

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

WILLOUGHBY DRIVE CITY OF NIAGRA FALLS

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DATE: OCTOBER 2024

PROJECT NO. 221377

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1.0 INTRODUCTION

The purpose of this report is to provide site servicing and stormwater management (SWM) design information in support of the Zoning By-law Amendment (ZBA) for the site at Willoughby Drive in the City of Niagara Falls.

Specifically, this report will demonstrate the SWM measures that will be undertaken to deal with the quantity and quality requirements for the site. As well, the capacity of the existing municipal servicing systems to accommodate the site is reviewed.

1.1 Site Description

The site is located on the east side of Willoughby Drive, north of Weinbrenner Road in the City of Niagara Falls. The site is currently vacant and has an area of 11.0ha. The site location is shown on **Figure 1**.

The proposed development includes 3 multi-storey apartment blocks (660 units), 13 front loaded Towns (91 units), 12 back-to-back towns (146units),10 stacked towns (81 units), 1 park block and 4 new municipal roads as per Concept P1 prepared by Fotenn Planning + Design. The development includes a total of 318 townhouse units and 660 apartments.

1.2 Background

The Servicing and SWM design for the site has been prepared to meet the requirements of the City of Niagara Falls and Niagara Region. The following materials were referenced in the preparation of this report:

- The <u>Stormwater Management Planning and Design Manual (MECP Guidelines)</u>, prepared by the Ministry of the Environment, March 2003, were referenced in the preparation of the stormwater management plan.
- The <u>Engineering Design Guidelines Manual</u>, prepared by the City of Niagara Falls, April 2016.
- The <u>Niagara Peninsula Conservation Authority Stormwater Management Guidelines</u>, prepared by the Niagara Peninsula Conservation Authority and Aecom, March 2010.
- The <u>Niagara Region Water and Wastewater Master Servicing Plan Updates</u>, prepared by the Niagara Region, December 2023.
- The <u>Development Charges Background Study</u>, prepared by Regional Municipality of Niagara, May 2022.
- Willoughby Drive Road Reconstruction drawings and design sheets, prepared by MTE, dated June 2024.
- The <u>Preliminary Sanitary and Water Servicing Investigation</u> memorandum for Willoughby Drive Development, prepared by Husson Limited dated February 10, 2023.

2.0 STORM DRAINAGE

2.1 Existing Drainage

The following is a summary of the existing services and storm drainage features around the perimeter of the site:

- Storm sewers on Willoughby Drive ending at a 1050mm diameter sewer at the proposed Caronpost Road.
- 675mm diameter storm sewer on Cattell Drive.
- Drainage ditch along the future Caronpost Road conveying drainage from Willoughby Drive to the Little Mississippi Drain.
- Drainage ditch on Weinbrenner Road conveying drainage to the Little Mississippi Drain.

The existing site has been divided in to two catchment areas, 100 and 101. Catchment 100 represents the drainage from north of Caronpost, and Catchment 101 represents the drainage from south of Caronpost Drive. Both catchments generally drain to the existing channel on Caronpost Road. Some perimeter drainage will be directed to Cattell Drive or Weinbrenner Road, but all drainage ultimately drains to the Mississippi Drain. Refer to **Figure 2** for the existing site drainage.

An analysis of the existing storm sewer on Cattell Drive was completed to determine if there was any surplus capacity in the sewer to accept drainage from the site. The analysis was completed using the 5-year Niagara Falls design storm and catchment plan as shown on **Figure 3**. The analysis shows that there is no surplus capacity. Refer to **Appendix A** for the Cattell Road storm sewer design sheet.

2.2 Site Grading

All grading will be completed in a manner to satisfy the following goals:

- Enable gravity storm connection (where possible) to the outlet at the Little Mississippi Drain.
- Meet the stormwater management objectives for the site.

The development will be graded such that the surface flows from the development will be directed to municipal boulevards and captured by catchbasins and directed to the proposed storm sewers. It is proposed to construct Caronpost Road; a dedicated right-of-way which currently has a section of the channel which conveys flows from Willoughby Drive to the Little Mississippi Drain the flows towards the Niagara River. As part of the development, it is proposed to construct Caronpost Road through our development and the channel will be replaced with a municipal storm sewer. Caronpost Road will not be controlled but all of the other private developments and proposed municipal roads that are being constructed will be controlled before the storm sewer connects to the mainline sewer on Caronpost.

The site will be graded to suit the City's design criteria and accommodate any constraints imposed by the storm drainage and servicing objectives.

2.3 Minor System Drainage

The development will include the extension of Caronpost Road. This will require filling in the existing drainage ditch and construction of a new storm sewer system out letting to the Little Mississippi Drain.

The internal storm sewer system will be designed to collect drainage from the proposed rooftops and driveways for a 5-year design storm, as per the City's criteria. The majority storm drainage will drain to the Little Mississippi Drain.

The proposed storm sewer will collect drainage from Willoughby Drive. An inlet flow rate of 848L/s has been included from the external catchment area as per the MTE design sheets.

Rainwater leaders from the townhouse units will discharge at grade. The storm sewer systems from the private blocks will convey drainage to oil/grit separators which will provide pre-treatment for drainage entering the stormwater chambers. The storm connections from the municipal roads connecting to the Caronpost Road storm sewer will also be conveyed through oil/grit separators for quality control.

Peak flow controls will be provided on the proposed private development blocks. Further controls will be provided within the proposed municipal roads to further reduce flows to meet the pre-development target flow rates.

Refer to Figure 4 for the proposed minor system design and Section 3.0 for details on the on-site controls.

2.4 Major System Drainage

The development blocks will be designed to convey all flows on-site up to the 100-year event and discharge to the minor system at a controlled rate. For storms in excess of the 100-year event, or in the case of a blockage, overland flow will be directed to the adjacent municipal roads.

The municipal road has been designed with saw-toothed grading, such that for storms up to the 100-year event, runoff will pond above the catchbasins and discharge to the minor-system, where it can be controlled by the stormwater chambers.

Refer to Figure 5 for the grading and major system drainage design.

3.0 STORMWATER MANAGEMENT PLAN

3.1 Stormwater Management Criteria

The City and Niagara Peninsula Conservation Authority (NPCA) have indicated that the stormwater management criteria are as follows:

- Water quality *Enhanced* control is required based on MECP Guidelines. This requires removal of 80 percent of total suspended solids on an annual basis.
- Water quantity Peak flow controls for all storm events, if existing channel does not have capacity for the uncontrolled flows. Peak flow controls will be required to control private developments and for new municipal roads to the allowable flow to the storm sewers.
- Water Balance Niagara Region strongly encourages the use of Low Impact Development (LID) practices to retain water on-site for re-use or infiltration.
- Erosion Control Niagara Region typically requires the retention of the 25mm design storm to be released over 24 hours to mitigate downstream erosion impacts.

We note that the proposed Caronpost Road is not considered in the storm water management design for the site. It has a large upstream catchment area with limited stormwater management controls. It would be challenging to implement controls within the proposed roadway to service the large upstream catchment area.

3.2 Stormwater Management Facilities

For the storm drainage and stormwater management design for the site, three options were investigated.

1. Provide no peak flow controls on-site and either confirm capacity in the Little Mississippi Drain, or up-size it to convey drainage to the Niagara River.

- 2. Review the capacity of the storm sewer on Cattell Drive and discharge a portion of the flow to this outlet.
- 3. Provide peak flow controls to control the post development peak flow to predevelopment levels on site.

For the first option, it was noted that downstream improvements to the channel had recently been completed. The cross section was approximately 15m wide and provided a low flow channel and floodplain. It was determined that the longitudinal grade of the channel near the Caronpost outlet will be about 0.1 percent, compared to 0.2 percent or greater where the channel was improved downstream. As well, the downstream section was greater than 2m deep downstream whereas it is approximately 1.5m deep near the Caronpost outlet. These two factors resulted in a channel section that would be greater than 30m in width. It was therefore, determined not to pursue this option.

For the second option, a design sheet for Cattell Drive was prepared based on the proposed reduction in the catchment area, resulting from the Willoughby Drive improvements. It was determined that the existing sewers are at or over capacity based on the 5-year storm. Therefore, it is not proposed to direct any additional flow to this sewer.

Therefore, on-site controls to pre-development rates have been selected as the preferred option.

A treatment train approach will be used to meet the stormwater management objectives for the site, as follows:

- Private development blocks (apartment and townhouse) will be required to provide on-site controls to meet unit flow target release rates (refer to section 3.4). For the preliminary design, it is assumed that an underground storage chamber and orifice control will be provided on each block; however, at the detailed design stage, alternatives such as controlled flow roof drainage, surface storage or oversized pipes can be investigated.
- Private development blocks will be required to provide Normal quality control (80 percent TSS removal). The specific mechanism can be determined at the detailed design stage for each block.
- Oil/grit separators will be provided at each connection point to the mainline sewer on Caronpost Road.
- Peak Flow controls for the municipal roads will be provided by underground storage chambers located within the municipal roadways.
- The proposed stormwater chambers will have an open bottom capable of infiltration. At the detailed design stage, the feasibility of infiltration will be investigated. This will be dependent on the depth and permeability of the soils.

The proposed controls within the municipal roads are described below:

3.3 Quality Control

As per the Niagara Region criteria, Normal quality control (70 percent TSS removal is required for the site. For the proposed municipal roads, this will be provided by 4 oil/grit separators located upstream of the connections to Caronpost Road. Preliminary sizing is based on Stormceptor EF oil/grit separators using ETV particle size distribution. The locations are shown on **Figure 6** and preliminary sizing is provided in **Table 1**.

Catchment Area (ha)		Imperviousness	Unit	TSS Removal
103+108	3.0	65%	EF12	62
104	0.56	65%	EF06	63
105	0.27	65%	EF04	63
106	0.53	65%	EF06	64

Table 1. Oil/Grit Separator Sizing

Therefore, the proposed oil/grit separators provide greater than 60 percent quality control.

As noted above, it is proposed to investigate infiltration to meet water balance objectives for the site. This will be reviewed at the detailed design stage when soil and groundwater information is available.

With the proposed oil/grit separators and infiltration facilities in place, the requirement for 70 percent TSS removal will be met. In the event that infiltration is not feasible on the site, an ETV verified filter unit will be required for each connection point. While this is feasible for the site, they typically have increased long-term maintenance requirements, compared to oil/grit separators.

OGS unit sizing and details are provided in Appendix B.

3.4 Quantity Control

3.4.1 Quantity Control Measures

Quantity control will be provided in the stormwater chambers in conjunction with orifice controls which allow for excess runoff to be stored and released at a controlled rate.

Uncontrolled Drainage

There will be one catchment, Catchment 110, which will discharge to Caronpost Road uncontrolled. This has an area of 0.18ha, and consists of townhouse rooftop and rear yard areas. All other areas of the site will be overcontrolled to account for this uncontrolled drainage.

Stormwater Chamber Storage

For the functional design of the stormwater management facilities, it was assumed that a crate storage system would be used. The crates will have a height of 1.0m and a width up to 2.4m wide, when located within the municipal right-of-ways.

Orifice controls will be provided at the outlet for each catchment to meet the target release rates. **Table 2** provides a summary of the storage-discharge for each catchment. Refer to **Appendix C** for storage-discharge calculations.

Catchment Pipe/Chamber Storage (m ³)		Orifice Size (mm)	Peak Flow (L/s)
103+108	1,290	120	48
104	120	204	86
105	120	74*	9
106	195	152	48

Table 2. Catchment Storage-Discharge

* Use inlet control device for orifice less than 75mm diameter.

For the private development blocks, unit flow rates will be implemented for the 5- and 100-year design storms. as shown in **Table 3**.

Table 3.	Unit Flow Rates

Storm Event	Unit Flow Rate (L/s/ha)	
5 Year	14	
100 Year	35	

3.4.2 Hydrology Modelling

The Visual OTTHYMO 6 (VO) model was used to calculate the flows for the site for the pre and post development conditions. VO is a single event hydrologic model that is based on unit hydrograph theory. The simulation for this site uses the StandHyd method for the primarily impervious catchments and NasHyd method for landscape catchments. The Route Reservoir command is used to simulate the peak flow controls for the site to estimate the storage requirements. Rainfall is based on a 4-hour Chicago Storm using the latest NPCA SWM Guideline IDF curves for the 100-year storm.

The following additional parameters were assumed for the modelling:

- CN for pervious areas of 77.
- Initial abstraction of 5mm for pervious areas and 1mm for impervious areas.
- Rain fall distribution was based on the 5- and 100-year 4-hour Chicago storm and the NPCA SWM Guideline IDF curves.

An existing conditions VO model was prepared to estimate to the peak flow from the site to the Caronpost outlet. **Table 4** provides a summary for each catchment and the target flow.

	······						
Catchment	Area (ha)	5-Year Peak Flow (L/s)	100-Year Peak Flow (L/s)				
100	6.88	92	230				
101	3.39	55	137				
Total	10.27	144	361				

Table 4.	Peak	Development	Model	Summary
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Table 5 provides a summary of the catchment parameters for the post development scenario.

Catchment	Area (ha)	Development Type	Imperviousness
103	2.50	Townhouse	65%
104	0.65	Townhouse	65%
105	0.27	Townhouse	65%
106	0.53	Townhouse	65%
107	1.81	Private Townhouse	65%
108	0.50	Park	
109	0.57	Private Townhouse	65%
110	0.18	Townhouse	65%
111	0.58	Private Townhouse	65%
112	0.34	Private Townhouse	65%
113	0.68	Private Apartment	75%
114	0.80	Private Apartment	75%
115	0.86	Private Apartment	75%
Total	10.27		

 Table 5.
 Post Development Catchment Summary

The post development model was prepared using the parameters in **Table 5** for each catchment and the proposed stormwater controls as outlined in **Table 2**. For the private blocks, an estimate is included in the model for the required storage. This will depend on the final site layout and availability of rooftop and parking lot storage.

Table 6 provides a summary of the post development storage requirements.

Catchment	Storage Provided (m ³)	100-year Storage Required (m ³)
103+108	1290	1285
104	220	218
105	120	101
106	190	172
107*		615
109*		220
110*		Uncontrolled
111*		225
112*		130
113*		274
114*		335
115*		350

 Table 6.
 Post Development Storage Summary

* Required storage is an estimate, subject to site design.

Table 7 provides a comparison of the 5- and 100-year peak flows from the site in the pre and post

 development scenarios.

Table 7. Peak	Flow	Compa	rison
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Storm Event	Pre- Development (L/s)	Post Development (L/s)
5 Year	144	144
100 Year	361	250

As shown in **Table 7**, the peak flows for the 5 and 100 year storms in the post development scenario will be equal or less than pre-development.

Figure 6 shows the proposed catchment plan. Hydrology calculations are provided in Appendix D.

The existing municipal storm infrastructure can support the proposed site without the need for external upgrades or retrofit.

3.5 Water Balance

As per the Niagara Region criteria, (LID) practices to retain water on-site for re-use or infiltration. This will be investigated at the detailed design stage when geotechnical and groundwater information is available.

3.6 Erosion Control

Niagara Region typically requires the retention of the 25mm design storm to be released over 24 hours to mitigate downstream erosion impacts. Another option frequently implemented for erosion control is to retain or infiltrate runoff from frequent storm events. This can reduce the overall volume of surface runoff to the receiving watercourse. This will be investigated at the detailed design stage when geotechnical and groundwater information is available.

4.0 WASTEWATER

4.1 Receiving Systems

The City is in the process of reconstructing Willoughby Drive (90% detailed design stage was just completed by MTE Consultants) and as part of that work new sanitary sewer is being installed on Willoughby Drive through the entire frontage of the proposed development. There is a proposed 200mm diameter sanitary sewer from Willguard Court, flowing north to Cattell Drive and a 300mm diameter sanitary sewer from Willguard Court, flowing south to Weinbrenner Road. A 300mm diameter service stub is being provided for the proposed development at the beginning (west side) of the Caronpost right-of-way; which is currently a drainage ditch, but will need to be constructed as a municipal road as part of the proposed subdivision.

In addition, there is an existing 375mm diameter sanitary sewer on Cattell Drive flowing west to the new sewer on Willoughby Drive, and an existing 250mm diameter sanitary sewer on Weinbrenner Road flowing west which connects with the new sanitary sewer on Willoughby Drive and then to the existing 450mm diameter sanitary sewer on Weinbrenner Road which flows westward and eventually discharges to the Low Lift Pumping Station for South Niagara Falls.

The Niagara Region Water and Wastewater Master Servicing Plan (2023) was used to calculate the contributing peak flow from the site to the existing sewer. The Harmon equation was used to calculate the peaking factor for the apartment buildings and townhouse dwellings. The existing and proposed sanitary flows from the site are shown in **Table 8**.

Table 8. Sanitary Flow Comparison

Land Use	Equivalent Population ¹	Peaking Factor ²	Equivalent Peak Flow (L/s)²
Pre-Development: • Undeveloped	_	_	_
Post Development:	-	-	-
 Residential: 660 Apartment Units¹ 	1,314		
Residential: 318 Townhouse Units	<u>665</u>		
	1,979	3.58	20.9

⁺⁺¹ Equivalent population as per the latest Niagara Region *DC Study- Table 6-1b – Residential D.C. by Unit Type (2022)* (2.92 persons/unit: Single and Semi-Detached Dwelling, 2.09 persons/ unit: Other Multiples, 1.99 persons/unit: Apartments 2+Bedrooms, 1.21 persons/unit: Apartments 1 Bedroom; Apartment units are considered 2+bedrooms to be conservative.

² Equivalent Flow as per the Niagara Region *Water and Wastewater Master Servicing Plan (2021)* (Average wastewater flow = 255 litres/capita/day, Harmon formula with values between 2 and 4)

The sanitary flows are summarized in **Table 9** below.

Table 9. Sanitary Flow Summary

Scenario	Population	Sanitary Flow (L/s)	Infiltration Flow (L/s)*	Total (L/s)
Post Development	1,979	20.9	3.2	24.1

*Infiltration flows are based off a site area of 11.0ha and a design flow rate of 0.286L/s/ha.

Therefore, the proposed development of the site will result in a peak sanitary flow of 24.1L/s. The existing 300mm diameter sanitary sewer on Willoughby Drive is adequate to convey these flows (full flow capacity of the existing 300mm diameter sanitary adjacent to the site is 59.6L/s of which our site accounts for 42% of the capacity).

4.2 Sanitary Sewer Downstream Capacity Analysis

A <u>Preliminary Sanitary and Watermain Servicing Investigation</u> memorandum (memorandum) for the proposed development was prepared by Husson Limited on February 10, 2023; which was approved by the City. As part of the servicing memo, a downstream sanitary assessment (DSA) was completed based on a contributing equivalent population of 2,497 people from the development. As noted in Option 2 in the memorandum, there was capacity in the existing sanitary sewer if the development was connected to the existing 450mm diameter sanitary sewer on Weinbrenner Road. This has also been taken in to account with the reconstruction work for Willoughby Drive that is being completed by the City (detailed design by MTE Consultants) and as part of that work the City is providing a 300mm sanitary sewer stub at the future Caronpost Road; which is sufficient for the proposed development.

The proposed development has an equivalent population of 1,979 people which is less than the 2,497 people that was accounted for in the memorandum, and so no further analysis was required. Refer to **Appendix E** for the memorandum.

4.3 Internal Sanitary Drainage

A private gravity sanitary sewer can be extended into the site to provide services to each townhouse and apartment buildings within the development. The detailed design of the sanitary sewers within the subdivision will be completed at the detailed design stage but it should be noted that the sanitary sewer on Willoughby Drive is over 3m deeper than the storm sewer on Caronpost Road and so crossing conflicts are not anticipated.

Refer to Figure 7 for the detailed site servicing information.

5.0 WATER DISTRIBUTION

5.1 Water Servicing

The City is in the process of reconstructing Willoughby Drive (90% detailed design stage was just completed by MTE Consultants) and as part of that work new watermain is being installed on Willoughby Drive. There is a proposed 300mm diameter watermain through the frontage of the proposed development. A 300mm diameter service stub is being provided for the proposed development at the beginning (west side) of the Caronpost right-of-way; which is currently a drainage ditch, but will need to be constructed as a municipal road as part of the proposed subdivision.

In addition, here is an existing 250mm diameter watermain on Cattell Drive and a 200mm diameter watermain on Weinbrenner Drive.

It is proposed to service the development off of the 300mm diameter watermain on Willoughby Drive; and will be looped with a second connection to the existing 250mm diameter watermain on Cattell Drive. The watermain design will follow the Niagara Region Water and Wastewater Master Servicing Plan (2023).

Refer to Figure 8 for the proposed watermain design.

In addition, a hydrant flow test was completed by L&D Waterworks on November 14, 2022 for the hydrant located in front of 8563 Willoughby Drive which is across the road from the proposed development, refer to **Appendix E** for information.

5.2 Watermain Analysis

The following calculations for water demand and fire flow for the proposed development are based on the Niagara Region's design criteria and the Fire Underwriters Survey (FUS).

Persons per unit (ppu):	Single and Semi-Detached Dwelling	2.92
Persons per unit (ppu):	Other Multiples	2.09
Persons per unit (ppu):	Apartments 2+Bedrooms	1.99
Residential average day d	lemand:	240L/cap/day
Peaking Factor (pf):	Peak Hour	2.5

Maxii	mum Day	1.3
Acceptable pressure range		40 – 100 psi
Fire Flow: 250L/s or	n Regional watermains at residual pre	ssure of 30 psi
Average Daily Demand:		
Apartment	= 1,314 (eq. population from Tabl	e 8) x 240L/cap/day
	= 315,360 L/day	
	= 219L/min	
Townhouse	= 665 (eq. population from Table	8) x 240L/cap/day
	= 159,600 L/day	
Maximum Hour Demand:	= 110.8L/min	
Apartment	= 219L/m x 2.5(pf)	
	= 547.5L/min	
Townhouse	= 110.8L/min x 2.5(pf)	
	= 277L/min	
Maximum Day Demand:		
Apartment	= 219L/m x 1.3(pf)	
	= 284.7L/min	
Townhouse Development	= 110.8L/min x 1.3(pf)	
	= 144L/min	

Interpolating on the hydrant flow test graph demonstrates that under peak hour and maximum day demand flow conditions, the pressure in the watermain will be approximately 607kPa (88psi); therefore, the proposed site will meet the City's minimum pressure of 275kPa (40psi).

Fire Analysis:

The existing watermain had a residual static pressure of 90psi and theoretical minimum fire flow of 5,625GPM (21,300L/min) at 20psi. Based on the information in the hydrant flow test, and the City's minimum fire flow requirement of 250L/s (15,000L/min) on Regional watermains at residual pressure of 30psi, there are no concerns regarding adequate water supply for the proposed development; however, a fire/booster pump may be required for the internal fire protection systems for the proposed townhouse and apartment blocks. This will need to be determined by the mechanical engineer at the detailed design stage.

6.0 CONCLUSIONS

The proposed development meets the City's requirements as follows:

- A treatment train approach including infiltration measures and oil/grit separators will be implemented within the municipal right-of-ways to provide the required Normal quality control. The infiltration design will be confirmed at the detailed design stage.
- Normal quality control will be provided on each of the private development blocks.
- Orifice controls in conjunction with stormwater chambers will provide the storage required to limit the release rate to the capacity of the storm sewer in the easement, up to the 100year storm.
- Private development blocks will be required to implement peak flow controls based on 14L/s/ha for the 5-year storm and 35L/s/ha for the 100-year storm.
- Water balance and erosion controls measures will be investigated at the detailed design stage when soil and groundwater information is available.
- Gravity sanitary sewers through the subdivision are proposed to connect to the 300mm diameter sanitary sewer stub that is being provided by the City at Caronpost Road and Willoughby Drive.
- The receiving sanitary sewer has adequate capacity for the proposed development as determined by the City on approval of the <u>Preliminary Sanitary and Water Servicing</u> <u>Investigation</u> memorandum for Willoughby Drive Development, prepared by Husson Limited dated February 10, 2023.
- Watermain for the subdivision will be extended from the existing watermain on Cattell Road and the proposed watermain on Willoughby Drive. The watermain will be looped internally within the proposed subdivision.
- A hydrant flow has been completed to confirm that the existing watermain has sufficient pressure to provide fire and domestic flows to the proposed development.

With the proposed controls in place, the site design will meet the requirements of the City with respect to the current zoning application.



Greg Rapp, P.Eng.











FIGURE 3 WILLOUGHBY DRIVE CATTELL STORM DRAINAGE PLAN

DATE: OCTOBER 2024 SCALE: 1:5000 PROJECT: 221377





<u>LEGEND</u> 175.00 EXISTING ELEVATION 175.00 PROPOSED ELEVATION 175.00TW PROPOSED TOP OF WALL ELEVATION 175.00BW PROPOSED BOTTOM OF WALL ELEVATION _____ SLOPE _____ MAX 3:1 EMBANKMENT OVERLAND FLOW ROUTE O PROPOSED STORM MANHOLE PROPOSED STORM CAHBASIN PROPOSED SANITARY \bowtie VALVE HYDRANT AND VALVE ÷ EXISTING STORM CAHBASIN EXISTING STORM MANHOLE \bigcirc EXISTING SANITARY MANHOLE EXISTING VALVE \bowtie EXISTING HYDRANT -****-WILLOUGHBY DRIVE, NIAGARA FALLS, ON **N**0 S ENGINEERING + MANAGEMENT \mathbf{S} ₽ 905.709.5825 ΗU 200 CACHET WOODS COURT, SUITE 204 MARKHAM, ON L&C 028 HUSSON.CA FIGURE 5 WILLOUGHBY DRIVE MAJOR SYSTEM DRAINAGE PLAN

DATE: OCTOBER 2024 SCALE: 1:1000 PROJECT: 221377







		TEDUAN
	EXISTING WA	TERMAIN
VB.	WATERMAIN	
⊠ -0-	VALVE AND	BOX
GAS ——	EXISTING TO	JMMØ GAS SERVICE
	EXISTING GA	S LINES
CTV	EXISTING CT	V LINES
BELL	EXISTING BEI	LL LINES
	PROPERTY L	INE
$\textcircled{\bullet}$	TEMPORARY	WELL
VC ⊕	VALVE CHAM	IBER
	NIAGARA F	FALLS, ON
	0	
		ENGINEERING + MANAGEMENT
		 ₱ 905.709.5825 200 CACHET WOODS COURT, SUITE 204 MARKHAM, ON L8C 028
		HUSSON.CA
	۱۸	
		STRIBUTION PLAN
	DATE: OCTOBER 202	4 SCALE: 1:1000 PROJECT: 221377



	Storm Design 5-Year Storm Rainfall Intensity	= <u>A</u> (Tc+B)^c	-												NOSSUH				
A = B = c = Starting Tc =	5-YEAR 719.5 6.34 0.7687 10	min												Project #: Date: Designed by:	221377 October 7, 20 JA	24			
			5-YEAR	5-YEAR	5-YEAR	5-YEAR	5-YEAR	5-YEAR	TOTAL								UPSTREAM		DOWNSTREAM
STREET	FROM	то	AREA	RUNOFF	"AR"	ACCUM.	RAINFALL	ACCUM.	FLOW	LENGTH	SLOPE	PIPE	Manning's	FULL FLOW	FULL FLOW	% FULL	TIME OF	TIME OF	TIME OF
	мн	MH		COEFFICIENT		"AR"	INTENSITY	FLOW		<i>.</i>		DIAMETER	"n"	CAPACITY	VELOCITY		CONC.	CONC.	CONC.
Cattell Drive	1	2	(ha)	"R" 0.45			(mm/hr) 94.02	(m3/s)	(m3/s)	(m) 76.9	(%)	(mm) 525	0.013	(m3/s)	(m/s)		(min)	(min)	(min) 10.011
Cattell Drive	2	3	0.17	0.45	0.08	0.08	84.02	0.018	0.018	82.4	0.00	675	0.013	0.531	1.486	3%	10.000	0.925	10.925
Cattell Drive	2	4	0.17	0.45	0.00	0.00	80.54	0.069	0.068	37.6	0.40	750	0.013	0.001	1.400	10%	10.000	0.304	11 319
Cattell Drive	5	4	0.01	0.45	0.20	0.01	70.40	0.000	0.000	57.0	0.40	130	0.013	0.704	1.334	10 /0	10.925	0.334	11.310
Catteli Drive	4	5	1.90	0.45	0.88	1.19	79.16	0.261	0.261	59.5	0.30	825	0.013	0.786	1.471	33%	11.318	0.674	11.993
Cattell Drive	5	6	9.07	0.45	4.08	5.27	76.91	1.126	1.126	129.4	0.10	1200	0.013	1.232	1.090	91%	11.993	1.978	13.971
Cattell Drive	6	7	7.15	0.45	3.22	8.49	71.09	1.676	1.676	57.9	0.10	1200	0.013	1.232	1.090	136%	13.971	0.885	14.856
Cattell Drive	7	8	0.43	0.45	0.19	8.68	68.79	1.659	1.659	67.7	0.10	1200	0.013	1.232	1.090	135%	14.856	1.034	15.890
Cattell Drive	8	9	2.02	0.45	0.91	9.59	66.32	1.767	1.767	77.7	0.10	1200	0.013	1.232	1.090	143%	15.890	1.187	17.078
Cattell Drive	9	10	0.64	0.45	0.29	9.88	63.72	1.748	1.748	64.9	0.10	1200	0.013	1.232	1.090	142%	17.078	0.993	18.070
Cattell Drive	10	11	1.15	0.45	0.52	10.40	61.72	1.782	1.782	119.6	0.10	1200	0.013	1.232	1.090	145%	18.070	1.829	19.899
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STRET Imp Lot Lot <thlot< th=""> <thlot< th="" th<=""><th>A = B = c = Starting Tc =</th><th>5-Year = 719.5 = 6.34 = 0.769</th><th>(Tc+B)^c 0 min</th><th>_</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>Project: Project #: Date: Designed by:</th><th>Willoughby D 221377 October 7, 20 JT</th><th>Drive D24</th><th></th><th></th></thlot<></thlot<>	A = B = c = Starting Tc =	5-Year = 719.5 = 6.34 = 0.769	(Tc+B)^c 0 min	_																Project: Project #: Date: Designed by:	Willoughby D 221377 October 7, 20 JT	Drive D24		
Interf Arm Arm<																								
Image Image <th< th=""><th>STREET</th><th>FROM MH</th><th>то МН</th><th>5-YR AREA</th><th>5-YR RUNOFF COEFFICIENT</th><th>5-YR "AR"</th><th>5-YR ACCUM. "AR"</th><th>5-YR RAINFALL INTENSITY</th><th>5-YR ACCUM. FLOW</th><th>EXT or BLDG Area</th><th>EXT/BLDG FLOW RATE</th><th>EXT or BLDG FLOW</th><th>ACCUM. EXT/BLDG FLOW</th><th>100-YR RUNOFF COEFF.</th><th>100-YR RAINFALL INTENSITY</th><th>Total Flow</th><th>LENGTH</th><th>SLOPE</th><th>PIPE DIAMETER</th><th>FULL FLOW CAPACITY</th><th>FULL FLOW VELOCITY</th><th>TIME OF CONCENTRATION</th><th>ACC. TIME OF CONC.</th><th>% Full</th></th<>	STREET	FROM MH	то МН	5-YR AREA	5-YR RUNOFF COEFFICIENT	5-YR "AR"	5-YR ACCUM. "AR"	5-YR RAINFALL INTENSITY	5-YR ACCUM. FLOW	EXT or BLDG Area	EXT/BLDG FLOW RATE	EXT or BLDG FLOW	ACCUM. EXT/BLDG FLOW	100-YR RUNOFF COEFF.	100-YR RAINFALL INTENSITY	Total Flow	LENGTH	SLOPE	PIPE DIAMETER	FULL FLOW CAPACITY	FULL FLOW VELOCITY	TIME OF CONCENTRATION	ACC. TIME OF CONC.	% Full
Mil12 Mil17 Lift Lift <thlift< th=""> Lift Lift <t< td=""><th></th><td></td><td></td><td>(ha)</td><td>"R"</td><td></td><td></td><td>(mm/hr)</td><td>(m3/s)</td><td>(ha)</td><td>(l/s/ha)</td><td>(m3/s)</td><td>(m3/s)</td><td>"R"</td><td>(mm/hr)</td><td>(m3/s)</td><td>(m)</td><td>(%)</td><td>(mm)</td><td>(m3/s)</td><td>(m/s)</td><td>(min)</td><td>(min)</td><td></td></t<></thlift<>				(ha)	"R"			(mm/hr)	(m3/s)	(ha)	(l/s/ha)	(m3/s)	(m3/s)	"R"	(mm/hr)	(m3/s)	(m)	(%)	(mm)	(m3/s)	(m/s)	(min)	(min)	
Altrig Multip 0.17 0.10 0.17 0.00 0.17 0.00 0.17 0.00 0.17 0.00 0.17 0.00 0.17 0.00 0.17 0.00 0.17 0.00 0.17 0.00 0.17 0.00 0.17 0.00 0.17 0.00 0.17 0.00 0.17 0.00 0.17 0.17 0.10 0.13		MH122	MH121	1.81	0.70	1.27	1.27	83.95	0.295					0.850	200.63	0.295	13.3	0.15	675	0.325	0.910	0.244	10.244	91%
Amilia Millia 0.17		MH128	MH127	0.12	0.70	0.08	0.08	83.95	0.020					0.850	200.63	0.020	33.7	0.30	375	0.096	0.869	0.646	10.646	20%
OM 110 WH102 0.21 0.21 0.13 0.14 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.13 0.14 0.15 0.15 0.15 0.13 0.14 0.15 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.16 0.15 0.16 0.16 0.16 0.16 0.15 0.16 0.16 0.16 0.15 0.16 0.16		MH127	MH121	0.17	0.70	0.12	0.20	81.49	0.046					0.850	193.89	0.046	84.3	0.20	450	0.127	0.802	1.753	12.399	36%
MB1179 CGR CGR O/O O/O<		MH121	MH120	0.17	0.70	0.12	1.59	75.56	0.334					0.850	177.91	0.334	11.8	0.15	750	0.431	0.976	0.202	12.601	77%
model Marcing Orig		MH120	MH137	0.21	0.70	0.15	1.74	74.94	0.361					0.850	176.26	0.361	126.0	0.15	750	0.431	0.976	2.152	14.753	84%
EXMIN MITIQ 0.70 0.70 0.83 25 0.04 0.84 70 0.85 70 0.85 70 0.85 70 0.85 70 0.85 70 0.88 70 0.01 70 0.17 80 0.22 80 0.94 70 0.22 70 0.88 70 0.90 70 0.85 70 0.88 70 0.90 70 0.85 70 0.88 70 0.90 70 0.18 70 0.90 70 0.18 70 0.90 70 0.18 70 <th></th> <td>0651</td> <td>MH103</td> <td>0.10</td> <td>0.70</td> <td>0.07</td> <td>1.01</td> <td>68 75</td> <td>0.340</td> <td></td> <td></td> <td></td> <td></td> <td>0.650</td> <td>150.04</td> <td>0.340</td> <td>4.9</td> <td>0.10</td> <td>825</td> <td>0.454</td> <td>0.849</td> <td>0.090</td> <td>14.049</td> <td>76%</td>		0651	MH103	0.10	0.70	0.07	1.01	68 75	0.340					0.650	150.04	0.340	4.9	0.10	825	0.454	0.849	0.090	14.049	76%
MH192 MH104 0.69 0.75 0.52 0.52 0.52 0.53 0.00 0.71 1.64 0.19 0.00 0.194 0.037 0.238		EX MH	MH104		0.70		1.01	83.95	0.040	1 000	848 170	0.848	0.848	0.300	200.63	0.848	79.2	0.10	1200x2400	2 690	0.049	1 420	19.560	32%
NH103 NH103 0.17 0.70 0.12 0.64 58.91 0.104 0.686 0.836 1.437 0.026 1.2002400 2.000 0.900 1.128 1.028 95% MH133 MH103 0.344 0.77 0.24 83.95 0.056 0.650 1.060 1.05 1.0002400 2.060 0.930 1.400 2.228 10.225 17.58 MH130 MH103 0.16 0.70 0.13 3.41 5.701 0.540 2.080 0.030 1.400 2.228 10.225 17.58 MH111 MH115 0.14 0.70 0.10 8.356 0.023 0.850 12.07.1 1.255 3.75 0.088 0.794 1.638 11.638 25% MH131 MH112 0.161 7.70 0.51 0.256 0.74 0.107 1.74% 47% OGS2 MH133 MH102 0.56 0.70 0.41 0.41 8.386 0.091		MH132	MH104	0.69	0.70	0.52	0.52	83.95	0 121	1.000	040.170	0.040	0.040	0.875	200.63	0.040	16.4	0.00	600	0 194	0.550	0.398	10.398	62%
MH136 MH103 0.80 0.75 0.90 0.86 0.84 0.875 20.083 0.140 12.0 0.15 0.60 0.238 0.241 0.238 10.238 10.238 59% MH100 MH102 0.18 0.70 0.13 3.41 57.01 0.365 10.65 20.053 0.666 0.20 375 0.076 0.710 0.225 10.225 122.57 17% MH1101 MH1102 0.18 0.70 0.13 3.41 57.01 0.023 77 0.25 375 0.088 0.794 1.636 28% MH115 OGS2 0.13 0.70 0.76 0.041 0.505 184.50 0.041 5.1 0.26 375 0.088 0.794 0.167 11.743 47% MH131 MH102 0.58 0.70 0.39 0.39 0.39 0.39 0.39 0.39 0.39 0.39 0.39 0.39 0.31 0.44 <		MH104	MH103	0.00	0.70	0.02	0.64	58.91	0.121				0.848	0.850	134 57	0.952	62.9	0.05	1200x2400	2 690	0.930	1 126	20.686	35%
IMH30 MH103 0.34 0.70 0.24 0.24 0.540 0.640 0.850 200.83 0.096 9.6 0.20 0.75 0.701 0.225 1.025 71% MH103 MH107 0.14 0.70 0.10 0.13 5.41 5.701 0.540 0.650 120.251 775 0.080 0.784 0.140 2.260 5.275 0.081 0.784 0.140 2.265 775 0.081 0.784 1.136 28% 0.652 MH117 MH102 0.56 0.76 0.091 7.766 0.041 0.550 1543.64 0.041 7.3 0.30 0.757 0.089 0.400 11.843 42% MH131 MH102 0.568 0.70 0.41 0.41 83.55 0.095 1.096.5 1.096.5 1.090 1.579 0.20 450 0.127 0.802 0.410 1.539 0.733 8.355 0.071 0.41 0.41 8.455 0.095		MH135	MH103	0.80	0.75	0.60	0.60	83.95	0.140				01010	0.875	200.63	0.140	12.0	0.15	600	0.238	0.841	0.238	10.238	59%
MH103 MH102 0.18 0.70 0.10 0.540 0.648 0.850 129.77 1.388 78.1 0.05 12002-2400 2.890 0.30 1.400 22.086 52% MH115 0.052 0.13 0.70 0.09 0.19 78.01 0.023 0.79 1.885 0.014 5.1 0.25 375 0.088 0.794 1.140 1.443 47% OGS2 MH102 0.56 0.70 0.38 0.39 83.55 0.641 6.500 183.54 0.041 7.3 0.30 0.37 0.086 0.794 0.117 11.43 47% MH131 MH102 0.56 0.70 0.38 0.39 0.39 0.39 0.30 14.48 72% MH113 MH102 0.68 0.70 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33 0.33		MH130	MH103	0.34	0.70	0.24	0.24	83.95	0.056					0.850	200.63	0.056	9.6	0.20	375	0.078	0.710	0.225	10.225	71%
MH117 MH115 0.14 0.70 0.10 0.10 0.10 0.835 0.023 77.9 0.28 37.5 0.088 0.794 1.636 11.636 20% OGS2 MH102 - 0.19 77.66 0.041 - 0.850 184.50 0.041 7.3 0.30 37.5 0.088 0.794 1.638 11.638 24% MH131 MH102 0.58 0.70 0.39 0.39 63.35 0.091 200.61 0.019 27.6 0.088 0.991 200.63 0.091 200 0.20 450 0.127 0.802 0.310 11.638 47% MH131 MH102 0.58 0.70 0.41 4.80 54.44 0.71 0.48 0.80 200.63 0.091 12.01 1200 4.80 0.10 13.73 52.749 53.749 53.749 53.749 53.749 53.749 53.749 53.749 53.749 53.749 53.749 53.749		MH103	MH102	0.18	0.70	0.13	3.41	57.01	0.540				0.848	0.850	129.77	1.388	78.1	0.05	1200x2400	2.690	0.930	1.400	22.086	52%
MH115 OGS2 0.13 0.70 0.90 0.19 77.60 0.041 P 0.850 184.50 0.041 5.1 0.25 37.5 0.088 0.74 0.107 11.743 47% MH131 MH102 0.56 0.70 0.39 0.39 0.39 0.39 0.39 0.39 0.416 11.833 47% MH136 MH102 0.56 0.70 0.41 0.41 83.95 0.091 0.850 200.63 0.091 2.0 450 0.127 0.802 0.416 10.416 72% MH102 MH111 0.47 0.70 0.31 4.80 6.071 0.880 2.0051 10.97 0.802 0.310 16.33 2.2749 50% MH112 MH111 0.47 0.70 0.35 77.15 0.125 0.880 120.71 6.15 600 0.238 0.841 181.3 13.713 52% MH110 MH106 0.36 0.70		MH117	MH115	0.14	0.70	0.10	0.10	83.95	0.023					0.850	200.63	0.023	77.9	0.25	375	0.088	0.794	1.636	11.636	26%
OGS2 MH102 U U D, 0 77.66 0.041 U D, 0 183.54 0.041 7.3 0.30 375 0.086 0.869 0.140 11.883 42% MH136 MH102 0.58 0.70 0.41 0.41 83.95 0.091 0.860 20.63 0.095 149 0.20 450 0.127 0.802 0.310 11.813 42% MH136 MH102 0.58 0.70 0.41 0.49 54.84 0.71 0.860 20.063 0.095 149 0.20 450 0.127 0.802 0.310 11.813 12.74 MH112 MH111 0.477 0.70 0.33 0.33 63.95 0.077 0.818 0.860 12.013 17.57 0.15 525 0.166 0.769 13.900 11.900 46% MH111 MH110 M109 0.23 0.70 0.25 0.725 0.125 0.165 0.125 0.15 600 0.238 0.841 1.813 1.731 62% MH110 <t< th=""><th></th><th>MH115</th><th>OGS2</th><th>0.13</th><th>0.70</th><th>0.09</th><th>0.19</th><th>78.01</th><th>0.041</th><th></th><th></th><th></th><th></th><th>0.850</th><th>184.50</th><th>0.041</th><th>5.1</th><th>0.25</th><th>375</th><th>0.088</th><th>0.794</th><th>0.107</th><th>11.743</th><th>47%</th></t<>		MH115	OGS2	0.13	0.70	0.09	0.19	78.01	0.041					0.850	184.50	0.041	5.1	0.25	375	0.088	0.794	0.107	11.743	47%
MH131 MH102 0.56 0.70 0.39 0.39 8.395 0.091 0.850 20.03 0.091 20.0 450 0.127 0.802 0.416 172% MH102 MH101 0.58 0.70 0.41 0.490 53.95 0.095 1 0.850 20.83 0.091 1.50 1200x2400 2.60 0.50 1200x2400 2.60 0.500 1200x2400 2.60 0.500 1200x2400 2.60 0.500 1200x2400 2.60 0.50 1200x2400 2.60 0.50 1200x2400 2.60 0.500 1200x2400 2.60 0.500 1200x2400 2.60 0.500 1200x2400 2.60 0.50 1200x2400 2.60 0.500 1200x2400 2.60 0.500 1200x2400 2.60 0.50 1200x2400 2.60 0.52 0.166 0.70 0.33 12.70 0.431 0.79 0.431 0.79 0.431 0.79 0.431 0.79 0.431 0.79 0.431 0.79 0.431 0.79 0.431 0.79 0.431 0.79 <		OGS2	MH102				0.19	77.66	0.041					0.500	183.54	0.041	7.3	0.30	375	0.096	0.869	0.140	11.883	42%
MH136 MH102 0.58 0.70 0.41 8.39 0.99 0.850 20.08 0.99 14.9 0.20 450 0.127 0.802 0.310 10.310 74% MH102 MH111 0.411 0.58 0.70 0.41 4.80 54.84 0.731 0.781 0.850 1200.2400 250 0.66 0.769 1.900 0.130 0.740 74% MH112 MH111 0.47 0.70 0.33 0.38 0.957 0.48 0.850 200.63 0.077 87.7 0.15 620 0.66 0.769 1.900 1.130 64% MH110 MH109 0.23 0.70 0.16 0.74 71.20 0.148 0 0.16 0.12 0.16 0.238 0.841 0.133 13.713 65% MH109 MH108 MH107 0.47 0.70 0.33 1.20 0.148 0.850 167.2 0.148 84.4 0.15 600 0.238 0.841 0.450 0.25 0.50 0.431 0.976 1.240		MH131	MH102	0.56	0.70	0.39	0.39	83.95	0.091					0.850	200.63	0.091	20.0	0.20	450	0.127	0.802	0.416	10.416	72%
MH102 MH101 0.58 0.70 0.41 4.80 54.84 0.73 0 124.31 1.579 92.8 0.05 1200x240 2.690 0.90 1.683 23.749 59% MH111 MH110 0.47 0.70 0.33 0.33 0.38 0.70 1.65 52.00 0.16 0.160 0.23 0.80 13.713 52% MH110 MH109 0.23 0.70 0.16 0.74 77.12 0.128 0.850 167.72 0.148 1.55 600 0.238 0.841 1.813 13.713 52% MH109 MH108 0.33 0.70 0.16 0.74 77.12 0.148 0.850 166.89 0.16 84.4 0.15 750 0.431 0.976 1.400 13.408 62% MH108 MH107 0.47 0.70 0.33 1.20 67.33 0.24 0.800 149.25 0.50 1.55 0.613 0.612 10.215 43% Chamber MH108 0.470 0.70 0.33 1.58		MH136	MH102	0.58	0.70	0.41	0.41	83.95	0.095					0.850	200.63	0.095	14.9	0.20	450	0.127	0.802	0.310	10.310	74%
MH112 MH111 0.47 0.70 0.33 0.16 0.77 0.15 525 0.16 0.769 1.900 14.90 MH10 MH109 0.23 0.70 0.16 0.74 71.72 0.148 0.850 167.72 0.148 12.9 0.15 600 0.238 0.841 1.025 13.968 62% MH108 MH107 0.47 0.70 0.33 0.12 0.74 71.2 0.148 0.50 155 750 0.431 0.976 1.404 15.09 32% MH108 MH107 0.470 0.70 0.33 0.13 83.95 0.029 0.650 165.58 0.125 0.50 300 0.068 0.967 0.215		MH102	MH101	0.58	0.70	0.41	4.80	54.84	0.731				0.848	0.850	124.31	1.579	92.8	0.05	1200x2400	2.690	0.930	1.663	23.749	59%
MH111 MH110 0.36 0.70 0.25 0.58 77.15 0.125 0.15 0.125 0.15 600 0.238 0.841 1.013 13.713 52% MH10 MH109 0.110 0.23 0.70 0.26 0.74 71.72 0.148 0.850 167.72 0.148 12.15 0.15 600 0.238 0.841 1.025 13.968 62% MH109 MH108 MH107 0.47 0.70 0.33 1.20 67.38 0.224 0.50 165.84 0.125 750 0.431 0.976 1.204 16.612 52% Chamber MH108 0.55 0.70 0.33 1.20 67.38 0.224 0.850 165.34 0.224 70.5 0.15 750 0.431 0.976 1.204 16.612 52% Chamber MH106 0.55 0.70 0.33 1.58 64.65 0.294 0.250 149.25 0.224 0.50 149.25 0.50 10.215 43% MH106 MH106 MH106		MH112	MH111	0.47	0.70	0.33	0.33	83.95	0.077					0.850	200.63	0.077	87.7	0.15	525	0.166	0.769	1.900	11.900	46%
MH100 MH109 0.023 0.70 0.16 0.74 71.02 0.148 0 0.148 12.9 0.15 600 0.238 0.847 0.1265 13.968 62% MH109 MH108 MH107 0.47 0.70 0.33 1.20 67.38 0.224 0.16 0.168.89 0.146 84.4 0.15 750 0.431 0.976 1.204 16.612 52% Chamber MH108 0.50 0.25 0.13 0.13 83.95 0.029 0.850 156.34 0.224 70.5 0.15 750 0.431 0.976 1.204 16.612 52% Chamber MH107 0.477 0.13 0.33 4.65 0.284 0.55 0.10 825 0.465 0.465 0.465 0.465 0.00 0.665 0.465		MH111	MH110	0.36	0.70	0.25	0.58	77.15	0.125					0.850	182.16	0.125	91.5	0.15	600	0.238	0.841	1.813	13.713	52%
MH109 MH108 C 0.74 71.03 0.146 0.046 0.165.84 0.15 750 0.431 0.976 1.400 15.409 34% MH108 MH107 0.70 0.33 1.20 67.38 0.224 0.850 156.34 0.224 70.5 0.15 750 0.431 0.976 1.240 16.612 52% Chamber MH108 0.50 0.25 0.13 0.13 83.95 0.029 0.855 20.63 0.029 1.55 750 0.431 0.976 1.240 16.612 52% MH107 MH106 0.55 0.70 0.39 1.58 64.65 0.284 0.850 149.25 0.284 65.5 0.10 825 0.454 0.849 0.215 10.215 43% MH105 MH106 MH105 1.58 61.99 0.272 0.284 0.850 149.25 0.284 65.5 0.10 825 0.454 0.849 0.297 18.165 60% MH105 MH106 0.283 MH106 0.283 <th< th=""><th></th><th>MH110</th><th>MH109</th><th>0.23</th><th>0.70</th><th>0.16</th><th>0.74</th><th>71.72</th><th>0.148</th><th></th><th></th><th></th><th></th><th>0.850</th><th>167.72</th><th>0.148</th><th>12.9</th><th>0.15</th><th>600</th><th>0.238</th><th>0.841</th><th>0.255</th><th>13.968</th><th>62%</th></th<>		MH110	MH109	0.23	0.70	0.16	0.74	71.72	0.148					0.850	167.72	0.148	12.9	0.15	600	0.238	0.841	0.255	13.968	62%
MH108 MH107 0.47 0.70 0.33 1.20 67.38 0.224 0.850 156.34 0.224 7.05 0.15 750 0.431 0.976 1.204 16.612 52% Chamber MH108 0.50 0.25 0.13 0.13 83.95 0.0284 0.825 20.063 0.020 1.06 0.431 0.976 1.204 16.612 52% MH107 MH106 0.55 0.70 0.39 1.58 64.65 0.284 0.850 149.25 0.284 65.5 0.10 825 0.454 0.849 0.257 18.155 60% MH106 MH106 0.80 0.70 0.38 0.295 0.500 142.42 0.272 1.01 825 0.454 0.849 0.257 18.155 60% MH106 MH116 OGS3 0.70 1.78 59.80 0.295 0.500 138.82 0.295 7.2 0.10 825 0.454 0.849 <th0< th=""><th></th><th>MH109</th><th>MH108</th><th>0.47</th><th>0.70</th><th>0.00</th><th>0.74</th><th>71.03</th><th>0.146</th><th></th><th></th><th></th><th></th><th>0.500</th><th>165.89</th><th>0.146</th><th>84.4</th><th>0.15</th><th>750</th><th>0.431</th><th>0.976</th><th>1.440</th><th>15.409</th><th>34%</th></th0<>		MH109	MH108	0.47	0.70	0.00	0.74	71.03	0.146					0.500	165.89	0.146	84.4	0.15	750	0.431	0.976	1.440	15.409	34%
Chamber WH 106 0.30 0.23 0.13 0.13 0.33 0.029 12.5 0.00 300 0.066 0.997 0.215 10.215 143% MH 107 MH 106 0.55 0.70 0.39 1.58 64.65 0.29 149.55 0.20 300 305 0.065 0.089 0.215 1.215 1.68 MH 106 MH 105 MH 105 MH 105 MH 106 0.280 0.70 0.20 1.78 61.49 0.304 0.850 142.42 0.272 13.1 0.10 825 0.454 0.849 0.257 1.8155 60% MH 105 MH 116 0.28 0.70 0.20 1.78 61.49 0.304 0.850 141.15 0.304 46.2 0.10 825 0.454 0.849 0.215 1.902 67% MH 105 MH 116 0.280 0.70 1.78 59.54 0.295 0.295 7.2 0.10 825 0.454 0.849 0.141 19.023 65% GSite MH 114 0.88		MH108	MH107	0.47	0.70	0.33	1.20	67.38	0.224					0.850	156.34	0.224	70.5	0.15	750	0.431	0.976	1.204	16.612	52%
Million		MU107	MH106	0.50	0.25	0.13	0.13	64.65	0.029					0.025	200.03	0.029	12.5	0.50	300	0.068	0.967	0.215	17,900	43%
Minus Minus <th< th=""><th> </th><th>MH106</th><th>MH105</th><th>0.55</th><th>0.70</th><th>0.59</th><th>1.50</th><th>61.00</th><th>0.204</th><th></th><th></th><th></th><th></th><th>0.000</th><th>143.23</th><th>0.204</th><th>13.1</th><th>0.10</th><th>825</th><th>0.454</th><th>0.049</th><th>0.257</th><th>18 155</th><th>60%</th></th<>		MH106	MH105	0.55	0.70	0.59	1.50	61.00	0.204					0.000	143.23	0.204	13.1	0.10	825	0.454	0.049	0.257	18 155	60%
Minute		MH105	MH116	0.28	0.70	0.20	1.00	61.99	0.304					0.500	141 15	0.304	46.2	0.10	825	0.454	0.049	0.207	19.062	67%
Mint		MH116	0683	0.20	5.70	0.20	1 78	59.80	0.295					0.500	136.82	0.295	72	0.10	825	0.454	0.849	0.141	19,203	65%
Site MH14 0.88 0.75 0.66 0.66 83.95 0.154 0.875 200.63 0.154 10.0 0.60 0.161<		OGS3	MH101	1	0.70		1.78	59.54	0.294					0.850	136.17	0.294	8.9	0.10	825	0.454	0.849	0.175	19.378	65%
MH14 MH18 0.40 0.70 0.28 0.94 83.53 0.218 0.850 199.66 0.218 100 0.60 525 0.333 1.539 1.093 11.201 66% MH18 OGS4 0.14 0.70 0.28 0.94 83.53 0.218 0.850 199.46 0.218 100.9 0.60 525 0.333 1.539 1.093 11.201 66% MH18 OGS4 0.14 0.70 0.10 1.04 79.50 0.229 58.9 0.30 600 0.336 1.189 0.825 12.026 68% OGS4 MH101 1.04 76.74 0.221 0.500 181.06 0.221 13.3 0.15 675 0.325 0.910 0.244 12.270 68% MH101 MH100 7.61 52.50 1.110 0.848 0.500 118.45 1.959 32.5 0.05 1200x2400 2.690 0.930 0.583		Site	MH114	0.88	0.75	0.66	0.66	83.95	0.154					0,875	200.63	0.154	10.0	0.50	600	0.434	1,536	0.109	10,109	35%
MH18 OGS4 0.14 0.70 0.10 1.04 76.74 0.229 188.9 0.229 58.9 0.30 600 0.336 1.189 0.825 12.026 68% OGS4 MH10 1.04 76.74 0.221 0.848 0.500 188.49 0.30 600 0.336 1.189 0.825 12.026 68% MH101 MH100 7.61 52.50 1.10 0.848 0.500 118.45 1.959 32.5 0.05 1200x2400 2.690 0.930 0.583 24.332 73%		MH114	MH118	0.40	0.70	0.28	0.94	83.53	0.218					0,850	199.46	0.218	100.9	0.60	525	0,333	1,539	1.093	11,201	66%
OGS4 MH101 1.04 76.74 0.221 181.06 0.221 13.3 0.15 675 0.325 0.910 0.244 12.270 68% MH101 MH100 7.61 52.50 1.10 0.848 0.500 118.45 1.959 32.5 0.05 1200x2400 2.690 0.930 0.583 24.332 73%		MH118	OGS4	0.14	0.70	0.10	1.04	79.50	0.229	1		1	1	0.850	188.49	0.229	58.9	0.30	600	0.336	1.189	0.825	12.026	68%
MH101 MH100 7.61 52.50 1.110 0.848 0.500 118.45 1.959 32.5 0.05 1200x2400 2.690 0.930 0.583 24.332 73%		OGS4	MH101				1.04	76.74	0.221					0.500	181.06	0.221	13.3	0.15	675	0.325	0.910	0.244	12.270	68%
		MH101	MH100				7.61	52.50	1.110			1	0.848	0.500	118.45	1.959	32.5	0.05	1200x2400	2.690	0.930	0.583	24.332	73%







City: Niagara Falls Project Number: 221377 Nearest Rainfall Station: ST CATHARINES AP Designer Name: Greg Rapp Climate Station Id: 6137287 Designer Company: Husson Limited Years of Rainfall Data: 33 Designer Famil: greg.rapp@husson.ca Years of Rainfall Data: 33 Designer Phone: 416-788-1414 Site Name: 103 EOR Name: EOR Company: EOR Company: Drainage Area (ha): 3.0 EOR Company: EOR Phone: EOR Phone: Windperviousness: 65.00 EOR Phone: EOR Phone: EOR Phone: Particle Size Distribution: CA ETV CA ETV Target TSS Removal (%): 60.0 Sizing Summary Required Water Quality Runoff Volume Capture (%): 90.00 Sizing Summary Sizing Summary Estimated Water Quality Flow Rate (L/s): 64.37 Yes Stormceptor TSS Removal (%) Oil / Fuel Spill Risk Site? Yes Yes Stormceptor TSS Removal Provided (%)	ity: Niagara Fails Project Number: 221377 Wearest Rainfall Station: ST CATHARINES AP Designer Name: Greg Rapp Limate Station Id: 6137287 Designer Company: Husson Limited Greg Rapp@husson.ca Designer Email: greg.rapp@husson.ca Designer Area (ha): 3.0 GEOR Rapp: EOR Company: Husson Limited Trainage Area (ha): 3.0 EOR Company: EOR Company:	Province:	Ontario		Project Nan	ne:	Willoughby	
Nearest Rainfall Station: ST CATHARINES AP Designer Name: Greg Rapp Climate Station Id: 6137287 Designer Company: Husson Limited Years of Rainfall Data: 33 Designer Phone: 416-788-1414 Site Name: 103 EOR Company: Using Phone: 416-788-1414 Drainage Area (ha): 3.0 EOR Company: Using Phone: EOR Company: Wimperviousness: 65.00 EOR Phone: EOR Phone: EOR Phone: Particle Size Distribution: CA ETV EOR Phone: Net Annual Sediment (TSS) Load Reduction Sizing Summary Required Water Quality Runoff Volume Capture (%): 90.00 Sizing Summary Sizing Summary Sitimated Water Quality Flow Rate (L/s): 64.37 Yes Stormceptor TSS Removal (%)	Vearest Rainfall Station: ST CATHARINES AP Designer Name: Greg Rapp Limate Station Id: 6137287 'ears of Rainfall Data: 33 ite Name: 103 brainage Area (ha): 3.0 ite Name: 50.0 Runoff Coefficient 'c': 0.69 article Size Distribution: CA ETV Runoff Coefficient 'c': 0.69 article Size Distribution: CA ETV rarticle Size Distribution: CA ETV equired Water Quality Runoff Volume Capture (%): 90.00 stimated Water Quality Flow Rate (L/s): 64.37 Nil / Fuel Spill Risk Site? Yes pstream Flow Control? No eak Conveyance (maximum) Flow Rate (L/s): 1641 stimated Average Annual Sediment Load (kg/yr): 1641 stimated Average Annual Sediment Volume (L/yr): 1334 EFO10 59 EFO12 62 Recommended Stormceptor EFO Model: EFO12 EFO12 62	City:	Niagara Falls		Project Nur	nber:	221377	
Climate Station Id: 6137287 Designer Company: Husson Limited Years of Rainfall Data: 33 Designer Email: greg.rapp@husson.ca Site Name: 103 Designer Phone: 416-788-1414 Drainage Area (ha): 3.0 EOR Name: EOR Company: % Imperviousness: 65.00 EOR Email: EOR Phone: Particle Size Distribution: CA ETV CA ETV Target TSS Removal (%): 60.0 Required Water Quality Runoff Volume Capture (%): 90.00 90.00 Sizing Summary Estimated Water Quality Flow Rate (L/s): 64.37 Stormceptor TSS Remove Model Oil / Fuel Spill Risk Site? Yes Yes Stormceptor TSS Remove Model	Ilimate Station Id: 6137287 ears of Rainfall Data: 33 ite Name: 103 besigner Email: greg.rapp@husson.ca Designer Phone: 416-788-1414 EOR Name: EOR Name: ite Name: 0.0 fungerviousness: 65.00 Runoff Coefficient 'c': 0.69 article Size Distribution: CA ETV arget TSS Removal (%): 60.0 equired Water Quality Runoff Volume Capture (%): 90.00 stimated Water Quality Flow Rate (L/s): 64.37 Nil / Fuel Spill Risk Site? Yes pstream Flow Control? No eak Conveyance (maximum) Flow Rate (L/s): 1641 stimated Average Annual Sediment Load (kg/yr): 1641 stimated Average Annual Sediment Volume (L/yr): 1334	Nearest Rainfall Station:	ST CATHARINES AP		Designer Na	me:	Greg Rapp	
Years of Rainfall Data: 33 Designer Email: greg.rapp@husson.ca Site Name: 103 Designer Phone: 416-788-1414 Drainage Area (ha): 3.0 EOR Name: EOR Company: % Imperviousness: 65.00 EOR Email: EOR Phone: Runoff Coefficient 'c': 0.69 EOR Phone: Met Annual Sediment (TSS) Load Reduction Sizing Summary Particle Size Distribution: CA ETV Particle Size Distribution: CA ETV Stormceptor Target TSS Removal (%): 60.0 90.00 Stormceptor Stormceptor TSS Removal (%): Estimated Water Quality Runoff Volume Capture (%): 90.00 Stormceptor TSS Removal (%): Stormceptor TSS Removal (%): Oil / Fuel Spill Risk Site? Yes Yes Stormceptor TSS Removal (%): 28	rears of Rainfall Data: 33 idears of Rainfall Data: 103	Climate Station Id:	6137287		Designer Co	mpany:	Husson Limited	
Designer Phone: 416-788-1414 Site Name: 103 Drainage Area (ha): 3.0 Drainage Area (ha): 3.0 Wimperviousness: 65.00 Runoff Coefficient 'c': 0.69 Particle Size Distribution: CA ETV Farget TSS Removal (%): 60.0 Required Water Quality Runoff Volume Capture (%): 90.00 Stimated Water Quality Flow Rate (L/s): 64.37 Dil / Fuel Spill Risk Site? Yes Designer Phone: 416-788-1414 EOR Name: EOR Company: EOR Email: EOR Phone: EOR Ph	Designer Phone: 416-788-1414 Designer Phone: 416-788-1414 EOR Name: EOR Name: EOR Company: EOR Company: EOR Email: EOR Phone: article Size Distribution: CA ETV arget TSS Removal (%): 60.0 required Water Quality Runoff Volume Capture (%): 90.00 stimated Water Quality Flow Rate (L/s): 64.37 Nil / Fuel Spill Risk Site? Yes pstream Flow Control? No eak Conveyance (maximum) Flow Rate (L/s): 200 stimated Average Annual Sediment Load (kg/yr): 1641 stimated Average Annual Sediment Load (kg/yr): 1334	Years of Rainfall Data:	33		Designer En	nail:	greg.rapp@husson	.ca
Site Name: 103 Drainage Area (ha): 3.0 Drainage Area (ha): 3.0 & Imperviousness: 65.00 Runoff Coefficient 'c': 0.69 Particle Size Distribution: CA ETV Target TSS Removal (%): 60.0 Required Water Quality Runoff Volume Capture (%): 90.00 Estimated Water Quality Flow Rate (L/s): 64.37 Dil / Fuel Spill Risk Site? Yes	iite Name: 103 Orainage Area (ha): 3.0 6 Imperviousness: 65.00 Runoff Coefficient 'c': 0.69 article Size Distribution: CA ETV arget TSS Removal (%): 60.0 sequired Water Quality Runoff Volume Capture (%): 90.00 stimated Water Quality Flow Rate (L/s): 64.37 bil / Fuel Spill Risk Site? Yes pstream Flow Control? No eak Conveyance (maximum) Flow Rate (L/s): 1641 filuent TSS Concentration (mg/L): 200 stimated Average Annual Sediment Load (kg/yr): 1641 stimated Average Annual Sediment Load (kg/yr): 1641 EFO10 59 EFO12 62				Designer Ph	one:	416-788-1414	
Drainage Area (ha): 3.0 Burnerviousness: 65.00 Runoff Coefficient 'c': 0.69 Particle Size Distribution: CA ETV Farget TSS Removal (%): 60.0 Required Water Quality Runoff Volume Capture (%): 90.00 Estimated Water Quality Flow Rate (L/s): 64.37 Dil / Fuel Spill Risk Site? Yes	Drainage Area (ha): 3.0 6 Imperviousness: 65.00 Runoff Coefficient 'c': 0.69 article Size Distribution: CA ETV arget TSS Removal (%): 60.0 sequired Water Quality Runoff Volume Capture (%): 90.00 stimated Water Quality Flow Rate (L/s): 64.37 Nil / Fuel Spill Risk Site? Yes Ipstream Flow Control? No eak Conveyance (maximum) Flow Rate (L/s): 1641 stimated Average Annual Sediment Load (kg/yr): 1641 stimated Average Annual Sediment Volume (L/yr): 1334	Site Name:	103		EOR Name:			
% Imperviousness: 65.00 Runoff Coefficient 'c': 0.69 Particle Size Distribution: CA ETV Target TSS Removal (%): 60.0 Required Water Quality Runoff Volume Capture (%): 90.00 Estimated Water Quality Flow Rate (L/s): 64.37 Dil / Fuel Spill Risk Site? Yes EEQUIPACE FEO4	6 Imperviousness: 65.00 Runoff Coefficient 'c': 0.69 article Size Distribution: CA ETV arget TSS Removal (%): 60.0 sequired Water Quality Runoff Volume Capture (%): 90.00 stimated Water Quality Flow Rate (L/s): 64.37 Nil / Fuel Spill Risk Site? Yes Ipstream Flow Control? No eak Conveyance (maximum) Flow Rate (L/s): 200 stimated Average Annual Sediment Load (kg/yr): 1641 stimated Average Annual Sediment Volume (L/yr): 1334	Drainage Area (ha):	3.0		EOR Compa	ny:		
Runoff Coefficient 'c': 0.69 Particle Size Distribution: CA ETV Target TSS Removal (%): 60.0 Required Water Quality Runoff Volume Capture (%): 90.00 Estimated Water Quality Flow Rate (L/s): 64.37 Dil / Fuel Spill Risk Site? Yes EEOR Phone: EEOR Phone:	Bunoff Coefficient 'c': 0.69 Bunoff Coefficient 'c': 0.69 Particle Size Distribution: CA ETV arget TSS Removal (%): 60.0 stimated Water Quality Runoff Volume Capture (%): 90.00 stimated Water Quality Flow Rate (L/s): 64.37 bil / Fuel Spill Risk Site? Yes Ipstream Flow Control? No eak Conveyance (maximum) Flow Rate (L/s): 1641 offluent TSS Concentration (mg/L): 200 stimated Average Annual Sediment Volume (L/yr): 1334 Recommended Stormceptor EFO Model: EFO	% Imperviousness:	65.00		EOR Email:			
Particle Size Distribution: CA ETV Farget TSS Removal (%): 60.0 Required Water Quality Runoff Volume Capture (%): 90.00 Estimated Water Quality Flow Rate (L/s): 64.37 Dil / Fuel Spill Risk Site? Yes	Particle Size Distribution: CA ETV arget TSS Removal (%): 60.0 sequired Water Quality Runoff Volume Capture (%): 90.00 stimated Water Quality Flow Rate (L/s): 64.37 Dil / Fuel Spill Risk Site? Yes Ipstream Flow Control? No eak Conveyance (maximum) Flow Rate (L/s): 200 stimated Average Annual Sediment Load (kg/yr): 1641 stimated Average Annual Sediment Volume (L/yr): 1334 Recommended Stormceptor EFO Model:	Runoff C	oefficient 'c': 0.69	-	EOK Phone:			
Target TSS Removal (%): 60.0 Required Water Quality Runoff Volume Capture (%): 90.00 Estimated Water Quality Flow Rate (L/s): 64.37 Dil / Fuel Spill Risk Site? Yes Estimated Water Quality Runoff Volume Capture (%): 90.00 Estimated Water Quality Flow Rate (L/s): 64.37	arget TSS Removal (%): 60.0 iequired Water Quality Runoff Volume Capture (%): 90.00 stimated Water Quality Flow Rate (L/s): 64.37 Dil / Fuel Spill Risk Site? Yes Ipstream Flow Control? No eak Conveyance (maximum) Flow Rate (L/s): 1641 tifuent TSS Concentration (mg/L): 200 stimated Average Annual Sediment Load (kg/yr): 1641 stimated Average Annual Sediment Volume (L/yr): 1334 Recommended Stormceptor EFO Model:	Particle Size Distribution	CA FTV					
Target TSS Removal (%): 90.00 Required Water Quality Runoff Volume Capture (%): 90.00 Estimated Water Quality Flow Rate (L/s): 64.37 Oil / Fuel Spill Risk Site? Yes Estimated Water Quality Flow Rate (L/s): 64.37	anget 135 Removal (%): 000 bequired Water Quality Runoff Volume Capture (%): 90.00 stimated Water Quality Flow Rate (L/s): 64.37 bil / Fuel Spill Risk Site? Yes Upstream Flow Control? No reak Conveyance (maximum) Flow Rate (L/s): 1641 offluent TSS Concentration (mg/L): 200 stimated Average Annual Sediment Load (kg/yr): 1641 stimated Average Annual Sediment Volume (L/yr): 1334 Recommended Stormceptor EFO Model:	Target TSS Demoval (%):					(TSS) Lood	Poduction
Required Water Quality Runoff Volume Capture (%): 90.00 Estimated Water Quality Flow Rate (L/s): 64.37 Oil / Fuel Spill Risk Site? Yes FEO4 28	dequired Water Quality Runoff Volume Capture (%): 90.00 istimated Water Quality Flow Rate (L/s): 64.37 Dil / Fuel Spill Risk Site? Yes Ipstream Flow Control? No reak Conveyance (maximum) Flow Rate (L/s): EFO4 Influent TSS Concentration (mg/L): 200 stimated Average Annual Sediment Load (kg/yr): 1641 stimated Average Annual Sediment Volume (L/yr): 1334 EFO12 62						Sizing S	ummary
Dil / Fuel Spill Risk Site? Yes Stormceptor TSS Remov FEO4 28	Stormceptor ISS Removal Dil / Fuel Spill Risk Site? Yes Ipstream Flow Control? No reak Conveyance (maximum) Flow Rate (L/s): EFO4 Influent TSS Concentration (mg/L): 200 stimated Average Annual Sediment Load (kg/yr): 1641 stimated Average Annual Sediment Volume (L/yr): 1334 EFO10 59 EFO12 62	Required Water Quality Runc	off Volume Capture (%):	90.00			Charmanantan	
Oil / Fuel Spill Risk Site? Yes Notice (1)	Dil / Fuel Spill Risk Site? Yes Ipstream Flow Control? No reak Conveyance (maximum) Flow Rate (L/s): EFO4 Influent TSS Concentration (mg/L): 200 stimated Average Annual Sediment Load (kg/yr): 1641 stimated Average Annual Sediment Volume (L/yr): 1334 EFO10 59 EFO12 62		v Rate (L/S):	64.37			Stormceptor	Provided (%)
	Ipstream Flow Control? No EFO4 38 reak Conveyance (maximum) Flow Rate (L/s): EFO6 48 influent TSS Concentration (mg/L): 200 EFO8 54 stimated Average Annual Sediment Load (kg/yr): 1641 EFO10 59 stimated Average Annual Sediment Volume (L/yr): 1334 EFO12 62	Dil / Fuel Spill Risk Site?		Yes				20
Jpstream Flow Control? No EFO4 38	Peak Conveyance (maximum) Flow Rate (L/s): EFO6 48 Influent TSS Concentration (mg/L): 200 EFO8 54 stimated Average Annual Sediment Load (kg/yr): 1641 EFO10 59 stimated Average Annual Sediment Volume (L/yr): 1334 EFO12 62 Recommended Stormceptor EFO Model: EFO	Jpstream Flow Control?		No			EF04	38
Peak Conveyance (maximum) Flow Rate (L/s):	Influent TSS Concentration (mg/L): 200 EFO8 54 stimated Average Annual Sediment Load (kg/yr): 1641 EFO10 59 stimated Average Annual Sediment Volume (L/yr): 1334 EFO12 62 Recommended Stormceptor EFO Model: EFO	Peak Conveyance (maximum)) Flow Rate (L/s):				EFO6	48
Influent TSS Concentration (mg/L): 200 EFO8 54	istimated Average Annual Sediment Load (kg/yr): 1641 EFO10 59 istimated Average Annual Sediment Volume (L/yr): 1334 EFO12 62 Recommended Stormceptor EFO Model: EFO	Influent TSS Concentration (n	ng/L):	200			EFO8	54
Estimated Average Annual Sediment Load (kg/yr): 1641 EFO10 59	Istimated Average Annual Sediment Volume (L/yr): 1334 EFO12 62 Recommended Stormceptor EFO Model:	Estimated Average Annual Se	diment Load (kg/yr):	1641			EFO10	59
Estimated Average Annual Sediment Volume (L/yr): 1334 EFO12 62	Recommended Stormceptor EFO Model:	Estimated Average Annual Se	diment Volume (L/yr):	1334			EFO12	62
				1	Nater Oua	lity Runoff	Volume Capt	ure (%): <mark>></mark>





THIRD-PARTY TESTING AND VERIFICATION

► Stormceptor® EF and Stormceptor® EFO are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV Procedure for Laboratory Testing of Oil-Grit Separators and performance has been third-party verified in accordance with the ISO 14034 Environmental Technology Verification (ETV) protocol.

PERFORMANCE

► Stormceptor® EF and EFO remove stormwater pollutants through gravity separation and floatation, and feature a patentpending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including highintensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

► The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV *Procedure for Laboratory Testing of Oil-Grit Separators* for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle	Percent Less	Particle Size	Dercent
Size (µm)	Than	Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5







Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	9.2	9.2	2.88	173.0	16.0	70	6.5	6.5
1.00	20.5	29.7	5.75	345.0	33.0	70	14.4	20.9
2.00	16.5	46.2	11.51	691.0	66.0	67	11.1	32.0
3.00	11.3	57.5	17.26	1036.0	99.0	63	7.2	39.2
4.00	9.1	66.7	23.02	1381.0	132.0	60	5.4	44.6
5.00	5.5	72.2	28.77	1726.0	164.0	57	3.2	47.8
6.00	4.5	76.7	34.53	2072.0	197.0	55	2.5	50.3
7.00	4.2	80.9	40.28	2417.0	230.0	53	2.3	52.5
8.00	3.5	84.4	46.04	2762.0	263.0	52	1.8	54.3
9.00	2.0	86.5	51.79	3107.0	296.0	51	1.1	55.4
10.00	1.5	88.0	57.55	3453.0	329.0	50	0.7	56.1
11.00	1.8	89.8	63.30	3798.0	362.0	49	0.9	57.0
12.00	1.1	90.9	69.06	4143.0	395.0	48	0.5	57.6
13.00	1.1	92.0	74.81	4489.0	427.0	47	0.5	58.1
14.00	1.4	93.4	80.56	4834.0	460.0	46	0.7	58.7
15.00	0.8	94.2	86.32	5179.0	493.0	45	0.4	59.1
16.00	0.6	94.8	92.07	5524.0	526.0	44	0.3	59.4
17.00	0.5	95.3	97.83	5870.0	559.0	43	0.2	59.6
18.00	0.3	95.6	103.58	6215.0	592.0	42	0.1	59.7
19.00	0.2	95.9	109.34	6560.0	625.0	42	0.1	59.8
20.00	0.2	96.1	115.09	6906.0	658.0	42	0.1	59.9
21.00	0.5	96.6	120.85	7251.0	691.0	42	0.2	60.1
22.00	0.4	97.0	126.60	7596.0	723.0	41	0.2	60.3
23.00	0.3	97.3	132.36	7941.0	756.0	41	0.1	60.4
24.00	0.0	97.3	138.11	8287.0	789.0	41	0.0	60.4
25.00	0.2	97.4	143.87	8632.0	822.0	41	0.1	60.5
30.00	1.6	99.1	172.64	10358.0	987.0	40	0.7	61.1
35.00	0.6	99.7	201.41	12085.0	1151.0	38	0.2	61.4
40.00	0.0	99.7	230.18	13811.0	1315.0	35	0.0	61.4
45.00	0.3	100.0	258.96	15537.0	1480.0	32	0.1	61.5
			Es	timated Ne	t Annual Sedim	ent (TSS) Loa	d Reduction =	61 %

Climate Station ID: 6137287 Years of Rainfall Data: 33



Stormceptor[®]

Stormceptor[®]EF Sizing Report









Maximum Pipe Diameter / Peak Conveyance												
Stormceptor EF / EFO	Model D	Diameter	Min Angle Inlet / Outlet Pipes	Max Inle Diame	et Pipe eter	Max Out Diame	let Pipe eter	Peak Cor Flow	nveyance Rate			
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)			
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15			
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35			
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60			
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100			
EF12 / EF012	3.6	12	90	1828	72	1828	72	2830	100			

SCOUR PREVENTION AND ONLINE CONFIGURATION

► Stormceptor® EF and EFO feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV Procedure for Laboratory Testing of Oil-Grit Separators, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

DESIGN FLEXIBILITY

► Stormceptor[®] EF and EFO offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

► While Stormceptor[®] EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor[®] EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid reentrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.











INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

- 0° 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
- 45° 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

Pollutant Capacity

*Increased sump depth may be added to increase sediment storage capacity ** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To		
Patent-pending enhanced flow treatment	Superior, verified third-party	Regulator, Specifying & Design Engineer		
Third-party verified light liquid capture	Proven performance for fuel/oil hotspot	Regulator, Specifying & Design Engineer,		
and retention for EFO version	locations	Site Owner		
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer		
Minimal drop between inlet and outlet	Site installation ease	Contractor		
Large diameter outlet riser for inspection	Easy maintenance access from grade	Maintenance Contractor & Site Owner		

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef







Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results Stormceptor® EFO								
SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	
1	70	660	42	1320	35	1980	24	
30	70	690	42	1350	35	2010	24	
60	67	720	41	1380	34	2040	23	
90	63	750	41	1410	34	2070	23	
120	61	780	41	1440	33	2100	23	
150	58	810	41	1470	32	2130	22	
180	56	840	41	1500	32	2160	22	
210	54	870	41	1530	31	2190	22	
240	53	900	41	1560	31	2220	21	
270	52	930	40	1590	30	2250	21	
300	51	960	40	1620	29	2280	21	
330	50	990	40	1650	29	2310	21	
360	49	1020	40	1680	28	2340	20	
390	48	1050	39	1710	28	2370	20	
420	47	1080	39	1740	27	2400	20	
450	47	1110	38	1770	27	2430	20	
480	46	1140	38	1800	26	2460	19	
510	45	1170	37	1830	26	2490	19	
540	44	1200	37	1860	26	2520	19	
570	43	1230	37	1890	25	2550	19	
600	42	1260	36	1920	25	2580	18	
630	42	1290	36	1950	24	2600	26	





STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

- 2.1.1 4 ft (1219 mm) Diameter OGS Units:
 - 6 ft (1829 mm) Diameter OGS Units:
 - 8 ft (2438 mm) Diameter OGS Units:
 - 10 ft (3048 mm) Diameter OGS Units:
 - 12 ft (3657 mm) Diameter OGS Units:

 $\begin{array}{l} 1.19 \ m^{3} \ sediment \ / \ 265 \ L \ oil \\ 3.48 \ m^{3} \ sediment \ / \ 609 \ L \ oil \\ 8.78 \ m^{3} \ sediment \ / \ 1,071 \ L \ oil \\ 17.78 \ m^{3} \ sediment \ / \ 1,673 \ L \ oil \\ 31.23 \ m^{3} \ sediment \ / \ 2,476 \ L \ oil \\ \end{array}$

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall






remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m² to 1400 L/min/m², and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m² and 1400 L/min/m² shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 $L/min/m^2$ shall be assumed to be identical to the sediment removal efficiency at 40 $L/min/m^2$. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 $L/min/m^2$.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m² shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m², and shall be calculated using a simple proportioning formula, with 1400 L/min/m² in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m².

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**.

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m².

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This reentrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to





assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m² to 2600 L/min/m²) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.







City: Niagara Falls Project Number: 221377 Nearest Rainfall Station: ST CATHARINES AP Designer Name: Greg Rapp Climate Station Id: 6137287 Designer Company: Husson Limited Vears of Rainfall Data: 33 Designer Email: greg.rapp@husson.ca Site Name: 104 Designer Phone: 416-788-1414 Drainage Area (ha): 0.65 EOR Company: EOR Company: Runoff Coefficient 'c': 0.69 EOR Phone: EOR Phone: 'article Size Distribution: CA ETV Net Annual Sedime (TSS) Load Reduction (Size Summary)
Nearest Rainfall Station: ST CATHARINES AP Designer Name: Greg Rapp Climate Station Id: 6137287 Designer Company: Husson Limited Years of Rainfall Data: 33 Designer Phone: 416-788-1414 Site Name: 104 EOR Name: EOR Company: EOR Company: Drainage Area (ha): 0.65 65.00 EOR Email: EOR Email: EOR Phone: Runoff Coefficient 'c': 0.69 EOR Phone: Met Annual Sedime (TSS) Load Reduction (TSS) Load Reduct
Climate Station Id: 6137287 /ears of Rainfall Data: 33 Site Name: 104 Drainage Area (ha): 0.65 % Imperviousness: 65.00 Runoff Coefficient 'c': 0.69 Particle Size Distribution: CA ETV Target TSS Removal (%): 60.0 Designer Company: Husson Limited Designer Company: Husson Limited Designer Email: greg.rapp@husson.ca Designer Phone: 416-788-1414 EOR Name: EOR Company: EOR Email: EOR Phone: Net Annual Sedime (TSS) Load Reduction (TSS) Load Re
ears of Rainfall Data: 33 ite Name: 104 brainage Area (ha): 0.65 6 Imperviousness: 65.00 Runoff Coefficient 'c': 0.69 article Size Distribution: CA ETV arget TSS Removal (%): 60.0
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% Imperviousness: 65.00 Runoff Coefficient 'c': 0.69 Particle Size Distribution: CA ETV Farget TSS Removal (%): 60.0
Runoff Coefficient 'c': 0.69 Particle Size Distribution: CA ETV Target TSS Removal (%): 60.0 Carticle Size Distribution: CA ETV
Particle Size Distribution: CA ETV Net Annual Sedime Parget TSS Removal (%): 60.0 (TSS) Load Reduction
article Size Distribution. CALIV Net Annual Sedime arget TSS Removal (%): 60.0 (TSS) Load Reduction
arget ISS Removal (%): 60.0
Required Water Quality Runoff Volume Capture (%): 90.00
istimated Water Quality Flow Rate (L/s): 13.95 Stormceptor TSS Rem
vil / Fuel Spill Risk Site? Yes NODE Provider
Ipstream Flow Control? No EFO4 56
Peak Conveyance (maximum) Flow Rate (L/s): EFO6 63
nfluent TSS Concentration (mg/L): 200 EFO8 66
Estimated Average Annual Sediment Load (kg/yr): 361 EFO10 68
Estimated Average Annual Sediment Volume (L/yr): 294 EFO12 69





THIRD-PARTY TESTING AND VERIFICATION

► Stormceptor® EF and Stormceptor® EFO are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV Procedure for Laboratory Testing of Oil-Grit Separators and performance has been third-party verified in accordance with the ISO 14034 Environmental Technology Verification (ETV) protocol.

PERFORMANCE

► Stormceptor® EF and EFO remove stormwater pollutants through gravity separation and floatation, and feature a patentpending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including highintensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

► The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV *Procedure for Laboratory Testing of Oil-Grit Separators* for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle	Percent Less	Particle Size	Dercent
Size (µm)	Than	Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5







Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)		
0.50	9.2	9.2	0.62	37.0	14.0	70	6.5	6.5		
1.00	20.5	29.7	1.25	75.0	28.0	70	14.4	20.9		
2.00	16.5	46.2	2.49	150.0	57.0	69	11.4	32.3		
3.00	11.3	57.5	3.74	224.0	85.0	64	7.3	39.5		
4.00	9.1	66.7	4.99	299.0	114.0	62	5.6	45.1		
5.00	5.5	72.2	6.23	374.0	142.0	59	3.3	48.4		
6.00	4.5	76.7	7.48	449.0	171.0	57	2.6	50.9		
7.00	4.2	80.9	8.73	524.0	199.0	54	2.3	53.2		
8.00	3.5	84.4	9.97	598.0	228.0	53	1.9	55.1		
9.00	2.0	86.5	11.22	673.0	256.0	53	1.1	56.2		
10.00	1.5	88.0	12.47	748.0	284.0	52	0.8	56.9		
11.00	1.8	89.8	13.72	823.0	313.0	51	0.9	57.9		
12.00	1.1	90.9	14.96	898.0	341.0	50	0.5	58.4		
13.00	1.1	92.0	16.21	973.0	370.0	49	0.5	58.9		
14.00	1.4	93.4	17.46	1047.0	398.0	48	0.7	59.6		
15.00	0.8	94.2	18.70	1122.0	427.0	47	0.4	60.0		
16.00	0.6	94.8	19.95	1197.0	455.0	47	0.3	60.3		
17.00	0.5	95.3	21.20	1272.0	484.0	46	0.2	60.5		
18.00	0.3	95.6	22.44	1347.0	512.0	45	0.1	60.7		
19.00	0.2	95.9	23.69	1421.0	540.0	44	0.1	60.8		
20.00	0.2	96.1	24.94	1496.0	569.0	43	0.1	60.9		
21.00	0.5	96.6	26.18	1571.0	597.0	42	0.2	61.1		
22.00	0.4	97.0	27.43	1646.0	626.0	42	0.2	61.2		
23.00	0.3	97.3	28.68	1721.0	654.0	42	0.1	61.4		
24.00	0.0	97.3	29.92	1795.0	683.0	42	0.0	61.4		
25.00	0.2	97.4	31.17	1870.0	711.0	41	0.1	61.4		
30.00	1.6	99.1	37.40	2244.0	853.0	41	0.7	62.1		
35.00	0.6	99.7	43.64	2618.0	996.0	40	0.3	62.3		
40.00	0.0	99.7	49.87	2992.0	1138.0	38	0.0	62.3		
45.00	0.3	100.0	56.11	3366.0	1280.0	36	0.1	62.5		
45.00 0.3 100.0 56.11 3366.0 1280.0 36 0.1 Estimated Net Annual Sediment (TSS) Load Reduction =										

Climate Station ID: 6137287 Years of Rainfall Data: 33



Stormceptor[®]







			Maximum Pip	pe Diamete	r / Peak C	Conveyance			
Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inle Diame	et Pipe eter	Max Out Diame	let Pipe eter	Peak Cor Flow	nveyance Rate
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EF012	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

► Stormceptor® EF and EFO feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV Procedure for Laboratory Testing of Oil-Grit Separators, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

DESIGN FLEXIBILITY

► Stormceptor[®] EF and EFO offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

► While Stormceptor[®] EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor[®] EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid reentrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.











INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

- 0° 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
- 45° 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Stormceptor EF / EFO	Moo Diam	del eter	Depth Pipe In Sump	(Outlet vert to Floor)	Oil Vo	Oil Volume Sedimer Maintenance		mended ment Ice Depth *	ended Maximum ent Sediment Volume * e Depth *			Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)	
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250	
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375	
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750	
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500	
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875	

Pollutant Capacity

*Increased sump depth may be added to increase sediment storage capacity ** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To		
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer		
Third-party verified light liquid capture	Proven performance for fuel/oil hotspot	Regulator, Specifying & Design Engineer,		
and retention for EFO version	locations	Site Owner		
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer		
Minimal drop between inlet and outlet	Site installation ease	Contractor		
Large diameter outlet riser for inspection	Easy maintenance access from grade	Maintenance Contractor & Site Owner		

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

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	Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results Stormceptor® EFO												
SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL						
1	70	660	42	1320	35	1980	24						
30	70	690	42	1350	35	2010	24						
60	67	720	41	1380	34	2040	23						
90	63	750	41	1410	34	2070	23						
120	61	780	41	1440	33	2100	23						
150	58	810	41	1470	32	2130	22						
180	56	840	41	1500	32	2160	22						
210	54	870	41	1530	31	2190	22						
240	53	900	41	1560	31	2220	21						
270	52	930	40	1590	30	2250	21						
300	51	960	40	1620	29	2280	21						
330	50	990	40	1650	29	2310	21						
360	49	1020	40	1680	28	2340	20						
390	48	1050	39	1710	28	2370	20						
420	47	1080	39	1740	27	2400	20						
450	47	1110	38	1770	27	2430	20						
480	46	1140	38	1800	26	2460	19						
510	45	1170	37	1830	26	2490	19						
540	44	1200	37	1860	26	2520	19						
570	43	1230	37	1890	25	2550	19						
600	42	1260	36	1920	25	2580	18						
630	42	1290	36	1950	24	2600	26						





STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

- 2.1.1 4 ft (1219 mm) Diameter OGS Units:
 - 6 ft (1829 mm) Diameter OGS Units:
 - 8 ft (2438 mm) Diameter OGS Units:
 - 10 ft (3048 mm) Diameter OGS Units:
 - 12 ft (3657 mm) Diameter OGS Units:

 $\begin{array}{l} 1.19 \ m^{3} \ sediment \ / \ 265 \ L \ oil \\ 3.48 \ m^{3} \ sediment \ / \ 609 \ L \ oil \\ 8.78 \ m^{3} \ sediment \ / \ 1,071 \ L \ oil \\ 17.78 \ m^{3} \ sediment \ / \ 1,673 \ L \ oil \\ 31.23 \ m^{3} \ sediment \ / \ 2,476 \ L \ oil \\ \end{array}$

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall







remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m² to 1400 L/min/m², and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m² and 1400 L/min/m² shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 $L/min/m^2$ shall be assumed to be identical to the sediment removal efficiency at 40 $L/min/m^2$. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 $L/min/m^2$.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m² shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m², and shall be calculated using a simple proportioning formula, with 1400 L/min/m² in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m².

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**.

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m².

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This reentrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to





assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m² to 2600 L/min/m²) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.







rovince:	Ontario		Project Name:	Willoughby			
ity:	Niagara Falls		Project Number:	221377			
earest Rainfall Station:	ST CATHARINES AP		Designer Name:	Greg Rapp			
imate Station Id:	6137287		Designer Company:	Husson Limited			
ears of Rainfall Data:	33		Designer Email:	greg.rapp@hussor	n.ca		
			Designer Phone:	416-788-1414	416-788-1414		
ite Name:	105		EOR Name:				
rainage Area (ha):	0.27		EOR Company:				
Imperviousness:	65.00		EOR Email:				
Runoff Co	pefficient 'c': 0.69						
Particle Size Distribution: CA ETV Net Annual Sed Target TSS Removal (%): 60.0 (TSS) Load Redu							
arget TSS Removal (%):	60.0			(TSS) Load	Reduction		
equired Water Quality Runo	ff Volume Capture (%):	90.00		Sizing S	TSS) Load Reduction Sizing Summary rmceptor TSS Removal		
stimated Water Quality Flow	Nater Quality Flow Rate (L/s):			Stormceptor	TSS Removal		
		Yes		Model	Provided (%)		
pstream Flow Control?		No		EFO4	63		
eak Conveyance (maximum)	Flow Rate (L/s):			EFO6	67		
		200		EFO8	69		
stimated Average Annual Sec	diment Load (kg/yr).	150		EFO10	70		
stimated Average Annual Se	diment Volume (I /vr):	122		FF012	70		
		122			,,,		
			Recommended S	tormceptor EFO	Model: El		
	Estima	ated Net A	Annual Sediment (T	SS) Load Reduct	ion (%): 🦷		
		1	Water Quality Run	off Volume Capt	ure (%): <mark>></mark>		





THIRD-PARTY TESTING AND VERIFICATION

► Stormceptor® EF and Stormceptor® EFO are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV Procedure for Laboratory Testing of Oil-Grit Separators and performance has been third-party verified in accordance with the ISO 14034 Environmental Technology Verification (ETV) protocol.

PERFORMANCE

► Stormceptor® EF and EFO remove stormwater pollutants through gravity separation and floatation, and feature a patentpending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including highintensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

► The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV *Procedure for Laboratory Testing of Oil-Grit Separators* for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle	Percent Less	Particle Size	Dercent
Size (µm)	Than	Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5







Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)		
0.50	9.2	9.2	0.26	16.0	13.0	70	6.5	6.5		
1.00	20.5	29.7	0.52	31.0	26.0	70	14.4	20.9		
2.00	16.5	46.2	1.04	62.0	52.0	69	11.4	32.3		
3.00	11.3	57.5	1.55	93.0	78.0	66	7.4	39.7		
4.00	9.1	66.7	2.07	124.0	104.0	62	5.7	45.4		
5.00	5.5	72.2	2.59	155.0	129.0	60	3.3	48.7		
6.00	4.5	76.7	3.11	186.0	155.0	58	2.6	51.3		
7.00	4.2	80.9	3.63	218.0	181.0	56	2.4	53.7		
8.00	3.5	84.4	4.14	249.0	207.0	54	1.9	55.6		
9.00	2.0	86.5	4.66	280.0	233.0	53	1.1	56.7		
10.00	1.5	88.0	5.18	311.0	259.0	53	0.8	57.4		
11.00	1.8	89.8	5.70	342.0	285.0	52	1.0	58.4		
12.00	1.1	90.9	6.21	373.0	311.0	51	0.5	58.9		
13.00	1.1	92.0	6.73	404.0	337.0	50	0.5	59.5		
14.00	1.4	93.4	7.25	435.0	363.0	49	0.7	60.2		
15.00	0.8	94.2	7.77	466.0	388.0	49	0.4	60.6		
16.00	0.6	94.8	8.29	497.0	414.0	48	0.3	60.8		
17.00	0.5	95.3	8.80	528.0	440.0	47	0.2	61.1		
18.00	0.3	95.6	9.32	559.0	466.0	46	0.2	61.2		
19.00	0.2	95.9	9.84	590.0	492.0	45	0.1	61.3		
20.00	0.2	96.1	10.36	621.0	518.0	45	0.1	61.4		
21.00	0.5	96.6	10.88	653.0	544.0	44	0.2	61.7		
22.00	0.4	97.0	11.39	684.0	570.0	43	0.2	61.8		
23.00	0.3	97.3	11.91	715.0	596.0	42	0.1	62.0		
24.00	0.0	97.3	12.43	746.0	621.0	42	0.0	62.0		
25.00	0.2	97.4	12.95	777.0	647.0	42	0.1	62.0		
30.00	1.6	99.1	15.54	932.0	777.0	41	0.7	62.7		
35.00	0.6	99.7	18.13	1088.0	906.0	41	0.3	63.0		
40.00	0.0	99.7	20.72	1243.0	1036.0	40	0.0	63.0		
45.00	0.3	100.0	23.31	1398.0	1165.0	38	0.1	63.1		
45.00 0.3 100.0 23.31 1398.0 1165.0 38 0.1 Estimated Net Annual Sediment (TSS) Load Reduction =										

Climate Station ID: 6137287 Years of Rainfall Data: 33



Stormceptor[®]









			Maximum Pip	pe Diamete	r / Peak C	Conveyance			
Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inle Diame	et Pipe eter	Max Out Diame	let Pipe eter	Peak Cor Flow	nveyance Rate
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EF012	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

► Stormceptor® EF and EFO feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV Procedure for Laboratory Testing of Oil-Grit Separators, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

DESIGN FLEXIBILITY

► Stormceptor[®] EF and EFO offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

► While Stormceptor[®] EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor[®] EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid reentrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.











INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

- 0° 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
- 45° 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Stormceptor EF / EFO	Moo Diam	del eter	Depth Pipe In Sump	(Outlet vert to Floor)	Oil Vo	Oil Volume Sedimen Maintenance I		nended Maximum nent Sediment Volume * ce Depth *		Maximum Sediment Mass **		
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
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Pollutant Capacity

*Increased sump depth may be added to increase sediment storage capacity ** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture	Proven performance for fuel/oil hotspot	Regulator, Specifying & Design Engineer,
and retention for EFO version	locations	Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

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120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
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330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
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600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26





STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

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 - 8 ft (2438 mm) Diameter OGS Units:
 - 10 ft (3048 mm) Diameter OGS Units:
 - 12 ft (3657 mm) Diameter OGS Units:

 $\begin{array}{l} 1.19 \ m^{3} \ sediment \ / \ 265 \ L \ oil \\ 3.48 \ m^{3} \ sediment \ / \ 609 \ L \ oil \\ 8.78 \ m^{3} \ sediment \ / \ 1,071 \ L \ oil \\ 17.78 \ m^{3} \ sediment \ / \ 1,673 \ L \ oil \\ 31.23 \ m^{3} \ sediment \ / \ 2,476 \ L \ oil \\ \end{array}$

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall







remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m² to 1400 L/min/m², and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m² and 1400 L/min/m² shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 $L/min/m^2$ shall be assumed to be identical to the sediment removal efficiency at 40 $L/min/m^2$. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 $L/min/m^2$.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m² shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m², and shall be calculated using a simple proportioning formula, with 1400 L/min/m² in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m².

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**.

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m².

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This reentrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to





assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m² to 2600 L/min/m²) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.







Province:	Ontario		Project Name:	Willoughby	
City:	Niagara Falls		Project Number:	221377	
vearest Rainfall Station:	ST CATHARINES AP		Designer Name:	Greg Rapp	
limate Station Id:	6137287		Designer Company:	Husson Limited	
ears of Rainfall Data:	33		Designer Email:	greg.rapp@husso	n.ca
			Designer Phone:	416-788-1414	
ite Name:	106		EOR Name:		
Drainage Area (ha):	0.53		EOR Company:		
6 Imperviousness:	65.00		EOR Email:		
Runoff C	oefficient 'c': 0.69		LOR FIDILE.		
article Size Distribution:	CA ETV			Net Annua	al Sediment
Target TSS Removal (%):	60.0			(TSS) Load	Reduction
 Required Water Quality Runo	ff Volume Capture (%):	90.00		Sizing S	Summary
Estimated Water Quality Flow	/ Rate (L/s):	11.37		Stormceptor	TSS Removal
 Dil / Fuel Spill Risk Site?		Yes		Model	Provided (%)
pstream Flow Control?		No		EFO4	58
eak Conveyance (maximum)	Flow Rate (L/s):			EFO6	64
nfluent TSS Concentration (m	ng/l)·	200		EFO8	67
stimated Average Annual Se	diment Load (kg/vr):	299		EFO10	69
	diment Volume (L/vr):	243		EFO12	69
		1.0			
			Recommended	Stormceptor EFC) Model: El
	Estima	ated Net A	nnual Sediment	(TSS) Load Reduc	tion (%): 💦
		١	Nater Quality Ru	noff Volume Cap	ture (%): <mark>></mark>





THIRD-PARTY TESTING AND VERIFICATION

► Stormceptor® EF and Stormceptor® EFO are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV Procedure for Laboratory Testing of Oil-Grit Separators and performance has been third-party verified in accordance with the ISO 14034 Environmental Technology Verification (ETV) protocol.

PERFORMANCE

► Stormceptor® EF and EFO remove stormwater pollutants through gravity separation and floatation, and feature a patentpending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including highintensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterwavs.

PARTICLE SIZE DISTRIBUTION (PSD)

► The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV *Procedure for Laboratory Testing of Oil-Grit Separators* for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle	Percent Less	Particle Size	Dercent
Size (µm)	Than	Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5







Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	9.2	9.2	0.51	30.0	12.0	70	6.5	6.5
1.00	20.5	29.7	1.02	61.0	23.0	70	14.4	20.9
2.00	16.5	46.2	2.03	122.0	46.0	70	11.6	32.5
3.00	11.3	57.5	3.05	183.0	70.0	66	7.4	40.0
4.00	9.1	66.7	4.07	244.0	93.0	63	5.8	45.7
5.00	5.5	72.2	5.08	305.0	116.0	62	3.4	49.1
6.00	4.5	76.7	6.10	366.0	139.0	59	2.7	51.8
7.00	4.2	80.9	7.12	427.0	162.0	57	2.4	54.2
8.00	3.5	84.4	8.13	488.0	186.0	56	2.0	56.2
9.00	2.0	86.5	9.15	549.0	209.0	54	1.1	57.3
10.00	1.5	88.0	10.17	610.0	232.0	53	0.8	58.0
11.00	1.8	89.8	11.18	671.0	255.0	53	1.0	59.0
12.00	1.1	90.9	12.20	732.0	278.0	52	0.6	59.6
13.00	1.1	92.0	13.22	793.0	302.0	51	0.6	60.1
14.00	1.4	93.4	14.23	854.0	325.0	50	0.7	60.9
15.00	0.8	94.2	15.25	915.0	348.0	50	0.4	61.3
16.00	0.6	94.8	16.27	976.0	371.0	49	0.3	61.5
17.00	0.5	95.3	17.28	1037.0	394.0	48	0.2	61.8
18.00	0.3	95.6	18.30	1098.0	417.0	48	0.2	61.9
19.00	0.2	95.9	19.32	1159.0	441.0	47	0.1	62.1
20.00	0.2	96.1	20.33	1220.0	464.0	46	0.1	62.2
21.00	0.5	96.6	21.35	1281.0	487.0	46	0.2	62.4
22.00	0.4	97.0	22.37	1342.0	510.0	45	0.2	62.6
23.00	0.3	97.3	23.38	1403.0	533.0	44	0.1	62.7
24.00	0.0	97.3	24.40	1464.0	557.0	44	0.0	62.7
25.00	0.2	97.4	25.42	1525.0	580.0	43	0.1	62.8
30.00	1.6	99.1	30.50	1830.0	696.0	42	0.7	63.4
35.00	0.6	99.7	35.58	2135.0	812.0	41	0.3	63.7
40.00	0.0	99.7	40.67	2440.0	928.0	40	0.0	63.7
45.00	0.3	100.0	45.75	2745.0	1044.0	39	0.1	63.8
Estimated Net Annual Sediment (TSS) Load Reduction =							64 %	

Climate Station ID: 6137287 Years of Rainfall Data: 33



Stormceptor[®]







	Maximum Pipe Diameter / Peak Conveyance										
Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inle Diame	et Pipe eter	Max Out Diame	let Pipe eter	Peak Cor Flow	nveyance Rate		
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)		
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15		
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35		
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60		
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100		
EF12 / EF012	3.6	12	90	1828	72	1828	72	2830	100		

SCOUR PREVENTION AND ONLINE CONFIGURATION

► Stormceptor® EF and EFO feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV Procedure for Laboratory Testing of Oil-Grit Separators, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

DESIGN FLEXIBILITY

► Stormceptor[®] EF and EFO offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

► While Stormceptor[®] EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor[®] EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid reentrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.











INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

- 0° 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
- 45° 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

	i onatant capacity											
Stormceptor EF / EFO	Moo Diam	del eter	Depth Pipe In Sump	(Outlet vert to Floor)	Oil Volume Recommended Sediment Sediment Maintenance Depth *		Oil Volume Recommended Maximum Sediment Sediment Volume * Maintenance Depth *		Maxim Sediment I	ium Mass **		
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

Pollutant Capacity

*Increased sump depth may be added to increase sediment storage capacity ** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture	Proven performance for fuel/oil hotspot	Regulator, Specifying & Design Engineer,
and retention for EFO version	locations	Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef







Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results Stormceptor® EFO							
SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	42	1320	35	1980	24
30	70	690	42	1350	35	2010	24
60	67	720	41	1380	34	2040	23
90	63	750	41	1410	34	2070	23
120	61	780	41	1440	33	2100	23
150	58	810	41	1470	32	2130	22
180	56	840	41	1500	32	2160	22
210	54	870	41	1530	31	2190	22
240	53	900	41	1560	31	2220	21
270	52	930	40	1590	30	2250	21
300	51	960	40	1620	29	2280	21
330	50	990	40	1650	29	2310	21
360	49	1020	40	1680	28	2340	20
390	48	1050	39	1710	28	2370	20
420	47	1080	39	1740	27	2400	20
450	47	1110	38	1770	27	2430	20
480	46	1140	38	1800	26	2460	19
510	45	1170	37	1830	26	2490	19
540	44	1200	37	1860	26	2520	19
570	43	1230	37	1890	25	2550	19
600	42	1260	36	1920	25	2580	18
630	42	1290	36	1950	24	2600	26





STANDARD PERFORMANCE SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

- 2.1.1 4 ft (1219 mm) Diameter OGS Units:
 - 6 ft (1829 mm) Diameter OGS Units:
 - 8 ft (2438 mm) Diameter OGS Units:
 - 10 ft (3048 mm) Diameter OGS Units:
 - 12 ft (3657 mm) Diameter OGS Units:

 $\begin{array}{l} 1.19 \ m^{3} \ sediment \ / \ 265 \ L \ oil \\ 3.48 \ m^{3} \ sediment \ / \ 609 \ L \ oil \\ 8.78 \ m^{3} \ sediment \ / \ 1,071 \ L \ oil \\ 17.78 \ m^{3} \ sediment \ / \ 1,673 \ L \ oil \\ 31.23 \ m^{3} \ sediment \ / \ 2,476 \ L \ oil \\ \end{array}$

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall







remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m² to 1400 L/min/m², and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m² and 1400 L/min/m² shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 $L/min/m^2$ shall be assumed to be identical to the sediment removal efficiency at 40 $L/min/m^2$. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 $L/min/m^2$.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m² shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m², and shall be calculated using a simple proportioning formula, with 1400 L/min/m² in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m².

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**.

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m².

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This reentrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to





assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m² to 2600 L/min/m²) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.





OSD Storage-Dicharge

HUSSON	Project: Project No.: Municipality: Catchment:	Willoughby Drive 221377 City of Niagara Falls 103 & 108
Orifice Plate Invert Size Co-efficient Area	173.37 m 120 m 0.62 0.0113 m	າ @ MH116 າm າ ²

Elevation	Area (m²)	Incremental Storage (m ³)	Total Storage (m ³)	Head on Orifice (m)	Orifice Flow (m ³ /s)
173.370		0.00	0.0	0.00	0.000
173.371		229.75	229.8	0.00	0.000
173.940	1046	297.70	238.0	0.51	0.022
174.950	1046	1056.86	1294.8	1.52	0.038
174.951		0.52	1295.3	1.52	0.038
175.860		0.00	1295.3	2.43	0.048

Pipe/Structure Storage Volumes

NO	Project:	Willoughby Drive
SC	Project No.:	221377
S	Municipality:	City of Niagara Falls
로	Catchment:	103 & 108

Pipe Storage

Diameter	Lenath	Storage Volume
150	0	0.00
200	0	0.00
250	0	0.00
300	12.47	0.88
375	0	0.00
450	0	0.00
525	87.66	18.98
600	104.34	29.50
675	0	0.00
750	154.84	68.41
825	124.81	66.72
900	0	0.00
975	0	0.00
1050	0	0.00
1200	0	0.00
1350	0	0.00
1500	0	0.00
1800	0	0.00

Manhole Storage

Description	MH Inside Diam. (mm)	Invert (m)	Top Elev. (m)	Storage Depth (m)	Storage Volume (m ³)
MH116	1800	173.37	175.86	2.49	6.34
MH105	1800	173.45	176.20	2.75	7.00
MH106	1800	173.52	176.23	2.71	6.90
MH107	1800	173.64	176.25	2.61	6.64
MH108	1500	173.79	176.30	2.51	4.44
MH109	1500	173.91	176.27	2.36	4.17
MH110	1500	174.08	176.23	2.15	3.80
MH111	1500	174.24	176.23	1.99	3.52
MH112	1500	174.44	175.84	1.40	2.47

Total	45.27 m ³
Total Storage	229.8 m ³

184.48 m³

Total

OSD Storage-Dicharge

HUSSON	Project: Project No.: Municipality: Catchment:	Willoughby Drive 221377 City of Niagara Falls 104
Orifice Plate Invert Size Co-efficient Area	173.43 n 204 n 0.62 0.0327 n	n @ MH137 nm n ²

Elevation	Area (m²)	Incremental Storage (m ³)	Total Storage (m ³)	Head on Orifice (m)	Orifice Flow (m ³ /s)
173.430	221	0.00	0.0	0.00	0.000
174.440	221	223.01	223.0	0.91	0.086
Pipe/Structure Storage Volumes

N	Project:	Willoughby Drive
SI	Project No.:	221377
S	Municipality:	City of Niagara Falls
문	Catchment:	104

Pipe Storage

Diamatan	1 41	Storage
Diameter	Length	volume
150	0	0.00
200	0	0.00
250	0	0.00
300	0	0.00
375	46.73	5.16
450	84.34	13.41
525	0	0.00
600	13.27	3.75
675	0	0.00
750	71.52	31.60
825	0	0.00
900	0	0.00
975	0	0.00
1050	0	0.00
1200	0	0.00
1350	0	0.00
1500	0	0.00
1800	0	0.00

Manhole Storage

Description	MH Inside Diam. (mm)	Invert (m)	Top Elev. (m)	Storage Depth (m)	Storage Volume (m ³)
MH137	1500	173.43	175.83	2.40	4.24
MH119	1500	173.51	175.98	2.47	4.36
MH120	1500	173.65	176.03	2.38	4.21
MH121	1500	173.72	175.97	2.25	3.98
MH127	1500	174.20	176.03	1.83	3.23
MH128	1500	174.38	176.10	1.72	3.04

Total	23.06 m ³
Total Storage	77.0 m ³

53.92 m³

Total

OSD Storage-Dicharge

_	NOSSUH	Project: Project No.: Municipality: Catchment:	Willoughby Di 221377 City of Niagar 105	rive a Falls	
Orifice Plate Invert Size Co-efficient Area		174.09 r 74 r 0.62 0.0043 r	n nm n ²	@ MH115	*Use ICD

Elevation	Area (m²)	Incremental Storage (m ³)	Total Storage (m ³)	Head on Orifice (m)	Orifice Flow (m ³ /s)
174.09	175	0.00	0.0	0.00	0.000
174.75	175	121.48	121.5	0.62	0.009

٦

Pipe/Structure Storage Volumes

N	Project:	Willoughby Drive
SC	Project No.:	221377
~	Municipality:	City of Niagara Falls
= =	Catchment:	105

Pipe Storage

Diameter	Length	Storage Volume
150	0	0.00
200	0	0.00
250	0	0.00
300	0	0.00
375	0	0.00
450	0	0.00
525	0	0.00
600	0	0.00
675	0	0.00
750	0	0.00
825	0	0.00
900	0	0.00
975	0	0.00
1050	0	0.00
1200	0	0.00
1350	0	0.00
1500	0	0.00
1800	0	0.00

Manhole Storage

Description	MH Inside Diam. (mm)	Invert (m)	Top Elev. (m)	Storage Depth (m)	Storage Volume (m ³)
MH115	1500	174.09	175.78	1.69	2.99
MH117	1500	174.33	176.13	1.80	3.18

Total	6.17 m ³
Total Storage	6.2 m ³

0.00 m³

Total

OSD Storage-Dicharge

_	NOSSUH	Project: Project No.: Municipality: Catchment:	Willoughby Drive 221377 City of Niagara Falls 106
Orifice Plate Invert Size Co-efficient Area		173.4 n 152 n 0.62 0.0181 n	n @ MH118 nm n ⁴

Elevation	Area (m²)	Incremental Storage (m ³)	Total Storage (m ³)	Head on Orifice (m)	Orifice Flow (m ³ /s)
173.40	186	0.00	0.0	0.00	0.000
174.41	186	193.80	193.8	0.93	0.048

-

Pipe/Structure Storage Volumes

ISSON	Project: Project No.: Municipality:	Willoughby Drive 221377 City of Niagara Falls
= =	Catchment:	106

Pipe Storage

Diamatar	Longth	Storage
Diameter	Length	volume
150	0	0.00
200	0	0.00
250	0	0.00
300	19.16	1.35
375	0	0.00
450	0	0.00
525	0	0.00
600	0	0.00
675	0	0.00
750	0	0.00
825	0	0.00
900	0	0.00
975	0	0.00
1050	0	0.00
1200	0	0.00
1350	0	0.00
1500	0	0.00
1800	0	0.00

Description	MH Inside Diam. (mm)	Invert (m)	Top Elev. (m)	Storage Depth (m)	Storage Volume (m ³)	
MH118	1500	173.40	175.86	2.46	4.35	

Total	4.35 m ³
Total Storage	5.7 m ³

1.35 m³

Total







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 I I V V (v 6.2.2015) SS SS V V v v I v v Т VV I 000 TTTTT M M 000 ΤM 0 0 0 0 T T MM MM 0 0 M M 0 0 M M 000 -T 000 Developed and Distributed by Smart City Water Inc Copyright 2007 - 2022 Smart City Water Inc All rights reserved. ***** DETAILED OUTPUT ***** filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat Input Output filename: C:\Users\workstation\AppData\Local\Civica\VH5\ccf76975-8d50-4b70-aa0c-30fee69c1cca \1de2ee67-3cec-4a14-9fca-412ca05fac51\ Summary filename: C:\Users\workstation\AppData\Local\Civica\VH5\ccf76975-8d50-4b70-aa0c-30fee69c1cca \1de2ee67-3cec-4a14-9fca-412ca05fac51\ DATE: 10-03-2024 TIME: 05:26:57 USER: COMMENTS: _____ ***** ** SIMULATION : CHI4hr - 005yr ***** | CHICAGO STORM | IDF curve parameters: A= 719.500 | Ptotal= 41.74 mm | B= 6.340 C= 0.769 used in: INTENSITY = A / (t + B)^C Duration of storm = 4.00 hrs Storm time step = 10.00 min Time to peak ratio = 0.33RAIN |' TIME mm/hr |' hrs 22.26 | 2.00 TIME RAIN | TIME RAIN | TIME RAIN hrs mm/hr | hrs mm/hr | hrs mm/hr 3.00 1.00 0.00 2.99 | 6.94 I 3.54 2.17 84.02 | 0.17 3.41 | 1.17 5.92 I 3.17 3.30 0.33 4.01 | 1.33 28.87 2.33 5.19 3.33 3.08 4.90 | 1.50 15.67 | 2.50 4.63 3.50 2.90 0.50

 4.90 |
 1.50
 15.67 |
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 6.42 |
 1.67
 10.90 |
 2.67

 9.66 |
 1.83
 8.44 |
 2.83

 0.67 4.19 | 3.67 2.74 0.83 3.84 | 3.83 2.60 _____ _____ L CALTR | NASHYD (0101) | Area (ha)= 3.39 Curve Number (CN)= 77.0 Ia (mm)= 5.00 # of Linear Res.(N)= 3.00 |ID= 1 DT= 5.0 min | U.H. Tp(hrs) = 0.65 NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP. ---- TRANSFORMED HYETOGRAPH ----RAIN | TIME RAIN |' TIME mm/hr | hrs mm/hr |' hrs TIME RAIN | TIME RAIN hrs mm/hr | hrs mm/hr 6.94 | 3.08 2.99 | 1.083 22.26 | 2.083 0.083 3.54 2.99 | 1.167 3.41 | 1.250 22.26 | 2.167 3.17 3.25 0.167 6.94 I 3 54 84.02 | 2.250 5.92 | 0.250 3.30 0.333 3.41 | 1.333 84.02 | 2.333 5.92 | 3.33 3.30

5.19 |

4.63 |

3.42

3.58

5.19 | 3.50

4.63 3.67

3.08

2.90

2.90

3.08

28.87 | 2.417

28.87 | 2.500

0.417

0.500

0 583

0.667

4.01 | 1.417

4.01 | 1.417 4.01 | 1.500 4.90 | 1.583

4.90|1.58315.67|2.5834.90|1.66715.67|2.667

0.833 0.833 0.917 9.66 1.917 10.90 2.833 4.19 3.83 2.74 3.84 3.92 2.60 1.000 9.66 2.000 8.44 3.000 3.84 4.00 2.60	
Unit Hyd Qpeak (cms)= 0.199	
PEAK FLOW (cms) = 0.055 (i) TIME TO PEAK (hrs) = 2.167 RUNOFF VOLUME (mm) = 11.987 TOTAL RAINFALL (mm) = 41.741 RUNOFF COEFFICIENT = 0.287	
(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.	
CALIB NASHYD (0100) Area (ha)= 6.88 Curve Number (CN)= 77.0 ID= 1 DT= 5.0 min Ia (mm)= 5.00 # of Linear Res.(N)= 3.00 U.H. Tp(hrs)= 0.86	
NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.	
TRANSFORMED HYETOGRAPH	
TIMERAINITIMERAINITIMERAINITIMERAINhrsmm/hrhrsmm/hrihrsmm/hrihrsmm/hr0.0832.991.08322.262.0836.943.083.540.1672.991.16722.262.2505.923.253.300.2503.411.25084.022.2505.923.253.300.3333.411.33384.022.3335.923.333.300.4174.011.41728.872.4175.193.423.080.5004.011.50028.872.5005.193.503.080.5834.901.58315.672.5834.633.582.900.6674.901.66715.672.6674.633.672.900.7506.421.75010.902.7504.193.752.740.8336.421.83310.902.8334.193.832.740.9179.661.9178.442.9173.843.922.601.0009.662.0008.443.0003.844.002.60	
Unit Hyd Qpeak (cms)= 0.306	
PEAK FLOW (cms) = 0.092 (i) TIME TO PEAK (hrs) = 2.500 RUNOFF VOLUME (mm) = 11.987 TOTAL RAINFALL (mm) = 41.741 RUNOFF COEFFICIENT = 0.287 (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.	
ID = 3 (0001): 10.27 0.144 2.33 11.99	
NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.	
FTNISH	
V V I SSSSS U U A L (v 6.2.2015) V V I SS U U A A L V V I SS U U AAAAA L V V I SS U U A A L VV I SSSSS UUUUU A A LLLLL	
000 TTTTT TTTTT H H Y Y M M 000 TM 0 0 T T H H Y Y MM MM 0 0 0 0 T T H H Y M M 0 0 000 T T H H Y M M 000 Developed and Distributed by Smart City Water Inc Copyright 2007 - 2022 Smart City Water Inc	

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***** DETAILED OUTPUT *****

Input filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat filename: C:\Users\workstation\AppData\Local\Civica\VH5\ccf76975-8d50-4b70-aa0c-30fee69c1cca Output \19fae142-5519-47d3-bcce-c605c0282ca2\ Summary filename: C:\Users\workstation\AppData\Local\Civica\VH5\ccf76975-8d50-4b70-aa0c-30fee69c1cca \19fae142-5519-47d3-bcce-c605c0282ca2\ DATE: 10-03-2024 TIME: 05:26:56 USER · COMMENTS: _____ ****** ** SIMULATION : CHI4hr - 100yr ** | CHICAGO STORM | IDF curve parameters: A=1264.570 | Ptotal= 68.11 mm | B= 7.720 C= 0.781 _____ used in: INTENSITY = A / (t + B)^C Duration of storm = 4.00 hrs Storm time step = 10.00 min Time to peak ratio = 0.33 TIME RAIN |' TIME hrs mm/hr |' hrs 1.00 37.64 | 2.00 TIME RAIN | TIME RAIN | TIME RAIN hrs mm/hr | mm/hr | hrs mm/hr 0.00 4.74 1.00 11.39 | 3.00 5.65 5.44 | 1.17 133.78 | 0.17 2.17 9.65 | 3.17 5.25 0.33 6.43 | 1.33 48.90 | 2.33 8.41 | 3.33 4.90 0.50 7.93 | 1.50 26.44 | 2.50 7.47 | 3.50 4.60 10.51 | 1.67 18.20 | 2.67 16.06 | 1.83 13.96 | 2.83 0.67 6.73 | 3.67 4.34 6.14 | 3.83 0.83 4.10 _____ _____ L CALTB (ha)= 3.39 Curve Number (CN)= 77.0 (mm)= 5.00 # of Linear Res.(N)= 3.00 NASHYD 0101) Area |ID= 1 DT= 5.0 min | Ia U.H. Tp(hrs) = 0.65 _____ NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP. --- TRANSFORMED HYETOGRAPH ----RAIN , mm/hr | hic 39 | 3.08 3.17 RAIN | TIME RAIN | ' TIME RAIN | TIME mm/hr | hrs mm/hr | hrs mm/hr | hrs TIME RAIN hrs nm/hr | 110 4.74 | 1.083 mm/hr 0.083 37.64 | 2.083 11.39 | 5.65 4.74 | 1.167 37.64 | 2.167 0.167 11.39 | 5.65 5.44 | 1.250 133.78 | 2.250 5.44 | 1.333 133.78 | 2.333 9.65 j 3.25 0.250 5.25 0.333 9.65 | 3.33 5.25 0.417 6.43 | 1.417 48.90 | 2.417 8.41 | 3.42 4.90 48.90 | 2.500 0.500 6.43 | 1.500 8.41 | 3.50 4 90 0.583 7.93 | 1.583 26.44 | 2.583 7.47 | 3.58 4.60 7.93 | 1.667 0.667 26.44 | 2.667 7.47 | 3.67 4.60 0.750 10.51 | 1.750 18.20 | 2.750 6.73 I 3.75 4.34 0.833 10.51 | 1.833 18.20 | 2.833 6.73 | 3.83 4.34 0.917 16.06 | 1.917 1.000 16.06 | 2.000 13.96 | 2.917 13.96 | 3.000 6.14 | 3.92 4.10 6.14 | 4.00 4.10 Unit Hyd Qpeak (cms)= 0.199 (cms) = 0.137 (i) (hrs) = 2.167 PEAK FLOW TIME TO PEAK TOTAL RAINFALL (mm) = 28.656 RUNOFF COEFFICIENT = 0.421 (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB NASHYD (0100) Area ID= 1 DT= 5.0 min Ia U.H.	(ha) = (mm) = Tp(hrs) =	6.88 5.00 0.86	Curve Nu # of Lin	umber (CN)= 77.0 hear Res.(N)= 3.00	
NOTE: RAINFALL WAS	TRANSFORM	MED TO	5.0 MIN.	TIME STEP.	
TIME RAI hrs mm/f 0.083 4.7 0.167 4.7 0.250 5.4 0.333 5.4 0.417 6.4 0.500 6.4 0.583 7.5 0.750 10.5 0.750 10.5 0.833 10.5 0.917 16.0 1.000 16.0 Unit Hyd Qpeak (cms)= PEAK FLOW (cms)= TIME TO PEAK (hrs)= RUNOFF VOLUME (mm)= RUNOFF COEFFICIENT = (i) PEAK FLOW DOES NOT	TI TN TIME IT hrs 44 1.083 44 1.167 44 1.250 44 1.333 33 1.417 43 1.500 33 1.583 33 1.667 14 1.833 66 1.917 06 2.000 0.306 0.230 (2 2.417 28.657 68.109 0.421 INCLUDE BA	RANSFORME RAIN mm/hr 37.64 133.78 133.78 133.78 133.78 48.90 26.44 26.44 26.44 18.20 18.20 13.96 13.96	ED HYETOG ' TIME ' hrss 2.083 2.167 2.250 2.233 2.417 2.500 2.583 2.667 2.750 2.833 2.917 3.000	SRAPH 2 RAIN TIME a mm/hr hrs 11.39 3.08 11.39 3.17 9.65 3.25 9.65 3.33 8.41 3.42 8.41 3.50 7.47 3.58 7.47 3.67 6.73 3.75 6.73 3.83 6.14 4.00	RAIN mm/hr 5.65 5.25 5.25 4.90 4.60 4.60 4.34 4.34 4.10 4.10
(1) PEAK FLOW DOES NOT	INCLUDE BA	ASEFLOW 1	F ANY.		
ADD HYD (0001) 1 + 2 = 3 ID1= 1 (0100): + ID2= 2 (0101):	AREA ((ha) 6.88 0 3.39 0	QPEAK (cms) .230 .137	TPEAK (hrs) 2.42 2.17	R.V. (mm) 28.66 28.66	
ID = 3 (0001):	10.27 0	.361	2.33	28.66	
NOTE: PEAK FLOWS DO NO	T INCLUDE	BASEFIOW	IS IF ANY		
				·	





ENGINEERING + MANAGEMENT P 905.709.5825 500 CACHET WOODS COURT, SUITE 204 MARI(HM, ON LISC 028 HUSSON.CA

FIGURE D2 WILLOUGHBY DRIVE VO POST DEVELOPMENT

DATE: OCTOBER 2024 SCALE: N.T.S. PROJECT: 221377

____ SSSSS U U A L SS U U A A L SS U U AAAAA L SS U U A A L SSSSS UUUUU A A LLLLL V V V I I (v 6.2.2015) SS V v v I v v Т VV I 000 TTTTT TTTTT H ΤM 0 0 0 0 T T T 000 Developed and Distributed by Smart City Water Inc Copyright 2007 - 2022 Smart City Water Inc All rights reserved. ***** DETAILED OUTPUT ***** filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat Input Output filename: C:\Users\workstation\AppData\Local\Civica\VH5\ccf76975-8d50-4b70-aa0c-30fee69c1cca \4ded57e8-a7e4-49c8-978f-553d056c4008\ Summary filename: C:\Users\workstation\AppData\Local\Civica\VH5\ccf76975-8d50-4b70-aa0c-30fee69c1cca \4ded57e8-a7e4-49c8-978f-553d056c4008\ DATE: 10-08-2024 TIME: 06:28:21 USER: COMMENTS: _____ ****** ** SIMULATION : CHI4hr - 005yr ***** | CHICAGO STORM | IDF curve parameters: A= 719.500 | Ptotal= 41.74 mm | B= 6.340 C= 0.769 used in: INTENSITY = A / (t + B) ^C Duration of storm = 4.00 hrs Storm time step = 10.00 min Time to peak ratio = 0.33 RAIN |' TIME mm/hr |' hrs 22.26 | 2.00 TIME RAIN | TIME RAIN | TIME RAIN hrs hrs mm/hr | mm/hr | hrs mm/hr 6.94 | 3.00 1.00 0.00 2.99 | 3.54 2.17 2.33 3.41 | 1.17 4.01 | 1.33 0.17 84.02 | 5.92 I 3.17 3.30 0.33 28.87 5.19 3.33 3.08
 1.50
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 2.67

 9.66
 1.83
 8.44
 2.83
 4.63 3.50 2.90 0.50 0.67 4.19 | 3.67 2.74 0.83 3.84 | 3.83 2.60 _____ _____ | CALIB Area (ha)= 0.18 Total Imp(%)= 65.00 Dir. Conn.(%)= 50.00 STANDHYD (0110) |ID= 1 DT= 5.0 min | _____ IMPERVIOUS PERVIOUS (i) 0.06 Surface Area 0.12 (ha) = Dep. Storage (mm) =1.50 (%)= 1.00 2.00 Average Slope (m) = 34.0. 0.013 34.64 40.00 0.250 Length Mannings n NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP. --- TRANSFORMED HYETOGRAPH ----
 RAIN
 TIME
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 TIME
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 hrs
 mm/hr
 ' TIME
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 ' TIME
 RAIN

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 1.083
 22.26
 2.083
 6.94
 3.08
 3.54

 2.99
 1.167
 22.26
 2.167
 6.94
 3.17
 3.54
 TIME hrs

1

0 083 0.167

0.250 3.4 0.333 3.4 0.417 4.0 0.500 4.0 0.583 4.5 0.667 4.4 0.833 6.4 0.917 9.6 1.000 9.6	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	2.250 2.333 2.417 2.500 2.583 2.667 2.750 2.833 2.917 3.000	5.92 3.25 3. 5.92 3.33 3. 5.19 3.42 3. 5.19 3.50 3. 4.63 3.58 2. 4.63 3.67 2. 4.19 3.75 2. 3.84 3.92 2. 3.84 4.00 2.	30 30 08 90 90 74 74 60 60
Max.Eff.Inten.(mm/hr)= over (min) Storage Coeff. (min)= Unit Hyd. Tpeak (min)= Unit Hyd. peak (cms)=	84.02 5.00 1.45 (ii) 5.00 0.33	63.55 10.00 9.91 (ii) 10.00 0.11	+momat 0+	
PEAK FLOW (cms)= TIME TO PEAK (hrs)= RUNOFF VOLUME (mm)= TOTAL RAINFALL (mm)= RUNOFF COEFFICIENT =	0.02 1.33 40.74 41.74 0.98	0.01 1.42 22.97 41.74 0.55	0.027 (iii) 1.33 31.82 41.74 0.76	
***** WARNING: STORAGE COEFF (i) CN PROCEDURE SELF CN* = 85.0 (ii) TIME STEP (DT) SF THAN THE STORAGE (iii) PEAK FLOW DOES NO	T. IS SMALLER THAN CTED FOR PERVIOUS Ia = Dep. Storage OULD BE SMALLER O COEFFICIENT. DT INCLUDE BASEFLO	TIME STEP! LOSSES: (Above) R EQUAL W IF ANY.		
CALIB STANDHYD (0103) Area ID= 1 DT= 5.0 min Tota	(ha) = 2.50 . Imp(%) = 65.00	Dir. Conn.(%)= 55.00	
Surface Area(ha)=Dep. Storage(mm)=Average Slope(%)=Length(m)=Mannings n=	IMPERVIOUS P 1.62 1.00 1.00 129.10 0.013	ERVIOUS (i) 0.88 1.50 2.00 40.00 0.250		
NOTE: RAINFALL WAS	S TRANSFORMED TO	5.0 MIN. TI	ME STEP.	
TIME RA: hrs mm/H 0.083 2.5 0.167 2.5 0.250 3.4 0.333 3.4 0.417 4.6 0.583 4.5 0.667 4.5 0.750 6.4 0.833 6.4 0.917 9.6 1.000 9.6	TRANSFORM NN TIME RAIN hr hrs mm/hr 99 1.083 22.26 99 1.167 22.26 11 1.250 84.02 11 1.333 84.02 11 1.500 28.87 30 1.583 15.67 30 1.667 15.67 12 1.750 10.90 56 1.917 8.44 56 2.000 8.44	ED HYETOGRAP ' TIME ' hrs 2.083 2.167 2.250 2.333 2.417 2.500 2.583 2.667 2.750 2.833 2.917 3.000	H RAIN TIME F mm/hr hrs mm 6.94 3.08 3. 5.92 3.25 3. 5.92 3.33 3. 5.19 3.42 3. 4.63 3.58 2. 4.63 3.58 2. 4.63 3.67 2. 4.19 3.75 2. 3.84 3.92 2. 3.84 4.00 2.	AIN 54 54 30 30 08 90 90 74 74 60 60
Max.Eff.Inten.(mm/hr)= over (min) Storage Coeff. (min)= Unit Hyd. Tpeak (min)= Unit Hyd. peak (cms)=	84.02 5.00 3.19 (ii) 5.00 0.27	53.67 15.00 12.25 (ii) 15.00 0.09		
PEAK FLOW (cms)= TIME TO PEAK (hrs)= RUNOFF VOLUME (mm)= TOTAL RAINFALL (mm)= RUNOFF COEFFICIENT =	0.31 1.33 40.74 41.74 0.98	0.07 1.50 21.82 41.74 0.52	*TOTALS* 0.351 (iii) 1.33 32.22 41.74 0.77	
***** WARNING: STORAGE COEFI	. IS SMALLER THAN	TIME STEP!		
 (i) CN PROCEDURE SELF CN* = 85.0 (ii) TIME STEP (DT) SF THAN THE STORAGE (iii) PEAK FLOW DOES NO 	CTED FOR PERVIOUS Ia = Dep. Storage HOULD BE SMALLER O COEFFICIENT. DT INCLUDE BASEFLO	LOSSES: (Above) R EQUAL W IF ANY.		

CALIB STANDHYD (0108 ID= 1 DT= 5.0 min) Area Total	(ha) = Imp(%) = 2	0.50 0.00 Din	c. Conn.(%)= 20.00	
Surface Area Dep. Storage Average Slope Length Mannings n	(ha) = (mm) = (%) = (m) = =	IMPERVIOU 0.10 1.00 1.00 57.74 0.013	S PERVI 0 1 2 40 0.2	IOUS (i) .40 .50 .00 .00 250		
NOTE: RA	INFALL WAS	TRANSFORME	D TO 5.0) MIN. TI	ME STEP.	
T 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.	IME RAII hrs mm/h 083 2.9 167 2.9 250 3.4 333 3.4 417 4.0 500 4.0 583 4.9 667 4.9 750 6.4 833 6.4	TRA N TIME 9 1.083 9 1.167 1 1.250 1 1.333 1 1.417 1 1.500 0 1.583 0 1.667 2 1.750 2 1.833	NSFORMED RAIN ' 22.26 2 22.26 2 84.02 2 28.87 2 28.87 2 15.67 2 10.90 2 10.90 2	HYETOGRAP TIME hrs 2.083 2.167 2.250 2.333 2.417 2.500 2.583 2.667 2.750 2.833 3.417	H RAIN TI mm/hr h 6.94 3.0 6.94 3.1 5.92 3.2 5.92 3.3 5.19 3.4 5.19 3.5 4.63 3.6 4.19 3.7 4.19 3.8	ME RAIN rs mm/hr 8 3.54 7 3.54 5 3.30 3 3.30 2 3.08 0 3.08 8 2.90 7 2.90 5 2.74 3 2.74
0. 1.	917 9.6 000 9.6	6 1.917 6 2.000	8.44 2	2.917 3.000	3.84 3.9 3.84 4.0	2 2.60 0 2.60
Max.Eff.Inten ov Storage Coeff Unit Hyd. Tpe Unit Hyd. pea	.(mm/hr)= er (min) . (min)= ak (min)= k (cms)=	84.02 5.00 1.97 5.00 0.31	28 15 (ii) 13 15 0	.90 .00 .57 (ii) .00 .08		
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFAL RUNOFF COEFFI	(cms) = (hrs) = (mm) = L (mm) = CIENT =	0.02 1.33 40.74 41.74 0.98	0 1 19 41 0	.02 .50 .04 .74 .46	*TOTALS* 0.034 (1.33 23.36 41.74 0.56	iii)
***** WARNING: STO	RAGE COEFF AREAS WITH	. IS SMALLE IMPERVIOUS	R THAN TIN RATIOS BI	ME STEP! ELOW 20%		
(i) CN PROC CN* = (ii) TIME ST THAN TH (iii) PEAK FL	EDURE SELE 85.0 EP (DT) SHO E STORAGE (OW DOES NO	CTED FOR PE Ia = Dep. S DULD BE SMA COEFFICIENT F INCLUDE B	RVIOUS LOS torage (<i>1</i> LLER OR E(ASEFLOW IN	AREA. SSES: Above) QUAL 7 ANY.		
ADD HYD (0003 1 + 2 = 3		AREA OP				
ID1= 1 (+ ID2= 2 (0103): 0108):	(ha) (c 2.50 0.3 0.50 0.0	ms) (hi 51 1.3 34 1.3	rs) (1 33 32. 33 23.	mm) 22 36	
======= ID = 3 (0003):	3.00 0.3	85 1.3	33 30.	=== 75	
NOTE: PEAK F	LOWS DO NO'	F INCLUDE B	ASEFLOWS :	IF ANY.		
RESERVOIR(1001 IN= 2> OUT= 1 DT= 5.0 min) OVE] OUT: (cr 0. 0. 0.	RFLOW IS OF FLOW STO ns) (ha 0000 0. 0000 0. 0220 0.	F RAGE .m.) 0000 0230 0460	OUTFLOW (cms) 0.0380 0.0480 0.0000	STORAGE (ha.m.) 0.1290 0.1290 0.0000	
INFLOW : ID= 2 OUTFLOW: ID= 1	(0003) (1001)	AREA (ha) 3.000 3.000	QPEAK (cms) 0.385 0.026	TPEAK (hrs) 1.3 3.2	R.V. (mm) 3 30.7 5 22.9	5 9
	PEAK FL TIME SHIF MAXIMUM	OW REDUCT I OF PEAK F STORAGE U	ION [Qout, LOW SED	/Qin](%)= (min)= (ha.m.)=	6.83 115.00 0.0683	

_____ _____ | CALIB STANDHYD (0105) Area (ha)= 0.27 Total Imp(%)= 65.00 Dir. Conn.(%)= 65.00 Area |ID= 1 DT= 5.0 min | _____ IMPERVIOUS PERVIOUS (i) 0.18 0.09 (ha) = Surface Area (mm) = 1.00 Dep. Storage 1.50 Average Slope (%)= 1.00 2.00 40.00 0.250 Length (m) = 42.43 = Mannings n 0.013 NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP. ---- TRANSFORMED HYETOGRAPH ----RAIN | TIME TIME RAIN |' TIME mm/hr |' hrs RAIN | TIME RATN mm/hr | mm/hr | hrs mm/hr hrs hrs 3.54 0.083 2.99 | 1.083 2.99 | 1.083 2.99 | 1.167 22.26 | 2.083 6.94 | 3.08 0.167 22.26 | 2.167 6.94 | 3.17 0.250 3.41 | 1.250 84.02 | 2.250 5.92 | 3.25 3.30 84.02 | 2.333 28.87 | 2.417 0.333 3.41 | 1.333 5.92 | 3.33 3.30 0.417 4.01 | 1.417 5.19 i 3.42 3.08 3.50 0.500 4.90 | 1.583 4.01 | 1.500 28.87 | 2.500 5.19 j 3.08 0.583 15.67 | 2.583 4.63 | 3.58 2.90 0.667 4.90 | 1.667 15.67 | 2.667 4.63 | 3.67 3.75 2.90
 4.90
 | 1.667
 15.67
 | 2.667

 6.42
 | 1.750
 10.90
 | 2.750

 6.42
 | 1.833
 10.90
 | 2.833

 9.66
 | 1.917
 8.44
 | 2.917
 0.750 4.19 | 2.74 0.833 4.19 | 3.83 2.74 0.917 3.84 | 3.92 2.60 8.44 | 3.000 9.66 | 2.000 1.000 3.84 | 4.00 2.60
 over (min)
 84.02
 28.90

 Storage Coeff. (min)=
 1.64 (ii)
 13.23 (ii)

 Unit Hyd. Tpeak (min)=
 5.00
 15.00

 Unit Hyd. peak (cms)=
 0.32
 0.08
 TOTALS 0.04
 TOTALS

 0.01
 0.044 (iii)

 1.50
 1.33

 19.04
 33.11

 41.74
 41.74

 0.46
 0.79
 PEAK FLOW TIME TO PEAK 0.04 1.33 40.74 41.74 0.98 (hrs) =TIME TO PEAK (hrs) = RUNOFF VOLUME (mm) = TOTAL RAINFALL (mm) = RUNOFF COEFFICIENT = 0.98 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. _____ _____ | RESERVOIR(1005)| OVERFLOW IS OFF | IN= 2---> OUT= 1 |
 OUTFLOW
 STORAGE
 OUTFLOW
 STORAGE

 (cms)
 (ha.m.)
 (cms)
 (ha.m.)

 0.0000
 0.0000
 0.0090
 0.0120
 | DT= 5.0 min | -----0.0120
 AREA
 QPEAK
 TPEAK
 R.V.

 (ha)
 (cms)
 (hrs)
 (mm)

 INFLOW:
 ID=
 2 (0105)
 0.270
 0.044
 1.33
 33.11

 OUTFLOW:
 ID=
 1 (1005)
 0.270
 0.004
 2.33
 31.89
 PEAKFLOWREDUCTION[Qout/Qin](%) =9.87TIME SHIFT OF PEAK FLOW(min) =60.00MAXIMUMSTORAGEUSED(ha.m.) =0.0057 _____ I CALTR | STANDHYD (0107) | Area (ha) = 1.81 |ID= 1 DT= 5.0 min | Total Imp(%) = 65.00 Dir. Conn.(%) = 50.00 IMPERVIOUS PERVIOUS (i) 0.63 1.18 Dep. Storage Surface Area (ha) = (mm) = Average Slope ope (%)= (m)= (%)= 1.00 2.00 1.00 109.85 2.00 40.00 0.250 Length Mannings n = 0.013 NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

	-	TRA	NSFORME	ED HYETOGRA	PH		
TIME	RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr
0.083	2.99	1.083	22.26	2.083	6.94	3.08	3.54
0.167	2.99	1.167	22.26	2.167	6.94	3.17	3.54
0.250	3.41	1.250	84.02	2.250	5.92	3.25	3.30
0.333	3.41	1.333	84.02	2.333	5.92	3.33	3.30
0.417	4.01	1.417	28.87	2.417	5.19	3.42	3.08
0.500	4.01	1.500	28.87	2.500	5.19	3.50	3.08
0.583	4.90	1.583	15.67	2.583	4.63	3.58	2.90
0.667	4.90	1.667	15.67	2.667	4.63	3.67	2.90
0.750	6.42	1.750	10.90	2.750	4.19	3.75	2.74
0.833	6.42	1.833	10.90	2.833	4.19	3.83	2.74
0.917	9.66	1.917	8.44	2.917	3.84	3.92	2.60
1.000	9.66	2.000	8.44	3.000	3.84	4.00	2.60
Max.Eff.Inten.(m	m/hr)=	84.02		63.55			
over	(min)	5.00		15.00			
Storage Coeff.	(min) =	2.90	(ii)	11.36 (ii)			
Unit Hyd. Tpeak	(min) =	5.00		15.00			
Unit Hyd. peak	(cms) =	0.28		0.09			
					TOTAI	S	
PEAK FLOW	(cms) =	0.21		0.07	0.24	3 (iii)	
TIME TO PEAK	(hrs) =	1.33		1.50	1.3	3	
RUNOFF VOLUME	(mm) =	40.74		22.97	31.8	5	
TOTAL RAINFALL	(mm) =	41.74		41.74	41.7	4	
RUNOFF COEFFICIE	NT =	0.98		0.55	0.7	6	
***** WARNING: STORAG	E COEFF. IS	SMALLE	R THAN	TIME STEP!			
(i) CN PROCEDU	RE SELECTEI	FOR PE	RVIOUS	LOSSES:			

- CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(2000) IN= 2> OUT= 1	OVERFLO	OW IS OFF	7		
DT= 5.0 min	OUTFLO (cms) 0.000	N STOP (ha.) 0.0	RAGE .m.) 0000	OUTFLOW (cms) 0.0630	STORAGE (ha.m.) 0.0620
INFLOW : ID= 2 (OUTFLOW: ID= 1 (0107) 2000)	AREA (ha) 1.810 1.810	QPEAK (cms) 0.243 0.035	TPEAK (hrs) 1.33 2.25	R.V. (mm) 31.85 31.72

_____ -----| CALIB | STANDHYD (0104) | Area (ha)= 0.65 |ID=1 DT= 5.0 min | Total Imp(%)= 65.00 Dir. Conn.(%)= 65.00 1 IMPERVIOUS PERVIOUS (i)

Surface Area	(ha) =	0.42	0.23
Average Slope	(8) =	1.00	2.00
Length	(m) =	65.83	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

TRANSFORMED HYETOGRAPH										
TIME	RAIN		TIME	RAIN		TIME	RAIN	TIME	RAIN	
hrs	mm/hr		hrs	mm/hr		hrs h	mm/hr	hrs	mm/hr	
0.083	2.99		1.083	22.26		2.083	6.94	3.08	3.54	
0.167	2.99		1.167	22.26		2.167	6.94	3.17	3.54	
0.250	3.41		1.250	84.02		2.250	5.92	3.25	3.30	
0.333	3.41		1.333	84.02		2.333	5.92	3.33	3.30	
0.417	4.01		1.417	28.87		2.417	5.19	3.42	3.08	
0.500	4.01		1.500	28.87		2.500	5.19	3.50	3.08	
0.583	4.90		1.583	15.67		2.583	4.63	3.58	2.90	
0.667	4.90		1.667	15.67		2.667	4.63	3.67	2.90	
0.750	6.42		1.750	10.90		2.750	4.19	3.75	2.74	
0.833	6.42		1.833	10.90		2.833	4.19	3.83	2.74	
0.917	9.66		1.917	8.44		2.917	3.84	3.92	2.60	

1.000 9.66 2.000 8.44 3.000 3.84 4.00 2.	60
Max.Eff.Inten.(mm/hr)= 84.02 28.90 over (min) 5.00 15.00 Storage Coeff. (min)= 2.13 (ii) 13.73 (ii) Unit Hyd. Tpeak (min)= 5.00 15.00 Unit Hyd. peak (cms)= 0.31 0.08	
TOTALS PEAK FLOW (cms) = 0.10 0.01 0.104 (iii) TIME TO PEAK (hrs) = 1.33 1.50 1.33 RUNOFF VOLUME (mm) = 40.74 19.04 33.13 TOTAL RAINFALL (mm) = 41.74 41.74 41.74 RUNOFF COEFFICIENT = 0.98 0.46 0.79	
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!	
 (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. 	
 ADD HYD (0002) 1 + 2 = 3 AREA QPEAK TPEAK R.V. (ha) (cms) (hrs) (mm) ID1= 1 (0104): 0.65 0.104 1.33 33.13	
+ ID2= 2 (2000): 1.81 0.035 2.25 31.72	
ID = 3 (0002): 2.46 0.120 1.33 32.09	
NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.	
RESERVOIR(1000) OVERFLOW IS OFF IN= 2> OUT= 1 DT= 5.0 min OUTFLOW STORAGE OUTFLOW STORAGE (cms) (ha.m.) (cms) (ha.m.) 0.0000 0.0000 0.0860 0.0220	
AREA QPEAK TPEAK R.V. (ha) (cms) (hrs) (mm) INFLOW: ID= 2 0002) 2.460 0.120 1.33 32.09 OUTFLOW: ID= 1 (1000) 2.460 0.047 2.17 32.07	
TIME SHIFT OF PEAK FLOW (min) = 39.37 TIME SHIFT OF PEAK FLOW (min) = 50.00 MAXIMUM STORAGE USED (ha.m.) = 0.0121	
 CALIB STANDHYD (0112) Area (ha)= 0.34 ID= 1 DT= 5.0 min Total Imp(%)= 65.00 Dir. Conn.(%)= 50.00	
IMPERVIOUS PERVIOUS (i) Surface Area (ha) = 0.22 0.12 Dep. Storage (mm) = 1.00 1.50 Average Slope (%) = 1.00 2.00 Length (m) = 47.61 40.00 Mannings n = 0.013 0.250	
NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.	
TRANSFORMED HYETOGRAPH	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	AIN 54 54 30 08 90 74 74 60
Max.Eff.Inten.(mm/hr)= 84.02 63.55	

Unit Hyd. Tpeak Unit Hyd. peak	(min) = (min) = (cms) =	5.00 1.75 (ii) 5.00 0.32	15.00 10.22 (ii) 15.00 0.09	****
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICIE	(cms) = (hrs) = (mm) = (mm) = NT =	0.04 1.33 40.74 41.74 0.98	0.01 1.50 22.97 41.74 0.55	0.047 (iii) 1.33 31.84 41.74 0.76
***** WARNING: STORAG	E COEFF. IS	SMALLER THAN	TIME STEP!	
(i) CN PROCEDU	RE SELECTED	FOR PERVIOUS	LOSSES:	
CN* = 8 (ii) TIME STEP	5.0 Ia = (DT) SHOULD	Dep. Storage BE SMALLER O	(Above) R EQUAL	
THAN THE S (iii) PEAK FLOW	TORAGE COEF	FICIENT. CLUDE BASEFLO	W IF ANY.	
(1007)	OVEREIO	A TO OPE		
IN= 2> OUT= 1	OVERFLO	W IS OFF		
DT= 5.0 min	OUTFLOW (cms)	STORAGE (ha.m.)	OUTFLOW (cms)	STORAGE (ha.m.)
	0.0000	0.0000	0.0110	0.0130
		DEA ODEA	v mdeak	D 17
	1	(ha) (cms) (hrs)	(mm)
INFLOW : ID= 2 (OUTFLOW: ID= 1 (0112) 1007)	0.340 0. 0.340 0.	047 1.33 004 2.58	31.84 30.66
PE	AK FLOW	REDUCTION [O	out/Oinl(%)=	9.52
TI	ME SHIFT OF	PEAK FLOW	(min) =	75.00
PA	AIMOM SION	AGE 03ED	(114.111.) -	0.0072
CALIB STANDHYD (0109)	D	0.57		
ID= 1 DT= 5.0 min	Total Imp	(%) = 65.00	Dir. Conn.(%) = 50.00
ID= 1 DT= 5.0 min	Total Imp	na)= 0.57 (%)= 65.00 PERVIOUS P	Dir. Conn.(% ERVIOUS (i))= 50.00
Surface Area Dep. Storage	Total Imp IM: (ha) = (mm) =	na)= 0.57 (%)= 65.00 PERVIOUS P: 0.37 1.00	Dir. Conn.(% ERVIOUS (i) 0.20 1.50)= 50.00
Surface Area Dep. Storage Average Slope Length	Area () Total Imp (ha) = (mm) = (%) = (m) =	na) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 61 64	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00)= 50.00
Surface Area Dep. Storage Average Slope Length Mannings n	Afea () Total Imp (ha) = (mm) = (%) = (m) = =	(%) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 61.64 0.013	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250)= 50.00
Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINF	Afea () Total Imp (ha) = (%) = (%) = (m) = = ALL WAS TRAI	(%) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 61.64 0.013 NSFORMED TO	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM)= 50.00 E STEP.
ID= 1 DT= 5.0 min ID= 1 DT= 5.0 min 	Afea () Total Imp (ha) = (mm) = (%) = (m) = = ALL WAS TRAN	(%) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 61.64 0.013 NSFORMED TO	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM)= 50.00 E STEP.
ID= 1 DT= 5.0 min ID= 1 DT= 5.0 min Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINF	Afea () Total Imp IM (ha) = (%) = (%) = (m) = = ALL WAS TRAN	(%) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 61.64 0.013 NSFORMED TO TRANSFORM. TIME BAIN	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH)= 50.00 E STEP. RAIN TIME RAIN
ID= 1 DT= 5.0 min ID= 1 DT= 5.0 min 	Afea () Total Imp IM (ha) = (%) = (%) = (%) = (m) = = ALL WAS TRAI ALL WAS TRAI ALL WAS TRAI	ma) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 61.64 0.013 NSFORMED TO TRANSFORM TIME RAIN hrs mm/hr	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m)= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr
ID= 1 DT= 5.0 min ID= 1 DT= 5.0 min 	Afea () Total Imp (ha) = (%) = (%) = (m) = = ALL WAS TRAI ALL WAS TRAI ALL WAS TRAI 2.99 2	na) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 61.64 0.013 0.013 NSFORMED TO TIME RAIN hrs mm/hr 1.083 22.266 1.167 22.26	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 2.083 6 2.167 6)= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr .94 3.08 3.54 .94 3.17 3.54
ID= 1 DT= 5.0 min ID= 1 DT= 5.0 min 	Afea (1) Total Imp (ha) = (mm) = (%) = (m) = = ALL WAS TRAI ALL WAS TRAI RAIN 2.99 2.99 3.41	na) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 1.00 61.64 0.013 NSFORMED TO TRANSFORM: TIME RAIN hrs <mm hr<="" td=""> 1.083 22.26 1.167 22.26 1.250 84.02 1.333 84.02</mm>	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 2.083 6 2.167 6 2.250 5 2.333 5)= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr .94 3.08 3.54 .94 3.17 3.54 .92 3.25 3.30
ID= 1 DT= 5.0 min ID= 1 DT= 5.0 min 	Afea (() Total Imp IM: (ha) = (m) = (%) = (m) = ALL WAS TRAN ALL WAS TRAN 	na) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 1.00 61.64 0.013 NSFORMED TO TIME RAIN hrs mm/hr 1.083 22.26 1.167 22.26 1.250 84.02 1.333 84.02 1.417 28.87	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 2.083 6 2.167 6 2.250 5 2.333 5 2.417 5)= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr .94 3.08 3.54 .94 3.17 3.54 .92 3.25 3.30 .92 3.33 3.30 .19 3.42 3.08
Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINF TIME hrs 0.083 0.167 0.250 0.333 0.417 0.500	Afea () Total Imp IM: (ha) = (mm) = (%) = (m) = = ALL WAS TRAI ALL WAS TRAI	na) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 61.64 0.013 0.013 NSFORMED TO TIME RAIN hrs mm/hr 1.083 22.26 1.167 22.26 1.250 84.02 1.333 84.02 1.417 28.87 1.500 28.87 1.583 15.67	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 2.083 6 2.167 6 2.250 5 2.333 5 2.417 5 2.500 5 2.583 4)= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr .94 3.08 3.54 .94 3.17 3.54 .92 3.25 3.30 .92 3.25 3.30 .19 3.42 3.08 .19 3.50 3.08 .63 3.58 2.90
Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINF TIME hrs 0.083 0.167 0.250 0.333 0.417 0.500 0.583 0.667 0.750	Afea (() Total Imp (ha) = (mm) = (%) = (m) = (%) = (m) = (%) = (m) = (%)	ha) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 1.00 61.64 0.013 NSFORMED TO TRANSFORM: TIME RAIN hrs mm/hr 1.083 22.26 1.250 84.02 1.333 84.02 1.417 28.87 1.583 15.67 1.567 16.597	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 2.083 6 2.167 6 2.250 5 2.333 5 2.417 5 2.503 4 2.503 4 2.567 4 2.750 4)= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr .94 3.08 3.54 .94 3.17 3.54 .92 3.25 3.30 .92 3.33 3.30 .19 3.42 3.08 .19 3.50 3.08 .63 3.58 2.90 .63 3.67 2.90 .19 3.75 2.74
Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINF TIME hrs 0.083 0.167 0.250 0.333 0.417 0.500 0.583 0.667 0.750 0.833 0.911	Afea (() Total Imp IM: (ha) = (mm) = (%) = (m) = = ALL WAS TRAIN MM/hr 2.99 3.41 4.01 4.01 4.90 6.42 6.42 6.42 9.66	na) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 1.00 61.64 0.013 NSFORMED TO TRANSFORM: TIME RAIN hrs mm/hr 1.083 22.26 1.250 84.02 1.333 84.02 1.417 28.87 1.500 28.87 1.667 15.67 1.667 15.67 1.633 10.90 1.833 10.90	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 1 2.083 6 1 2.167 6 1 2.250 5 1 2.417 5 1 2.500 5 1 2.417 5 1 2.583 4 1 2.667 4 1 2.750 4 1 2.833 4 1 2.817 3 1 2.813 4 1 2.817 3 1 2.813 4 1 2.817 3 1 2.813 4 1 2.817 3 1 2.817 3 1 2.817 4 1 2.917 4 1 3 3 4 1 2.917 4 1 3 3 4 1 3 4 1 3 5 1 3 5)= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr .94 3.08 3.54 .94 3.17 3.54 .92 3.25 3.30 .92 3.33 3.30 .19 3.42 3.08 .19 3.42 3.08 .19 3.42 3.08 .19 3.50 3.08 .63 3.58 2.90 .63 3.57 2.74 .19 3.83 2.74 .84 3.92 2.60
Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINF TIME hrs 0.083 0.167 0.250 0.333 0.417 0.580 0.583 0.667 0.750 0.833 0.917 1.000	Afea (U Total Imp (ha) = (mm) = (%) = (m) = (%) = (m) = (%) = (m) = (%)	ha) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 1.00 61.64 0.013 NSFORMED TO TIME RAIN hrs mm/hr 1.083 22.26 1.167 22.26 1.250 84.02 1.583 15.67 1.583 15.67 1.667 15.67 1.833 10.90 1.917 8.44 2.000 8.44	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 2.083 6 (2.167 6 (2.250 5 (2.333 5 (2.417 5) 2.583 4 (2.667 4) (2.750 4) (2.750 4) (2.750 4) (2.833 4) (2.917 3) (3.000 3))= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr .94 3.08 3.54 .94 3.17 3.54 .92 3.25 3.30 .92 3.25 3.30 .19 3.42 3.08 .19 3.42 3.08 .19 3.50 3.08 .63 3.58 2.90 .63 3.67 2.90 .19 3.75 2.74 .19 3.83 2.74 .84 3.92 2.60 .84 4.00 2.60
Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINF TIME hrs 0.083 0.167 0.250 0.333 0.417 0.500 0.583 0.667 0.750 0.833 0.917 1.000 Max.Eff.Inten.(m	Afea (U Total Imp IM (ha) = (m) = (%) = (m) = = ALL WAS TRAI ALL WAS TRAI AL	na) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 1.00 61.64 0.013 NSFORMED TO TRANSFORM: TIME RAIN hrs mm/hr 1.083 22.26 1.333 84.02 1.417 28.87 1.583 15.67 1.750 10.90 1.833 10.90 1.917 8.44 84.02 4.02	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 2.083 6 2.167 6 2.250 5 2.417 5 2.500 5 2.583 4 2.500 5 2.583 4 2.667 4 2.750 4 2.833 4 2.917 3 3.000 3 3.55)= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr .94 3.08 3.54 .92 3.25 3.30 .92 3.25 3.30 .92 3.25 3.30 .92 3.42 3.08 .19 3.50 3.08 .63 3.58 2.90 .63 3.67 2.90 .63 3.67 2.90 .63 3.75 2.74 .19 3.83 2.74 .84 3.92 2.60 .84 4.00 2.60
Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINF TIME hrs 0.083 0.167 0.250 0.333 0.417 0.500 0.583 0.667 0.750 0.833 0.917 1.000 Max.Eff.Inten.(m over Storage Coeff.	Afea () Total Imp IM: (ha) = (mm) = (%) = (m) = = ALL WAS TRAIN Mm/hr 2.99 3.41 4.01 4.01 4.90 6.42 6.642 9.66 9.66 m/hr) = (min) (min) =	ha) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 1.00 61.64 0.013 NSFORMED TO TRANSFORM: TIME RAIN hrs mm/hr 1.083 22.26 1.250 84.02 1.333 84.02 1.417 28.87 1.500 28.87 1.667 15.67 1.6750 10.90 1.833 10.90 1.917 8.44 84.02 5.00 2.055 (ii)	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 2.083 6 2.167 6 2.250 5 2.2417 5 2.2503 4 2.2503 5 2.2503 4 2.2503 4 2.)= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr .94 3.08 3.54 .94 3.17 3.54 .92 3.25 3.30 .92 3.33 3.30 .19 3.42 3.08 .19 3.42 3.08 .19 3.50 3.08 .63 3.58 2.90 .63 3.58 2.90 .19 3.75 2.74 .19 3.83 2.74 .84 3.92 2.60 .84 4.00 2.60
Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINF TIME hrs 0.083 0.167 0.250 0.333 0.417 0.500 0.583 0.667 0.750 0.833 0.917 1.000 Max.Eff.Inten.(m over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. Tpeak	Afea () Total Imp IM: (ha) = (mm) = (%) = (m) = = ALL WAS TRAIN MM/hr 2.99 3.41 4.01 4.01 4.01 4.90 6.42 6.42 9.66 9.66 m/hr) = (min) = (min) = (min) = (min) =	ha) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 1.00 1.00 1.00 61.64 0.013 NSFORMED TO TRANSFORM: TIME RAIN hrs <mm hr<="" td=""> 1.083 22.26 1.167 22.26 1.250 84.02 1.333 84.02 1.667 15.67 1.667 15.67 1.90 8.33 1.917 8.44 84.02 5.00 2.05 (ii) 5.00 0.31</mm>	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 12.083 6 12.167 6 12.250 5 12.333 5 12.417 5 12.500 5 12.583 4 12.667 4 12.667 4 12.750 4 12.833 4 12.667 4 12.833 4 12.667 4 12.833 4 12.667 4 12.833 4 12.667 4 12.833 4 12.917 3 13.000 3 63.55 15.00 10.51 (ii) 15.00 0.09)= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr .94 3.08 3.54 .94 3.17 3.54 .92 3.25 3.30 .92 3.25 3.30 .19 3.42 3.08 .19 3.50 3.08 .63 3.58 2.90 .63 3.58 2.90 .63 3.57 2.74 .19 3.83 2.74 .84 3.92 2.60
Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINF TIME hrs 0.083 0.167 0.250 0.333 0.417 0.500 0.583 0.667 0.750 0.833 0.917 1.000 Max.Eff.Inten.(m over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. Tpeak	Afea (() Total Imp IM: (ha) = (mm) = (%) = (m) = (%) = (m) = ALL WAS TRAIN ALL WAS TRAIN Mm/hr 2.99 2.99 3.41 4.01 4.01 4.90 6.42 9.66 9.66 9.66 (min) = (min) = (min) = (cms) = (cms) =	ha) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 1.00 61.64 0.013 NSFORMED TO TIME RAIN hrs mm/hr 1.083 22.26 1.167 22.26 1.250 84.02 1.583 15.67 1.667 15.67 1.583 10.90 1.917 8.44 84.02 5.00 2.05 (ii) 5.00 0.31 0.07 0.97	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 1 2.083 6 2.167 6 2.250 5 2.333 5 2.2.417 5 2.2.50 5 2.2.583 4 2.667 4 2.667 4 2.667 4 2.667 4 2.750 4 2.667 4 2.750 4 2.750 4 2.583 4 3.000 3 63.55 15.00 10.51 (ii) 15.00 0.09	<pre>>= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr .94 3.08 3.54 .94 3.17 3.54 .92 3.25 3.30 .92 3.25 3.30 .19 3.42 3.08 .19 3.50 3.08 .63 3.58 2.90 .63 3.67 2.90 .19 3.75 2.74 .19 3.83 2.74 .10 2.60 </pre>
Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINF TIME hrs 0.083 0.167 0.250 0.333 0.417 0.500 0.583 0.667 0.750 0.833 0.917 1.000 Max.Eff.Inten.(m over Storage Coeff. Unit Hyd. Tpeak PEAK FLOW TIME TO PEAK	Afea () Total Imp IM: (ha) = (mm) = (%) = (m) = = ALL WAS TRAN ALL WAS TRAN ALL WAS TRAN ALL WAS TRAN (mm/hr (min) = (min) = (cms) = (hrs) = Total Imp IM: 10.0000 10.000 10.000 10.0000 10.0000 10.000 10.	ha) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 1.00 61.64 0.013 NSFORMED TO TRANSFORM: TIME RAIN hrs mm/hr 1.083 22.26 1.333 84.02 1.417 28.87 1.550 28.87 1.583 15.67 1.750 10.90 1.833 10.90 1.917 8.44 84.02 5.00 2.055 (ii) 5.00 0.31 0.07 1.33 1.33 10.97	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 2.083 6 2.167 6 2.250 5 2.2417 5 2.2503 5 2.417 5 2.2503 4 2.2503 5 2.417 5 2.2503 4 2.2667 4 2.2503 4 2.2667 4 2.2667 4 2.2503 5 1.2.667 4 2.2.503 4 2.2.503 4 2.2.503 5 1.2.667 4 2.2.503 4 2.2.503 5 1.2.667 4 2.2.503 4 2.2.503 4 2.2.503 4 1.2.504 1 3.0000 3 63.55 15.00 10.51 (ii) 15.00 0.02 1.500 0 0.02	<pre>>= 50.00 E STEP. RAIN TIME RAIN m/hr hrs mm/hr .94 3.08 3.54 .92 3.25 3.30 .92 3.25 3.30 .92 3.33 3.30 .19 3.50 3.08 .63 3.58 2.90 .63 3.58 2.90 .63 3.58 2.90 .63 3.57 2.94 .19 3.75 2.74 .19 3.83 2.74 .84 3.92 2.60 .84 4.00 2.60 *TOTALS* 0.078 (iii) 1.33 1.33</pre>
Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINF Mannings n NOTE: RAINF NOTE: RAINF 0.833 0.417 0.500 0.833 0.417 0.500 0.833 0.917 1.000 Max.Eff.Inten.(m over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. Tpeak Unit Hyd. peak PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL	Afea () Total Imp IM: (ha) = (mm) = (%) = (m) = = ALL WAS TRAIN Mm/hr 2.99 3.41 4.01 4.01 4.90 6.42 6.66 9.66 9.66 9.66 9.66 9.66 (min) = (min) = (mm) = (m	ha) = 0.57 (%) = 65.00 PERVIOUS P: 0.37 1.00 1.00 1.00 61.64 0.013 NSFORMED TO TRANSFORM TIME RAIN hrs mm/hr 1.083 22.26 1.167 22.26 1.250 84.02 1.333 84.02 1.667 15.67 1.667 15.67 1.6750 10.90 1.917 8.44 84.02 5.00 2.055 (ii) 5.00 0.31 0.07 1.33 40.74 41.74	Dir. Conn.(% ERVIOUS (i) 0.20 1.50 2.00 40.00 0.250 5.0 MIN. TIM ED HYETOGRAPH ' TIME ' hrs m 2.083 6 2.167 6 2.250 5 2.2417 5 2.2503 4 2.2503 4 2.2513 4 2.2514 4 2.2515 4 2.2515 4 2.2515 4 2.2515 4 2.2517 6 2.2515 4 2.2515 4 2.2517 5 2.2517 4 2.2515 4 2.2517 5 2.2517 4 2.2517 5 3.3515 4 2.2517 5 2.2517 5 2.	<pre>>= 50.00 E STEP</pre>

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:

CN* = 85.((ii) TIME STEP (D' THAN THE STOI (iii) PEAK FLOW DOI	0 Ia = Dep. I) SHOULD BE S RAGE COEFFICIE ES NOT INCLUDE	. Storage SMALLER OF ENT. E BASEFLOU	(Above) R EQUAL W IF ANY.		
RESERVOIR(1002) IN= 2> OUT= 1 DT= 5.0 min	OVERFLOW IS OUTFLOW S (cms) 0.0000 0.0120	OFF STORAGE (ha.m.) 0.0000 0.0220	OUTFLOW (cms) 0.0190 0.0000	STORAGE (ha.m.) 0.0220 0.0000	
INFLOW : ID= 2 (010 OUTFLOW: ID= 1 (100 PEAK TIME	AREA (ha) 09) 0.57(02) 0.57(FLOW REDU SHIFT OF PEAR	QPEAI (cms) 0 0.0 0 0.0 UCTION [Q0 5 FLOW	K TPEAK) (hrs) 078 1.3 007 2.6 put/Qin](%)=	R.V. (mm) 33 31.85 57 31.04 = 8.71 = 80.00	
MAXII	MUM STORAGE	USED	(ha.m.)=	= 0.0125	
CALIB STANDHYD (0115) 2 ID= 1 DT= 5.0 min 5	Area (ha)= Total Imp(%)=	0.86 75.00	Dir. Conn.	(%)= 75.00	
Surface Area () Dep. Storage (r Average Slope Length Mannings n	IMPERVI ha)= 0.6 nm)= 1.0 (%)= 1.0 (m)= 75.7 = 0.01	IOUS PI 65 00 00 72 13	ERVIOUS (i) 0.22 1.50 2.00 40.00 0.250		
NOTE: RAINFAL	L WAS TRANSFOR	RMED TO	5.0 MIN. TI	IME STEP.	
TIME hrs 0.083 0.167 0.250 0.333 0.417 0.500 0.583 0.667 0.750 0.833 0.917 1.000	RAIN TIM mm/hr hrs 2.99 1.083 2.99 1.083 3.41 1.250 3.41 1.250 3.41 1.333 4.01 1.417 4.01 1.500 4.90 1.583 4.90 1.583 4.90 1.667 6.42 1.833 9.666 1.917 9.666 2.000	TRANSFORMI Construction S mm/hr 3 22.26 0 84.02 7 28.87 3 15.67 7 15.67 7 16.90 3 15.47 0 28.87 3 15.47 10.900 3 10.900 7 8.44 3.44	ED HYETOGRAH ' TIME ' hrs 2.083 2.167 2.250 2.333 2.417 2.500 2.583 2.667 2.750 2.833 2.917 3.000	PH RAIN TIME mm/hr hrs 6.94 3.17 5.92 3.25 5.92 3.33 5.19 3.42 5.19 3.50 4.63 3.58 4.63 3.75 4.19 3.75 4.19 3.83 3.84 3.92 3.84 4.00	RAIN mm/hr 3.54 3.30 3.30 3.08 3.08 2.90 2.90 2.74 2.74 2.60 2.60
Max.Eff.Inten.(mm/) over(m: Storage Coeff.(m: Unit Hyd. Tpeak(m: Unit Hyd. peak(cr	hr)= 84.0 in) 5.0 in)= 2.3 in)= 5.0 ms)= 0.3	02 00 32 (ii) 00 30	35.29 10.00 7.19 (ii) 10.00 0.14	*20221.0*	
PEAK FLOW (CI TIME TO PEAK (h: RUNOFF VOLUME (I TOTAL RAINFALL (I RUNOFF COEFFICIENT	ms)= 0.1 rs)= 1.3 mm)= 40.7 mm)= 41.7 = 0.9	15 33 74 78 98	0.02 1.42 19.04 41.74 0.46	0.162 (iii) 1.33 35.31 41.74 0.85	
<pre>***** WARNING: STORAGE (</pre>	COEFF. IS SMAN SELECTED FOR D Ia = Dep. T) SHOULD BE S RAGE COEFFICII ES NOT INCLUDE	LLER THAN PERVIOUS Storage SMALLER OF ENT. E BASEFLOW	TIME STEP! LOSSES: (Above) R EQUAL W IF ANY.		
RESERVOIR(2001) IN= 2> OUT= 1 DT= 5.0 min	OVERFLOW IS OUTFLOW 5 (cms) 0.0000 0.0220	OFF STORAGE (ha.m.) 0.0000 0.0350	OUTFLOW (cms) 0.0300 0.0000	STORAGE (ha.m.) 0.0350 0.0000	

INFLOW : ID= 2 (OUTFLOW: ID= 1 (0115) 2001)	AREA (ha) 0.860 0.860	QPEAK (cms) 0.162 0.013	TPEAK (hrs) 1.33 2.33	R.V. (mm) 35.31 34.84	
P T M	EAK FLOW IME SHIFT O AXIMUM STO	REDUCTI F PEAK FL RAGE US	ON [Qout/Q OW ED	<pre>Din](%)= 7 (min)= 60 (ha.m.)= 0</pre>	.95 .00 .0205	
CALIB STANDHYD (0106) ID= 1 DT= 5.0 min	Area Total Im	(ha)= 0 p(%)= 65	.53 .00 Dir.	Conn.(%)=	55.00	
Surface Area Dep. Storage Average Slope Length Mannings n	I (ha) = (mm) = (%) = (m) = =	MPERVIOUS 0.34 1.00 1.00 59.44 0.013	PERVIC 0.1 1.5 2.0 40.0 0.25	DUS (i) 9 00 00 50		
NOTE: RAIN	FALL WAS TR	ANSFORMED	TO 5.0	MIN. TIME	STEP.	
TIM hr 0.08 0.16 0.25 0.33 0.41 0.50 0.50 0.58 0.66 0.75 0.83 0.91 1.00	E RAIN s mm/hr 3 2.99 7 2.99 0 3.41 3 3.41 7 4.01 3 4.90 7 4.90 0 6.42 3 9.66 0 9.66	TIME hrs 1.083 1.167 1.250 1.333 1.417 1.500 1.583 1.667 1.750 1.833 1.917 2.000	SFORMED H) mm/hr ' 22.26 22.26 24.02 284.02 28.87 15.67 15.67 10.90 10.90 8.44 8.44	<pre>ZETOGRAPH TIME RA hrs mm// 083 6.9 167 6.9 250 5.9 333 5.9 417 5.1 583 4.6 6667 4.6 750 4.1 833 4.1 833 4.1 833 4.1</pre>	IN TIME hr hrs 4 3.08 4 3.17 2 3.25 2 3.33 9 3.42 9 3.50 3 3.58 3 3.58 3 3.67 9 3.75 9 3.83 4 3.92 4 4.00	RAIN mm/hr 3.54 3.54 3.30 3.08 2.90 2.90 2.90 2.74 2.74 2.60 2.60
Max.Eff.Inten.(over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak PEAK FLOW	<pre>mm/hr) = (min) (min) = (min) = (cms) = (cms) =</pre>	84.02 5.00 2.00 (5.00 0.31	53.6 15.0 ii) 11.0 15.0 0.0	57 00 06 (ii) 00 99 *'	TOTALS* 0.077 (iii)	
TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICI	(hrs) = (mm) = (mm) = ENT =	1.33 40.74 41.74 0.98	1.5 21.8 41.7 0.5	50 32 74 52	1.33 32.22 41.74 0.77	
***** WARNING: STORA (i) CN PROCED CN* = (ii) TIME STEP THAN THE (iii) PEAK FLOW	GE COEFF. I URE SELECTE 85.0 Ia (DT) SHOUL STORAGE COE DOES NOT I	S SMALLER D FOR PER = Dep. St D BE SMAL FFICIENT. NCLUDE BA	THAN TIME VIOUS LOSS orage (Ak LER OR EQU SEFLOW IF	C STEP! SES: JOOVE) JAL ANY.		
ADD HYD (0004) 1 + 2 = 3	AR (h	EA QPE a) (cm	AK TPEA s) (hrs	AK R.V. s) (mm)		
ID1= 1 (01 + ID2= 2 (20 ===========	06): 0. 01): 0.	53 0.07 86 0.01 =======	/ 1.33 3 2.33	32.22 34.84		
ID = 3 (00	04): 1.	39 0.08	4 1.33	33.84		
NOTE: PEAK FLC	WS DO NOT I	NCLUDE BA	SEFLOWS IF			
RESERVOIR(1004) IN= 2> OUT= 1 DT= 5.0 min	OVERFL OUTFLO (cms) 0.000	OW IS OFF W STOR (ha. 0 0.0	AGE C m.) 000	OUTFLOW (cms) 0.0480	STORAGE (ha.m.) 0.0190	
INFLOW · ID= 2 (0004)	AREA (ha) 1.390	QPEAK (cms) 0.084	TPEAK (hrs) 1-33	R.V. (mm) 33.84	

OUTFLOW: ID= 1 (1004) 1.390 0.024 2.08 33.78 PEAK FLOW REDUCTION [Qout/Qin] (%) = 29.20
 PEAK
 FLOW
 REDUCTION
 Reduction

 TIME SHIFT OF PEAK FLOW
 (min) = 45.00
 (min) = 0.0097

 COUDDOCF
 USED
 (ha.m.) = 0.0097
 MAXIMUM STORAGE USED _____ _____ | CALIB | STANDHYD (0114) | Area (ha)= 0.80 |ID= 1 DT= 5.0 min | Total Imp(%)= 75.00 Dir. Conn.(%)= 75.00 ------IMPERVIOUS PERVIOUS (i)
 Participation
 PERVICUS
 PERVICUS

 pe
 (ha) =
 0.60
 0.20

 pe
 (mm) =
 1.00
 1.50

 ope
 (%) =
 1.00
 2.00

 (m) =
 73.03
 40.00

 =
 0.013
 0.250
 Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP. ---- TRANSFORMED HYETOGRAPH ----RAIN | TIME RAIN | TIME mm/hr | hrs mm/hr | hrs TIME RAIN | TIME RAIN

 RAIN
 |
 TIME
 RAIN
 |
 TIME

 mm/hr
 |
 hrs
 mm/hr
 |
 hrs

 2.99
 |
 1.083
 22.26
 |
 2.083

 2.99
 |
 1.167
 22.26
 |
 2.167

 3.41
 |
 1.250
 84.02
 |
 2.333

 4.01
 |
 1.417
 28.87
 |
 2.417

 4.01
 |
 1.500
 28.87
 |
 2.500

 4.90
 |
 1.667
 15.67
 |
 2.667

 6.42
 |
 1.750
 10.90
 |
 2.750

 6.42
 |
 1.833
 10.90
 |
 2.833

 9.66
 |
 1.917
 8.44
 |
 2.917

 9.66
 |
 2.000
 8.44
 |
 3.000

 hrs mm/hr .08 3.54 mm/hr | hrs 6.94 | 3.08 hrs 0.083 0.167 6.94 | 3.17 3.54 3.30 0.250 5.92 | 3.25 0.333 5.92 I 3.33 3.30 5.19 0.417 3.42 3.08 0.500 5.19 | 3.50 3.08 0.583 4.63 | 3.58 2.90 2.90 0.667 4.63 | 3.67 0.750 4.19 | 3.75 2.74 4.19 | 3.83 0.833 2.74 3.84 | 3.92 3.84 | 4.00 0.917 2.60 1.000 2.60
 84.02
 35.29

 5.00
 10.00

 2.27
 (ii)
 7.14

 5.00
 10.00

 0.30
 0.14
 Max.Eff.Inten.(mm/hr)= over (min) Storage Coeff. (min)= 7.14 (ii) Unit Hyd. Tpeak (min)= Unit Hyd. peak (cms) = *TOTALS*
 TOTALS

 PEAK FLOW (cms)=
 0.14
 0.01
 0.151 (iii)

 TIME TO PEAK (hrs)=
 1.33
 1.42
 1.33

 RUNOFF VOLUME (mm)=
 40.74
 19.04
 35.31

 TOTAL RAINFALL (mm)=
 41.74
 41.74
 41.74

 RUNOFF COEFFICIENT =
 0.98
 0.46
 0.85
 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: (i) CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. _____ | RESERVOIR(1008)| OVERFLOW IS OFF IN= 2---> OUT= 1 |
 OUTFLOW
 STORAGE
 OUTFLOW
 STORAGE

 (cms)
 (ha.m.)
 (cms)
 (ha.m.)

 0.0000
 0.0000
 0.0280
 0.0340

 0.0190
 0.0340
 0.0000
 0.0000
 DT= 5.0 min
 AREA
 QPEAK
 TPEAK
 R.V.

 (ha)
 (cms)
 (hrs)
 (mm)

 INFLOW:
 ID= 2
 0114)
 0.800
 0.151
 1.33
 35.31

 OUTFLOW:
 ID= 1
 (1008)
 0.800
 0.011
 2.50
 34.75
 PEAK FLOW REDUCTION [Qout/Qin](%) = 7.23 TIME SHIFT OF PEAK FLOW (min) = 70.00 MAXIMUM STORAGE USED (ha.m.) = 0.0195 _____ _____ | CALIB Area (ha) = 0.68 Total Imp(%) = 75.00 Dir. Conn.(%) = 75.00 | STANDHYD (0113) | Area |ID= 1 DT= 5.0 min | _____ IMPERVIOUSPERVIOUS (i)Surface Area(ha) =0.510.17

Dep. Storage	(mm) =	1.00	1.50
Average Slope	(%) =	1.00	2.00
Length	(m) =	67.33	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

TIME RAIN I TIME RAIN I Imm mm/hr Imm Imm	Nr
Max.Eff.Inten.(mm/hr)= 84.02 35.29 over (min) 5.00 10.00 Storage Coeff. (min)= 2.16 (ii) 7.04 (ii) Unit Hyd. Tpeak (min)= 5.00 10.00 Unit Hyd. peak (cms)= 0.31 0.14 *TOTALS*	
PEAK FLOW (cms) = 0.12 0.01 0.128 (iii) TIME TO PEAK (hrs) = 1.33 1.42 1.33 RUNOFF VOLUME (mm) = 40.74 19.04 35.31 TOTAL RAINFALL (mm) = 41.74 41.74 41.74 RUNOFF COEFFICIENT = 0.98 0.46 0.85	
<pre>(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.</pre>	
RESERVOIR(1003) OVERFLOW IS OFF IN= 2> OUT= 1 DT= 5.0 min OUTFLOW STORAGE OUTFLOW STORAGE (cms) (ha.m.) (cms) (ha.m.) 0.0000 0.0000 0.0230 0.0280 0.0190 0.0280 0.0000 0.0000	
AREA QPEAK TPEAK R.V. (ha) (cms) (hrs) (mm) INFLOW: ID= 2 0113) 0.680 0.128 1.33 35.31 OUTFLOW: ID= 1 (1003) 0.680 0.011 2.25 34.77 PEAK FLOW REDUCTION [Oout/Oin] (%) = 8.42	
TIME SHIFT OF PEAK FLOW (min) = 55.00 MAXIMUM STORAGE USED (ha.m.) = 0.0159	
CALIB STANDHYD (0111) Area (ha)= 0.58 ID= 1 DT= 5.0 min Total Imp(%)= 65.00 Dir. Conn.(%)= 50.00	
IMPERVIOUS PERVIOUS (i) Surface Area (ha) = 0.38 0.20 Dep. Storage (mm) = 1.00 1.50 Average Slope (%) = 1.00 2.00 Length (m) = 62.18 40.00 Mannings n = 0.013 0.250	
NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.	
TRANSFORMED HYETOGRAPH TIME RAIN TIME RAIN TIME RAIN TIME RAIN hrs mm/hr hrs mm/hr hrs mm/hr hrs mm/h 0.083 2.99 1.083 22.26 2.083 6.94 3.08 3.54 0.167 2.99 1.167 22.26 2.167 6.94 3.17 3.54 0.250 3.41 1.250 84.02 2.250 5.92 3.25 3.30	N

$ \begin{array}{cccccccccccccccccccccccccccccccccccc$) 3 3) 1 1 2)
Max.Eff.Inten.(mm/hr) = 84.02 63.55 over (min) 5.00 15.00 Storage Coeff. (min) = 2.06 (ii) 10.52 (ii) Unit Hyd. Tpeak (min) = 5.00 15.00 Unit Hyd. peak (cms) = 0.31 0.09 PEAK FLOW (cms) = 0.07 0.02 0.079 (iii)	
TIME TO PEAK (hrs)= 1.33 1.50 1.33 RUNOFF VOLUME (mm)= 40.74 22.97 31.85 TOTAL RAINFALL (mm)= 41.74 41.74 41.74 RUNOFF COEFFICIENT = 0.98 0.55 0.76	
***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!	
 (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. 	
RESERVOIR(1006) OVERFLOW IS OFF IN= 2> OUT= 1 DT= 5.0 min OUTFLOW STORAGE OUTFLOW STORAGE (cms) (ha.m.) (cms) (ha.m.) 0.0000 0.0000 0.0200 0.0230 0.0130 0.0230 0.0000 0.0000	
AREA QPEAK TPEAK R.V. (ha) (cms) (hrs) (mm) INFLOW: ID= 2 0111) 0.580 0.079 1.33 31.85 OUTFLOW: ID= 1 (1006) 0.580 0.007 2.67 31.09	
PEAK FLOW REDUCTION [Qout/Qin](%)= 8.96 TIME SHIFT OF PEAK FLOW (min)= 80.00 MAXIMUM STORAGE USED (ha.m.)= 0.0126	
ADD HYD (0001) 1 + 2 = 3 AREA QPEAK TPEAK R.V. (ha) (cms) (hrs) (mm) ID1= 1 (1000): 2.46 0.047 2.17 32.07 + ID2= 2 (1001): 3.00 0.026 3.25 22.99	
ID = 3 (0001): 5.46 0.073 2.25 27.08	
NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.	
ADD HYD (0001) 3 + 2 = 1 AREA QPEAK TPEAK R.V.	
(ha) (cms) (hrs) (mm) TD1= 3 (0001): 5.46 0.073 2.25 27.08	
+ ID2= 2 (1002): 0.57 0.007 2.67 31.04	
ID = 1 (0001): 6.03 0.080 2.25 27.46	
NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.	

ADD	Н	YD	((000	1)								
1	+	2	=	3	3	1		AREA	QF	PEAK		TPEAK		R.V.
								(ha)	(<	cms)		(hrs)		(mm)
		ID	1=	1	(0001):		6.03	0.0	080		2.25		27.46
	+	ID	2=	2	(1003):		0.68	0.0)11		2.25		34.77
		==:	===		===		====			====	===	=====	===	======
		ID	=	3	(0001):		6.71	0.0	90		2.25		28.20

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

AI	D HYD (0001)					
	3 + 2 = 1	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	
	ID1= 3 (0001): + ID2= 2 (1004):	6.71 1.39	0.090 0.024	2.25 2.08	28.20 33.78	
	ID = 1 (0001):	8.10	0.115	2.25	29.16	
	NOTE: PEAK FLOWS DO	NOT INCL	IDE BASEFI	OWS TE A	NY.	
	עא מע					
	1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.	
	ID1= 1 (0001):	(na) 8.10	0.115	2.25	29.16	
	+ 1D2= 2 (1005):	0.27	0.004	2.33	31.89	
	ID = 3 (0001):	8.37	0.119	2.25	29,24	
	NOTE: PEAK FLOWS DO	NOT INCL	JDE BASEFI	LOWS IF AN	NY. 	
AI 	DD HYD (0001) 3 + 2 = 1	AREA	QPEAK	TPEAK	R.V.	
	ID1= 3 (0001) ·	(ha) 8.37	(cms) 0.119	(hrs) 2.25	(mm) 29.24	
	+ ID2= 2 (1006):	0.58	0.007	2.67	31.09	
	ID = 1 (0001):	8.95	0.126	2.25	29.36	
	NOTE: PEAK FLOWS DO	NOT INCL	JDE BASEFI	LOWS IF AN	NY.	
AI	D HYD (0001)	3	00737		D 11	
 	1 + 2 = 3	AREA (ha)	(Cms)	(hrs)	R.V. (mm)	
	ID1= 1 (0001): + ID2= 2 (1007):	8.95 0.34	0.126 0.004	2.25 2.58	29.36 30.66	
	ID = 3 (0001):	9.29	0.130	2.25	29.41	
	NOTE: PEAK FLOWS DO	NOT INCL	JDE BASEFI	LOWS IF AN	NY.	
 AI	DD HYD (0001)					
	3 + 2 = 1	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)	
	ID1= 3 (0001): + ID2= 2 (1008).	9.29 0.80	0.130	2.25	29.41 34.75	
	TD = 1 (0001)	10 09	0 1 4 1	2 25	29.83	
	NOTE: DEAK FLONG DO	10.02	U		22.03	
	NOID. FEAR FLOWS DU			Al		
AI 	1 + 2 = 3	AREA	QPEAK	TPEAK	R.V.	
	ID1= 1 (0001):	(ha) 10.09	(cms) 0.141	(hrs) 2.25	(mm) 29.83	
	+ ID2= 2 (0110):	0.18	0.027	1.33	31.82	
	ID = 3 (0001):	10.27	0.144	2.17	29.87	
	NOTE: PEAK FLOWS DO	NOT INCLU	JDE BASEFI	JOWS IF AN	NY.	
गान्	ITSH					
====		========				
	-					
	V V I SSSSS	U U	A L		(v 6	.2.2015)
	V V I SS V V I SS	U U U II	AA L AAAAA T.			

V V I SS U U A A L VV I SSSSS UUUUU A A LLLLL 000 TTTTT TTTTT H Н Ү Ү М М 000 ΤM H H Y Y MM MO O H H Y M M O O H H Y M M OOO 0 0 0 0 т Т Т т 000 Т т Developed and Distributed by Smart City Water Inc Copyright 2007 - 2022 Smart City Water Inc All rights reserved. ***** DETAILED OUTPUT ***** filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat filename: C:\Users\workstation\AppData\Local\Civica\VH5\ccf76975-8d50-4b70-aa0c-30fee69c1cca Input Output 3e338b66-ac2e-404b-95c9-f18e0ced622bSummary filename: C:\Users\workstation\AppData\Local\Civica\VH5\ccf76975-8d50-4b70-aa0c-30fee69c1cca \3e338b66-ac2e-404b-95c9-f18e0ced622b\ DATE: 10-08-2024 TIME: 06:28:20 USER: COMMENTS: _____ ***** ** SIMULATION : CHI4hr - 100yr _____ | CHICAGO STORM | | Ptotal= 68.11 mm | IDF curve parameters: A=1264.570 B= 7.720 C= 0.781 ----used in: INTENSITY = A / (t + B) ^C Duration of storm = 4.00 hrs Storm time step = 10.00 min Time to peak ratio = 0.33 RAIN |' TIME mm/hr |' hrs TIME RAIN | TIME RAIN | TIME RAIN mm/hr | hrs 20 | 3.00 RAIN mm/hr | hrs hrs hrs mm/hr 37.64 | 2.00 0.00 4.74 | 1.00 11.39 | 5.65 1.17 133.78 3.17 2.17 0.17 5.44 | 9.65 | 5.25 6.43 | 1.33 7.93 | 1.50 48.90 | 2.33 26.44 | 2.50 8.41 | 7.47 | 3.33 3.50 0.33 4.90 0.50 4.60 0.67 10.51 | 1.67 18.20 | 2.67 6.73 | 3.67 4.34 16.06 | 1.83 0.83 13.96 | 2.83 6.14 | 3.83 4.10 _____ _____ | CALIB Area (ha)= 0.18 Total Imp(%)= 65.00 Dir. Conn.(%)= 50.00 | STANDHYD (0110)| |ID= 1 DT= 5.0 min | ____ _____ IMPERVIOUS PERVIOUS (i) 0.06 Surface Area (ha) = 0.12 Dep. Storage (mm) = 1.00 1.50 1.00 34.64 Average Slope (%) = 2.00 (m) = 40.00 Length Mannings n = 0.013 0.250 NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP. ---- TRANSFORMED HYETOGRAPH ----RAIN |' TIME mm/hr |' hrs TIME RAIN | TIME RAIN | TIME RAIN mm/hr | hrs hrs mm/hr | hrs mm/hr 37.64 | 2.083 37.64 | 2.167 1.083 11.39 | 3.08 0.083 4.74 5.65

 4.74
 1.167
 37.64
 2.167

 5.44
 1.250
 133.78
 2.250

 3.17 3.25 0.167 11 39 1 5.65 9.65 I 0.250 5.25 0.333 5.44 | 1.333 133.78 | 2.333 9.65 | 3.33 5.25 0.417 6.43 | 1.417 48.90 | 2.417 8.41 | 3.42 4.90

8.41 | 3.50

7.47 | 3.67

3.58

7.47 |

4.90

4.60

4.60

6.43 | 1.500 48.90 | 2.500

26.44 | 2.583 26.44 | 2.667

7.93 | 1.583 7.93 | 1.667

0.500

0.583

0.667

0.75 0.83 0.91 1.00	0 10.51 3 10.51 7 16.06 0 16.06	1.750 1.833 1.917 2.000	18.20 18.20 13.96 13.96	2.750 2.833 2.917 3.000	6.73 3.75 6.73 3.83 6.14 3.92 6.14 4.00	4.34 4.34 4.10 4.10
Max.Eff.Inten.(over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak	<pre>mm/hr) = (min) (min) = (min) = (cms) =</pre>	133.78 5.00 1.20 5.00 0.33	1 (ii)	29.26 10.00 7.57 (ii) 10.00 0.13	***\0**1 5 *	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICI	(cms) = (hrs) = (mm) = (mm) = ENT =	0.03 1.33 67.11 68.11 0.99		0.02 1.42 45.68 68.11 0.67	0.048 (iii) 1.33 56.38 68.11 0.83	
***** WARNING: STORA	GE COEFF. I	S SMALLE	R THAN	TIME STEP!		
 (i) CN PROCED CN* = (ii) TIME STEP THAN THE (iii) PEAK FLOW 	URE SELECTE 85.0 Ia (DT) SHOUL STORAGE COE DOES NOT I	D FOR PE = Dep. S D BE SMA FFICIENT NCLUDE B	RVIOUS torage LLER OF ASEFLOW	LOSSES: (Above) R EQUAL N IF ANY.		
CALIB STANDHYD (0103) ID= 1 DT= 5.0 min	Area Total Im	(ha)= p(%)= 6	2.50 5.00	Dir. Conn.	(%)= 55.00	
Surface Area Dep. Storage Average Slope Length Mannings n	I (ha) = (mm) = (%) = (m) = =	MPERVIOU 1.62 1.00 1.00 129.10 0.013	S PE	ERVIOUS (i) 0.88 1.50 2.00 40.00 0.250		
NOTE: RAIN	FALL WAS TR	ANSFORME	D TO	5.0 MIN. T	IME STEP.	
			VGEODW		D <i>U</i>	
TIM hr 0.08 0.16 0.25 0.33 0.41 0.50 0.58 0.66 0.75 0.83 0.91 1.00	E RAIN s mm/hr 3 4.74 7 4.74 0 5.44 3 5.44 7 6.43 3 7.93 0 10.51 3 10.51 7 16.06 0 16.06	TIME hrs 1.083 1.167 1.250 1.333 1.417 1.500 1.583 1.667 1.750 1.833 1.917 2.000	NSFORME RAIN mm/hr 37.64 133.78 48.90 48.90 26.44 26.44 18.20 18.20 13.96 13.96	ED HYETOGRA ' TIME hrs 2.083 2.167 2.250 2.333 2.417 2.500 2.583 2.667 2.750 2.833 2.917 3.000	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	RAIN mm/hr 5.65 5.25 5.25 4.90 4.90 4.60 4.60 4.34 4.34 4.10 4.10
Max.Eff.Inten.(over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak	<pre>mm/hr) = (min) (min) = (min) = (cms) =</pre>	133.78 5.00 2.65 5.00 0.29	1 (ii)	11.09 10.00 9.42 (ii) 10.00 0.12	+200231.04	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICI	(cms) = (hrs) = (mm) = (mm) = ENT =	0.50 1.33 67.11 68.11 0.99		0.18 1.42 44.02 68.11 0.65	*TOTALS* 0.654 (iii) 1.33 56.72 68.11 0.83	
***** WARNING: STORA	GE COEFF. I	S SMALLE	R THAN	TIME STEP!		
 (i) CN PROCED CN* = (ii) TIME STEP THAN THE (iii) PEAK FLOW 	URE SELECTE 85.0 Ia (DT) SHOUL STORAGE COE DOES NOT I	D FOR PE = Dep. S D BE SMA FFICIENT NCLUDE B	RVIOUS torage LLER OF ASEFLOW	LOSSES: (Above) R EQUAL N IF ANY.		
CALIB						

| STANDHYD (0108) | Area (ha) = 0.50 |ID= 1 DT= 5.0 min | Total Imp(%) = 20.00 Dir. Conn.(%) = 20.00

IMPERVIOUS PERVIOUS (i)

(ha) =	0.10	0.40
(mm) =	1.00	1.50
(%) =	1.00	2.00
(m) =	57.74	40.00
=	0.013	0.250
	(ha) = (mm) = (%) = (m) = =	$\begin{array}{llllllllllllllllllllllllllllllllllll$

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

		TR	ANSFORM	ED HYETOGRA	APH		_
TIME	RAIN	TIME	RAIN	TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr
0.083	4.74	1.083	37.64	2.083	11.39	3.08	5.65
0.16/	4./4	1.16/	3/.04	2.16/	11.39	3.1/	5.05
0.230	5 44 1	1 333	133.70	2.230	9.00	3.23	5.25
0.333	6 43 1	1 417	18 90	2.333	9.0J 8.41	3.42	1 90
0.500	6 43 1	1 500	48 90	1 2 500	8 41 1	3 50	4 90
0.583	7 93 1	1 583	26 44	2.500	7 47 1	3 58	4 60
0.667	7.93	1.667	26.44	2.667	7.47	3.67	4.60
0.750	10.51 j	1.750	18.20	2.750	6.73 j	3.75	4.34
0.833	10.51	1.833	18.20	2.833	6.73	3.83	4.34
0.917	16.06	1.917	13.96	2.917	6.14	3.92	4.10
1.000	16.06	2.000	13.96	3.000	6.14	4.00	4.10
Max.Eff.Inten.(mm/h	1r)=	133.78		76.26			
over (mi	n)	5.00		10.00			
Storage Coeff. (mi	n)=	1.64	(ii)	9.50 (ii)			
Unit Hyd. Tpeak (mi	.n)=	5.00		10.00			
Unit Hyd. peak (cm	ıs)=	0.32		0.12	+ = 0 =	310+	
PEAK FLOW (cm	(s) =	0 04		0 06	* 1.0.1	ALS* 084 (iii)
TIME TO PEAK (br	(s) =	1 33		1.42	1	.33	/
RUNOFF VOLUME (m	um) =	67.11		39.82	4.5	.26	
TOTAL RAINFALL (m	m) =	68.11		68.11	68	.11	
RUNOFF COEFFICIENT	=	0.99		0.58	C	.66	
 (i) CN PROCEDURE CN* = 85.0 (ii) CN PROCEDURE 	SELECTEI	ERVIOU ER SPLI D FOR PI = Dep. 3	S RATIOS TTING TH ERVIOUS Storage	HE AREA. LOSSES: (Above)	5		
(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE	AGE COEF	FICIEN	ALLER OF T. BASEFLOV	R EQUAL W IF ANY.			
(11) TIME STEP (DT THAN THE STOR (111) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3	AGE COEF	FFICIEN NCLUDE	ALLER OF F. BASEFLOU 	R EQUAL W IF ANY. 	R.V.		
(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3	AGE COEP S NOT IN ARE (ha	EA Q (1)	ALLER OF F. BASEFLOV PEAK cms)	R EQUAL W IF ANY. TPEAK (hrs)	R.V. (mm)		
(11) TIME STEP (DT THAN THE STOP (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103):	AGE COEF	EA Q EA Q EA Q EA Q EA Q	ALLER OI I. BASEFLOU PEAK cms) 654	R EQUAL W IF ANY. TPEAK (hrs) 1.33 56	R.V. (mm) 5.72		
(11) TIME STEP (DT THAN THE STOR (111) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108):	AGE COEH S NOT IN ARE (ha 2.5 0.5	EA Q 2 0 0. EA Q 2 0. 50 0.	ALLER OI F. BASEFLOW PEAK cms) 654 084	R EQUAL W IF ANY. TPEAK (hrs) 1.33 56 1.33 45	R.V. (mm) 5.72 5.26		
(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ================ ID = 3 (0003):	ARE (ha 2.5 0.5 3.0	EA Q 50 0. 50 0. 50 0. 50 0. 50 0.	ALLER OF F. BASEFLOW PEAK Cms) 654 084 ======= 737	TPEAK (hrs) 1.33 56 1.33 54	R.V. (mm) 5.72 5.26 ===== 4.81		
(11) TIME STEP (DT THAN THE STOP (111) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ====== ID = 3 (0003): NOTE: PEAK FLOWS D	ARE (ha 2.5 0.5 3.0 00 NOT IN	SEA Q:	ALLER OF F. BASEFLOW PEAK Cms) 654 084 ======= 737 BASEFLOW	TPEAK (hrs) 1.33 56 1.33 45 1.33 54 0.33 54 0.33 54 0.35 54 0.35 15 ANY.	R.V. (mm) 5.72 5.26 ===== 4.81		
(11) TIME STEP (DT THAN THE STOR (111) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ID = 3 (0003): NOTE: PEAK FLOWS D	ARE COEH S NOT IN ARE (ha 2.5 0.5 3.0 00 NOT IN	EA Q a) ((50 0 (50 0 (50 0 (50 0 (100) 0 (100) 0	ALLER OF F. BASEFLOW PEAK cms) 654 084 737 BASEFLOW	TPEAK (hrs) 1.33 56 1.33 54 0.33 54 0.33 54 0.33 54	R.V. (mm) 5.72 5.26 ===== 4.81		
(11) TIME STEP (DT THAN THE STOR (111) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ====================================	ARE (ha 2.5 0.5 3.0 00 NOT IN OVERFLO	EA Q: EA Q: a) (50 0 50 0 50 0 00 0 00 0 00 0 00 0 00 0 00 0 00 0 00 0 00 0 00 0	ALLER OF F. BASEFLOW PEAK cms) 654 084 ======== 737 BASEFLOW ====== FF	R EQUAL W IF ANY. TPEAK (hrs) 1.33 56 1.33 54 NS IF ANY.	R.V. (mm) 5.72 5.26 ===== 1.81		
(11) TIME STEP (DT THAN THE STOR (111) PEAK FLOW DOE (111) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ====================================	ARE (ha 2.5 0.5 3.0 00 NOT IN OVERFLO	Discord Second FFICIENT NCLUDE 1 CA Q A) (1 50 0. 50 0. 50 0. 50 0. 900 0. NCLUDE 1 NCLUDE 1 DOW IS 02	ALLER OF F. BASEFLOW PEAK cms) 654 084 BASEFLOW BASEFLOW FF DRAGE	TPEAK (hrs) 1.33 50 1.33 54 WS IF ANY.	R.V. (mm) 5.72 5.26 ===== 1.81		
(11) TIME STEP (DT THAN THE STOP (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ID = 3 (0003): NOTE: PEAK FLOWS D RESERVOIR(1001) IN= 2> OUT= 1 DT= 5.0 min	ARE (ha 2.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0	EA Q: cal ("	ALLER OF F. BASEFLOW PEAK cms) 654 084 BASEFLOW BASEFLOW FF FF DRAGE a.m.)	R EQUAL W IF ANY. TPEAK (hrs) 1.33 56 1.33 45 1.33 54 WS IF ANY.	R.V. (mm) 5.72 5.26 ===== 1.81	PRAGE	
(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ====================================	ARE (hase coefficients) ARE (hase coefficients) ARE (h	Description Sea Qi VCLUDE 1 VCLUDE 1 VCLUDE 1 Sea Qi VCLUDE 1 Solo 0.1 Solo 0.1 VCLUDE 1 VCLUDE 1 VCLUDE 1 VCLUDE 1 VVCLUDE 1 VCLUDE 1 VCLUDE 1 VVCLUD 1 VCLUD 1 VCLUD 1	ALLER OF F. BASEFLOW PEAK cms) 654 084 ====================================	<pre>R EQUAL W IF ANY. TPEAK (hrs) 1.33 56 1.33 45 1.33 54 WS IF ANY. OUTFLOW (cms) 0.0380</pre>	R.V. (mm) 5.72 5.26 ===== 1.81 V STC (ha) C)RAGE m.) .1290	
(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ====================================	ARE (hase coefficients) ARE (hase coefficients) ARE (h	Description State State Qi VCLUDE V State Qi Qi Qi	ALLER OF F. BASEFLOW PEAK cms) 654 084 ======= 737 BASEFLOW FF FF DRAGE a.m.) .0000 .0230	<pre>R EQUAL W IF ANY. TPEAK (hrs) 1.33 54 1.33 54 WS IF ANY. OUTFLOV (Cms) 0.0380 0.0480</pre>	R.V. (mm) 5.72 5.26 4.81 V STC (ha) C	DRAGE m.) 0.1290 .1290	
(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ====================================	ARE (hase coefficients) (ARE COEFFICIENTS) (ARE (hase coefficients) (hase coefficients	Discord String Discord String NCLUDE I NCLUDE I String (i) String (i) String (i) NCLUDE I NCLUDE I NCLUDE I NCLUDE I NCLUDE I NCLUDE I N STM N STM N STM N STM N N N STM	ALLER OF T. BASEFLOW PEAK cms) 654 084 ======= BASEFLOW FF DRAGE a.m.) .0000 .0230 .02460	TPEAK (hrs) 1.33 54 1.33 54 1.33 54 1.33 54 WS IF ANY. 000TFLOW 00038 0.0380 0.0480 0.0000	R.V. (rmm) 5.72 5.26 ===== 4.81 V STC (ha) 0 C 0 C	DRAGE m.) .1290 .0000	
(11) TIME STEP (DT THAN THE STOR (111) PEAK FLOW DOE (111) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103) : + ID2= 2 (0108) : = ==================================	ARE (hage coeff S NOT IN (hage) (hage	Des Sm. SEA Q: ACLUDE 1 SEA Q:	ALLER OI r. BASEFLOW PEAK cms) 654 084 ======== 737 BASEFLOW FF DRAGE a.m.) .0230 .0460 OPEAI	R EQUAL W IF ANY. TPEAK (hrs) 1.33 1.33 1.33 45 MS IF ANY. I OUTFLOW (cms) 0.0380 0.0480 0.0480 0.0480 TPEAK	R.V. (mm) 5.72 5.26 ===== 1.81 V STC (ha 0 C 0 C	DRAGE m.) 0.1290 0.0000 R.V.	
(11) TIME STEP (DT THAN THE STOR (111) PEAK FLOW DOE (111) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103) : + ID2= 2 (0108) : ====================================	ARE (hase coefficient of the coe	Discontract Stress Discontract Discontract Stress Discontract Discontract Discontract Distret Distr<	ALLER OI r. BASEFLOW PEAK cms) 654 084 737 BASEFLOW FF DRAGE a.m.) .0000 .0230 .0460 QPEAI (cms)	R EQUAL W IF ANY. TPEAK (hrs) 1.33 56 1.33 56 1.33 56 WS IF ANY. OUTFLOW (cms) 0.0380 0.0000 K TPEAH) (hrs)	R.V. (mm) 5.72 5.26 ===== 1.81 V STC (ha 0 C 0 C 0 C	PRAGE 1.m.) .1290 .1290 .0000 R.V. (mm)	
(11) TIME STEP (DT THAN THE STOR (111) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ====================================	ARE (ha 2.5 0.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	DEE SM. FFICIEN' VCLUDE 1 CA QA QAREA (ha) 3.000	ALLER OI T. BASEFLOW PEAK Cms) 654 084 BASEFLOW 084 BASEFLOW 0737 FF DRAGE a.m.) .0000 .0230 .0460 QPEAI (Cms) 0.02	R EQUAL W IF ANY. TPEAK (hrs) 1.33 50 1.33 45 1.33 54 WS IF ANY. 0.038(0.038(0.038(0.048(0.0000) K TPEAH 0 (hrs) 737 1.	R.V. (mm) 5.72 5.26 4.81 4.81 0 C (ha 0 C 0 C 0 C 0 C	DRAGE m.) .1290 .1290 .0000 R.V. (mm) 54.81	
<pre>(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ====================================</pre>	ARE (haGE COEH S NOT IN (ha 2.5 0.5 3.0 00 NOT IN 00 NOT IN 00 VERFLO (cms) 0.0000 0.0220 03)	Disconstruct Structure FFICIEN' VCLUDE 1 VCLUDE 1 VCLU	ALLER OI T. BASEFLOW PEAK cms) 654 084 BASEFLOW 084 BASEFLOW 0737 BASEFLOW 0.0230 .0460 QPEAI (cms) 0.0. 0.0.	R EQUAL W IF ANY. TPEAK (hrs) 1.33 50 1.33 45 1.33 54 WS IF ANY. 0.038 0.048(0.0000 0 (cms) 0.038 0.048(0.048(0.0000 K TPEAH 0 (hrs) 737 1. 038 3.	R.V. (mm) 5.72 5.26 4.81 4.81 0 C 0 C 0 C 0 C 0 C 0 C 0 C 0 C 0 C	DRAGE m.) .1290 .1290 .0000 R.V. (mm) 54.81 47.05	
(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ID = 3 (0003) : NOTE: PEAK FLOWS D RESERVOIR (1001) IN= 2> OUT= 1 DT= 5.0 min INFLOW : ID= 2 (000 OUTFLOW: ID= 1 (100)	ARE (haGE COEH S NOT IN (ha 2.5 0.5 3.0 00 NOT IN 00 NOT IN 00 VERFLO (cms) 0.0000 0.0220 0.0220 03)	Disconstruct Structure FFICIENT NCLUDE 1 Structure NCLUDE 1 Structure NCLUDE 1 Structure NCLUDE 1 NCLUDE 1 NCLUDE 1 Structure NCLUDE 1 NCLUDE 1 NCLUDE 1 NW IS 02 N NW IS 02 N AREA 3.000 3.000 BEDUCC	ALLER OI T. BASEFLOW PEAK (cms) 654 084 BASEFLOW 054 084 BASEFLOW 0737 FF DRAGE a.m.) .0000 .0230 .0460 QPEAI (cms) 0.7 0.0 .0 .0 .0 .0 .0 .0 .0 .0	R EQUAL W IF ANY. TPEAK (hrs) 1.33 50 1.33 45 1.33 50 NS IF ANY. 0.038 0.0480000000000	R.V. (mm) 5.72 5.26 1.81 V STC (ha 0) C 0) C 0 0 C 0 0 C	DRAGE m.) .1290 .1290 .0000 R.V. (mm) 54.81 47.05	
(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ====================================	ARE (haGE COEH S NOT IN (ha 2.5 0.5 0.000 NOT IN OVERFLO OUTFLOW (cms) 0.00000 0.00000 0.00000 0.00000 0.000000	Design String Design Clubel NCLUDE 1 Clubel NCLUDE 1 Clubel String Clubel String Clubel NCLUDE 1 Clubel NO O NO O NO Clubel NCLUDE 1 Clubel NO O NO O NO NO NO NO NO NO NO NO	ALLER OI F. BASEFLOW PEAK cms) 654 084 ======== 737 BASEFLOW 084 084 084 084 084 084 084 084	<pre>R EQUAL W IF ANY. TPEAK (hrs) 1.33 56 1.33 56 1.33 56 NS IF ANY. OUTFLOW (cms) 0.038(0.048(0.048(0.0000(K TPEAH 0.048(1.038 3.0000(24)) 0.038 0.048(0.0</pre>	R.V. (mm) 5.72 5.26 ===== 4.81 V STC (ha 0 C 0 C 0 C 33 58 = 5.14	PRAGE m.) .1290 .1290 .0000 R.V. (mm) 54.81 47.05	
(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): DT= 3 (0003): NOTE: PEAK FLOWS D RESERVOIR (1001) IN= 2> OUT= 1 DT= 5.0 min INFLOW : ID= 2 (000 OUTFLOW: ID= 1 (100 PEAK TIME MAXTM	ARE (haGE COEH S NOT IN (ha 2.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0	Design String Design Clubel NCLUDE 1 Clubel String Club String	ALLER OI r. BASEFLOW PEAK cms) 654 084 ========= 737 BASEFLOW BASEFLOW 0230 .0230 .0230 .0460 QPEAI (cms) 0.1 CTION [Q4 FLOW USED	<pre>R EQUAL W IF ANY. TPEAK (hrs) 1.33 56 1.33 56 1.33 56 WS IF ANY. OUTFLOW OUTFLOW</pre>	R.V. (mm) 5.72 5.26 ===== 1.81 V STC (ha 0 C 0 C 0 C 33 5.8 = 5.14 =135.00	PRAGE m.) .1290 .1290 .0000 R.V. (mm) 54.81 47.05	
(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ====================================	ARE (haGE COEH S NOT IN (ha 2.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0	Design String Design Comparison String Comparison	ALLER OI r. BASEFLOU PEAK cms) 654 084 ========= 737 BASEFLOU BASEFLOU 084 084 084 084 084 084 084 084	<pre>R EQUAL W IF ANY. TPEAK (hrs) 1.33 54 1.33 54 WS IF ANY. OUTFLOW OUTFLOW</pre>	R.V. (mm) 5.72 5.26 1.81 1.81 0 STC (ha 0 C 0 C 0 C 33 58 = 5.14 =135.00 = 0.12	DRAGE m.) .1290 .1290 .0000 R.V. (mm) 54.81 47.05 .85	
(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ====================================	ARE (haGE COEH S NOT IN (ha 2.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0	Del SM. SEA Q: NCLUDE 1 NCLUDE 1 SEA Q:	ALLER OI F. BASEFLOW PEAK cms) 654 084 BASEFLOW BASEFLOW 084 FF DRAGE a.m.) 0000 .0230 .0460 QPEAI (cms) 0.1 CTION [QC FLOW USED 	<pre>R EQUAL W IF ANY. TPEAK (hrs) 1.33 56 1.33 45 1.33 54 WS IF ANY. OUTFLOW OUTFLOW</pre>	R.V. (mm) 5.72 5.26 4.81 4.81 4.81 5.14 5.26 (ha 0 C 0 C 0 C 5.26 (ha 0 C 0 C 0 C 5.26 (ha 0 C 0 C 0 C 5.26 (ha 0 C 0 C 0 C 0 C 0 C 0 C 0 C 0 C 0 C 0 C	PRAGE m.) .1290 .1290 .0000 R.V. (mm) 54.81 47.05	
(11) TIME STEP (DT THAN THE STOR (iii) PEAK FLOW DOE ADD HYD (0003) 1 + 2 = 3 ID1= 1 (0103): + ID2= 2 (0108): ====================================	ARE (haGE COEH S NOT IN (ha 2.5 0.5 0.5 0.000 IN 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.00000 0.00000 0.00000 0.000000	Description State State Qi VCLUDE V State Qi	ALLER OI F. BASEFLOU PEAK cms) 654 084 BASEFLOU BASEFLOU 084 FF DRAGE a.m.) 0000 .0230 .0460 QPEAI (cms) 0.1 CTION [QC FLOW USED 	R EQUAL W IF ANY. TPEAK (hrs) 1.33 56 1.33 45 1.33 54 WS IF ANY. OUTFLOW OUTFLOW Ccms) 0.038(0.048(0.	R.V. (mm) 5.72 5.26 4.81 4.81 4.81 5.14 5.26 (ha 0 C 0 C 0 C 5.26 (ha 0 C 0 C 20 5.26 (ha 1.81 5.26 (ha 0 C 20 5.26 (ha 20 (ha (ha 20 (ha 20 (ha 20 (ha (ha 20 (ha (ha (ha (ha (ha (ha (ha (ha (ha (ha	PRAGE m.) .1290 .1290 .0000 R.V. (mm) 54.81 47.05	

Average Sl Length Mannings r	rea (ha) = .ge (mm) = .ope (%) = (m) =	IMPERVIOUS 0.18 1.00 1.00 42.43 0.013	PERVIOUS (i) 0.09 1.50 2.00 40.00 0.250	
NOTE:	RAINFALL WAS	S TRANSFORMED TO	5.0 MIN. T	IME STEP.
	TIME RA: hrs mm/l 0.083 4. 0.167 4. 0.250 5. 0.333 5.4 0.417 6.4 0.500 6.4 0.583 7.2 0.667 7.5 0.667 7.5 0.750 10.5 0.833 10.5 0.917 16.1	TRANSFOR IN TIME RAI IN hrs mm/h 74 1.083 37.6 74 1.167 37.6 74 1.250 133.7 44 1.233 133.7 43 1.417 48.9 43 1.500 48.9 53 1.667 26.4 53 1.667 26.4 51 1.750 18.2 51 1.833 18.2 56 1.917 13.9 56 2.000 13.9 57 1.833 18.2 58 1.917 13.9 59 1.917 13.9 50 2.000 13.9 50 1.917 13.9 50 2.000 13.9 50 1.917 13.9 51 1.917	RMED HYETOGRA: IN ' TIME hrs 54 2.083 54 2.083 54 2.167 78 2.250 78 2.250 78 2.533 90 2.417 90 2.583 14 2.667 20 2.750 20 2.750 20 2.917 96 3.000	PH RAIN TIME RAIN mm/hr hrs mm/hr 11.39 3.08 5.65 11.39 3.17 5.65 9.65 3.25 5.25 9.65 3.33 5.25 8.41 3.42 4.90 8.41 3.50 4.90 7.47 3.58 4.60 7.47 3.67 4.60 6.73 3.75 4.34 6.14 3.92 4.10 6.14 4.00 4.10
Max.Eff.In Storage Co Unit Hyd. Unit Hyd.	ten.(mm/hr)= over (min) eeff. (min)= Tpeak (min)= peak (cms)=	133.78 5.00 1.36 (ii) 5.00 0.33	76.26 10.00 6.26 (ii) 10.00 0.15	
PEAK FLOW TIME TO PE RUNOFF VOI TOTAL RAIN RUNOFF COE	(cms) = AK (hrs) = UME (mm) = FALL (mm) =	0.07 1.33 67.11 68.11 0.99	0.02 1.42 39.82 68.11 0.58	*TOTALS* 0.079 (iii) 1.33 57.54 68.11 0.84
(ii) TIME THAN (iii) PEAK	STEP (DT) SH THE STORAGE FLOW DOES NO 	COEFFICIENT. DT INCLUDE BASEFI	OR EQUAL	
IN= 2> 001 DT= 5.0 min		TFLOW STORAGE cms) (ha.m.) .0000 0.0000	OUTFLOW (cms) 0.0090	STORAGE (ha.m.) 0.0120
	- 2 (0105)	AREA QPE (ha) (cm 0.270 (EAK TPEAK ns) (hrs) 0.079 1.3	R.V. (mm) 33 57.54
INFLOW : ID= OUTFLOW: ID=	1 (1005)	0.270 (2.2	25 56.32
INFLOW : ID= OUTFLOW: ID=	PEAK FI TIME SHII MAXIMUM	LOW REDUCTION (FT OF PEAK FLOW STORAGE USED).008 2.: [Qout/Qin](%): (min): (ha.m.):	= 9.64 = 55.00 = 0.0101
INFLOW : ID= OUTFLOW: ID= CALIB STANDHYD (0 ID= 1 DT= 5.0	2 (0105) 2 1 (1005) PEAK FI TIME SHIN MAXIMUM 107) Area min Total	(ha) = 1.81 (ha) = 65.00).008 2.: [Qout/Qin](%): (min): (ha.m.): 	<pre>25 56.32 = 9.64 = 55.00 = 0.0101</pre>
INFLOW : ID= OUTFLOW: ID= (CALIB STANDHYD (0 ID= 1 DT= 5.0 Surface Ar Dep. Stora Average S1 Length Mannings m	PEAK FI TIME SHI MAXIMUM 107) Area min Tota ea (ha)= ge (mm)= ope (%)= (m)=	(ha) = 1.81 (ha) = 1.81 (ha) = 65.00 (ha) = 1.81 (ha) = 65.00 (ha) = 65.00 (ha) = 1.81 (ha) = 0.01 (ha) = 0.00 (ha) = 0.00 (ha	<pre>).008 2.: [Qout/Qin](%): (min): (ha.m.): Dir. Conn. PERVIOUS (i) 0.63 1.50 2.00 40.00 0.250</pre>	<pre>25 56.32 = 9.64 = 55.00 = 0.0101 (%) = 50.00</pre>

0.250 0.333 0.417 0.500 0.583 0.667 0.750 0.833 0.917 1.000	5.44 5.44 6.43 7.93 7.93 10.51 16.06 16.06	1.250 1.333 1.417 1.500 1.583 1.667 1.750 1.833 1.917 2.000	133.78 133.78 48.90 26.44 26.44 18.20 18.20 13.96 13.96	2.250 2.333 2.417 2.500 2.583 2.667 2.750 2.833 2.917 3.000	$\begin{array}{cccc} 9.65 & \\ 9.65 & \\ 8.41 & \\ 8.41 & \\ 7.47 & \\ 7.47 & \\ 6.73 & \\ 6.73 & \\ 6.14 & \\ 6.14 & \end{array}$	3.25 3.33 3.42 3.50 3.58 3.67 3.75 3.83 3.92 4.00	5.25 5.25 4.90 4.60 4.60 4.34 4.34 4.10 4.10
Max.Eff.Inten.(mr over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak	n/hr) = (min) (min) = (min) = (cms) =	133.78 5.00 2.41 5.00 0.30	1 (ii)	29.26 10.00 8.77 (ii) 10.00 0.12			
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICIEN	(cms) = (hrs) = (mm) = (mm) = JT =	0.33 1.33 67.11 68.11 0.99		0.16 1.42 45.68 68.11 0.67	*TOT 0. 1 56 68 0	ALS* 465 (iii) .33 .39 .11 .83	
***** WARNING: STORAGE	E COEFF. IS	SMALLE	R THAN	TIME STEP!			
(i) CN PROCEDUH CN* = 85 (ii) TIME STEP THAN THE S7 (iii) PEAK FLOW I	RE SELECTED 5.0 Ia = (DT) SHOULD FORAGE COEF DOES NOT IN(FOR PE Dep. S BE SMA FICIENT CLUDE B	RVIOUS torage LLER OF ASEFLOW	LOSSES: (Above) R EQUAL N IF ANY.			
RESERVOIR(2000) IN= 2> OUT= 1 DT= 5.0 min	OVERFLO OUTFLOW (cms) 0.0000	W IS OF STO (ha 0.	F RAGE .m.) 0000	OUTFLOW (cms) 0.0630	STO (ha 0	PRAGE m.) .0620	
INFLOW : ID= 2 ((OUTFLOW: ID= 1 (2 PEA TIN MAX	2000) AK FLOW ME SHIFT OF KIMUM STOR	1.810 1.810 REDUCT PEAK F AGE U	ION [Qc SED	(min) (ha.m.)	33 08 = 13.42 = 45.00 = 0.06	56.39 56.26	
CALIB STANDHYD (0104) ID= 1 DT= 5.0 min	Area (1 Total Imp	ha)= (%)= 6	0.65 5.00	Dir. Conn.	(%)= 6	5.00	
Surface Area Dep. Storage Average Slope Length Mannings n	IM: (ha) = (mm) = (%) = (m) = =	PERVIOU 0.42 1.00 1.00 65.83 0.013	S PE	CRVIOUS (i) 0.23 1.50 2.00 40.00 0.250			
NOTE: RAINF?	ALL WAS TRAD	NSFORME	D TO	5.0 MIN. T	IME STE	P.	
TIME hrs 0.083 0.167 0.250 0.333 0.417 0.500 0.583 0.667 0.750 0.833 0.917 1.000	RAIN 4.74 4.74 5.44 5.44 6.43 6.43 7.93 7.93 10.51 10.51 16.06	TIME hrs 1.083 1.167 1.250 1.333 1.417 1.500 1.583 1.667 1.750 1.833 1.917 2.000	NSFORME RAIN mm/hr 37.64 133.78 133.78 48.90 26.44 26.44 18.20 18.20 13.96 13.96	D HYETOGRA ' TIME ' hrs 2.083 2.167 2.250 2.333 2.417 2.500 2.583 2.667 2.750 2.833 2.917 3.000	PH RAIN mm/hr 11.39 9.65 9.65 8.41 8.41 7.47 6.73 6.73 6.14 6.14	TIME hrs 3.08 3.17 3.25 3.33 3.42 3.50 3.58 3.67 3.75 3.83 3.92 4.00	RAIN mm/h1 5.65 5.25 5.25 4.90 4.90 4.60 4.60 4.60 4.34 4.34 4.10
1.000				, 0.000	~ • ± •		

Unit Hyd. peak PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICI ***** WARNING: STORA (i) CN PROCEL CN* = (ii) TIME STEF THAN THE (iii) PEAK FLOW	<pre>(cms) = (cms) = (hrs) = (mm) = (mm) = ENT = GE COEFF. I URE SELECTE 85.0 Ia (DT) SHOUL STORAGE COE DOES NOT I</pre>	0.32 0.16 1.33 67.11 68.11 0.99 S SMALLER TH D FOR PERVIO = Dep. Stora D BE SMALLER FFICIENT. NCLUDE BASEF	0.14 0.04 1.42 39.82 68.11 0.58 AN TIME STEP US LOSSES: ge (Above) OR EQUAL LOW IF ANY.	*TOTALS* 0.188 (iii) 1.33 57.55 68.11 0.84	
ADD HYD (0002) 1 + 2 = 3 ID1= 1 (01 + ID2= 2 (20 ID = 3 (00 NOTE: PEAK FLC	AR (h 04): 0. 00): 1. =====020 02): 2. WS DO NOT I	EA QPEAK a) (cms) 65 0.188 81 0.062 46 0.218 NCLUDE BASEF	TPEAK (hrs) 1.33 5 2.08 5 1.33 5 LOWS IF ANY.	R.V. (mm) 7.55 6.26 ===== 6.60	
RESERVOIR(1000) IN= 2> OUT= 1 DT= 5.0 min INFLOW : ID= 2 (OUTFLOW: ID= 1 (F T	OVERFL OUTFLO (cms) 0.000 1000) EAK FLOW IME SHIFT O AXIMUM STO	OW IS OFF W STORAGE (ha.m.) 0 0.0000 AREA QP (ha) (c 2.460 2.460 REDUCTION F PEAK FLOW RAGE USED	OUTFLC (cms) 0.086 EAK TPEA ms) (hrs 0.218 1 0.085 2 [Qout/Qin](% (min (ha.m.	W STORAGE (ha.m.) 0 0.0220 K R.V.) (mm) .33 56.60 .08 56.58 c) = 38.93 c) = 45.00) = 0.0218	
CALIB STANDHYD (0112) ID= 1 DT= 5.0 min Surface Area Dep. Storage Average Slope Length Mannings n NOTE: RAIN	Area Total Im (ha) = (mm) = (%) = (m) = = FALL WAS TR	(ha) = 0.34 p(%) = 65.00 MPERVIOUS 0.22 1.00 1.00 47.61 0.013 ANSFORMED TO	Dir. Conn PERVIOUS (i 0.12 1.50 2.00 40.00 0.250 5.0 MIN.	(%) = 50.00 .) TIME STEP.	
TIM hr 0.08 0.16 0.25 0.33 0.41 0.50 0.58 0.66 0.75 0.83 0.91 1.00	E RAIN s mm/hr 3 4.74 7 4.74 0 5.44 3 5.44 7 6.43 3 7.93 7 7.93 7 7.93 10.51 3 10.51 7 16.06 0 16.06	TIME RA hrs mm/ 1.083 37. 1.167 37. 1.250 133. 1.333 133. 1.417 48. 1.500 48. 1.583 26. 1.667 26. 1.750 18. 1.833 18. 1.917 13. 2.000 13.	RMED HYETOGR IN ' TIME hrs ' hrs 64 2.083 64 2.167 78 2.250 78 2.333 90 2.417 90 2.583 44 2.667 20 2.750 20 2.750 20 2.917 96 3.000	APH RAIN TIME mm/hr hrs 11.39 3.08 11.39 3.17 9.65 3.25 9.65 3.33 8.41 3.42 8.41 3.50 7.47 3.58 7.47 3.67 6.73 3.75 6.73 3.83 6.14 3.92 6.14 4.00	RAIN mm/hr 5.65 5.25 5.25 4.90 4.60 4.60 4.60 4.60 4.34 4.34 4.10 4.10
Max.Eff.Inten.(over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak PEAK FLOW	<pre>mm/hr) = (min) (min) = (min) = (cms) = (cms) =</pre>	133.78 5.00 1.46 (ii) 5.00 0.33 0.06	129.26 10.00 7.83 (ii 10.00 0.13 0.03) *TOTALS* 0.090 (iii)	

TIME TO PEAK	(hrs) =	1.33	1.42	1.33
RUNOFF VOLUME	(mm) =	67.11	45.68	56.39
TOTAL RAINFALL	(mm) =	68.11	68.11	68.11
RUNOFF COEFFICI	ENT =	0.99	0.67	0.83

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

 (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
 (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(1007)	OVERFL	OW IS OFF			
IN= 2> OUT= 1 DT= 5.0 min	OUTFLO (cms) 0.000 0.008	W STORAG (ha.m. 0 0.000 0 0.013	E OUTFLOW) (cms) 0 0.0110 0 0.0000	<pre>N STORAGE (ha.m.) 0 0.0130 0 0.00000</pre>	
INFLOW : ID= 2 (OUTFLOW: ID= 1 (0112) 1007)	AREA Q (ha) (0.340 0.340	PEAK TPEAR cms) (hrs) 0.090 1. 0.008 2.	R.V. (mm) .33 56.39 .50 55.19	
E T N	PEAK FLOW TIME SHIFT O MAXIMUM STO	REDUCTION F PEAK FLOW RAGE USED	[Qout/Qin](%) (min) (ha.m.)	= 8.91 = 70.00 = 0.0130	
CALIB STANDHYD (0109) ID= 1 DT= 5.0 min	Area Total Im	(ha)= 0.5 p(%)= 65.0	7 0 Dir. Conn.	.(%)= 50.00	
Surface Area Dep. Storage Average Slope Length Mannings n	I (ha) = (mm) = (%) = (m) = =	MPERVIOUS 0.37 1.00 1.00 61.64 0.013	PERVIOUS (i) 0.20 1.50 2.00 40.00 0.250		
NOTE: RAIN	IFALL WAS TR	ANSFORMED T	0 5.0 MIN. 1	TIME STEP.	
TIN hr 0.02 0.33 0.41 0.55 0.56 0.66 0.66 0.65 0.66 0.65 0.66 0.65 0.66 0.65 0.66 0.65 0.65	ME RAIN I cs mm/hr I 33 4.74 I 57 4.74 I 50 5.44 I 53 5.44 I 53 5.43 I 53 7.93 I 56 10.51 I 33 10.51 I 57 16.06 I	TIME R hrs mm 1.083 37 1.167 37 1.250 133 1.333 133 1.417 48 1.500 48 1.583 26 1.667 26 1.750 18 1.833 18 1.917 13 2.000 13	ORMED HYETOGRA AIN ' TIME /hr ' hrs .64 2.083 .64 2.167 .78 2.333 .90 2.417 .90 2.500 .44 2.583 .44 2.667 .20 2.750 .20 2.833 .96 2.917 .96 3.000	APH RAIN TIME mm/hr hrs 11.39 3.08 11.39 3.17 9.65 3.25 9.65 3.25 9.65 3.33 8.41 3.42 8.41 3.50 7.47 3.58 7.47 3.67 6.73 3.75 6.73 3.83 6.14 4.00	RAIN mm/hr 5.65 5.25 5.25 4.90 4.90 4.60 4.60 4.34 4.34 4.10 4.10
Max.Eff.Inten. over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak	<pre>(mm/hr) = (min) (min) = (min) = (cms) =</pre>	133.78 5.00 1.70 (ii 5.00 0.32	129.26 10.00) 8.07 (ii) 10.00 0.13	*#0#318*	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICI	(cms) = (hrs) = (mm) = (mm) = TENT =	0.11 1.33 67.11 68.11 0.99	0.05 1.42 45.68 68.11 0.67	0.149 (iii) 1.33 56.39 68.11 0.83	
***** WARNING: STORA	AGE COEFF. I	S SMALLER T	HAN TIME STEP!		
(i) CN PROCEI CN* =	URE SELECTE 85.0 Ia	D FOR PERVI = Dep. Stor	OUS LOSSES: age (Above)		

(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.

(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(1002)	OVERFLO	W IS OFF			
IN= 2> ODT= 1 DT= 5.0 min	OUTFLOW (cms) 0.0000 0.0120	STORAGE (ha.m.) 0.0000 0.0220	OUTFLOW (cms) 0.0190 0.0000	STORAGE (ha.m.) 0.0220 0.0000	
INFLOW : ID= 2 (OUTFLOW: ID= 1 (0109) 1002)	AREA QPEAI (ha) (cms) 0.570 0.1 0.570 0.1	K TPEAK (hrs) 149 1.33 016 2.25	R.V. (mm) 3 56.39 5 55.58	
98 TI M#	AK FLOW ME SHIFT OF XIMUM STOR.	REDUCTION [Q PEAK FLOW AGE USED	<pre>put/Qin](%) = (min) = (ha.m.) =</pre>	10.79 55.00 0.0220	
CALIB STANDHYD (0115) ID= 1 DT= 5.0 min	Area (Total Imp	ha)= 0.86 (%)= 75.00	Dir. Conn.(<pre>≥) = 75.00</pre>	
Surface Area Dep. Storage Average Slope Length Mannings n	IM (ha) = (mm) = (%) = (m) = =	PERVIOUS PI 0.65 1.00 1.00 75.72 0.013	ERVIOUS (i) 0.22 1.50 2.00 40.00 0.250		
NOTE: RAINE	ALL WAS TRA	NSFORMED TO	5.0 MIN. TIN	ME STEP.	
TIME	RAIN	TRANSFORM TIME RAIN	ED HYETOGRAPH	H RAIN TIME	RAIN
0.083 0.167 0.250 0.333 0.417 0.500 0.583 0.667 0.750	mm/hr 4.74 5.44 5.44 6.43 6.43 7.93 7.93 10.51	nrs mm/nr 1.083 37.64 1.250 133.78 1.333 133.78 1.417 48.90 1.500 48.90 1.583 26.44 1.667 26.44 1.750 18.20	2.083 12 2.167 12 2.250 9 2.333 9 2.417 8 2.500 8 2.583 12 2.667 12	mm/nr nrs 1.39 3.08 1.39 3.17 9.65 3.25 9.65 3.33 3.41 3.42 3.41 3.50 7.47 3.58 7.47 3.67 7.73 3.75	mm/nr 5.65 5.25 5.25 4.90 4.90 4.60 4.60 4.34
0.833 0.917 1.000	10.51 16.06 16.06	1.83318.201.91713.962.00013.96	2.833 (2.917 (3.000 (6.73 3.83 6.14 3.92 6.14 4.00	4.34 4.10 4.10
Max.Eff.Inten.(m over Storage Coeff. Unit Hyd. Tpeak Unit Hyd. peak	<pre>m/hr) = (min) (min) = (min) = (cms) =</pre>	133.78 5.00 1.92 (ii) 5.00 0.31	76.26 10.00 5.97 (ii) 10.00 0.15	+=0=31.0+	
PEAK FLOW TIME TO PEAK RUNOFF VOLUME TOTAL RAINFALL RUNOFF COEFFICIE	(cms) = (hrs) = (mm) = (mm) = NT =	0.24 1.33 67.11 68.11 0.99	0.04 1.42 39.82 68.11 0.58	0.270 (iii) 1.33 60.28 68.11 0.89	
***** WARNING: STORAG	E COEFF. IS	SMALLER THAN	TIME STEP!		
 (i) CN PROCEDU CN* = 8 (ii) TIME STEP THAN THE 5 (iii) PEAK FLOW 	RE SELECTED 5.0 Ia = (DT) SHOULD TORAGE COEF DOES NOT IN	FOR PERVIOUS Dep. Storage BE SMALLER OI FICIENT. CLUDE BASEFLOU	LOSSES: (Above) R EQUAL W IF ANY.		
RESERVOIR (2001) IN= 2> OUT= 1 DT= 5.0 min	OVERFLO OUTFLOW (cms) 0.0000 0.0220	W IS OFF STORAGE (ha.m.) 0.0000 0.0350	OUTFLOW (cms) 0.0300 0.0000	STORAGE (ha.m.) 0.0350 0.0000	
INFLOW : ID= 2 (OUTFLOW: ID= 1 (0115) 2001)	AREA QPEA (ha) (cms 0.860 0.2 0.860 0.1	K TPEAK (hrs) 270 1.33 026 2.1	R.V. (mm) 3 60.28 7 59.82	
PE	AK FLOW	REDUCTION [Q	out/Qin](%)=	9.62	

TIME SHIF	T OF PEAK	FLOW	(min) =	50.00
MAXIMUM	STORAGE	USED	(ha.m.) =	0.0350

CALIB STANDHYD (0106) ID= 1 DT= 5.0 min	Area Total	(ha)= 0. Imp(%)= 65.	53 00 Dir. Conn.(%)=	55.00
Surface Area Dep. Storage	(ha) = (mm) =	IMPERVIOUS 0.34 1.00	PERVIOUS (i) 0.19 1.50	
Average Slope Length Mannings n	(%) = (m) = =	1.00 59.44 0.013	2.00 40.00 0.250	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

		TRA	NSFORMED HYETOGR	APH	
TIME	RAIN	TIME	RAIN ' TIME	RAIN TIME	RAIN
hrs	mm/hr	hrs	mm/hr ' hrs	mm/hr hrs	mm/hr
0.083	4.74	1.083	37.64 2.083	11.39 3.08	5.65
0.167	4.74	1.167	37.64 2.167	11.39 3.17	5.65
0.250	5.44	1.250	133.78 2.250	9.65 3.25	5.25
0.333	5.44	1.333	133.78 2.333	9.65 3.33	5.25
0.417	6.43	1.417	48.90 2.417	8.41 3.42	4.90
0.500	6.43	1.500	48.90 2.500	8.41 3.50	4.90
0.583	7.93	1.583	26.44 2.583	7.47 3.58	4.60
0.667	7.93	1.667	26.44 2.667	7.47 3.67	4.60
0.750	10.51	1.750	18.20 2.750	6.73 3.75	4.34
0.833	10.51	1.833	18.20 2.833	6.73 3.83	4.34
0.917	16.06	1.917	13.96 2.917	6.14 3.92	4.10
1.000	16.06	2.000	13.96 3.000	6.14 4.00	4.10
Max.Eff.Inten.(m	m/hr)=	133.78	111.09		
over	(min)	5.00	10.00		
Storage Coeff.	(min)=	1.66	(ii) 8.43 (ii)	
Unit Hyd. Tpeak	(min) =	5.00	10.00		
Unit Hyd. peak	(cms) =	0.32	0.12		
				TOTALS	
PEAK FLOW	(cms) =	0.11	0.04	0.142 (iii)	
TIME TO PEAK	(hrs)=	1.33	1.42	1.33	
RUNOFF VOLUME	(mm) =	67.11	44.02	56.71	
TOTAL RAINFALL	(mm) =	68.11	68.11	68.11	
RUNOFF COEFFICIE	INT =	0.99	0.65	0.83	

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above)
 (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

ADD	ΗY	ĽD	((000	4)					
1	+	2	=	(3	1		AREA	QPEAK	TPEAK	R.V.
 								(ha)	(cms)	(hrs)	(mm)
		ID1	L=	1	(0106)	:	0.53	0.142	1.33	56.71
	+	ID2	2=	2	(2001)	:	0.86	0.026	2.17	59.82
		===			===		=====				
		ID	=	3	(0004)	:	1.39	0.154	1.33	58.63

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY. ----------

RESERVOIR(1004) OVERFLO	DW IS OFF			
IN= 2> OUT= 1					
DT= 5.0 min	OUTFLOW	V STORAGE	6	OUTFLOW	STORAGE
	(cms)	(ha.m.)		(cms)	(ha.m.)
	0.0000	0.0000)	0.0480	0.0190
		AREA OF	PEAK	TPEAK	RV
		(1) (1		(1	10.0.
		(na) (c	cms)	(nrs)	(mm)
INFLOW : ID= 2	(0004)	1.390	0.154	1.33	58.63
OUTFLOW: ID= 1	(1004)	1.390	0.043	2.00	58.57
	PEAK FLOW	REDUCTION	[Qout/	Qin](%)= 2	28.12
	TIME SHIFT OF	F PEAK FLOW		(min) = 4	40.00
	MAXIMUM STOP	RAGE USED		(ha.m.) =	0.0172

_____ _____ | CALIB STANDHYD (0114) | Area Area (ha)= 0.80 Total Imp(%)= 75.00 Dir. Conn.(%)= 75.00 |ID= 1 DT= 5.0 min | -----IMPERVIOUS PERVIOUS (i) 0.60 0.20 (ha) = Surface Area (mm) = 1.00 Dep. Storage 1.50 Average Slope (%)= 1.00 2.00 73.03 40.00 0.250 Length (m) = = Mannings n 0.013 NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP. ---- TRANSFORMED HYETOGRAPH ----RAIN | TIME RAIN | TIME TIME RAIN |' TIME mm/hr |' hrs RATN mm/hr | mm/hr | hrs mm/hr hrs hrs 0.083 5.65 0.167 3.17 5.65 0.250 5.44 | 1.250 133.78 | 2.250 9.65 | 3.25 5.25 5.44 | 1.333 133.78 | 2.333 6.43 | 1.417 48.90 | 2.417 0.333 9.65 | 3.33 5.25 0.417 8.41 | 3.42 4.90 3.50 0.500 6.43 | 1.500 48.90 | 2.500 8.41 | 4.90 0.583 7.93 | 1.583 26.44 | 2.583 7.47 | 3.58 4.60
 0.667
 7.93
 1.667
 26.44
 2.667

 0.750
 10.51
 1.750
 18.20
 2.750

 0.833
 10.51
 1.833
 18.20
 2.833

 0.917
 16.06
 1.917
 13.96
 2.917

 1.000
 16.06
 2.000
 13.96
 3.000
 7.47 | 3.67 3.75 4.60 6.73 | 4.34 6.73 I 3.83 4.34 6.14 3.92 4.10 6.14 | 4.00 4.10
 133.78
 76.26

 5.00
 10.00

 1.88
 (ii)
 5.93

 5.00
 10.00

 0.32
 0.15
 Max.Eff.Inten.(mm/hr)= over (min) Storage Coeff. (min) = Unit Hyd. Tpeak (min) = 5.93 (ii) Unit Hyd. peak (cms) = *TOTALS* 0.22 1.33 67.11 68.11 0 00 0.03 1.42 39.82 68.11 0.58 PEAK FLOW (cms) = 0.251 (iii) TIME TO PEAK (hrs) =TIME TO PEAK (hrs)= RUNOFF VOLUME (mm)= TOTAL RAINFALL (mm)= 1.33 60.28 68.11 RUNOFF COEFFICIENT = 0.89 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP! (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES: CN* = 85.0 Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT. (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY. _____ ------| RESERVOIR(1008)| OVERFLOW IS OFF | IN= 2---> OUT= 1 |
 DUTFLOW
 STORAGE
 |
 OUTFLOW
 STORAGE

 (cms)
 (ha.m.)
 |
 (cms)
 (ha.m.)

 0.0000
 0.0000
 |
 0.0280
 0.0340

 0.0190
 0.0340
 |
 0.0000
 0.0000
 DT= 5.0 min OUTFLOW _____ (cms)
 AREA
 QPEAK
 TPEAK

 (ha)
 (cms)
 (hrs)

 0.800
 0.251
 1.33

 0.800
 0.019
 2.42
 R.V. (mm) 60.2 INFLOW : ID= 2 (0114) OUTFLOW: ID= 1 (1008) 60.28 59.72 _____ _____ L CALTB 1 Area (ha)= 0.68 Total Imp(%)= 75.00 Dir. Conn.(%)= 75.00 | STANDHYD (0113) | |ID= 1 DT= 5.0 min | IMPERVIOUS PERVIOUS (i) (ha) = 0.51 0.17 1.00 1.50 Surface Area Dep. Storage (mm) =Average Slope (%)= 1.00 2.00 40.00 0.250 Length (m) = 67.33 0.013 Mannings n = NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

		TRA	ANSFORME	D HYETOGRA	PH		
TIME	RAIN	TIME	RAIN	' TIME	RAIN	TIME	RAIN
hrs	mm/hr	hrs	mm/hr	' hrs	mm/hr	hrs	mm/hr
0.083	4.74	1.083	37.64	2.083	11.39	3.08	5.65
0.167	4.74	1.167	37.64	2.167	11.39	3.17	5.65
0.250	5.44	1.250	133.78	2.250	9.65	3.25	5.25
0.333	5.44	1.333	133.78	2.333	9.65	3.33	5.25
0.417	6.43	1.417	48.90	2.417	8.41	3.42	4.90
0.500	6.43	1.500	48.90	2.500	8.41	3.50	4.90
0.583	7.93	1.583	26.44	2.583	7.47	3.58	4.60
0.667	7.93	1.667	26.44	2.667	7.47	3.67	4.60
0.750	10.51	1.750	18.20	2.750	6.73	3.75	4.34
0.833	10.51	1.833	18.20	2.833	6.73	3.83	4.34
0.917	16.06	1.917	13.96	2.917	6.14	3.92	4.10
1.000	16.06	2.000	13.96	3.000	6.14	4.00	4.10
Max.Eff.Inten.(mr	n/hr)=	133.78		76.26			
over	(min)	5.00		10.00			
Storage Coeff.	(min) =	1.79	(ii)	5.84 (ii)			
Unit Hyd. Tpeak	(min) =	5.00	. ,	10.00			
Unit Hyd. peak	(cms) =	0.32		0.15			
					TOTAI	S	
PEAK FLOW	(cms) =	0.19		0.03	0.21	.4 (iii)	
TIME TO PEAK	(hrs) =	1.33		1.42	1.3	33	
DINOFE VOLUME	(mm) -	67 11		30 02	60 3	0	

RUNOFI
 39.82
 60.28

 68.11
 68.11

 0.58
 0.89
 NONOFF VOLUME(mm) =67.11TOTAL RAINFALL(mm) =68.11RUNOFF COEFFICIENT=0.99

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

Max

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
- $CN^* = 85.0$ Ia = Dep. Storage (Above) (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL THAN THE STORAGE COEFFICIENT.
- (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

RESERVOIR(1003)	OVERFLOW IS O	FF		
IN= 2> OUT= 1				
DT= 5.0 min	OUTFLOW ST	ORAGE	OUTFLOW	STORAGE
	(cms) (h	a.m.)	(cms)	(ha.m.)
	0.0000 0	.0000	0.0230	0.0280
	0.0190 0	.0280	0.0000	0.0000
	AREA	QPEAK	TPEAK	R.V.
	(ha)	(cms)	(hrs)	(mm)
INFLOW : ID= 2 (0	0.680	0.214	1.33	60.28
OUTFLOW: ID= 1 (1	003) 0.680	0.019	2.25	59.74
		TON CONT	(o;=1(8)= 0	<u> </u>

PEAKFLOWREDUCTION[Qout/Qin](%) =8.68TIME SHIFT OF PEAK FLOW(min) =55.00MAXIMUMSTORAGEUSED(ha.m.) =0.0274

_____ | CALIB | STANDHYD (0111)| |ID= 1 DT= 5.0 min | Area (ha)= 0.58 Total Imp(%)= 65.00 Dir. Conn.(%)= 50.00 Area _____

		IMPERVIOUS	PERVIOUS (1)
Surface Area	(ha) =	0.38	0.20
Dep. Storage	(mm) =	1.00	1.50
Average Slope	(%)=	1.00	2.00
Length	(m) =	62.18	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----RAIN |' TIME mm/hr |' hrs RAIN | TIME mm/hr | hrs TIME RAIN | TIME RAIN hrs mm/hr | hrs mm/hr 0.083 4.74 | 1.083 37.64 | 2.083 11.39 | 3.08 5.65 3.17 3.25 3.33 0.167 11.39 | 5.65 0.250 9.65 i 5.25 0.333 9.65 | 5.25 0.417 8.41 3.42 4.90 0.500 6.43 | 1.500 48.90 | 2.500 8.41 | 3.50 4.90 0.583 7.93 1.583 26.44 2.583 0.667 7.93 1.667 26.44 2.667 0.750 10.51 1.750 18.20 2.750 26.44 | 2.583 7.47 | 3.58 4.60 7.47 | 3.67 6.73 | 3.75 4.60 4.34
0.917 16.0 1.000 16.0	1 1.83 6 1.91 6 2.00	33 18.20 17 13.96 10 13.96	0 2.833 5 2.91 5 3.000	3 6.7 7 6.1 0 6.1	3 3.83 4 3.92 4 4.00	4.34 4.10 4.10
<pre>Max.Eff.Inten.(mm/hr)=</pre>	133. 5. 1. 5. 0.	.78 .00 .71 (ii) .00 .32	129.26 10.00 8.08 10.00 0.13	(ii) *		
PEAK FLOW (cms) = TIME TO PEAK (hrs) = RUNOFF VOLUME (mm) = TOTAL RAINFALL (mm) = RUNOFF COEFFICIENT =	0. 1. 67. 68. 0.	11 33 11 11 .99	0.05 1.42 45.68 68.11 0.67		0.152 (iii) 1.33 56.39 68.11 0.83	
***** WARNING: STORAGE COEFF	. IS SMA	ALLER THAN	N TIME S'	TEP!		
 (i) CN PROCEDURE SELE CN* = 85.0 (ii) TIME STEP (DT) SH THAN THE STORAGE (iii) PEAK FLOW DOES NO 	CTED FOF Ia = Dep OULD BE COEFFICI T INCLUE	R PERVIOUS Storage SMALLER (EENT. DE BASEFLO	S LOSSES e (Above DR EQUAL DW IF AN	: e) Y.		
RESERVOIR(1006) OVE IN= 2> OUT= 1	RFLOW IS	S OFF				
DT= 5.0 min OUT (c 0. 0.	FLOW ms) 0000 0130	STORAGE (ha.m.) 0.0000 0.0230	OUT) (cr 0.0	FLOW ms) 0200 0000	STORAGE (ha.m.) 0.0230 0.0000	
	AREA (ha)	A QPEA (cms	AK T1 5) (1	PEAK hrs)	R.V. (mm)	
INFLOW : ID= 2 (0111) OUTFLOW: ID= 1 (1006)	0.58	30 0. 30 0.	.152 .013	1.33 2.58	56.39 55.63	
PEAK FL	OW RED	DUCTION [(Qout/Qin] (%) = 8	.38	
TIME SHIF MAXIMUM	T OF PEA STORAGE	AK FLOW USED	(r (ha	min)= 75 .m.)= 0	0.00 0.0225	
ADD HYD (0001) 1 + 2 = 3	AREA (ha)	QPEAK (cms)	TPEAK (hrs)	R.V. (mm)		
ADD HYD (0001) 1 + 2 = 3 ID1= 1 (1000): + ID2= 2 (1001):	AREA (ha) 2.46 3.00	QPEAK (cms) 0.085 0.038	TPEAK (hrs) 2.08 3.58	R.V. (mm) 56.58 47.05		
ADD HYD (0001) 1 + 2 = 3 ID1= 1 (1000): + ID2= 2 (1001): ID = 3 (0001):	AREA (ha) 2.46 3.00 ======= 5.46	QPEAK (cms) 0.085 0.038 0.121	TPEAK (hrs) 2.08 3.58 2.17	R.V. (mm) 56.58 47.05 51.34		
ADD HYD (0001) 1 + 2 = 3 	AREA (ha) 2.46 3.00 5.46 T INCLUE	QPEAK (cms) 0.085 0.038 0.121 DE BASEFL(TPEAK (hrs) 2.08 3.58 2.17 2.17	R.V. (mm) 56.58 47.05 ===== 51.34 NY.		
ADD HYD (0001) 1 + 2 = 3 ID1= 1 (1000): + ID2= 2 (1001): ID = 3 (0001): NOTE: PEAK FLOWS DO NO	AREA (ha) 2.46 3.00 5.46 T INCLUE	QPEAK (cms) 0.085 0.038 0.121 DE BASEFL(TPEAK (hrs) 2.08 3.58 2.17 DWS IF AN	R.V. (mm) 56.58 47.05 51.34 NY.		
ADD HYD (0001) 1 + 2 = 3 ID1= 1 (1000): + ID2= 2 (1001): ID = 3 (0001): NOTE: PEAK FLOWS DO NO	AREA (ha) 2.46 3.00 5.46 T INCLUE	QPEAK (cms) 0.085 0.038 0.121 DE BASEFLC	TPEAK (hrs) 2.08 3.58 2.17 DWS IF AN	R.V. (mm) 56.58 47.05 51.34 NY.		
ADD HYD (0001) 1 + 2 = 3 ID1= 1 (1000): + ID2= 2 (1001): ID = 3 (0001): NOTE: PEAK FLOWS DO NO	AREA (ha) 2.46 3.00 5.46 T INCLUE AREA (ha)	QPEAK (cms) 0.085 0.038 0.121 DE BASEFL(QPEAK (cms)	TPEAK (hrs) 2.08 3.58 2.17 DWS IF AI TPEAK (hrs)	R.V. (mm) 56.58 47.05 51.34 NY. R.V. (mm)		
ADD HYD (0001) 1 + 2 = 3 ID1= 1 (1000): + ID2= 2 (1001): ID = 3 (0001): NOTE: PEAK FLOWS DO NO 	AREA (ha) 2.46 3.00 5.46 T INCLUE AREA (ha) 5.46 0.57	QPEAK (cms) 0.085 0.121 DE BASEFLO QPEAK (cms) 0.121 0.121 0.016	TPEAK (hrs) 2.08 3.58 2.17 DWS IF AN TPEAK (hrs) 2.17 2.25	R.V. (mm) 56.58 47.05 51.34 NY. R.V. (mm) 51.34 55.58		
ADD HYD (0001) 1 + 2 = 3 ID1= 1 (1000): + ID2= 2 (1001): ID = 3 (0001): NOTE: PEAK FLOWS DO NO ADD HYD (0001) 3 + 2 = 1 ID1= 3 (0001): + ID2= 2 (1002): ID = 1 (0001):	AREA (ha) 2.46 3.00 5.46 T INCLUE AREA (ha) 5.46 0.57 6.03	QPEAK (cms) 0.085 0.121 DE BASEFLC QPEAK (cms) 0.121 0.016 0.137	TPEAK (hrs) 2.08 3.58 2.17 DWS IF AI TPEAK (hrs) 2.17 2.25 2.25	R.V. (mm) 56.58 47.05 51.34 NY. R.V. (mm) 51.34 55.58 51.74		
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<pre></pre>	AREA (ha) 2.46 3.00 5.46 T INCLUE AREA (ha) 5.46 0.57 	QPEAK (cms) 0.085 0.038 0.121 DE BASEFLC QPEAK (cms) 0.137 DE BASEFLC QPEAK (cms) 0.137	TPEAK (hrs) 2.08 3.58 2.17 DWS IF AI TPEAK (hrs) 2.25 DWS IF AI 2.25 TPEAK (hrs) 2.25	R.V. (mm) 56.58 47.05 51.34 NY. R.V. (mm) 51.34 55.58 51.74 NY. R.V. (mm) 51.74		
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<pre></pre>	AREA (ha) 2.46 3.00 5.46 T INCLUE AREA (ha) 5.46 0.57 6.03 T INCLUE AREA (ha) 6.03 0.68 6.71	QPEAK (cms) 0.085 0.038 0.121 DE BASEFLC QPEAK (cms) 0.1121 0.016 0.1137 DE BASEFLC QPEAK (cms) 0.137 0.137 0.137 0.137 0.135	TPEAK (hrs) 2.08 3.58 2.17 DWS IF AI TPEAK (hrs) 2.25 2.25 DWS IF AI TPEAK (hrs) 2.25 2.25 2.25 2.25	R.V. (mm) 56.58 47.05 51.34 NY. R.V. (mm) 51.34 55.58 51.74 NY. R.V. (mm) 51.74 59.74 52.55		
<pre></pre>	AREA (ha) 2.46 3.00 5.46 T INCLUE AREA (ha) 5.46 0.57 6.03 T INCLUE AREA (ha) 6.03 0.68 6.71 T INCLUE	QPEAK (cms) 0.085 0.121 DE BASEFLC QPEAK (cms) 0.121 0.016 0.137 DE BASEFLC QPEAK (cms) 0.137 0.137 0.137 0.137 0.155 DE BASEFLC	TPEAK (hrs) 2.08 3.58 2.17 DWS IF AI TPEAK (hrs) 2.17 2.25 2.25 DWS IF AI TPEAK (hrs) 2.25 2.25 DWS IF AI	R.V. (mm) 56.58 47.05 51.34 WY. R.V. (mm) 51.34 55.58 51.74 NY. R.V. (mm) 51.74 59.74 59.74		
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ID1= 3 (0001): + ID2= 2 (1004):	6.71 1.39	0.155 0.043	2.25 2.00	52.55 58.57	
ID = 1 (0001):	8.10	0.198	2.25	53.59	
NOTE: PEAK FLOWS DO	NOT INCLU	JDE BASEFI	OWS IF AN	WY.	
ADD HYD (0001) 1 + 2 = 3 ID1= 1 (0001): + ID2= 2 (1005):	AREA (ha) 8.10 0.27	QPEAK (cms) 0.198 0.008	TPEAK (hrs) 2.25 2.25	R.V. (mm) 53.59 56.32	
ID = 3 (0001):	8.37	0.206	2.25	53.67	
NOTE: PEAK FLOWS DO	NOT INCLU	JDE BASEFI	OWS IF AN	WY.	
ADD HYD (0001) 3 + 2 = 1 ID1= 3 (0001): + ID2= 2 (1006):	AREA (ha) 8.37 0.58	QPEAK (cms) 0.206 0.013	TPEAK (hrs) 2.25 2.58	R.V. (mm) 53.67 55.63	
ID = 1 (0001):	8.95	0.218	2.25	53.80	
NOTE: PEAK FLOWS DO	NOT INCLU	JDE BASEFI	OWS IF AN	WY.	
ADD HYD (0001) 1 + 2 = 3 ID1= 1 (0001): + ID2= 2 (1007):	AREA (ha) 8.95 0.34	QPEAK (cms) 0.218 0.008	TPEAK (hrs) 2.25 2.50	R.V. (mm) 53.80 55.19	
ID = 3 (0001):	9.29	0.226	2.25	53.85	
NOTE: PEAK FLOWS DO	NOT INCLU	JDE BASEFI	OWS IF AN	1Y.	
ADD HYD (0001) 3 + 2 = 1 ID1= 3 (0001): + ID2= 2 (1008):	AREA (ha) 9.29 0.80	QPEAK (cms) 0.226 0.019	TPEAK (hrs) 2.25 2.42	R.V. (mm) 53.85 59.72	
ID = 1 (0001):	10.09	0.245	2.25	54.32	
NOTE: PEAK FLOWS DO	NOT INCLU	JDE BASEFI	OWS IF AN	WY.	
ADD HYD (0001) 1 + 2 = 3 ID1= 1 (0001): + ID2= 2 (0110):	AREA (ha) 10.09 0.18	QPEAK (cms) 0.245 0.048	TPEAK (hrs) 2.25 1.33	R.V. (mm) 54.32 56.38	
ID = 3 (0001):	10.27	0.250	2.25	54.35	
NOTE: PEAK FLOWS DO	NOT INCLU	JDE BASEFI	OWS IF AN	WY.	





MEMO

Februar	y 10, 2023
File No.	221377
To:	Mark Bristoll
From:	Charles Groen
Re:	Willoughby Drive Development Preliminary Sanitary and Water Servicing Investigation Updated to Address City Comments Village of Chippawa, City of Niagara Falls

As requested, we have undertaken a preliminary sanitary and watermain servicing investigation for the proposed development located on the east side of Willoughby Drive in Niagara Falls, Ontario.

1.0 SITE DESCRIPTION

The 11.01ha development is located on the east side of Willoughby Drive between Cattell Drive and Weinbrenner Road which is currently undeveloped.

A preliminary concept plan, Development Concept 2, prepared by GSP Group has been provided for the site, refer to **Appendix A**. The concept plan includes the development of two 4-storey townhouse blocks, four 8 to 10-storey apartment blocks, one park block and two new municipal roads. The full buildout of the development includes 924 units.

2.0 SANITARY SERVICING

The following background information from the City of Niagara and Niagara Region was used to complete the assessment:

• Pre-construction meeting minutes.

ENGINEERING + MANAGEMENT P 905.709.5825 200 CACHET WOODS COURT, SUITE 204 MARKHAM, ON L6C 028 HUSSON.CA

- Plan and Profiles for: Banting Street, Bridgewater Street, Cattell Drive, Lyon's Creek Road, Main Street, Nassau Avenue, Sodom Street, Sophia Avenue, Southerland Court, Weinbrenner Road, and Welland Street.
- The latest City of Niagara Falls Sewer Design Criteria.
- Niagara Region 2016 Water and Wastewater Master Servicing Study.
- Niagara Region flow data from 2022 for the Low Lift Sewage Pumping Station

Based on the pre-consultation meeting minutes for the proposed development, a Functional Servicing Report would be required to review the impacts of the contribution from the proposed development on the existing sanitary sewer. Through correspondence with Josiah Jordan from the City, it was determined that a downstream sanitary sewer assessment would be required to confirm capacity for the proposed development. It was understood from the email on July 27, 2022 that the City did not have drainage modeling for the south side of Niagara Falls and that the drainage modeling would need to be completed through plan and profiles and design sheets based on City record information. Alternatively, GM BluePlan has a contract with the City to complete the downstream assessment at the cost of the developer (refer to the City standard fees for additional details).

Based on the depth of the existing sanitary sewers on Cattell Drive, Willoughby Drive and Weinbrenner Road and the estimated first floor elevations for the proposed buildings, we do not anticipate any concerns with providing gravity sewer connections for the proposed development.

2.1 Pre-development Downstream Sanitary Sewer Assessment

The area on the south side of Niagara Falls consists of a catchment area of approximately 520ha with a network of local City sanitary sewers that gravity drain to the Southside Low Lift Pumping Station; which is the Region pumping station for south Niagara Falls. The pumping station is located on the north side of the Welland River on the south side of Chippawa Parkway. Based on the Region Master Servicing Study there is capacity in the Southside Low Lift Pumping Station for forecasted growth up to 2041. The City requires an assessment to confirm capacity in the local sanitary sewers downstream of our development.

The pre-development downstream sanitary sewer drainage plan is provided in **Figure 1**. Based on our review of the existing sewers in south Niagara Falls, there are 5 separate gravity connections to the Region sewers connecting to the Southside Low Lift Pumping Station. The



Willoughby Drive development can either connect to the north-central (green boundary) or south-west (orange boundary) drainage areas which are included in the downstream sanitary sewer assessment/sanitary sewer design sheets. There are drainage areas in the centre of south Niagara Falls (blue boundary) and on the west side of Niagara Falls (red boundary) that have direct connections to a Region sewer and a drainage area on the north side of the Welland River (magenta boundary) that we have been advised by the City connects directly to the Southside Low Lift Pumping Station. These areas have not been included in the downstream sanitary sewer assessment.

The sanitary sewer analysis has been completed following the City's Sewer Design Criteria. The pre-development sanitary sewer design sheet is attached in **Appendix B**. Note that the Willoughby Drive development has been included in the north-central catchment area with a population density based on the current zoning. It was determined that there are sections of the existing sanitary sewer that are already over capacity.

In the north-central drainage area the existing sanitary sewer is over capacity (between 118 to 164% full) from the last downstream sewer on Willoughby Drive, on Gunning Drive from Willoughby Drive to the Chippawa Lions Park, in the easement through the park, and Sophia Avenue between the park and Bridgewater Street. This section of sewer is almost 1200m in length and is 375mm diameter sewer running at a slope of approximately 0.15%.

The south-west drainage area is only over capacity in the last length of the sanitary sewer on Lyon's Creek Road (approximately 150m in length) which is flowing at 240% full; a 375mm diameter sewer at a slope of 0.33%. The City provided comments which requested adding ~82ha with peaked flow of ~140L/s for other future developments in this drainage area; which accounts for the large increase to the flow since the first submission.

2.2 Post-development Downstream Sanitary Sewer Assessment

Two separate options were considered for the post-development scenarios:

- Option 1 Proposed development to connect to the existing sanitary sewers adjacent to the development. The majority of the site would drain to the North-Central drainage area and a small area would drain to the South-West drainage area.
- Option 2 The entire proposed development would connect to the South-West drainage area which has more capacity.



2.2.1 Post-Development Option 1

The post-development downstream sanitary sewer drainage plan – Option 1 (**Figure 2**) and corresponding sanitary sewer design sheet are attached in **Appendix C**. See **Table 1** below for a comparison of the sections of the existing sanitary sewer that were already over capacity prior to development in the pre- and post-development conditions. No additional sewers were over capacity as a result of the proposed development.

Street	МН	МН	Pre-Development	Post-Development	Increase		
	(From)	(TO)	(% Full)	Option 1 (% Full)	(% Full)		
Willoughby Dr.	MH13A	MH12A	118%	146%	28%		
Gunning Drive	MH12A	MH11A	122%	150%	28%		
Gunning Drive	MH11A	MH10A	122%	150%	28%		
Gunning Drive	MH10A	MH9A	126%	154%	28%		
Gunning Drive	MH9A	MH8A	134%	162%	28%		
Gunning Drive	MH8A	MH7A	135%	163%	28%		
Gunning Drive	MH7A	MH6A	138%	166%	28%		
Gunning Drive	MH6A	MH5A	139%	167%	28%		
Easement	MH5A	MH4A	159%	185%	26%		
Sophia Ave.	MH4A	МНЗА	164%	191%	27%		
Sophia Ave.	МНЗА	MH50A	164%	191%	27%		
Sophia Ave.	MH50A	MH49A	164%	191%	27%		
Lyon's Creek	MH23A	MH22A	240%	242%	2%		

Table 1. Comparison of Sanitary Sewers Over Capacity – Option 1

In the north-central drainage area the existing sanitary sewer is over capacity (between 146 to 191% full) from the last downstream sewer on Willoughby Drive, on Gunning Drive from Willoughby Drive to the park, in the easement through the park, and Sophia Avenue between the



park and Bridgewater Street. The increased density for the proposed development would result in an increase of 28% the capacity of the pipe; which is already over capacity.

The south-west drainage area has capacity except in the last length of the sanitary sewer on Lyon's Creek Road which is at 242% full. The increased density for the proposed development would result in an increase of 2% of the capacity of the pipe.

2.2.2 Post-development Option 2

The post-development downstream sanitary sewer drainage plan – Option 2 (**Figure 3**) and corresponding sanitary sewer design sheet is attached in **Appendix D**. See **Table 2** below for a comparison of the sections of the existing sanitary sewer that were already over capacity prior to development. No additional sewers were over capacity as a result of the proposed development.

Street	мн	мн	Pre-Development	Post-Development	Increase
	(From)	(TO)	(% Full)	Option 2 (% Full)	(% Full)
Willoughby Dr.	MH13A	MH12A	118%	101%	-17%
Gunning Drive	MH12A	MH11A	122%	105%	-17%
Gunning Drive	MH11A	MH10A	122%	105%	-17%
Gunning Drive	MH10A	MH9A	126%	109%	-17%
Gunning Drive	MH9A	MH8A	134%	117%	-17%
Gunning Drive	MH8A	MH7A	135%	118%	-17%
Gunning Drive	MH7A	MH6A	138%	121%	-17%
Gunning Drive	MH6A	MH5A	139%	123%	-16%
Easement	MH5A	MH4A	159%	143%	-16%
Sophia Ave.	MH4A	МНЗА	164%	147%	-17%
Sophia Ave.	МНЗА	MH50A	164%	147%	-17%

Table 2. Comparison of Sanitary Sewers Over Capacity – Option 2



Sophia Ave.	MH50A	MH49A	164%	147%	-17%
Lyon's Creek	MH23A	MH22A	240%	270%	30%

In the north-central drainage area the existing sanitary sewer is over capacity (between 101% to 147%) from the last downstream sewer on Willoughby Drive, on Gunning Drive from Willoughby Drive to the park, in the easement through the park, and Sophia Avenue between the park and Bridgewater Street. The exceedance of the pipe capacity is reduced as the majority of the proposed development had been included in the north-central drainage area in the predevelopment condition based on the zoning of the undeveloped property and this area is now transferred over to the south-west drainage area which has more capacity.

The south-west drainage area has capacity for the proposed development except in the last length of the sanitary sewer on Lyon's Creek Road which is at 270% full. Adding the proposed development to the south-west drainage area would result in an increase of 30% the capacity of the one downstream pipe; which is already over capacity. There is capacity in the rest of the sewers for the proposed development.

If should be noted that in order for the proposed development to connect to the south-west drainage boundary about 265m of sanitary sewer on Willoughby Drive would need to be reconstructed to flow south instead of north; alternatively, a municipal sewer could be routed through the site in an easement as well as upsizing approximately 220m of sewer on Weinbrenner Road on the east side of Willoughby Drive to 300mm diameter. The easement option is show on **Figure 3** for reference. The details for the sanitary sewer upgrades can be confirmed during the detailed design stage.

2.3 Considerations for Overcapacity Sanitary Sewers

Based on our review of the downstream assessments for both the north-central and south-west drainage areas there are existing sewers over capacity prior to development. In order to support the proposed development, there are a number of ways to confirm or improve capacity in the existing sewers, as noted below.

 a) Based on a review of the 2016 Niagara Region Master Servicing Study for the Southside Low Lift Pumping Station, the total equivalent population in 2016 was 11,684 for the 520ha on the south side of Niagara Falls with an existing design peak wet



weather flow of 233.3L/s (refer to Part F Niagara Falls Wastewater System, page 22 for reference). Based on the north-central and south-west drainage areas that have been assessed in the sanitary sewer design for the pre-development condition, the equivalent population was calculated to be 17,902 for the area of 245ha (about 50% of the contributing area to the pumping station and already 153% of the total population) with an existing average peak wet weather flow of 295.8L/s (already 127% more than the calculated flow to the pumping station). The analysis appears to be extremely conservative. It is understood that the Region Master Servicing Study is in the process of being updated which will not be available until next year at the earliest.

In addition, Niagara Region provided flow monitoring data for the Low Lift Sewage Pumping Station for 2022, refer to Appendix F.

b) It should be confirmed if the City has completed any flow monitoring on the existing sanitary sewer system to confirm the peak wet weather flows. If the monitoring data is available, it can be reviewed to confirm if the assessment is reasonable or whether the calculated flows are conservative. Alternatively, we have contacted the Region to confirm if any flow monitoring has been completed on the Region sewers upstream of the Southside Low Lift Pumping Station.

The City has confirmed that they do not have any flow monitoring. The Region provided flow monitoring data for the Low Lift Sewage Pumping Station for 2022, refer to Appendix F. The data shows the average monthly dry weather flows for the Low Lift catchment area were 20.41L/s to 57.60L/s with the maximum daily average flow of 259.33L/s. See attached Figure 5 in Appendix F showing the Low Lift Catchment Drainage Boundary for reference. No reduction was considered in the analysis in this memorandum; which should be very conservative.

c) Complete flow monitoring in key locations on the south side of Niagara Falls to confirm the existing peak wet weather flow in the City sewers.

Based on the email comments from Brian Kostuk on January 30, 2023 flow monitoring is not required by the City.



d) Complete a hydraulic gradeline analysis on the existing sanitary sewers to confirm what the impact is on the existing system due to the system being over capacity. If it can be determined that the hydraulic gradeline is sufficiently below existing basements, the sewer may be acceptable in its surcharged condition.

Refer to Section 2.4 for the hydraulic gradeline analysis based on Option 2; where the development flows are directed to the south-west drainage boundary.

e) Consider upgrades to the existing sanitary sewers. For the north-central drainage area the existing 1200m of 375mm diameter surcharged sanitary sewer would need to be replaced with a minimum of 525mm diameter sanitary sewer at an average slope of 0.15% (if proceeding with the Post-development Option 1). For the south-west drainage area, the final downstream 375mm diameter sanitary sewer would need to be replaced with a 450mm diameter sanitary sewer at 0.33%; although it might be better to replace with a 600mm diameter sanitary sewer to match the size of the existing pipe immediately upstream (if proceeding with the Post-development Option 2).

Based on the email comments from Brian Kostuk on January 30, 2023 upgrades to the final downstream sewers on Lyons Creek Road will not be required by the City as part of the proposed development.

2.4 Hydraulic Grade Line Analysis

Based on our discussions with the City, the surcharging of the downstream system may be acceptable if it does not adversely impact connected properties or the environment. Given the depths of the existing surcharged sewers, it is likely that the required level of protection is provided. A hydraulic grade line (HGL) analysis has been prepared using Autodesk Storm and Sanitary Analysis (SSA). SSA is a dynamic model which is better suited for assessing surcharged sewer systems compared to a static spreadsheet analysis.

The downstream sewer system was assessed to determine if the surcharging sewers would adversely impact connected properties or the environment. City Criteria was reviewed, and no specific level of protection is specified. To be conservative and to provide an added factor of safety, the minimum depth criteria for sanitary sewers will be used for the freeboard requirement. Based on City Criteria, this is 2.80m for residential areas and 2.15m for industrial areas.



The results of the analysis are summarized below on **Table 3**. Refer to **Appendix G** for the SSA modeling information.

МН	Downstream Invert (m)	MH Top Elevation (m)	Maximum HGL (m)	Freeboard Provided (m)
MH18A	170.02	175.31	172.25	3.06
MH23A	167.53	174.57	170.86	3.71
MH24A	167.80	175.30	171.04	4.26
MH25A	167.92	175.61	171.18	4.43
MH26A	168.17	175.37	171.35	4.02
MH27A	168.29	175.16	171.45	3.71
MH28A	168.49	175.72	171.54	4.18
MH29A	168.59	175.27	171.63	3.64
MH30A	168.79	175.21	171.71	3.50
MH31A	168.92	175.59	171.78	3.81
MH32A	169.07	175.40	171.86	3.54
MH33A	169.20	175.41	171.94	3.47
MH34A	169.32	175.36	171.97	3.39
MH35A	169.51	175.16	172.04	3.12
MH36A	169.70	175.51	172.11	3.40
MH37A	169.86	175.18	172.18	3.00

Table 3. Results of the Hydraulic Gradeline Analysis

As shown above, sufficient freeboard is provided and there is no risk of basement flooding. Therefore, the required level of protection is provided and no upgrades or improvements are



required. The existing downstream sewer system can accommodate the proposed development.

The hydraulic gradeline analysis was only completed for the Post-Development Option 2 scenario where the proposed development is directed to the south-west drainage area. Hydraulic gradeline analysis was not completed for the north-central drainage area which is also surcharged in the existing condition but we do not anticipate connecting to it with the proposed development.

3.0 WATERMAIN SERVICING

There is existing City watermain surrounding the proposed development. There is a 250mm diameter watermain on Cattell Drive, a 200mm diameter and 400mm diameter watermain on Willoughby Drive, and a 200mm diameter watermain on Weinbrenner Drive.

The existing watermain can be extended to and looped, if necessary, in order to service the proposed development. The details for the watermain extension can be confirmed during the detailed design stage.

A hydrant flow test was completed by L&D Waterworks on November 14, 2022 for the hydrant located in front of 8563 Willoughby Drive which is across the road from the proposed development, refer to **Appendix E** for information. The existing watermain had a residual static pressure of 90psi and theoretical minimum fire flow of 5,625GPM (21,300L/min). Based on the information in the hydrant flow test, there are no concerns regarding adequate water supply for the proposed development; however, a fire/booster pump may be required for the internal fire protection systems for the proposed townhouse and apartment blocks. This will need to be determined by the mechanical engineer at the detailed design stage.

4.0 CONCLUSION

Based on a review of the existing sanitary and watermain infrastructure available to service the proposed development, we provide the following:

• The existing sanitary sewers downstream of the proposed development are already over capacity. There are options to consider in order for the development to proceed



which will need to be confirmed with the City (eg. flow monitoring or hydraulic gradeline analysis to confirm if any upgrades are required). It is our recommendation to connect the proposed development to the south-west drainage area as there is more capacity available in the existing sewers and there is only one sewer at the downstream end that is over capacity. If upgrades to the existing sewer on Lyon's Creek Road is required, this may be partially, or completely funded through the City, as the sewer is already over capacity.

- As required by the City, a hydraulic gradeline analysis was completed for Post-Development Option 2 for the south-west drainage area and it was determined that sufficient freeboard is provided and there is no risk of basement flooding. Based on this analysis there is capacity in the existing sanitary sewers in the south-west drainage area to service the entire proposed development.
- Based on the hydrant flow test there appears to be sufficient pressure and fire flow in the municipal system to service the proposed development. This will need to be confirmed during the detailed design stage.

We trust this satisfies your requirements at this time. If you have any questions or require further information, please feel free to contact our office.





DEVELOPMENT CONCEPT 2

Willoughby Drive, Niagara Falls

NOTE: This concept should be considered as a preliminary demonstration model that illustrates an 'order of magnitude' development scenario for the site. The number of units, floor area and parking supply are approximate and subject to more detailed design as well as municipal planning approvals. Property boundary is approximate and subject to survey.

Meters

Scale 1:2,000 | December 3, 2020 | Project No.: 20282 | Drawn By: SL







Table 1	ARFA		POP
	(ha)	(P/ha)	(#)
R2	4.73	45.5	215.2
R4	2.30	96.4	221.7
TOTAL	7.03	62.1	436.9
Table 2	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1C	0.64	45.5	29.1
GC	0.65	180.4	117.3
TOTAL	1.29	113.5	146.4
Table 3	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1C	0.66	45.5	30.0
GC	0.39	180.4	70.4
TOTAL	1.05	95.6	100.4
Table 4	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1-2	57.05	45.5	2595.8
GC	0.15	180.4	27.1
TOTAL	57.20	45.9	2622.9
Table 5	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1C	0.37	45.5	16.8
1	0.27	96.4	26.0
TOTAL	0.64	66.9	42.8
Table 6		DENCITY	DUD
	AREA	(P/ha)	FUP (#)
R1C	293	45.5	1.3.3.3
R4	2.90 1.48	-5.5 96.4	142.7
TOTAL	4.41	62.6	276.0
		DENOITY	2.22
lable /	AREA	DENSITY	P0P
R1_R2	31.06	(F/IIU) 45.5	1413.2
R3-R4	1.17	40.0 96.4	112.8
I	1.74	96.4	167.7
GC	7.79	180.4	1405.3
TOTAL	41.76	74.2	3099.0
Table 8	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1-R2	19.02	45.5	865.4
	0.42	96.4	40.5
TUTAL	19.44	40.0	905.9
Table 9	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1-R2	15.06	45.5	685.2
R5D	1.29	163.1	210.4
1	0.35	96.4	33.7
TOTAL	16.70	55.7	929.3
Table 10	ARFA	DENSITY	POP
			(#)
R1E	(ha)	(P/na)	
R4	(ha) 0.67	(P/hd) 45.5	30.5
	(ha) 0.67 7.92	45.5 96.4	30.5 763.5
R5B	(ha) 0.67 7.92 1.25	(P/nd) 45.5 96.4 163.1	30.5 763.5 203.9
R5B TOTAL	(ha) 0.67 7.92 1.25 9.84	(P7nd) 45.5 96.4 163.1 101.4	30.5 763.5 203.9 997.9
R5B TOTAL	(ha) 0.67 7.92 1.25 9.84	(P/nd) 45.5 96.4 163.1 101.4	30.5 763.5 203.9 997.9
R5B TOTAL Table 11	(ha) 0.67 7.92 1.25 9.84 AREA (ha)	(P/hd) 45.5 96.4 163.1 101.4 DENSITY (P/hd)	30.5 763.5 203.9 997.9 POP (#)
R5B TOTAL Table 11 R1-R2	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45	(P/hd) 45.5 96.4 163.1 101.4 DENSITY (P/ha) 45.5	30.5 763.5 203.9 997.9 POP (#) 20.5
R5B TOTAL Table 11 R1-R2 R3-R4	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45 32.05	(P/hd) 45.5 96.4 163.1 101.4 DENSITY (P/ha) 45.5 96.4	30.5 763.5 203.9 997.9 POP (#) 20.5 3089.6
R5B TOTAL Toble 11 R1-R2 R3-R4 GC	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45 32.05 1.39	(P/nd) 45.5 96.4 163.1 101.4 DENSITY (P/ha) 45.5 96.4 180.4	30.5 763.5 203.9 997.9 POP (#) 20.5 3089.6 250.8
R5B TOTAL Table 11 R1-R2 R3-R4 GC TOTAL	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45 32.05 1.39 37.26	(P/nd) 45.5 96.4 163.1 101.4 DENSITY (P/ha) 45.5 96.4 180.4 90.2	30.5 763.5 203.9 997.9 POP (#) 20.5 3089.6 250.8 3360.9
R5B TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45 32.05 1.39 37.26 ARFA	(P/nd) 45.5 96.4 163.1 101.4 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY	30.5 763.5 203.9 997.9 POP (#) 20.5 3089.6 250.8 3360.9 POP
R5B TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha)	(P/hd) 45.5 96.4 163.1 101.4 DENSITY (P/hd) 45.5 96.4 180.4 90.2 DENSITY (P/hd)	30.5 763.5 203.9 997.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#)
R5B TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37	(P/hd) 45.5 96.4 163.1 101.4 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5	30.5 763.5 203.9 997.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8
R5B TOTAL Table 11 R1-R2 R3-R4 GC TOTAL TotAL R1-R2 R4	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37 0.37 0.77	(P/hd) 45.5 96.4 163.1 101.4 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4	30.5 763.5 203.9 997.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8 74.2
R5B TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37 0.77 1.14	(P/hd) 45.5 96.4 163.1 101.4 DENSITY (P/hd) 45.5 96.4 180.4 90.2 DENSITY (P/hd) 45.5 96.4 79.8	30.5 763.5 203.9 997.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8 74.2 91.0
R5B TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Toble 12 R1-R2 R4 TOTAL Toble 13	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37 0.77 1.14	(P/hd) 45.5 96.4 163.1 101.4 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 79.8	30.5 763.5 203.9 997.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8 74.2 91.0
R5B TOTAL Toble 11 R1-R2 R3-R4 GC TOTAL Toble 12 R1-R2 R4 TOTAL Toble 13	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37 0.77 1.14 AREA (ha)	(P/nd) 45.5 96.4 163.1 101.4 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 79.8 DENSITY (P/ha)	30.5 763.5 203.9 997.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8 74.2 91.0 POP (#)
R5B TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL Table 13 R1-R2	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37 0.77 1.14 AREA (ha) 0.37	(P/hd) 45.5 96.4 163.1 101.4 DENSITY (P/hd) 45.5 96.4 180.4 90.2 DENSITY (P/hd) 45.5 96.4 79.8 DENSITY (P/hd) 45.5	30.5 763.5 203.9 997.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8 74.2 91.0 POP (#) 46.0
R5B TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL Table 13 R1-R2 R5	(ha) 0.67 7.92 1.25 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37 0.77 1.14 AREA (ha) 1.01 14.37	(P/hd) 45.5 96.4 163.1 101.4 DENSITY (P/hd) 45.5 96.4 180.4 90.2 DENSITY (P/hd) 45.5 96.4 79.8 DENSITY (P/hd) 45.5 163.1	30.5 763.5 203.9 997.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8 74.2 91.0 POP (#) 46.0 2343.7



Minimum Dia. =	200 mm
Mannings "n"=	0.013
Minimum Velocity =	0.6 m/s
Minimum Grade =	0.5 %
Avg. Proposed Domestic Flow =	380 l/c/d
Avg. Existing Domestic Flow =	380 l/c/d
Infiltration =	0.28 l/s/ha

Chippawa Region, City of Niagara Falls Sanitary Sewer Design Sheet Post-Development Option 1

Project No:	221377
Date:	10-Feb-23
Designed by:	CHG

Peaking Factors calculated as per City Criteria

Harmon equation: PF=1 + (14/(4+(P/1000)½))

2.0 min; 4.0 max

			RESIDENTIAL					EXTE	RNAL		F	LOW CALCUL	ATIONS			PIPE DATA						
STREET	FROM	то	AREA	ACC.				EXT.	ACC. EXT.	INFILTRATION	TOTAL	PEAKING	RES.	EXT.	TOTAL			Q	v	v	% FI II I	
SINCE	T NOM	10	(ha)	AREA	DENSITY	POP	ACC.	FLOW	FLOW	ALLOWANCE	ACC.	FACTOR	FLOW	FLOW	FLOW	DIA.	SLOPE	FULL	FULL	ACT	701 OLL	
				(ha)	(P/ha)		POP.	(l/s)	(I/s)	(l/s)	POP.		(I/s)	(I/s)	(l/s)	(mm)	(%)	(L/s)	(m/s)	(m/s)		
Willoughby Drive	MH18A	MH17A	1.09	1.09	163.1	178	178			0.31	178	4.00	3.13		3.44	375	0.20	78.4	0.71	0.35	4%	
Willoughby Drive	MH17A	MH16A	1.31	2.40	96.4	127	305			0.67	305	4.00	5.37		6.04	375	0.20	78.4	0.71	0.41	8%	
Canonpost Road	MH38A	MH16A	9.68	9.68	207.6	2010	2010			2.71	2010	3.58	31.68		34.39	375	0.15	67.9	0.61	0.61	51%	
Willoughby Drive	MH21A	MH20A	1.30	1.30	45.5	60	60			0.36	60	4.00	1.06		1.42	200	0.50	23.2	0.74	0.40	6%	
Willoughby Drive	MH19A	MH20A	2.27	2.27	96.4	219	219			0.64	219	4.00	3.85		4.49	200	0.50	23.2	0.74	0.56	19%	
Willoughby Drive	MH20A	MH16A		3.57			279			1.00	279	4.00	4.91		5.91	200	0.50	23.2	0.74	0.61	25%	
Canonpost Road	MH16A	MH15A	1.32	16.97	96.4	128	2722			4.75	2722	3.48	41.64		46.39	375	0.20	78.4	0.71	0.74	59%	
Willoughby Drive	MH15A	MH14A	1.29	18.26	163.2	211	2933			5.11	2933	3.45	44.51		49.63	375	0.20	78.4	0.71	0.75	63%	
Willoughby Drive	MH14A	MH13A	1.05	19.31	95.6	101	3034			5.41	3034	3.44	45.88		51.29	375	0.20	78.4	0.71	0.75	65%	
Cattrill Drive	MH39A	MH13A	54.56	54.56	45.9	2505	2505			15.28	2505	3.51	38.65		53.92	375	0.15	67.9	0.61	0.68	79%	
Willoughby Drive	MH13A	MH12A	0.66	74.53	45.5	31	5570	0.00	0.00	20.87	5570	3.20	78.42	0.00	99.29	375	0.15	67.9	0.61	0.70	146%	
Willoughby Drive	MH40A	MH12A	2.25	2.25	45.5	103	103			0.63	103	4.00	1.81		2.44	200	0.60	25.4	0.81	0.50	10%	
Gunning Drive	MH12A	MH11A	0.55	77.33	45.5	26	5699	0.00	0.00	21.65	5699	3.19	80.00	0.00	101.66	375	0.15	67.9	0.61	0.70	150%	
Gunning Drive	MH11A	MH10A	0.19	77.52	45.5	9	5708	0.00	0.00	21.71	5708	3.19	80.11	0.00	101.82	375	0.15	67.9	0.61	0.70	150%	
Bell Crescent	MH41A	MH10A	2.57	2.57	45.5	117	117			0.72	117	4.00	2.06		2.78	200	0.50	23.2	0.74	0.49	12%	
Gunning Drive	MH10A	MH9A	0.64	80.73	66.9	43	5868	0.00	0.00	22.60	5868	3.18	82.07	0.00	104.67	375	0.15	67.9	0.61	0.70	154%	



			RESIDENTIAL					EXTE	ERNAL		I	LOW CALCU	LATIONS								
STREET	FROM	то	AREA	ACC.				EXT.	ACC. EXT.	INFILTRATION	TOTAL	PEAKING	RES.	EXT.	TOTAL			Q	v	v	% FULL
		-	(ha)	AREA	DENSITY	POP	ACC.	FLOW	FLOW	ALLOWANCE	ACC.	FACTOR	FLOW	FLOW	FLOW	DIA.	SLOPE	FULL	FULL	ACT	
				(ha)	(P/ha)		POP.	(l/s)	(l/s)	(I/s)	POP.		(I/s)	(I/s)	(I/s)	(mm)	(%)	(L/s)	(m/s)	(m/s)	<u> </u>
Mears Crescent	MH42A	MH9A	4.41	4.41	62.6	277	277			1.23	277	4.00	4.87		6.11	250	0.50	42.0	0.86	0.60	15%
Gunning Drive	MH9A	MH8A	0.45	85.59	45.5	21	6166	0.00	0.00	23.97	6166	3.16	85.68	0.00	109.65	375	0.15	67.9	0.61	0.70	162%
Gunning Drive	MH8A	MH7A	0.85	86.44	45.5	39	6205	0.00	0.00	24.20	6205	3.16	86.15	0.00	110.35	375	0.15	67.9	0.61	0.70	163%
Gunning Drive	MH7A	MH6A	2.67	89.11	45.5	122	6327	0.00	0.00	24.95	6327	3.15	87.62	0.00	112.57	375	0.15	67.9	0.61	0.70	166%
Gunning Drive	MH6A	MH5A	0.84	89.95	45.5	39	6366	0.00	0.00	25.19	6366	3.15	88.09	0.00	113.28	375	0.15	67.9	0.61	0.70	167%
Parliament Avenue	MH43A	MH5A	19.44	19.44	46.6	906	906			5.44	906	3.83	15.25		20.69	300	0.30	52.9	0.75	0.70	39%
Easement	MH5A	MH4A		109.39	0.0	0	7272	0.00	0.00	30.63	7272	3.09	98.85	0.00	129.48	375	0.16	70.1	0.63	0.72	185%
Sophie Avenue	MH4A	МНЗА		109.39		0	7272	0.00	0.00	30.63	7272	3.09	98.85	0.00	129.48	375	0.15	67.9	0.61	0.70	191%
Sophie Avenue	МНЗА	MH50A		109.39		0	7272	0.00	0.00	30.63	7272	3.09	98.85	0.00	129.48	375	0.15	67.9	0.61	0.70	191%
Sophie Avenue	MH50A	MH49A	0.00	109.39	0.0	0	7272	0.00	0.00	30.63	7272	3.09	98.85	0.00	129.48	375	0.15	67.9	0.61	0.70	191%
Sophie Avenue	MH51A	MH49A	41.76	41.76	74.2	3099	3099			11.69	3099	3.43	46.76		58.45	450	0.15	110.4	0.69	0.70	53%
Sophie Avenue	MH49A	MH48A	0.37	151.52	45.5	17	10388			42.43	10388	2.94	134.24		176.67	525	0.35	254.3	1.17	1.27	69%
Sophie Avenue	MH48A	MH47A	0.54	152.06	45.5	25	10413			42.58	10413	2.94	134.52		177.09	525	0.30	235.4	1.09	1.19	75%
Sophie Avenue	MH47A	MH2A	0.09	152.15	45.5	5	10418			42.60	10418	2.94	134.57		177.17	525	0.30	235.4	1.09	1.19	75%
Weinbrenner Road	MH18A	MH37A	9.84	9.84	124.0	1221	1221	15.20	15.20	2.76	1221	3.74	20.10	15.20	38.05	450	0.13	102.7	0.65	0.60	37%
Weinbrenner Road	MH37A	MH36A	1.08	10.92	45.5	50	1271		15.20	3.06	1271	3.73	20.85	15.20	39.11	450	0.13	102.7	0.65	0.60	38%

					RESIDEN	TIAL		EXTE	RNAL		F	LOW CALCU	LATIONS					PIPE DATA			
STREET	FROM	то	AREA	ACC.				EXT.	ACC. EXT.	INFILTRATION	TOTAL	PEAKING	RES.	EXT.	TOTAL			Q	v	v	% FIII I
STREET	T KOM	10	(ha)	AREA	DENSITY	POP	ACC.	FLOW	FLOW	ALLOWANCE	ACC.	FACTOR	FLOW	FLOW	FLOW	DIA.	SLOPE	FULL	FULL	ACT	/01 OLL
				(ha)	(P/ha)		POP.	(I/s)	(I/s)	(I/s)	POP.		(I/s)	(I/s)	(I/s)	(mm)	(%)	(L/s)	(m/s)	(m/s)	
Weinbrenner Road	MH36A	MH35A	1.05	11.97	45.5	48	1319		15.20	3.35	1319	3.72	21.58	15.20	40.13	450	0.13	102.7	0.65	0.60	39%
Weinbrenner Road	MH35A	MH34A	1.04	13.01	45.5	48	1367		15.20	3.64	1367	3.71	22.30	15.20	41.14	450	0.13	102.7	0.65	0.61	40%
Roosevelt Street	MH45A	MH34A	9.54	9.54	45.5	435	435			2.67	435	4.00	7.65		10.32	450	0.13	102.7	0.65	0.41	10%
Weinbrenner Road	MH34A	MH33A	0.98	23.53	45.5	45	1847		15.20	6.59	1847	3.61	29.34	15.20	51.13	525	0.10	135.9	0.63	0.58	38%
Weinbrenner Road	MH33A	MH32A	15.38	38.91	155.4	2391	4238		15.20	10.89	4238	3.31	61.71	15.20	87.81	525	0.10	135.9	0.63	0.67	65%
Weinbrenner Road	MH32A	MH31A	0.83	39.74	45.5	38	4276		15.20	11.13	4276	3.31	62.20	15.20	88.52	525	0.10	135.9	0.63	0.67	65%
Weinbrenner Road	MH31A	MH30A	0.44	40.18	45.5	21	4297		15.20	11.25	4297	3.31	62.47	15.20	88.92	525	0.10	135.9	0.63	0.67	65%
Weinbrenner Road	MH30A	MH29A	0.20	40.38	45.5	10	4307		15.20	11.31	4307	3.30	62.59	15.20	89.10	525	0.10	135.9	0.63	0.67	66%
Weinbrenner Road	MH29A	MH28A	1.14	41.52	79.8	91	4398		15.20	11.63	4398	3.30	63.76	15.20	90.58	525	0.10	135.9	0.63	0.67	67%
Weinbrenner Road	MH28A	MH27A		41.52	45.5		4398	90.50	105.70	11.63	4398	3.30	63.76	105.70	181.08	600	0.20	274.5	0.97	1.04	66%
Weinbrenner Road	MH27A	MH26A	37.26	78.78	90.2	3361	7759		105.70	22.06	7759	3.06	104.53	105.70	232.29	600	0.21	281.2	0.99	1.11	83%
Nassau Avenue	MH26A	MH25A	0.71	79.49	45.5	33	7792		105.70	22.26	7792	3.06	104.92	105.70	232.87	600	0.21	281.2	0.99	1.11	83%
Southerland Court	MH55A	MH54A	0.82	0.82	45.5	38	38			0.23	38	4.00	0.67		0.90	250	1.00	59.4	1.21	0.42	2%
Southerland Court	MH54A	MH53A	0.55	1.37	45.5	26	64			0.38	64	4.00	1.13		1.51	250	0.40	37.6	0.77	0.36	4%
Southerland Court	MH53A	MH52A	0.22	1.59	45.5	11	75			0.45	75	4.00	1.32		1.76	250	0.40	37.6	0.77	0.38	5%
Southerland Court	MH52A	MH25A	0.29	1.88	45.5	14	89			0.53	89	4.00	1.57		2.09	250	0.40	37.6	0.77	0.41	6%
Nassau Avenue	MH25A	MH24A	0.43	81.80	45.5	20	7901		105.70	22.90	7901	3.06	106.18	105.70	234.78	600	0.21	281.2	0.99	1.11	83%
Nassau Avenue	MH24A	MH23A	0.37	82.17	45.5	17	7918		105.70	23.01	7918	3.05	106.38	105.70	235.08	600	0.21	281.2	0.99	1.11	84%
Lyon's Creek Road	MH23A	MH22A	11.00	93.17	45.5	501	8419	0.00	105.70	26.09	8419	3.03	112.14	105.70	243.93	375	0.33	100.7	0.91	1.04	242%





N		

	AREA	DENSITY	POP
_	(ha)	(P/ha)	(#)
R1-R2	0.77	45.5	35.0
BLOCK 3	0.52	163.2	175.5
IUTAL	1.29	103.2	210.5
Table 2	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
BLOCK 1	2.21		446.0
BLOCK 2	2.09		421.0
BLOCK 4	0.87		292.0
BLOCK 5	2.52		851.0
	0.69	207.6	2010.0
TOTAL	9.00	207.0	2010.0
Table 3	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1C	0.66	45.5	30.0
GC	0.39	180.4	70.4
TOTAL	1.05	95.6	100.4
Table 4	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1-2	54.41	45.5	2475.7
GC	0.15	180.4	27.1
TOTAL	54.56	45.9	2502.8
Table F			000
	AREA	(P/ba)	202 (#)
R1C	0.37	45.5	16.8
I	0.27	96.4	26.0
TOTAL	0.64	66.9	42.8
Table 6	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1C	2.93	45.5	133.3
	1.48 4.41	96.4	276.0
Table 7	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1-R2	31.06	45.5	1413.2
R3-R4	1.17 1 74	96.4 96.4	112.8 167.7
, GC	7.79	180.4	1405.3
TOTAL	41.76	74.2	3099.0
Table 8	AREA	DENSITY	POP
Table 8	AREA (ha)	DENSITY (P/ha)	POP (#)
Table 8 R1-R2	AREA (ha) 19.02 0.42	DENSITY (P/ha) 45.5 96.4	POP (#) 865.4 40.5
Table 8 R1-R2 I TOTAL	AREA (ha) 19.02 0.42 19.44	DENSITY (P/ha) 45.5 96.4 46.6	POP (#) 865.4 40.5 905.9
Table 8 R1-R2 I TOTAL	AREA (ha) 19.02 0.42 19.44	DENSITY (P/ha) 45.5 96.4 46.6	POP (#) 865.4 40.5 905.9
Toble 8 R1-R2 I TOTAL Toble 9	AREA (ha) 19.02 0.42 19.44 AREA	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY	POP (#) 865.4 40.5 905.9 POP
Table 8 R1-R2 I TOTAL Table 9	AREA (ha) 19.02 0.42 19.44 AREA (ha)	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha)	POP (#) 865.4 40.5 905.9 POP (#)
Table 8 R1-R2 I TOTAL Table 9 R1-R2	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5	POP (#) 865.4 40.5 905.9 POP (#) 685.2
Table 8 R1–R2 I TOTAL Table 9 R1–R2 R5D	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 337
Toble 8 R1-R2 I TOTAL Toble 9 R1-R2 R5D I TOTAL	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL ToTAL	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL TOTAL Table 10	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha)	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha)	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#)
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D PI 02/// 5	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9
Table 8 R1–R2 I TOTAL Table 9 R1–R2 R5D I TOTAL TOTAL Table 10 R1E R4 R5D BLOCK 6	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha)	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha)	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 POP (#) 20.2
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1-R2 R3-R4	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 POP (#) 20.5 3089.6
Table 8 R1-R2 I TOTAL ToDAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1-R2 R3-R4 GC	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05 1.39	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4 180.4	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 POP (#) 1220.2
Table 8 R1-R2 I TOTAL ToTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1-R2 R3-R4 GC TOTAL	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05 1.39 37.26	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 POP (#) 1220.2 9 311.0 1220.2
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1-R2 R3-R4 GC TOTAL	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05 1.39 37.26	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 POP (#) 20.5 3089.6 250.8 3360.9
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05 1.39 37.26	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 929.3 (#) 30.5 674.8 203.9 311.0 1220.2 700 (#) 20.5 3089.6 250.8 3360.9
Table 8 R1-R2 I TOTAL ToTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha)	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha)	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 POP (#) 20.5 3089.6 250.8 3360.9 POP (#)
Table 8 R1-R2 I TOTAL ToTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R1-R2 R1-R2 R2-R4 R3-R4 R4 R5-R4 R3-R4 R4 R5-	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha)	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha)	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 20.5 3089.6 250.8 3360.9
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.45 32.05 1.39	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 POP (#) 20.5 3089.6 250.8 3360.9 250.8 3360.9 POP (#) 16.8 74.2 91.0
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.45 32.05 1.39	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 20.5 3089.6 250.8 3360.9
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.45 32.05 1.39 37.26	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 7 POP (#) 20.5 3089.6 250.8 3360.9 250.8 3360.9 250.8 3360.9 POP (#) 16.8 74.2 91.0
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL Table 12 Table 13	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.45 32.05 1.39 37.26	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8 74.2 91.0
Table 8 R1-R2 I TOTAL Table 9 R1-R2 R5D I TOTAL Table 10 R1-R2 R5D I TotAL Table 10 R1E R4 R5D BLOCK 6 TOTAL R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL Table 12 R1-R2 R4 TOTAL Table 13 R1-R2	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05 1.39 37.26 XAREA (ha) 0.37 0.77 1.14	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8 74.2 91.0
Table 8 R1-R2 I ToTAL Table 9 R1-R2 R5D I ToTAL Table 10 R1-R2 R5D I ToTAL Table 10 R1E R4 R5D BLOCK 6 TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL Table 12 R1-R2 R4 TOTAL Table 13 R1-R2 R5	AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.67 7.92 1.25 0.92 9.84 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.45 32.05 1.39	DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 163.1 337.5 124.0 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 30.5 674.8 203.9 311.0 1220.2 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8 74.2 91.0 POP (#) 20.5



Minimum Dia. =	200 mm
Mannings "n"=	0.013
Minimum Velocity =	0.6 m/s
Minimum Grade =	0.5 %
Avg. Proposed Domestic Flow =	380 l/c/d
Avg. Existing Domestic Flow =	380 l/c/d
Infiltration =	0.28 l/s/ha

Chippawa Region, City of Niagara Falls Sanitary Sewer Design Sheet Post-Development Option 1

Project No:	221377
Date:	10-Feb-23
Designed by:	CHG

Peaking Factors calculated as per City Criteria

Harmon equation: PF=1 + (14/(4+(P/1000)½))

2.0 min; 4.0 max

					RESIDENT	TAL		EXTERNAL FLOW CALCULATIONS									PIPE DATA				
STREET	FROM	то	AREA	ACC.				EXT.	ACC. EXT.	INFILTRATION	TOTAL	PEAKING	RES.	EXT.	TOTAL			Q	v	v	% FI II I
SINCE	T NOM	10	(ha)	AREA	DENSITY	POP	ACC.	FLOW	FLOW	ALLOWANCE	ACC.	FACTOR	FLOW	FLOW	FLOW	DIA.	SLOPE	FULL	FULL	ACT	701 OLL
				(ha)	(P/ha)		POP.	(l/s)	(I/s)	(l/s)	POP.		(I/s)	(I/s)	(l/s)	(mm)	(%)	(L/s)	(m/s)	(m/s)	
Willoughby Drive	MH18A	MH17A	1.09	1.09	163.1	178	178			0.31	178	4.00	3.13		3.44	375	0.20	78.4	0.71	0.35	4%
Willoughby Drive	MH17A	MH16A	1.31	2.40	96.4	127	305			0.67	305	4.00	5.37		6.04	375	0.20	78.4	0.71	0.41	8%
Canonpost Road	MH38A	MH16A	9.68	9.68	207.6	2010	2010			2.71	2010	3.58	31.68		34.39	375	0.15	67.9	0.61	0.61	51%
Willoughby Drive	MH21A	MH20A	1.30	1.30	45.5	60	60			0.36	60	4.00	1.06		1.42	200	0.50	23.2	0.74	0.40	6%
Willoughby Drive	MH19A	MH20A	2.27	2.27	96.4	219	219			0.64	219	4.00	3.85		4.49	200	0.50	23.2	0.74	0.56	19%
Willoughby Drive	MH20A	MH16A		3.57			279			1.00	279	4.00	4.91		5.91	200	0.50	23.2	0.74	0.61	25%
Canonpost Road	MH16A	MH15A	1.32	16.97	96.4	128	2722			4.75	2722	3.48	41.64		46.39	375	0.20	78.4	0.71	0.74	59%
Willoughby Drive	MH15A	MH14A	1.29	18.26	163.2	211	2933			5.11	2933	3.45	44.51		49.63	375	0.20	78.4	0.71	0.75	63%
Willoughby Drive	MH14A	MH13A	1.05	19.31	95.6	101	3034			5.41	3034	3.44	45.88		51.29	375	0.20	78.4	0.71	0.75	65%
Cattrill Drive	MH39A	MH13A	54.56	54.56	45.9	2505	2505			15.28	2505	3.51	38.65		53.92	375	0.15	67.9	0.61	0.68	79%
Willoughby Drive	MH13A	MH12A	0.66	74.53	45.5	31	5570	0.00	0.00	20.87	5570	3.20	78.42	0.00	99.29	375	0.15	67.9	0.61	0.70	146%
Willoughby Drive	MH40A	MH12A	2.25	2.25	45.5	103	103			0.63	103	4.00	1.81		2.44	200	0.60	25.4	0.81	0.50	10%
Gunning Drive	MH12A	MH11A	0.55	77.33	45.5	26	5699	0.00	0.00	21.65	5699	3.19	80.00	0.00	101.66	375	0.15	67.9	0.61	0.70	150%
Gunning Drive	MH11A	MH10A	0.19	77.52	45.5	9	5708	0.00	0.00	21.71	5708	3.19	80.11	0.00	101.82	375	0.15	67.9	0.61	0.70	150%
Bell Crescent	MH41A	MH10A	2.57	2.57	45.5	117	117			0.72	117	4.00	2.06		2.78	200	0.50	23.2	0.74	0.49	12%
Gunning Drive	MH10A	MH9A	0.64	80.73	66.9	43	5868	0.00	0.00	22.60	5868	3.18	82.07	0.00	104.67	375	0.15	67.9	0.61	0.70	154%



					RESIDEN	TIAL		EXTE	ERNAL		I	LOW CALCU	LATIONS					PIPE DATA			
STREET	FROM	то	AREA	ACC.				EXT.	ACC. EXT.	INFILTRATION	TOTAL	PEAKING	RES.	EXT.	TOTAL			Q	v	v	% FULL
		-	(ha)	AREA	DENSITY	POP	ACC.	FLOW	FLOW	ALLOWANCE	ACC.	FACTOR	FLOW	FLOW	FLOW	DIA.	SLOPE	FULL	FULL	ACT	
				(ha)	(P/ha)		POP.	(l/s)	(l/s)	(I/s)	POP.		(I/s)	(I/s)	(I/s)	(mm)	(%)	(L/s)	(m/s)	(m/s)	<u> </u>
Mears Crescent	MH42A	MH9A	4.41	4.41	62.6	277	277			1.23	277	4.00	4.87		6.11	250	0.50	42.0	0.86	0.60	15%
Gunning Drive	MH9A	MH8A	0.45	85.59	45.5	21	6166	0.00	0.00	23.97	6166	3.16	85.68	0.00	109.65	375	0.15	67.9	0.61	0.70	162%
Gunning Drive	MH8A	MH7A	0.85	86.44	45.5	39	6205	0.00	0.00	24.20	6205	3.16	86.15	0.00	110.35	375	0.15	67.9	0.61	0.70	163%
Gunning Drive	MH7A	MH6A	2.67	89.11	45.5	122	6327	0.00	0.00	24.95	6327	3.15	87.62	0.00	112.57	375	0.15	67.9	0.61	0.70	166%
Gunning Drive	MH6A	MH5A	0.84	89.95	45.5	39	6366	0.00	0.00	25.19	6366	3.15	88.09	0.00	113.28	375	0.15	67.9	0.61	0.70	167%
Parliament Avenue	MH43A	MH5A	19.44	19.44	46.6	906	906			5.44	906	3.83	15.25		20.69	300	0.30	52.9	0.75	0.70	39%
Easement	MH5A	MH4A		109.39	0.0	0	7272	0.00	0.00	30.63	7272	3.09	98.85	0.00	129.48	375	0.16	70.1	0.63	0.72	185%
Sophie Avenue	MH4A	МНЗА		109.39		0	7272	0.00	0.00	30.63	7272	3.09	98.85	0.00	129.48	375	0.15	67.9	0.61	0.70	191%
Sophie Avenue	МНЗА	MH50A		109.39		0	7272	0.00	0.00	30.63	7272	3.09	98.85	0.00	129.48	375	0.15	67.9	0.61	0.70	191%
Sophie Avenue	MH50A	MH49A	0.00	109.39	0.0	0	7272	0.00	0.00	30.63	7272	3.09	98.85	0.00	129.48	375	0.15	67.9	0.61	0.70	191%
Sophie Avenue	MH51A	MH49A	41.76	41.76	74.2	3099	3099			11.69	3099	3.43	46.76		58.45	450	0.15	110.4	0.69	0.70	53%
Sophie Avenue	MH49A	MH48A	0.37	151.52	45.5	17	10388			42.43	10388	2.94	134.24		176.67	525	0.35	254.3	1.17	1.27	69%
Sophie Avenue	MH48A	MH47A	0.54	152.06	45.5	25	10413			42.58	10413	2.94	134.52		177.09	525	0.30	235.4	1.09	1.19	75%
Sophie Avenue	MH47A	MH2A	0.09	152.15	45.5	5	10418			42.60	10418	2.94	134.57		177.17	525	0.30	235.4	1.09	1.19	75%
Weinbrenner Road	MH18A	MH37A	9.84	9.84	124.0	1221	1221	15.20	15.20	2.76	1221	3.74	20.10	15.20	38.05	450	0.13	102.7	0.65	0.60	37%
Weinbrenner Road	MH37A	MH36A	1.08	10.92	45.5	50	1271		15.20	3.06	1271	3.73	20.85	15.20	39.11	450	0.13	102.7	0.65	0.60	38%

					RESIDEN	TIAL		EXTE	RNAL		F	LOW CALCU	LATIONS					PIPE DATA			
STREET	FROM	то	AREA	ACC.				EXT.	ACC. EXT.	INFILTRATION	TOTAL	PEAKING	RES.	EXT.	TOTAL			Q	v	v	% FIII I
STREET	T KOM	10	(ha)	AREA	DENSITY	POP	ACC.	FLOW	FLOW	ALLOWANCE	ACC.	FACTOR	FLOW	FLOW	FLOW	DIA.	SLOPE	FULL	FULL	ACT	/01 OLL
				(ha)	(P/ha)		POP.	(I/s)	(I/s)	(I/s)	POP.		(I/s)	(I/s)	(I/s)	(mm)	(%)	(L/s)	(m/s)	(m/s)	
Weinbrenner Road	MH36A	MH35A	1.05	11.97	45.5	48	1319		15.20	3.35	1319	3.72	21.58	15.20	40.13	450	0.13	102.7	0.65	0.60	39%
Weinbrenner Road	MH35A	MH34A	1.04	13.01	45.5	48	1367		15.20	3.64	1367	3.71	22.30	15.20	41.14	450	0.13	102.7	0.65	0.61	40%
Roosevelt Street	MH45A	MH34A	9.54	9.54	45.5	435	435			2.67	435	4.00	7.65		10.32	450	0.13	102.7	0.65	0.41	10%
Weinbrenner Road	MH34A	MH33A	0.98	23.53	45.5	45	1847		15.20	6.59	1847	3.61	29.34	15.20	51.13	525	0.10	135.9	0.63	0.58	38%
Weinbrenner Road	MH33A	MH32A	15.38	38.91	155.4	2391	4238		15.20	10.89	4238	3.31	61.71	15.20	87.81	525	0.10	135.9	0.63	0.67	65%
Weinbrenner Road	MH32A	MH31A	0.83	39.74	45.5	38	4276		15.20	11.13	4276	3.31	62.20	15.20	88.52	525	0.10	135.9	0.63	0.67	65%
Weinbrenner Road	MH31A	MH30A	0.44	40.18	45.5	21	4297		15.20	11.25	4297	3.31	62.47	15.20	88.92	525	0.10	135.9	0.63	0.67	65%
Weinbrenner Road	MH30A	MH29A	0.20	40.38	45.5	10	4307		15.20	11.31	4307	3.30	62.59	15.20	89.10	525	0.10	135.9	0.63	0.67	66%
Weinbrenner Road	MH29A	MH28A	1.14	41.52	79.8	91	4398		15.20	11.63	4398	3.30	63.76	15.20	90.58	525	0.10	135.9	0.63	0.67	67%
Weinbrenner Road	MH28A	MH27A		41.52	45.5		4398	90.50	105.70	11.63	4398	3.30	63.76	105.70	181.08	600	0.20	274.5	0.97	1.04	66%
Weinbrenner Road	MH27A	MH26A	37.26	78.78	90.2	3361	7759		105.70	22.06	7759	3.06	104.53	105.70	232.29	600	0.21	281.2	0.99	1.11	83%
Nassau Avenue	MH26A	MH25A	0.71	79.49	45.5	33	7792		105.70	22.26	7792	3.06	104.92	105.70	232.87	600	0.21	281.2	0.99	1.11	83%
Southerland Court	MH55A	MH54A	0.82	0.82	45.5	38	38			0.23	38	4.00	0.67		0.90	250	1.00	59.4	1.21	0.42	2%
Southerland Court	MH54A	MH53A	0.55	1.37	45.5	26	64			0.38	64	4.00	1.13		1.51	250	0.40	37.6	0.77	0.36	4%
Southerland Court	MH53A	MH52A	0.22	1.59	45.5	11	75			0.45	75	4.00	1.32		1.76	250	0.40	37.6	0.77	0.38	5%
Southerland Court	MH52A	MH25A	0.29	1.88	45.5	14	89			0.53	89	4.00	1.57		2.09	250	0.40	37.6	0.77	0.41	6%
Nassau Avenue	MH25A	MH24A	0.43	81.80	45.5	20	7901		105.70	22.90	7901	3.06	106.18	105.70	234.78	600	0.21	281.2	0.99	1.11	83%
Nassau Avenue	MH24A	MH23A	0.37	82.17	45.5	17	7918		105.70	23.01	7918	3.05	106.38	105.70	235.08	600	0.21	281.2	0.99	1.11	84%
Lyon's Creek Road	MH23A	MH22A	11.00	93.17	45.5	501	8419	0.00	105.70	26.09	8419	3.03	112.14	105.70	243.93	375	0.33	100.7	0.91	1.04	242%





Table 1	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1-R2	0.77	45.5	35.0
TOTAL	1.29	163.2	210.5
Table 2	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
BLOCK 1	2.21		446.0
BLOCK 2	2.09		421.0
BLOCK 3	0.52		176.0
BLOCK 4	0.87		292.0
BLOCK 5	2.52		851.0
PARKS/ROADS	1.90		
TOTAL	10.11	216.2	2186.0
Table 3	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R4	7.01	96.4	675.8
R5B	1.25	163.1	203.9
BLOCK 6	0.92		311.0
TOTAL	9.18	129.7	1190.2
Table 4	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1C	0.66	45.5	30.0
GC	0.39	180.4	70.4
TOTAL	1.05	95.6	100.4
Table 5	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1-2	54.41	45.5	2475.7
GC	0.15	180.4	27.1
FOTAL	54.56	45.9	2502.8
Table 6	AREA	DENSITY	POP
	(ha)	(P/ha)	(#)
R1C	0.37	45.5	16.8
	0.27	96.4	26.0
IUTAL	0.04	00.9	42.ð
		D	
lable 7	AREA		POP
	(ha)	(P/ha)	(#)
RIC	2.93	45.5	133.3
	1.40 4 41	90.4 62.6	276.0
1 1 2 2 2 2	1. 11	-2.0	2,0.0
TOTAL			
Table 8	AREA	DENSITY	POP
Table 8	AREA (ha)	DENSITY (P/ha)	POP (#)
Table 8 	AREA (ha) 31.06	DENSITY (P/ha) 45.5	POP (#) 1413.2
Table 8 R1-R2 R3-R4	AREA (ha) 31.06 1.17	DENSITY (P/ha) 45.5 96.4	POP (#) 1413.2 112.8
Table 8 R1-R2 R3-R4	AREA (ha) 31.06 1.17 1.74	DENSITY (P/ha) 45.5 96.4 96.4	POP (#) 1413.2 112.8 167.7
Table 8 R1-R2 R3-R4 I GC	AREA (ha) 31.06 1.17 1.74 7.79	DENSITY (P/ha) 45.5 96.4 96.4 180.4	POP (#) 1413.2 112.8 167.7 1405.3
Table 8 R1-R2 R3-R4 I GC TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2	POP (#) 1413.2 112.8 167.7 1405.3 3099.0
Table 8 R1-R2 R3-R4 I GC TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2	POP (#) 1413.2 112.8 167.7 1405.3 3099.0
Table 8 R1-R2 R3-R4 I GC TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2	POP (#) 1413.2 112.8 167.7 1405.3 3099.0
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9	AREA (ha) 31.06 1.17 1.74 7.79 41.76	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 R3-R4	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha)	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha)	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#)
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2	AREA (ha) 31.06 1.17 1.74 7.79 41.76 41.76 AREA (ha) 19.02 0.42	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 41.76 AREA (ha) 19.02 0.42	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 41.76 AREA (ha) 19.02 0.42 19.44	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL TotAL Table 10	AREA (ha) 31.06 1.17 1.74 7.79 41.76 41.76 AREA (ha) 19.02 0.42 19.44 AREA	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 POP (#)
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10	AREA (ha) 31.06 1.17 1.74 7.79 41.76 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha)	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha)	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 POP (#) POP (#)
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 P5D	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 905.9 POP (#) 685.2 210.4
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 905.9 POP (#) 685.2 210.4 33.7
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 19.02 0.42 19.44 5.06 1.29 0.35 16.70	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 (#) 865.4 40.5 905.9 905.9 905.9 (#) 685.2 210.4 33.7 220.3
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL TotAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL Table 11	AREA (ha) 31.06 1.17 1.74 7.79 41.76 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha)	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha)	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL Table 11 R1-R2	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.45	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 20.5
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL Table 10 R1-R2 R5D I TOTAL R1-R2 R5D I TOTAL R3-R4	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.45 32.05	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 (#) 865.4 40.5 905.9 905.9 (#) 685.2 210.4 3.3.7 929.3 929.3
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL ToTAL Table 11 R1-R2 R3-R4 GC	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.35 16.70	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 905.9 905.9 905.9 905.9 (#) 685.2 210.4 3.3.7 929.3 929.3 POP (#) 20.5 3089.6 250.8
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL ToTAL Table 10 R1-R2 R5D I TOTAL Table 11 R1-R2 R3-R4 GC TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26	DENSITY (P/ha) 45.5 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 163.1 96.4 155.7	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 (#) 865.4 40.5 905.9 905.9 905.9 (#) 685.2 210.4 33.7 929.3 929.3 POP (#) 20.5 3089.6 250.8 3360.9
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL ToTAL Table 10 R1-R2 R5D I TOTAL Table 11 R1-R2 R3-R4 GC TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 685.2 210.4 33.7 929.3
Table 8 R1-R2 R3-R4 GC TOTAL Table 9 R1-R2 I TOTAL Toble 10 R1-R2 R5D I TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 11 R1-R2 R3-R4 I Table 11 R1-R2 R3-R4 I Table 11 R1-R2 R3-R4 I Total Table 11 R1-R2 R3-R4 I Table 11 R1-R2 R3-R4 I Table 11 R1-R2 R3-R4 I Table 11 R1-R2 R3-R4	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 685.2 210.4 33.7 929.3
Table 8 R1-R2 R3-R4 GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 11 R1-R2 R3-R4 R	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha)	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha)	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 20.5 3089.6 250.8 3360.9
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL Table 10 R1-R2 R5D I TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R1-R2 GC TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha)	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 20.5 3089.6 250.8 3360.9 POP (#)
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 I TotAL Table 10 R1-R2 R1-R2 R5D I TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37 0.77	DENSITY (P/ha) 45.5 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 685.2 210.4 33.7 929.3 POP (#) 20.5 3089.6 250.8 3360.9 250.8 3360.9
Toble 8 R1-R2 R3-R4 I GC TOTAL Toble 9 R1-R2 I TOTAL Toble 10 R1-R2 I TOTAL Toble 10 R1-R2 R5D I TOTAL R1-R2 R5D I TOTAL TotAL TotAL TotAL TotAL R1-R2 R3-R4 GC TotAL Toble 12 R1-R2 R4 TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.45 32.05 1.39 37.26	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 (#) 865.4 40.5 905.9 (#) 865.4 40.5 905.9 (#) 865.2 210.4 33.7 929.3 (#) 20.5 3089.6 250.8 3089.6 250.8 3089.6 250.8 3089.6 250.8
Table 8 R1-R2 R3-R4 GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL Table 11 R1-R2 R5D I TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 MREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37 0.77 1.14	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 (#) 865.4 40.5 905.9 905.9 (#) 685.2 210.4 3.7 929.3 (#) 685.2 210.4 3.7 929.3 (#) 20.5 3089.6 250.8 3360.9 (#) 20.5 3089.6 250.8 3360.9
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 Co.42 19.44 MREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37 0.37 0.77 1.14	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 905.9 905.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8 74.2 91.0
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL Table 10 R1-R2 R5D I TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL Table 12 R4 TOTAL Table 13	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 MREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37 0.77 1.14	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8 74.2 91.0
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL Table 10 R1-R2 R5D I TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 12 R1-R2 R4 TOTAL Table 12 R1-R2 R4 TOTAL Table 13	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37 0.37 0.37 0.37 0.37 1.14	DENSITY (P/ha) 45.5 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 16.8 74.2 91.0
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Toble 10 R1-R2 R5D I TOTAL Table 10 R1-R2 R5D I TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 11 R1-R2 R4 TOTAL Table 12 R1-R2 R4 TOTAL Table 13 R1-R2 R5	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.37 0.77 1.14	DENSITY (P/ha) 45.5 96.4 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 20.5 3089.6 250.8 3360.9 250.8 3360.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 20.5 3089.6 250.8 3360.9 POP (#) 20.5 3089.6 250.8 3360.9 20.5 3089.6 250.8 3360.9 20.5 3089.6 250.8 3360.9 20.5 3089.6 250.8 3360.9 20.5 3089.6 250.8 3360.9 90.0 20.5 3089.6 250.8 3360.9 20.5 3089.6 250.8 3360.9 20.5 3089.6 250.8 3360.9 90.0 20.5 3089.6 250.8 3360.9 20.5 300.0 20.5 20.5 300.0 20.5 20.5 20.5 20.5 20.5 20.5 20.5
Table 8 R1-R2 R3-R4 I GC TOTAL Table 9 R1-R2 I TOTAL Table 10 R1-R2 R5D I TOTAL Table 10 R1-R2 R5D I TOTAL Table 11 R1-R2 R3-R4 GC TOTAL Table 11 R1-R2 R4 TOTAL Table 12 R1-R2 R4 TOTAL Table 13 R1-R2 R5 TOTAL	AREA (ha) 31.06 1.17 1.74 7.79 41.76 AREA (ha) 19.02 0.42 19.44 AREA (ha) 15.06 1.29 0.35 16.70 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.45 32.05 1.39 37.26 AREA (ha) 0.45 32.05 1.39 37.26	DENSITY (P/ha) 45.5 96.4 180.4 74.2 DENSITY (P/ha) 45.5 96.4 46.6 DENSITY (P/ha) 45.5 163.1 96.4 55.7 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2 DENSITY (P/ha) 45.5 96.4 180.4 90.2	POP (#) 1413.2 112.8 167.7 1405.3 3099.0 POP (#) 865.4 40.5 905.9 POP (#) 685.2 210.4 33.7 929.3 POP (#) 20.5 3089.6 250.8 3360.9 C (#) 20.5 3089.6 250.8 3360.9 C (#) 16.8 74.2 91.0 POP (#) 46.0 2343.7



Minimum Dia. =	200 mm
Mannings "n"=	0.013
Minimum Velocity =	0.6 m/s
Minimum Grade =	0.5 %
Avg. Proposed Domestic Flow =	380 l/c/d
Avg. Existing Domestic Flow =	380 l/c/d
Infiltration =	0.28 l/s/ha

City of Niagara Falls Sanitary Sewer Design Sheet Post-Development Option 2

Project No:	221377
Date:	10-Feb-23
Designed by:	CHG

Peaking Factors calculated as per City Criteria Harmon equation: PF=1 + (14/(4+(P/1000)½))

(000)¹/₂)) 2.0 min; 4.0 max

				-	RESIDEN	TIAL	-	EXTE	RNAL		FL	OW CALCUL	TIONS	-	-	PIPE DATA					
STREET	FROM	то	AREA	ACC.				EXT.	ACC. EXT.	INFILTRATION	TOTAL	PEAKING	RES.	EXT.	TOTAL			Q	v	v	% FULL
			(ha)	AREA	DENSITY	POP	ACC.	FLOW	FLOW	ALLOWANCE	ACC.	FACTOR	FLOW	FLOW	FLOW	DIA.	SLOPE	FULL	FULL	ACT	
				(ha)	(P/ha)		POP.	(I/s)	(I/s)	(l/s)	POP.		(I/s)	(I/s)	(I/s)	(mm)	(%)	(L/s)	(m/s)	(m/s)	
Willoughby Drive	MH18A-N	MH17A	1.09	1.09	163.1	178	178			0.31	178	4.00	3.13		3.44	375	0.20	78.4	0.71	0.35	4%
Willoughby Drive	MH17A	MH16A	1.31	2.40	96.4	127	305			0.67	305	4.00	5.37		6.04	375	0.20	78.4	0.71	0.41	8%
Canonpost Road	MH38A	MH16A										1.00				375	0.15	67.9	0.61		
Willoughby Drive	MH21A	MH20A	1.30	1.30	45.5	60	60			0.36	60	4.00	1.06		1.42	200	0.50	23.2	0.74	0.40	6%
Willoughby Drive	MH19A	MH20A	2.27	2.27	96.4	219	219			0.64	219	4.00	3.85		4.49	200	0.50	23.2	0.74	0.56	19%
Willoughby Drive	MH20A	MH16A		3.57			279			1.00	279	4.00	4.91		5.91	200	0.50	23.2	0.74	0.61	25%
Canonpost Road	MH16A	MH15A	1.32	7.29	96.4	128	712			2.04	712	3.89	12.18		14.22	375	0.20	78.4	0.71	0.53	18%
Willoughby Drive	MH15A	MH14A	0.63	7.92	45.5	29	741			2.22	741	3.88	12.65		14.86	375	0.20	78.4	0.71	0.54	19%
Willoughby Drive	MH14A	MH13A	1.05	8.97	95.6	101	842			2.51	842	3.85	14.25		16.76	375	0.20	78.4	0.71	0.56	21%
Catrill Drive	MH39A	MH13A	54.56	54.56	45.9	2505	2505			15.28	2505	3.51	38.65		53.92	375	0.15	67.9	0.61	0.68	79%
Willoughby Drive	MH13A	MH12A	0.66	64.19	45.5	31	3378	0.00	0.00	17.97	3378	3.40	50.49	0.00	68.46	375	0.15	67.9	0.61	0.70	101%
Willoughby Drive	MH40A	MH12A	2.25	2.25	45.5	103	103			0.63	103	4.00	1.81		2.44	200	0.60	25.4	0.81	0.50	10%
Gunning Drive	MH12A	MH11A	0.55	66.99	45.5	26	3507	0.00	0.00	18.76	3507	3.38	52.19	0.00	70.95	375	0.15	67.9	0.61	0.70	105%
Gunning Drive	MH11A	MH10A	0.19	67.18	45.5	9	3516	0.00	0.00	18.81	3516	3.38	52.31	0.00	71.12	375	0.15	67.9	0.61	0.70	105%
Bell Crescent	MH41A	MH10A	2.57	2.57	45.5	117	117			0.72	117	4.00	2.06		2.78	200	0.50	23.2	0.74	0.49	12%
Gunning Drive	MH10A	MH9A	0.64	70.39	66.9	43	3676	0.00	0.00	19.71	3676	3.37	54.42	0.00	74.13	375	0.15	67.9	0.61	0.70	109%



					RESIDEN	TIAL		EXTE	RNAL		Fl	OW CALCUL	ATIONS			PIPE DATA					
STREET	FROM	то	AREA	ACC.				EXT.	ACC. EXT.	INFILTRATION	TOTAL	PEAKING	RES.	EXT.	TOTAL			Q	v	v	% FULL
			(ha)	AREA	DENSITY (D(ba)	POP	ACC.	FLOW	FLOW		ACC.	FACTOR	FLOW	FLOW	FLOW	DIA.	SLOPE	FULL	FULL	ACT	
Mears Crescent	MH42A	MH9A	4.41	(na) 4.41	(P/IIa) 62.6	277	277	(1/5)	(05)	1.23	277	4.00	4.87	(1/5)	6.11	250	0.50	42.0	0.86	0.60	15%
Gunning Drive	MH9A	MH8A	0.45	75.25	45.5	21	3974	0.00	0.00	21.07	3974	3.34	58.31	0.00	79.38	375	0.15	67.9	0.61	0.70	117%
Gunning Drive	MH8A	MH7A	0.85	76.10	45.5	39	4013	0.00	0.00	21.31	4013	3.33	58.81	0.00	80.12	375	0.15	67.9	0.61	0.70	118%
Gunning Drive	MH7A	MH6A	2.67	78.77	45.5	122	4135	0.00	0.00	22.06	4135	3.32	60.39	0.00	82.44	375	0.15	67.9	0.61	0.70	121%
Gunning Drive	MH6A	MH5A	0.84	79.61	45.5	39	4174	0.00	0.00	22.29	4174	3.32	60.89	0.00	83.18	375	0.15	67.9	0.61	0.70	123%
Parliament Avenue	MH43A	MH5A	19.44	19.44	46.6	906	906			5.44	906	3.83	15.25		20.69	300	0.30	52.9	0.75	0.70	39%
Easement	MH5A	MH4A		99.05	0.0	0	5080	0.00	0.00	27.73	5080	3.24	72.36	0.00	100.09	375	0.16	70.1	0.63	0.72	143%
Sophie Avenue	MH4A	МНЗА		99.05		0	5080	0.00	0.00	27.73	5080	3.24	72.36	0.00	100.09	375	0.15	67.9	0.61	0.70	147%
Sophie Avenue	МНЗА	MH50A		99.05		0	5080	0.00	0.00	27.73	5080	3.24	72.36	0.00	100.09	375	0.15	67.9	0.61	0.70	147%
Sophie Avenue	MH50A	MH49A	0.00	99.05	0.0	0	5080	0.00	0.00	27.73	5080	3.24	72.36	0.00	100.09	375	0.15	67.9	0.61	0.70	147%
Sophie Avenue	MH51A	MH49A	41.76	41.76	74.2	3099	3099			11.69	3099	3.43	46.76		58.45	450	0.15	110.4	0.69	0.70	53%
Sophie Avenue	MH49A	MH48A	0.37	141.18	45.5	17	8196			39.53	8196	3.04	109.58		149.11	525	0.35	254.3	1.17	1.22	59%
Sophie Avenue	MH48A	MH47A	0.54	141.72	45.5	25	8221			39.68	8221	3.04	109.87		149.55	525	0.30	235.4	1.09	1.15	64%
Sophie Avenue	MH47A	MH2A	0.09	141.81	45.5	5	8226			39.71	8226	3.04	109.93		149.63	525	0.30	235.4	1.09	1.15	64%
Easement	MH57A	MH56A	10.11	10.11	216.2	2186	2186			2.83	2186	3.56	34.18		37.01	300	0.50	68.3	0.97	0.98	54%
Weinbrenner Road	MH56A	MH18A	9.18	19.29	129.7	1191	3377			5.40	3377	3.40	50.47		55.87	300	0.50	68.3	0.97	1.08	82%
Weinbrenner Road	MH18A	MH37A	0.89	20.18	45.5	41	3418	15.20	15.20	5.65	3418	3.39	51.02	15.20	71.87	450	0.13	102.7	0.65	0.70	70%
Weinbrenner Road	MH37A	MH36A	1.08	21.26	45.5	50	3468		15.20	5.95	3468	3.39	51.68	15.20	72.83	450	0.13	102.7	0.65	0.70	71%

				RESIDENTIAL				EXTERNAL			FL	OW CALCUL	ATIONS			PIPE DATA					
STREET	FROM	то	AREA	ACC.				EXT.	ACC. EXT.	INFILTRATION	TOTAL	PEAKING	RES.	EXT.	TOTAL			Q	v	v	% FUU I
0.1121			(ha)	AREA	DENSITY	POP	ACC.	FLOW	FLOW	ALLOWANCE	ACC.	FACTOR	FLOW	FLOW	FLOW	DIA.	SLOPE	FULL	FULL	ACT	<i>,</i>
				(ha)	(P/ha)		POP.	(I/s)	(I/s)	(l/s)	POP.		(I/s)	(I/s)	(I/s)	(mm)	(%)	(L/s)	(m/s)	(m/s)	
Weinbrenner Road	MH36A	MH35A	1.05	22.31	45.5	48	3516		15.20	6.25	3516	3.38	52.31	15.20	73.76	450	0.13	102.7	0.65	0.70	72%
Weinbrenner Road	MH35A	MH34A	1.04	23.35	45.5	48	3564		15.20	6.54	3564	3.38	52.95	15.20	74.68	450	0.13	102.7	0.65	0.70	73%
Roosevelt Street	MH45A	MH34A	9.54	9.54	45.5	435	435			2.67	435	4.00	7.65		10.32	450	0.13	102.7	0.65	0.41	10%
Weinbrenner Road	MH34A	MH33A	0.98	33.87	45.5	45	4044		15.20	9.48	4044	3.33	59.21	15.20	83.89	525	0.10	135.9	0.63	0.66	62%
Weinbrenner Road	MH33A	MH32A	15.38	49.25	155.4	2391	6435		15.20	13.79	6435	3.14	88.92	15.20	117.91	525	0.10	135.9	0.63	0.71	87%
Weinbrenner Road	MH32A	MH31A	0.83	50.08	45.5	38	6473		15.20	14.02	6473	3.14	89.37	15.20	118.60	525	0.10	135.9	0.63	0.71	87%
Weinbrenner Road	MH31A	MH30A	0.44	50.52	45.5	21	6494		15.20	14.15	6494	3.14	89.62	15.20	118.97	525	0.10	135.9	0.63	0.71	88%
Weinbrenner Road	MH30A	MH29A	0.20	50.72	45.5	10	6504		15.20	14.20	6504	3.14	89.74	15.20	119.15	525	0.10	135.9	0.63	0.71	88%
Weinbrenner Road	MH29A	MH28A	1.14	51.86	79.8	91	6595		15.20	14.52	6595	3.13	90.83	15.20	120.55	525	0.10	135.9	0.63	0.71	89%
Weinbrenner Road	MH28A	MH27A		51.86	45.5		6595	90.50	105.70	14.52	6595	3.13	90.83	105.70	211.05	600	0.20	274.5	0.97	1.07	77%
Weinbrenner Road	MH27A	MH26A	37.26	89.12	90.2	3361	9956		105.70	24.95	9956	2.96	129.46	105.70	260.12	600	0.21	281.2	0.99	1.13	92%
Nassau Avenue	MH26A	MH25A	0.71	89.83	45.5	33	9989		105.70	25.15	9989	2.96	129.83	105.70	260.68	600	0.21	281.2	0.99	1.13	93%
Southerland Court	MH55A	MH54A	0.82	0.82	45.5	38	38			0.23	38	4.00	0.67		0.90	250	1.00	59.4	1.21	0.42	2%
Southerland Court	MH54A	MH53A	0.55	1.37	45.5	26	64			0.38	64	4.00	1.13		1.51	250	0.40	37.6	0.77	0.36	4%
Southerland Court	MH53A	MH52A	0.22	1.59	45.5	11	75			0.45	75	4.00	1.32		1.76	250	0.40	37.6	0.77	0.38	5%
Southerland Court	MH52A	MH25A	0.29	1.88	45.5	14	89			0.53	89	4.00	1.57		2.09	250	0.40	37.6	0.77	0.41	6%
Nassau Avenue	MH25A	MH24A	0.43	92.14	45.5	20	10098		105.70	25.80	10098	2.95	131.04	105.70	262.54	600	0.21	281.2	0.99	1.13	93%
Nassau Avenue	MH24A	MH23A	0.37	92.51	45.5	17	10115		105.70	25.90	10115	2.95	131.23	105.70	262.83	600	0.21	281.2	0.99	1.13	93%
Lyon's Parkway	MH23A	MH22A	11.00	103.51	45.5	501	10616	0.00	105.70	28.98	10616	2.93	136.75	105.70	271.43	375	0.33	100.7	0.91	1.04	270%



Hydrant Flow Test Report

SITE NAME SITE ADDRE TEST HYDR BASE HYDR	: ESS / MUNICIPA ANT LOCATION	NLITY: I : N:	Willoughby I Front of # 8 (Hyd By # 872 (Hyd	Drive Niag 3563 Willou Irant ID # 0 9 Willough Irant ID # 0	ara Falls, On Ighby Drive 2029) Iby Drive 2032)		TEST DATE: Nov 14,2022 TEST TIME:						
TEST BY:	Luzia Wood	ł					9.30AIVI						
TEST DATA													
FLOW HYDRANT Pipe (in			8inch										
			PITOT 1		PITOT 2								
	SIZE OPENIN	G (inches):	2.5		2.5								
	COEFFICIENT	(note 1):	0.90		0.90								
	PITOT READI	NG (psi):	65		42 / 42								
	FLOW (usgpm	ı):	1353		2175								
	THEORETIC	al flow @) 20 PSI	5625									
BASE HY	DRANT	Pipe Diam. (in / mm)	8inch										
STATIC READING (psi):		90	RESIDUAL 1 (psi):	85	RESIDUAL 2 (psi):	80	_						
REMARKS:													

NOTE 1: Conversion factor of .90 used for flow calculation based on rounded and flush internal nozzle configuration. No appreciable difference in pipe invert between flow and base hydrants.



L & D Waterworks Inc.

491 Port Maitland Rd Dunnville, ON N1A 2W6 Ph: 289.684.6747









	Year: 2022									
		DWF Statistics	6	Monthl	y Average/Totals	i	Instant	Storm Factor	4	4
	Daily	Peak	Peak Factor	Max Daily Average Flow	% DWF to Max	Monthly Total	Peak		Daily Average High	Peak Flow High
Jan	Missing Data	Missing Data	Missing Data	Missing Data	Missing Data	Missing Data	0.00	Jan		
Feb	38.55	53.08	1.377	259.33	673%	Missing Data	528.70	Feb	yes	yes
Mar	44.65	57.60	1.290	157.26	352%	176499.87	277.30	Mar		
Apr	32.07	44.45	1.386	86.70	270%	118642.75	233.80	Apr		
Мау	25.41	33.00	1.299	93.89	370%	94885.62	169.80	Мау		
Jun	23.69	31.86	1.345	64.46	272%	Missing Data	119.80	Jun		
Jul	22.59	28.99	1.283	116.97	518%	75495.54	612.50	Jul	yes	yes
Aug	22.58	31.38	1.390	90.57	401%	87339.72	410.30	Aug	yes	
Sep	21.43	31.94	1.491	55.47	259%	Missing Data	132.00	Sep		
Oct	20.41	29.01	1.422	157.50	772%	Missing Data	267.20	Oct	yes	yes
Nov	Missing Data	Missing Data	Missing Data	Missing Data	Missing Data	Missing Data	0.00	Nov		
Dec	Missing Data	Missing Data	Missing Data	Missing Data	Missing Data	Missing Data	0.00	Dec		
							_			
Year to Date	27.92993162	37.92407407	1.364721506	259.3296992	929%	552863.502				

Instant. Peak is the highest instantaneous flow showing a big impact of the wet weather flows to the catchment/station.

2022 DWF Statisics


Willoughby Drive Sanitary Sewer Analysis

Option 2 - Post Development Dry Weather

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1/0-	1		£ ¦	440	£	₿ 		A NA	11.8	tt i	ŧ	20 4 4 4 0 4 0	£,	#	5Å 92 92	4		
177.5	184 ft	44	84 86 6			8 H 8	ч		68, 68, 0A	122	404 20 20 20 20 20 20 20 20 20 20 20 20 20	100 - 100 -	7Å ft 29 [268	유년	MH2 61 67.	₽ © ₽		
177	HH 1201	2	8-6	4 G2 3	9 1 - 0 - 0 2 - 1 - 0		4.0	2 4 6 1 4 6	ин: Ин: ин: ин:		H & G		199 199 199	с. щ	E C S	. 30		
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110.0	e a a	e.	rert	N A H D A A A A A A A A A A A A A A A A A A A		DVe DVe	a Nu	D a de	A A A		d a d d a d d a d d a d d d d	Z A H	ert ode	in Noe	In No	a A	. 57 L67	
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175.5												T				e	4 1 	
475					· · · · · · · · · · · · · · · · · · ·					1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1						PA PA	R H	
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<u>6</u> 172.5																	· · · · ·	
172		ink ID Pine 41	-						10.11.1									
۳ m	Le	ngth 107.85 ft	Link ID Pipe 42	Link ID Pipe 43					-	_		-						
171.5		Dia 0.45 m	Dia 0.45 m	Length 107.66 ft	Link ID Pipe 44	Link ID Pipe 45	Link ID Ding (16		2								
171	Un	pe 0.0012 m/m Invert 170.02 ft	Slope 0.0012 m/r	n Dia 0.45 m	Dia 0.45 m	Length 94.33 ft	Length 106.4	8 ft Link ID Pipe 47	Link ID Pine 48	Same State of the second								
	Dn	Invert 169.89 ft	Up Invert 169.86	ft Up Invert 169.70 ft	Slope 0.0013 m/m	Dia 0.53 m Slope 0.0010 m/m	Dia 0.53 m	Length 104.34 ft	Length 91.66 ft	Link ID Pipe 49	Link ID Pipe 50	ink ID Pine	51					
170.5				Dn Invert 169.55 ft	Up Invert 169.51 ft	Up Invert 169.32 ft	Slope 0.0010 i	m/m Slope 0.0012 m/m	Dia 0.53 m	Dia 0.53 m	Length 121.38 ft	Length 61.5	in ID Pipe	52 Link ID Pipe 53				
170	·····					Dn Invert 169.23 ft	Dn Invert 169.	09 ft Up Invert 169.07 ft	Slope 0.0012 m/m	Slope 0.0017 m/r	n Dia 0.53 m	Dia 0.60	rength 41.1	Length 93.59 f	t Link ID Pipe 54	Link ID Pine 55		υ
								Dn Invert 168.94 ft	Dn Invert 168.81 fl	Up Invert 168.79	ft Slope 0.0007 m/m Up Invert 168.59 ft	Sope 0.0028	Q107+0.0022	Dia 0.60 m	Length 67.35 ft	Length 94.02 ft		1 Pi
169.5											Dn Invert 168.51 ft	Dn nvert 16	10 mg Rrt 168	15 ope 0.0026 m/ 29 ff Lip Invert 168.17	18 lope 0.0013 m/	Dia 0.60 m	Link D Pipe :	56
169							1						h Invert 168.	Dn Invert 167.93	ttip Invert 167.92	Slope 0.0020 m/m In Invert 167 80 ft	Dia 0.38 m	
									- 10 - 10 - 10						Dn Invert 167.83	Bn Invert 167.61 ft	Slope 0.0014	m/m A
168.5 -																	Up Invert 167.	53 #
168	22222																	
167.5																		Q
107.0																		
167																		
166.5																		
100.0 [1+00	1+50 2+00) 2+50 3+	00 3+50 4+00	4+50 5+00	5+50 6+00	6+50 7+0	0 7+50 8+00	8+50 9+00	9+50 10+00	10+50 11+00	1+50 12+	00 12+	50 13+00	13+50 14+00	14+50 15+0	0 15+50 16+00) 16+50 17+0
									Station (ft)									
Node ID:	MH18A	MH:	37A	MH36A MI	Н35А М	Н34А МН	133A	MH32A M	H31A MH	130A N	1H29A I	4H28A N	4H27A MH	26A M	MH25A MH	24A MH	23A	Out-1Pipe 56
Rim (ft):	175.31	175	5.18	175.51 13	75.16 1	75.36 17	5.41	175.40 1	5.59 17	5.21	175.27	175.72	175.16 175	5.37	175.61 175	5.30 174	l.57	
Invert (ft):	170.02	169	9.86	169.70 16	69.51 1	69.32 16	9.20	169.07 10	8.92 16	8.79	168.59	168.49	168.29 168	3.17	167.92 167	7.80 167	7.53	167.31
Min Pipe Cover (m):	4.84	4.5	84	5.33 5	5.16 !	5.52 5.	.65	5.78	5.13 5	5.88	6.13	6.63	6.24 6.	57	7.08 6.	87 6.	36	
Max HGL (ft):	172.25	172	2.18	172.11 13	72.04 1	71.97 17	1.94	171.86 1	1.78 17	1.71	171.63	171.54	171.45 171	.35	171.18 171	1.04 170).86	167.66
Link ID:		Pipe 41	Pipe 42	Pipe 43	Pipe 44	Pipe 45	Pipe 46	Pipe 47	Pipe 48	Pipe 49	Pipe 50	Pipe 51	Pipe 52	Pipe 53	Pipe 54	Pipe 55	Pipe 56	
Length (ft):		107.85	108.34	107.66	107.99	94.33	106.48	104.34	91.66	101.72	121.38	61.51	41.12	93.59	67.35	94.02	157.47	
Dia (m):		0.0012	0.45	0.45	0.0010	0.0010	0.53	0.0012	0.0010	0.0017	0.007	0.60	0.60	0.60	0.60	0.60	0.0014	
Stope (m/m):	64 B	170.02	169.96	169.70	169.51	169.32	169.20	169.07	168.92	169.79	169.59	169./9	169.29	169.17	167.92	167.90	167.52	
Dn Invert (II):	8	169.89	169.73	169.55	169.37	169.23	169.09	168.94	168.81	168.62	168.51	168.32	168.20	167.93	167.83	167.61	167.31	
Max Q (cms):		0.07	0.07	0.07	0.07	0.08	0.12	0.12	0.12	0.12	0.12	0.21	0.25	0.25	0.26	0.26	0.26	
Max Vel (ft/s):		0.76	0.76	0.78	0.74	0.59	0.76	0.77	0.82	0.76	0.62	0.91	1.10	1.04	1.01	0.90	2.40	
Max Depth (m):		0.45	0.45	0.45	0.45	0.52	0.52	0.52	0.52	0.52	0.52	0.60	0.60	0.60	0.60	0.60	0.36	

Autodesk Storm and Sanitary Analysis



Autodesk® Storm and Sanitary Analysis 2016 - Version 13.5.195 (Build 0) _____ ***** Project Description **** File Name 23-02-06 SSA-post.SPF ***** Analysis Options *************** Flow Units cms Link Routing Method Hydrodynamic Storage Node Exfiltration.. None Starting Date MAY-31-2019 00:00:00 Ending Date JUN-02-2019 00:00:00 Report Time Step 00:05:00 ***** Element Count ********* Number of subbasins 0 Number of nodes 17 Number of links 16 ***** Node Summarv ********* Element Invert Maximum Ponded Type Elevation Elev. Area m m m² External Node ID Inflow _____ JUNCTION170.02175.310.000YesJUNCTION167.53174.570.000YesJUNCTION167.80175.300.000Yes MH18A MH23A MH24A 167.92175.610.000168.17175.370.000 JUNCTION MH25A Yes JUNCTION MH26A JUNCTION Yes 168.29 175.16 0.000 MH27A Yes 168.49 175.72 0.000 MH28A Yes 0.000 168.59 175.27 MH29A Yes 168.79 175.21 168.92 175.59 0.000 MH30A Yes MH31A Yes MH32A 169.07 175.40 0.000 Yes 169.20 175.41 169.32 175.36 0.000 MH33A Yes MH34A Yes 169.51175.160.000169.70175.510.000169.86175.180.000167.31167.690.000 MH35A Yes MH36A Yes MH37A JUNCTION Yes MH37A JUNCTION Out-1Pipe 56 OUTFALL ******** Link Summary ******** Length Slope Manning's m % Roughness Link From Node To Node Element ID Туре _____
 Pipe 41
 MH18A
 MH37A
 CONDUIT
 107.9
 0.2000
 0.0120

 Pipe 42
 MH37A
 MH36A
 CONDUIT
 108.3
 0.2000
 0.0120

 Pipe 43
 MH36A
 CONDUIT
 107.7
 0.2000
 0.0120

 Pipe 44
 MH35A
 CONDUIT
 107.7
 0.2000
 0.0120

 Pipe 44
 MH35A
 MH34A
 CONDUIT
 108.0
 0.2000
 0.0120

 Pipe 45
 MH34A
 MH33A
 CONDUIT
 94.3
 0.2000
 0.0120

 Pipe 46
 MH33A
 MH32A
 CONDUIT
 106.5
 0.2000
 0.0120

Autodesk Storm and Sanitary Analysis

Autodesk Storm and Sanitary Analysis

**************************************	Volume hectare-m	Volume Mliters
External Inflow	0.501	5.008
External Outflow	2.838	28.376
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.020	0.201

	-					
Cross Section *******	n Summary *****					
Link Design	Shape	Depth/	Width	No. of	Cross	Full Flow
ID		Diameter		Barrels	Sectional	Hydraulic
Flow					Area	Radius
Capacity					m 2	
cms		III	111		111	III
Pipe 41 0.14	CIRCULAR	0.45	0.45	1	0.16	0.11
Pipe 42	CIRCULAR	0.45	0.45	1	0.16	0.11
Pipe 43	CIRCULAR	0.45	0.45	1	0.16	0.11
0.14 Pipe 44	CIRCULAR	0.45	0.45	1	0.16	0.11
0.14 Pipe 45	CIRCULAR	0.53	0.53	1	0.22	0.13
0.21 Dime 46		0 50	0 53	-	0.22	0.12
0.21	CIRCULAR	0.55	0.55	Ţ	0.22	0.13
Pipe 47 0.21	CIRCULAR	0.53	0.53	1	0.22	0.13
Pipe 48	CIRCULAR	0.53	0.53	1	0.22	0.13
Pipe 49	CIRCULAR	0.53	0.53	1	0.22	0.13
0.21 Pipe 50	CIRCULAR	0.53	0.53	1	0.22	0.13
0.21 Dime 51	OTDOUT ND	0.00	0.60	1	0.20	0.15
0.35	CIRCULAR	0.60	0.60	Ţ	0.28	0.15
Pipe 52 0.31	CIRCULAR	0.60	0.60	1	0.28	0.15
Pipe 53	CIRCULAR	0.60	0.60	1	0.28	0.15
0.34 Pipe 54	CIRCULAR	0.60	0.60	1	0.28	0.15
0.30 Pipe 55	CIRCULAR	0.60	0.60	1	0.28	0.15
0.30 Dino 56	CIDCULAD	0.20	0.38	-	0 11	0.00
0.08	CIRCULAR	0.00	0.30	Ţ	0.11	0.09

Pipe 47	MH32A	MH31A	CONDUIT	104.3	0.2000	0.0120
Pipe 48	MH31A	MH30A	CONDUIT	91.7	0.2000	0.0120
Pipe 49	MH30A	MH29A	CONDUIT	101.7	0.2000	0.0120
Pipe 50	MH29A	MH28A	CONDUIT	121.4	0.2000	0.0120
Pipe 51	MH28A	MH27A	CONDUIT	61.5	0.2764	0.0120
Pipe 52	MH27A	MH26A	CONDUIT	41.1	0.2189	0.0120
Pipe 53	MH26A	MH25A	CONDUIT	93.6	0.2564	0.0120
Pipe 54	MH25A	MH24A	CONDUIT	67.4	0.2000	0.0120
Pipe 55	MH24A	MH23A	CONDUIT	94.0	0.2021	0.0120
Pipe 56	MH23A	Out-1Pipe 56	CONDUIT	157.5	0.2000	0.0120

Continuity Error (%) -0.003

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

Node ID	Average Depth Attained	Maximum Depth Attained	Maximum HGL Attained	Time Occu	of Max irrence	Total Flooded Volume	Total Time Flooded	Retention Time
	m	m	m	days	hh:mm	ha-mm	minutes	hh:mm:ss
MH18A	0.40	2.23	172.25	1	18:59	0	0	0:00:00
MH23A	1.28	3.33	170.86	1	19:00	0	0	0:00:00
MH24A	1.09	3.24	171.04	1	19:00	0	0	0:00:00
MH25A	1.04	3.26	171.18	1	19:00	0	0	0:00:00
MH26A	0.88	3.18	171.35	1	18:59	0	0	0:00:00
MH27A	0.84	3.16	171.45	1	18:59	0	0	0:00:00
MH28A	0.71	3.05	171.54	1	18:59	0	0	0:00:00
MH29A	0.71	3.04	171.63	1	19:00	0	0	0:00:00
MH30A	0.61	2.92	171.71	1	19:00	0	0	0:00:00
MH31A	0.61	2.86	171.78	1	19:00	0	0	0:00:00
MH32A	0.58	2.79	171.86	1	19:00	0	0	0:00:00
MH33A	0.57	2.74	171.94	1	19:00	0	0	0:00:00
MH34A	0.52	2.65	171.97	1	18:59	0	0	0:00:00
MH35A	0.47	2.53	172.04	1	19:00	0	0	0:00:00
MH36A	0.44	2.41	172.11	1	18:59	0	0	0:00:00
MH37A	0.42	2.32	172.18	1	18:59	0	0	0:00:00
Out-1Pipe 56	0.28	0.35	167.66	1	19:00	0	0	0:00:00

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Node Flow Summary ********

Node		Element	Maximum	Peak	Т	ime of	Maximum	Time of Peak
ID		Type	Lateral	Inflow	Peak	Inflow	Flooding	Flooding
			Inflow		Occu	rrence	Overflow	Occurrence
			cms	CMS	days	hh:mm	CMS	days hh:mm
MH18A		JUNCTION	0.072	0.072	0	18:00	0.00	
MH23A		JUNCTION	0.009	0.263	1	19:00	0.00	
MH24A		JUNCTION	0.000	0.255	1	19:00	0.00	
MH25A		JUNCTION	0.002	0.255	1	18:59	0.00	
MH26A		JUNCTION	0.001	0.254	1	18:59	0.00	
MH27A		JUNCTION	0.049	0.255	1	18:59	0.00	
MH28A		JUNCTION	0.090	0.206	1	18:59	0.00	
MH29A		JUNCTION	0.001	0.120	1	20:00	0.00	
MH30A		JUNCTION	0.000	0.117	1	19:00	0.00	
MH31A		JUNCTION	0.000	0.116	1	18:59	0.00	
MH32A		JUNCTION	0.001	0.116	1	18:59	0.00	
MH33A		JUNCTION	0.034	0.116	1	18:59	0.00	
MH34A		JUNCTION	0.009	0.082	1	18:59	0.00	
MH35A		JUNCTION	0.001	0.075	0	17:21	0.00	
MH36A		JUNCTION	0.001	0.073	0	17:24	0.00	
MH37A		JUNCTION	0.001	0.073	1	18:59	0.00	
Out-1Pipe 5	56	OUTFALL	0.000	0.263	1	19:00	0.00	

***** Outfall Loading Summary

Outfall	Node	ID	Flow	Average	Peak

Autodesk Storm and Sanitary Analysis

	Frequency (%)	Flow cms	Inflow cms
Out-1Pipe 56	99.99	0.152	0.263
System	99.99	0.152	0.263

Link I Ratio of	іD Е П	Element Cotal Reported	Tir	me of	Maximum	Length	Peak Flow	Design	Ratio of
Manimum		Type	Peak	Flow	Velocity	Factor	during	Flow	Maximum
Maximum	1		Occur	rence	Attained		Analysis	Capacity	/Design
Flow Su	ircharged	1	, ,	,	1				
Depth	minute	es	days I	nn:mm	m/sec		cms	cms	FIOW
Pipe 4	11 700	CONDUIT	1 1	18:59	0.76	1.00	0.072	0.138	0.52
I.UU Bipo 4	138	CONDUTT	0	17.24	0.76	1 00	0 072	0 130	0 52
1.00	78.5	SURCHARGED	0.	1/.24	0.70	1.00	0.072	0.130	0.52
Pipe 4	13	CONDUIT	0	17:21	0.78	1.00	0.074	0.138	0.53
1.00	866	5 SURCHARGED							
Pipe 4	14	CONDUIT	1 :	19:00	0.74	1.00	0.073	0.138	0.53
1.00	937	SURCHARGED							
Pipe 4	15	CONDUIT	1 1	19:00	0.59	1.00	0.082	0.208	0.40
1.00 Dipo 4	970	CONDUT	1 -	10.50	0.76	1 00	0 115	0 200	0 55
1 00	1024	L SUBCHARGED	1	10:39	0.70	1.00	0.115	0.200	0.55
Pipe 4	17	CONDUTT	1	19:00	0.77	1.00	0.116	0.208	0.55
1.00	1086	5 SURCHARGED							
Pipe 4	18	CONDUIT	1 1	19:00	0.82	1.00	0.116	0.208	0.56
1.00	1149	SURCHARGED							
Pipe 4	19	CONDUIT	1 2	20:00	0.76	1.00	0.119	0.208	0.57
1.00	1190) SURCHARGED							
Pipe 5	1075	CONDUIT	1 3	20:00	0.62	1.00	0.123	0.208	0.59
I.UU Pine 5	1 12/5	CONDUTT	1 .	18.59	0 91	1 00	0 206	0 350	0 59
1.00	1269	SURCHARGED	± .	10.00	0.91	1.00	0.200	0.550	0.00
Pipe 5	52	CONDUIT	1 1	18:59	1.10	1.00	0.254	0.311	0.82
1.00	1422	SURCHARGED							
Pipe 5	53	CONDUIT	1 1	19:00	1.04	1.00	0.253	0.337	0.75
1.00	1582	2 SURCHARGED							
Pipe 5	54	CONDUIT	1 :	19:00	1.01	1.00	0.255	0.298	0.86
1.00	2029	SURCHARGED	1	10.00	0 00	1 0 0	0 055	0 000	0.05
1 00)) 2015	CONDULT	1.	19:00	0.90	1.00	0.255	0.299	0.85
Pipe 5	2311 16	CONDUTT	1 .	19:00	2.40	1.00	0.263	0.085	3.09
0.97	() > CAPACITY							

* * * * *	*****	* * * *	* * * * * * * * * * * * * * * * * * * *
Highe	est Fl	ow	Instability Indexes
****	*****	* * *	* * * * * * * * * * * * * * * * * * *
Link	Pipe	52	(4)
Link	Pipe	54	(4)
Link	Pipe	53	(4)
Link	Pipe	51	(4)

Link Pipe 50 (3)

WARNING 108 : Surcharge elevation defined for Junction MH18A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH23A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH24A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH25A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH26A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH27A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH28A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH29A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH30A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH31A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH32A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH33A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH34A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH35A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH36A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 108 : Surcharge elevation defined for Junction MH37A is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation. WARNING 005 : Minimum slope used for Conduit Pipe 41. WARNING 005 : Minimum slope used for Conduit Pipe 42. WARNING 005 : Minimum slope used for Conduit Pipe 43. WARNING 005 : Minimum slope used for Conduit Pipe 44. WARNING 005 : Minimum slope used for Conduit Pipe 45. WARNING 005 : Minimum slope used for Conduit Pipe 46. WARNING 005 : Minimum slope used for Conduit Pipe 47. WARNING 005 : Minimum slope used for Conduit Pipe 48. WARNING 005 : Minimum slope used for Conduit Pipe 49. WARNING 005 : Minimum slope used for Conduit Pipe 50. WARNING 005 : Minimum slope used for Conduit Pipe 54. WARNING 005 : Minimum slope used for Conduit Pipe 56. Analysis began on: Wed Feb 8 14:07:37 2023 Analysis ended on: Wed Feb 8 14:07:38 2023

Autodesk Storm and Sanitary Analysis

Total elapsed time: 00:00:01

Hydrant Flow Test Report

SITE NAME SITE ADDRE TEST HYDR BASE HYDR	: ESS / MUNICIPA ANT LOCATION	NLITY: I : N:	Willoughby I Front of # 8 (Hyd By # 872 (Hyd	Drive Niag 3563 Willou Irant ID # 0 9 Willough Irant ID # 0	ara Falls, On Ighby Drive 2029) Iby Drive 2032)		TEST DATE: Nov 14,2022 TEST TIME:
TEST BY: Luzia Wood							9.30AIVI
			<u>TI</u>		<u> </u>		
FLOW HY	′DRANT	Pipe Diam. (in / mm)	8inch				
			PITOT 1		PITOT 2		
	SIZE OPENIN	G (inches):	2.5		2.5		
	COEFFICIENT	(note 1):	0.90		0.90		
	PITOT READI	NG (psi):	65		42 / 42		
	FLOW (usgpm	ı):	1353		2175		
	THEORETIC	al flow @) 20 PSI	5625			
BASE HY	DRANT	Pipe Diam. (in / mm)	8inch				
STATIC READING (psi): 90		RESIDUAL 1 (psi):	85	RESIDUAL 2 (psi):	80	_	
REMARKS:							

NOTE 1: Conversion factor of .90 used for flow calculation based on rounded and flush internal nozzle configuration. No appreciable difference in pipe invert between flow and base hydrants.



L & D Waterworks Inc.

491 Port Maitland Rd Dunnville, ON N1A 2W6 Ph: 289.684.6747



Fire Flow Calculation

Project: Willoughby Drive Development Project No.: 221377 Municipality: City of Niagara Falls

GUIDE FOR CALCULATING CAPACITY AT 20psi FOR FIRE FLOW (as per the NFPA 291: Recommended Practice for Fire Flow Testing and Marking of Hydrants. (2010). (Section 4.10.1.2.))

The Formula for Calculating Rated Capacity at 20psi

$Q_{R} = Q_{F} \times (H_{R} / H_{F})^{0.54}$

Where:

Based on hydrant flow test by Aquazition, November 14, 2022

Q_R = Rated Capacity at 20psi (in GPM)

 Q_F = Total test flow (in GPM)

H_R = Static Pressure minus 20 psi

H_F = Static Pressure minus Residual Pressure

Flow Test Parameters:	1 Port	
Static Pressure		90.0
Residual Pressure		85.0
Test Flow Rate		1353

Q _R =	5626 GPM
	21,297 L/min

Fire Flow Calculation at 30psi

Project: Willoughby Drive Development Project No.: 221377 Municipality: City of Niagara Falls

GUIDE FOR CALCULATING CAPACITY AT 20psi FOR FIRE FLOW (as per the NFPA 291: Recommended Practice for Fire Flow Testing and Marking of Hydrants. (2010). (Section 4.10.1.2.))

The Formula for Calculating Rated Capacity at 20psi

$Q_{R} = Q_{F} \times (H_{R} / H_{F})^{0.54}$

Where:

Based on hydrant flow test by Aquazition, November 14, 2022

Q_R = Rated Capacity at 20psi (in GPM)

 Q_F = Total test flow (in GPM)

 H_R = Static Pressure minus 20 psi

H_F = Static Pressure minus Residual Pressure

Flow Test Parameters:	1 Port	
Static Pressure		90.0
Residual Pressure		85.0
Test Flow Rate		1353

Q _R =	5177	GPM
	19,596	L/min