



File: 22176

FUNCTIONAL SERVICING REPORT

Glenwood Condominium, Welland March 2026

INTRODUCTION

This report is to address the servicing needs for the 22-unit townhouse development located at the south limit of Glenwood Parkway, south of Stanley Street in the City of Welland. The development site has historically been forested vacant land and located in proximity to Provincially Significant Wetlands to the south and west.

The development site is approximately 0.77 hectares and shall consist of 22 townhouse condominiums. The site shall include associated asphalt road, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain. The proposed development plan will include the extension of Glenwood Parkway to the site to provide a suitable entrance.

The objectives of this study are as follows:

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



WATER SERVICING

There is an existing 150mm diameter Cast Iron municipal watermain located on the north side of Stanley Street and the intersection of Glenwood Parkway. To provide adequate domestic supply and fire protection for this development, it is proposed to extend the existing watermain south on Glenwood Parkway and into the subject site.

Utilizing a density of 2.4 persons/unit per the Niagara Official Plan, the proposed development will result in a total population of 53 persons based on 22 units. Per the 2021 Regional Water Master Servicing Plan Update (MSPU), 240 L/cap/day is attributed as the average residential daily demand. However, a more conservative value of 270 L/cap/day has been utilized in accordance with the MECP Water Design Guidelines. Additionally, peaking factors of 2.75 and 4.13 can be used for maximum daily and peak hourly rates. Therefore, the average day, maximum day, and peak hour domestic requirements will be 0.07L/s, 19L/s, and 0.29L/s, respectively.

As part of this approval, a Fire Underwriters Survey (FUS) Calculation is required by the City of Welland and has been included in Appendix A to determine the minimum fire flow requirement based on the preliminary design for the development at this time. The calculation utilizes key parameters such as the type of construction, combustibility of contents and proximity to adjacent structures to determine the minimum fire flow required to provide adequate fire protection.

The calculations for this site have been completed using certain design measures to reduce the minimum fire flow requirement:

- The basements will be constructed at least 50% below grade
- The units will only be 1-storey
- Fire walls will be implemented between units 14/15 and between units 20/21

Per the Fire Underwriters Survey (2020) calculations included in Appendix A, a minimum fire flow of **83.3L/s** will be required at a pressure of 20psi (140kPa) under fire flow conditions.

Through previous Site Plan Applications for this property, a watermain analysis through the City's model determined that an upsizing of the Stanley Street watermain to 200mm diameter would be required to obtain the minimum fire flow of 137.5L/s. With the significantly reduced fire flow requirement for this site, it is anticipated that the Stanley Street watermain upsizing will not be necessary.

A hydrant fire flow calculation has been completed to determine the expected flow rate from the proposed on-site private hydrant that incorporates a 150mm diameter service from the connection at Stanley Street to the development with a Neptune Mach 10 (150mm diameter) watermeter chamber. The analysis utilizes hydrant flow test results from the original Site Plan Application submissions in 2022. The analysis concludes that a theoretical hydrant



flow rate of **123.4L/s** could be provided by the on-site hydrant. Therefore, it is expected that the existing municipal watermain system will have sufficient capacity to provide both domestic and fire water supply for the proposed development.

SANITARY SERVICING

There is an existing 200mm diameter sanitary sewer on Stanley Street conveying flows west towards Thornton Avenue. It is proposed to extend the sanitary sewer to the intersection of Glenwood Parkway and south to the proposed development site to provide a suitable sanitary outlet. An Environmental Compliance Approval will be required and obtained for the proposed sanitary sewer extension from the existing sewer to the proposed development site.

As shown in the sanitary sewer calculations in Appendix B, the existing 200mm diameter sanitary sewer flowing south-west on Stanley Street has a full flow capacity of 19.05L/s. The peak sanitary flow from the proposed development equates to approximately 1.09L/s and is calculated to occupy approximately 5.7% of the capacity within the existing sanitary sewer. It is expected that this will be an acceptable addition to the current capacity.

STORMWATER MANAGEMENT PLAN

As part of the site development, the following is a summary of the Stormwater Management Plan.

The criteria provided by the City of Welland and Region of Niagara for this development includes the requirement to control future development stormwater flows to allowable levels from this site for up to and including the 100-year design storm event. It is also required to improve stormwater quality levels to MECP Enhanced Protection (80% TSS removal) levels prior to discharge to the existing conveyance ditch southeast of the subject property.

To limit future stormwater flows to allowable levels, typically a control is placed on the outlet from the site that may include an orifice and site stormwater storage. To improve stormwater quality, typically a stormwater oil/grit separator or other ETV verified device provides the required TSS (Total Suspended Solids) removal for this type of development.

Existing Conditions

As stated previously, the proposed development site has historically remained an undeveloped vacant lot resulting in a Runoff Coefficient of 0.20 shown in Figure 1 (Appendix C). The majority of stormwater flows from the central and eastern portion development site are directed to an existing swale at the north limits of the site conveying flows east and ultimately to a tributary of the Welland Recreational Canal located east of the site as shown



in Figure 1 (Appendix C). This tributary will be discussed as the East Ditch for the purpose of this report.

The south portion of the site directs flows directly to the east ditch and the western portion conveys flows to the west limits of the site. All stormwater flows conveyed overland from the site all ultimately flow to the East Ditch. The East Ditch conveys stormwater flows from a large drainage area north of Forks Road, to the Welland Recreational Canal via an outlet approximately 230m south of Talbot Avenue. It was constructed simultaneously with the construction of the current Welland Canal east of the site to provide drainage for a significant portion of Dain City.

It should be noted that with the recent development of the Dain East Subdivision north of Forks Road, a large reduction of stormwater flows being directed to the upper limit of the East Ditch at Forks Road has occurred. Per the Dain East Stormwater Management Plan (Upper Canada Consultants, August 2021), a reduction of approximately 34.0 hectares will be removed from contributing stormwater flows to the East Ditch resulting in a reduction in peak flows of approximately 22% during the 5 year event and 33% during the 100 year event.

Proposed Conditions

The proposed development will result in the construction of 22 townhomes with an associated parking lot on the subject site. Stormwater will be collected through an internal stormwater management system and discharged to the east ditch via headwall outlet.

The future development has been modelled to establish the peak stormwater flows and volumes once development has been concluded. As shown in Figure 2 (Appendix C), the proposed grading design for this development will direct stormwater flows from the majority of the rear yards to the perimeter of the site with the majority of rooftop and all interior flows to be captured by the on-site stormwater management system and discharged to a proposed swale conveying flows to the East Ditch. The proposed development will redirect the majority of stormwater flows currently conveyed to the existing swale at the north limits, to the East Ditch. Stormwater flows will discharge from a headwall located at the east property limit to a conveyance swale outletting to the East Ditch.

As the development will result in a significant increase in impervious area and therefore peak stormwater flows, quantity controls will be required for this site. A preliminary calculation has been conducted per the Modified Rational Method for existing and future development conditions using the City of Welland IDF curves for the 5 & 100 year design storm event. The results of the modelling are shown in the table below:



Design Storm Event	Existing Flows (EX)	Future Flows (L/s)			Minimum Storage (m³)
		Uncontrolled (A10)	Controlled (A20)	Allowable (A20)	
5 Year	38.8	13.9	108.0	24.9	89.8
100 Year	61.2	21.8	170.4	39.3	132.9

Therefore, it is expected that approximately 133m³ of underground pipe storage will be required within the site to provide sufficient peak flow quantity controls, up to and including the 100 year design storm event. During extreme storm events, stormwater flows unable to enter the on-site stormwater system will be directed out to the Glenwood Parkway road allowance.

Improve stormwater quality levels discharging from the site, it is expected that an oil/grit separator or other ETV verified device will be used. It is required by the City of Welland to provide stormwater quality enhancements to Enhanced Protection (80% TSS removal) levels.

Detailed quality and quantity calculations will be provided as part of future Site Plan Approval Application submissions.



CONCLUSIONS AND RECOMMENDATIONS

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

1. The existing 150mm diameter watermain will have sufficient capacity to provide both domestic and fire protection water supply.
2. The existing 200mm diameter municipal sanitary sewer on Stanley Street will have adequate capacity for the proposed residential development.
3. Stormwater quantity controls will be provided to allowable conditions up to and including the 100-year design storm event.
4. The site extreme stormwater overland route from the road system is to Glenwood Parkway.
5. Stormwater quality protection will be provided to Enhanced Protection (80% TSS removal) levels.

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

Yours very truly,

Kurt Tiessen, P.Eng.
March 31, 2026
Encl.



APPENDICES



APPENDIX A

**Fire Underwriters Survey Calculations
Hydrant Flow Calculations
Niagara Regional Fire Protection – Hydrant Flow Test**

Fire Underwriters Survey

Water Supply for Public Fire Protection (2020) Calculations

Glenwood Condo Units 1-5

Required Fire Flow in Litres per Minute	F=	5,000 (L/m)
		83.33 (L/s)
		1,321 (USgmp)

Type of Construction	C=	1.00
Ordinary Construction (brick or other masonry walls, combustible floor and interior).		

Total Floor Area in square metres (including all stories, excluding basements at least 50% below grade)	A=	529 (m2)
NOTE: Fire Walls that meet or exceed Nation Building Code of Canada (2 hour fire resistance) divide building.		

Total Number of Floors		1
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2. Combustibility of Contents (may not reduce fire flow demand below 2,000 L/min)	=	-15%
Limited Combustible		

3. Sprinkler Systems		
Is there a complete automatic sprinkler protection system per NFPA (Yes/No).	No	0%
Water supply standard for both system and fire department hose lines (Yes/No).	No	0%
Is system fully monitored (Yes/No).	No	0%

Total Sprinkler Reduction to Overall Fire Flow Demand		0%
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4. Spacial Separation of Neighbouring Structures (within 45 metres)

Location of Building:	Units 1-5	
Distance to Nearest Building to the North	-	0%
Distance to Nearest Building to the South	19.0 m	15%
Distance to Nearest Building to the East	22.0 m	10%
Distance to Nearest Building to the West	-	0%

Total Spacial Separation to Adjacent Structures		25%
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Additions		
Is roof wood shingles or shakes (Yes/No).	No	

Fire Underwriters Survey

Water Supply for Public Fire Protection (2020) Calculations

Glenwood Condo Units 6-8

Required Fire Flow in Litres per Minute	F=	<input type="text" value="5,000"/>	(L/m)
		<input type="text" value="83.33"/>	(L/s)
		<input type="text" value="1,321"/>	(USgmp)

Type of Construction	C=	<input type="text" value="1.00"/>
<input type="text" value="Ordinary Construction (brick or other masonry walls, combustible floor and interior)."/>		

Total Floor Area in square metres (including all stories, excluding basements at least 50% below grade)	A=	<input type="text" value="316.8"/>	(m2)
NOTE: Fire Walls that meet or exceed Nation Building Code of Canada (2 hour fire resistance) divide building.			

Total Number of Floors	<input type="text" value="1"/>
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2. Combustibility of Contents (<i>may not reduce fire flow demand below 2,000 L/min</i>)	=	<input type="text" value="-15%"/>
<input type="text" value="Limited Combustible"/>		

3. Sprinkler Systems		
Is there a complete automatic sprinkler protection system per NFPA (Yes/No).	<input type="text" value="No"/>	<input type="text" value="0%"/>
Water supply standard for both system and fire department hose lines (Yes/No).	<input type="text" value="No"/>	<input type="text" value="0%"/>
Is system fully monitored (Yes/No).	<input type="text" value="No"/>	<input type="text" value="0%"/>

Total Sprinkler Reduction to Overall Fire Flow Demand	<input type="text" value="0%"/>
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4. Spacial Separation of Neighbouring Structures (within 45 metres)

Location of Building:	<input type="text" value="Units 6-8"/>	
Distance to Nearest Building to the North	<input type="text" value="-"/>	<input type="text" value="0%"/>
Distance to Nearest Building to the South	<input type="text" value="19.0 m"/>	<input type="text" value="15%"/>
Distance to Nearest Building to the East	<input type="text" value=""/>	<input type="text" value="25%"/>
Distance to Nearest Building to the West	<input type="text" value="22.0 m"/>	<input type="text" value="10%"/>

Total Spacial Separation to Adjacent Structures	<input type="text" value="50%"/>
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Additions	
Is roof wood shingles or shakes (Yes/No).	<input type="text" value="No"/>

Fire Underwriters Survey

Water Supply for Public Fire Protection (2020) Calculations

Glenwood Condo Units 9-11

Required Fire Flow in Litres per Minute	F=	4,000 (L/m)
		66.67 (L/s)
		1,057 (USgmp)

Type of Construction	C=	1.00
Ordinary Construction (brick or other masonry walls, combustible floor and interior).		

Total Floor Area in square metres (including all stories, excluding basements at least 50% below grade)	A=	272.4 (m2)
NOTE: Fire Walls that meet or exceed Nation Building Code of Canada (2 hour fire resistance) divide building.		

Total Number of Floors		1
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2. Combustibility of Contents (may not reduce fire flow demand below 2,000 L/min)	=	-15%
Limited Combustible		

3. Sprinkler Systems		
Is there a complete automatic sprinkler protection system per NFPA (Yes/No).	No	0%
Water supply standard for both system and fire department hose lines (Yes/No).	No	0%
Is system fully monitored (Yes/No).	No	0%

Total Sprinkler Reduction to Overall Fire Flow Demand		0%
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4. Spacial Separation of Neighbouring Structures (within 45 metres)

Location of Building:	Units 9-11	
Distance to Nearest Building to the North	-	0%
Distance to Nearest Building to the South	-	0%
Distance to Nearest Building to the East	-	0%
Distance to Nearest Building to the West	2.5 m	25%

Total Spacial Separation to Adjacent Structures		25%
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Additions		
Is roof wood shingles or shakes (Yes/No).	No	

Fire Underwriters Survey

Water Supply for Public Fire Protection (2020) Calculations

Glenwood Condo Units 12-14

Required Fire Flow in Litres per Minute	F=	5,000 (L/m)
		83.33 (L/s)
		1,321 (USgmp)

Type of Construction	C=	1.00
Ordinary Construction (brick or other masonry walls, combustible floor and interior).		

Total Floor Area in square metres (including all stories, excluding basements at least 50% below grade)	A=	271.9 (m2)
NOTE: Fire Walls that meet or exceed Nation Building Code of Canada (2 hour fire resistance) divide building.		

Total Number of Floors		1
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2. Combustibility of Contents (may not reduce fire flow demand below 2,000 L/min)	=	-15%
Limited Combustible		

3. Sprinkler Systems		
Is there a complete automatic sprinkler protection system per NFPA (Yes/No).	No	0%
Water supply standard for both system and fire department hose lines (Yes/No).	No	0%
Is system fully monitored (Yes/No).	No	0%

Total Sprinkler Reduction to Overall Fire Flow Demand		0%
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4. Spacial Separation of Neighbouring Structures (within 45 metres)

Location of Building:	Units 12-14	
Distance to Nearest Building to the North	18.0 m	15%
Distance to Nearest Building to the South	-	0%
Distance to Nearest Building to the East	2.5 m	25%
Distance to Nearest Building to the West	-	0%

Total Spacial Separation to Adjacent Structures		40%
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Additions		
Is roof wood shingles or shakes (Yes/No).	No	

Fire Underwriters Survey

Water Supply for Public Fire Protection (2020) Calculations

Glenwood Condo Units 18-20

Required Fire Flow in Litres per Minute	F=	5,000 (L/m)
		83.33 (L/s)
		1,321 (USgmp)

Type of Construction	C=	1.00
Ordinary Construction (brick or other masonry walls, combustible floor and interior).		

Total Floor Area in square metres (including all stories, excluding basements at least 50% below grade)	A=	291.9 (m2)
NOTE: Fire Walls that meet or exceed Nation Building Code of Canada (2 hour fire resistance) divide building.		

Total Number of Floors		1
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2. Combustibility of Contents (may not reduce fire flow demand below 2,000 L/min)	=	-15%
Limited Combustible		

3. Sprinkler Systems		
Is there a complete automatic sprinkler protection system per NFPA (Yes/No).	No	0%
Water supply standard for both system and fire department hose lines (Yes/No).	No	0%
Is system fully monitored (Yes/No).	No	0%

Total Sprinkler Reduction to Overall Fire Flow Demand		0%
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4. Spacial Separation of Neighbouring Structures (within 45 metres)

Location of Building:	Units 18-20	
Distance to Nearest Building to the North	19.0 m	15%
Distance to Nearest Building to the South	-	0%
Distance to Nearest Building to the East	2.5 m	25%
Distance to Nearest Building to the West	-	0%

Total Spacial Separation to Adjacent Structures		40%
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Additions		
Is roof wood shingles or shakes (Yes/No).	No	

Headloss in a Single Ended Lead for Fire Hydrant

Project: GLENWOOD CONDOMINIUM
 Project Number: 22176
 Date: MARCH 30, 2026
 Prepared by: Kurt Tiessen, P.Eng.

Proposed Hydrant: On Site

Single Lead Length (m):	72.0m	
Single Lead Diameter (mm):	150mm	0.15m
Hydrant Elevation (m):	175.15m	
Theoretical Flow at 20PSI (L/s):	120.75 L/s	1914 USgpm
Hydrant Rating (NFPA 291):	BLUE	
Fire Pressure (PSI):	20PSI	137895.14 Pa

Backflow Preventor:	None	.0 PSI
Fireflow Meter:	Neptune 6" Mach 10	1.6 PSI

	SINGLE	INTERNAL	
Total Number of 90° Elbows:	0	0	ke = 0.9
Valves:	4	0	ke = 0.2
Total Number of 45° Elbows:	2	0	ke = 0.4
Reducer:	0	0	ke = 0.06
Increaser:	0	0	ke = 0.15
Number Tee Fittings (straight):	1	0	ke = 0.4
Number of Tee Fittings (turn):	1	0	ke = 1.8

Known Hydrant - Stanley & Glenwood

Approximate Elevation (m):	174.80m	
Known Static Pressure (PSI):	58PSI	399895.91 Pa
Feeder Main Diameter (mm):	150mm	0.15m

	INTERNAL LOOP		
	SINGLE	SMALL	LARGE
D:	0.15	0.00	0.00
Re:	6.79E+05	5.09E+15	5.09E+15
V2:	6.83 m/s	7.69E+20	7.69E+20
Q:	0.1208 m3/s	0.0604 m3/s	0.0604 m3/s
A:	0.018 m2	0.000 m2	0.000 m2
y:	1.51E-06		
ks:	0.0000015		
f:	0.013	0.013	0.013
Density:	9810		
g:	9.81 m2/s		

Bernoulli Terms

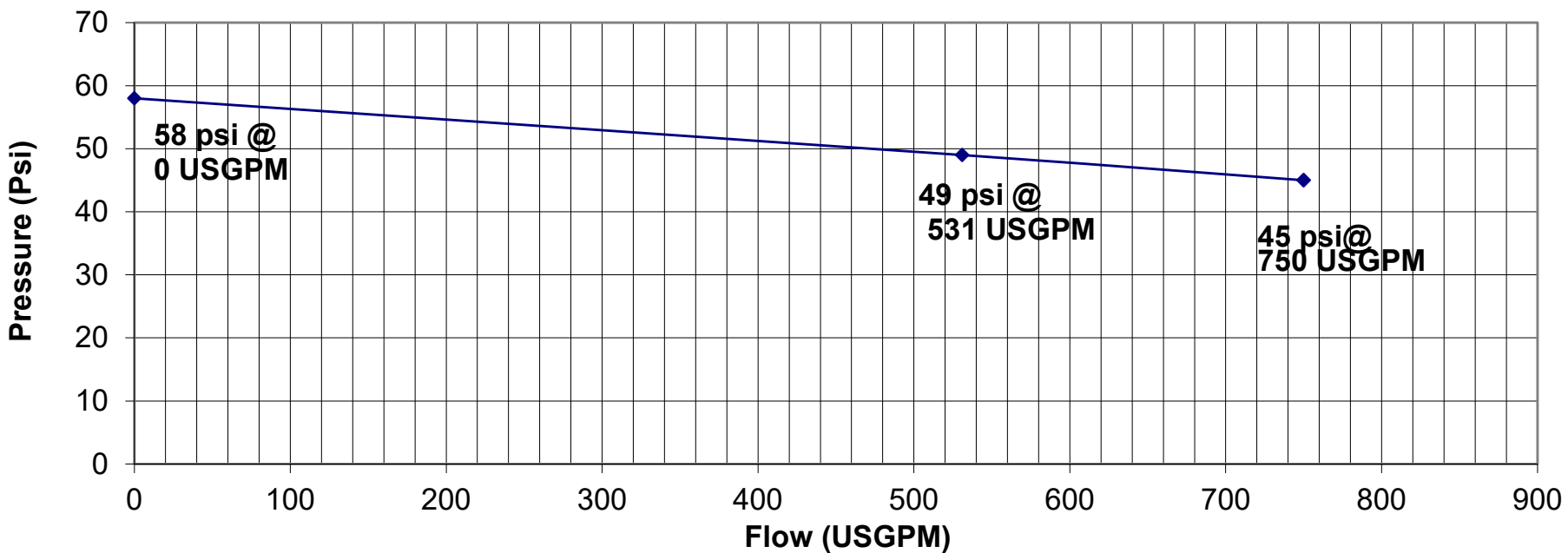
P1:	40.76 m	P2:	14.06 m
V1:	0.59 m	V2:	2.38 m
z1:	174.80m	Z2:	175.15m
		Fittings:	9.04 m
		Backflow:	0.00 m
		Fire:	1.15 m
		Straight:	14.39 m
TOTAL HEAD 1:	216.16 m	=	216.16 m

NIAGARA REGIONAL FIRE PROTECTION INC.

Flow Test Location: Stanley St. & Glenwood Parkway

Static Pressure (Psi)		Pitot Reading 1	10	# of Outlets Flowed 1	1
	58	Outlet Size 1	2.5	# of Outlets Flowed 2	2
Residual Pressure 1 (Psi)		Pitot Reading 2	5	# of Outlets Flowed 3	2
	49	Outlet Size 2	2.5	Graph Data:	
Residual Pressure 2 (Psi)		Pitot Reading 3	5	Pressure Values (y-axis)	Flow Values (x-axis)
	45	Outlet Size 3	2.5	58	0
Residual Pressure 3 (Psi)		Flow 1 Calculated		49	531
	45		530.6	45	750
		Flow 2 Calculated		45	750
			750.4	Date & Time of Test :	
Coefficient value		Flow 3 Calculated		Oct. 7/2022	
	0.9		750.4	9:00am	
				Performed by:	
				Alex & Sean	

Water Graph





APPENDIX B

Sanitary Flow Calculations

UPPER CANADA CONSULTANTS

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

DESIGN FLOWS

RESIDENTIAL: 255 LITRES/PERSON/DAY (AVERAGE DAILY FLOW)
 INFILTRATION RATE: 0.286 L / s / ha (M.O.E FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 L / s / ha)
 POPULATION DENSITY: 2.4 PERSONS / UNIT

SEWER DESIGN

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

MUNICIPALITY: CITY OF WELAND

PROJECT : GLENWOOD CONDO

SANITARY SEWER DESIGN SHEET

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

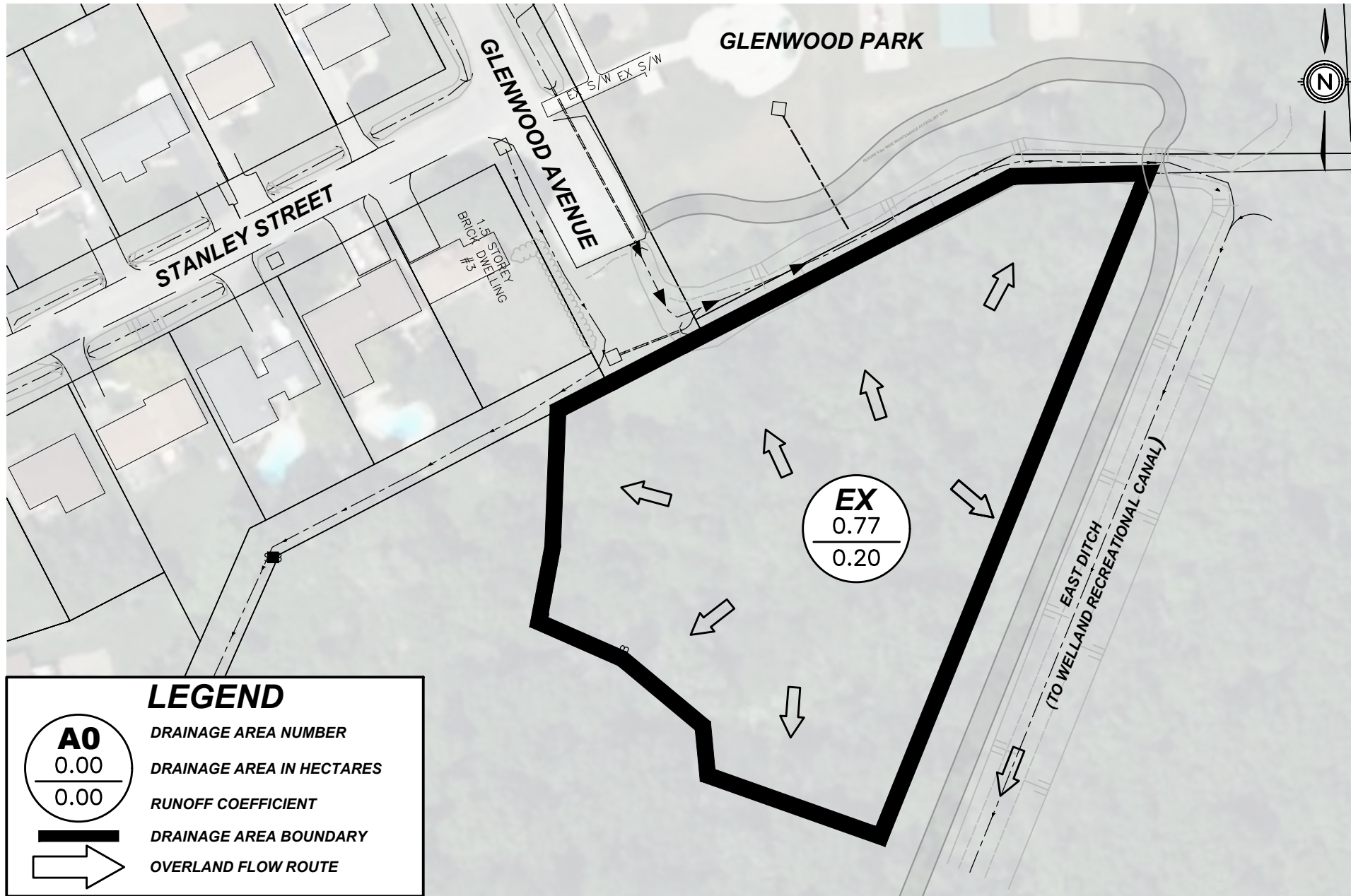
PROJECT NO: 22176

LOCATION			AREA		POPULATION				ACCUMULATED PEAK FLOW				DESIGN FLOW					
Location and Description	From M.H	To M.H.	Increment (hectares)	Accumulated (hectares)	Number of Units	Population Density (persons/unit)	Population Increment	Total Population Served	Peaking Factor	Flow (L/s)	Infiltration Flow L/s	Total Peak Flow (L/s)	Pipe Diameter (mm)	Pipe Length (m)	Pipe Slope (%)	Full Flow Velocity (m/s)	Full Flow Capacity (L/s)	Percent Full
SITE		MH B	0.76	0.76	22	2.4	53	53	4.31	0.67	0.22	0.89	200	40.3	0.40	0.67	21.64	4.1%
GLENWOOD AVE	MH B	MH A	0.11	0.87				53	4.31	0.67	0.25	0.92	200	57.9	0.40	0.67	21.64	4.3%
STANLEY STREET	MH A	EX MH	0.60	1.47				53	4.31	0.67	0.42	1.09	200	28.1	0.40	0.67	21.64	5.0%
STANLEY STREET	EX MH	EX MH		1.47				53	4.31	0.67	0.42	1.09	200	89.3	0.31	0.59	19.05	5.7%



APPENDIX C

Figure 1 – Existing Overall Storm Drainage Area Plan
Figure 2 – Proposed Overall Storm Drainage Area Plan
Weighted Impervious Calculation Sheet
Modified Rational Method Calculation Sheet – Peak Flows
Modified Rational Method Calculation Sheet – Required Volumes
Stage-Storage-Discharge Calculation Sheet



LEGEND

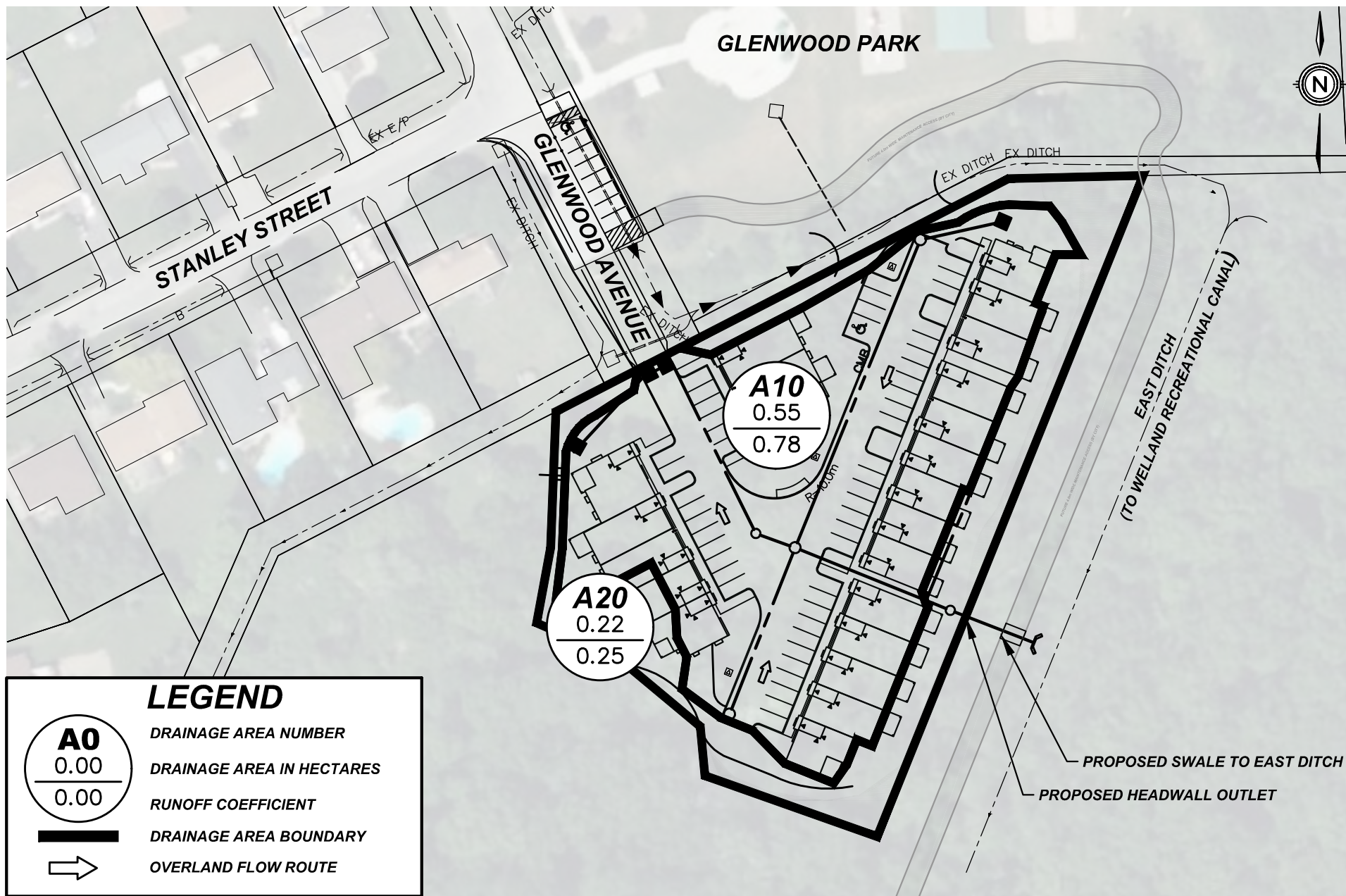
- A0** DRAINAGE AREA NUMBER
- 0.00 DRAINAGE AREA IN HECTARES
- 0.00 RUNOFF COEFFICIENT
- DRAINAGE AREA BOUNDARY
- OVERLAND FLOW ROUTE



**UPPER CANADA
CONSULTANTS**
ENGINEERS / PLANNERS

GLENWOOD CONDOMINIUM
CITY OF WELLAND
EXISTING STORM DRAINAGE AREA PLAN

DATE	2023-05-01
SCALE	1:1000 m
REF No.	22176
DWG No.	FIGURE 1



**UPPER CANADA
CONSULTANTS**
ENGINEERS / PLANNERS

GLENWOOD CONDOMINIUM
CITY OF WELLAND
PROPOSED STORM DRAINAGE AREA PLAN

DATE	2026-03-30
SCALE	1:1000 m
REF No.	22176
DWG No.	FIGURE 2

STORM SEWER DESIGN SHEET

PROJECT: GLENWOOD CONDO, WELLAND

LOCATION						TIME OF FLOW		STORMWATER ANALYSIS				
DESCRIPTION	FROM M.H.	TO M.H.	PIPE LENGTH (m)	INCREMENT AREA (hectares)	TOTAL AREA (hectares)	TO UPPER END (min)	IN SECTION (min)	RUNOFF COEFF	SECTION A X R	ACCUMLD A x R	RAINFALL INTENSITY (mm/hr)	PEAK FLOW (L/s)
<u>EXISTING CONDITIONS</u>												
EX	SITE	OUTLET		0.77	0.77	10.00	0.00	0.20	0.154	0.154	90.598	38.8
<u>FUTURE CONDITIONS</u>												
A10 - Uncontrolled	SITE	OUTLET		0.22	0.22	10.00	0.00	0.25	0.055	0.055	90.598	13.8
A20 - Controlled	SITE	OUTLET		0.55	0.55	10.00	0.00	0.78	0.429	0.429	90.598	108.0
ALLOWABLE PEAK OUTFLOW												24.9
PROVIDED OUTFLOW (250mm PIPE)												24.9

DESIGN BY:	UPPER CANADA CONSULTANTS 30 HANNOVER DRIVE, UNIT 3 ST. CATHARINES, ON L2W 1A3	<u>RAINFALL PARAMETERS:</u>	a = 830.00 mm/hr b = 7.30 minutes c = 0.78
DESIGN BY:	K.TIESSEN, P.ENG	Time to Upper End = 10 min.	City of Welland - 5 Year IDF Curve
DATE:	MARCH 2026		

Modified Rational Method (MRM) Required Storage Volume

Project: GLENWOOD CONDO, WELLAND
 Project No: 22176
 Date: MARCH 2026
 Design By: K.TIESSEN, P.ENG.
 Description: STORMWATER MANAGEMENT PLAN

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

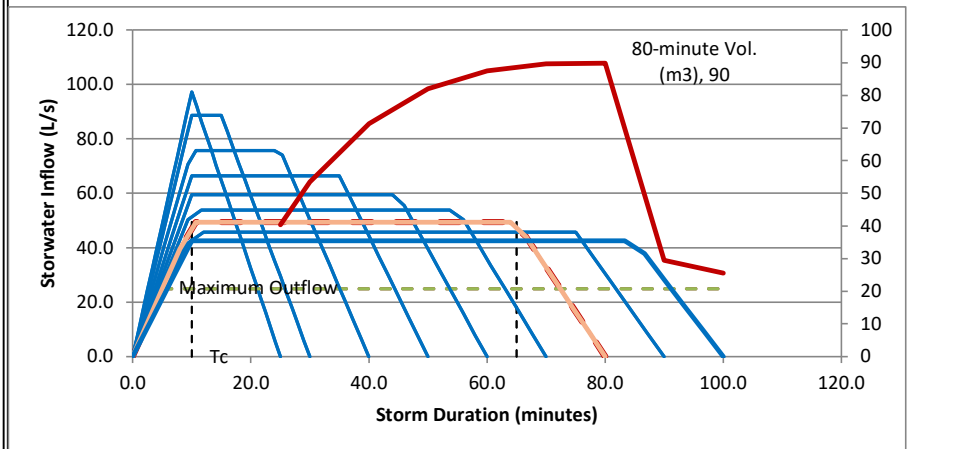
a = 830.00 mm/hr
 b = 7.30 minutes
 c = 0.78

Critical Storm Duration: 80.00 minutes Tail Multiplier (x1-11.5)
 Tc From Design: 10.00 minutes
 Storm Tail Time: 65.00 minutes
 Accumulated Area x R (Ha): 0.429 <-- Area x Runoff Coefficient (Sewer Design Sheet)
 Peak Rainfall Intensity: 41.47 mm/hr
 Peak Inflow at Tc: 49.42 L/s
 Maximum Release Rate: 24.91 <-- Outlet Full Flow Capacity (Design Sheet)
 Time When Outlet Exceeded: 5.04

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	24.91	-1.5	0.0
2.7	11.06	13.18	24.91	-1.9	0.0
5.3	22.12	26.36	24.91	0.2	0.2
8.0	33.17	39.53	24.91	2.3	2.6
10.7	41.47	49.42	24.91	3.9	6.5
13.3	41.47	49.42	24.91	3.9	10.4
16.0	41.47	49.42	24.91	3.9	14.3
18.7	41.47	49.42	24.91	3.9	18.3
21.3	41.47	49.42	24.91	3.9	22.2
24.0	41.47	49.42	24.91	3.9	26.1
26.7	41.47	49.42	24.91	3.9	30.0
29.3	41.47	49.42	24.91	3.9	33.9
32.0	41.47	49.42	24.91	3.9	37.9
34.7	41.47	49.42	24.91	3.9	41.8
37.3	41.47	49.42	24.91	3.9	45.7
40.0	41.47	49.42	24.91	3.9	49.6
42.7	41.47	49.42	24.91	3.9	53.5
45.3	41.47	49.42	24.91	3.9	57.5
48.0	41.47	49.42	24.91	3.9	61.4
50.7	41.47	49.42	24.91	3.9	65.3
53.3	41.47	49.42	24.91	3.9	69.2
56.0	41.47	49.42	24.91	3.9	73.1
58.7	41.47	49.42	24.91	3.9	77.1
61.3	41.47	49.42	24.91	3.9	81.0
64.0	41.47	49.42	24.91	3.9	84.9
66.7	36.86	43.93	24.91	3.0	87.9
69.3	29.49	35.14	24.91	1.6	89.6
72.0	22.12	26.36	24.91	0.2	89.8
74.7	14.74	17.57	24.91	-1.2	88.6
77.3	7.37	8.79	24.91	-2.6	86.0
80.0	0.00	0.00	24.91	-4.0	82.1

Variable Storm Duration Storage Requirements

Duration	Max Storage	Duration	Max Storage	Duration	Max Storage
25 Min	40.4 m3	50 Min	82.0 m3	80 Min	89.8 m3
30 Min	53.5 m3	60 Min	87.5 m3	90 Min	29.4 m3
40 Min	71.3 m3	70 Min	89.7 m3	100 Min	25.6 m3



STORM SEWER DESIGN SHEET

PROJECT: GLENWOOD CONDO, WELLAND

LOCATION						TIME OF FLOW		STORMWATER ANALYSIS				
DESCRIPTION	FROM M.H.	TO M.H.	PIPE LENGTH (m)	INCREMENT AREA (hectares)	TOTAL AREA (hectares)	TO UPPER END (min)	IN SECTION (min)	RUNOFF COEFF	SECTION A X R	ACCUMLD A x R	RAINFALL INTENSITY (mm/hr)	PEAK FLOW (L/s)
<u>EXISTING CONDITIONS</u>												
EX	SITE	OUTLET		0.77	0.77	10.00	0.00	0.20	0.154	0.154	142.985	61.2
<u>FUTURE CONDITIONS</u>												
A10 - Uncontrolled	SITE	OUTLET		0.22	0.22	10.00	0.00	0.25	0.055	0.055	142.985	21.8
A20 - Controlled	SITE	OUTLET		0.55	0.55	10.00	0.00	0.78	0.429	0.429	142.985	170.4
ALLOWABLE PEAK OUTFLOW												39.3
PROVIDED OUTFLOW (250mm PIPE)												39.3

DESIGN BY: UPPER CANADA CONSULTANTS
30 HANNOVER DRIVE, UNIT 3
ST. CATHARINES, ON L2W 1A3

DESIGN BY: K.TIESSEN, P.ENG
DATE: MARCH 2026

RAINFALL PARAMETERS:

a = 1020.00 mm/hr
 b = 4.70 minutes
 c = 0.73

Time to Upper End = 10 min.
 City of Welland - 100 Year IDF Curve

Modified Rational Method (MRM) Required Storage Volume

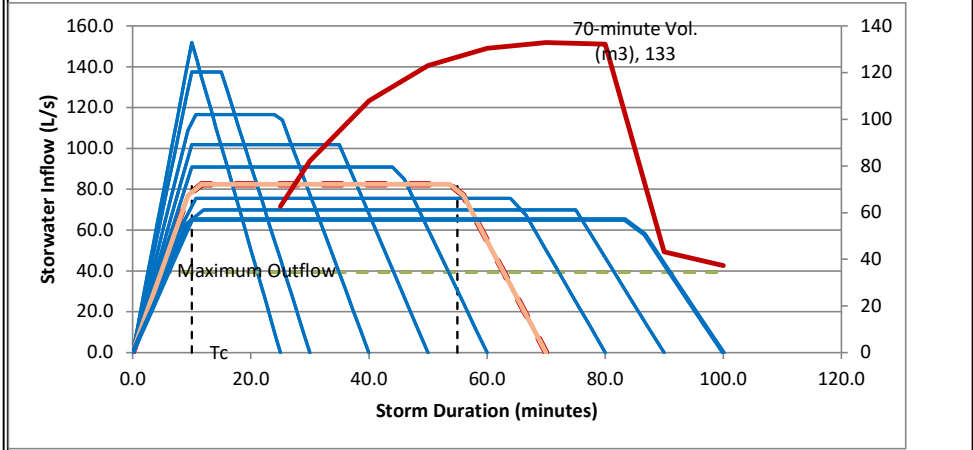
Project: GLENWOOD CONDO, WELLAND
 Project No: 22176
 Date: MARCH 2026
 Design By: K.TIESSEN, P.ENG.
 Description: STORMWATER MANAGEMENT PLAN

Storm Event: **City of Welland - 100 Year IDF Curve**
 a = 1020.00 mm/hr
 b = 4.70 minutes
 c = 0.73

Critical Storm Duration: 70.00 minutes Tail Multiplier (x1-11.5)
 Tc From Design: 10.00 minutes
 Storm Tail Time: 55.00 minutes
 Accumulated Area x R (Ha): 0.429 <-- Area x Runoff Coefficient (Sewer Design Sheet)
 Peak Rainfall Intensity: 69.16 mm/hr
 Peak Inflow at Tc: 82.42 L/s
 Maximum Release Rate: 39.32 <-- Outlet Full Flow Capacity (Design Sheet)
 Time When Outlet Exceeded: 4.77

Time (min)	Intensity (mm/hr)	Inflow (L/s)	Outflow (L/s)	Interval Volume (m3)	Total Required Volume (m3)
0.0	0.00	0.00	39.32	-2.4	0.0
2.3	16.14	19.23	39.32	-2.8	0.0
4.7	32.28	38.46	39.32	-0.1	0.0
7.0	48.42	57.69	39.32	2.6	2.6
9.3	64.55	76.93	39.32	5.3	7.8
11.7	69.16	82.42	39.32	6.0	13.9
14.0	69.16	82.42	39.32	6.0	19.9
16.3	69.16	82.42	39.32	6.0	25.9
18.7	69.16	82.42	39.32	6.0	32.0
21.0	69.16	82.42	39.32	6.0	38.0
23.3	69.16	82.42	39.32	6.0	44.0
25.7	69.16	82.42	39.32	6.0	50.1
28.0	69.16	82.42	39.32	6.0	56.1
30.3	69.16	82.42	39.32	6.0	62.1
32.7	69.16	82.42	39.32	6.0	68.2
35.0	69.16	82.42	39.32	6.0	74.2
37.3	69.16	82.42	39.32	6.0	80.2
39.7	69.16	82.42	39.32	6.0	86.3
42.0	69.16	82.42	39.32	6.0	92.3
44.3	69.16	82.42	39.32	6.0	98.3
46.7	69.16	82.42	39.32	6.0	104.4
49.0	69.16	82.42	39.32	6.0	110.4
51.3	69.16	82.42	39.32	6.0	116.4
53.7	69.16	82.42	39.32	6.0	122.5
56.0	64.55	76.93	39.32	5.3	127.7
58.3	53.79	64.11	39.32	3.5	131.2
60.7	43.04	51.28	39.32	1.7	132.9
63.0	32.28	38.46	39.32	-0.1	132.8
65.3	21.52	25.64	39.32	-1.9	130.9
67.7	10.76	12.82	39.32	-3.7	127.1
70.0	0.00	0.00	39.32	-5.5	121.6

Duration	Max Storage	Duration	Max Storage	Duration	Max Storage
25 Min	62.7 m3	50 Min	123.0 m3	80 Min	132.3 m3
30 Min	82.2 m3	60 Min	130.5 m3	90 Min	43.1 m3
40 Min	108.0 m3	70 Min	132.9 m3	100 Min	37.3 m3



Weighted Imperviousness Percentage Calculation Worksheet

Project Name:	Glenwood Condo
Project Number:	22176
Date:	March 2026
Person:	K.Tiessen

EX - EXISTING CONDITIONS

	<i>Footprint</i>	<i>Runoff Coefficient</i>	<i>Effective Impervious Area</i>
Rooftop	150.0 m ²	0.90	135.0 m ²
Landscape/Greenspace	2032.6 m ²	0.20	406.5 m ²
TOTAL CATCHMENT IMPERVIOUS AREAS			542 m ²
TOTAL CATCHMENT AREA			2,183 m ²
		EFFECTIVE RUNOFF COEFFICIENT	0.25

PROP - PROPOSED CONDITIONS

	<i>Footprint</i>	<i>Runoff Coefficient</i>	<i>Effective Impervious Area</i>
Proposed Buildings, Sidewalk & Roadway	4530.0 m ²	0.90	4077.0 m ²
Landscape/Greenspace	975.0 m ²	0.20	195.0 m ²
TOTAL CATCHMENT IMPERVIOUS AREAS			4,272 m ²
TOTAL CATCHMENT AREA			5,505 m ²
		EFFECTIVE RUNOFF COEFFICIENT	0.78