 2.00 14.849 3.00 5.963 4.00 3.818

```

025:0003

```

PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
=====

```

\* CATCHMENT 101 - EXISTING CONDITION (OUTLETS TO JAMES STREET NORTH)

```

CALIB STANDHYD Area (ha)= .39
01:101 DT= 1.00 Total Imp(%)= 99.00 Dir. Conn.(%)= 99.00

```

```

Surface Area (ha)= .39 .00
Dep. Storage (mm)= 1.00 8.47
Average Slope (%)= 1.70 .10
Length (m)= 22.00 .10
Mannings n = .015 .250
Max.eff.Inten.(mm/hr)= 146.10 66.94
over (min) 1.00 1.00
Storage Coeff. (min)= .82 (ii) 1.38 (ii)

```

```

*****
*
*
050:0002
*
-----
| READ STORM | Filename: 50-YR MT. HOPE (A=1954.8 B=10 C=0.826)
| Ptotal= 81.72 mm | Comments: 50-YR MT. HOPE (A=1954.8 B=10 C=0.826)
-----

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	4.881	1.17	47.876	2.17	13.160	3.17	6.012
.33	5.692	1.33	164.608	2.33	10.942	3.33	5.529
.50	6.856	1.50	63.166	2.50	9.374	3.50	5.122
.67	8.670	1.67	33.244	2.67	8.209	3.67	4.774
.83	11.887	1.83	22.146	2.83	7.309	3.83	4.473
1.00	19.086	2.00	16.518	3.00	6.594	4.00	4.210

```

050:0003
*
*****
*#
*# PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#
*#
*****
*# CATCHMENT 101 - EXISTING CONDITION (OUTLETS TO JAMES STREET NORTH)
*#

```

CALIB STANDHYD	Area (ha)=	Dir. Conn.(%)=
01:101 DT= 1.00	.39	99.00
Total Imp(%)= 99.00		
IMPERVIOUS PERVIOUS (i)		
Surface Area (ha)=	.39	.00
Dep. Storage (mm)=	1.00	8.47
Average Slope (%)=	1.70	.10
Length (m)=	22.00	.10
Mannings n =	.015	.250
Max. eff. Inten. (mm/hr)=	164.61	82.31
over (min)	1.00	1.00
Storage Coeff. (min)=	.78 (ii)	1.30 (ii)
Unit Hyd. Tpeak (min)=	1.00	1.00
Unit Hyd. peak (cms)=	1.22	.91
*TOTALS*		
PEAK FLOW (cms)=	.18	.00
TIME TO PEAK (hrs)=	1.33	1.333
RUNOFF VOLUME (mm)=	80.72	33.98
TOTAL RAINFALL (mm)=	81.72	81.723
RUNOFF COEFFICIENT =	.99	.982

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 75.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

050:0004
*
*****
*#
*# POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#
*#
*****
*# CATCHMENT 201 - PROPOSED CONDITION (CONTROLLED DISCHARGE TO JAMES ST NORTH)
*#

```

CALIB STANDHYD	Area (ha)=	Dir. Conn.(%)=
02:201 DT= 1.00	.39	99.00
Total Imp(%)= 99.00		
IMPERVIOUS PERVIOUS (i)		
Surface Area (ha)=	.39	.00
Dep. Storage (mm)=	1.00	8.47
Average Slope (%)=	2.00	.10
Length (m)=	15.00	.10
Mannings n =	.015	.250
Max. eff. Inten. (mm/hr)=	164.61	82.31
over (min)	1.00	1.00
Storage Coeff. (min)=	.59 (ii)	1.11 (ii)
Unit Hyd. Tpeak (min)=	1.00	1.00
Unit Hyd. peak (cms)=	1.38	1.01
*TOTALS*		
PEAK FLOW (cms)=	.18	.00
TIME TO PEAK (hrs)=	1.32	1.33
RUNOFF VOLUME (mm)=	80.72	33.98
TOTAL RAINFALL (mm)=	81.72	81.723
RUNOFF COEFFICIENT =	.99	.982

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 75.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

050:0005
-----
| ROUTE RESERVOIR | Requested routing time step = 1.0 min.
| IN>02:(201 ) |
| OUT<03:(201 ) |
-----
===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE | OUTFLOW STORAGE
(cms) (ha.m.) | (cms) (ha.m.)
.000 .000E+00 | .059 .830E-02
.039 .280E-02 | .080 .111E-01
.056 .560E-02 | .000 .000E+00
-----
ROUTING RESULTS | AREA | QPEAK | TPEAK | R.V.
----- | (ha) | (cms) | (hrs) | (mm)
INFLOW >02:(201 ) | .39 | .177 | 1.333 | 80.256
OUTFLOW <03:(201 ) | .39 | .074 | 1.367 | 80.255
OVERFLOW <04:(OVF ) | .00 | .000 | .000 | .000
-----
TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
CUMULATIVE TIME OF OVERFLOWS (hours) = .00
PERCENTAGE OF TIME OVERFLOWING (%) = .00

```

```

PEAK FLOW REDUCTION [Qout/Qin](%)= 41.744
TIME SHIFT OF PEAK FLOW (min)= 2.00
MAXIMUM STORAGE USED (ha.m.)= .9657E-02

```

```

050:0006
* RUN REMAINING DESIGN STORMS (HAMILTON MOUNT HOPE 5 TO 100-YR)
*

```

TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	hrs	mm/hr	hrs	mm/hr
.17	4.881	1.17	47.876	2.17	13.160	3.17	6.012
.33	5.692	1.33	164.608	2.33	10.942	3.33	5.529
.50	6.856	1.50	63.166	2.50	9.374	3.50	5.122
.67	8.670	1.67	33.244	2.67	8.209	3.67	4.774
.83	11.887	1.83	22.146	2.83	7.309	3.83	4.473
1.00	19.086	2.00	16.518	3.00	6.594	4.00	4.210

```

050:0002
*
** END OF RUN : 99

```

```

| START | Project dir.: T:\PROJECTS\17018\SWMHYMO\
| | Rainfall dir.: T:\PROJECTS\17018\SWMHYMO\
TZERO = .00 hrs on 0
METOUT= 2 (output = METRIC)
NRUN = 100
NSTORM= 1
# 1-MTH4100.stm

```

```

100:0002
*****
*# Project Name: 43-51 KING STREET EAST
*# HAMILTON, ONTARIO
*# JOB NUMBER : 17018
*# Date : APRIL 2017
*# Revised :
*# Company : S. LLEWELLYN AND ASSOCIATES LTD.
*# File : 17018.DAT
*#

```

CALIB STANDHYD	Area (ha)=	Dir. Conn.(%)=
01:101 DT= 1.00	.39	99.00
Total Imp(%)= 99.00		
IMPERVIOUS PERVIOUS (i)		
Surface Area (ha)=	.39	.00
Dep. Storage (mm)=	1.00	8.47
Average Slope (%)=	1.70	.10
Length (m)=	22.00	.10
Mannings n =	.015	.250
Max. eff. Inten. (mm/hr)=	164.61	82.31
over (min)	1.00	1.00
Storage Coeff. (min)=	.78 (ii)	1.30 (ii)
Unit Hyd. Tpeak (min)=	1.00	1.00
Unit Hyd. peak (cms)=	1.22	.91
*TOTALS*		
PEAK FLOW (cms)=	.18	.00
TIME TO PEAK (hrs)=	1.33	1.333
RUNOFF VOLUME (mm)=	80.72	33.98
TOTAL RAINFALL (mm)=	81.72	81.723
RUNOFF COEFFICIENT =	.99	.982

```

100:0003
*
*****
*#
*# PRE-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#
*#
*****
*# CATCHMENT 101 - EXISTING CONDITION (OUTLETS TO JAMES STREET NORTH)
*#

```

CALIB STANDHYD	Area (ha)=	Dir. Conn.(%)=
01:101 DT= 1.00	.39	99.00
Total Imp(%)= 99.00		
IMPERVIOUS PERVIOUS (i)		
Surface Area (ha)=	.39	.00
Dep. Storage (mm)=	1.00	8.47
Average Slope (%)=	1.70	.10
Length (m)=	22.00	.10
Mannings n =	.015	.250
Max. eff. Inten. (mm/hr)=	164.61	82.31
over (min)	1.00	1.00
Storage Coeff. (min)=	.75 (ii)	1.23 (ii)
Unit Hyd. Tpeak (min)=	1.00	1.00
Unit Hyd. peak (cms)=	1.25	.94
*TOTALS*		
PEAK FLOW (cms)=	.19	.00
TIME TO PEAK (hrs)=	1.33	1.333
RUNOFF VOLUME (mm)=	90.37	41.01
TOTAL RAINFALL (mm)=	91.37	91.372
RUNOFF COEFFICIENT =	.99	.984

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 75.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

```

100:0004
*****
*#
*# POST-DEVELOPMENT CONDITIONS HYDROLOGIC MODELING
*#
*#
*****
*# CATCHMENT 201 - PROPOSED CONDITION (CONTROLLED DISCHARGE TO JAMES ST NORTH)
*#

```

CALIB STANDHYD	Area (ha)=	Dir. Conn.(%)=
02:201 DT= 1.00	.39	99.00
Total Imp(%)= 99.00		
IMPERVIOUS PERVIOUS (i)		
Surface Area (ha)=	.39	.00

```

Dep. Storage (mm)= 1.00 8.47
Average Slope (%)= 2.00 .10
Length (m)= 15.00 .10
Mannings n = .015 .250

Max. eff. Inten. (mm/hr)= 181.81 97.96
over (min)= 1.00 1.00
Storage Coeff. (min)= .57 (ii) 1.05 (ii)
Unit Hyd. Tpeak (min)= 1.00 1.00
Unit Hyd. peak (cms)= 1.40 1.04

PEAK FLOW (cms)= .19 .00 *TOTALS*
TIME TO PEAK (hrs)= 1.32 1.33 .196 (iii)
RUNOFF VOLUME (mm)= 90.37 41.01 89.879
TOTAL RAINFALL (mm)= 91.37 91.37 91.372
RUNOFF COEFFICIENT = .99 .45 .984

```

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:  
CN\* = 75.0 Ia = Dep. Storage (Above)
- (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL  
THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

100:0005

```

-----
ROUTE RESERVOIR Requested routing time step = 1.0 min.
IN<02:(201 )
OUT<03:(201 )
===== OUTFLOW STORAGE TABLE =====
OUTFLOW STORAGE OUTFLOW STORAGE
(cms) (ha.m.) (cms) (ha.m.)
.000 .0000E+00 .069 .8300E-02
.039 .2800E-02 .080 .1110E-01
.056 .5600E-02 .000 .0000E+00

```

```

ROUTING RESULTS AREA QPEAK TPEAK R.V.
(ha) (cms) (hrs) (mm)
INFLOW >02: (201 ) .39 .196 1.333 89.879
OUTFLOW<03: (201 ) .39 .079 1.383 89.879
OVERFLOW<04: (OVF ) .00 .000 .000 .000

```

```

TOTAL NUMBER OF SIMULATED OVERFLOWS = 0
CUMULATIVE TIME OF OVERFLOWS (hours)= .00
PERCENTAGE OF TIME OVERFLOWING (%)= .00

```

```

PEAK FLOW REDUCTION [Qout/Qin](%)= 40.343
TIME SHIFT OF PEAK FLOW (min)= 3.00
MAXIMUM STORAGE USED (ha.m.)=.1094E-01

```

100:0006

\* RUN REMAINING DESIGN STORMS (HAMIL/TON MOUNT HOPE 5 TO 100-YR)

100:0002

100:0002

100:0002

100:0002

100:0002

FINISH

WARNINGS / ERRORS / NOTES

Simulation ended on 2017-04-10 at 08:47:47



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**APPENDIX C**

**WATER ANALYSIS INFORMATION**

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**FIRE FLOW DEMAND REQUIREMENTS - FIRE UNDERWRITERS SURVEY (FUS GUIDELINES)**

**Project Number:** 17018  
**Project Name:** 43-51 King Street East  
**Date:** 09-Apr-17

Fire flow demands for the FUS method is based on information and guidance provided in "Water Supply for Public Protection" (Fire Underwriters Survey, 1999).

An estimate of the fire flow required is given by the following formula:

$$F = 220 C \sqrt{A} \quad (1)$$

where:

F = the required fire flow in litres per minute  
 C = coefficient related to the type of construction  
 = 1.5 for wood frame construction (structure essentially all combustible).  
 = 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)  
 = 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls)  
 = 0.6 for fire-resistive construction (fully protected frame, floors, roof)  
 A = Total floor area in square metres

Building / Location	Building Area			Type of Construction	(1)		(2)			(3)		(4)		Final Adjusted Fire Flow	
	Footprint Area (m <sup>2</sup> )	# of Storeys	Total GFA (m <sup>2</sup> )		Fire Flow "F"		Occupancy			Sprinkler		Exposure		(l/min)	(l/s)
					(l/min)	(l/s)	%	Adjustment (l/min)	Adjusted Fire Flow (l/min)	%	Adjustment (l/min)	%	Adjustment (l/min)		
<b>43-51 King Street East</b>	<b>10311.7</b>	<b>1</b>	<b>10311.7</b>	<b>0.6</b>	13000	216.7	<b>-15</b>	-1950.0	<b>11050.0</b>	<b>-50</b>	-5525.0	70	7735.0	<b>13000</b>	<b>217</b>

<u>Total Area Calculation:</u>	<u>Floor</u>	<u>Area</u>	<u>Tot. Area</u>	<u>Cumm. Area</u>	<u>Floor</u>	<u>Area</u>	<u>Tot. Area</u>	<u>Cumm. Area</u>
Two largest adjoining floors plus 50% of any floors immediately above them up to eight floors	1	2090.17	2090.17	2090.2	6	2013.79	1006.895	7404.5
	2	1919.47	1919.47	4009.6	7-10	1453.58	2907.16	10311.7
	3	1399.64	699.82	4709.5				
	4-5	1688.17	1688.17	6397.6				

<u>(2) Occupancy</u>		<u>(3) Sprinkler</u>
Non-Combustible	-25%	Minimum credit for systems designed to NFPA 13 is 30%.
Limited Combustible	-15%	
Combustible	No charge	If the domestic and fire services are supplied by the same municipal water system, then take an additional 10%.
Free Burning	15%	
Rapid Burning	25%	If the sprinkler system is fully supervised (ie. annunciator panel that alerts the Fire Dept., such as a school), then an additional 10% can be taken. Maximum credit = 50%.

<u>(4) Exposure</u>		Side	Exposure (m)	Charge (%)
0 to 3m	25%	North =	<b>±15</b>	<b>15</b>
3.1 to 10m	20%	South =	<b>±20</b>	<b>15</b>
10.1 to 20m	15%	East =	<b>0</b>	<b>25</b>
20.1 to 30m	10%	West =	<b>±12</b>	<b>15</b>
30.1 to 45m	5%	<b>Total Exposure =</b>		<b>70</b>