UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

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FUNCTIONAL SERVICING REPORT

8168 McLeod Road, Niagara Falls
18 Townhouse Units
City of Niagara Falls
June 2024

INTRODUCTION

This report is to address the servicing needs for the 18 townhouse unit development located at 8168 McLeod Road, south of McLeod Road, west of Pin Oak Drive, and east of Kalar Road. This property has existing sanitary and storm services at the northern property line which were designed and constructed to service the subject property.

The development site is 0.8 hectares and shall consist of 18 townhouses, with each townhouse having an accessory dwelling allowing for an extra 18 units for a total of 36 units. The site shall include associated asphalt road and parking, concrete curb, catch basins, storm sewers, sanitary sewers and watermain.

Currently, the subject lands consist of one two-storey single-family residential dwelling.

The objectives of this study are as follows:

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

WATER SERVICING

There is an existing 50mm diameter service that connects to a 300mm diameter watermain located on McLeod Road fronting the site, which will be decommissioned as part of the development. It is proposed to extend a 200mm diameter watermain within the site from the existing 300mm diameter watermain on McLeod Road to provide domestic water supply and fire protection. A proposed fire hydrant will be located within the site on the west side of the proposed access route, that will provide adequate fire protection for the entire site. Spacing for the hydrant to the site entrance has been provided per Ontario Building Code Requirements section 3.10.3.4. The access route for the proposed development is 6m wide, as per the requirements of the Ontario Building Code section 3.2.5.6.

The City of Niagara Falls requires a minimum of 150 L/s for available fire flow for townhouse units and 200 L/s for stacked townhouse units. A hydrant flow test was conducted for the hydrant located

at 8196 McLeod Road, approximately 6.17m north of the northeast limits of the subject lands. Calculations were undertaken that indicate a 150mm diameter watermain for this site is unsuitable, providing only 140L/s which is less then required by City Standards. A continuous 200 mm diameter watermain to the central hydrant will provide 272 L/s for fire flow purposes. Therefore, a 200mm diameter watermain will provide sufficient fire flow for townhouse units and stacked townhouse units. Results of the hydrant flow test and the corresponding calculations have been included in Appendix H.

Calculations for the peak domestic water demand were conducted for the maximum daily flow and maximum hourly flow using the Ministry of the Environment Design Guidelines for Drinking-Water Systems. To calculate the peak domestic water demand, the MOE guidelines suggest a domestic water demand between 250 to 450 L/(cap*day). Therefore, a conservative domestic water demand of 450 L/(cap*day) was used to determine the peak domestic water demand for this site. The population of the site was estimated to be 55 people assuming 1.55 persons per unit and 36 units. Peaking factors for the maximum daily demand and maximum hourly demand were taken from the MOE Guidelines for a population of less then 500 people and is summarized in table 1 below.

Table 1. Water Demand Calculations

	Maximum Daily Flow	Maximum Hourly Flow
Peaking Factor	2.75	4.13
Peak Domestic Water Demand (L/s)	0.79	1.18

The peak domestic water demand for the site is the greater of the maximum daily demand and maximum hourly demand. Therefore, the peak domestic water demand is 1.18 L/s as seen in Table 1 above.

The combined required fire flow for fire protection and peak hourly domestic water supply flow is 201.18L/s. Therefore, the proposed 200mm diameter watermain will have sufficient capacity to provide domestic water supply and fire protection for the proposed site, since it shall provide a flow 272 L/s.

SANITARY SERVICING

There is an existing manhole at the property line and 200mm diameter sanitary sewer at the northern limit of the site which connects to the existing 600mm diameter sanitary sewer located on McLeod Road that was designed and constructed to service this site. It is proposed to extend a 200mm diameter sanitary sewer to service the proposed townhouse units. The peak sanitary flow from the site shall be approximately 0.90 L/s which is approximately 4.2% of the capacity of the existing 200mm diameter sewer and 0.3% of the capacity of the 600mm diameter sewer on McLeod Road. See Appendix A for the Sanitary Drainage Areas and Appendix B for the Sanitary Sewer Design Sheet. Therefore, the existing 200mm diameter stub and existing 600mm diameter sanitary sewer shall have adequate capacity for the proposed townhouses.

The proposed site shall convey sanitary flows to the South Niagara Falls sanitary system. Therefore, a wet and dry weather flow analysis is required by the Region of Niagara to ensure the system has adequate capacity throughout the sanitary sewer's lifecycle. Table 2 summarizes the corresponding wet and dry weather sanitary flows generated from the site.

Table 2. Wet and Dry Weather Flow Analysis	
Residential Dry Weather Flow	
255 L/cap/day - 54 *persons*	13,770 L/day
Allowable Leakage per OPSS.MUNI 410	
0.075 L/mm diameter/100m of sewer/hour - *200 mm dia, 126.5m total sewer length*	455 L/day
Maximum Infiltration Allowance as Provided by the City of Niagara Falls	
0.286 L/s/ha – *0.61 ha*	15,073 L/day

STORMWATER MANAGEMENT

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

New developments are required to provide stormwater management in accordance with provincial and municipal policies including the Stormwater Management Planning and Design Manual (MOE, March 2004)

The proposed development is located within the relocated Warren Creek watershed. The Warren Creek Watershed Master Plan (2002) and Municipal Class Environmental Assessment Warren Creek Watershed Plan Implementation (2007) outline a comprehensive strategy for the rechannelization and restoration of the two branches of Warren Creek within the study area and the management of stormwater flows. These documents identified the following stormwater management constraints/issues related to the proposed development of 8168 McLeod Road.

The storm drainage outlet for the proposed development is Warren Creek at the southwest limits of the site, upstream of the Brown Road culvert. The Warren Creek Watershed Master Plan (June 2000) and the Municipal Class Environmental Assessment - Warren Creek Watershed Plan Implementation (November 2007) indicates that the Warren Creek system has been designed to accommodate stormwater peak flows from a fully urbanized drainage area. Therefore, stormwater **quantity** controls are not required.

The criteria provided by the City of Niagara Falls and the Region of Niagara requires to improve stormwater **quality** levels to MECP Enhanced Protection (80% TSS removal) levels prior to discharge from the site.

Existing Conditions

The site presently contains one single family dwelling, with a majority of the area being open space. The subject land is relatively flat, with storm water flows directed towards Warren Creek. The existing drainage areas have been assessed and are shown in Figure 2 (Appendix C).

As part of the McLeod Road reconstruction and urbanization, the City of Niagara Falls installed a 375mm diameter PVC stub for future development of this site. However, the elevation of the stub is above the lowest point of the proposed on-site storm sewer and therefore, it is irrelevant. This stub connects to the existing storm sewer on McLeod Road that ultimately outlets to Warren Creek.

Proposed Conditions

The proposed residential development shall consist of approximately 18 townhouse units, roadways and walkways. The future lands drainage areas have been assessed and are shown in Figure 3 (Appendix C). The proposed stormwater management plan will collect flows from the site via catch basins and discharge to Warren Creek at the southwest corner of the site. See Appendix D for the Proposed Storm Sewer Design Sheet.

Quality Controls

To improve stormwater quality levels to Enhanced Protection (80% TSS removal) levels prior to discharging from this site, an oil/grit separator is proposed. The contributing Drainage Area to the proposed Oil/Grit Separator is approximately 0.61 hectares with a conservatively assumed impervious coverage of 71.4%. The modelling for a Hydroworks unit has indicated that an HD4 will provide 83% TSS overall removal and capture 98% of the stormwater flows. Therefore, the Hydroworks HD4 is proposed for this site development. Output calculations for the quality assessment can be found in Appendix F.

Permitted Uses in the Floodplain

There is an identified flood plain within the site. The majority of the flood plain within the site consists of a spill area. As outlined in the Niagara Peninsula Conservation Authority's Polices, Procedures and Guidelines for the Administration of Ontario Regulation 155/06 and Land Use Planning Policy Document section 6.2.12.2, flow that occurs in these areas are not considered part of the natural floodplain, hence preservation of flood storage is not required. Areas within the spill area have had grading modifications conducted as per Niagara Peninsula Conservation Authority's policies and regulations. All dwellings are located outside the floodplain limits and the flood plain is consistent and remains unchanged, a Cut/Fill Analysis can be found in Appendix E. The 100 year design storm event will flow overland to Warren Creek and will not impact the storm infrastructure within the floodplain.

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MAINTENANCE OF STORMWATER MANAGEMENT FACILITY

HD4 Oil/Grit Separator

The HD 4 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 G 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 proposed 200mm diameter watermain will have sufficient capacity to provide both domestic water supply and fire protection.

2. The existing sanitary sewer on McLeod Road will have adequate capacity for the proposed development.

3. Quantity Controls are not required, since the Warren Creek system has been designed to accommodate stormwater peak flows from a fully urbanized drainage area .

4. Stormwater quality protection will be provided by a Hydroworks HD4 oil/grit separator or approved equivalent to Enhanced Protection (80% TSS removal) levels.

5. The site extreme stormwater overland route is to Warren Creek.

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

Yours very truly,

Adam Keane, P.Eng.
June 13, 2024

Encl.

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APPENDICES

UPPER CANADA CONSULTANTS
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APPENDIX A

Sanitary Sewer Drainage Areas

LEGEND

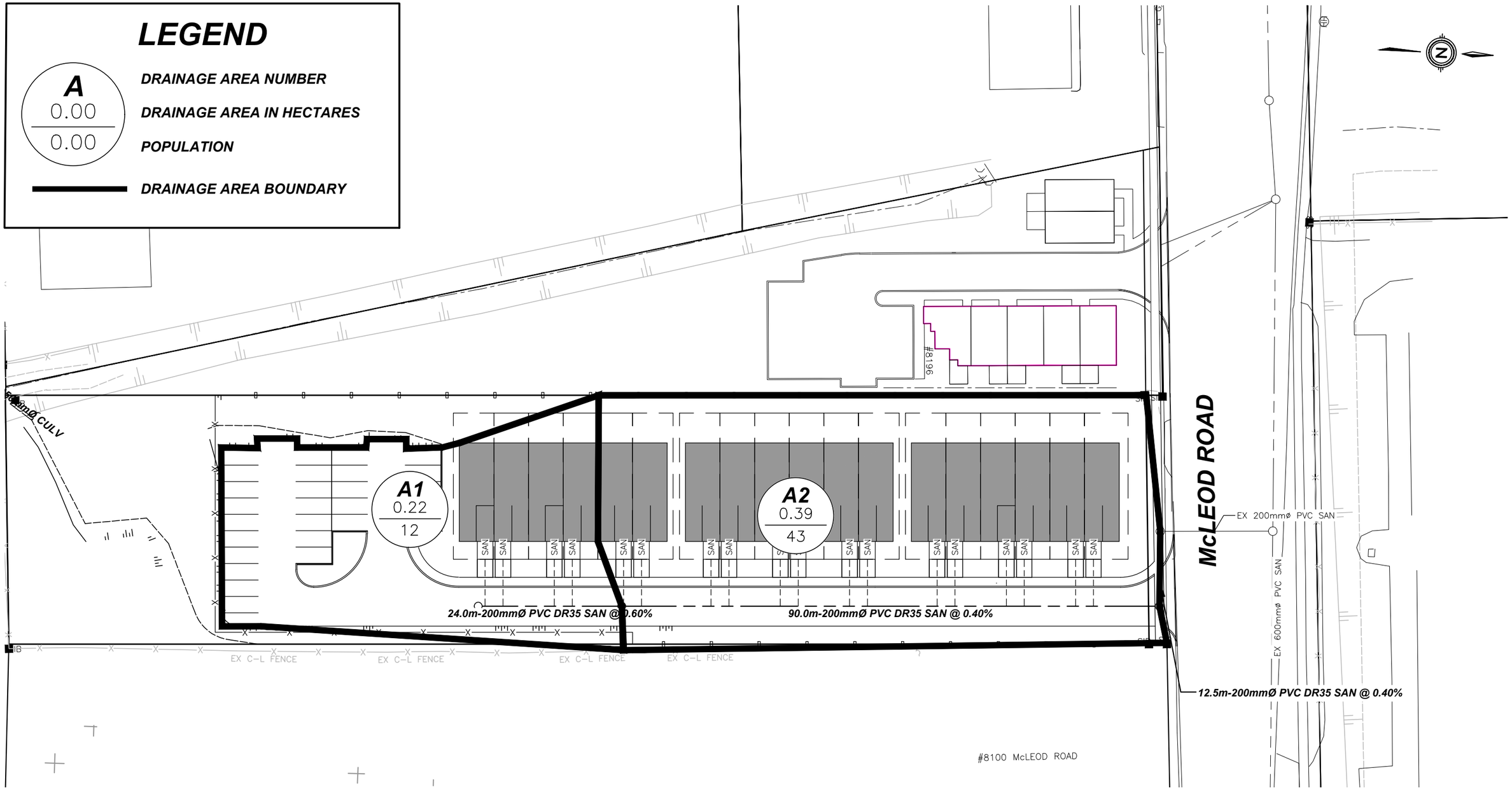
A
0.00
0.00

DRAINAGE AREA NUMBER

DRAINAGE AREA IN HECTARES

POPULATION

DRAINAGE AREA BOUNDARY



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8168 McLEOD ROAD
CITY NIAGARA FALLS
SANITARY DRAINAGE AREAS

DATE	2024–02–16
SCALE	NTS
REF No.	.
DWG No.	***FIGURE 1***

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APPENDIX B

Sanitary Sewer Design Sheet

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

DESIGN FLOWS

RESIDENTIAL: 255 LITRES/PERSON/DAY (NIAGARA FALLS AVERAGE DAILY FLOW)
INFILTRATION RATE: 0.286 LITRES/HECTARE (M.O.E FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 LITRES/HECTARE)
POPULATION / UNIT: 1.55 PERSONS

SEWER DESIGN

PIPE ROUGHNESS: 0.013 FOR MANNING'S EQUATION
PIPE SIZES: 1.016 IMPERIAL EQUIVALENT FACTOR
PERCENT FULL: TOTAL PEAK FLOW / CAPACITY
PEAKING FACTOR = when P<1710, PF=4.5
P>1710, PF=5/((P/1000)^0.2)

MUNICIPALITY: CITY OF NIAGARA FALLS
PROJECT : 8168 McLeod Road
PROJECT NO: 2232

S A N I T A R Y S E W E R D E S I G N S H E E T

LOCATION			AREA		POPULATION		ACCUMULATED PEAK FLOW				DESIGN FLOW					
Description	From M.H	To M.H.	Increment (hectares)	Accumulated (hectares)	Population Increment	Total Population Served (P)	Peaking Factor (PF)	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
A1	A	B	0.22	0.22	12	12	4.50	0.16	0.06	0.22	24.0	200	0.60	0.8	26.50	0.8%
A2	B	C	0.39	0.61	43	55	4.50	0.73	0.17	0.90	90.0	200	0.40	0.7	21.64	4.2%
A3	C	EX MH	0.00	0.61	0	55	4.50	0.73	0.17	0.90	12.5	200	0.40	0.7	21.64	4.2%
EX SAN SERVICE TO SITE	EX MH	EX SEWER								0.90		200	0.40	0.7	21.64	4.2%
EX SAN SEWER ON MCLEOD	EX MH	EX SEWER								0.90		600	0.18	0.9	271.77	0.3%

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APPENDIX C

Existing Storm Drainage Area Plan
Future Storm Drainage Area Plan

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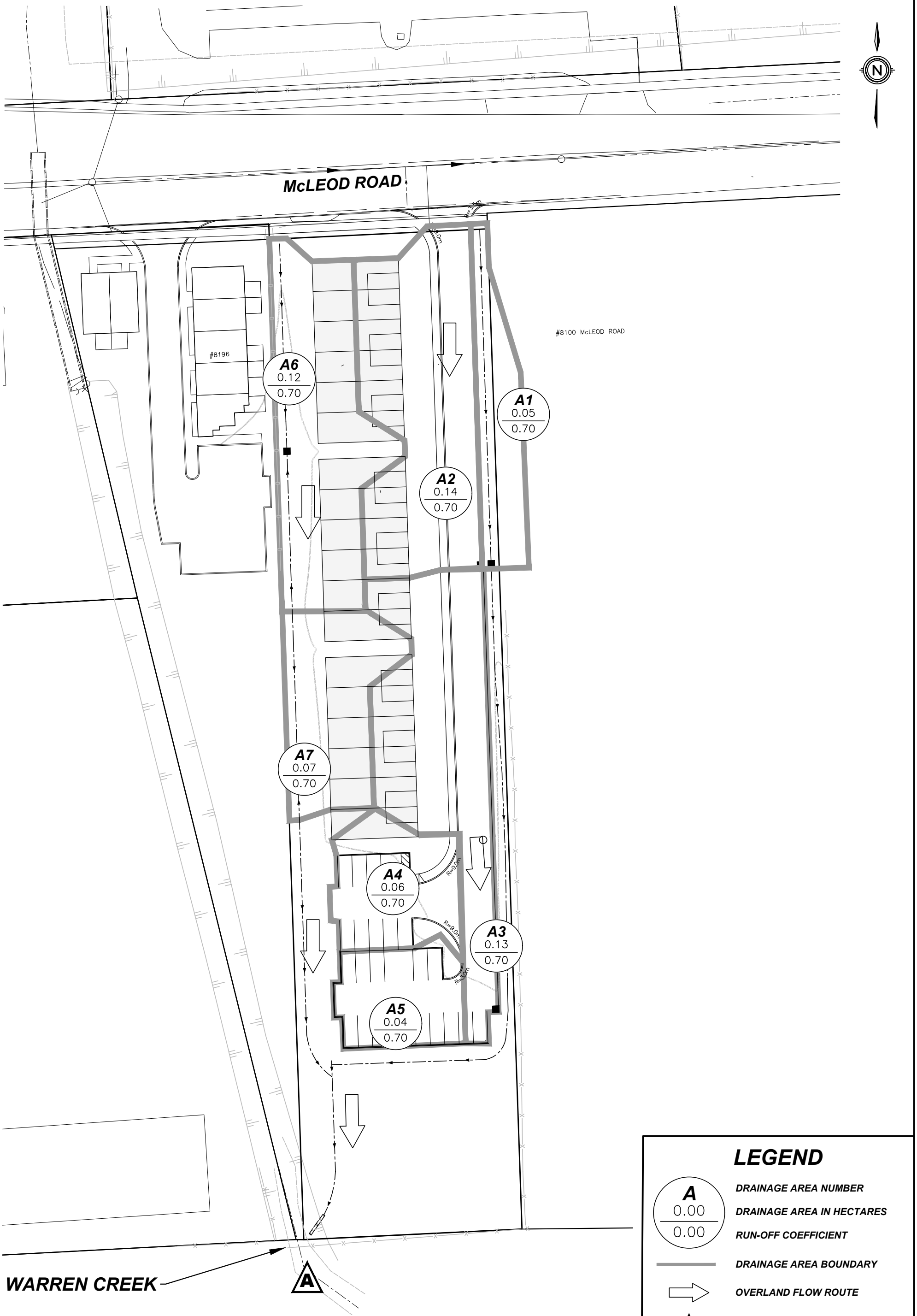
8168 MCLEOD ROAD, NIAGARA FALLS
EXISTING STORM DRAINAGE AREA PLAN

DATE	2024-02-01
SCALE	1:500m
REF No.	2232
DWG No.	FIGURE 2



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8168 MCLEOD ROAD, NIAGARA FALLS
FUTURE STORM DRAINAGE AREA PLAN

DATE	2024-02-01
SCALE	1:500 m
REF No.	2232
DWG No.	FIGURE 3

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APPENDIX D

Storm Sewer Design Sheet

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

RAINFALL PARAMETERS: A = 719.50 mm/hr
5 YEAR DESIGN STORM EVENT B = 6.34 minutes
CITY OF NIAGARA FALLS IDF C = 0.769

SEWER DESIGN: PIPE ROUGHNESS: 0.013 FOR MANNING'S EQUATION
PIPE SIZES: 1.016 ACTUAL DIAMETER SIZE FACTOR
PERCENT FULL: TOTAL PEAK FLOW / CAPACITY

MUNICIPALITY: CITY OF NIAGARA FALLS
PROJECT NAME: 8168 MCLEOD ROAD
PROJECT NO.: 2232

STORM SEWER DESIGN SHEET

LOCATION			STORMWATER ANALYSIS								STORM SEWER DESIGN					
DESCRIPTION	From	To	A Area (hectares)	R Runoff Coeff.	A*R	Accumulated A*R	Time of Concentration (min)	Flow Time (min.)	Rainfall Intensity (mm/hr)	Peak Flow (L/s)	Length (m)	Nominal Diameter (mm.)	Slope (%)	Full Flow Capacity (L/s)	Full Flow Velocity (m/s)	Percent Full
A1	CB'7'	CB'8'	0.05	0.70	0.035	0.035	10.00	0.03	84.0	8.2	2.1	200	1.00	34.2	1.1	23.9%
A2	CB'8'	MH'3'	0.14	0.70	0.098	0.133	10.03	1.21	83.8	31.0	52.5	250	0.35	36.7	0.7	84.4%
A3	MH'3'	CBMH'3'	0.13	0.70	0.091	0.224	11.24	0.52	79.4	49.4	25.7	300	0.35	59.7	0.8	82.7%
A4	CBMH'3'	CBMH2	0.06	0.70	0.042	0.266	11.63	0.39	78.0	57.7	19.0	300	0.35	59.7	0.8	96.6%
A5	CB'4'	CBMH'2'	0.04	0.70	0.028	0.028	10.00	0.55	84.0	6.5	24.8	200	0.50	24.2	0.7	27.0%
	CBMH'2'	MH'1'				0.294	12.18	0.20	76.2	62.3	8.5	375	0.20	81.8	0.7	76.1%
A6	CB'6'	CB'5'	0.12	0.70	0.084	0.084	10.00	1.97	84.0	19.6	64.6	250	0.20	27.7	0.5	70.6%
A7	CB'5'	MH'1'	0.07	0.70	0.049	0.133	11.97	1.23	76.9	28.4	45.8	300	0.20	45.1	0.6	63.0%

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APPENDIX E

Cut/Fill Analysis

FLOOD VOLUMES TABLE

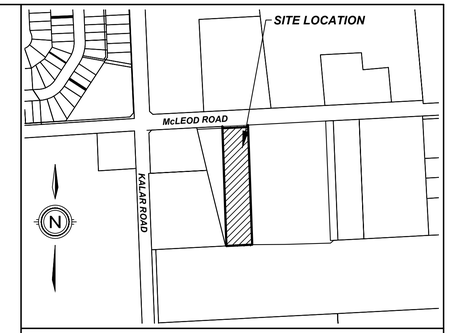
MINIMUM ELEVATION	MAXIMUM ELEVATION	CUT	FILL	NET
181.33	181.63	61.83	36.45	−25.38
181.03	181.33	55.56	74.93	19.37
180.73	181.03	96.79	46.30	−50.49
180.43	180.73	130.03	5.33	−124.70
180.13	180.43	3.47	0.00	−3.47
Total	–	347.68	163.01	−184.67

LEGEND

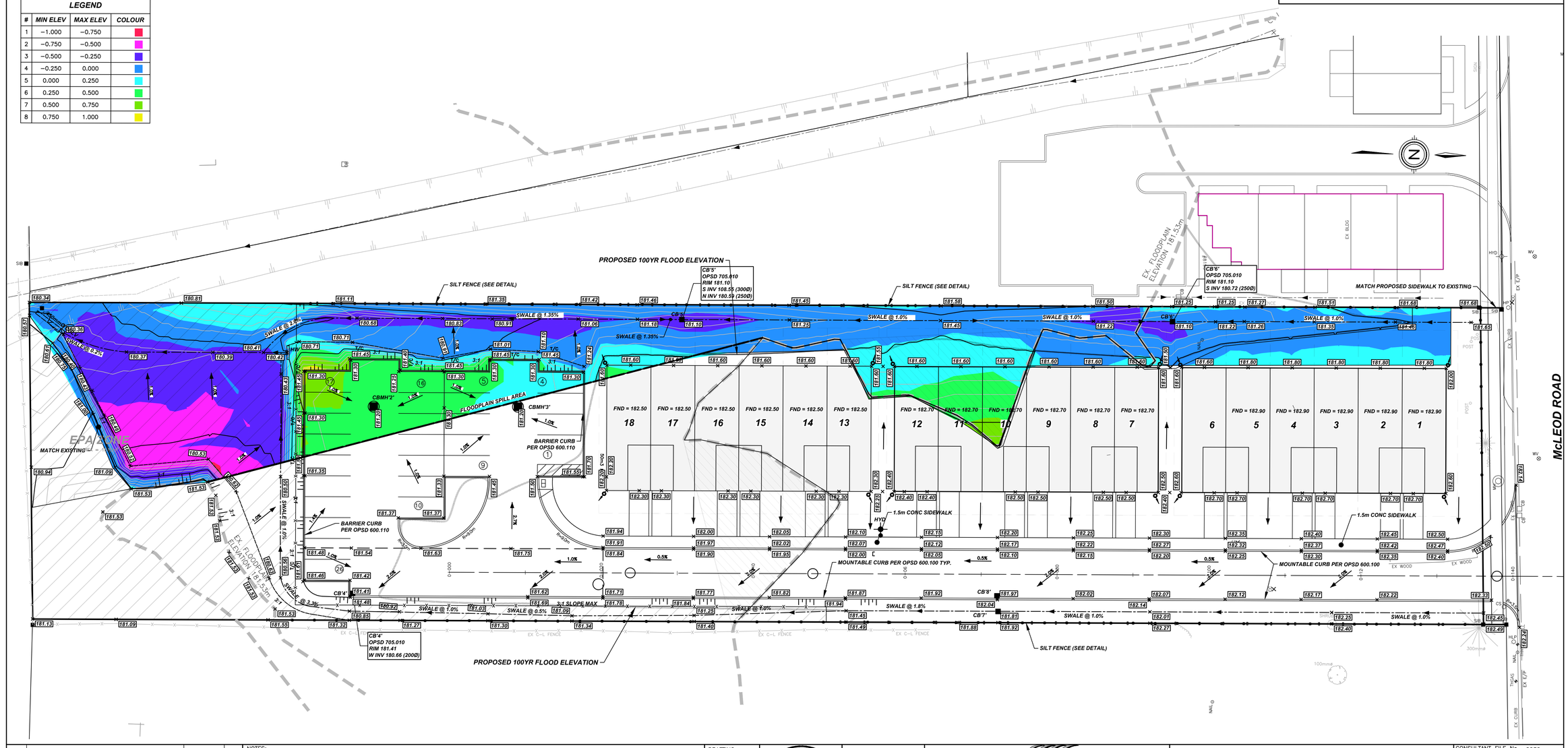
#	MIN ELEV	MAX ELEV	COLOUR
1	−1.000	−0.750	
2	−0.750	−0.500	
3	−0.500	−0.250	
4	−0.250	0.000	
5	0.000	0.250	
6	0.250	0.500	
7	0.500	0.750	
8	0.750	1.000	

Jun 19 2023 15.80PM; BASE SURFACE:EG; FINISHED SURFACE :FG; CUT FACTOR:1.0; FILL FACTOR:1.0

AREA	TOTAL AREA	TOPSOIL	CUT	FILL	NET	STRIPPING	PREGRADE
ID	m^2	m^3	m^3	m^3	m^3	depth	depth
AREA1	2256	0	345	186	159.8	0	0
TOTALS:	2256	0.0	345.3	185.5	159.8		



KEY PLAN
N.T.S.



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.	.	.	.
.	.	.	.
1	ISSUED FOR SITE PLAN APPROVAL	2024–06–12	Z.B.
#	REVISION	DATE	INIT

NOTES:
1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER, AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
2. PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.
3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING	M.C.
DESIGN	M.C.
CHECKED BY	A.K
APPROVED BY	A.K

LICENSED PROFESSIONAL ENGINEER
A. S. KEANE
100109861
Jun/12/24
PROVINCE OF ONTARIO

NiagaraFalls CANADA
UPPER CANADA CONSULTANTS
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8168 MCLEOD ROAD
CITY OF NIAGARA FALLS
CUT AND FILL

CONSULTANT FILE No.	2232
DATE	2024–06–12
PRINTED	2024–06–12
SCALE	1:250 m
REF No.	-
DWG No.	2232-C+F
REV	

DRAWING FILE: F:\2232\Engineering\2232-BASE 5JUN 19 – CUT&FILL-VOLUMES BY SLICES.DWG PLOTTED: Jun 12, 2024 – 2:49pm PLOTTED BY: zach

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APPENDIX F

Hydroworks Modelling Output

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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 *
        ************************************************
        8168 McLeod Road
        City of Niagara Falls
        HydroDome Simulation
    ########################################
    #  Precipitation Block Input Commands  #
    ########################################
   Station Name.........................  St. Catherines A
   Station Location.....................  Ontario
   Station, ISTA........................    7287
   Beginning date, IYBEG (Yr/Mo/Dy).....  1971/ 1/ 1
   Ending date, IYEND (Yr/Mo/Dy).........  2005/12/31
   Minimum interevent time, MIT..........     1
   Number of ranked storms, NPTS.........    10
   NWS format, IFORM (See text)..........     1
   Print storm summary, ISUM (O-No 1-Yes)     0
   Print all rainfall, IYEAR (O-No 1-Yes)     0
   Save storm event data on NSCRAT(1)....     0
   (IFILE =0 -Do not save, =1 -Save data)
   IDECID 0 - Create interface file
          1 - Create file and analyze
          2 - Synoptic analysis..........     2
   Plotting position parameter, A........  0.40
   Storm event statistics, NOSTAT........  1100
   KODEA (from optional group B0)........     2
    = 0, Do not include NCDC cumulative values.
    = 1, Average NCDC cumulative values.
    = 2, Use NCDC cumulative value as inst. rain.
   KODEPR (from optional group B0).......     0
    Print NCDC special codes in event summary:
    = 0, only on days with events.
    = 1, on all days with codes present.
    Codes: A = accumulated value, I = incomplete value,
           M = missing value,     O = other code present
*********************************************************
*  Precipitation output created using the Rain block    *
*  Number of precipitation stations...         1        *
*********************************************************
Location Station Number
-------- --------------
       1.     7287
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       #
##################################################
                  8168 McLeod Road
                  City of Niagara Falls
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.
Wet/Dry time step length (seconds)...                   450.
Simulation length is......                     20051231.0 Yr/Mo/Dy
Percent of impervious area with zero detention depth    25.0
Horton infiltration model being used
Rate for regeneration of infiltration = REGEN * DECAY
DECAY is read in for each subcatchment
REGEN = ..........................................   0.01000
*********************************************************
*   Processed Precipitation will be read from file     *
*********************************************************
  ##############################
  #        Data Group F1       #
  # Evaporation Rate (mm/day)  #
  ##############################
 JAN.  FEB.  MAR.  APR.  MAY   JUN.  JUL.  AUG.  SEP.  OCT.  NOV.  DEC.
 ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----
 0.00  0.00  0.00  2.54  2.54  3.81  3.81  3.81  2.54  2.54  0.00  0.00
*********************************************************
*         C H A N N E L  A N D  P I P E  D A T A         *
*********************************************************
Input   NAMEG:     Drains                          Invert  L Side   R Side  Intial     Max  Mann-   Full
equen  Channel      to     Channel  Width  Length   Slope   Slope    Slope   Depth    Depth   ings   Flow
umber    ID #      NGTO:    Type     (m)    (m)     (m/m)   (m/m)    (m/m)    (m)      (m)    "N"   (cms)
-----  ------------------ -------- ------ -------   ------- -------- ------- -------  ------- -----  -----
  1        201        200   Dummy     0.0     0.0    0.0000   0.0000  0.0000     0.0      0.0  0.0000 0.00E+00
 *****************************************************
 *          S U B C A T C H M E N T  D A T A          *
 *****************************************************
*NOTE. SEE LATER TABLE FOR OPTIONAL SUBCATCHMENT PARAMETERS*
      SUBCATCH-  CHANNEL      WIDTH    AREA  PERCENT    SLOPE    RESISTANCE  FACTOR    DEPRES. STORAGE(MM) INFILTRATION
DECAY RATE GAGE  MAXIMUM
       MENT NO.  OR INLET       (M)    (HA)  IMPERV.    (M/M)     IMPERV.     PERV.    IMPERV.     PERV.       RATE(MM/HR)
(1/SEC)    NO.  VOLUME
                                                                                                              MAXIMUM
MINIMUM                      (MM)
 ---  --------   -------- --------- --------  -----   -------    -------  --------    ------    ------     ----   -----
--  -------  ------ -------
  1        300        200     78.10     0.61  71.40    0.0200      0.015     0.250     0.510     5.080    63.50   10.16
0.00055     1  101.60000
```

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```
TOTAL NUMBER OF SUBCATCHMENTS...              1
TOTAL TRIBUTARY AREA (HECTARES).           0.61
IMPERVIOUS AREA (HECTARES)......           0.44
PERVIOUS AREA (HECTARES)........           0.17
TOTAL WIDTH (METERS)............          78.10
PERCENT IMPERVIOUSNESS..........          71.40
*********************************************************
*      G R O U N D W A T E R   I N P U T   D A T A      *
*********************************************************
```

SUB-CATCH NUMBER	CHANNEL OR INLET	ELEVATIONS GROUND (M)	BOTTOM (M)	STAGE (M)	BC (M)	TW (M)	FLOW CONSTANTS A1 (MM/HR-M^B1)	B1	A2 (MM/HR-M^B2)	B2	A3 (MM/HR-M^2)
0	602	3.05	0.00	0.00	0.61	0.61	3.484E-04	2.600	0.000E+00	1.000	0.00E+00

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

S O I L P R O P E R T I E S

SUBCAT. NO.	POROSITY	SATURATED HYDRAULIC CONDUCTIVITY (mm/hr)	WILTING POINT	FIELD CAPACITY	INITIAL MOISTURE	MAX. DEEP PERCOLATION (mm/hr)	PERCOLATION PARAMETERS HCO	PCO	ET PARAMETERS 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.....
    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        #
#############################################
```

LAND USE NAME)	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 FRACTION (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

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```
##############################################
#     Constituent data on data group J3      #
##############################################
                                Total Su
                                --------
Constituent units.........      mg/l
Type of units.............           0
KALC......................           2
Type of buildup calc.....    EXPONENTIAL(2)
KWASH.....................           0
Type of washoff calc.....  POWER EXPONEN.(0)
KACGUT....................           1
Dependence of buildup....          AREA(1)
LINKUP....................           0
Linkage to snowmelt......   NO SNOW LINKAGE
Buildup param 1 (QFACT1).         28.020
Buildup param 2 (QFACT2).          0.500
Buildup param 3 (QFACT3).         67.250
Buildup param 4 (QFACT4).          0.000
Buildup param 5 (QFACT5).          0.000
Washoff power (WASHPO)...          1.100
Washoff coef. (RCOEF)....          0.086
Init catchb conc (CBFACT)        100.000
Precip. conc. (CONCRN)...          0.000
Street sweep effic (REFF)          0.300
Remove fraction (REMOVE).          0.000
1st order QDECAY, 1/day..          0.000
Land use number.........              1
************************************************
* Constant Groundwater Quality Concentration(s) *
************************************************
 Total Susp has a concentration of..    0.0000   mg/l
************************************************
* REMOVAL FRACTIONS FOR SELECTED CHANNEL/PIPES *
* FROM J7 LINES                                *
************************************************
  CHANNEL/   CONSTITUENT
     PIPE Total Susp
----------  --------
       201     0.000
******************************************************
*     Subcatchment surface quality on data group L1 *
******************************************************
                            Total   Number   Input
                     Land    Gutter     of    Loading
              Land    Use    Length   Catch-  load/ha
         No.  Usage    No.      Km     Basins   Total Su
       ------ -------- ----   -------- --------  -------
   1        300 Urban De  1         0.16     2.00  0.0E+00
   Totals (Loads in kg or other)    0.16     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      *
          ******************************************
         8168 McLeod Road
         City of Niagara Falls
Rainfall Station    St. Catherines A
State/Province      Ontario
Rainfall Depth Summary (mm)
Year     Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sep   Oct   Nov   Dec    Total
1971.     31.    0.    0.    0.    0.    0.  126.   93.   52.   60.   29.    0.    391.
1972.      0.    0.    0.   47.   65.  100.   39.  115.   63.   90.    1.    0.    521.
1973.      0.    0.    0.  103.   77.   71.   53.   29.   63.  139.    0.    0.    534.
1974.      0.    0.    0.   67.  105.   62.   50.   31.   74.   37.  110.    0.    536.
1975.      0.    0.    0.    0.    0.   94.   78.   76.   73.   56.   59.    6.    442.
1976.      0.    0.    0.  119.  136.   87.  101.   60.   72.   73.   13.    1.    662.
```

1977.	0.	0.	0.	94.	29.	69.	57.	150.	230.	71.	0.	1.	701.
1978.	0.	0.	0.	72.	43.	72.	43.	86.	156.	95.	0.	0.	567.
1979.	0.	0.	0.	84.	92.	33.	91.	88.	84.	129.	71.	0.	673.
1980.	0.	0.	0.	81.	39.	122.	60.	32.	79.	96.	45.	0.	554.
1981.	0.	0.	0.	91.	71.	106.	122.	61.	123.	91.	84.	0.	749.
1982.	0.	0.	0.	28.	65.	97.	36.	66.	82.	25.	143.	0.	544.
1983.	0.	0.	0.	78.	100.	65.	55.	106.	75.	122.	92.	0.	694.
1984.	0.	0.	0.	31.	113.	136.	19.	51.	144.	24.	44.	0.	562.
1985.	0.	0.	67.	32.	52.	64.	40.	94.	42.	109.	0.	1.	501.
1986.	0.	0.	0.	93.	113.	60.	85.	83.	98.	80.	43.	65.	719.
1987.	0.	2.	11.	77.	42.	80.	122.	97.	99.	71.	94.	34.	730.
1988.	0.	0.	41.	71.	42.	21.	110.	82.	70.	68.	75.	5.	585.
1989.	0.	0.	13.	63.	137.	108.	36.	45.	89.	73.	84.	0.	647.
1990.	0.	2.	38.	99.	124.	44.	68.	95.	56.	112.	96.	0.	735.
1991.	0.	0.	86.	124.	67.	31.	85.	57.	79.	64.	61.	28.	682.
1992.	0.	0.	29.	127.	56.	92.	185.	116.	77.	47.	103.	38.	869.
1993.	3.	0.	7.	83.	56.	86.	32.	61.	71.	92.	80.	38.	610.
1994.	0.	0.	44.	88.	105.	124.	48.	77.	117.	15.	0.	15.	633.
1995.	112.	23.	16.	48.	37.	60.	123.	66.	8.	137.	94.	0.	724.
1998.	0.	0.	0.	0.	51.	54.	64.	29.	9.	0.	1.	0.	207.
1999.	0.	0.	0.	79.	59.	35.	61.	58.	116.	78.	0.	0.	487.
2000.	0.	0.	0.	123.	134.	216.	51.	0.	0.	0.	10.	0.	534.
2001.	0.	0.	0.	56.	88.	45.	25.	30.	81.	129.	0.	0.	454.
2002.	0.	0.	0.	73.	104.	64.	53.	49.	52.	65.	8.	0.	468.
2003.	0.	0.	0.	10.	163.	77.	81.	64.	67.	73.	2.	0.	537.
2004.	0.	0.	0.	131.	126.	99.	115.	40.	88.	17.	0.	0.	616.
2005.	0.	0.	0.	38.	42.	78.	53.	120.	112.	0.	0.	0.	443.

Total Rainfall Depth for Simulation Period 19310. (mm)

Rainfall Intensity Analysis (mm/hr)

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

Total # of Intensities 28803

Daily Rainfall Depth Analysis (mm)

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

Total # Days with Rain 2767

```
************************************************
*      End of time step DO-loop in Runoff      *
************************************************
Final Date (Mo/Day/Year)   =                  1/ 1/2006
Total number of time steps =                    2056406
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   6207526   1575126
************************************************
*     Extrapolation Summary for Channel/Pipes  *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of GUTNR Calls      *
************************************************
Chan/Pipe   # Steps   # Calls Chan/Pipe   # Steps   # Calls Chan/Pipe   # Steps   # Calls
 --------   -------   -------  --------   -------   -------  --------   -------   -------
      201         0         0
*********************************************
*       Continuity Check for Surface Water  *
*********************************************
                                                                Millimeters over
                                                 cubic meters  Total Basin
Total Precipitation (Rain plus Snow)                 117501.     19263.
Total Infiltration                                    33432.      5481.
Total Evaporation                                      8476.      1390.
Surface Runoff from Watersheds                        76366.     12519.
Total Water remaining in Surface Storage                  0.         0.
Infiltration over the Pervious Area...                33432.     19164.
                    --------
Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
Water remaining in Snow Cover.........               118274.     19390.
Total Precipitation + Initial Storage.               117501.     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.................................       -0.658 Percent
*********************************************
*       Continuity Check for Channel/Pipes  *
*********************************************
                                                                Millimeters over
                                                 cubic meters  Total Basin
Initial Channel/Pipe Storage.................             0.         0.
Final Channel/Pipe Storage...................             0.         0.
Surface Runoff from Watersheds...............         76366.     12519.
Baseflow.....................................             0.
Groundwater Subsurface Inflow................             0.         0.
Evaporation Loss from Channels...............             0.         0.
Channel/Pipe/Inlet Outflow...................         76366.     12519.
Initial Storage + Inflow.....................         76366.     12519.
Final Storage + Outflow......................         76366.     12519.
*********************************************
* Final Storage + Outflow + Evaporation  - *
* Watershed Runoff - Groundwater Inflow  - *
*     Initial Channel/Pipe Storage         *
*     ---------------------------------    *
*  Final Storage + Outflow  + Evaporation  *
*********************************************
```

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```
Error.....................................      0.000 Percent
**************************************************
*     Continuity Check for Subsurface Water      *
**************************************************
                                                                Millimeters over
                                                cubic meters    Subsurface Basin

Total Infiltration                                        0.          0.
Total Upper Zone ET                                       0.          0.
Total Lower Zone ET                                       0.          0.
Total Groundwater flow                                    0.          0.
Total Deep percolation                                    0.          0.
Initial Subsurface Storage                             5578.        914.
Final Subsurface Storage                               5578.        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
                              ====================================

                                                    PERVIOUS AREA     IMPERVIOUS AREA     TOTAL SUBCATCHMENT AREA
                                                    -------------     ---------------     -----------------------
                                          TOTAL     TOTAL          PEAK                PEAK                PEAK     PEAK
                GUTTER                SIMULATED   RUNOFF TOTAL RUNOFF   RUNOFF    RUNOFF      RUNOFF RUNOFF   UNIT
   SUBCATCH-  OR INLET  AREA  PERCENT  RAINFALL    DEPTH LOSSES   RATE     DEPTH     RATE        DEPTH   RATE    RUNOFF
   MENT NO.     NO.     (HA)  IMPER.    (MM)       (MM)    (MM)   (CMS)     (MM)     (CMS)       (MM)    (CMS)  (MM/HR)
  ------------------------------------------------------------------------------------------------------------------------
       300        200    0.61    71.419262.47   100.309******** 0.05817491.057    0.237 12517.303    0.295  175.437

          *** NOTE *** IMPERVIOUS AREA STATISTICS AGGREGATE IMPERVIOUS AREAS WITH AND WITHOUT DEPRESSION STORAGE
                                    SUMMARY STATISTICS FOR CHANNEL/PIPES
                                   ======================================

                                          MAXIMUM   MAXIMUM   MAXIMUM  MAXIMUM     TIME        LENGTH     MAXIMUM    RATIO
OF  RATIO OF
            FULL      FULL      FULL    COMPUTED  COMPUTED  COMPUTED COMPUTED     OF           OF      SURCHARGE   MAX.
TO  MAX. DEPTH
   CHANNEL  FLOW   VELOCITY    DEPTH     INFLOW    OUTFLOW    DEPTH   VELOCITY OCCURRENCE    SURCHARGE   VOLUME      FULL
TO FULL
    NUMBER  (CMS)     (M/S)       (M)       (CMS)     (CMS)       (M)     (M/S)    DAY   HR.      (HOUR)      (CU-M)      FLOW
DEPTH
  -------- -------------------------   ---------------------------------------------------   ---------------------- -----
--------------
       201                                  0.00                                1/ 0/1900  0.00
       200                                  0.29                                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.....       13.
 2. TOTAL SURFACE BUILDUP.....    10643.
 3. INITIAL CATCHBASIN LOAD.....      0.
```

```
 4. TOTAL CATCHBASIN LOAD.......        0.
 5. TOTAL CATCHBASIN AND
    SURFACE BUILDUP (2+4).......    10643.
Remaining Loads
---------------
 6. LOAD REMAINING ON SURFACE...        5.
 7. REMAINING IN CATCHBASINS....        0.
 8. REMAINING IN CHANNEL/PIPES..        0.
Removals
--------
 9. STREET SWEEPING REMOVAL.....      903.
10. NET SURFACE BUILDUP (2-9)...     9740.
11. SURFACE WASHOFF.............     9733.
12. CATCHBASIN WASHOFF..........        0.
13. TOTAL WASHOFF (11+12).......     9733.
14. LOAD FROM OTHER CONSTITUENTS        0.
15. PRECIPITATION LOAD..........        0.
15a.SUM SURFACE LOAD (13+14+15).     9733.
16. TOTAL GROUNDWATER LOAD......        0.
16a.TOTAL I/I LOAD..............        0.
17. NET SUBCATCHMENT LOAD
    (15a-15b-15c-15d+16+16a)....     9733.
>>Removal in channel/pipes (17a, 17b):
17a.REMOVE BY BMP FRACTION......        0.
17b.REMOVE BY 1st ORDER DECAY...        0.
18. TOTAL LOAD TO INLETS........     9733.
19. FLOW WT'D AVE.CONCENTRATION  mg/l
    (INLET LOAD/TOTAL FLOW).....      128.
Percentages
-----------
20. STREET SWEEPING (9/2).......        8.
21. SURFACE WASHOFF (11/2)......       91.
22. NET SURFACE WASHOFF(11/10)..      100.
23. WASHOFF/SUBCAT LOAD(11/17)..      100.
24. SURFACE WASHOFF/INLET LOAD
    (11/18).....................      100.
25. CATCHBASIN WASHOFF/
    SUBCATCHMENT LOAD (12/17)...        0.
26. CATCHBASIN WASHOFF/
    INLET LOAD (12/18)..........        0.
27. OTHER CONSTITUENT LOAD/
    SUBCATCHMENT LOAD (14/17)...        0.
28. INSOLUBLE FRACTION/
    INLET LOAD (14/18)..........        0.
29. PRECIPITATION/
    SUBCATCHMENT LOAD (15/17)...        0.
30. PRECIPITATION/
    INLET LOAD (15/18)..........        0.
31. GROUNDWATER LOAD/
    SUBCATCHMENT LOAD (16/17)...        0.
32. GROUNDWATER LOAD/
    INLET LOAD (16/18)..........        0.
32a.INFILTRATION/INFLOW LOAD/
    SUBCATCHMENT LOAD (16a/17)..        0.
32b.INFILTRATION/INFLOW LOAD/
    INLET LOAD (16a/18).........        0.
32c.CH/PIPE BMP FRACTION REMOVAL/
    SUBCATCHMENT LOAD (17a/17)..        0.
32d.CH/PIPE 1st ORDER DECAY REMOVAL/
    SUBCATCHMENT LOAD (17b/17)..        0.
33. INLET LOAD SUMMATION ERROR
    (18+8+6a+17a+17b-17)/17.....        0.
CAUTION. Due to method of quality routing (Users Manual, Appendix IX)
quality routing through channel/pipes is sensitive to the time step.
Large "Inlet Load Summation Errors" may result.
These can be reduced by adjusting the time step(s).
Note: surface accumulation during dry time steps at end of simulation is
not included in totals.  Buildup is only performed at beginning of
wet steps or for street cleaning.
*******************************************************
*            TSS Particle Size Distribution           *
*******************************************************
   Diameter    %     Specific    Settling Velocity   Critical Peclet
     (um)             Gravity        (m/s)               Number
      20.    20.0      2.65         0.000267            0.093400
      30.    10.0      2.65         0.000597            0.113900
```

50.	10.0	2.65	0.001629	0.152500
100.	20.0	2.65	0.006044	0.235000
250.	20.0	2.65	0.026615	0.391296
1000.	20.0	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	0.045	0.045	97.9	76.6
HD 4	0.045	0.045	97.9	83.3
HD 5	0.045	0.045	97.9	88.5
HD 6	0.045	0.045	97.9	91.6
HD 7	0.045	0.045	97.9	94.0
HD 8	0.045	0.045	97.9	95.5
HD 10	0.045	0.045	97.9	97.5
HD 12	0.045	0.045	97.9	98.2

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

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.	9568.	8760.	187.	151.	36.	5.	91.6	78.8
1972.	12298.	11069.	247.	209.	38.	12.	90.0	80.5
1973.	12210.	12171.	271.	227.	43.	1.	99.7	83.7
1974.	12473.	12135.	285.	252.	32.	6.	97.3	86.8
1975.	10569.	10220.	245.	201.	43.	4.	96.7	80.9
1976.	15732.	15184.	305.	261.	44.	9.	96.5	83.2
1977.	16858.	16250.	297.	235.	63.	9.	96.4	76.7
1978.	13452.	13408.	289.	233.	55.	1.	99.7	80.6
1979.	16105.	15610.	325.	276.	49.	7.	96.9	83.1
1980.	12973.	12775.	307.	259.	48.	3.	98.5	83.6
1981.	17908.	17745.	345.	299.	46.	2.	99.1	86.3
1982.	12614.	12557.	281.	244.	37.	1.	99.5	86.5
1983.	16638.	16293.	353.	300.	53.	8.	97.9	83.1
1984.	13397.	13397.	278.	231.	48.	0.	100.0	82.8
1985.	11687.	11679.	274.	231.	43.	0.	99.9	84.2
1986.	17037.	16944.	372.	319.	53.	2.	99.5	85.2
1987.	17617.	17243.	373.	319.	54.	3.	97.9	84.8
1988.	14097.	13837.	313.	272.	42.	2.	98.2	86.3
1989.	15528.	15151.	301.	265.	36.	4.	97.6	86.8
1990.	17600.	17441.	382.	337.	45.	4.	99.1	87.3
1991.	16493.	16248.	357.	307.	50.	4.	98.5	85.0
1992.	20967.	20773.	415.	347.	68.	4.	99.1	82.8
1993.	14269.	14237.	354.	312.	41.	1.	99.8	88.2
1994.	15283.	14281.	279.	232.	47.	14.	93.4	79.4
1995.	17729.	17219.	336.	280.	56.	13.	97.1	80.4
1998.	4606.	4606.	134.	109.	25.	0.	100.0	81.3
1999.	11254.	11125.	267.	221.	46.	2.	98.9	82.3
2000.	12943.	12842.	232.	181.	52.	2.	99.2	77.2
2001.	10255.	10255.	219.	194.	25.	0.	100.0	88.4
2002.	10706.	10687.	256.	219.	37.	0.	99.8	85.3
2003.	12179.	12097.	263.	217.	47.	1.	99.3	81.9
2004.	14585.	14585.	271.	223.	48.	0.	100.0	82.4
2005.	10542.	9825.	200.	153.	47.	7.	93.2	74.1

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.	9568.	8760.	187.	162.	25.	5.	91.6	84.4
1972.	12298.	11069.	247.	223.	24.	12.	90.0	85.9
1973.	12210.	12171.	271.	242.	29.	1.	99.7	88.9
1974.	12473.	12135.	285.	266.	18.	6.	97.3	91.7
1975.	10569.	10220.	245.	216.	28.	4.	96.7	86.8
1976.	15732.	15184.	305.	279.	27.	9.	96.5	88.8
1977.	16858.	16250.	297.	252.	45.	9.	96.4	82.5
1978.	13452.	13408.	289.	249.	40.	1.	99.7	86.0
1979.	16105.	15610.	325.	292.	33.	7.	96.9	88.1
1980.	12973.	12775.	307.	273.	34.	3.	98.5	88.1
1981.	17908.	17745.	345.	317.	27.	2.	99.1	91.6

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1982.	12614.	12557.	281.	258.	23.	1.	99.5	91.5
1983.	16638.	16293.	353.	319.	34.	8.	97.9	88.4
1984.	13397.	13397.	278.	244.	34.	0.	100.0	87.8
1985.	11687.	11679.	274.	247.	27.	0.	99.9	90.1
1986.	17037.	16944.	372.	341.	31.	2.	99.5	91.0
1987.	17617.	17243.	373.	335.	38.	3.	97.9	89.1
1988.	14097.	13837.	313.	285.	29.	2.	98.2	90.4
1989.	15528.	15151.	301.	280.	21.	4.	97.6	91.7
1990.	17600.	17441.	382.	355.	27.	4.	99.1	92.1
1991.	16493.	16248.	357.	325.	32.	4.	98.5	90.1
1992.	20967.	20773.	415.	368.	47.	4.	99.1	87.8
1993.	14269.	14237.	354.	326.	27.	1.	99.8	92.2
1994.	15283.	14281.	279.	246.	33.	14.	93.4	84.2
1995.	17729.	17219.	336.	298.	37.	13.	97.1	85.6
1998.	4606.	4606.	134.	116.	18.	0.	100.0	86.8
1999.	11254.	11125.	267.	235.	32.	2.	98.9	87.4
2000.	12943.	12842.	232.	196.	36.	2.	99.2	83.8
2001.	10255.	10255.	219.	204.	15.	0.	100.0	93.0
2002.	10706.	10687.	256.	231.	24.	0.	99.8	90.4
2003.	12179.	12097.	263.	230.	34.	1.	99.3	86.9
2004.	14585.	14585.	271.	238.	33.	0.	100.0	88.0
2005.	10542.	9825.	200.	167.	33.	7.	93.2	80.5

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

Rainfall Intensity (mm/h)	Flow (L/s)	Percentage %
1.50	1.9	NaN
2.25	2.8	NaN
3.00	3.7	NaN
3.75	4.7	NaN
4.75	5.9	NaN
5.75	7.2	NaN
8.00	10.0	NaN
10.00	12.5	NaN
15.50	19.3	NaN
23.25	29.0	NaN

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

8168 McLeod Road
City of Niagara Falls

Date Mo/Da/Year	Time Hr:Min	Flow cum/s	Total Su mg/l
Flow wtd means.....		0.000	128.
Flow wtd std devs..		0.002	66.
Maximum value.....		0.295	292.
Minimum value.....		0.000	0.
Total loads.....		76349.	9739.
		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... February 20, 2024 *
* Time... 9:44:26.769 *
* Ending Date... February 20, 2024 *
* Time... 9:44:29.751 *
* Elapsed Time... 0.050 minutes. *
* Elapsed Time... 2.982 seconds. *

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APPENDIX G

Oil/Grit Sample Inspection Report

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SAMPLE INSPECTION REPORT

Owner:

Location:

Manhole Oil/Grit Separator:

Type of Inspection ☐ Monthly ☐ Annually ☐ Special

Inlet/Outlet Information

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

Action Taken:

Sediment Tank Information

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

B. Measurement from Rim to Sediment Level: m

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

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

Presence of Contaminants

Oil	☐ Yes	☐ No	Depth	m
Foam	☐ Yes	☐ No	Depth	m

Action Taken:

Name of Regulatory Agency Telephone No.:

Transaction No.:

Name of Licensed Waste Management Collector Telephone No.:

Transaction No.:

Owner Notification ☐ Yes ☐ No Other:

Time: Date:

Name of Inspector:

Signed: Date:

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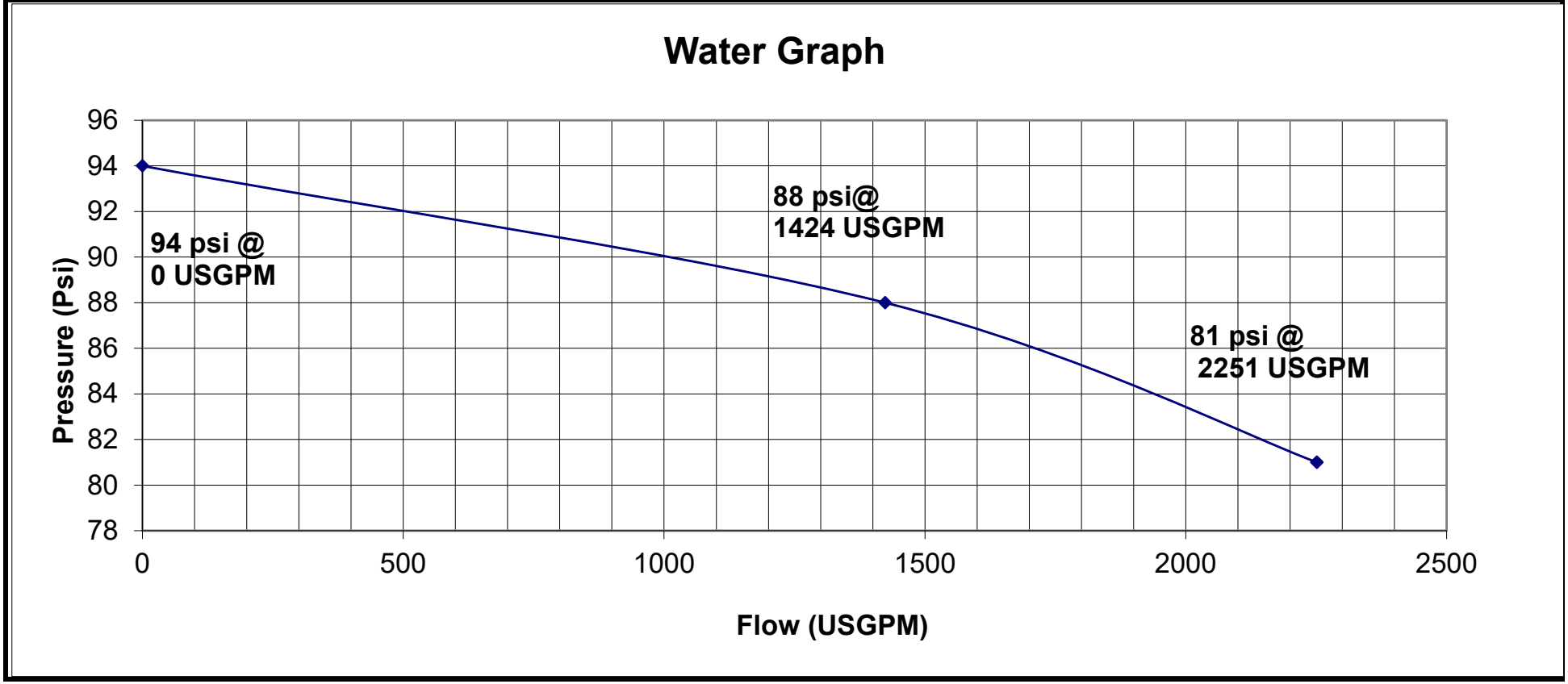
APPENDIX H

Hydrant Flow Test

NIAGARA REGIONAL FIRE PROTECTION INC.

Flow Test Location: 8196 McLeod Rd.

Static Pressure (Psi)		**Pitot Reading 1**	72	**# of Outlets Flowed 1**	1
	94	**Outlet Size 1**	2.5	**# of Outlets Flowed 2**	2
Residual Pressure 1 (Psi)		**Pitot Reading 2**	45	**# of Outlets Flowed 3**	2
	88	**Outlet Size 2**	2.5	**Graph Data:**	
Residual Pressure 2 (Psi)		**Pitot Reading 3**	45	**Pressure Values (y-axis)**	**Flow Values (x-axis)**
	81	**Outlet Size 3**	2.5	94	0
Residual Pressure 3 (Psi)		**Flow 1 Calculated**		88	1424
	81		1423.8	81	2251
		Flow 2 Calculated		81	2251
			2251.2	**Date & Time of Test :**	**May 28/2024**
Coefficient value		**Flow 3 Calculated**			**11:00AM**
	0.9		2251.2	**Performed by:**	Mike & Cam



Headloss in a Single Ended Lead for Fire Hydrant

Project:	8168 McLeod Road, Niagara Falls
Project Number:	2232
Date:	June 4, 2024
Prepared by:	Adam Keane, P.Eng.

Proposed Hydrant: On Site

Single Lead Length (m):	90.5m		
Single Lead Diameter (mm):	200mm		0.20m
Internal W/M Loop Length (m):	0.0m	0.0m	
Internal W/M Loop Diameter (mm)	000mm	000mm	
Hydrant Elevation (m):	182.12m		
Theoretical Flow at 20PSI (L/s):	303 L/s		4799 USgpm
Reduced Hydrant Flow (L/s):	272 L/s		4319 USgpm
Hydrant Rating (NFPA 291):	BLUE		
Fire Pressure (PSI):	20PSI		137895.14 Pa
Backflow Preventor:	None		.0 PSI
Fireflow Meter:	None		.0 PSI

	SINGLE	INTERNAL	
Total Number of 90° Elbows:	1	0	ke = 0.9
Valves:	2	0	ke = 0.2
Total Number of 45° Elbows:	0	0	ke = 0.4
Reducer:	0	0	ke = 0.06
Increaser:	0	0	ke = 0.15
Number Tee Fittings (straight):	0	0	ke = 0.4
Number of Tee Fittings (turn):	2	0	ke = 1.8

Known Hydrant -8196 Mcleod Raod, Niagara Falls

Approximate Elevation (m):	182.12m		
Known Static Pressure (PSI):	94PSI		648107.16 Pa
Feeder Main Diameter (mm):	300mm		0.30m

Calculated Headloss

		INTERNAL LOOP	
	SINGLE	SMALL	LARGE
D:	0.20	0.00	0.00
Re:	1.28E+06	1.28E+16	1.28E+16
V2:	9.64 m/s	1.93E+21	1.93E+21
Q:	0.3027 m3/s	0.1514 m3/s	0.1514 m3/s
A:	0.031 m2	0.000 m2	0.000 m2
y:	1.51E-06		
ks:	0.0000015		
f:	0.011	0.011	0.011
Density:	9810		
g:	9.81 m2/s		

Bernoulli Terms

P1:	66.07 m	P2:	14.06 m
V1:	0.23 m	V2:	4.73 m
z1:	182.12m	Z2:	182.12m
		Fittings:	23.19 m
		Backflow:	0.00 m
		Fire:	0.00 m
		Straight:	24.33 m
TOTAL HEAD 1:	248.42 m	=	248.42 m