



UCC File: 1124

PRELIMINARY FUNCTIONAL SERVICING REPORT

**1 GRIFFITH STREET
CITY OF WELLAND
May 2026**

INTRODUCTION

The purpose of this Preliminary Functional Servicing Report (FSR) is to address the municipal servicing requirements for the proposed condominium development located at 1 Griffith Street in the City of Welland in support of the current application for Official Plan and Zoning Bylaw Amendment.

The current designation for the property in the City of Welland Official Plan (Exemption 4.2.3.20.E) permits a 12-storey, 70 unit apartment. The subject lands are designated as High Density Residential (RH-64).

The subject lands are approximately 0.37 hectares and is proposed to consist of a 12-storey condominium building housing a total of 144 apartment units.

The subject lands will be developed to include associated asphalt parking lot, underground parking, concrete curb, concrete sidewalk, catch basins, storm servicing, sanitary servicing, and water servicing.

The objectives of this report are as follows:

1. Identify domestic and fire protection water servicing 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 municipal watermain 300mm diameter watermain on King Street and an existing 150mm diameter municipal watermain that downsizes to a 100mm diameter watermain on Regent Street.

It is proposed to extend a new private water service for the subject lands from the 150mm diameter existing watermain on Regent Street. The size and location of the private water service connection will be determined as part of the detailed Engineering Design.



The subject lands are currently zoned as High Density Residential (RH-64) and designated under Exemption 4.2.3.20.E in the Official Plan to permit a 12-storey apartment building containing 70 units.

The existing permissible domestic water demand based on the 12 storey 70-unit apartment building (140 persons) permitted under the current Official Plan designation and to the proposed domestic water demand 12 storey 144-unit apartment (288 persons) have been calculated and are summarized in Table 1 below.

An average residential water demand of 275 L/capita/day has been assumed in accordance with MECP Design Guidelines and a population density of 2.0 persons per unit. Domestic peaking factors have been interpolated from Table 3-3 of the MOE Design Guidelines for Drinking Water Systems. Peak domestic demand calculations will be confirmed during the detailed engineering design stage.

Table 1. Estimated Peak Water Demand		
Estimated Peak Domestic Water Demand	Current Designation (140 persons)	Future Conditions (288 persons)
Average Domestic Demand <i>275 L/cap/day</i>	0.45 L/s	0.92 L/s
Maximum Day Domestic Peaking Factor	5.3	3.7
Maximum Day Domestic Demand	2.39 L/s	3.40 L/s
Peak Hour Domestic Peaking Factor	8.0	5.6
Peak Hour Domestic Demand	3.60 L/s	5.15 L/s

There is an existing municipal fire hydrant on the southwest corner of the Regent Street and King Street intersection. is expected to provide adequate fire protection for the proposed development.

If required, private fire hydrants can be provided within the development site to provide additional fire protection for the proposed dwellings. The spacing and location of any private fire hydrants will be provided in accordance with the City of St. Welland design standards and Ontario Building Code requirements as part of the detailed engineering design.

Given the preliminary nature of the application, a detailed design of the proposed apartment building has not been undertaken to determine the required fire flow requirements. However, fire protection measures provided through the detailed building design will be informed from the available fire flow from the existing municipal watermain system.



The City of Welland requires the subject lands to be reviewed through the City of Welland watermain modelling, the results of this modelling will determine the capacity within the existing watermain to provide domestic water supply and fire protection for the subject lands, and the available fire flows from the existing system.

SANITARY SERVICING

There is an existing 600mm diameter municipal sanitary sewer flowing northerly on King Street, as well as an existing 250mm diameter sanitary sewer flowing easterly on Regent Street.

Based on the current Official Plan Designation, the subject lands were permitted a total residential population of 140 persons (70 units) and the proposed site will include a future population of 288 persons (144 units).

Preliminary Sanitary Design Sheet calculations have been provided in Appendix A for both peak sanitary flow permitted based on the current Official Plan Designation and the proposed population density, assuming a total sanitary drainage area of 0.37 hectares for the subject lands.

As shown in Appendix A, the peak sanitary flow under the current Official Plan Designation was calculated to be 1.98 L/s, which utilizes approximately 5.2% and 1.0% of the full flow capacities of the existing 250mm diameter sanitary sewer on Regent Street and the existing 600mm diameter sanitary sewer on King Street respectively.

The peak sanitary flow under proposed conditions was calculated to be 3.85 L/s, which utilizes approximately 10.1% and 1.9% of the full flow capacities of the existing 250mm diameter sanitary sewer on Regent Street and the existing 600mm diameter sanitary sewer on King Street respectively, and is a 1.87 L/s increase from the currently permissible peak flow.

A Sanitary Drainage Area Plan prepared by the City of Welland for King Street has also been included in Appendix A for reference. As shown in this Drainage Area Plan, the subject lands were included in the original Sanitary Drainage Area for the 600mm diameter sanitary sewer on King Street as part of Drainage Area 4.

Therefore, there is expected to be adequate capacity within the downstream sanitary system for the subject lands. All sanitary sewer calculations can be found in Appendix A for reference.

The City of Welland has indicated that the subject lands are to be reviewed via the City of Welland Sanitary Modelling to confirm capacity in the existing sanitary sewer system for the development.



STORMWATER MANAGEMENT

There is an existing 1800mm diameter municipal storm sewer on King Street flowing northerly from Regent Street to Griffith Street, a 2400mm diameter municipal storm sewer on King Street flowing northerly from Griffith Street to the north, and a 300mm diameter storm sewer on Regent Street.

A Storm Drainage Area Plan prepared by the City of Welland for King Street has been included in Appendix C for reference. As shown in this Drainage Area Plan, the subject lands were included in the original Storm Drainage Area for the 1800mm and 2400mm diameter storm sewers on King Street as part of Drainage Area 4 and 5. Drainage Area 4, which comprises the majority of the subject lands was allocated a runoff coefficient of 0.425 and Drainage Area 5 was allocated a runoff coefficient of 0.80.

The existing stormwater drainage patterns within the site were evaluated based on existing topographical data and are illustrated in Figure 1, with the delineations between the areas allocated runoff coefficients of 0.425 and 0.80 per the City of Welland Storm Drainage Area Plan shown.

Drainage Area EX1 consists of a total area of 0.33 hectares and an overall runoff coefficient of 0.425 based on the City of Welland Storm Drainage Plan.

Drainage Area EX2 consists of a total area of 0.19 hectares and an overall runoff coefficient of 0.80 based on the City of Welland Storm Drainage Plan.

Figure 2 shows the preliminary future Storm Drainage Areas for the subject site.

Drainage Area A1 represents the area where future stormwater flows will be captured in the proposed internal storm sewer system and consists of an area of 0.37 hectares with an overall runoff coefficient of 0.70, which is the typical runoff coefficient for apartment land uses provided in the City of Welland Municipal Standards.

Drainage Area A2 consists of an area of 0.12 hectares with the runoff coefficient of 0.80 that was previously allocated as part of Drainage Area 5 in the City of Welland Storm Drainage Area Plan and represents the area that will convey existing stormwater flows into the subject lands.

Drainage Area A3 consists of an area of 0.02 hectares with the runoff coefficient of 0.425 that was previously allocated as part of Drainage Area 5 in the City of Welland Storm Drainage Area Plan and represents the area that will convey existing stormwater flows into the subject lands.



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1 GRIFFITH STREET
City of Welland
EXISTING STORM DRAINAGE AREA PLAN

DATE	2026-05-19
SCALE	1:750 m
REF No.	1124
DWG No.	Figure 1

WELLAND RECREATIONAL WATERWAY

EXISTING
MERRITT
PARK

GRIFFITH STREET

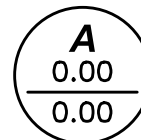
GRIFFITH STREET



REGENT STREET

KING STREET

LEGEND



DRAINAGE AREA NUMBER
DRAINAGE AREA IN HECTARES
RUN-OFF COEFFICIENT



DRAINAGE AREA BOUNDARY



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1 GRIFFITH STREET

City of Welland

PROPOSED STORM DRAINAGE AREA PLAN

DATE	2026-05-19
SCALE	1:750 m
REF No.	1124
DWG No.	Figure 2



Stormwater Quantity Assessment

To assess the required stormwater management quantity controls for the subject lands, Modified Rational Method (MRM) calculations have been prepared for the subject lands to identify existing and future peak stormwater flows discharging from the subject lands under the 5 and 100 year design storm events. The MRM calculations can be found in Appendix C and D for the 5 and 100 year design storm events respectively.

5 Year Design Storm

The City of Welland requires that the peak 5 year flow of the new development be controlled to the peak 2 year flow of the existing site conditions. Under existing conditions, the peak 2 year flow from Drainage Area's EX1 and EX2 is 62.7 L/s.

The total future peak 5 year flow from Drainage Areas A1, A2, and A3 is 77.9 L/s, which exceeds existing conditions and therefore stormwater management quantity controls will be required.

As shown in the 5 year MRM calculations provided in Appendix C, approximately 5.4 m³ of on-site stormwater storage is required to reduce future peak stormwater flows to the existing 62.7 L/s. It is proposed to provide this storage via oversized underground storm sewer storage. Preliminary calculations determine this volume can be provided by 48 m of 375mm diameter pipe.

To reduce the rate of flow discharging from the subject lands, a control orifice will be installed immediately upstream of the site's outlet. The exact size and location of the control orifice and storm sewer storage will be determined as part of the Detailed Engineering Design.

100 Year Design Storm

As shown in the 100 year MRM calculations provided in Appendix D, existing peak flows from Drainage Areas EX1 and EX2 combine to ultimately discharge 116.1 L/s.

The future peak 100 year flow from Drainage Area's A1, A2, and A3 is 144.4 L/s, which exceeds existing conditions, and therefore stormwater management quantity controls will be required.

Under future conditions, the subject lands will ultimately convey future 100 year stormwater flows the Old Welland Canal. The path of major overland flows will be determined through detailed engineering design.

Preliminary calculations determine that a storage volume of 1.0 m³ is required to control future peak 100 year flows to the allowable rate of 116.1 L/s, which is lower than the required storage volume to control future stormwater flows for the 5 year design storm event.

Therefore, adequate stormwater storage is also available to control future 100 year peak flows from the subject lands.



Stormwater Quality Assessment

Stormwater quality controls are required for the future stormwater flows discharging from the subject lands. To improve stormwater quality levels to Enhanced Protection (80% TSS removal) levels prior to discharging from this site, an oil/grit separator (OGS) is proposed.

The contributing drainage area from the proposed development and adjacent lands to the proposed oil/grit separator is 0.51 hectares (Drainage Areas A1, A2, and A3).

Drainage Areas A2 and A3 consist of the rear yard areas of the existing dwellings fronting on King Street, between Regent Street and Griffith Street that will contribute clean stormwater flows from the roof and grassed areas to the proposed storm sewer system within the subject lands. Therefore, from a quality control perspective, Drainage Areas A2 and A3 are considered at an imperviousness of 0% to reflect the TSS Loading from these areas.

Drainage Area A1 will contribute all TSS Loading to the proposed Oil/Grit Separator as an area with an overall imperviousness of 71.4% (equivalent imperviousness for a runoff coefficient of 0.70).

Therefore, the overall weighted imperviousness for quality control calculations is 51.8%

The Hydroworks modelling software has indicated that an HD5 will provide 82.5% TSS overall removal and capture 99.5% of the stormwater flows. Therefore, a Hydroworks HD5 can provide adequate quality improvements to the required 80% TSS Removal. The modelling output file has been provided in Appendix E.

MAINTENANCE OF STORMWATER MANAGEMENT FACILITY

Oil/Grit Separator

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 F 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.



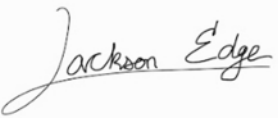
CONCLUSIONS AND RECOMMENDATIONS

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

1. The existing municipal watermain system is expected to have adequate capacity to provide both domestic and fire protection water supply for the subject lands, subject to confirmation from the City of Welland Water Modelling.
2. The 600mm diameter municipal sanitary sewer is expected to have adequate capacity to service the subject lands, subject to confirmation from the City of Welland Sanitary Modelling.
3. Stormwater management quantity controls for the 5 year storm event can be provided to existing 2 year conditions via internal storm sewer storage and a control orifice.
4. Stormwater quantity controls for the 100 year storm event can be provided to existing levels.
5. Stormwater quality controls can be provided to MECP Normal Levels with a Hydroworks HD5 oil/grit separator.

Based on the above and the accompanying calculations, there exists adequate municipal infrastructure 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.

Prepared By:



Jackson Edge, B.Eng.

Reviewed By:



Brendan Kapteyn, P.Eng.

Encl.



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APPENDICES



**UPPER CANADA
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APPENDIX A

**Preliminary Sanitary Sewer Calculations
King Street Sanitary Drainage Area Plan (City of Welland, 2000)**

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

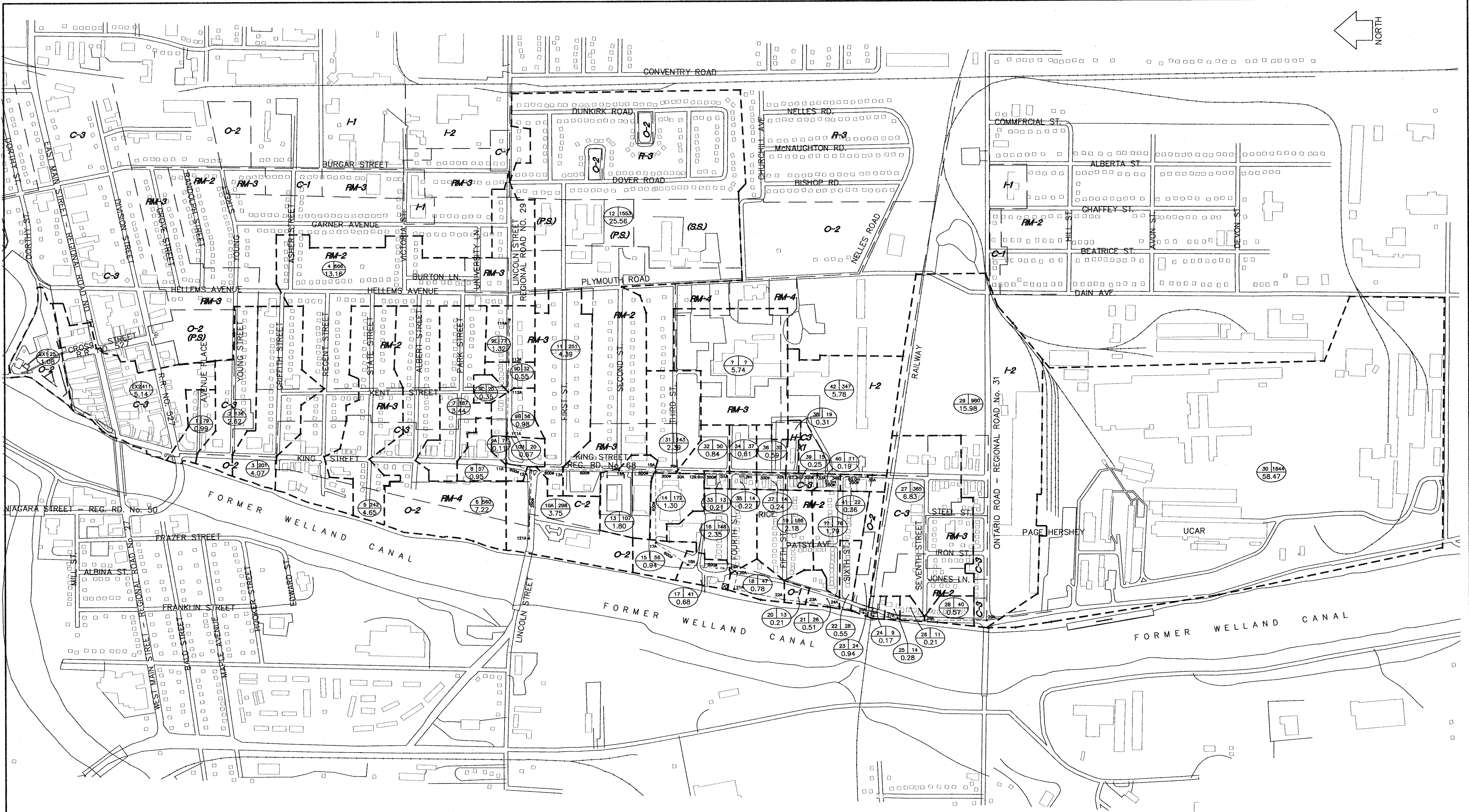
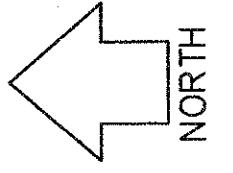
DESIGN FLOWS						SEWER DESIGN					
RESIDENTIAL:	275 LITRES/PERSON/DAY (AVERAGE DAILY FLOW)					PIPE ROUGHNESS:	0.013 FOR MANNING'S EQUATION				
INFILTRATION RATE:	0.286 LITRES/HECTARE (MECP EXTRANEIOUS FLOW ALLOWANCE)					PIPE SIZES:	1.016 IMPERIAL EQUIVALENT FACTOR				
POPULATION DENSITY:	2.0 PERSONS / UNIT (RESIDENTIAL APARTMENT DENSITY)					PERCENT FULL:	TOTAL PEAK FLOW / CAPACITY				

MUNICIPALITY: CITY OF WELLAND
PROJECT : 1 Griffith Street
PROJECT NO: 1124

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

LOCATION			AREA				ACCUMULATED PEAK FLOW					DESIGN FLOW				
Location and Description	From M.H	To M.H.	Increment (hectares)	Accumulated (hectares)	Population Increment	Total Population Served	Peaking Factor	Flow (L/s)	Infiltration Flow L/s	Total Peak Flow (L/s)	Pipe Length (m)	Pipe Diameter (mm)	Pipe Slope (%)	Full Flow Velocity (m/s)	Full Flow Capacity (L/s)	Percent Full
EXISTING O.P. / ZONING	SITE	EX MH	0.37	0.37	140	140	4.20	1.87	0.11	1.98		250	0.38	0.75	38.24	5.2%
				0.37		140	4.20	1.87	0.11	1.98		600	0.10	0.69	202.56	1.0%
PROPOSED CONDITIONS	SITE	EX MH	0.37	0.37	288	288	4.09	3.75	0.11	3.85		250	0.38	0.75	38.24	10.1%
				0.37		288	4.09	3.75	0.11	3.85		600	0.10	0.69	202.56	1.9%

77.8
V5



CATCHMENT NUMBER	00 00	POPULATION EQUIVALENT
AREA HECTARES		

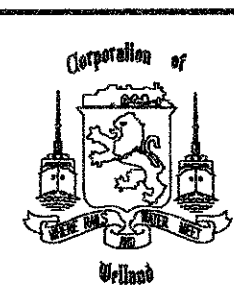
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NOTES		
1) THE POSITION OF POLE LINES, CONDUITS, WATERMANS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONSTRUCTION DRAWINGS AND WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.		
2) BEFORE STARTING THE WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.		
3) HYDRO AND BELL POLES ARE TO BE ANCHORED TO THE GROUND WHERE REQUIRED SO AS TO ENSURE THE STABILITY OF THE POLE LINES.		
4) THE CONTRACTOR IS TO CHECK WITH ALL THE UTILITIES INVOLVED.		
5) ALL MANHOLE FRAMES, CATCH BASIN FRAMES, WATER VALVES AND GAS VALVES TO BE ADJUSTED TO FINISH GRADE.		
6) EXISTING TREES AND VEGETATION OUTSIDE OF CONSTRUCTION AREAS TO REMAIN UNDISTURBED.		
No.	REVISION	DATE

LEGEND

DRAFTING BY:	J.H.
DESIGN BY:	J. Jaeger P.Eng.
APPROVED BY:	D. Tsang, C.E.T.

KERRY T. HOWE
ENGINEERING LTD.



CITY OF WELLAND
ENGINEERING DEPARTMENT

KING STREET
REGIONAL ROAD No. 68
INFRASTRUCTURE WORKS - 1998
SANITARY DRAINAGE PLAN

CAD FILE NAME:	97039SAN.dwg
PLOT DATE:	April 7, 2000
SCALE:	HORIZONTAL: 1:4000 VERTICAL: N/A
DRAWING No.	97-037-SAN
REV.	

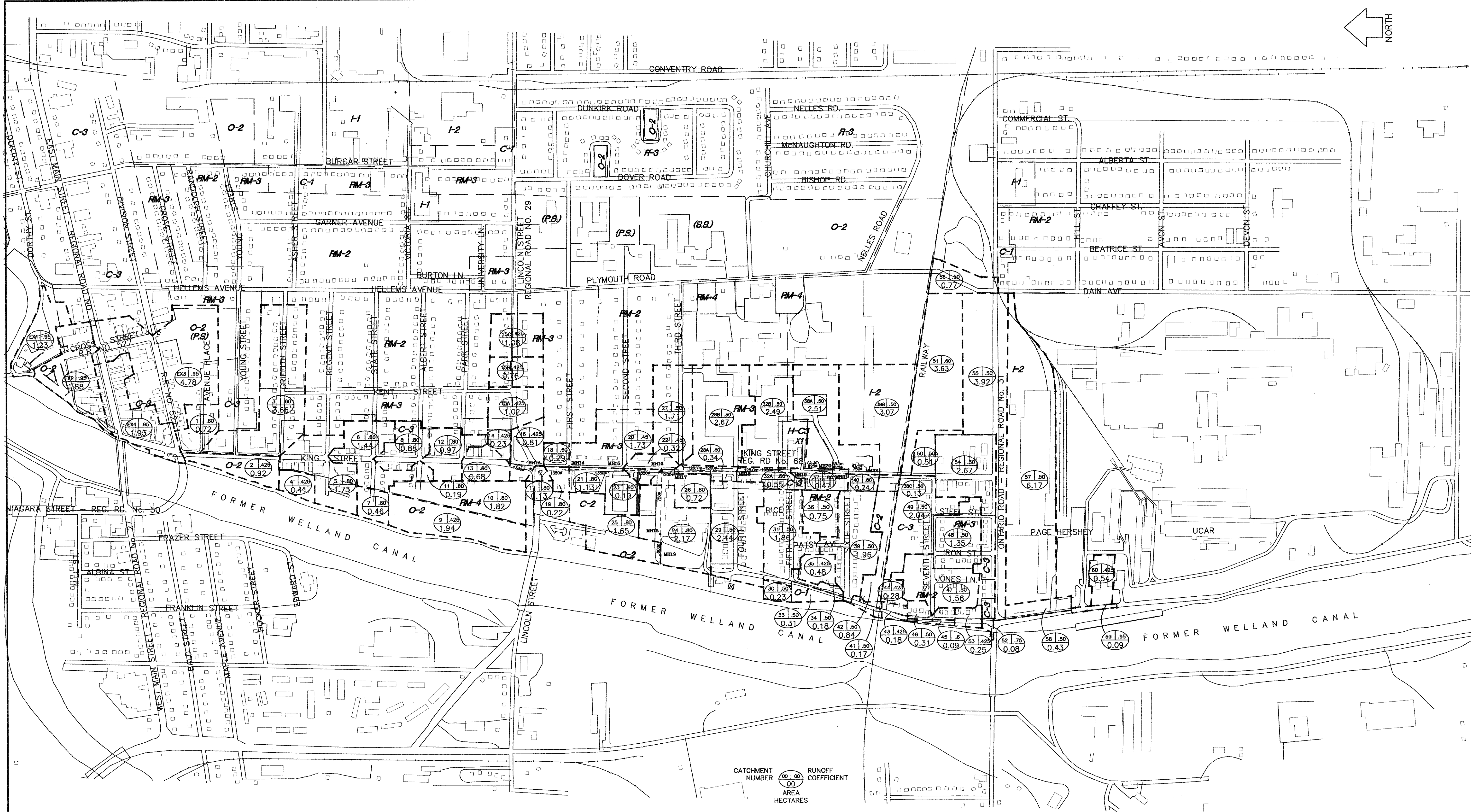
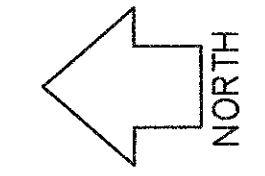


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APPENDIX B

King Street Storm Drainage Area Plan (City of Welland, 2000)

77.9
VS



CATCHMENT
NUMBER
00
00
AREA
HECTARES

RUNOFF
COEFFICIENT

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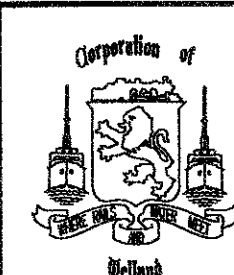
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No.	REVISION	DATE

LEGEND

DRAFTING BY:
J.H.

DESIGN BY:
J. Jaeger P.Eng.

APPROVED BY:
D. Tsang, C.E.T.



CITY OF WELLAND
ENGINEERING DEPARTMENT

KERRY T. HOWE
ENGINEERING LTD.

KING STREET
REGIONAL ROAD No. 68
INFRASTRUCTURE WORKS - 1998
STORM DRAINAGE PLAN

CAD FILE NAME:
97039ST2.dwg

PLOT DATE:
APRIL 7, 2000

SCALE:
HORIZONTAL: 1:4000
VERTICAL: N/A

DRAWING No.
97-037-ST2

REV.



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APPENDIX C

5 Year Design Storm Modified Rational Method (MRM) Calculations

STORM SEWER DESIGN SHEET
5 YEAR DESIGN STORM

PROJECT: 1 Regent Street, City of Welland

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												
EX1				0.33	0.33	10.00	0.00	0.425	0.140	0.140	77.186	30.1
EX2				0.19	0.52	10.00	0.00	0.800	0.152	0.292	77.186	62.7
FUTURE CONDITIONS												
A1 - Controlled				0.37	0.37	10.00	0.00	0.700	0.259	0.259	77.186	55.5
A2 - Controlled				0.12	0.49	10.00	0.00	0.800	0.096	0.355	77.186	76.1
A3 - Controlled				0.02	0.51	10.00	0.00	0.425	0.009	0.364	77.186	77.9

DESIGN BY:	UPPER CANADA CONSULTANTS	<u>RAINFALL PARAMETERS:</u>	a = 755.00 mm/hr
	30 HANNOVER DRIVE, UNIT 3	Time to Upper End = 10 min.	b = 8.00 minutes
	ST. CATHARINES, ON L2W 1A3	City of Welland - 2 Year IDF Curve	c = 0.79
DESIGN BY:			
DATE:			

Modified Rational Method (MRM) Required Storage Volume

5YEAR DESIGN STORM

Project: 1 Regent Street, City of Welland
 Project No: 1124
 Date:
 Design By:

Description: STORMWATER MANAGEMENT PLAN

Storm Event: **City of Welland - 5 Year IDF Curve**

a = 830.00 mm/hr
 b = 7.30 minutes
 c = 0.78

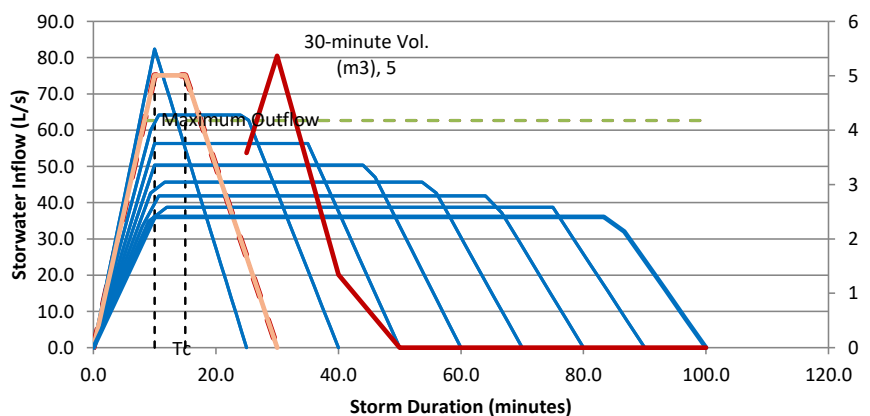
Critical Storm Duration: 30.00 minutes Tail Multiplier (x1-11.5)
 Tc From Design: 10.00 minutes
 Storm Tail Time: 15.00 minutes

Accumulated Area x R (Ha): 0.364 <-- Area x Runoff Coefficient (Sewer Design Sheet)
 Peak Rainfall Intensity: 74.38 mm/hr
 Peak Inflow at Tc: 75.10 L/s
 Maximum Release Rate: 62.66 <-- Outlet Full Flow Capacity (Design Sheet)
 Time When Outlet Exceeded: 8.34

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	62.66	-3.8	0.0
1.0	7.44	7.51	62.66	-3.3	0.0
2.0	14.88	15.02	62.66	-2.9	0.0
3.0	22.31	22.53	62.66	-2.4	0.0
4.0	29.75	30.04	62.66	-2.0	0.0
5.0	37.19	37.55	62.66	-1.5	0.0
6.0	44.63	45.06	62.66	-1.1	0.0
7.0	52.06	52.57	62.66	-0.6	0.0
8.0	59.50	60.08	62.66	-0.2	0.0
9.0	66.94	67.59	62.66	0.3	0.3
10.0	74.38	75.10	62.66	0.7	1.0
11.0	74.38	75.10	62.66	0.7	1.8
12.0	74.38	75.10	62.66	0.7	2.5
13.0	74.38	75.10	62.66	0.7	3.3
14.0	74.38	75.10	62.66	0.7	4.0
15.0	74.38	75.10	62.66	0.7	4.8
16.0	69.42	70.09	62.66	0.4	5.2
17.0	64.46	65.09	62.66	0.1	5.4
18.0	59.50	60.08	62.66	-0.2	5.2
19.0	54.54	55.07	62.66	-0.5	4.8
20.0	49.59	50.07	62.66	-0.8	4.0
21.0	44.63	45.06	62.66	-1.1	2.9
22.0	39.67	40.05	62.66	-1.4	1.6
23.0	34.71	35.05	62.66	-1.7	0.0
24.0	29.75	30.04	62.66	-2.0	0.0
25.0	24.79	25.03	62.66	-2.3	0.0
26.0	19.83	20.03	62.66	-2.6	0.0
27.0	14.88	15.02	62.66	-2.9	0.0
28.0	9.92	10.01	62.66	-3.2	0.0
29.0	4.96	5.01	62.66	-3.5	0.0
30.0	0.00	0.00	62.66	-3.8	0.0

Variable Storm Duration Storage Requirements

Duration	Max Storage	Duration	Max Storage	Duration	Max Storage
25 Min	3.6 m3	50 Min	0.0 m3	80 Min	0.0 m3
30 Min	5.4 m3	60 Min	0.0 m3	90 Min	0.0 m3
40 Min	1.3 m3	70 Min	0.0 m3	100 Min	0.0 m3





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APPENDIX D

100 Year Design Storm Modified Rational Method (MRM) Calculations

STORM SEWER DESIGN SHEET
100 YEAR DESIGN STORM

PROJECT: 1 Regent Street, City of Welland

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												
EX1				0.33	0.33	10.00	0.00	0.425	0.140	0.140	142.985	55.7
EX2				0.19	0.52	10.00	0.00	0.800	0.152	0.292	142.985	116.1
FUTURE CONDITIONS												
A1 - Controlled				0.37	0.37	10.00	0.00	0.700	0.259	0.259	142.985	102.9
A2 - Controlled				0.12	0.49	10.00	0.00	0.800	0.096	0.355	142.985	141.0
A3 - Controlled				0.02	0.51	10.00	0.00	0.425	0.009	0.364	142.985	144.4

DESIGN BY:	UPPER CANADA CONSULTANTS	<u>RAINFALL PARAMETERS:</u>	a = 1020.00 mm/hr
	30 HANNOVER DRIVE, UNIT 3	Time to Upper End = 10 min.	b = 4.70 minutes
	ST. CATHARINES, ON L2W 1A3	City of Welland - 100 Year IDF Curve	c = 0.73
DESIGN BY:			
DATE:			

Modified Rational Method (MRM) Required Storage Volume

100 YEAR DESIGN STORM

Project: 1 Regent Street, City of Welland

Project No: 1124

Date:

Design By:

Description: STORMWATER MANAGEMENT PLAN

Storm Event: **City of Welland - 100 Year IDF Curve**

a = 1020.00 mm/hr

b = 4.70 minutes

c = 0.73

Critical Storm Duration: 25.00 minutes Tail Multiplier (x1-11.5)

Tc From Design: 10.00 minutes

Storm Tail Time: 10.00 minutes

Accumulated Area x R (Ha): 0.364 <-- Area x Runoff Coefficient (Sewer Design Sheet)

Peak Rainfall Intensity: 127.48 mm/hr

Peak Inflow at Tc: 128.72 L/s

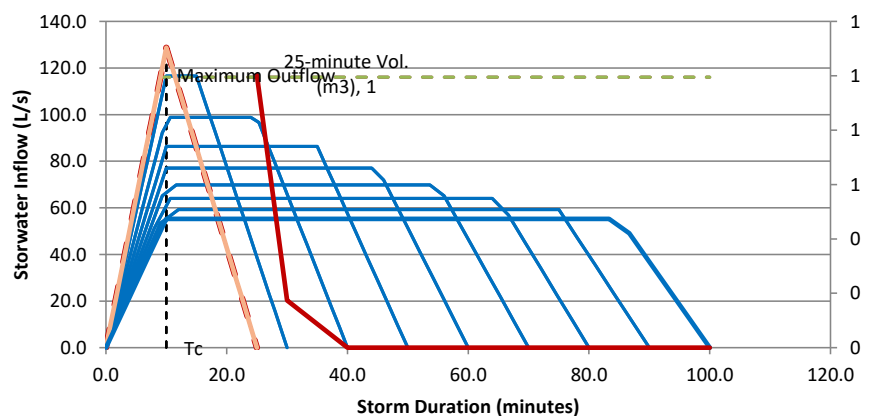
Maximum Release Rate: 116.08 <-- Outlet Full Flow Capacity (Design Sheet)

Time When Outlet Exceeded: 9.02

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	116.08	-7.0	0.0
0.8	10.62	10.73	116.08	-5.3	0.0
1.7	21.25	21.45	116.08	-4.7	0.0
2.5	31.87	32.18	116.08	-4.2	0.0
3.3	42.49	42.91	116.08	-3.7	0.0
4.2	53.12	53.63	116.08	-3.1	0.0
5.0	63.74	64.36	116.08	-2.6	0.0
5.8	74.36	75.08	116.08	-2.0	0.0
6.7	84.98	85.81	116.08	-1.5	0.0
7.5	95.61	96.54	116.08	-1.0	0.0
8.3	106.23	107.26	116.08	-0.4	0.0
9.2	116.85	117.99	116.08	0.1	0.1
10.0	127.48	128.72	116.08	0.6	0.7
10.8	120.39	121.56	116.08	0.3	1.0
11.7	113.31	114.41	116.08	-0.1	0.9
12.5	106.23	107.26	116.08	-0.4	0.5
13.3	99.15	100.11	116.08	-0.8	0.0
14.2	92.07	92.96	116.08	-1.2	0.0
15.0	84.98	85.81	116.08	-1.5	0.0
15.8	77.90	78.66	116.08	-1.9	0.0
16.7	70.82	71.51	116.08	-2.2	0.0
17.5	63.74	64.36	116.08	-2.6	0.0
18.3	56.66	57.21	116.08	-2.9	0.0
19.2	49.57	50.06	116.08	-3.3	0.0
20.0	42.49	42.91	116.08	-3.7	0.0
20.8	35.41	35.75	116.08	-4.0	0.0
21.7	28.33	28.60	116.08	-4.4	0.0
22.5	21.25	21.45	116.08	-4.7	0.0
23.3	14.16	14.30	116.08	-5.1	0.0
24.2	7.08	7.15	116.08	-5.4	0.0
25.0	0.00	0.00	116.08	-5.8	0.0

Variable Storm Duration Storage Requirements

Duration	Max Storage	Duration	Max Storage	Duration	Max Storage
25 Min	1.0 m3	50 Min	0.0 m3	80 Min	0.0 m3
30 Min	0.2 m3	60 Min	0.0 m3	90 Min	0.0 m3
40 Min	0.0 m3	70 Min	0.0 m3	100 Min	0.0 m3





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APPENDIX E

Hydroworks OGS Output Files



**UPPER CANADA
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```
*****
*   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 *
*****
```

Hydroworks Sizing Program V. 5.8.5
Copyright Hydroworks, LLC, 2024
HydroDome Simulation

```
#####
# Precipitation Block Input Commands #
#####
```

```
Station Name..... St. Catharines 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 (0-No 1-Yes) 0
Print all rainfall, IYEAR (0-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
```



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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, 0 = other code present

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

Location Station Number

1. 7287

STATION 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 #
#####

Hydroworks Sizing Program V. 5.8.5
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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
Runoff 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.



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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

* CHANNEL AND PIPE DATA *

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

* SUBCATCHMENT DATA *

NOTE. SEE LATER TABLE FOR OPTIONAL SUBCATCHMENT PARAMETERS

SUBCATCH- MENT NO.	CHANNEL OR INLET	WIDTH (M)	AREA (HA)	PERCENT IMPERV.	SLOPE (M/M)	RESISTANCE IMPERV.	FACTOR PERV.	DEPRES. IMPERV.	STORAGE(MM) PERV.	INFILTRATION RATE(MM/HR) MAXIMUM MINIMUM	DECAY RATE (1/SEC)	GAGE NO.	MAXIMUM VOLUME (MM)
1	300	200	71.41	0.51	51.80	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)... 0.51
IMPERVIOUS AREA (HECTARES)..... 0.26
PERVIOUS AREA (HECTARES)..... 0.25
TOTAL WIDTH (METERS)..... 71.41
PERCENT IMPERVIOUSNESS..... 51.80

* GROUNDWATER INPUT DATA *

SUB- CATCH NUMBER	CHANNEL OR INLET	===== E L E V A T I O N S =====	===== F L O W C O N S T A N T S =====
		GROUND BOTTOM STAGE BC TW A1 B1 A2 B2 A3	
		(M) (M) (M) (M) (M) (MM/HR-M^B1) (MM/HR-M^B2) (MM/HR-M^A2)	
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	

* GROUNDWATER INPUT DATA (CONTINUED) *

SUBCAT. NO.	SOIL PROPERTIES	PERCOLATION PARAMETERS	ET PARAMETERS				
	SATURATED HYDRAULIC POROSITY CONDUCTIVITY (mm/hr)	WILTING FIELD POINT CAPACITY (mm/hr)	INITIAL MOISTURE	MAX. DEEP PERCOLATION (mm/hr)	HCO PCO	DEPTH OF ET (m)	FRACTION OF ET TO UPPER ZONE
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.....



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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 #
#####

AND USE LNAME)	BUILDUP EQUATION TYPE (METHOD)	FUNCTIONAL DEPENDENCE OF BUILDUP PARAMETER(JACGUT)	LIMITING BUILDUP QUANTITY (DDLIM)	BUILDUP POWER (DDPOW)	BUILDUP COEFF. (DDFACT)	CLEANING INTERVAL IN DAYS (CLFREQ)	AVAIL. FACTOR (AVSWP)	DAYS SINCE LAST SWEEPING (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 effc (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



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

CHANNEL/ CONSTITUENT
PIPE Total Susp

201 0.000

* Subcatchment surface quality on data group L1 *

	Land No.	Usage	Land Use No.	Total Gutter Length Km	Number of Catch- Basins	Input Loading load/ha Total Su
1	300	Urban De	1	0.14	2.00	0.0E+00
Totals (Loads in kg or other)				0.14	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

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

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Rainfall Station St. Catharines 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.	100.	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.



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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 = 2056355
Final Julian Date = 2006001
Final time of day = 1. 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 | 6145140 | 1553900 | | | | | | |

* 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 *



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| | cubic meters | Millimeters over
Total Basin |
|---|--------------|---------------------------------|
| Total Precipitation (Rain plus Snow) | 98238. | 19263. |
| Total Infiltration | 47145. | 9244. |
| Total Evaporation | 4958. | 972. |
| Surface Runoff from Watersheds | 46715. | 9160. |
| Total Water remaining in Surface Storage | 0. | 0. |
| Infiltration over the Pervious Area... | 47145. | 19179. |
| ----- | | |
| Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
Water remaining in Snow Cover..... | 98818. | 19376. |
| Total Precipitation + Initial Storage. | 98238. | 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..... | -0.590 Percent |

* Continuity Check for Channel/Pipes *

| | cubic meters | Millimeters over
Total Basin |
|---|---------------|---------------------------------|
| Initial Channel/Pipe Storage..... | 0. | 0. |
| Final Channel/Pipe Storage..... | 0. | 0. |
| Surface Runoff from Watersheds..... | 46715. | 9160. |
| Baseflow..... | 0. | 0. |
| Groundwater Subsurface Inflow..... | 0. | 0. |
| Evaporation Loss from Channels..... | 0. | 0. |
| Channel/Pipe/Inlet Outflow..... | 46715. | 9160. |
| Initial Storage + Inflow..... | 46715. | 9160. |
| Final Storage + Outflow..... | 46715. | 9160. |
| ***** | | |
| * 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 *

| | cubic meters | Millimeters over
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 | 4663. | 914. |
| Final Subsurface Storage | 4663. | 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

| SUBCATCH-
MENT NO. | GUTTER
OR INLET
NO. | AREA
(HA) | PERCENT
IMPER. | TOTAL
SIMULATED
RAINFALL
(MM) | PERVIOUS AREA | | IMPERVIOUS AREA | | TOTAL SUBCATCHMENT AREA | | |
|-----------------------|---------------------------|--------------|-------------------|--|----------------------------------|-------------------------|---------------------------------|---------------------------------|-------------------------|---------------------------------|-----------------------------------|
| | | | | | TOTAL
RUNOFF
DEPTH
(MM) | TOTAL
LOSSES
(MM) | PEAK
RUNOFF
RATE
(CMS) | PEAK
RUNOFF
RATE
(CMS) | RUNOFF
DEPTH
(MM) | PEAK
RUNOFF
RATE
(CMS) | PEAK
UNIT
RUNOFF
(MM/HR) |
| 300 | 200 | 0.51 | 51.81 | 9262.47 | 83.332 | ***** | 0.06817 | 603.375 | 0.144 | 9158.714 | 0.211 150.527 |



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*** 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 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 | | | | 0.21 | | | | 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..... 11.
2. TOTAL SURFACE BUILDUP..... 7589.
3. INITIAL CATCHBASIN LOAD.... 0.
4. TOTAL CATCHBASIN LOAD..... 0.
5. TOTAL CATCHBASIN AND
  SURFACE BUILDUP (2+4)..... 7589.
```

Remaining Loads

```
-----
6. LOAD REMAINING ON SURFACE... 6.
7. REMAINING IN CATCHBASINS.... 0.
8. REMAINING IN CHANNEL/PIPES.. 0.
```

Removals

```
-----
9. STREET SWEEPING REMOVAL..... 773.
10. NET SURFACE BUILDUP (2-9)... 6815.
11. SURFACE WASHOFF..... 6809.
12. CATCHBASIN WASHOFF..... 0.
13. TOTAL WASHOFF (11+12)..... 6809.
14. LOAD FROM OTHER CONSTITUENTS 0.
15. PRECIPITATION LOAD..... 0.
15a. SUM SURFACE LOAD (13+14+15). 6809.
16. TOTAL GROUNDWATER LOAD..... 0.
16a. TOTAL I/I LOAD..... 0.
17. NET SUBCATCHMENT LOAD
    (15a-15b-15c-15d+16+16a).... 6809.
>>Removal in channel/pipes (17a, 17b):
17a. REMOVE BY BMP FRACTION..... 0.
17b. REMOVE BY 1st ORDER DECAY... 0.
18. TOTAL LOAD TO INLETS..... 6809.
19. FLOW WT'D AVE. CONCENTRATION mg/l
    (INLET LOAD/TOTAL FLOW)..... 146.
```

Percentages

```
-----
20. STREET SWEEPING (9/2)..... 10.
21. SURFACE WASHOFF (11/2)..... 90.
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.
```



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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
(um) | % | Specific
Gravity | Settling Velocity
(m/s) | Critical Peclet
Number |
|------------------|------|---------------------|----------------------------|---------------------------|
| 2. | 5.0 | 2.65 | 0.000003 | 0.054484 |
| 5. | 5.0 | 2.65 | 0.000017 | 0.061150 |
| 8. | 10.0 | 2.65 | 0.000043 | 0.067744 |
| 20. | 15.0 | 2.65 | 0.000267 | 0.093400 |
| 50. | 10.0 | 2.65 | 0.001629 | 0.152500 |
| 75. | 5.0 | 2.65 | 0.003548 | 0.196250 |
| 100. | 10.0 | 2.65 | 0.006044 | 0.235000 |
| 150. | 15.0 | 2.65 | 0.012234 | 0.297500 |
| 250. | 15.0 | 2.65 | 0.026615 | 0.391296 |
| 500. | 5.0 | 2.65 | 0.060604 | 0.602917 |
| 1000. | 5.0 | 2.65 | 0.111334 | 0.928988 |

* Summary of TSS Removal *

TSS Removal based on Lab Performance Curve

| Model
| Low Q Treated
(cms) | High Q Treated
(cms) | Runoff Treated
(%) | TSS Removed
(%) |
|------------|------------------------|-------------------------|-----------------------|--------------------|
| Unavailabl | 0.060 | 0.060 | 99.5 | 70.2 |
| HD 4 | 0.060 | 0.060 | 99.5 | 77.2 |
| HD 5 | 0.060 | 0.060 | 99.5 | 82.5 |
| HD 6 | 0.060 | 0.060 | 99.5 | 86.5 |
| HD 7 | 0.060 | 0.060 | 99.5 | 90.0 |
| HD 8 | 0.060 | 0.060 | 99.5 | 92.5 |
| HD 10 | 0.060 | 0.060 | 99.5 | 95.6 |
| HD 12 | 0.060 | 0.060 | 99.5 | 97.4 |

* Summary of Annual Flow Treatmetn & TSS Removal *

| Unavailabl
Year | Flow Vol
(m3) | Flow Treated
(m3) | TSS In
(kg) | TSS Rem
(kg) | TSS Out
(kg) | TSS Byp
(kg) | Flow Treated
(%) | TSS Removal
(%) |
|--------------------|------------------|----------------------|----------------|-----------------|-----------------|-----------------|---------------------|--------------------|
| 1971. | 10920. | 10713. | 135. | 89. | 46. | 0. | 98.1 | 65.7 |
| 1972. | 14038. | 12857. | 175. | 123. | 52. | 7. | 91.6 | 67.5 |
| 1973. | 13678. | 13678. | 188. | 134. | 55. | 0. | 100.0 | 71.0 |
| 1974. | 13979. | 13892. | 199. | 146. | 53. | 1. | 99.4 | 73.0 |
| 1975. | 11853. | 11853. | 173. | 117. | 56. | 0. | 100.0 | 67.8 |
| 1976. | 17640. | 17401. | 219. | 153. | 66. | 2. | 98.6 | 69.2 |
| 1977. | 18927. | 18613. | 218. | 141. | 76. | 3. | 98.3 | 64.2 |
| 1978. | 15058. | 15058. | 203. | 139. | 65. | 0. | 100.0 | 68.2 |
| 1979. | 18058. | 17866. | 234. | 166. | 68. | 1. | 98.9 | 70.3 |
| 1980. | 14531. | 14531. | 213. | 149. | 64. | 0. | 100.0 | 70.1 |
| 1981. | 20066. | 20066. | 244. | 177. | 67. | 0. | 100.0 | 72.5 |
| 1982. | 14115. | 14115. | 195. | 142. | 53. | 0. | 100.0 | 72.8 |
| 1983. | 18612. | 18581. | 251. | 176. | 74. | 0. | 99.8 | 70.3 |
| 1984. | 14998. | 14998. | 196. | 137. | 59. | 0. | 100.0 | 69.7 |
| 1985. | 13092. | 13092. | 189. | 135. | 54. | 0. | 100.0 | 71.4 |
| 1986. | 19069. | 19069. | 260. | 187. | 73. | 0. | 100.0 | 71.8 |
| 1987. | 19731. | 19653. | 263. | 186. | 77. | 0. | 99.6 | 70.6 |
| 1988. | 15866. | 15866. | 219. | 159. | 59. | 0. | 100.0 | 72.8 |
| 1989. | 17376. | 17376. | 216. | 157. | 60. | 0. | 100.0 | 72.3 |
| 1990. | 19679. | 19679. | 268. | 197. | 71. | 0. | 100.0 | 73.5 |
| 1991. | 18443. | 18443. | 252. | 181. | 71. | 0. | 100.0 | 71.9 |
| 1992. | 23446. | 23446. | 300. | 209. | 91. | 0. | 100.0 | 69.8 |
| 1993. | 15967. | 15967. | 241. | 181. | 60. | 0. | 100.0 | 75.0 |



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| | | | | | | | | |
|-------|--------|--------|------|------|-----|----|-------|------|
| 1994. | 17191. | 17053. | 207. | 137. | 70. | 1. | 99.2 | 65.9 |
| 1995. | 19812. | 19812. | 248. | 168. | 80. | 0. | 100.0 | 67.8 |
| 1998. | 5181. | 5181. | 89. | 61. | 28. | 0. | 100.0 | 68.8 |
| 1999. | 12629. | 12629. | 185. | 129. | 56. | 0. | 100.0 | 69.8 |
| 2000. | 14471. | 14471. | 170. | 111. | 59. | 0. | 100.0 | 65.5 |
| 2001. | 11494. | 11494. | 151. | 113. | 38. | 0. | 100.0 | 75.0 |
| 2002. | 12003. | 12003. | 175. | 127. | 48. | 0. | 100.0 | 72.4 |
| 2003. | 13652. | 13652. | 184. | 129. | 55. | 0. | 100.0 | 70.1 |
| 2004. | 16378. | 16378. | 193. | 135. | 58. | 0. | 100.0 | 70.0 |
| 2005. | 11878. | 11778. | 146. | 92. | 54. | 0. | 99.2 | 62.9 |

| HD 4
Year | Flow Vol
(m3) | Flow Treated
(m3) | TSS In
(kg) | TSS Rem
(kg) | TSS Out
(kg) | TSS Byp
(kg) | Flow Treated
(%) | TSS Removal
(%) |
|--------------|------------------|----------------------|----------------|-----------------|-----------------|-----------------|---------------------|--------------------|
| 1971. | 10920. | 10713. | 135. | 99. | 36. | 0. | 98.1 | 73.1 |
| 1972. | 14038. | 12857. | 175. | 136. | 39. | 7. | 91.6 | 74.6 |
| 1973. | 13678. | 13678. | 188. | 146. | 42. | 0. | 100.0 | 77.6 |
| 1974. | 13979. | 13892. | 199. | 161. | 38. | 1. | 99.4 | 80.4 |
| 1975. | 11853. | 11853. | 173. | 130. | 42. | 0. | 100.0 | 75.5 |
| 1976. | 17640. | 17401. | 219. | 170. | 49. | 2. | 98.6 | 76.8 |
| 1977. | 18927. | 18613. | 218. | 158. | 60. | 3. | 98.3 | 71.5 |
| 1978. | 15058. | 15058. | 203. | 153. | 51. | 0. | 100.0 | 75.0 |
| 1979. | 18058. | 17866. | 234. | 183. | 51. | 1. | 98.9 | 77.5 |
| 1980. | 14531. | 14531. | 213. | 165. | 48. | 0. | 100.0 | 77.6 |
| 1981. | 20066. | 20066. | 244. | 193. | 51. | 0. | 100.0 | 79.2 |
| 1982. | 14115. | 14115. | 195. | 154. | 41. | 0. | 100.0 | 79.2 |
| 1983. | 18612. | 18581. | 251. | 194. | 57. | 0. | 99.8 | 77.2 |
| 1984. | 14998. | 14998. | 196. | 150. | 46. | 0. | 100.0 | 76.5 |
| 1985. | 13092. | 13092. | 189. | 147. | 42. | 0. | 100.0 | 78.0 |
| 1986. | 19069. | 19069. | 260. | 204. | 56. | 0. | 100.0 | 78.6 |
| 1987. | 19731. | 19653. | 263. | 205. | 58. | 0. | 99.6 | 77.9 |
| 1988. | 15866. | 15866. | 219. | 174. | 44. | 0. | 100.0 | 79.7 |
| 1989. | 17376. | 17376. | 216. | 172. | 45. | 0. | 100.0 | 79.4 |
| 1990. | 19679. | 19679. | 268. | 216. | 52. | 0. | 100.0 | 80.7 |
| 1991. | 18443. | 18443. | 252. | 199. | 53. | 0. | 100.0 | 79.0 |
| 1992. | 23446. | 23446. | 300. | 230. | 69. | 0. | 100.0 | 76.8 |
| 1993. | 15967. | 15967. | 241. | 196. | 45. | 0. | 100.0 | 81.2 |
| 1994. | 17191. | 17053. | 207. | 154. | 53. | 1. | 99.2 | 74.0 |
| 1995. | 19812. | 19812. | 248. | 186. | 61. | 0. | 100.0 | 75.3 |
| 1998. | 5181. | 5181. | 89. | 67. | 22. | 0. | 100.0 | 75.6 |
| 1999. | 12629. | 12629. | 185. | 140. | 45. | 0. | 100.0 | 75.9 |
| 2000. | 14471. | 14471. | 170. | 124. | 46. | 0. | 100.0 | 72.9 |
| 2001. | 11494. | 11494. | 151. | 123. | 28. | 0. | 100.0 | 81.5 |
| 2002. | 12003. | 12003. | 175. | 138. | 37. | 0. | 100.0 | 78.8 |
| 2003. | 13652. | 13652. | 184. | 141. | 43. | 0. | 100.0 | 76.6 |
| 2004. | 16378. | 16378. | 193. | 147. | 46. | 0. | 100.0 | 76.3 |
| 2005. | 11878. | 11778. | 146. | 103. | 43. | 0. | 99.2 | 70.3 |

| HD 5
Year | Flow Vol
(m3) | Flow Treated
(m3) | TSS In
(kg) | TSS Rem
(kg) | TSS Out
(kg) | TSS Byp
(kg) | Flow Treated
(%) | TSS Removal
(%) |
|--------------|------------------|----------------------|----------------|-----------------|-----------------|-----------------|---------------------|--------------------|
| 1971. | 10920. | 10713. | 135. | 107. | 28. | 0. | 98.1 | 79.2 |
| 1972. | 14038. | 12857. | 175. | 145. | 30. | 7. | 91.6 | 79.6 |
| 1973. | 13678. | 13678. | 188. | 156. | 33. | 0. | 100.0 | 82.7 |
| 1974. | 13979. | 13892. | 199. | 171. | 29. | 1. | 99.4 | 85.3 |
| 1975. | 11853. | 11853. | 173. | 139. | 33. | 0. | 100.0 | 80.7 |
| 1976. | 17640. | 17401. | 219. | 181. | 37. | 2. | 98.6 | 82.0 |
| 1977. | 18927. | 18613. | 218. | 170. | 48. | 3. | 98.3 | 77.2 |
| 1978. | 15058. | 15058. | 203. | 163. | 40. | 0. | 100.0 | 80.3 |
| 1979. | 18058. | 17866. | 234. | 193. | 41. | 1. | 98.9 | 82.1 |
| 1980. | 14531. | 14531. | 213. | 175. | 38. | 0. | 100.0 | 82.3 |
| 1981. | 20066. | 20066. | 244. | 207. | 37. | 0. | 100.0 | 84.7 |
| 1982. | 14115. | 14115. | 195. | 166. | 29. | 0. | 100.0 | 85.3 |
| 1983. | 18612. | 18581. | 251. | 207. | 43. | 0. | 99.8 | 82.7 |
| 1984. | 14998. | 14998. | 196. | 160. | 36. | 0. | 100.0 | 81.4 |
| 1985. | 13092. | 13092. | 189. | 158. | 31. | 0. | 100.0 | 83.5 |
| 1986. | 19069. | 19069. | 260. | 219. | 41. | 0. | 100.0 | 84.3 |
| 1987. | 19731. | 19653. | 263. | 218. | 45. | 0. | 99.6 | 82.6 |
| 1988. | 15866. | 15866. | 219. | 186. | 33. | 0. | 100.0 | 84.9 |
| 1989. | 17376. | 17376. | 216. | 185. | 32. | 0. | 100.0 | 85.4 |
| 1990. | 19679. | 19679. | 268. | 229. | 39. | 0. | 100.0 | 85.6 |
| 1991. | 18443. | 18443. | 252. | 212. | 40. | 0. | 100.0 | 84.1 |
| 1992. | 23446. | 23446. | 300. | 246. | 53. | 0. | 100.0 | 82.2 |
| 1993. | 15967. | 15967. | 241. | 208. | 33. | 0. | 100.0 | 86.3 |
| 1994. | 17191. | 17053. | 207. | 165. | 42. | 1. | 99.2 | 79.5 |
| 1995. | 19812. | 19812. | 248. | 201. | 47. | 0. | 100.0 | 81.1 |
| 1998. | 5181. | 5181. | 89. | 73. | 16. | 0. | 100.0 | 81.8 |
| 1999. | 12629. | 12629. | 185. | 152. | 33. | 0. | 100.0 | 82.3 |
| 2000. | 14471. | 14471. | 170. | 133. | 37. | 0. | 100.0 | 78.5 |
| 2001. | 11494. | 11494. | 151. | 131. | 21. | 0. | 100.0 | 86.4 |
| 2002. | 12003. | 12003. | 175. | 148. | 27. | 0. | 100.0 | 84.5 |
| 2003. | 13652. | 13652. | 184. | 150. | 34. | 0. | 100.0 | 81.5 |
| 2004. | 16378. | 16378. | 193. | 157. | 36. | 0. | 100.0 | 81.5 |
| 2005. | 11878. | 11778. | 146. | 112. | 34. | 0. | 99.2 | 76.3 |

HD 6



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| Year | Flow Vol
(m3) | Flow Treated
(m3) | TSS In
(kg) | TSS Rem
(kg) | TSS Out
(kg) | TSS Byp
(kg) | Flow Treated
(%) | TSS Removal
(%) |
|-------|------------------|----------------------|----------------|-----------------|-----------------|-----------------|---------------------|--------------------|
| 1971. | 10920. | 10713. | 135. | 113. | 22. | 0. | 98.1 | 83.8 |
| 1972. | 14038. | 12857. | 175. | 152. | 22. | 7. | 91.6 | 83.8 |
| 1973. | 13678. | 13678. | 188. | 164. | 25. | 0. | 100.0 | 86.8 |
| 1974. | 13979. | 13892. | 199. | 179. | 20. | 1. | 99.4 | 89.5 |
| 1975. | 11853. | 11853. | 173. | 147. | 26. | 0. | 100.0 | 85.0 |
| 1976. | 17640. | 17401. | 219. | 191. | 27. | 2. | 98.6 | 86.5 |
| 1977. | 18927. | 18613. | 218. | 180. | 37. | 3. | 98.3 | 81.8 |
| 1978. | 15058. | 15058. | 203. | 172. | 31. | 0. | 100.0 | 84.6 |
| 1979. | 18058. | 17866. | 234. | 204. | 30. | 1. | 98.9 | 86.4 |
| 1980. | 14531. | 14531. | 213. | 182. | 30. | 0. | 100.0 | 85.7 |
| 1981. | 20066. | 20066. | 244. | 216. | 28. | 0. | 100.0 | 88.7 |
| 1982. | 14115. | 14115. | 195. | 175. | 20. | 0. | 100.0 | 89.5 |
| 1983. | 18612. | 18581. | 251. | 218. | 32. | 0. | 99.8 | 87.0 |
| 1984. | 14998. | 14998. | 196. | 169. | 27. | 0. | 100.0 | 86.0 |
| 1985. | 13092. | 13092. | 189. | 166. | 23. | 0. | 100.0 | 87.9 |
| 1986. | 19069. | 19069. | 260. | 230. | 30. | 0. | 100.0 | 88.5 |
| 1987. | 19731. | 19653. | 263. | 228. | 35. | 0. | 99.6 | 86.6 |
| 1988. | 15866. | 15866. | 219. | 193. | 25. | 0. | 100.0 | 88.4 |
| 1989. | 17376. | 17376. | 216. | 192. | 24. | 0. | 100.0 | 88.8 |
| 1990. | 19679. | 19679. | 268. | 239. | 29. | 0. | 100.0 | 89.0 |
| 1991. | 18443. | 18443. | 252. | 220. | 32. | 0. | 100.0 | 87.5 |
| 1992. | 23446. | 23446. | 300. | 257. | 43. | 0. | 100.0 | 85.8 |
| 1993. | 15967. | 15967. | 241. | 216. | 24. | 0. | 100.0 | 89.8 |
| 1994. | 17191. | 17053. | 207. | 174. | 33. | 1. | 99.2 | 83.6 |
| 1995. | 19812. | 19812. | 248. | 208. | 39. | 0. | 100.0 | 84.2 |
| 1998. | 5181. | 5181. | 89. | 76. | 13. | 0. | 100.0 | 85.7 |
| 1999. | 12629. | 12629. | 185. | 159. | 26. | 0. | 100.0 | 86.1 |
| 2000. | 14471. | 14471. | 170. | 140. | 29. | 0. | 100.0 | 82.7 |
| 2001. | 11494. | 11494. | 151. | 136. | 15. | 0. | 100.0 | 89.9 |
| 2002. | 12003. | 12003. | 175. | 155. | 21. | 0. | 100.0 | 88.2 |
| 2003. | 13652. | 13652. | 184. | 157. | 27. | 0. | 100.0 | 85.5 |
| 2004. | 16378. | 16378. | 193. | 166. | 27. | 0. | 100.0 | 85.9 |
| 2005. | 11878. | 11778. | 146. | 118. | 28. | 0. | 99.2 | 80.6 |

| HD 7
Year | Flow Vol
(m3) | Flow Treated
(m3) | TSS In
(kg) | TSS Rem
(kg) | TSS Out
(kg) | TSS Byp
(kg) | Flow Treated
(%) | TSS Removal
(%) |
|--------------|------------------|----------------------|----------------|-----------------|-----------------|-----------------|---------------------|--------------------|
| 1971. | 10920. | 10713. | 135. | 118. | 17. | 0. | 98.1 | 87.1 |
| 1972. | 14038. | 12857. | 175. | 159. | 16. | 7. | 91.6 | 87.4 |
| 1973. | 13678. | 13678. | 188. | 170. | 18. | 0. | 100.0 | 90.3 |
| 1974. | 13979. | 13892. | 199. | 185. | 14. | 1. | 99.4 | 92.5 |
| 1975. | 11853. | 11853. | 173. | 154. | 19. | 0. | 100.0 | 89.1 |
| 1976. | 17640. | 17401. | 219. | 198. | 20. | 2. | 98.6 | 89.6 |
| 1977. | 18927. | 18613. | 218. | 188. | 30. | 3. | 98.3 | 85.4 |
| 1978. | 15058. | 15058. | 203. | 180. | 23. | 0. | 100.0 | 88.5 |
| 1979. | 18058. | 17866. | 234. | 211. | 23. | 1. | 98.9 | 89.7 |
| 1980. | 14531. | 14531. | 213. | 191. | 22. | 0. | 100.0 | 89.6 |
| 1981. | 20066. | 20066. | 244. | 225. | 19. | 0. | 100.0 | 92.3 |
| 1982. | 14115. | 14115. | 195. | 180. | 15. | 0. | 100.0 | 92.3 |
| 1983. | 18612. | 18581. | 251. | 227. | 24. | 0. | 99.8 | 90.4 |
| 1984. | 14998. | 14998. | 196. | 176. | 20. | 0. | 100.0 | 89.8 |
| 1985. | 13092. | 13092. | 189. | 172. | 17. | 0. | 100.0 | 91.2 |
| 1986. | 19069. | 19069. | 260. | 238. | 21. | 0. | 100.0 | 91.8 |
| 1987. | 19731. | 19653. | 263. | 238. | 25. | 0. | 99.6 | 90.2 |
| 1988. | 15866. | 15866. | 219. | 200. | 18. | 0. | 100.0 | 91.6 |
| 1989. | 17376. | 17376. | 216. | 198. | 18. | 0. | 100.0 | 91.6 |
| 1990. | 19679. | 19679. | 268. | 248. | 20. | 0. | 100.0 | 92.4 |
| 1991. | 18443. | 18443. | 252. | 230. | 22. | 0. | 100.0 | 91.3 |
| 1992. | 23446. | 23446. | 300. | 267. | 32. | 0. | 100.0 | 89.2 |
| 1993. | 15967. | 15967. | 241. | 224. | 17. | 0. | 100.0 | 92.9 |
| 1994. | 17191. | 17053. | 207. | 181. | 26. | 1. | 99.2 | 87.1 |
| 1995. | 19812. | 19812. | 248. | 217. | 30. | 0. | 100.0 | 87.9 |
| 1998. | 5181. | 5181. | 89. | 79. | 10. | 0. | 100.0 | 89.1 |
| 1999. | 12629. | 12629. | 185. | 165. | 19. | 0. | 100.0 | 89.5 |
| 2000. | 14471. | 14471. | 170. | 146. | 23. | 0. | 100.0 | 86.3 |
| 2001. | 11494. | 11494. | 151. | 142. | 10. | 0. | 100.0 | 93.7 |
| 2002. | 12003. | 12003. | 175. | 161. | 14. | 0. | 100.0 | 91.9 |
| 2003. | 13652. | 13652. | 184. | 163. | 20. | 0. | 100.0 | 89.1 |
| 2004. | 16378. | 16378. | 193. | 174. | 19. | 0. | 100.0 | 90.1 |
| 2005. | 11878. | 11778. | 146. | 125. | 21. | 0. | 99.2 | 85.3 |

| HD 8
Year | Flow Vol
(m3) | Flow Treated
(m3) | TSS In
(kg) | TSS Rem
(kg) | TSS Out
(kg) | TSS Byp
(kg) | Flow Treated
(%) | TSS Removal
(%) |
|--------------|------------------|----------------------|----------------|-----------------|-----------------|-----------------|---------------------|--------------------|
| 1971. | 10920. | 10713. | 135. | 121. | 14. | 0. | 98.1 | 89.3 |
| 1972. | 14038. | 12857. | 175. | 163. | 11. | 7. | 91.6 | 89.8 |
| 1973. | 13678. | 13678. | 188. | 174. | 14. | 0. | 100.0 | 92.6 |
| 1974. | 13979. | 13892. | 199. | 190. | 10. | 1. | 99.4 | 94.7 |
| 1975. | 11853. | 11853. | 173. | 158. | 14. | 0. | 100.0 | 91.7 |
| 1976. | 17640. | 17401. | 219. | 204. | 15. | 2. | 98.6 | 92.2 |
| 1977. | 18927. | 18613. | 218. | 196. | 22. | 3. | 98.3 | 88.8 |
| 1978. | 15058. | 15058. | 203. | 185. | 18. | 0. | 100.0 | 91.2 |
| 1979. | 18058. | 17866. | 234. | 216. | 18. | 1. | 98.9 | 91.9 |
| 1980. | 14531. | 14531. | 213. | 197. | 16. | 0. | 100.0 | 92.4 |
| 1981. | 20066. | 20066. | 244. | 231. | 13. | 0. | 100.0 | 94.6 |
| 1982. | 14115. | 14115. | 195. | 184. | 11. | 0. | 100.0 | 94.6 |



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| | | | | | | | | |
|-------|--------|--------|------|------|-----|----|-------|------|
| 1983. | 18612. | 18581. | 251. | 233. | 18. | 0. | 99.8 | 92.9 |
| 1984. | 14998. | 14998. | 196. | 182. | 14. | 0. | 100.0 | 92.8 |
| 1985. | 13092. | 13092. | 189. | 177. | 12. | 0. | 100.0 | 93.7 |
| 1986. | 19069. | 19069. | 260. | 244. | 16. | 0. | 100.0 | 94.0 |
| 1987. | 19731. | 19653. | 263. | 245. | 19. | 0. | 99.6 | 92.8 |
| 1988. | 15866. | 15866. | 219. | 205. | 13. | 0. | 100.0 | 93.9 |
| 1989. | 17376. | 17376. | 216. | 202. | 14. | 0. | 100.0 | 93.5 |
| 1990. | 19679. | 19679. | 268. | 254. | 14. | 0. | 100.0 | 94.7 |
| 1991. | 18443. | 18443. | 252. | 236. | 16. | 0. | 100.0 | 93.5 |
| 1992. | 23446. | 23446. | 300. | 275. | 25. | 0. | 100.0 | 91.7 |
| 1993. | 15967. | 15967. | 241. | 229. | 12. | 0. | 100.0 | 94.9 |
| 1994. | 17191. | 17053. | 207. | 186. | 21. | 1. | 99.2 | 89.6 |
| 1995. | 19812. | 19812. | 248. | 225. | 23. | 0. | 100.0 | 90.8 |
| 1998. | 5181. | 5181. | 89. | 82. | 7. | 0. | 100.0 | 92.0 |
| 1999. | 12629. | 12629. | 185. | 171. | 14. | 0. | 100.0 | 92.6 |
| 2000. | 14471. | 14471. | 170. | 151. | 18. | 0. | 100.0 | 89.1 |
| 2001. | 11494. | 11494. | 151. | 145. | 7. | 0. | 100.0 | 95.6 |
| 2002. | 12003. | 12003. | 175. | 165. | 10. | 0. | 100.0 | 94.4 |
| 2003. | 13652. | 13652. | 184. | 170. | 14. | 0. | 100.0 | 92.4 |
| 2004. | 16378. | 16378. | 193. | 180. | 13. | 0. | 100.0 | 93.2 |
| 2005. | 11878. | 11778. | 146. | 130. | 16. | 0. | 99.2 | 88.8 |

| HD 10
Year | Flow Vol
(m3) | Flow Treated
(m3) | TSS In
(kg) | TSS Rem
(kg) | TSS Out
(kg) | TSS Byp
(kg) | Flow Treated
(%) | TSS Removal
(%) |
|---------------|------------------|----------------------|----------------|-----------------|-----------------|-----------------|---------------------|--------------------|
| 1971. | 10920. | 10713. | 135. | 125. | 9. | 0. | 98.1 | 92.9 |
| 1972. | 14038. | 12857. | 175. | 168. | 7. | 0. | 91.6 | 92.3 |
| 1973. | 13678. | 13678. | 188. | 181. | 7. | 0. | 100.0 | 96.1 |
| 1974. | 13979. | 13892. | 199. | 193. | 6. | 1. | 99.4 | 96.5 |
| 1975. | 11853. | 11853. | 173. | 164. | 9. | 0. | 100.0 | 95.1 |
| 1976. | 17640. | 17401. | 219. | 209. | 9. | 2. | 98.6 | 94.7 |
| 1977. | 18927. | 18613. | 218. | 205. | 13. | 3. | 98.3 | 93.0 |
| 1978. | 15058. | 15058. | 203. | 194. | 9. | 0. | 100.0 | 95.5 |
| 1979. | 18058. | 17866. | 234. | 223. | 11. | 1. | 98.9 | 94.6 |
| 1980. | 14531. | 14531. | 213. | 203. | 10. | 0. | 100.0 | 95.4 |
| 1981. | 20066. | 20066. | 244. | 237. | 7. | 0. | 100.0 | 97.0 |
| 1982. | 14115. | 14115. | 195. | 190. | 5. | 0. | 100.0 | 97.4 |
| 1983. | 18612. | 18581. | 251. | 240. | 11. | 0. | 99.8 | 95.5 |
| 1984. | 14998. | 14998. | 196. | 189. | 7. | 0. | 100.0 | 96.4 |
| 1985. | 13092. | 13092. | 189. | 183. | 6. | 0. | 100.0 | 96.8 |
| 1986. | 19069. | 19069. | 260. | 251. | 9. | 0. | 100.0 | 96.6 |
| 1987. | 19731. | 19653. | 263. | 253. | 10. | 0. | 99.6 | 95.9 |
| 1988. | 15866. | 15866. | 219. | 212. | 7. | 0. | 100.0 | 96.9 |
| 1989. | 17376. | 17376. | 216. | 207. | 9. | 0. | 100.0 | 95.8 |
| 1990. | 19679. | 19679. | 268. | 260. | 8. | 0. | 100.0 | 97.0 |
| 1991. | 18443. | 18443. | 252. | 242. | 10. | 0. | 100.0 | 96.1 |
| 1992. | 23446. | 23446. | 300. | 286. | 14. | 0. | 100.0 | 95.5 |
| 1993. | 15967. | 15967. | 241. | 235. | 6. | 0. | 100.0 | 97.5 |
| 1994. | 17191. | 17053. | 207. | 193. | 14. | 1. | 99.2 | 92.8 |
| 1995. | 19812. | 19812. | 248. | 233. | 15. | 0. | 100.0 | 94.0 |
| 1998. | 5181. | 5181. | 89. | 85. | 3. | 0. | 100.0 | 96.2 |
| 1999. | 12629. | 12629. | 185. | 177. | 8. | 0. | 100.0 | 95.8 |
| 2000. | 14471. | 14471. | 170. | 159. | 11. | 0. | 100.0 | 93.6 |
| 2001. | 11494. | 11494. | 151. | 148. | 3. | 0. | 100.0 | 97.8 |
| 2002. | 12003. | 12003. | 175. | 170. | 5. | 0. | 100.0 | 97.1 |
| 2003. | 13652. | 13652. | 184. | 176. | 8. | 0. | 100.0 | 95.8 |
| 2004. | 16378. | 16378. | 193. | 186. | 7. | 0. | 100.0 | 96.4 |
| 2005. | 11878. | 11778. | 146. | 136. | 11. | 0. | 99.2 | 92.4 |

| HD 12
Year | Flow Vol
(m3) | Flow Treated
(m3) | TSS In
(kg) | TSS Rem
(kg) | TSS Out
(kg) | TSS Byp
(kg) | Flow Treated
(%) | TSS Removal
(%) |
|---------------|------------------|----------------------|----------------|-----------------|-----------------|-----------------|---------------------|--------------------|
| 1971. | 10920. | 10713. | 135. | 129. | 5. | 0. | 98.1 | 95.8 |
| 1972. | 14038. | 12857. | 175. | 171. | 4. | 7. | 91.6 | 93.9 |
| 1973. | 13678. | 13678. | 188. | 185. | 4. | 0. | 100.0 | 98.0 |
| 1974. | 13979. | 13892. | 199. | 196. | 4. | 1. | 99.4 | 97.8 |
| 1975. | 11853. | 11853. | 173. | 167. | 5. | 0. | 100.0 | 96.9 |
| 1976. | 17640. | 17401. | 219. | 213. | 6. | 2. | 98.6 | 96.4 |
| 1977. | 18927. | 18613. | 218. | 210. | 8. | 3. | 98.3 | 95.4 |
| 1978. | 15058. | 15058. | 203. | 198. | 5. | 0. | 100.0 | 97.6 |
| 1979. | 18058. | 17866. | 234. | 228. | 6. | 1. | 98.9 | 96.7 |
| 1980. | 14531. | 14531. | 213. | 208. | 5. | 0. | 100.0 | 97.6 |
| 1981. | 20066. | 20066. | 244. | 240. | 4. | 0. | 100.0 | 98.4 |
| 1982. | 14115. | 14115. | 195. | 193. | 2. | 0. | 100.0 | 98.8 |
| 1983. | 18612. | 18581. | 251. | 244. | 6. | 0. | 99.8 | 97.4 |
| 1984. | 14998. | 14998. | 196. | 192. | 4. | 0. | 100.0 | 97.9 |
| 1985. | 13092. | 13092. | 189. | 186. | 3. | 0. | 100.0 | 98.4 |
| 1986. | 19069. | 19069. | 260. | 256. | 4. | 0. | 100.0 | 98.4 |
| 1987. | 19731. | 19653. | 263. | 257. | 6. | 0. | 99.6 | 97.6 |
| 1988. | 15866. | 15866. | 219. | 215. | 4. | 0. | 100.0 | 98.3 |
| 1989. | 17376. | 17376. | 216. | 211. | 5. | 0. | 100.0 | 97.5 |
| 1990. | 19679. | 19679. | 268. | 264. | 5. | 0. | 100.0 | 98.3 |
| 1991. | 18443. | 18443. | 252. | 246. | 6. | 0. | 100.0 | 97.7 |
| 1992. | 23446. | 23446. | 300. | 292. | 7. | 0. | 100.0 | 97.6 |
| 1993. | 15967. | 15967. | 241. | 238. | 3. | 0. | 100.0 | 98.8 |
| 1994. | 17191. | 17053. | 207. | 197. | 10. | 1. | 99.2 | 94.9 |
| 1995. | 19812. | 19812. | 248. | 238. | 10. | 0. | 100.0 | 96.2 |
| 1998. | 5181. | 5181. | 89. | 87. | 2. | 0. | 100.0 | 97.8 |
| 1999. | 12629. | 12629. | 185. | 181. | 4. | 0. | 100.0 | 97.8 |



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| | | | | | | | | |
|-------|--------|--------|------|------|----|----|-------|------|
| 2000. | 14471. | 14471. | 170. | 164. | 6. | 0. | 100.0 | 96.6 |
| 2001. | 11494. | 11494. | 151. | 150. | 2. | 0. | 100.0 | 98.9 |
| 2002. | 12003. | 12003. | 175. | 172. | 3. | 0. | 100.0 | 98.4 |
| 2003. | 13652. | 13652. | 184. | 179. | 4. | 0. | 100.0 | 97.6 |
| 2004. | 16378. | 16378. | 193. | 189. | 4. | 0. | 100.0 | 97.9 |
| 2005. | 11878. | 11778. | 146. | 139. | 7. | 0. | 99.2 | 95.1 |

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

| Rainfall Intensity (mm/h) | Flow (L/s) | Percentage % |
|---------------------------|------------|--------------|
| 1.50 | 1.3 | NaN |
| 2.25 | 1.9 | NaN |
| 3.00 | 2.5 | NaN |
| 3.75 | 3.1 | NaN |
| 4.75 | 4.0 | NaN |
| 5.75 | 4.8 | NaN |
| 8.00 | 6.7 | NaN |
| 10.00 | 8.3 | NaN |
| 15.50 | 12.9 | NaN |
| 23.25 | 19.4 | NaN |

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

Hydroworks Sizing Program V. 5.8.5
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| Date | Time | Flow | Total Su |
|---------------------|--------|---------|----------|
| Mo/Da/Year | Hr:Min | cum/s | mg/l |
| ----- | ----- | ----- | ----- |
| Flow wtd means.... | | 0.000 | 146. |
| Flow wtd std devs.. | | 0.001 | 61. |
| Maximum value..... | | 0.211 | 292. |
| Minimum value..... | | 0.000 | 0. |
| Total loads..... | | 46709. | 6813. |
| | | 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... May      27, 2026              *
* Time...           11: 8: 1.729                  *
* Ending Date... May      27, 2026              *
* Time...           11: 8: 4.169                  *
* Elapsed Time...     0.041 minutes.              *
* Elapsed Time...     2.440 seconds.              *
*****
```



**UPPER CANADA
CONSULTANTS**
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APPENDIX F

Sample OGS Inspection Report

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 350mm 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: | |