BURNSIDE

Functional Servicing and Stormwater Management Report

678 Niagara Street & 418-430 Aqueduct Street, Welland, ON

The Development Squad GP Inc.
201 City Centre Drive
Mississauga, ON L5B 4E4

Functional Servicing and Stormwater Management Report
678 Niagara Street & 418-430 Aqueduct Street, Welland, ON

The Development Squad GP Inc.
201 City Centre Drive
Mississauga, ON L5B 4E4

R.J. Burnside & Associates Limited
1465 Pickering Parkway Suite 200
Pickering ON L1V 7G7 CANADA

November 2023 (Revised Sept 2024)
300052233.0000

Distribution List

No. of Hard Copies	PDF	Email	Organization Name
0	Yes	Yes	Regional Municipality of Niagara

Record of Revisions

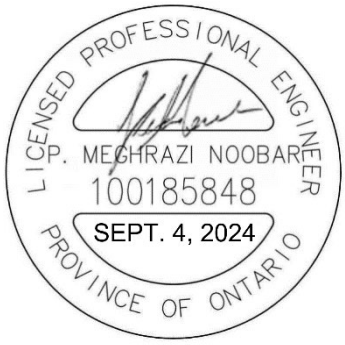
Revision	Date	Description
0	November 17, 2023	Initial Submission to City of Welland and Regional Municipality of Niagara
1	June 7, 2024	Second Submission to City of Welland and Regional Municipality of Niagara
2	Sept 4, 2024	Third Submission to City of Welland and Regional Municipality of Niagara

R.J. Burnside & Associates Limited

Report Prepared By:

Jennifer Scherer, P. Eng.
Project Engineer
JS/PM:cv

Report Reviewed By:



Pegah Meghrazi, P.Eng.
Project Engineer

Table of Contents

Tables

Figures

Drawing List

S1 Servicing Plan
G1 Grading Plan
ESC1 Erosion and Sediment Control Plan

Appendices

Disclaimer

Other than by the addressee, copying or distribution of this document, in whole or in part, is not permitted without the express written consent of R.J. Burnside & Associates Limited.

In the preparation of the various instruments of service contained herein, R.J. Burnside & Associates Limited was required to use and rely upon various sources of information (including but not limited to: reports, data, drawings, observations) produced by parties other than R.J. Burnside & Associates Limited. For its part R.J. Burnside & Associates Limited has proceeded based on the belief that the third party/parties in question produced this documentation using accepted industry standards and best practices and that all information was therefore accurate, correct and free of errors at the time of consultation. As such, the comments, recommendations and materials presented in this instrument of service reflect our best judgment in light of the information available at the time of preparation. R.J. Burnside & Associates Limited, its employees, affiliates and subcontractors accept no liability for inaccuracies or errors in the instruments of service provided to the client, arising from deficiencies in the aforementioned third party materials and documents.

R.J. Burnside & Associates Limited makes no warranties, either express or implied, of merchantability and fitness of the documents and other instruments of service for any purpose other than that specified by the contract.

1.0 Introduction

1.1 General Information

R.J. Burnside & Associates Limited (Burnside) has been retained by The Development Squad GP Inc. to prepare a Functional Servicing and Stormwater Management Report for the proposed residential development at 650-678 Niagara Street and 418-430 Aqueduct Street in Welland, Ontario.

The subject site consists of 8 large single family home lots with a total area of 3.88 ha and is located southeast of the intersection of Woodlawn Road and Niagara Street. The subject site will assemble several properties known as 650-678 Niagara Street and 418-430 Aqueduct Street. Refer to Figure 1 for the proposed site location.

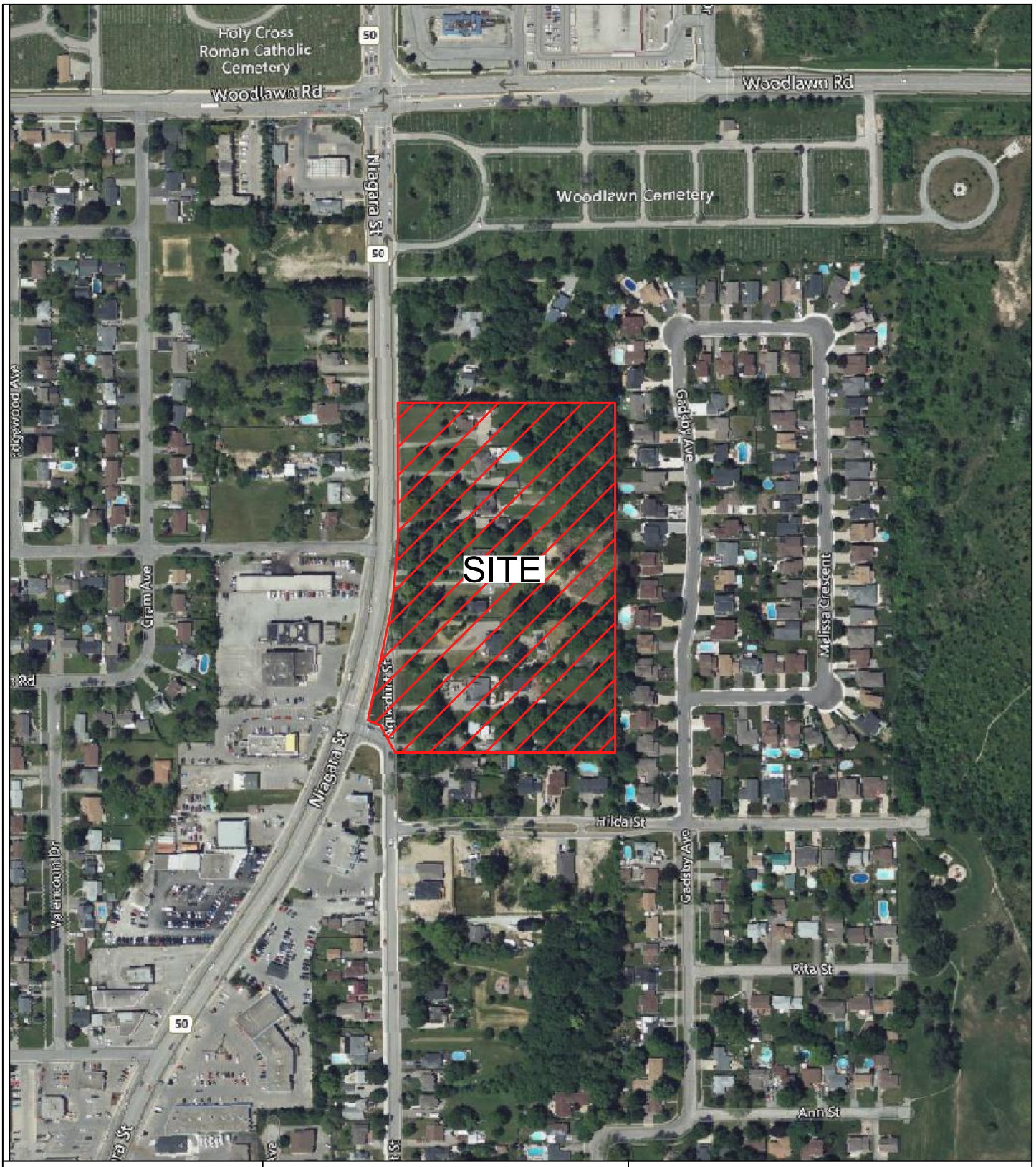
This Functional Servicing and Stormwater Management Report (FSR) will support the Official Plan Amendment and Rezoning Applications and future Site Plan Application for the development. The attached engineering designs and drawings related to site servicing and grading will incorporate the functional concepts outlined in this report.

1.2 Objectives

The objectives of this Functional Servicing and Stormwater Management Report are:

- To evaluate and confirm adequate supply and on-site distribution of municipal water to meet domestic and fire flow requirements.
- To evaluate and confirm capacity for sanitary servicing.
- To evaluate stormwater management opportunities and constraints including:
  - Determine suitable methods for attenuation and treatment of stormwater runoff.
  - Design post-development stormwater management controls to ensure the required runoff rates are met.
  - Demonstrate compliance with the stormwater management requirements outlined by the City of Welland, Regional Municipality of Niagara and Niagara Peninsula Conservation Authority.

The above will be completed in accordance with accepted engineering practices and governing criteria from the approval agencies in support of the development application. Site lighting, traffic, and parking considerations are not part of the scope of this report and will be addressed by others.



N

BURNSIDE

1465 Pickering Parkway, Pickering, Ontario, L1V 7G7
telephone (905) 420-5777 **fax** (905) 420-5247

Client

THE DEVELOPMENT SQUAD GP INC.

27 MELLOWOOD AVENUE
BRAMPTON, ON
L6P 2P2

Project Name

SITE PLAN DEVELOPMENT

Drawing Title

SITE LOCATION PLAN

Drawn	Checked	Date	Drawing No.
GP	JS	24/06/06	**FIG1**
Scale		Project No.	
N.T.S.		300052233	

File Name: 052233 - FIG1.dwg Date Plotted: September 4, 2024 - 12:18 PM

2.0 Background

2.1 Existing Site Conditions

The subject site located at 650-678 Niagara Street and 418-430 Aqueduct Street is bound by Woodlawn Cemetery to the North, a wooded grassland and an existing subdivision to the East, existing residential development to the South, and Niagara Street and Aqueduct Street to the West. The existing site has a total area of 3.88 ha and is currently composed of eight large single-family home lots with associated driveways, other structures and greenspace which is heavily wooded. Refer to Figure 2 for the existing site conditions.

The existing buildings will be demolished prior to the proposed redevelopment of the site. The existing site features are outlined in Table 1.

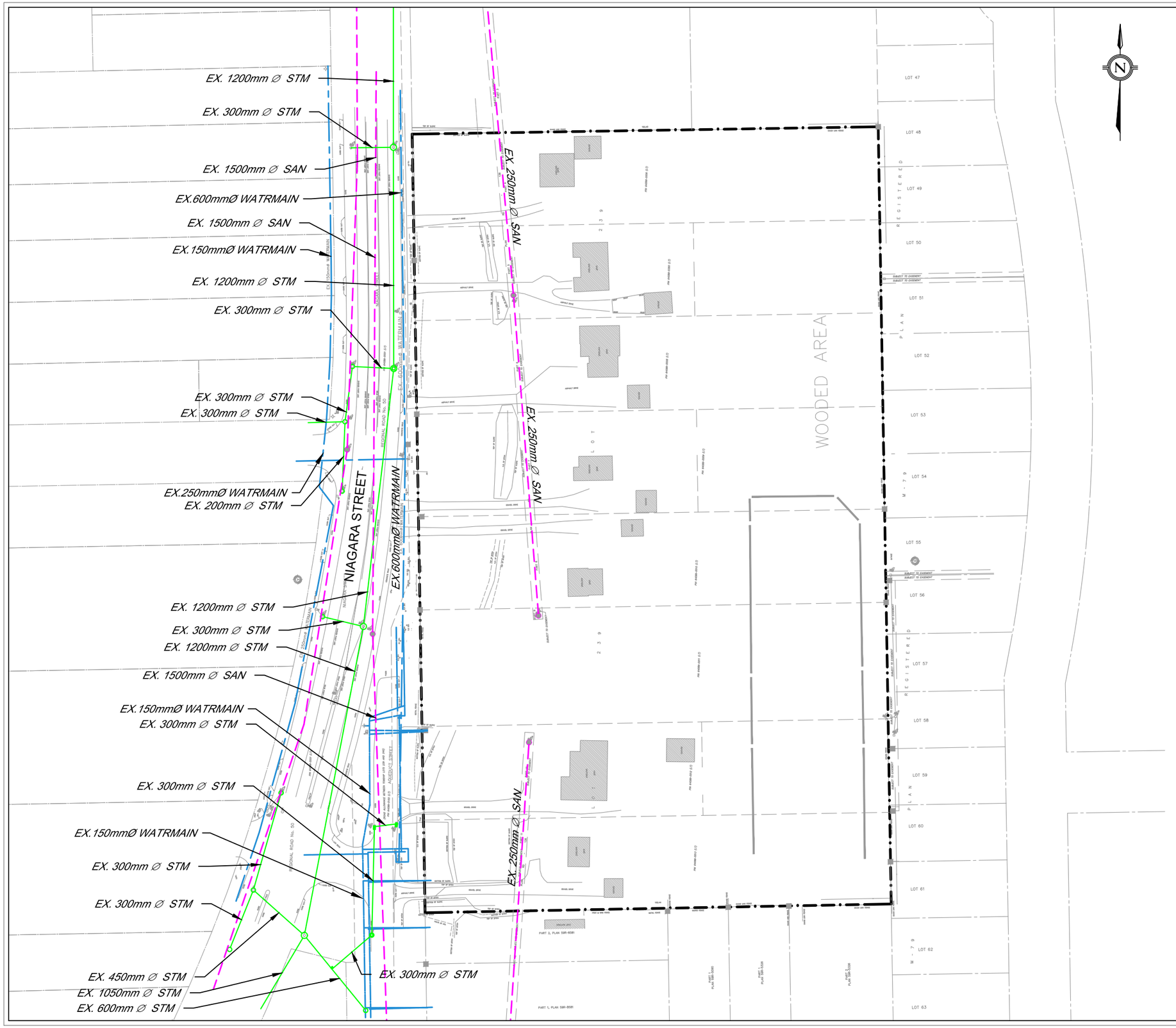
Table 1: Existing Site Breakdown

Site Component	Area
Existing Buildings	0.20 ha
Existing Hardscape	0.39 ha
Existing Landscape	3.29 ha
Total Area	**3.88 ha**

Under existing conditions, there are two easements that run through the subject property which are in favour of the City of Welland for municipal sanitary sewer infrastructure. The first easement is located within the properties at 650-678 Niagara Street under Instrument Numbers R0192891, R0192892, R0192893, R0192899, and R0192895 which consists of a 250 mm diameter sanitary sewer that flows in a northerly direction. The second easement is located within the properties at 418 & 424 Aqueduct Street under Instrument Numbers R0193922 and R0192987 which consists of a 250 mm diameter sanitary sewer that flows in a southerly direction. These easements are proposed to be released within the extent of the subject properties as part of the proposed development.

There is an existing ditch which crosses the existing properties which conveys drainage from the existing residential lots to the north of the site. This falls under the Niagara Peninsula Conservation Authority Regulation Lands.

The existing site is serviced via existing watermain, sanitary sewer connections within Niagara Street. The existing stormwater on site is collected by the existing ditch which ultimately conveys the flow to the existing storm sewer within Niagara Street. The existing municipal infrastructure within Niagara Street right-of-way (ROW) can be used to service the proposed re-development. Refer to Appendix A for plan and profiles obtained from the City of Welland and Regional Municipality of Niagara.



KEY PLAN
SCALE: N.T.S.

Notes

1. This drawing is the exclusive property of R. J. Burnside & Associates Limited. The reproduction of any part without prior written consent of this office is strictly prohibited.
2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

LEGEND:

- SITE PROPERTY LINE
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING WATERMAIN

BURNSIDE

R.J. Burnside & Associates Limited
1465 Pickering Parkway
Pickering, Ontario, L1V 7G7
telephone (905) 420-5777 **fax** (905) 420-5247
web www.rjburnside.com

Client

THE DEVELOPMENT SQUAD GP INC.

27 MELLOWOOD AVENUE
BRAMPTON, ON
L6P 2P2

Project Name

SITE PLAN DEVELOPMENT

Drawing Title

EXISTING SITE CONDITIONS PLAN

Drawn	Checked	Date	Drawing No.
GP	JS	24/06/06	**FIG2**
Scale		Project No.	
1:1250		300052233	

File Name: 052233 - FIG2.dwg Date Plotted: September 4, 2024 - 12:18 PM

2.2 Proposed Development

The proposed development at 650-678 Niagara Street and 418-430 Aqueduct Street will include the demolition of the existing buildings on site and the construction of a mixed-use development that will consist of five buildings including residential and commercial uses.

Building A consists of a 10-storey residential tower with 2-storey units at grade and associated amenity spaces.

Building B consists of one 8-storey and one 16-storey residential tower which includes a 7-storey podium housing the associated amenities, retail and two levels of above grade parking. Buildings A and B share a two-level underground parking garage.

Building C consists of a 16-storey residential tower which includes an 8-storey podium housing commercial space and 2-storey units at grade and associated amenities. Building C has a two-level underground parking garage.

Building D and Building E each consist of 4-storey stacked townhouse units and at grade parking.

The proposed development will include three private roads to service the proposed residential buildings in addition to a pedestrian promenade and landscaped areas on site.

A 0.71 ha area in the northeast corner of the existing property is proposed to be protected and will not be considered as part of the development site area. The proposed redevelopment will have a modified site area of 3.17 ha.

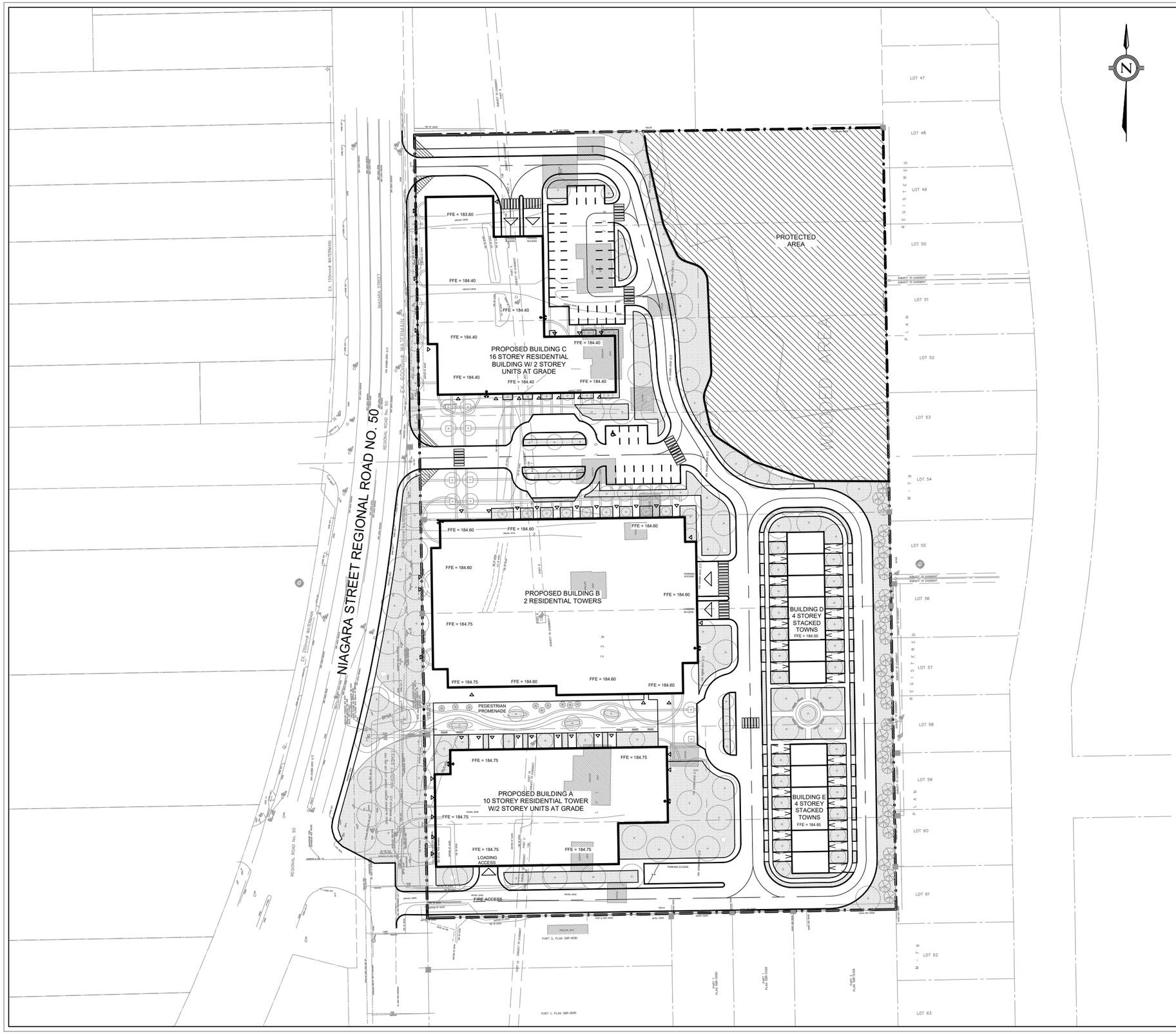
Refer to Table 2 for the proposed site breakdown.

Table 2: Proposed Site Breakdown

Land Use	Area
Rooftop	0.73 ha
Green Roof	0.37 ha
Hardscape	1.22 ha
Landscape	0.85 ha
Total Area	**3.17 ha**

Refer to Figure 3 for the proposed ground level plan.

As part of the proposed development, the existing Aqueduct Street ROW located at the frontage of the site is proposed to be closed as it will no longer be required to service the residential development. Coordination with the City of Welland will be required to facilitate the closure of the existing ROW.



KEY PLAN
SCALE: N.T.S.

Notes

1. This drawing is the exclusive property of R. J. Burnside & Associates Limited. The reproduction of any part without prior written consent of this office is strictly prohibited.
2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

LEGEND:

SITE PROPERTY LINE

BURNSIDE

R.J. Burnside & Associates Limited
1465 Pickering Parkway
Pickering, Ontario, L1V 7G7
telephone (905) 420-5777 **fax** (905) 420-5247
web www.rjburnside.com

Client

THE DEVELOPMENT SQUAD GP INC.

27 MELLOWOOD AVENUE
BRAMPTON, ON
L6P 2P2

Project Name

SITE PLAN DEVELOPMENT

Drawing Title

GROUND LEVEL SITE PLAN

Drawn	Checked	Date	Drawing No.
GP	JS	23/11/01	**FIG3**
Scale		Project No.	
1:1250		300052233	

File Name: 052233 - FIG3.dwg Date Plotted: September 4, 2024 - 12:18 PM

3.0 Water Supply and Distribution

3.1 Existing Water Infrastructure

The existing water infrastructure adjacent to the site includes:

- A 250 mm diameter watermain within the west side of Niagara Street
- A 150 mm diameter watermain within the west side of Niagara Street.
- A 600 mm diameter trunk watermain within the east side of Niagara Street and Aqueduct Street.

The existing water servicing conditions were obtained from the Plan and Profiles received from the City of Welland and Regional Municipality of Niagara (included in Appendix A). A Subsurface Utility Engineering (SUE) Investigation will be required in the future to confirm the existing servicing layout. Refer to Figure 2 for the existing watermain layout.

3.2 Proposed Water Infrastructure

The proposed development of 650-678 Niagara Street and 418-430 Aqueduct Street will consist of five buildings on site consisting of a 10-storey tower, an 8-storey tower, two 16-storey towers, 14-storey tower, and two 4-storey stacked townhouses. The development is proposed to be serviced via two connections to the existing water infrastructure within Niagara Street and Aqueduct Street to provide an internal looped watermain system to ensure that the site will not experience interruptions in water servicing.

A 250 mm diameter connection to the existing 250 mm diameter watermain within Niagara Street is proposed on the north side of the site, within Private Street B. A 250 mm diameter connection to the existing 150 mm diameter watermain within Aqueduct Street is proposed on the south side of the site, within Private Street C. Both services are proposed to be connected to the municipal watermains by tapping sleeve, valve and box as per City of Welland standard. A water meter chamber will be provided within the site close to the property line for each connection.

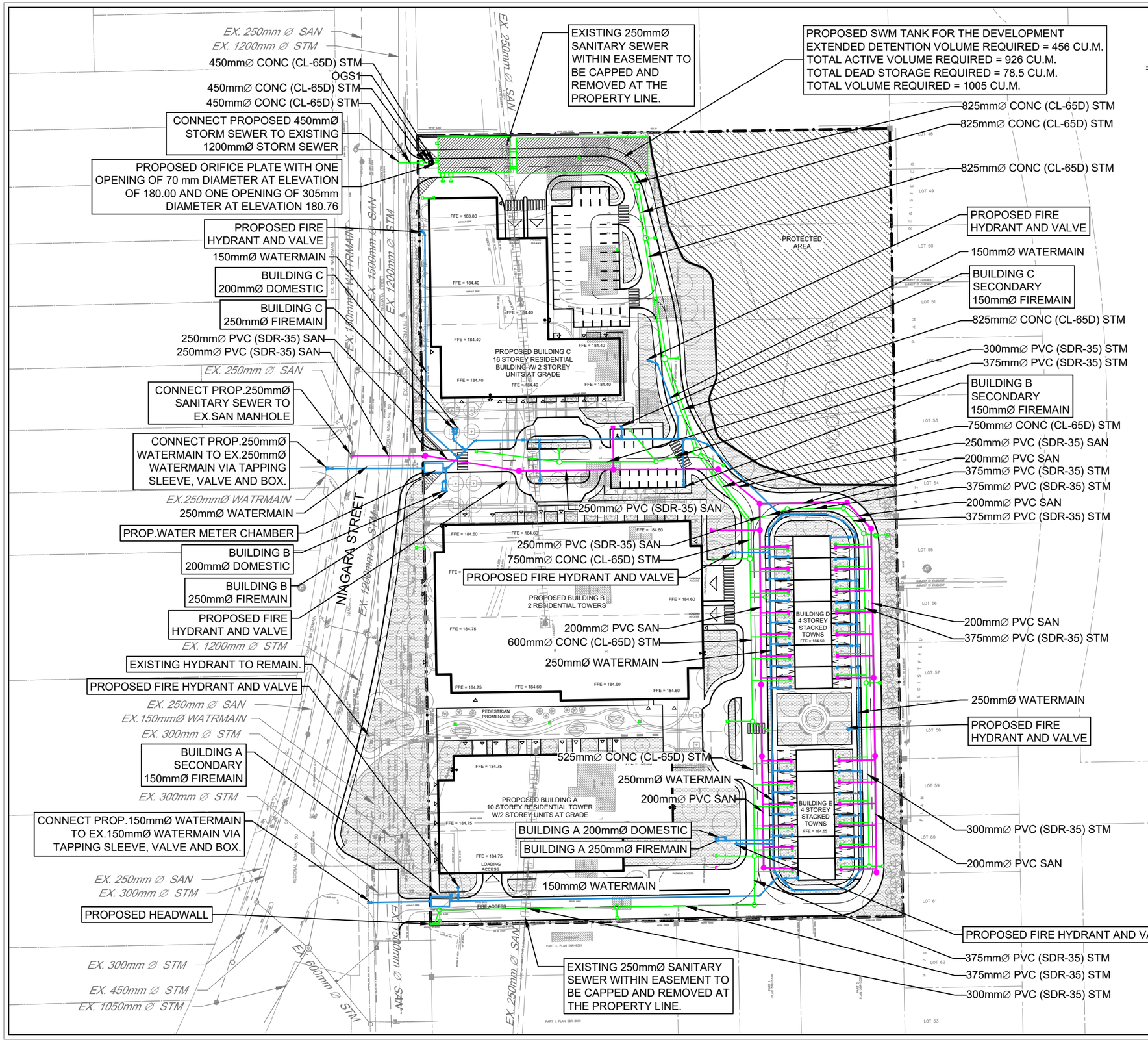
Building A is proposed to be serviced via a combined 250 mm diameter fire and a 200 mm diameter domestic service connection to the proposed 250 mm diameter watermain within Private Street A. A 150 mm diameter secondary fire connection has been proposed to the proposed 250 mm diameter watermain within Private Street C. The domestic connection will be equipped with a meter and backflow preventor within the building. The proposed building will be equipped with an adequately designed system conforming to NFPA 13 and other sprinkler standards.

Building B is proposed to be serviced via combined 250 mm diameter fire and a 200 mm diameter domestic service connection to the proposed 250 mm diameter watermain within Private Street B. It has been considered both Towers on Building B which are connected by the shared podium are going to be considered as one building under the OBC and will have a shared fire protection system. A 150 mm diameter secondary fire connection has been proposed to the proposed 250 mm diameter watermain within Private Street B. The proposed valving within Private Street B will allow for the isolation of these two connections. The domestic connection will be equipped with a meter and backflow preventor within the building. The proposed building will be equipped with an adequately designed system conforming to NFPA 13 and other sprinkler standards.

Building C is proposed to be serviced via combined 250 mm diameter fire and a 200 mm diameter domestic service connection to the proposed 250 mm diameter watermain within Private Street B. A 150 mm diameter secondary fire connection has been proposed to the proposed 250 mm diameter watermain within Private Street B. The proposed valving within Private Street B will allow for the isolation of these two connections. The domestic connection will be equipped with a meter and backflow preventor within the building. The proposed building will be equipped with an adequately designed system conforming to NFPA 13 and other sprinkler standards.

Buildings D and E consist of 26, 4-storey townhouse units. As per City of Welland requirements, each townhouse has been serviced with a 50 mm diameter connection to the proposed 250 mm diameter watermain within Private Street A. Each townhouse will be equipped with a water meter within the units.

Fire protection for the proposed buildings will be provided utilizing the existing hydrants within Niagara Street and Aqueduct Street, in addition to seven proposed hydrants within the site. Refer to Figure 4 and Drawing S1 for details.



KEY PLAN
SCALE: N.T.S.

Notes

1. This drawing is the exclusive property of R. J. Burnside & Associates Limited. The reproduction of any part without prior written consent of this office is strictly prohibited.
2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

LEGEND:

- SITE PROPERTY LINE
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING WATERMAIN
- PROPOSED STORM SEWER
- PROPOSED SANITARY SEWER
- PROPOSED WATERMAIN
- PIPE REMOVALS

BURNSIDE

R.J. Burnside & Associates Limited
1465 Pickering Parkway
Pickering, Ontario, L1V 7G7
telephone (905) 420-5777 **fax** (905) 420-5247
web www.rjburnside.com

Client

THE DEVELOPMENT SQUAD GP INC.

27 MELLOWOOD AVENUE
BRAMPTON, ON
L6P 2P2

Project Name

SITE PLAN DEVELOPMENT

Drawing Title

FUNCTIONAL SERVICING PLAN

Drawn	Checked	Date	Drawing No.
GP	JS	24/06/06	**FIG4**
Scale		Project No.	
1:1250		300052233	

File Name: 052233 - FIG4.dwg Date Plotted: September 4, 2024 - 12:18 PM

3.3 Proposed Water Demand

The fire flow for the proposed development will be calculated in accordance with the Fire Underwriters Survey's "Water Supply for Public Fire Protection, A Guide to Recommended Practice in Canada (2020)". The following assumptions were made to complete the fire flow calculations:

- The development will be non-combustible construction and protected (1 hour rating) with a coefficient of 0.8.
- The largest floor area has been considered plus 25% of each of the two immediately adjoining floors.
- An occupancy reduction of 15% has been considered for limited combustible contents for residential occupancies.
- A reduction of 30% has been considered for Buildings A, B and C to include an NFPA sprinkler system.

As per the City of Welland Municipal Standards (February 2013), an average consumption rate of 320 L/cap/day has been considered. As per the Ministry of Environment's Design Guidelines for Drinking-Water Systems (2008), a maximum hourly peaking factor of 3.0 was considered in the domestic flow calculation to determine the maximum domestic peak hour demand for proposed development.

Using the Fire Underwriters Survey and completing the fire protection calculations as per the "Water Supply for Public Fire Protection, A Guide to Recommended Practice", Building A requires a fire flow protection of 204 L/s (3,226 GPM), Building B requires a fire flow protection of 307 L/s (4,859 GPM), Building C requires a fire flow protection of 193L/s (3,056 GPM), Building D requires a fire flow protection of 96 L/s (1,521 GPM) and Building E requires a fire flow protection of 103 L/s (1,633 GPM). Refer to Appendix B for the fire flow calculations for the proposed development.

Hydrant flow testing was completed by L&D Waterworks on August 20, 2021, for the existing fire hydrants on Niagara Street and Aqueduct Street. The fire flow test results (refer to Appendix B) indicated that the flow is 4,041 GPM at 20 psi for the hydrant located on Niagara Street and 4,464 GPM at 20 psi for the hydrant located along Aqueduct Street. A Development Review was completed by the City of Welland for the proposed water distribution centre, dated May 13, 2024. The hydraulic analysis concluded that the scenarios reviewed would provide pressure above the minimum requirement of 275 kPA. Refer to Appendix B for the results of the water modelling.

As such, the existing water distribution system has adequate pressure and flow without the need for external upgrades to support the development. Refer to Figure 4 and Drawing S1 for further details.

4.0 Stormwater Management Analysis

4.1 Design Criteria

The proposed development is located within the City of Welland, within the Region of Niagara and Niagara Peninsula Conservation Authority. The site must comply with the City of Welland, Region of Niagara and Niagara Peninsula Conservation Authority stormwater criteria. The stormwater management design criteria for the site are as follows:

- Control the post-development peak flows to pre-development levels for all storms up to and including the 100-year storm (2, 5, 10, 25, 50, and 100-year storm events).
- Pre- and post-development flows were calculated using runoff coefficients of:
  - Landscaping 0.25
  - Commercial, Industrial, Road Right of Way 0.90
  - Driveways/Parking lots (asphalt and gravel) 0.90
- Water balance controls are to retain the 5 mm rain event through infiltration, evapotranspiration, or rainwater re-use.
- Runoff from the 25 mm design storm is to be retained or detained and released over a period of at least 24 hours to reduce the potential for stream erosion, even where connections directly to a storm sewer occur.
- The proposed development ensures no increase in erosion or downstream flooding.
- Provide an enhanced level of stormwater quality treatment (80% TSS Removal).

As per the City of Welland requirements, the drainage of abutting properties shall not be adversely affected, and all drainage shall be collected and discharged at an approved location.

4.2 Method of Analysis

The Modified Rational Method (MRM) was used to calculate runoff rates from all drainage catchments, to quantify the detention storage for all control measures, and to demonstrate the site's overall SWM compliance, as specified by the City of Welland, Niagara Region, and Niagara Peninsula Conservation Authority. Intensity Duration Frequency curves for the City of Welland were used to simulate rainfall data. Refer to Appendix C for the stormwater management calculations.

5.0 Stormwater Management Plan

5.1 Existing Stormwater Infrastructure

The existing stormwater infrastructure adjacent to the site includes:

- An existing 1200 mm diameter storm sewer within Niagara Street which flows north to Woodlawn Road. This sewer eventually becomes a 1350 mm storm sewer.
- An existing 300 mm diameter storm sewer within Aqueduct Street which flows south to connect into the existing 600 mm diameter storm sewer within Niagara Street.
- An existing 200 mm to 300 mm diameter storm sewer on the west side of Niagara Street which connects into the existing 1200 mm diameter storm sewer.
- An existing 600 mm diameter storm sewer within Niagara Street which flows northwest to connect into the existing 1200 mm diameter storm sewer within Niagara Street.

Under existing conditions, there is an existing ditch located along the west side of the residential lots which collects the stormwater from the existing yards and conveys it in a northerly direction. This existing ditch falls under the Niagara Peninsula Conservation Authority Regulation Lands.

5.2 Existing Drainage Patterns

The subject site at 650-678 Niagara Street and 418-430 Aqueduct Street is 3.88 ha in size and is composed of eight large single family home lots with associated driveways, other structures and greenspace which is heavily wooded.

A review of the topographic survey and Lidar information available for the subject properties was completed to confirm the existing drainage patterns. It was determined that under existing conditions, the property is divided into two separate drainage areas.

Drainage Area 1 consists of the westerly portion of the existing site with a total area of 3.07 ha. Drainage Area 1 ultimately outlets to the existing 1200 mm storm sewer within Niagara Street which flows in a northerly direction Woodlawn Road. The existing drainage ditch along the frontage of the properties flows North through the two single-family homes to the north and into a headwall that inlets to the 1200 mm storm sewer.

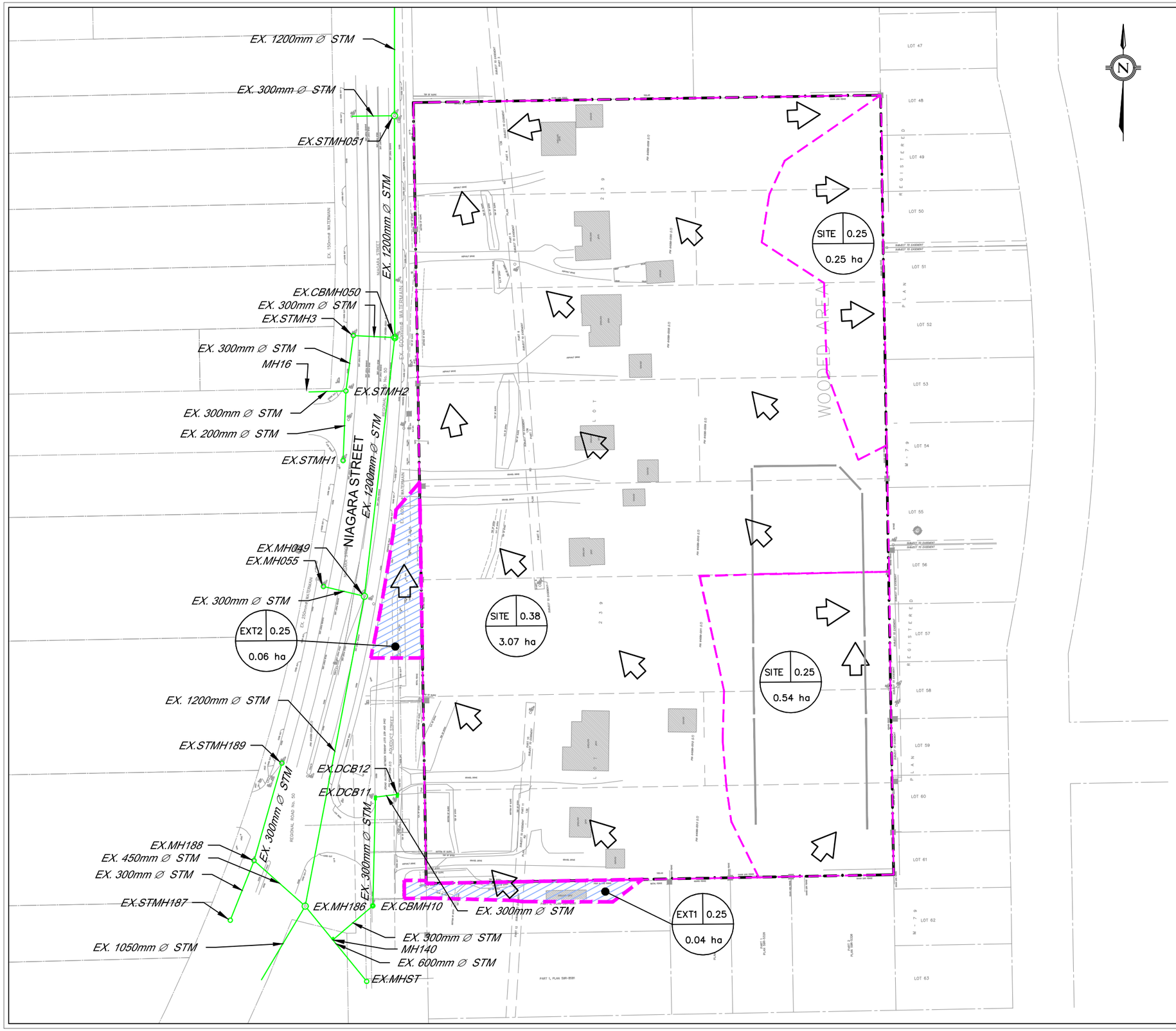
Drainage Area 2 consists of the northeasterly portion of the existing site with a total area of 0.25 ha. This is a portion of the wooded area which will make up a portion of the protected area on site. This area drains to the east where it would be collected by the existing rear yard catchbasins in the existing subdivision.

Drainage Area 3 consists of the southeast corner of the existing site with a total area of 0.54 ha. This area outlets to the west where the storm drainage is captured by catchbasins within an easement that ultimately outlet to Gadsby Avenue.

Under the existing conditions, is an external drainage area which outlets through the subject site. There is an existing external drainage area along the south edge of the site which outlets into the existing drainage ditch located on the west side of the site.

Refer to Figure 5 for the existing drainage patterns on the subject site.

The existing drainage conditions were obtained from the Plan and Profiles received from the City of Welland and Regional Municipality of Niagara. A Subsurface Utility Engineering (SUE) Investigation will be required in the future to confirm the existing servicing layout. Refer to Figure 5 for the Pre-Development Storm Drainage Plan and Drawing G1 for further details.



KEY PLAN
SCALE: N.T.S.

Notes

1. This drawing is the exclusive property of R. J. Burnside & Associates Limited. The reproduction of any part without prior written consent of this office is strictly prohibited.
2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

LEGEND:

- SITE PROPERTY LINE
- EXISTING STORM SEWER
- DRAINAGE BOUNDARY
- OVERLAND FLOW ROUTE
- EXTERNAL DRAINAGE AREA
- DRAINAGE AREA NUMBER
- RUNOFF COEFFICIENT
- DRAINAGE AREA (ha)

SITE 0.25 0.54 ha

BURNSIDE

R.J. Burnside & Associates Limited
1465 Pickering Parkway
Pickering, Ontario, L1V 7G7
telephone (905) 420-5777 **fax** (905) 420-5247
web www.rjburnside.com

Client
THE DEVELOPMENT SQUAD GP INC.
27 MELLOWOOD AVENUE
BRAMPTON, ON
L6P 2P2

Project Name
SITE PLAN DEVELOPMENT

Drawing Title
PRE-DEVELOPMENT DRAINAGE PLAN

Drawn	Checked	Date	Drawing No.
GP	JS	24/06/06	**FIG5**
Scale		Project No.	
1:1250		300052233	

File Name: 052233 - FIG5.dwg Date Plotted: September 4, 2024 - 12:18 PM

5.3 Allowable Release Rate

In accordance with the City of Welland, Region of Niagara and Niagara Peninsula Conservation Authority stormwater management guidelines, the post development flows for the 2- through 100-year events must be controlled back to the pre-development flow rates.

The allowable release rates for the drainage area were modelled using the City of Welland IDF curves for the 2, 5, 10, 25, 50, and 100-year storm events. The modified site area of 3.88 ha which includes the proposed buildings, private roads and adjacent landscaped areas have been considered for the stormwater management calculations. The existing site drainage area of 3.88 ha has a runoff coefficient of C=0.35. The allowable release rates for the modified site area are summarized in Table 3.

Table 3: Existing Site Release Rates

Storm Event	Release Rates (L/s)
2-year	290.5
5-year	341.0
10-year	381.2
25-year	446.0
50-year	489.9
100-year	538.1

Under existing conditions, the fully modified site area of 3.88 ha does not outlet to the existing 1200 mm storm sewer within Niagara Street. As such, the existing flow has been calculated for Drainage Area 1 with a 3.07 ha with a runoff coefficient of C=0.38. The site will be controlled to the 2-year pre-development flow which contributes to the 1200 mm diameter storm sewer to ensure that there is no increase in flow to the existing system.

The existing release rates for Drainage Area 1 are summarized in Table 4.

Table 4: Existing Release Rates – Drainage Area 1

Storm Event	Release Rates (L/s)
2-year	247.4
5-year	290.4
10-year	324.7
25-year	379.9
50-year	417.3
100-year	458.3

In accordance with the City of Welland, the combination of both the storm sewer system and overland flow within the right-of-way must be able to provide sufficient drainage in the event of a 100-year storm event.

The subject site is proposed to outlet directly into the existing 1200 mm diameter storm sewer within Niagara Street. The release rate from the subject site will be controlled to the 2-year pre-development storm event flow of 247.4 L/s for all storm events to ensure that the proposed development does not cause surcharging of the existing system. Refer to Appendix C for the stormwater calculations.

6.0 Proposed Stormwater Management

6.1 Stormwater Quantity Control and Extended Detention

The proposed redevelopment has been designed with one drainage area that will outlet to the existing storm sewer within Niagara Street. The subject site has been designed to control the post development flows to the pre-development levels for all storm events up to and including the 100-year storm (2, 5, 10, 25, 50, and 100-year storm events). As the site is proposing to connect directly into the existing 1200 mm diameter storm sewer in Niagara Street, to prevent surcharging, the flow from the site will be over-controlled and reduced to the 2-year pre-development levels for each storm event and on-site storage has been provided accordingly.

There may be runoff from rainstorms that exceeds the capacity of the City's storm service connections. Therefore, the Owner shall be responsible for providing flood protection or a safe overland flow route for the proposed redevelopment without causing damage to the proposed and adjacent public and private properties. Existing drainage patterns on adjacent properties shall not be altered and stormwater runoff from the subject redevelopment shall not be directed to drain onto adjacent properties.

The controlled flow for the site is proposed to outlet via 375 mm diameter storm sewer connection to the existing 1200 mm diameter storm sewer within Niagara Street. Refer to Figure 6 Post-Development Drainage Plan and Drawing S1 for details.

Under the proposed conditions, there are two external drainage areas which will be conveyed through the subject site. External Drainage Area 1 is 0.04 ha in size and consists of the area to the south of the property which will enter the site stormwater system via headwall along the south side of Private Street C. External Drainage Area 2 is 0.06 ha in size and consists of a portion of the boulevard with storm flow that will be captured via catchbasin and discharge into the site. Both external drainage areas are proposed to be conveyed through the storm sewer system for all storms up to and including the 100-year event. As the site will be controlled to the 2-year pre-development levels at the outlet, the allowable release rate has been adjusted to include the 100-year storm flow contributing to the site from both external drainage areas. External Drainage Areas 1 and 2 contribute a storm flow of 4.5 L/s and 6.1 L/s in the 100-year storm event, respectively. When these flows are added to the allowable release rate of 247.4 L/s, the adjusted allowable release rate to be considered going forward is 258.0 L/s [247.4 L/s+4.5 L/s + 6.1 L/s].

Table 5 summarizes the stormwater quantity requirements to meet the allowable release rate for the site.

Table 5: Drainage Area Release Rates and Storage Volumes

Area ID	Description	Area (ha)	Target Release Rate (L/s)	Actual Release Rate (L/s)	Required Storage (m^3)	Provided Storage (m^3)
DEV	Rooftop	0.73	258.0	236.0*	926	1005
	Green Roof	0.37				
	Hardscape	1.18				
	Landscape	0.77				
UNC	Uncontrolled	0.12		21.46	-	
Total		**3.17**	**258.0**	**257.46**	**926**	**1005**

*Note: Represents the orifice-controlled flow at the outlet of the stormwater management tank.

As per the City of Welland, Region of Niagara and Niagara Peninsula Conservation Authority stormwater criteria, the site must provide extended detention on site. Runoff from the 25 mm design storm is to be retained or detained and released over a period of at least 24 hours to reduce the potential for stream erosion, even where connections directly to a storm sewer occur. The extended detention volume for the proposed site is 456.00 m^3 and will be retained within the stormwater management tank on site for a period of 24 hours.

A series of orifice controlled are required to provide the extended detention on site and to ensure that the outlet to the proposed storm sewer system discharges at or below the target release rate. The orifice controls will be placed within MH1 and will include:

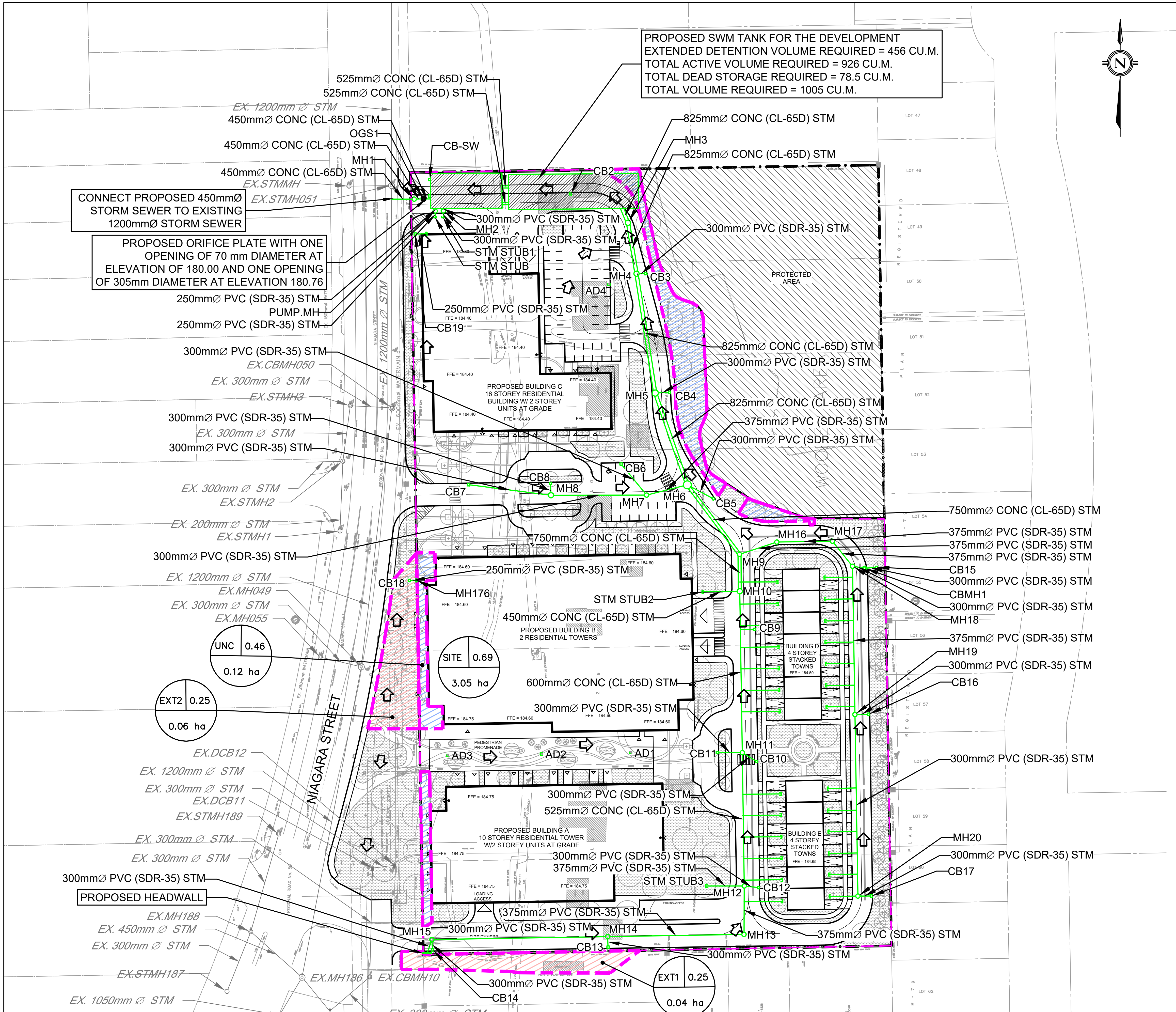
- 70 mm diameter orifice located at an elevation of 180.00 to provide the extended detention of 456 m^3 of stormwater over a period of 24 hours.
- A 305 mm diameter orifice located at an elevation of 180.76 to provide the quantity control for all storm events up to and including the 100-year event.

The maximum orifice-controlled release rate from the stormwater management tank of 236.0 L/s ensures that the post-development flows does not exceed the allowable controlled release rate of 236.54 L/s [258.00 L/s – 21.46 L/s]. The proposed stormwater storage tank will be located within Private Street A, north of Building C. The required active storage volume is 926 m^3. The required storage volume is based on an actual release rate of 236.0 L/s; should the release rate be controlled to less than 236.0 L/s, the required storage will be greater than 926 m^3. The total storage provided, which will include the dead storage volume (78.5 m^3) will be 1005 m^3.

Under the proposed conditions, there is one uncontrolled drainage area, located along the northeast edge of the site. This area of 0.12 ha will drain uncontrolled to the wooded area which will make up a portion of the protected area on site. This area drains to the east where it would be collected by the existing rear yard catchbasins in the existing subdivision. Under existing conditions, there is an existing drainage area of 0.25 ha which outlets to the east. As the proposed uncontrolled landscape area of 0.12 ha is

smaller than the existing 0.25 ha area, no stormwater controls will be required for this uncontrolled drainage area.

Refer to Figure 6, Drawing G1, Drawing S1, and Appendix C for further details.



PROPOSED SWM TANK FOR THE DEVELOPMENT
EXTENDED DETENTION VOLUME REQUIRED = 456 CU.M.
TOTAL ACTIVE VOLUME REQUIRED = 926 CU.M.
TOTAL DEAD STORAGE REQUIRED = 78.5 CU.M.
TOTAL VOLUME REQUIRED = 1005 CU.M.
525mmØ CONC (CL-65D) STM
525mmØ CONC (CL-65D) STM
EX. 1200mm Ø STM
450mmØ CONC (CL-65D) STM
OGS1
450mmØ CONC (CL-65D) STM
MH1
450mmØ CONC (CL-65D) STM
EX.STMMH
CONNECT PROPOSED 450mmØ STORM SEWER TO EXISTING 1200mmØ STORM SEWER
EX.STMH051
PROPOSED ORIFICE PLATE WITH ONE OPENING OF 70 mm DIAMETER AT ELEVATION OF 180.00 AND ONE OPENING OF 305mm DIAMETER AT ELEVATION 180.76
250mmØ PVC (SDR-35) STM
PUMP.MH
250mmØ PVC (SDR-35) STM
CB-SW
CB2
825mmØ CONC (CL-65D) STM
MH3
825mmØ CONC (CL-65D) STM
300mmØ PVC (SDR-35) STM
MH2
300mmØ PVC (SDR-35) STM
STM STUB1
STM STUB
MH4
CB3
AD4
250mmØ PVC (SDR-35) STM
CB19
300mmØ PVC (SDR-35) STM
PROTECTED AREA
825mmØ CONC (CL-65D) STM
300mmØ PVC (SDR-35) STM
300mmØ PVC (SDR-35) STM
EX.CBMH050
EX. 300mm Ø STM
EX.STMH3
PROPOSED BUILDING C
16 STOREY RESIDENTIAL BUILDING W/ 2 STOREY UNITS AT GRADE
MH5
CB4
825mmØ CONC (CL-65D) STM
375mmØ PVC (SDR-35) STM
300mmØ PVC (SDR-35) STM
300mmØ PVC (SDR-35) STM
EX. 300mm Ø STM
300mmØ PVC (SDR-35) STM
EX. 1200mm Ø STM
CB6
CB8
MH8
CB7
MH7
MH6
CB5
EX. 300mm Ø STM
EX.STMH2
EX. 200mm Ø STM
EX.STMH1
750mmØ CONC (CL-65D) STM
MH16
MH17
750mmØ CONC (CL-65D) STM
375mmØ PVC (SDR-35) STM
375mmØ PVC (SDR-35) STM
375mmØ PVC (SDR-35) STM
CB15
300mmØ PVC (SDR-35) STM
CBMH1
300mmØ PVC (SDR-35) STM
MH18
300mmØ PVC (SDR-35) STM
EX. 1200mm Ø STM
250mmØ PVC (SDR-35) STM
MH9
CB18
MH176
EX.MH049
MH10
STM STUB2
EX. 300mm Ø STM
EX.MH055
450mmØ CONC (CL-65D) STM
CB9
PROPOSED BUILDING B
2 RESIDENTIAL TOWERS
375mmØ PVC (SDR-35) STM
MH19
300mmØ PVC (SDR-35) STM
CB16
BUILDING D
4 STOREY STACKED TOWNS
UNC 0.46
0.12 ha
SITE 0.69
3.05 ha
EXT2 0.25
0.06 ha
600mmØ CONC (CL-65D) STM
300mmØ PVC (SDR-35) STM
NIAGARA STREET
PEDESTRIAN PROMENADE
AD3
AD2
AD1
CB11
MH11
CB10
300mmØ PVC (SDR-35) STM
EX.DCB12
EX. 1200mm Ø STM
EX. 300mm Ø STM
EX.DCB11
EX.STMH189
300mmØ PVC (SDR-35) STM
525mmØ CONC (CL-65D) STM
PROPOSED BUILDING A
10 STOREY RESIDENTIAL TOWER W/2 STOREY UNITS AT GRADE
EX. 300mm Ø STM
EX. 300mm Ø STM
300mmØ PVC (SDR-35) STM
375mmØ PVC (SDR-35) STM
STM STUB3
BUILDING E
4 STOREY STACKED TOWNS
MH20
300mmØ PVC (SDR-35) STM
CB17
300mmØ PVC (SDR-35) STM
PROPOSED HEADWALL
CB12
MH12
EX.MH188
EX. 450mm Ø STM
EX. 300mm Ø STM
375mmØ PVC (SDR-35) STM
MH15
300mmØ PVC (SDR-35) STM
MH14
MH13
375mmØ PVC (SDR-35) STM
CB13
300mmØ PVC (SDR-35) STM
EX.STMH187
EX.MH186
EX.CBMH10
300mmØ PVC (SDR-35) STM
EXT1 0.25
0.04 ha
CB14
EX. 1050mm Ø STM
EX. 300mm Ø STM

KEY PLAN
SCALE: N.T.S.

Notes

1. This drawing is the exclusive property of R. J. Burnside & Associates Limited. The reproduction of any part without prior written consent of this office is strictly prohibited.
2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

LEGEND:

- SITE PROPERTY LINE
- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- DRAINAGE BOUNDARY
- OVERLAND FLOW ROUTE
- UNCONTROLLED AREA
- EXTERNAL DRAINAGE AREA
- DRAINAGE AREA NUMBER (SITE)
- RUNOFF COEFFICIENT (0.69)
- DRAINAGE AREA (ha) (3.05 ha)

BURNSIDE

R.J. Burnside & Associates Limited
1465 Pickering Parkway
Pickering, Ontario, L1V 7G7
telephone (905) 420-5777 **fax** (905) 420-5247
web www.rjburnside.com

Client
THE DEVELOPMENT SQUAD GP INC.
27 MELLOWOOD AVENUE
BRAMPTON, ON
L6P 2P2

Project Name
SITE PLAN DEVELOPMENT

Drawing Title
POST-DEVELOPMENT DRAINAGE PLAN

Drawn	Checked	Date	Drawing No.
GP	JS	24/06/06	FIG6
Scale		Project No.	
1:1250		300052233	

File Name: 052233 - FIG6.dwg Date Plotted: September 4, 2024 - 12:19 PM

6.2 Stormwater Retention (Water Balance)

As per the City of Welland and Region of Niagara Design Guidelines, it is required that the 5 mm rainfall event be retained on-site through infiltration, evapotranspiration, or rainwater re-use. The subject site for the proposed industrial building expansion is approximately 3.17 ha in size and is composed of rooftop, hardscape, landscape, and private streets. This area has been considered in determining the minimum rainfall re-use volume to meet both quality control and water balance requirements for the proposed development. The following method has been used to determine the minimum rainfall re-use volume for the subject area:

Minimum Rainfall Re-Use = Site Area (m^2) * 5 mm

Minimum Rainfall Re-Use = 31,664.32 m^2 x 0.005 m = 158.32 m^3

The infiltration requirements for the subject site include the proposed roof area, landscape, and hardscape. Refer to Table 6.

Table 6: Initial Abstraction

Surface	Initial Abstraction (m)	Area (m^2)	Initial Abstraction Volume (m^3)
Impervious Roof	0.001	7,341.30	7.34
Green Roof	0.005	3,743.80	18.72
Impervious Areas	0.001	12,071.74	12.04
Pervious Areas	0.005	8,507.48	42.54
	Total	**31,664.32**	**80.67**

The following method has been used to determine the minimum rainfall reuse volume following initial abstraction:

Minimum Rainfall Re-Use = Site Area (m^2) * 5 mm - IA

Minimum Rainfall Re-Use = 31,664.32 m^2 x 0.005 m – 80.67 m^3 = 77.65 m^3

To achieve the water balance criteria, the required retention and reuse for the proposed site area of 3.17 ha is 77.65 m^3.

Dead storage has been provided beneath the outlet of the stormwater storage tank in the proposed area to retain the 77.65 m^3 of rainfall volume. The proposed stormwater system will be designed to re-use the stormwater for irrigation (rainwater harvesting) on-site. Further details will be provided in future submissions to confirm the design of the proposed reuse system on site. Refer to Appendix C for further details.

6.3 Stormwater Quality Control

As per the City of Welland, Region of Niagara, Niagara Peninsula Conservation Authority requirements and the Ministry of the Environment Stormwater Management Planning and Design Manual (March 2003), stormwater quality control is required to provide the long-term average removal of 80% of Total Suspended Solids (TSS) on an annual loading basis from all runoffs leaving the proposed development site based on the post-development level of imperviousness. Stormwater quality treatment for the proposed development will be provided using a variety of water quality measures in a treatment train approach.

The annual loading for the site was determined using the Ministry of the Environment Stormwater Management Planning and Design Manual (March 2003) Table 6.3: Annual Sediment Loadings which identifies the annual sediment loading based on the post-development levels of imperviousness. The percent imperviousness for each post-development surface was calculated using the runoff coefficients. Using the Region of Niagara's guidelines for TSS removal based on surface type, the TSS remaining of the annual loading was determined using the site area of 3.17 ha.

The quality control requirements for the proposed development will be met by a treatment train approach consisting of an underground storage tank to capture the stormwater on site which is equipped with an Isolator Row which provides 50% TSS removal, then the tank will retain the 5 mm rainfall event volume for reuse for irrigation. Based on the City of Welland and Region of Niagara Design Standards, the 5 mm rainfall event represents approximately 50% of the total annual rainfall depth. This volume being retained and reused for irrigation on site, results in 50% of the annual rainfall being retained, removing 50% of the annual loading of TSS, as this runoff will not enter the storm sewer system. When the runoff reduction is applied, the remaining TSS is treated to an additional 50% TSS removal. Based on the calculations, the proposed development achieves a TSS removal rate of 82%.

To minimize the concerns of resuspension of settled pollutants resulting from the flow on site being captured and reused on site, an oil and grit separator unit has been proposed upstream of the outlet from the subject site. Additional details for the make and model of oil and grit separator will be provided at the time of detailed design.

Refer to Table 7 for the treatment train approach summary.

Table 7: Overall Efficiency Removal Estimate of Water Quality Control

Catchment Area Description	Treated Drainage Area (m2)	RC	% Impervious	Annual TSS Loading (m^3/ha)*	Annual TSS Loading (m^3)	Removal Efficiency						
						Step 1		Step 2		Step 3		Total Efficiency
						Surface type**	TSS Remaining (m^3)	Isolator Row	TSS Remaining (m^3)	TSS Removal Using Runoff Reduction***	TSS Remaining (m^3)	
Controlled Hardscape	11691.1	0.90	100%	4.8	5.61	0%	5.61	50%	2.81	50%	1.40	**75%**
Controlled Landscape	7711.9	0.25	7%	0.001	0.00	80%	0.00	50%	0.00	50%	0.00	**95%**
Rooftop	7341.3	0.90	100%	4.8	3.52	80%	0.70	50%	0.35	50%	0.18	**95%**
Green Roof	3743.8	0.50	43%	1.1	0.41	80%	0.08	50%	0.04	50%	0.02	**95%**
Uncontrolled Landscape	795.6	0.25	7%	0.001	0.00	80%	0.00	0%	0.00	0%	0.00	**80%**
Uncontrolled Hardscape	380.6	0.90	100%	4.8	0.18	0%	0.18	0%	0.18	0%	0.18	**0%**
Total	**31664.3**				**9.73**		**6.58**		**3.38**		**1.78**	**82%**

7.0 Sanitary Servicing

7.1 Existing Sanitary Servicing

The existing site is a mixture of single-family residential dwellings, hardscape, and landscape with a total area of approximately 3.17 ha located on the southeast corner of Woodlawn Road and Niagara Street/Aqueduct Street. Currently, there is existing municipal sanitary infrastructure adjacent to 650-678 Niagara Street and 418-430 Aqueduct Street. Refer to Figure 2 for details.

The existing sanitary infrastructure adjacent to the site includes:

- A 250 mm diameter sanitary sewer on the west side of Niagara Street travelling in an east direction.
- A 1500 mm diameter Regional sanitary sewer within Aqueduct Street and Niagara Street travelling in an east direction.
- A 250 mm diameter sanitary sewer located within an easement on the existing property which outlets to the north of the subject site.
- A 250 mm diameter sanitary sewer located within an easement on the existing property which outlets to the south of the subject site.

Calculations have been completed to estimate the existing sanitary flow generated from the existing buildings on site. The total peak sanitary flow for the existing site (including the infiltration allowance) has been calculated as 2.64 L/s (including infiltration allowance). Under existing conditions, 1.32 L/s of the existing sanitary flow outlets to the existing 250 mm diameter sanitary sewer which flows to the north and 1.32 L/s of the existing sanitary flow outlets to the existing 250 mm diameter sanitary sewer which flows to the south. Refer to Appendix D for the existing sanitary calculations.

The existing drainage conditions were obtained from the Plan and Profiles received from the City of Welland and Regional Municipality of Niagara. A Subsurface Utility Engineering (SUE) Investigation will be required in the future to confirm the existing servicing layout.

7.2 Proposed Sanitary Servicing

The proposed development of 650-678 Niagara Street and 418-430 Aqueduct Street will consist of five residential buildings on site, which will be service via proposed internal sanitary sewer system. The proposed sanitary flows from the subject site will outlet to the existing 250 mm diameter sanitary sewer within Niagara Street using one proposed connection at Private Street B.

Building A will consist of a 10-storey residential tower and will be serviced via 200 mm diameter sanitary sewer connection to the proposed 200 mm diameter internal sanitary sewer network within Private Street C.

Building B will consist of one 8-storey and one 16-storey residential tower and will be serviced via 200 mm diameter sanitary sewer connection to the proposed 250 mm diameter internal sanitary sewer network within Private Street C.

Building C will consist of a 16-storey residential tower and will be serviced via a 200 mm diameter sanitary sewer connection to the proposed 250 mm diameter internal sanitary sewer network within Private Street B.

Building D will consist of 14, 4-storey townhouse units which will each be serviced via 100 mm diameter sanitary sewer connections to the proposed 200 mm diameter internal sanitary sewer network within Private Street A.

Building E will consist of 12, 4-storey townhouse units which will each be serviced via 100 mm diameter sanitary sewer connections to the proposed 200 mm diameter internal sanitary sewer network within Private Street A.

As the proposed development will not require the sanitary sewers that exist within the existing easement on the property to service the site, it is proposed to remove the existing sanitary sewer networks and release the existing easements within the site.

An equivalent population was calculated to determine the proposed sanitary flow using population densities for residential units per the City of Toronto Design Criteria for Sewers and Watermains (January 2021). The residential sanitary flow for the proposed redevelopment was calculated using an average daily flow of 320 L/cap/day for residential uses with an infiltration rate of 0.28 L/s/ha.

Using the sanitary flows noted above, the proposed sanitary contribution from the proposed development was calculated for each building. Refer to Table 8 for details.

Table 8: Proposed Sanitary Site Flows

Building	Population	Sanitary Flow (L/s)
Building A	479	7.13
Building B	834	12.03
Building C	790	11.37
Building D	38	0.62
Building E	32	0.53
Total	**2,173**	**31.68**

The total sanitary flow generated by the proposed development is 31.68 L/s. The proposed development will contribute to the 250 mm diameter sanitary sewer within Niagara Street which will result in a 31.68 L/s increase in flow to the sanitary sewer system.

A sanitary analysis was completed by GEI Consultants Canada Limited on behalf of the City of Welland to confirm that capacity exists within the existing Municipal sanitary network for the proposed development. The sanitary flow for the subject site was calculated considering City of Welland standards which were considered in the sanitary analysis which results in a total flow of 17.55 L/s. The downstream sanitary analysis completed in May 2024 considered a sanitary flow of 23.13 L/s using the City of Welland criteria, and the 44.62 L/s increase in flow calculated per the above considerations. The sanitary analysis confirmed that there is capacity within the existing sanitary network for the proposed development. As the flow proposed in this submission of 31.68 L/s (17.55 L/s) is less than what was presented previously, we can confirm there is capacity for the proposed development without the need for external upgrades. Refer to Appendix D for further details.

Refer to Figure 4 and Drawing S1 for further details regarding the proposed connection locations. Refer to Appendix D for the proposed sanitary calculations.

8.0 Erosion and Sediment Control

The Erosion and Sediment Control Plan for the site will be designed in conformance with the Region of Niagara Guidelines. The erosion and sediment control strategy will include the following:

- Temporary sediment control fence at construction limits and/or downstream of any disturbed areas prior to grading.
- Gravel mud mats at construction vehicle access points to minimize off-site tracking of any sediments.
- Sediment traps in existing and proposed catchbasins.
- Routine inspections, monitoring, and repair as necessary of all erosion and sediment control measures during construction.
- Removal of temporary controls once the areas they serve are restored and stable.

All reasonable measures will be taken to ensure that sediment loading is minimized both during and following construction. Refer to Drawing ESC1 (Erosion and Sediment Control Plan) for further details.

9.0 Conclusions and Recommendations

The servicing analysis provided above is summarized as follows:

9.1 Water Servicing

- Fire protection will be accommodated through the existing hydrants within the Municipal Right-of-Way adjacent to the site in addition to seven proposed hydrants within the site.
- The proposed development of Building A requires a fire flow protection of 204 L/s (3,227 GPM), Building B requires a fire flow protection of 204 L/s (3,226 GPM), Building B requires a fire flow protection of 307 L/s (4,859 GPM), Building C requires a fire flow protection of 193L/s (3,056 GPM), Building D requires a fire flow protection of 96 L/s (1,521 GPM) and Building E requires a fire flow protection of 103 L/s (1,633 GPM).
- The proposed Buildings A, B and C will be equipped with an adequately designed system conforming to NFPA 13 and other NFPA sprinkler standards.
- The existing water distribution system has adequate pressure and flow without the need for external upgrades to support the development.

9.2 Storm Servicing

- The site will control the post-development flows to the 2-year pre-development flows at a runoff coefficient of 0.35.
- A storm connection will be provided to connect into the existing storm sewer system northwest of the proposed development.
- Quantity control will be achieved using a stormwater management tank with orifice controls located within Private Street A.
- Stormwater retention and water balance will be achieved through the re-use of stormwater for irrigation on-site.
- Stormwater quality control objectives will be achieved using an Isolator Row in a treatment train approach.

9.3 Sanitary Servicing

- Sanitary drainage will be conveyed via 250 mm diameter sanitary connection to the existing 250 mm diameter sewer within Niagara Street.
- The proposed development will generate a peak flow of 31.68 L/s.
- Capacity is available within the existing sanitary sewer to support the proposed development.

In summary, the site can be serviced by the surrounding municipal infrastructure with the construction of an on-site stormwater management system capable of satisfying the

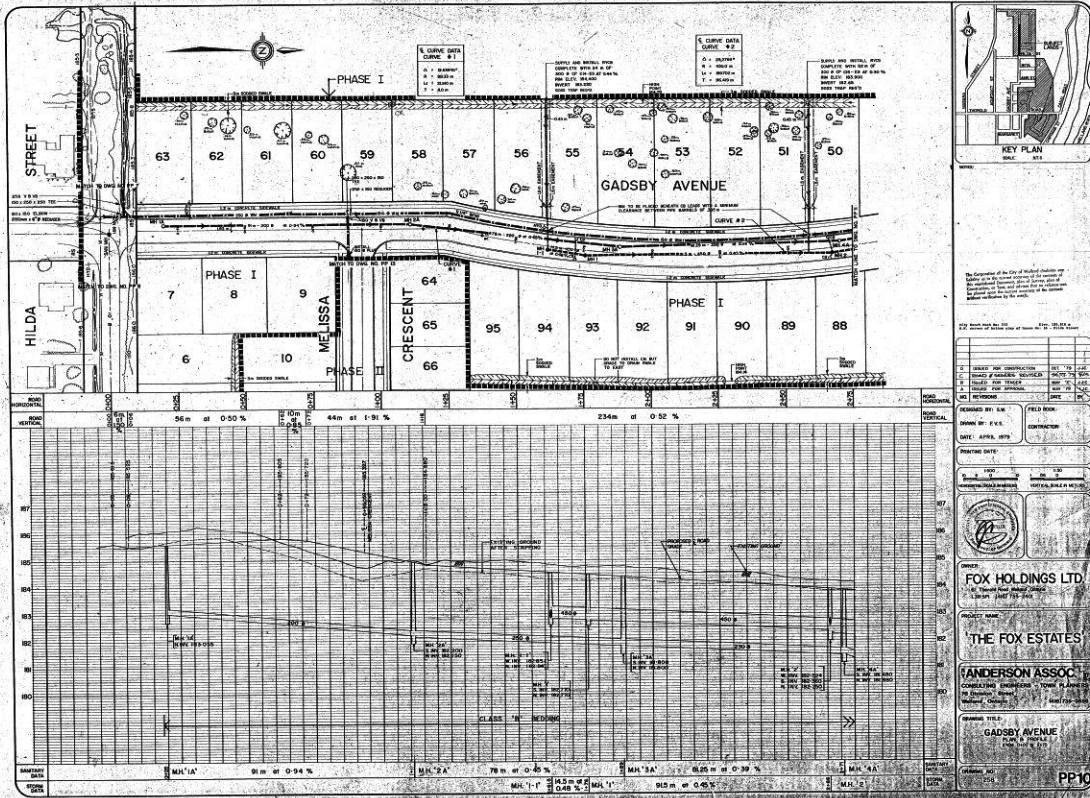
applicable SWM criteria. Accordingly, upon receipt of a SUE Investigation for the existing servicing on site, we hereby recommend the adoption of the report as it relates to the provision of servicing and stormwater management works, and for the purposes of this application for Rezoning and future Site Plan Applications.

BURNSIDE

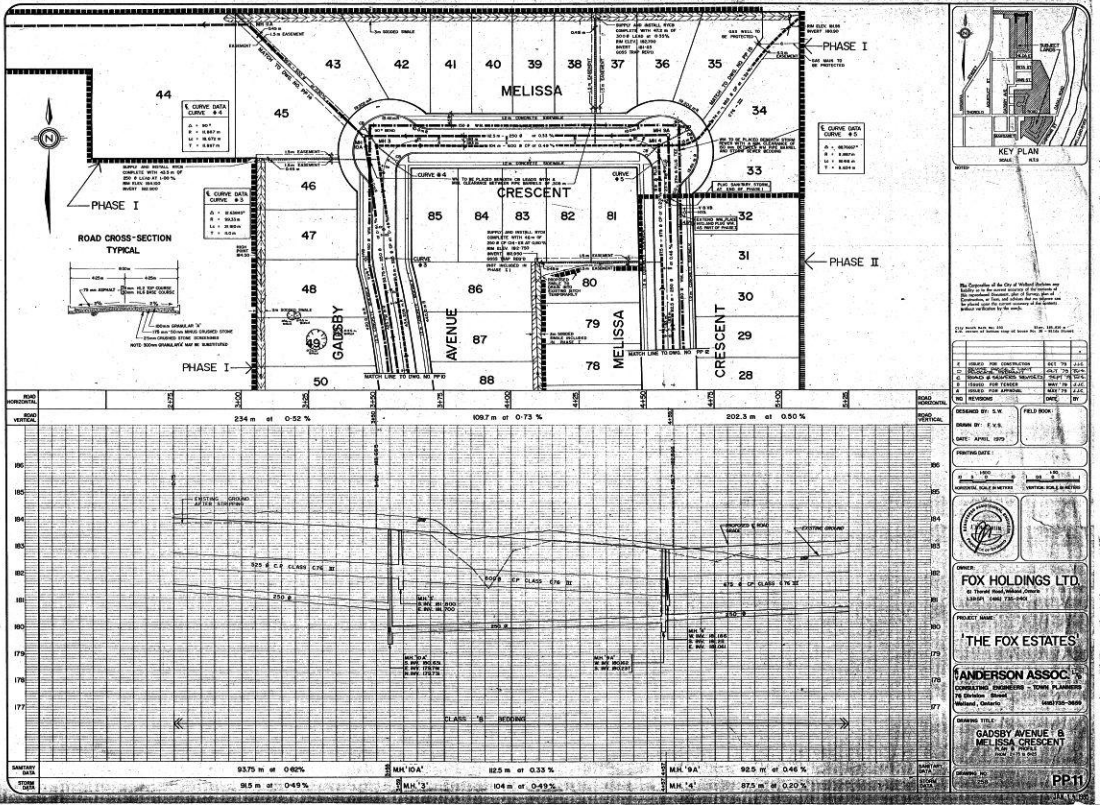
[THE DIFFERENCE IS OUR PEOPLE]

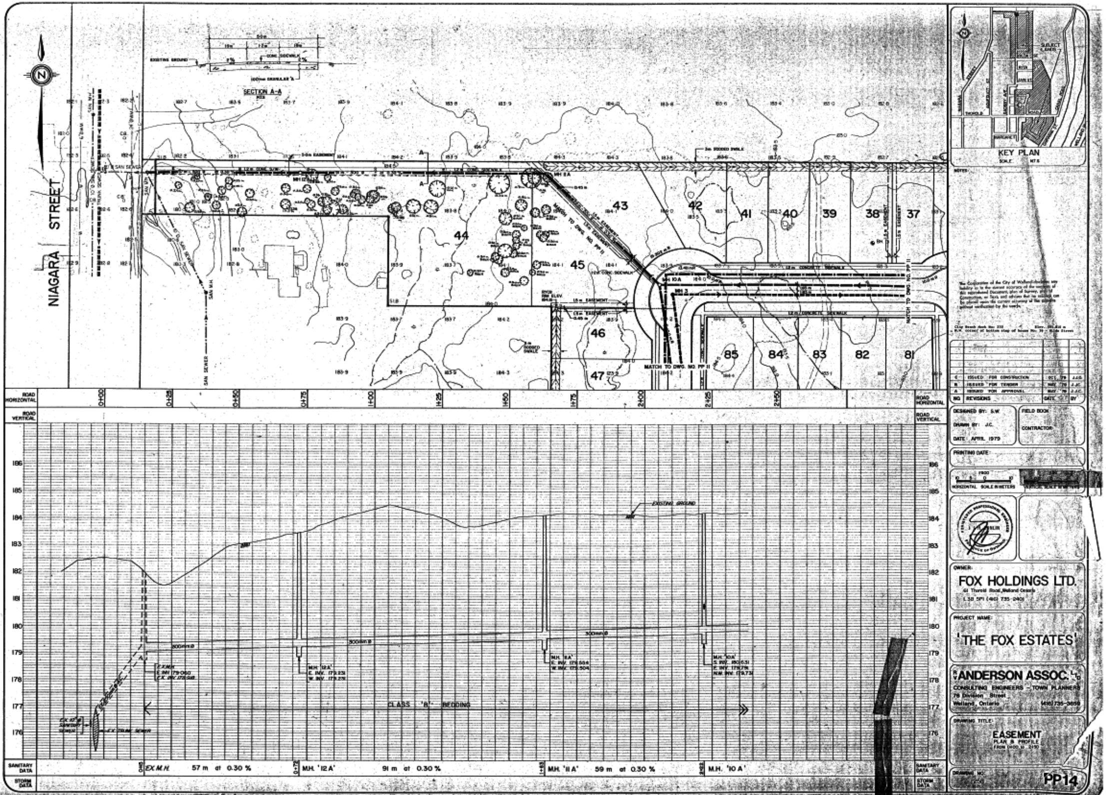
Appendix A

Background Information

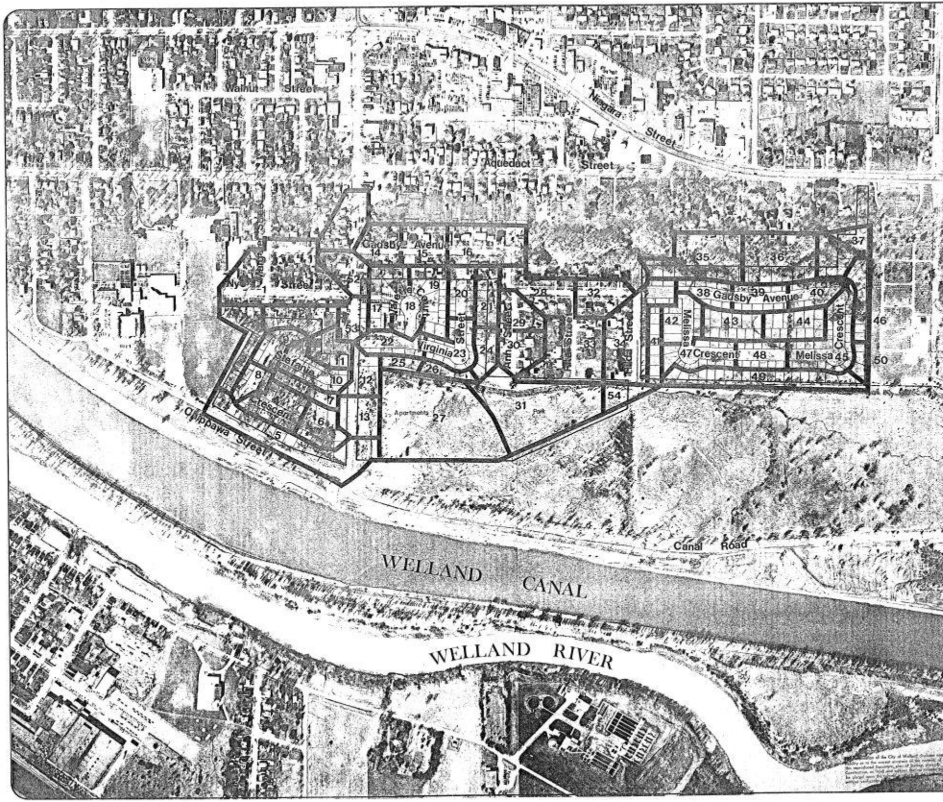


PHASE I
℄ CURVE DATA CURVE #1
℄ CURVE DATA CURVE #2
STREET
HILDA
GADSBY AVENUE
MELISSA
CRESCENT
PHASE I
PHASE II
63
62
61
60
59
58
57
56
55
54
53
52
51
50
7
8
9
6
10
64
65
66
95
94
93
92
91
90
89
88
CURVE #2
CURVE #1
MATCH TO DWG. NO. PP 13
MATCH LINE TO DWG NO. PP 11
3m SODDED SWALE
1.2 m CONCRETE SIDEWALK
DO NOT INSTALL CB BUT GRADE TO DRAIN SWALE TO EAST
HIGH POINT
ROAD HORIZONTAL
ROAD VERTICAL
56m at 0.50 %
10m at 0.85 %
44m at 1.91 %
234m at 0.52 %
187
186
185
184
183
182
181
180
EXISTING GROUND AFTER STRIPPING
PROPOSED ℄ ROAD GRADE
EXISTING GROUND
200 ø
250 ø
450 ø
CLASS 'B' BEDDING
SANITARY DATA
STORM DATA
M.H. '1A'
91 m at 0.94 %
M.H. '2A'
78 m at 0.45 %
M.H. '3A'
81.25 m at 0.39 %
M.H. '4A'
M.H. '1-1'
14.5 m at 0.48 %
M.H. '1'
91.5 m at 0.45 %
M.H. '2'
KEY PLAN
SUBJECT LANDS
NO. REVISIONS DATE BY
D ISSUED FOR CONSTRUCTION
C
B ISSUED FOR TENDER
A ISSUED FOR APPROVAL
DESIGNED BY: S.W.
DRAWN BY: E.V.S.
DATE: APRIL 1979
FIELD BOOK:
CONTRACTOR:
PRINTING DATE:
HORIZONTAL SCALE IN METERS
VERTICAL SCALE IN METERS
OWNER:
FOX HOLDINGS LTD.
PROJECT NAME:
'THE FOX ESTATES'
ANDERSON ASSOC.
CONSULTING ENGINEERS TOWN PLANNERS
Welland, Ontario
DRAWING TITLE:
GADSBY AVENUE
PLAN & PROFILE
DRAWING NO.
PP10


MELISSA
CRESCENT
GADSBY AVENUE
PHASE I
PHASE II
ROAD CROSS-SECTION TYPICAL
KEY PLAN
234 m at 0·52 %
109.7 m at 0·73 %
202.3 m at 0.50 %
93.75 m at 0·62%
98.5 m at 0·49 %
M.H. '10A'
M.H. '3'
122.5 m at 0.33 %
104 m at 0.49%
M.H. '9A'
M.H. '4'
92.5 m at 0.46 %
87.5 m at 0.20 %
CLASS 'B' BEDDING
EXISTING GROUND
PROPOSED ℄ ROAD GRADE
FOX HOLDINGS LTD.
'THE FOX ESTATES'
ANDERSON ASSOC.
GADSBY AVENUE & MELISSA CRESCENT
PP.11



KEY PLAN
SECTION A-A
NIAGARA STREET
MATCH TO DWG. NO. PP 11
EXISTING GROUND
CLASS 'B' BEDDING
EX.M.H. 57 m at 0.30 %
M.H. '12 A' 91 m at 0.30 %
M.H. '11 A' 59 m at 0.30 %
M.H. '10 A'
C ISSUED FOR CONSTRUCTION
B ISSUED FOR TENDER
A ISSUED FOR APPROVAL
NO REVISIONS DATE BY
DESIGNED BY: S.W.
DRAWN BY: J.C.
DATE: APRIL 1979
FIELD BOOK
CONTRACTOR
PRINTING DATE:
HORIZONTAL SCALE IN METERS
OWNER:
FOX HOLDINGS LTD.
PROJECT NAME:
'THE FOX ESTATES'
R.V. ANDERSON ASSOC. LTD.
CONSULTING ENGINEERS - TOWN PLANNERS
78 Division Street
Welland, Ontario
DRAWING TITLE:
EASEMENT
PLAN & PROFILE
DRAWING NO.:
PP14



LEGEND

AREA	ACRES	HECTARES	RUNOFF COEFFICIENT
1	4·94	2·00	·425
2	1·51	·61	·425
3	1·70	·69	·425
4	1·66	·67	·425
5	4·15	1·68	·425
6	1·56	·63	·425
7	·69	·28	·425
8	·79	·32	·425
9	·99	·40	·425
10	1·56	·63	·425
11	1·08	·43	·425
12	1·11	·45	·60
13	1·24	·50	·60
14	1·14	·46	·425
15	1·58	·64	·425
16	2·55	1·03	·425
17	1·41	·57	·425
18	1·11	·45	·425
19	1·63	·66	·425
20	1·09	·44	·425
21	1·26	·51	·425
22	1·26	·51	·425
23	1·64	·66	·425
24	·96	·39	·425
25	·49	·20	·425
26	·57	·23	·425
27	7·31	2·96	·70
28	1·83	·74	·425
29	1·01	·41	·425
30	1·28	·51	·425
31	5·07	2·05	·25
32	1·46	·59	·425
33	3·61	1·46	·425
34	3·53	1·43	·425
35	2·89	1·17	·425
36	2·97	1·23	·425
37	1·63	·66	·425
38	·99	·40	·425
39	1·46	·59	·425
40	1·14	·46	·425
41	·72	·29	·425
42	1·33	·54	·425
43	1·36	·55	·425
44	1·4[illegible]	·57	·425
45	2·74	1·11	·425
46	[illegible]	·46	·425
47	[illegible]	[illegible]	·425
48	[illegible]	·47	·425
49	2·[illegible]	[illegible]	[illegible]
[illegible]	·[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	·[illegible]	[illegible]
52	1·28	·52	·425
53	1·01	·41	·425
54	·59	·24	·25

NO.	REVISIONS	DATE	BY
C	ISSUED FOR CONSTRUCTION	[illegible] '79	J.J.C.
B	ISSUED FOR TENDER	MAY '79	J.J.C.
A	ISSUED FOR APPROVAL	MAY '79	J.J.C.

DESIGNED BY:
DRAWN BY:
DATE:

FIELD BOOK
CONTRACTOR

PRINTING DATE:

1" = 200'
SCALE IN FEET

OWNER:

FOX HOLDINGS LTD.

61 THOROLD ROAD, WELLAND, ONTARIO
L3B-5P1 (416) 735-2401

PROJECT NAME:

'THE FOX ESTATES'

R.V. ANDERSON ASSOC. LTD.
CONSULTING ENGINEERS – TOWN PLANNERS
76 Division Street
Welland, Ontario (416) 735-3859

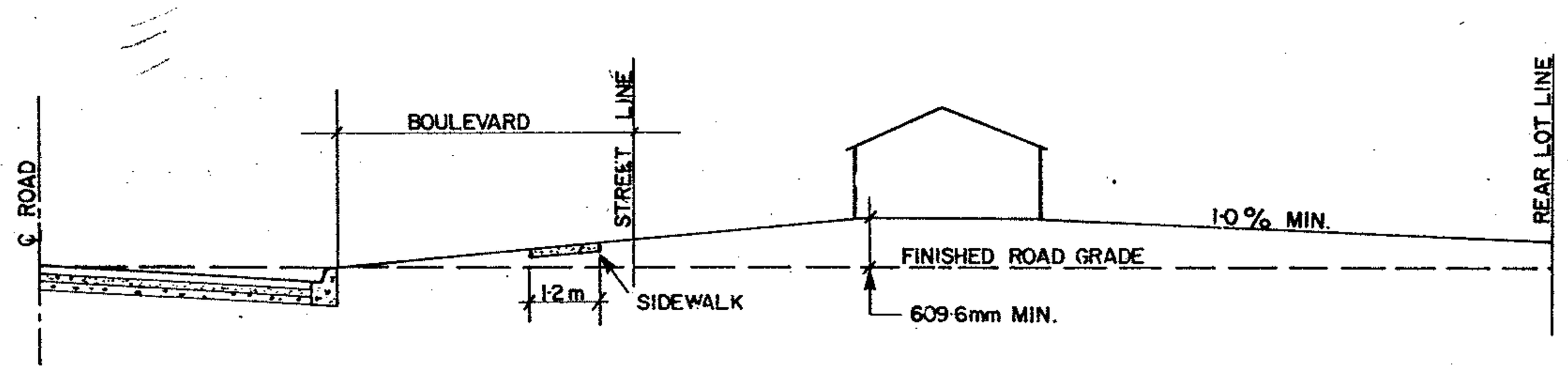
DRAWING TITLE:

STORM DRAINAGE PLAN

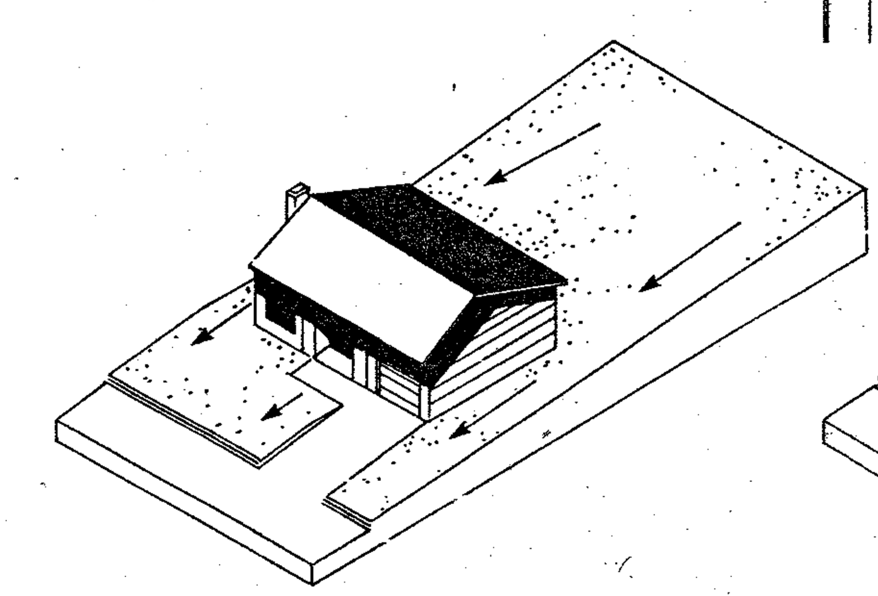
DRAWING NO.
258 258 - SD 3

JAN 14 [illegible]

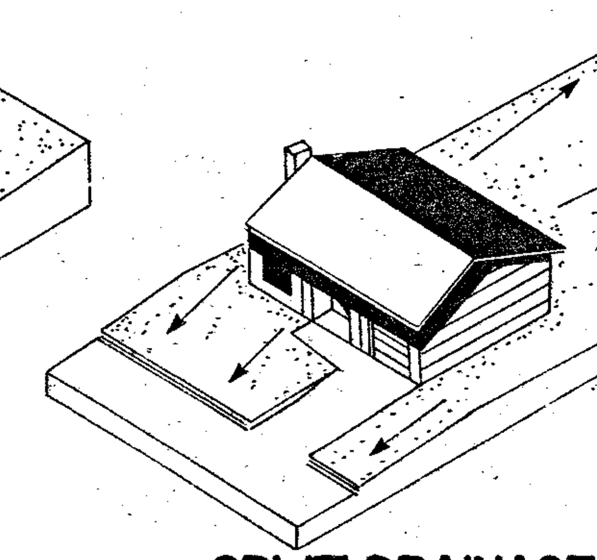
NO	REVISIONS	DATE	BY
D	RYCB ELEV. REVISED	NOV. 1979	F.V.S.
C	ISSUED FOR CONSTRUCTION	OCT. 1979	J.J.C.
B	ISSUED FOR TENDER	MAY 1979	J.J.C.
A	ISSUED FOR APPROVAL	MAY 1979	J.J.C.



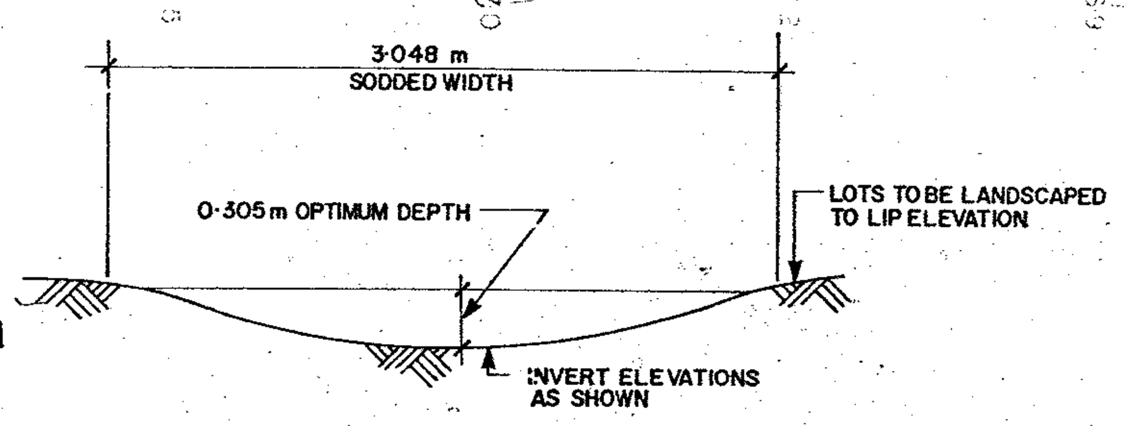
PROTECTIVE APRON
N.T.S.



REAR TO FRONT DRAINAGE



SPLIT DRAINAGE



CROSS SECTION OF TYPICAL SWALE
N.T.S.

The Corporation of the City of Welland disclaims any liability as to the current accuracy of the contents of this reproduced Document, plan of Survey, plan of Construction, or Text, and advises that no reliance can be placed upon the current accuracy of the contents without verification by the user/s.

LEGEND

183.375	PROPOSED CENTRE LINE ELEVATION
(185.08)	PROPOSED APRON ELEVATION
182.70	PROPOSED SWALE ELEVATION
(185.52 / 184.52)	PROPOSED APRON ELEVATION SPLIT GRADE
185.20	PROPOSED ELEVATION
▨	DRAINAGE SWALE
←	DIRECTION OF DRAINAGE FLOW

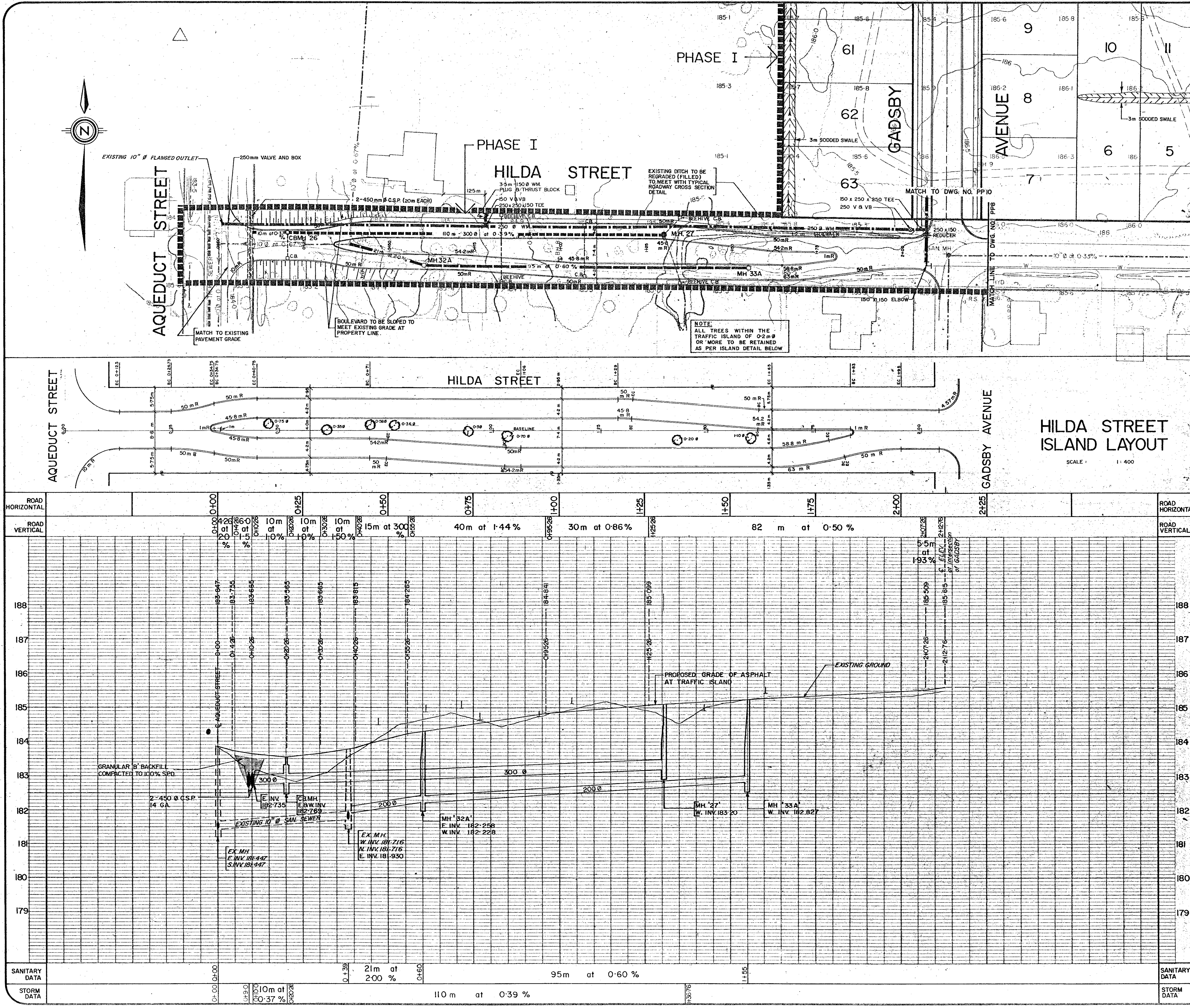
'THE FOX ESTATES'

PRINTING DATE:

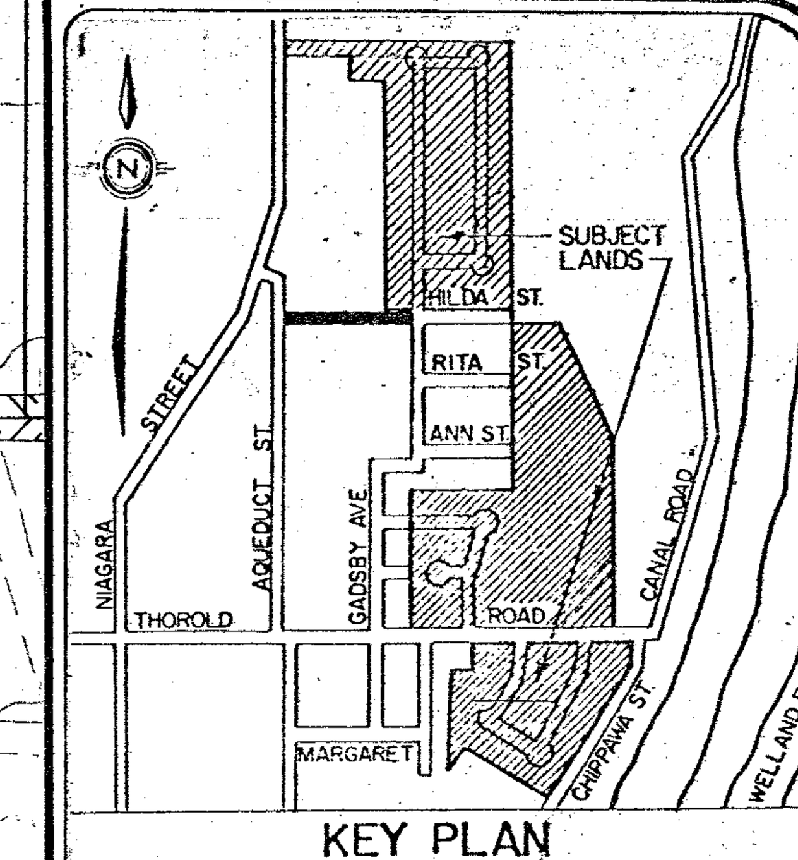
1:500
20 15 10 5 0 10 20
SCALE IN METERS

R.V. ANDERSON ASSOC. LTD
CONSULTING ENGINEERS - TOWN PLANNERS
76 Division Street
Welland, Ontario (416) 735-3659

GRADING PLAN GP3



KEY PLAN



SCALE: N.T.S.

NOTES:

The Corporation of the City of Welland disclaims any liability as to the current accuracy of the contents of this reproduced Document, plan of Survey, plan of Construction, or Text, and advises that no reliance can be placed upon the current accuracy of the contents without verification by the user/s.

City Bench Mark No: 190 Elev. 185.584 m
N.E. corner of bottom step of House No: 175

NO.	REVISIONS	DATE	BY
F	ISSUED FOR CONSTRUCTION	OCT. 1979	J.J.C.
E	ISLAND & RD GRADES	OCT 1979	F.V.S.
D	ST. & SEWER GRADE CHANGED	OCT. 1979	F.V.S.
C	HILDA STREET ISLAND LAYOUT	SEPT. 1979	J.C.
B	ISSUED FOR TENDER	MAY 1979	J.J.C.
A	ISSUED FOR APPROVAL	MAY 1979	J.J.C.

DESIGNED BY: S.W.
DRAWN BY: J.C.
DATE: APRIL 1979

FIELD BOOK:
CONTRACTOR:

PRINTING DATE:

HORIZONTAL SCALE IN METERS 1:500
VERTICAL SCALE IN METERS 1:50

REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

OWNER:

FOX HOLDINGS LTD.
61 Thorold Road, Welland, Ontario
L3B 5P1 (416) 735-2401

PROJECT NAME:

'THE FOX ESTATES'

R.V. ANDERSON ASSOC. LTD
CONSULTING ENGINEERS - TOWN PLANNERS
76 Division Street
Welland, Ontario (416) 735-3659

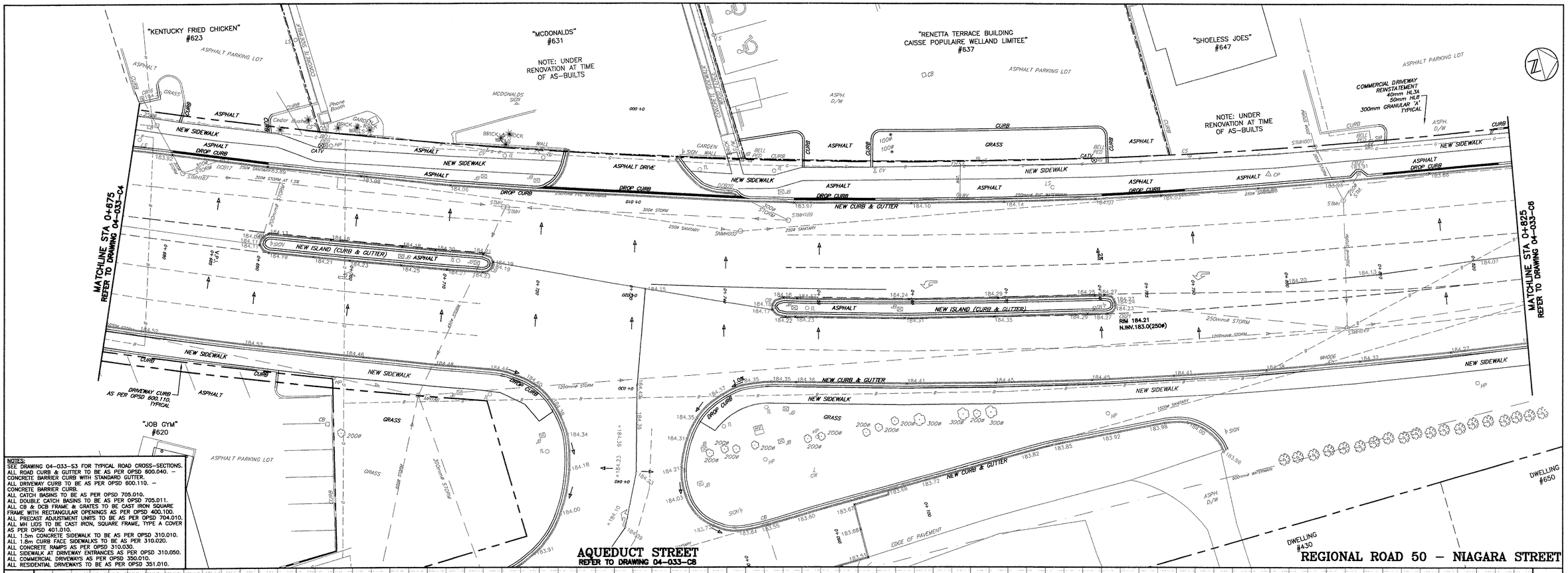
DRAWING TITLE:

HILDA STREET
PLAN & PROFILE
FROM 0+00 to 2+25

DRAWING NO: 258

PP7

JAN 1 5 1980



NOTES:
SEE DRAWING 04-033-S3 FOR TYPICAL ROAD CROSS-SECTIONS.
ALL ROAD CURB & GUTTER TO BE AS PER OPSD 600.040. - CONCRETE BARRIER CURB WITH STANDARD GUTTER.
ALL DRIVEWAY CURB TO BE AS PER OPSD 600.110. - CONCRETE BARRIER CURB.
ALL CATCH BASINS TO BE AS PER OPSD 705.010.
ALL DOUBLE CATCH BASINS TO BE AS PER OPSD 705.011.
ALL CB & DCB FRAME & GRATES TO BE CAST IRON SQUARE FRAME WITH RECTANGULAR OPENINGS AS PER OPSD 400.100.
ALL PRECAST ADJUSTMENT UNITS TO BE AS PER OPSD 704.010.
ALL MH LIDS TO BE CAST IRON, SQUARE FRAME, TYPE A COVER AS PER OPSD 401.010.
ALL 1.5m CONCRETE SIDEWALK TO BE AS PER OPSD 310.010.
ALL 1.8m CURB FACE SIDEWALKS TO BE AS PER 310.020.
ALL CONCRETE RAMPS AS PER OPSD 310.030.
ALL SIDEWALK AT DRIVEWAY ENTRANCES AS PER OPSD 310.050.
ALL COMMERCIAL DRIVEWAYS AS PER OPSD 350.010.
ALL RESIDENTIAL DRIVEWAYS TO BE AS PER OPSD 351.010.

NO.	REVISION DESCRIPTION	DATE	BY
4	RECORD OF CONSTRUCTION	OCT. 2007	JH
3	ISSUED FOR TENDER	AUG. 2006	JH
2	ISSUED FOR COMMENT	AUG. 2006	JH
1	ISSUED FOR SERVICE LOCATES	APRIL 2006	JH

SYMBOL LEGEND

AS-BUILT SYMBOLS: GAS VALVE; BELL PEDESTAL; WATER VALVE; HYDRO VAULT; CURB STOP; CURB & EDGE OF PAVEMENT; CATCH BASIN; DOUBLE CATCH BASIN; ROAD GRADE CROSS FALL; FIRE HYDRANT & GUYWIRES; ELEVATIONS

EXISTING SYMBOLS: SANITARY MH; STORM MH; CATCH BASIN; CATCH BASIN MH; FIRE HYDRANT; WATER VALVE; CURB STOP; STANDARD IRON BAR; IRON BAR; CONTROL BAR; MAIL BOX; TRAFFIC LIGHT; LIGHT STANDARD; HYDRO POLE; GUY WIRE; ELECTRICAL HANDHOLE; JUNCTION BOX; CURB STOP; STREET SIGN; BELL PEDESTAL; BELL MH

GENERAL NOTES
1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONSTRUCTION DRAWINGS, AND WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.
2. BEFORE STARTING THE WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE LOCATION OF SUCH UTILITIES AND STRUCTURES, AND THEREFORE HE SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
3. HYDRO AND BELL POLES ARE TO BE ANCHORED TO THE GROUND WHERE REQUIRED SO AS TO ENSURE THE STABILITY OF THE POLE LINES.
4. THE CONTRACTOR IS TO CHECK WITH ALL THE UTILITIES INVOLVED.
5. ALL MANHOLE FRAMES, CATCHBASIN FRAMES, WATER VALVES AND GAS VALVES ARE TO BE ADJUSTED TO FINISH GRADE.
6. EXISTING TREES AND VEGETATION OUTSIDE OF THE CONSTRUCTION AREAS ARE TO REMAIN UNDISTURBED.

BENCH MARK DATUM
MON.#0018197017 40
N.4765776.910 E.642607.735
ELE. 181.673
MON.#00519930018
N.4762730.209 E.642629.810
ELE. 185.269

DRAFTING: J.H.
DESIGN: J.H.
CHECKED BY: W.A.G.Mackay
PROJECT SUPVR.: W.A.G.Mackay

KERRY T. HOWE ENGINEERING LIMITED
07/11/22

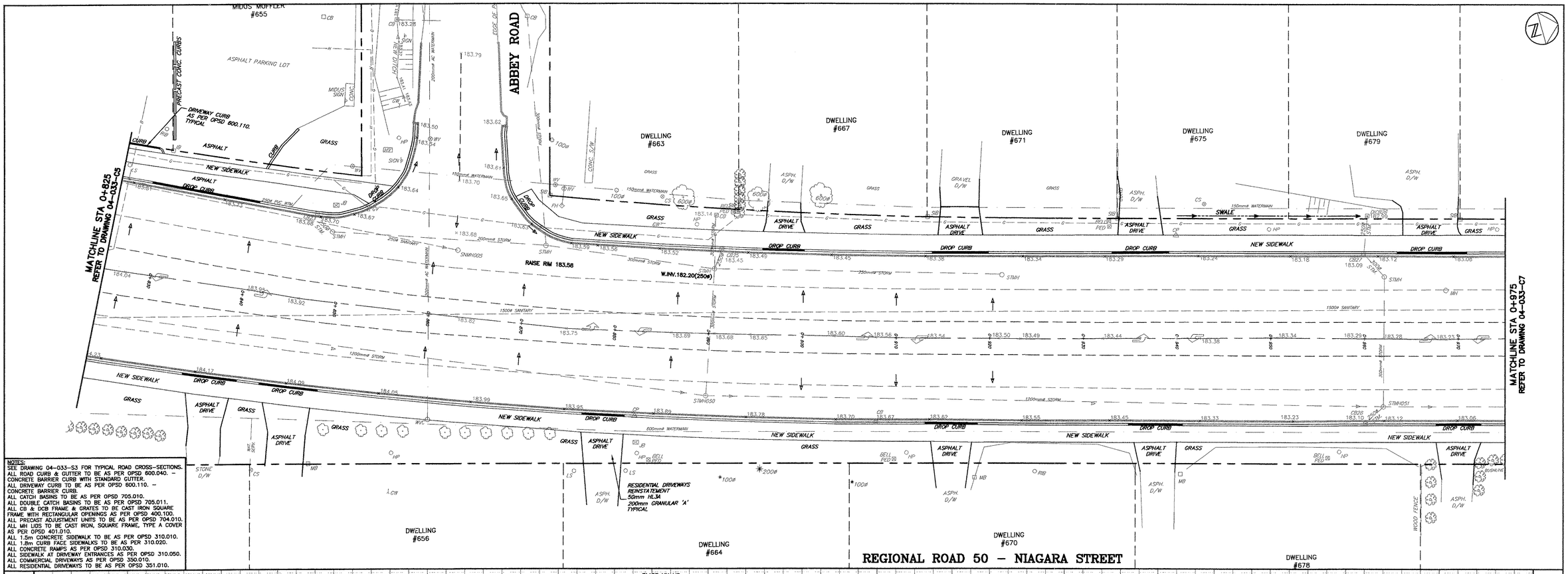
Regional Niagara — THE REGIONAL MUNICIPALITY OF NIAGARA
Public Works Department

KERRY T. HOWE ENGINEERING LIMITED
CONSULTING ENGINEERS
98 Church Street St.
Catharines ,Ontario
(905) 688-6550

PROJECT NAME: **RECONSTRUCTION AND WIDENING OF REGIONAL ROAD #50 (NIAGARA STREET)**
CITY OF WELLAND

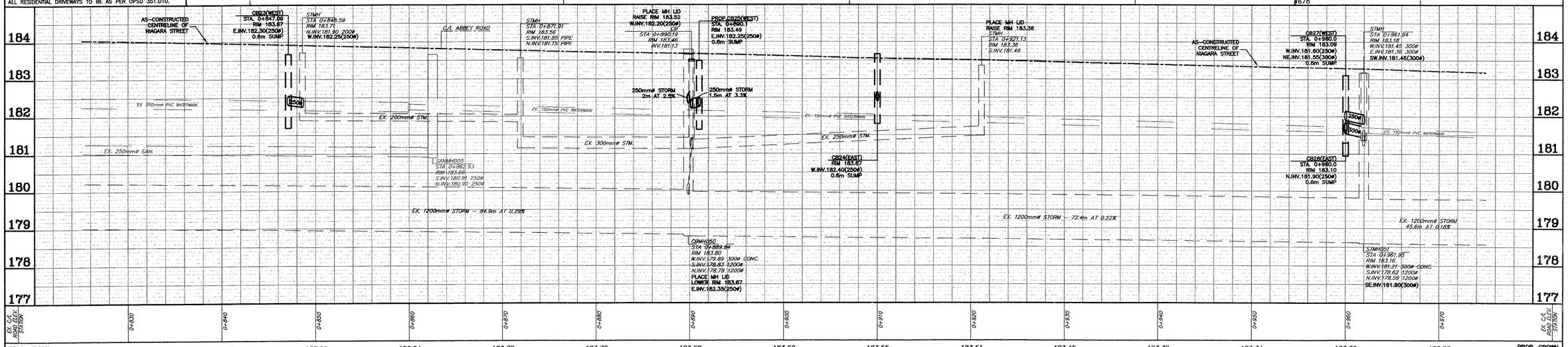
DRAWING NAME: FROM THOROLD ROAD to WOODLAWN ROAD
RECORD OF CONSTRUCTION
STATION 0+675 TO STATION 0+825

FIELD NOTES: KTH BOOK #821
MUNICIPAL REFERENCE NUMBER: RN 06-27
SCALE: HOR. 1:200 VERT. 1:50
PLOT DATE: Nov. 22, 2007
DRAWING NO.: 04-033-C5
REVISION: 4
CAD FILE: 04-033-ROC.dwg



NOTES:

SEE DRAWING 04-033-S3 FOR TYPICAL ROAD CROSS-SECTIONS.
ALL ROAD CURB & GUTTER TO BE AS PER OPSD 600.040. – CONCRETE BARRIER CURB WITH STANDARD GUTTER.
ALL DRIVEWAY CURB TO BE AS PER OPSD 600.110. – CONCRETE BARRIER CURB.
ALL CATCH BASINS TO BE AS PER OPSD 705.010.
ALL DOUBLE CATCH BASINS TO BE AS PER OPSD 705.011.
ALL CB & DCB FRAME & GRATES TO BE CAST IRON SQUARE FRAME WITH RECTANGULAR OPENINGS AS PER OPSD 400.100.
ALL PRECAST ADJUSTMENT UNITS TO BE AS PER OPSD 704.010.
ALL MH LIDS TO BE CAST IRON, SQUARE FRAME, TYPE A COVER AS PER OPSD 401.010.
ALL 1.5m CONCRETE SIDEWALK TO BE AS PER OPSD 310.010.
ALL 1.8m CURB FACE SIDEWALKS TO BE AS PER 310.020.
ALL CONCRETE RAMPS AS PER OPSD 310.030.
ALL SIDEWALK AT DRIVEWAY ENTRANCES AS PER OPSD 310.050.
ALL COMMERCIAL DRIVEWAYS AS PER OPSD 350.010.
ALL RESIDENTIAL DRIVEWAYS TO BE AS PER OPSD 351.010.



NO.	REVISION DESCRIPTION	DATE	BY
4	RECORD OF CONSTRUCTION	OCT. 2007	JH
3	ISSUED FOR TENDER	AUG. 2006	JH
2	ISSUED FOR COMMENT	AUG. 2006	JH
1	ISSUED FOR SERVICE LOCATES	APRIL 2006	JH

AS-BUILT SYMBOLS

GV GAS VALVE; WV WATER VALVE; CS CURB STOP; CB CATCH BASIN; DCB DOUBLE CATCH BASIN; FH FIRE HYDRANT; HP HYDRO POLES & GUYWIRES; BELL PEDESTAL; HV HYDRO VAULT; CURB & EDGE OF PAVEMENT; ROAD GRADE CROSS FALL; ×185.37 ELEVATIONS

SYMBOL LEGEND

EXISTING SYMBOLS			
SMH	SANITARY MH	TL	TRAFFIC LIGHT
STMH	STORM MH	LS	LIGHT STANDARD
CB	CATCH BASIN	HP	HYDRO POLE
CBMH	CATCH BASIN MH	GW	GUY WIRE
FH	FIRE HYDRANT	HH	ELECTRICAL HANDHOLE
WV	WATER VALVE	JB	JUNCTION BOX
CS	CURB STOP	FP	CURB STOP
SIB	STANDARD IRON BAR	SIGN	STREET SIGN
IB	IRON BAR	BELL	BELL PEDESTAL
CP	CONTROL BAR	BELL MH	BELL MH
MB	MAIL BOX		

GENERAL NOTES

1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONSTRUCTION DRAWINGS, AND WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.
2. BEFORE STARTING THE WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE LOCATION OF SUCH UTILITIES AND STRUCTURES, AND THEREFORE HE SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
3. HYDRO AND BELL POLES ARE TO BE ANCHORED TO THE GROUND WHERE REQUIRED SO AS TO ENSURE THE STABILITY OF THE POLE LINES.
4. THE CONTRACTOR IS TO CHECK WITH ALL THE UTILITIES INVOLVED.
5. ALL MANHOLE FRAMES, CATCHBASIN FRAMES, WATER VALVES AND GAS VALVES ARE TO BE ADJUSTED TO FINISH GRADE.
6. EXISTING TREES AND VEGETATION OUTSIDE OF THE CONSTRUCTION AREAS ARE TO REMAIN UNDISTURBED.

BENCH MARK DATUM

MON.#001819701740
N.4765776.910 E.642607.735
ELE. 181.673

MON.#005193930018
N.4762730.209 E.642629.810
ELE. 185.269

DRAFTING: J.H.
DESIGN: J.H.
CHECKED BY: W.A.G.Mackay
PROJECT SUPVR.: W.A.G.Mackay

REGISTERED PROFESSIONAL ENGINEER W. A. G. MACKAY — KERRY T. HOWE ENGINEERING LIMITED

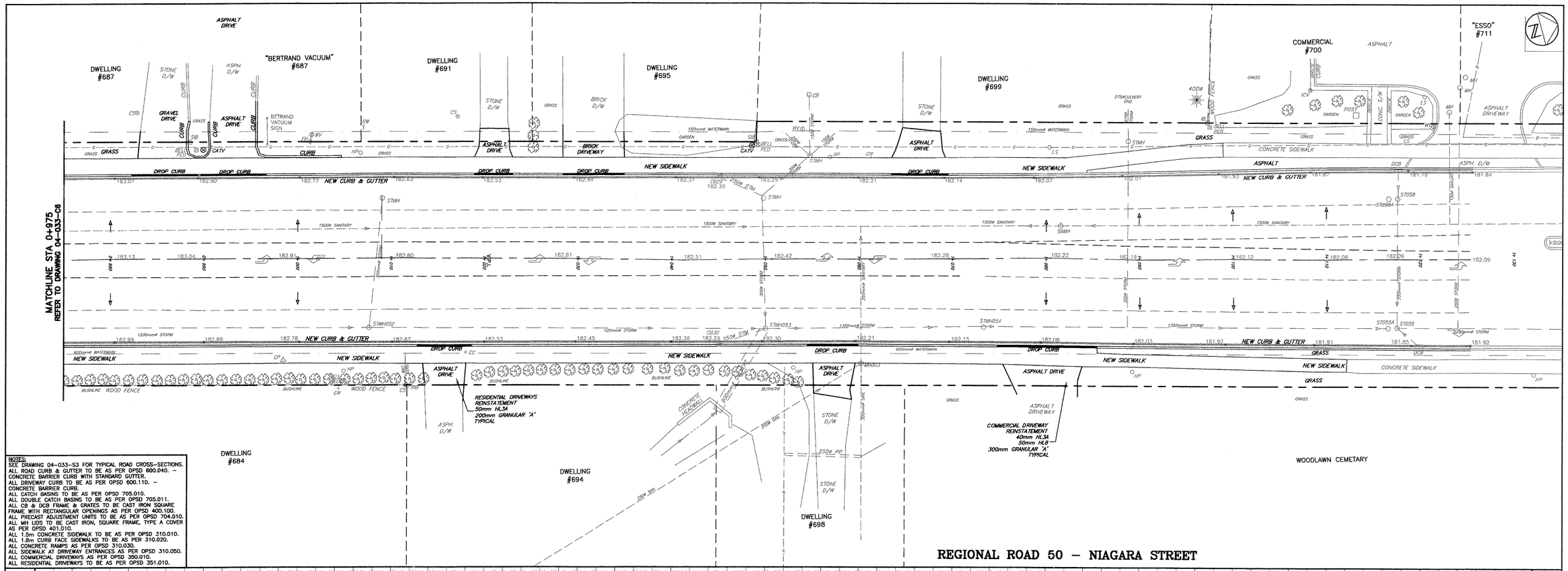
Ontario NIAGARA — THE REGIONAL MUNICIPALITY OF NIAGARA, Public Works Department

KERRY T. HOWE ENGINEERING LIMITED
CONSULTING ENGINEERS
98 Church Street St.
Catharines ,Ontario
(905) 688-6550

PROJECT NAME: RECONSTRUCTION AND WIDENING OF REGIONAL ROAD #50 (NIAGARA STREET)
CITY OF WELLAND

DRAWING NAME: FROM THOROLD ROAD to WOODLAWN ROAD
RECORD OF CONSTRUCTION
STATION 0+825 TO STATION 0+975

FIELD NOTES: KTH BOOK #821
MUNICIPAL REFERENCE NUMBER: RN 06-27
SCALE: HOR. 1:200, VERT. 1:50
PLOT DATE: Nov. 22, 2007
DRAWING NO.: 04-033-C6
REVISION: 4
CAD FILE: 04-033-ROC.dwg



NOTES:
SEE DRAWING 04-033-S3 FOR TYPICAL ROAD CROSS-SECTIONS.
ALL ROAD CURB & GUTTER TO BE AS PER OPSD 600.040. – CONCRETE BARRIER CURB WITH STANDARD GUTTER.
ALL DRIVEWAY CURB TO BE AS PER OPSD 600.110. – CONCRETE BARRIER CURB.
ALL CATCH BASINS TO BE AS PER OPSD 705.010.
ALL DOUBLE CATCH BASINS TO BE AS PER OPSD 705.011.
ALL CB & DCB FRAME & GRATES TO BE CAST IRON SQUARE FRAME WITH RECTANGULAR OPENINGS AS PER OPSD 400.100.
ALL PRECAST ADJUSTMENT UNITS TO BE AS PER OPSD 704.010.
ALL MH LIDS TO BE CAST IRON, SQUARE FRAME, TYPE A COVER AS PER OPSD 401.010.
ALL 1.5m CONCRETE SIDEWALK TO BE AS PER OPSD 310.010.
ALL 1.8m CURB FACE SIDEWALKS TO BE AS PER 310.020.
ALL CONCRETE RAMPS AS PER OPSD 310.030.
ALL SIDEWALK AT DRIVEWAY ENTRANCES AS PER OPSD 310.050.
ALL COMMERCIAL DRIVEWAYS AS PER OPSD 350.010.
ALL RESIDENTIAL DRIVEWAYS TO BE AS PER OPSD 351.010.

NO.	REVISION DESCRIPTION	DATE	BY
4	RECORD OF CONSTRUCTION	OCT. 2007	JH
3	ISSUED FOR TENDER	AUG. 2006	JH
2	ISSUED FOR COMMENT	AUG. 2006	JH
1	ISSUED FOR SERVICE LOCATES	APRIL 2006	JH

AS-BUILT SYMBOLS
GV, GAS VALVE; BELL PEDESTAL; WV WATER VALVE; HYDRO VAULT; CS CURB STOP; CB CATCH BASIN; CURB & EDGE OF PAVEMENT; DCB DOUBLE CATCH BASIN; ROAD GRADE CROSS FALL; FH FIRE HYDRANT; HP HYDRO POLES; GW; x185.37 ELEVATIONS

SYMBOL LEGEND

EXISTING SYMBOLS			
SMH	SANITARY MH	TL	TRAFFIC LIGHT
STMH	STORM MH	LS	LIGHT STANDARD
CB	CATCH BASIN	HP	HYDRO POLE
CBMH	CATCH BASIN MH	GW	GUY WIRE
FH	FIRE HYDRANT	HH	ELECTRICAL HANDHOLE
WV	WATER VALVE	JB	JUNCTION BOX
CS	CURB STOP	FP	CURB STOP
SIB	STANDARD IRON BAR	SIGN	STREET SIGN
IB	IRON BAR	BELL PED	BELL PEDESTAL
CP	CONTROL BAR	B	BELL MH
MB	MAIL BOX		

GENERAL NOTES
1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONSTRUCTION DRAWINGS, AND WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.
2. BEFORE STARTING THE WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE LOCATION OF SUCH UTILITIES AND STRUCTURES, AND THEREFORE HE SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
3. HYDRO AND BELL POLES ARE TO BE ANCHORED TO THE GROUND WHERE REQUIRED SO AS TO ENSURE THE STABILITY OF THE POLE LINES.
4. THE CONTRACTOR IS TO CHECK WITH ALL THE UTILITIES INVOLVED.
5. ALL MANHOLE FRAMES, CATCHBASIN FRAMES, WATER VALVES AND GAS VALVES ARE TO BE ADJUSTED TO FINISH GRADE.
6. EXISTING TREES AND VEGETATION OUTSIDE OF THE CONSTRUCTION AREAS ARE TO REMAIN UNDISTURBED.

BENCH MARK DATUM
MON.#0018197017 40
N.4765776.910 E.642607.735
ELE. 181.673
MON.#0051993 0018
N.4762730.209 E.642629.810
ELE. 185.269

DRAFTING: J.H.
DESIGN: J.H.
CHECKED BY: W.A.G.Mackay
PROJECT SUPVR.: W.A.G.Mackay

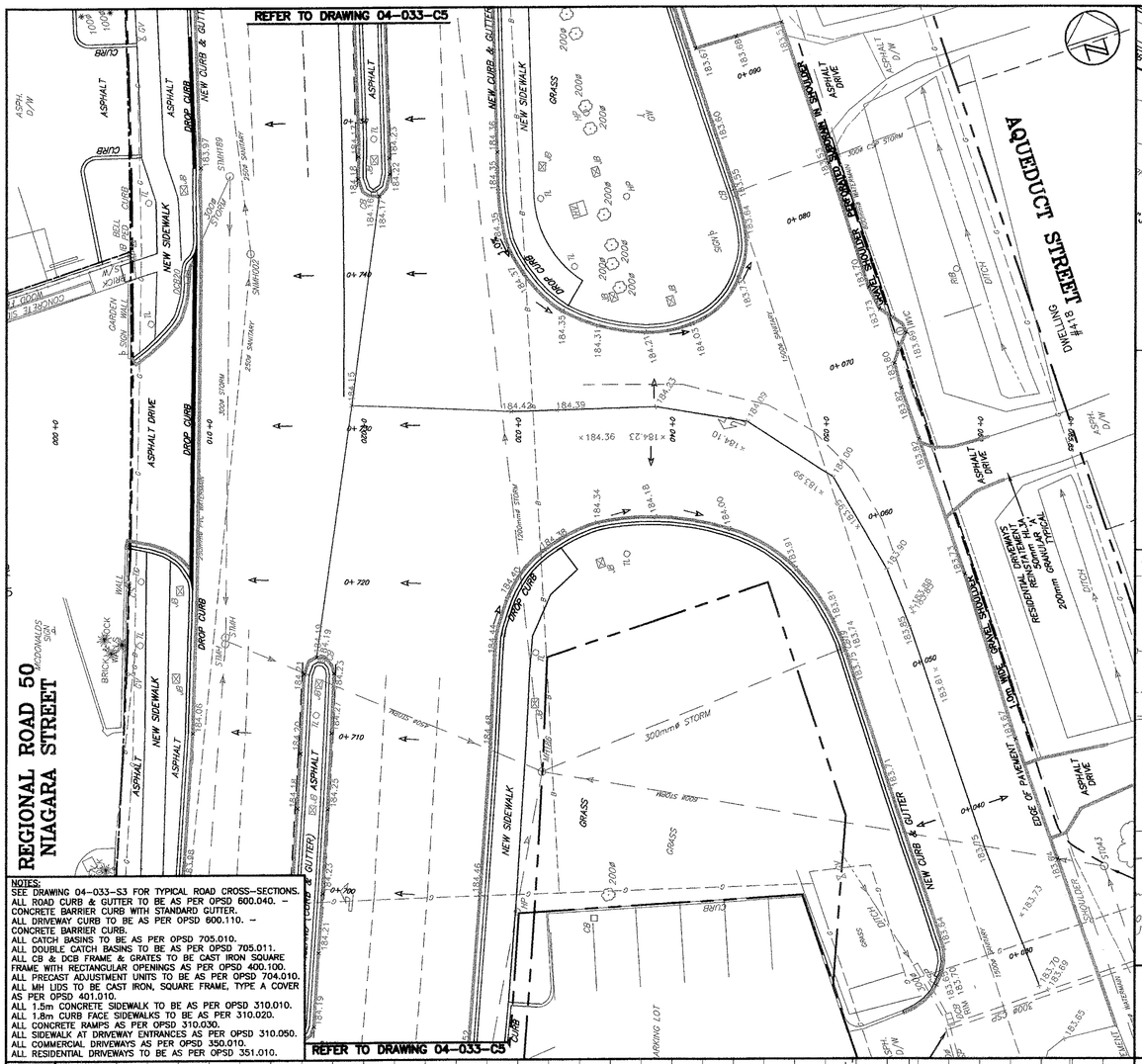
KERRY T. HOWE ENGINEERING LIMITED

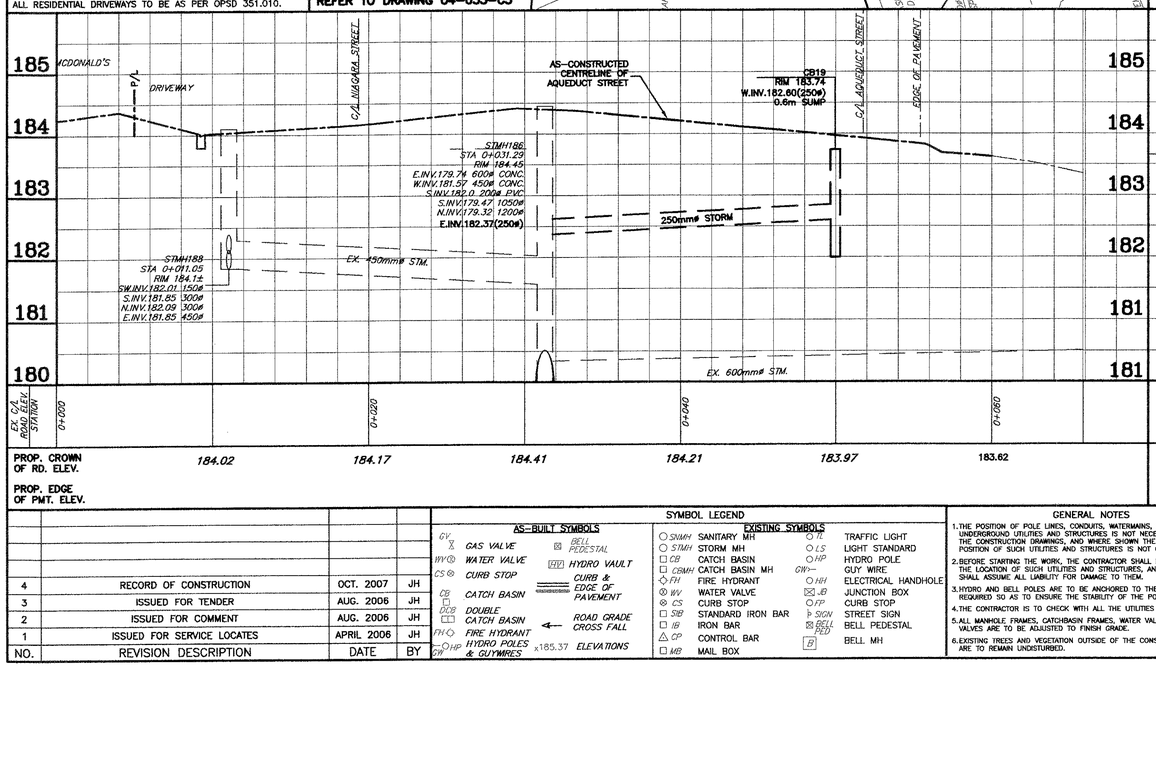
Regional Municipality of NIAGARA
THE REGIONAL MUNICIPALITY OF NIAGARA
Public Works Department

KERRY T. HOWE ENGINEERING LIMITED
CONSULTING ENGINEERS
98 Church Street St.
Catharines Ontario
(905) 688-6550

PROJECT NAME: RECONSTRUCTION AND WIDENING OF REGIONAL ROAD #50 (NIAGARA STREET)
CITY OF WELLAND
DRAWING NAME: FROM THOROLD ROAD to WOODLAWN ROAD
RECORD OF CONSTRUCTION
STATION 0+975 TO STATION 1+130

FIELD NOTES: KTH BOOK #821
MUNICIPAL REFERENCE NUMBER: RN 06-27
SCALE: HOR. 1:200 VERT. 1:50
PLOT DATE: Nov. 22, 2007
DRAWING NO.: 04-033-C7
REVISION: 4
CAD FILE: 04-033-ROC.dwg





NOTES:
SEE DRAWING 04-033-S3 FOR TYPICAL ROAD CROSS-SECTIONS.
ALL ROAD CURB & GUTTER TO BE AS PER OPSD 600.040. - CONCRETE BARRIER CURB WITH STANDARD GUTTER.
ALL DRIVEWAY CURB TO BE AS PER OPSD 600.110. - CONCRETE BARRIER CURB.
ALL CATCH BASINS TO BE AS PER OPSD 705.010.
ALL DOUBLE CATCH BASINS TO BE AS PER OPSD 705.011.
ALL CB & DCB FRAME & GRATES TO BE CAST IRON SQUARE FRAME WITH RECTANGULAR OPENINGS AS PER OPSD 400.100.
ALL PRECAST ADJUSTMENT UNITS TO BE AS PER OPSD 704.010.
ALL MH LIDS TO BE CAST IRON, SQUARE FRAME, TYPE A COVER AS PER OPSD 401.010.
ALL 1.5m CONCRETE SIDEWALK TO BE AS PER OPSD 310.010.
ALL 1.8m CURB FACE SIDEWALKS TO BE AS PER 310.020.
ALL CONCRETE RAMPS AS PER OPSD 310.030.
ALL SIDEWALK AT DRIVEWAY ENTRANCES AS PER OPSD 310.050.
ALL COMMERCIAL DRIVEWAYS AS PER OPSD 350.010.
ALL RESIDENTIAL DRIVEWAYS TO BE AS PER OPSD 351.010.

NO.	REVISION DESCRIPTION	DATE	BY
4	RECORD OF CONSTRUCTION	OCT. 2007	JH
3	ISSUED FOR TENDER	AUG. 2006	JH
2	ISSUED FOR COMMENT	AUG. 2006	JH
1	ISSUED FOR SERVICE LOCATES	APRIL 2006	JH

AS-BUILT SYMBOLS

GV GAS VALVE; BELL PEDESTAL; WV WATER VALVE; HV HYDRO VAULT; CS CURB STOP; CURB & EDGE OF PAVEMENT; CB CATCH BASIN; DCB DOUBLE CATCH BASIN; ROAD GRADE CROSS FALL; FH FIRE HYDRANT; HP HYDRO POLES & GUYWIRES; x185.37 ELEVATIONS

EXISTING SYMBOLS

SMH	SANITARY MH	TL	TRAFFIC LIGHT
STMH	STORM MH	LS	LIGHT STANDARD
CB	CATCH BASIN	HP	HYDRO POLE
CBMH	CATCH BASIN MH	GW	GUY WIRE
FH	FIRE HYDRANT	MH	ELECTRICAL HANDHOLE
WV	WATER VALVE	JB	JUNCTION BOX
CS	CURB STOP	CP	CURB STOP
SIB	STANDARD IRON BAR	SIGN	STREET SIGN
IB	IRON BAR	BELL PED	BELL PEDESTAL
CP	CONTROL BAR	BELL	BELL MH
MB	MAIL BOX		

GENERAL NOTES

1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONSTRUCTION DRAWINGS, AND WHERE SHOWN THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.
2. BEFORE STARTING THE WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE LOCATION OF SUCH UTILITIES AND STRUCTURES, AND THEREFORE HE SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
3. HYDRO AND BELL POLES ARE TO BE ANCHORED TO THE GROUND WHERE REQUIRED SO AS TO ENSURE THE STABILITY OF THE POLE LINES.
4. THE CONTRACTOR IS TO CHECK WITH ALL THE UTILITIES INVOLVED.
5. ALL MANHOLE FRAMES, CATCHBASIN FRAMES, WATER VALVES AND GAS VALVES ARE TO BE ADJUSTED TO FINISH GRADE.
6. EXISTING TREES AND VEGETATION OUTSIDE OF THE CONSTRUCTION AREAS ARE TO REMAIN UNDISTURBED.

BENCH MARK DATUM

MON.#001819701740
N.4765776.910 E.642607.735
ELE. 181.673

MON.#00519930018
N.4762730.209 E.642629.810
ELE. 185.269

DRAFTING: J.H.
DESIGN: J.H.
CHECKED BY: W.A.G.Mackay
PROJECT SUPVR.: W.A.G.Mackay

KERRY T. HOWE ENGINEERING LIMITED

Regional Niagara — THE REGIONAL MUNICIPALITY OF NIAGARA, Public Works Department

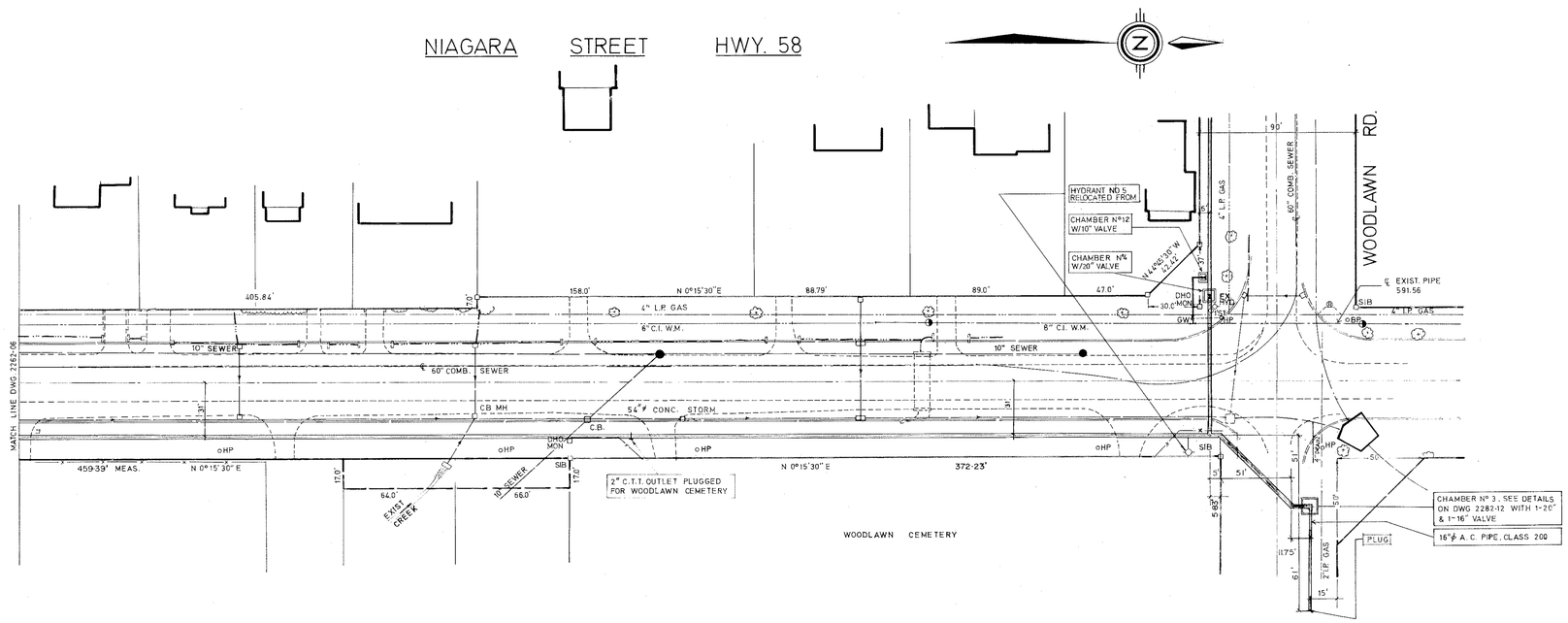
KERRY T. HOWE ENGINEERING LIMITED
CONSULTING ENGINEERS
98 Church Street St.
Catharines ,Ontario
(905) 688-5550

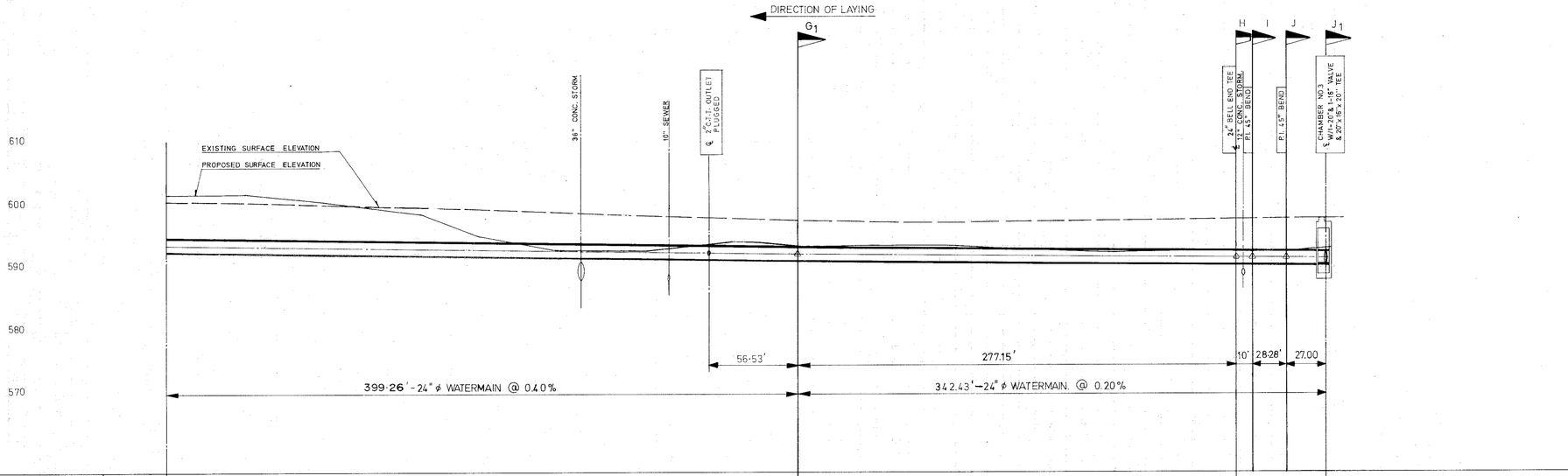
PROJECT NAME: **RECONSTRUCTION AND WIDENING OF REGIONAL ROAD # 50 (NIAGARA STREET)**
CITY OF WELLAND

DRAWING NAME: AQUEDUCT STREET
RECORD OF CONSTRUCTION

FIELD NOTES: KTH BOOK #821
MUNICIPAL REFERENCE NUMBER: RN 06-27
SCALE: HOR. 1:200 VERT. 1:50
PLOT DATE: Nov. 22, 20
DRAWING NO.: 04-033-C8
CAD FILE: 04-033-ROC.dwg

ISSUE	REVISIONS	DATE	BY
A	ISSUED FOR CONSTRUCTION	7-22 '69	F.C.P.
B	R. CHAINAGES AMENDED	AUG. '69	J.D.W.





SCHEDULE OF CONSTRUCTION:

1. NIAGARA ST. FROM N.L.S. WOODLAWN RD. SOUTHERLY TO HILDA ST.
2. WOODLAWN RD. FROM NIAGARA ST. TO EXIST. WATERMAIN AT FIRST AVE.
3. AQUEDUCT ST. N. & S. FROM HILDA ST. TO MERRITT ST.

NOTES:

- ALL FLANGED OUTLETS, OTHER THAN FOR FIRE HYDRANTS, ARE TO MEASURE 3'-0" FROM ℄ OF 24" PIPE TO FACE OF FLANGE
- FLANGED OUTLETS FOR FIRE HYDRANTS TO MEASURE 1'-10" FROM ℄ OF 24" PIPE TO FACE OF FLANGE.
- ALL CAST IRON PIPE & FITTINGS TO BE CEMENT MORTAR LINED THOROUGHLY COATED WITH PITCH BASE PAINT AND WRAPPED WITH 6 MIL. POLYETHYLENE FILM, TAPED IN PLACE.
- CONTRACTOR TO LOWER ALL SERVICES OBSTRUCTING FEEDER MAIN.

BEFORE YOU DIG, CALL THE PROVINCIAL GAS CO. ST. CATHERINES, ONT. TEL. 685-5441 (IN EMERGENCIES CALL 685-4844)

BOARD OF WATER COMMISSIONERS
WELLAND ONTARIO

24" FEEDER MAIN-SCHEDULE 2 PART 2 D

ON AQUEDUCT AND NIAGARA ST'S NORTH FROM THOROLD RD. EAST TO WOODLAWN RD.

R.V. ANDERSON ASSOCIATES LTD.
TORONTO CONSULTING ENGINEERS WELLAND

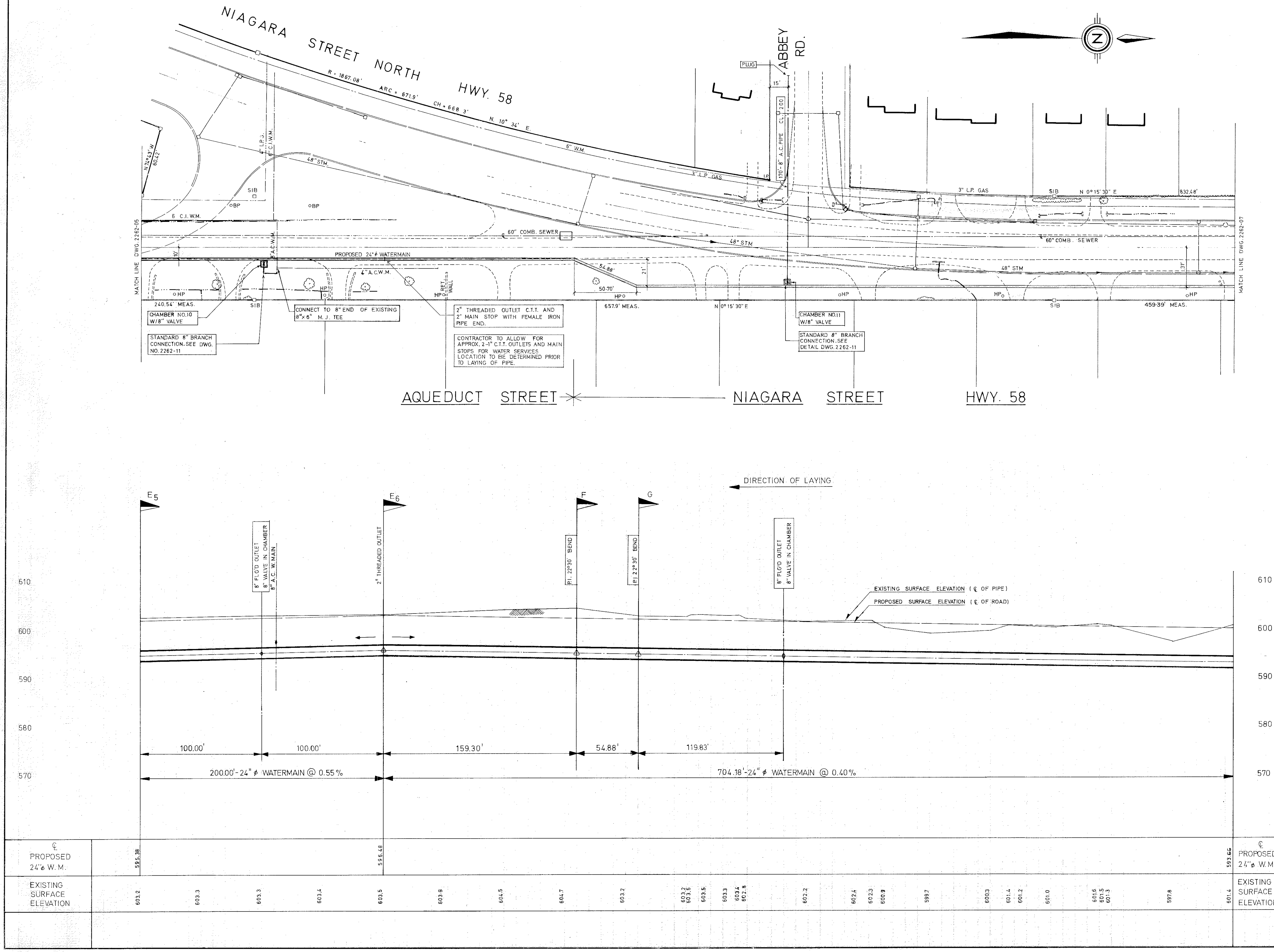
SCALE HORIZ.	SCALE VERT.	BENCH MARK	FIELD BOOK
1"= 40'-0"	1"= 10'-0"	CONC. MONUMENT EAST SIDE OF AQUEDUCT AT MERRITT ST. ELEV. 588.76	

	BY	DATE
DESIGNED	F.C.P.	JUNE 10/69
DRAWN	T.B.	JUNE 10/69
CHECKED	K.A.H.	JUNE 10/69

R.V.A.A.L. DWG. NO. 2262 - 07
ISSUE

DRAWING NO. A-51

ISSUE	REVISIONS	DATE	BY
A	ISSUED FOR CONSTRUCTION	7-22 '69	F.C.P.
B	R. CHAINAGES AMENDED	AUG. '69	J.D.W.



SCHEDULE OF CONSTRUCTION

1. NIAGARA ST. FROM N.S.L. WOODLAWN RD. SOUTHERLY TO HILDA ST.
2. WOODLAWN RD. FROM NIAGARA ST. TO EXIST. WATERMAIN AT FIRST AVE.
3. AQUEDUCT ST. N. & S. FROM HILDA ST. TO MERRITT ST.

NOTES:

— ALL FLANGED OUTLETS, OTHER THAN FOR FIRE HYDRANTS, ARE TO MEASURE 3'-0" FROM ℄ OF 24" PIPE TO FACE OF FLANGE.
— FLANGED OUTLETS FOR FIRE HYDRANTS TO MEASURE 1'-10" FROM ℄ OF 24" PIPE TO FACE OF FLANGE
— ALL CAST IRON PIPE & FITTINGS TO BE CEMENT MORTAR LINED. THOROUGHLY COATED WITH PITCH BASE PAINT AND WRAPPED WITH 6 MIL. POLYETHYLENE FILM TAPED IN PLACE.
— CONTRACTOR TO LOWER ALL SERVICES OBSTRUCTING FEEDER MAIN.

BEFORE YOU DIG, CALL THE PROVINCIAL GAS CO. ST. CATHERINES, ONT. TEL. 665-5441 (IN EMERGENCIES CALL 685-4844)

BOARD OF WATER COMMISSIONERS
WELLAND ONTARIO

24" FEEDER MAIN-SCHEDULE 2 PART 2C
ON AQUEDUCT AND NIAGARA ST'S NORTH
FROM THOROLD RD. EAST TO WOODLAWN RD.

R.V. ANDERSON ASSOCIATES LTD.
TORONTO CONSULTING ENGINEERS WELLAND

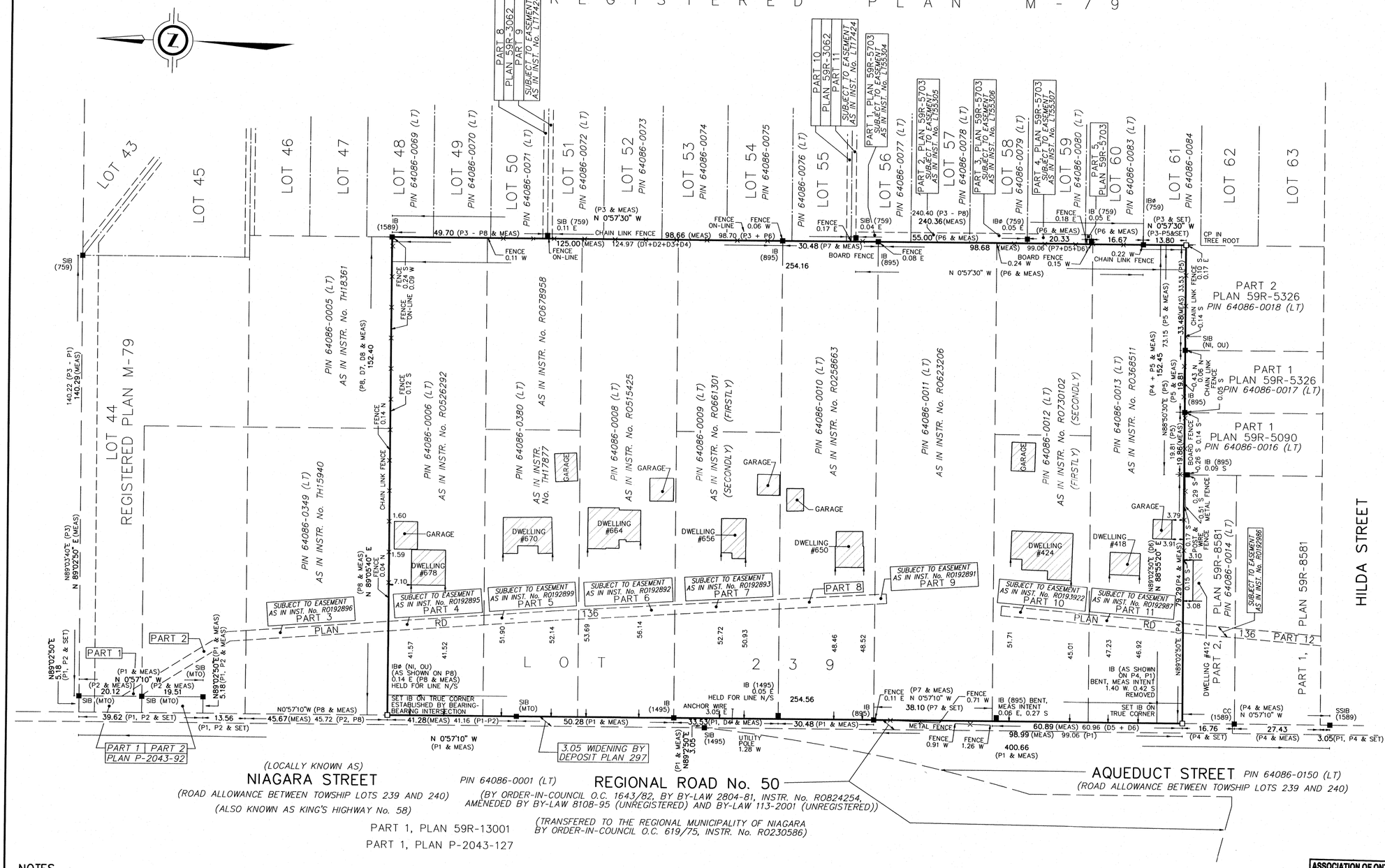
SCALE		BENCH MARK	FIELD BOOK
HORIZ. 1" = 40'-0"	VERT. 1" = 10'-0"	CONC. MONUMENT EAST SIDE OF AQUEDUCT & MERRITT ST. ELEV. 588.78	

	BY	DATE
DESIGNED	F.C.P.	JUNE 10/69
DRAWN	T.B.	JUNE 10/69
CHECKED	K.A.H.	JUNE 10/69

R.V.A.A.L. DWG. NO. 2262 - 06

ISSUE

DRAWING NO. A-50



SURVEYOR'S REAL PROPERTY REPORT
PART 1 - PLAN OF SURVEY OF

PART OF LOT 239

GEOGRAPHIC TOWNSHIP OF THOROLD

NOW IN THE

CITY OF WELLAND

REGIONAL MUNICIPALITY OF NIAGARA

SCALE 1 : 750

25 0 10 20 30 40 50 metres

J.D. BARNES LIMITED

METRIC DISTANCES AND/OR COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

PART 2 - SURVEY REPORT

- **DESCRIPTION**
  PART OF LOT 239, GEOGRAPHIC TOWNSHIP OF THOROLD
- **REGISTERED EASEMENTS AND/OR RIGHTS-OF-WAY**
  PIN 64086-0006 (LT)
  SUBJECT TO EASEMENT OVER PART 4, PLAN RD-136 AS IN INSTR. No. RO192895
  NOTICE OF CLAIM AS IN INSTR. No. RO713557
  SUBJECT TO LIFE INTEREST AS IN INSTR. No. RO351887
  PIN 64086-0380 (LT)
  SUBJECT TO EASEMENT OVER PART 5, PLAN RD-136 AS IN INSTR. No. RO192899
  NOTICE OF CLAIM AS IN INSTR. No. RO713557
  RESTRICTIVE COVENANTS AS IN INSTR. No. TH17877Z
  PIN 64086-0008 (LT)
  SUBJECT TO EASEMENT OVER PART 6, PLAN RD-136 AS IN INSTR. No. RO192892
  NOTICE OF CLAIM AS IN INSTR. No. RO713557
  PIN 64086-0009 (LT)
  SUBJECT TO EASEMENT OVER PART 7, PLAN RD-136 AS IN INSTR. No. RO192893
  NOTICE OF CLAIM AS IN INSTR. No. RO713557
  PIN 64086-0011 (LT)
  SUBJECT TO EASEMENT OVER PART 9, PLAN RD-136 AS IN INSTR. No. RO192891
  NOTICE OF CLAIM AS IN INSTR. No. RO713557
  PIN 64086-0012 (LT)
  SUBJECT TO EASEMENT OVER PART 10, PLAN RD-136 AS IN INSTR. No. RO193922
  NOTICE OF CLAIM AS IN INSTR. No. RO713557
  PIN 64086-0013 (LT)
  SUBJECT TO EASEMENT OVER PART 11, PLAN RD-136 AS IN INSTR. No. RO192897
  NOTICE OF CLAIM AS IN INSTR. No. RO713557
- **BOUNDARY FEATURES**
  FENCING ALONG ALL LIMITS AS SHOWN ON PLAN
- **ZONING COMPLIANCE**
  NOT VERIFIED BY THIS SURVEY
- **ADDITIONAL REMARKS**
  PLAN PREPARED FOR 2786966 ONTARIO INC.

LEGEND

■	DENOTES	SURVEY MONUMENT FOUND
□	DENOTES	SURVEY MONUMENT SET
SIB	DENOTES	STANDARD IRON BAR
SSIB	DENOTES	SHORT STANDARD IRON BAR
IBø	DENOTES	ROUND IRON BAR
IB	DENOTES	IRON BAR
CC	DENOTES	CUT CROSS
CP	DENOTES	CONCRETE PIN AND WASHER
P1	DENOTES	PLAN 59R-13001
P2	DENOTES	PLAN RD-136
P3	DENOTES	REGISTERED PLAN M-79
P4	DENOTES	PLAN 59R-8581
P5	DENOTES	PLAN 59R-5326
P6	DENOTES	PLAN 59R-5703
P7	DENOTES	PLAN OF SURVEY BY C.J. CLARKE, O.L.S. DATED APRIL 24, 1986 FILE 64-1
P8	DENOTES	PLAN OF SURVEY BY SUDA & MALESZYK SURVEYING INC. O.L.S. DATED SEPTEMBER 22, 1999 FILE 99-131
D1	DENOTES	INSTR. No. RO526292
D2	DENOTES	INSTR. No. RO678958
D3	DENOTES	INSTR. No. RO515425
D4	DENOTES	INSTR. No. RO661301
D5	DENOTES	INSTR. No. RO730102
D6	DENOTES	INSTR. No. RO368511
D7	DENOTES	INSTR. No. TH15940
D8	DENOTES	INSTR. No. TH18361
MEAS	DENOTES	MEASURED
759	DENOTES	C.J. CLARKE, O.L.S.
895	DENOTES	D.A. LANE, O.L.S.
1495	DENOTES	P.D. REITSMA SURVEYING LTD. O.L.S.
1589	DENOTES	SUDA & MALESZYK SURVEYING INC. O.L.S.
MTO	DENOTES	MINISTRY OF TRANSPORTATION ONTARIO
NI	DENOTES	NOT IDENTIFIABLE
OU	DENOTES	ORIGIN UNKNOWN
	DENOTES	PROPERTY LINE
-×-	DENOTES	FENCE

N=NORTH / S=SOUTH / E=EAST / W=WEST

SURVEYOR'S CERTIFICATE

I CERTIFY THAT:

1. THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT AND THE REGULATIONS MADE UNDER THEM.
2. THE SURVEY WAS COMPLETED ON APRIL 6, 2021

April 9, 2021
DATE

DASHA PAGE
ONTARIO LAND SURVEYOR

THIS PLAN IS NOT VALID UNLESS EMBOSSED BY A SURVEYOR'S SEAL

NOTES

BEARINGS ARE UTM GRID, DERIVED FROM GNSS OBSERVATIONS, UTM ZONE 17, NAD83 (CSRS) (2010.0).

DISTANCES ARE GROUND AND CAN BE CONVERTED TO GRID BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 0.999827.

FOR BEARING COMPARISONS, A ROTATION OF 1°12'40" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON P2, P4, P7, P8 & D6.

FOR BEARING COMPARISONS, A ROTATION OF 1°16'00" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON P3, P5, & P6.

ASSOCIATION OF ONTARIO LAND SURVEYORS
PLAN SUBMISSION FORM
2161095
THIS PLAN IS NOT VALID UNLESS IT IS AN EMBOSSED ORIGINAL COPY ISSUED BY THE SURVEYOR In accordance with Regulation 1026, Section 29(3).

J.D.BARNES LIMITED SURVEYING MAPPING GIS
LAND INFORMATION SPECIALISTS
4318 PORTAGE ROAD - UNIT 2, NIAGARA FALLS, ON L2E 6A4
T: (905) 358-3693 F: (905) 358-6224 www.jdbarnes.com

DRAWN BY:	CHECKED BY:	REFERENCE NO.:
TW	AH	21-16-017-00

FILE: G:\2021\21-16-017\00\Drawing\21-16-017-00 SRPR.dgn

PLOTTED: 4/9/2021

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix B

Fire Flow Calculations

BURNSIDE

CALCULATION SHEET

Project: **418-430 Aqueduct and 650-678 Niagara**
Welland, Ontario
Fire Flow Calculations - Building A

Prepared by:	JS
Checked by:	PM
Project No:	300052233
Date:	August 30, 2024

Fire Flow Calculation
Based on Fire Underwriters Survey

1 F= 220 C (sqrt (A))

Where F= Fire flow in Lpm
C= construction type coefficient
= 0.8 for fire resistive construction
A = total floor area in sq.m. excluding basements, includes garage

Total	Building A Area (sq.m)	%	Largest Area (sq.m)
Level 1	2,375	100%	2,375
Level 2	1,512	25%	378
Level 3	1,512	25%	378

Largest Area= 3,131 sq.m
F = 9,848 L/min

Round to nearest 1000 l/min
F = 10,000 l/min

2 Occupancy Reduction
15% reduction for normal residential occupancy
Reduction = 1500 L/min
F = 8,500 L/min

3 Separation Charge

20%	North Side	3.1m to 10m
20%	East Side	3.1m to 10m
20%	South Side	3.1m to 10m
10%	West Side	20.1m to 30m
70%	Total Separation Charge,	**5950** L/min

Note: Maximum Total Separation Charge is 75%

4 Sprinkler Reduction
30% Reduction for NFPA Sprinkler System
Reduction = **2550** L/min

5 Domestic Flow Calculations

Residential
Population = 479 persons
Ave. Day Demand = 320 L/cap/day
106 L/min
Peak Hour Factor = 3.00 (Residential)
Max. Domestic Flow Rate F_{dom} = **319** L/min

F = 14,450 - 2550 + 319 = 12,219 l/min
F = 204 L/s
F = 3226 GPM

BURNSIDE

CALCULATION SHEET

Project: **418-430 Aqueduct and 650-678 Niagara**
Welland, Ontario
Fire Flow Calculations - Building B

Prepared by:	JS
Checked by:	PM
Project No:	300052233
Date:	August 30, 2024

Fire Flow Calculation
Based on Fire Underwriters Survey

1 F= 220 C (sqrt (A))

Where F= Fire flow in Lpm
C= construction type coefficient
= 0.8 for fire resistive construction
A = total floor area in sq.m. excluding basements, includes garage

Total	Building B Area (sq.m)	%	Largest Area (sq.m)
Level 1	4,550	100%	4,550
Level 2	4,550	25%	1,138
Level 3	4,492	25%	1,123

Largest Area= 6,811 sq.m
F = 14,525 L/min

Round to nearest 1000 l/min
F = 15,000 l/min

2 Occupancy Reduction
15% reduction for normal residential occupancy
Reduction = 2250 L/min
F = 12,750 L/min

3 Separation Charge

20%	North Side	3.1m to 10m
20%	East Side	3.1m to 10m
20%	South Side	3.1m to 10m
10%	West Side	20.1m to 30m
70%	Total Separation Charge,	**8925** L/min

Note: Maximum Total Separation Charge is 75%

4 Sprinkler Reduction
30% Reduction for NFPA Sprinkler System
Reduction = **3825** L/min

5 Domestic Flow Calculations

Residential
Population = 834 persons
Ave. Day Demand = 320 L/cap/day
185 L/min
Peak Hour Factor = 3.00 (Residential)
Max. Domestic Flow Rate F_{dom} = **556** L/min

F = 21,675 - 3825 + 556 = 18,406 l/min
F = 307 L/s
F = 4859 GPM

BURNSIDE

CALCULATION SHEET

Project: **418-430 Aqueduct and 650-678 Niagara**
Welland, Ontario
Fire Flow Calculations - Building C

Prepared by:	JS
Checked by:	PM
Project No:	300052233
Date:	August 30, 2024

Fire Flow Calculation
Based on Fire Underwriters Survey

1 F= 220 C (sqrt (A))

Where F= Fire flow in Lpm
C= construction type coefficient
= 0.8 for fire resistive construction
A = total floor area in sq.m. excluding basements, includes garage

Total	Building C Area (sq.m)	%	Largest Area (sq.m)
Level 1	2,354	100%	2,354
Level 2	2,122	25%	531
Level 3	2,046	25%	512

Largest Area= 3,396 sq.m
F = 10,256 L/min

Round to nearest 1000 l/min
F = 10,000 l/min

2 Occupancy Reduction
15% reduction for normal residential occupancy
Reduction = 1500 L/min
F = 8,500 L/min

3 Separation Charge

20%	North Side	3.1m to 10m
10%	East Side	20.1m to 30m
20%	South Side	3.1m to 10m
10%	West Side	20.1m to 30m
60%	Total Separation Charge,	**5100** L/min

Note: Maximum Total Separation Charge is 75%

4 Sprinkler Reduction
30% Reduction for NFPA Sprinkler System
Reduction = **2550** L/min

5 Domestic Flow Calculations

Residential

Population = 790 persons
Ave. Day Demand = 320 L/cap/day
176 L/min
Peak Hour Factor = 3.00 (Residential)
Max. Domestic Flow Rate F_{dom} = **527** L/min

F = 13,600 - 2550 + 527 = 11,577 l/min
F = 193 L/s
F = 3056 GPM

BURNSIDE

CALCULATION SHEET

Project: **418-430 Aqueduct and 650-678 Niagara**
Welland, Ontario
Fire Flow Calculations - Building D

Prepared by:	JS
Checked by:	PM
Project No:	300052233
Date:	August 30, 2024

Fire Flow Calculation
Based on Fire Underwriters Survey

1 F= 220 C (sqrt (A))

Where F= Fire flow in Lpm
C= construction type coefficient
= 0.8 for fire resistive construction
A = total floor area in sq.m. excluding basements, includes garage

Total	Building D Area (sq.m)	%	Largest Area (sq.m)
Level 1	590	100%	590
Level 2	590	25%	148
Level 3	590	25%	148

Largest Area= 885 sq.m
F = 5,236 L/min

Round to nearest 1000 l/min
F = 5,000 l/min

2 Occupancy Reduction
15% reduction for normal residential occupancy
Reduction = 750 L/min
F = 4,250 L/min

3 Separation Charge

10%	North Side	20.1m to 30m
15%	East Side	10.1m to 20m
20%	South Side	3.1m to 10m
20%	West Side	3.1m to 10m
65%	Total Separation Charge,	**2763** L/min

Note: Maximum Total Separation Charge is 75%

4 Sprinkler Reduction
30% Reduction for NFPA Sprinkler System
Reduction = **1275** L/min

5 Domestic Flow Calculations

Residential

Population = 38 persons
Ave. Day Demand = 320 L/cap/day
8 L/min
Peak Hour Factor = 3.00 (Residential)
Max. Domestic Flow Rate F_{dom} = **25** L/min

F = 7,013 - 1275 + 25 = 5,763 l/min
F = 96 L/s
F = 1521 GPM

BURNSIDE

CALCULATION SHEET

Project: **418-430 Aqueduct and 650-678 Niagara**
Welland, Ontario
Fire Flow Calculations - Building E

Prepared by:	JS
Checked by:	PM
Project No:	300052233
Date:	August 30, 2024

Fire Flow Calculation
Based on Fire Underwriters Survey

1 F= 220 C (sqrt (A))

Where F= Fire flow in Lpm
C= construction type coefficient
= 0.8 for fire resistive construction
A = total floor area in sq.m. excluding basements, includes garage

Total	Building E Area (sq.m)	%	Largest Area (sq.m)
Level 1	504	100%	504
Level 2	504	25%	126
Level 3	504	25%	126

Largest Area= 756 sq.m
F = 4,839 L/min

Round to nearest 1000 l/min
F = 5,000 l/min

2 Occupancy Reduction
15% reduction for normal residential occupancy
Reduction = 750 L/min
F = 4,250 L/min

3 Separation Charge
20% North Side 3.1m to 10m
15% East Side 10.1m to 20m
20% South Side 3.1m to 10m
20% West Side 3.1m to 10m
75% ation Charge, **3188** L/min
Note: Maximum Total Separation Charge is 75%

4 Sprinkler Reduction
30% Reduction for NFPA Sprinkler System
Reduction = **1275** L/min

5 Domestic Flow Calculations

Residential
Population = 32 persons
Ave. Day Demand = 320 L/cap/day
7 L/min
Peak Hour Factor = 3.00 (Residential)
Max. Domestic Flow Rate F_{dom} = **21** L/min

F = 7,438 - 1275 + 21 = 6,184 l/min
F = 103 L/s
F = 1633 GPM

Hydrant Flow Test Report

SITE NAME:

SITE ADDRESS / MUNICIPALITY: **Aqueduct Street - Welland**

TEST HYDRANT LOCATION : Across form #430 Aqueduct Street at Dead End, Hydrant ID:120 H16

BASE HYDRANT LOCATION: By #383 Aqueduct street Hydrant ID: 120 H15

TEST BY: Luzia Wood

TEST DATE: August 20 2021

TEST TIME: 7:40AM

TEST DATA

FLOW HYDRANT — Pipe Diam. (in / mm): 150mm P.V.C.

	PITOT 1	PITOT 2
SIZE OPENING (inches):	2.5	2.5
COEFFICIENT (**note 1**):	0.90	0.90
PITOT READING (psi):	38	34 / 34
FLOW (usgpm):	**1034**	**1957**

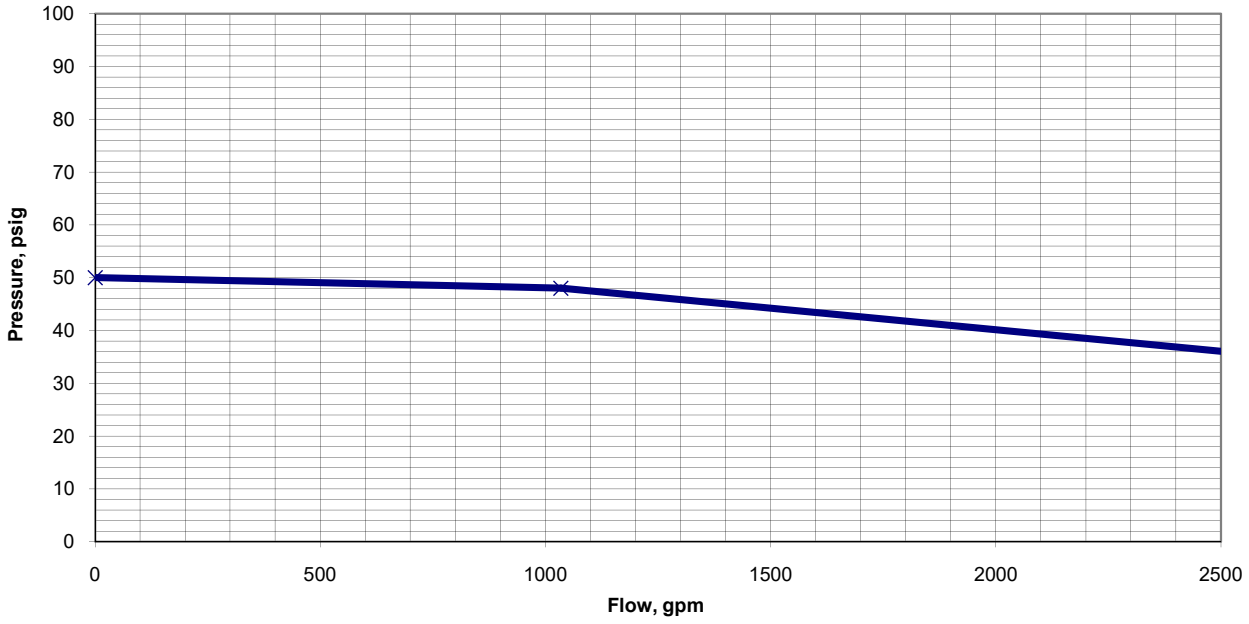
THEORETICAL FLOW @ 20 PSI 4464

BASE HYDRANT — Pipe Diam. (in / mm): 150mm P.V.C.

STATIC READING (psi): 50 RESIDUAL 1 (psi): 48 RESIDUAL 2 (psi): 45

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.



491 Port Maitland Rd
Dunnville, ON N1A 2W6

Hydrant Flow Test Report

SITE NAME:

SITE ADDRESS / MUNICIPALITY: **Niagara Street- Welland**

TEST HYDRANT LOCATION : Front of #637/641 Niagara Street Hydrant ID:120 H3

BASE HYDRANT LOCATION: 615 Niagara Street Hydrant ID: 120H2

TEST BY: Luzia Wood

TEST DATE: August 20 2021

TEST TIME: 8:25AM

TEST DATA

FLOW HYDRANT — Pipe Diam. (in / mm): 250mm P.V.C.

	PITOT 1	PITOT 2
SIZE OPENING (inches):	2.5	2.5
COEFFICIENT (**note 1**):	0.90	0.90
PITOT READING (psi):	45	36 / 36
FLOW (usgpm):	**1126**	**2014**

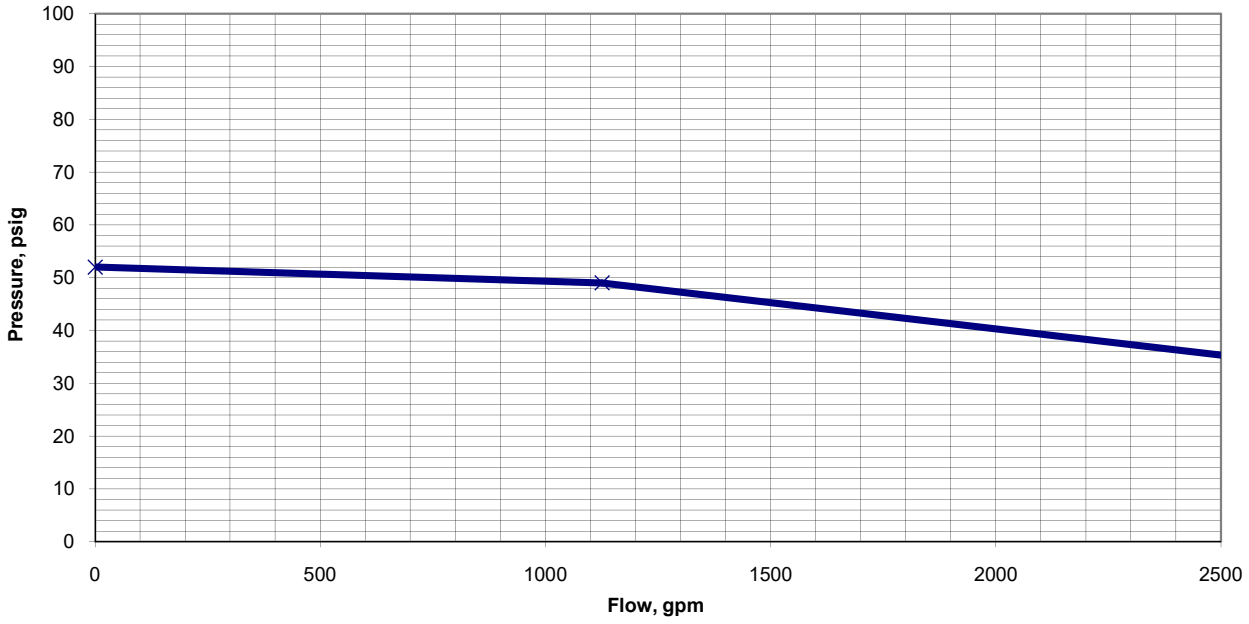
THEORETICAL FLOW @ 20 PSI 4041

BASE HYDRANT — Pipe Diam. (in / mm): 250mm P.V.C.

STATIC READING (psi): 52 RESIDUAL 1 (psi): 49 RESIDUAL 2 (psi): 46

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.



491 Port Maitland Rd
Dunnville, ON N1A 2W6

Infrastructure Services
Office of the City Engineer
Phone: 905-735-1700 | Fax: 905-735-7184
Email: eng@welland.ca | www.welland.ca

MEMORANDUM

TO: File

FROM: Samantha McCauley, P.Eng.
Senior Project Manager - Engineering

DATE: May 13, 2024

SUBJECT: Development Review – Water
418-430 Aqueduct Street and 650-678 Niagara Street

1 INTRODUCTION

A proposed development consisting of three high-rise buildings, as well as two stacked townhouses, with a total of up to 1,196 units and 1,121 m^2 of commercial space, is being considered over 418-430 Aqueduct Street and 650-678 Niagara Street. Figure 1-1 shows the location of this proposed development.

Based on the number of units proposed, a hydraulic analysis was required to assess the servicing requirements for the proposed development and the impact on the existing system. The results of the completed water analysis are summarized herein.

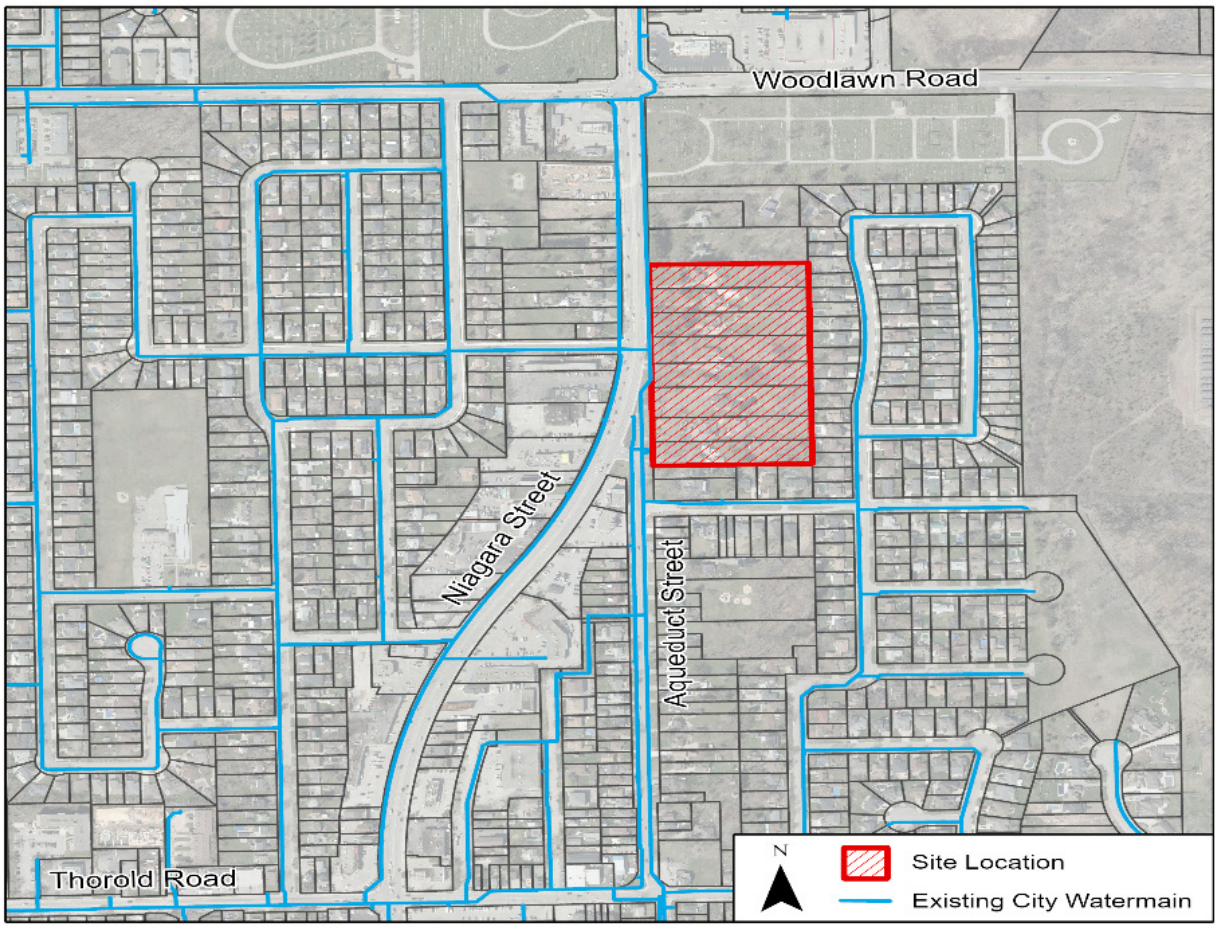


Figure 1-1 Site Location

2 BACKGROUND AND MODEL SET UP

2.1 Existing Distribution System and Model

The City's water distribution system receives potable water from the Regional Municipality of Niagara (the Region). The system includes the Welland Water Treatment Plant (WTP), the Shoalt's Reservoir, the Bemis Elevated Tank, and the Hunter's Pointe Booster Pumping Station (BPS). The majority of the City's distribution network, including the subject site, is part of a single pressure zone, with pressures influenced by the water level of the Bemis Tank (maximum hydraulic grade line (HGL) of 219.1 m). A small portion of the City (at higher elevations) receives boosted water via the Hunter's Pointe BPS. The Welland distribution system also supplies the

Town of Pelham (via the Shoalt's Pumping Station) and portions of the City of Thorold (via Hansler Road and Port Robinson West watermain connections).

The City maintains an InfoWater all-pipe model of the water distribution system. The latest version of this model was used for the 418-430 Aqueduct Street and 650-678 Niagara Street hydraulic analysis. Note that a full update and validation of this model was last conducted in December 2022.

The City's InfoWater model includes both existing and future average day and maximum day extended period simulation (EPS) scenarios. The future scenarios incorporate known planned future growth in the City. All analysis of the proposed 418-430 Aqueduct Street and 650-678 Niagara Street development was conducted using the future model scenarios.

2.2 418-430 Aqueduct Street and 650-678 Niagara Street Servicing

Watermains and junctions were added to the model to represent the proposed servicing for the 418-430 Aqueduct Street and 650-678 Niagara Street Development as per the Servicing Plan drawings prepared by R.J. Burnside and Associates Ltd (Drawings S1, S2, S3, Revision 1, October 24, 2023).

Figure 2-1 shows the proposed watermain and junctions added to the model, along with the location and size of existing watermains and junctions surrounding the site, and a potential additional proposed watermain that was assessed in the hydraulic analysis (refer to Section 3). Identification numbers for the junctions included in the results tables in Section 3 of this report are also included in Figure 2-1 for reference. Note that junctions denoted with an "H" are junctions that represent the proposed hydrants identified in the servicing drawings. Also, watermains denoted as "RMN" are watermains owned by the Niagara Region, with all other existing watermains shown being City owned.

Infrastructure Services
Office of the City Engineer
Phone: 905-735-1700 | Fax: 905-735-7184
Email: eng@welland.ca | www.welland.ca

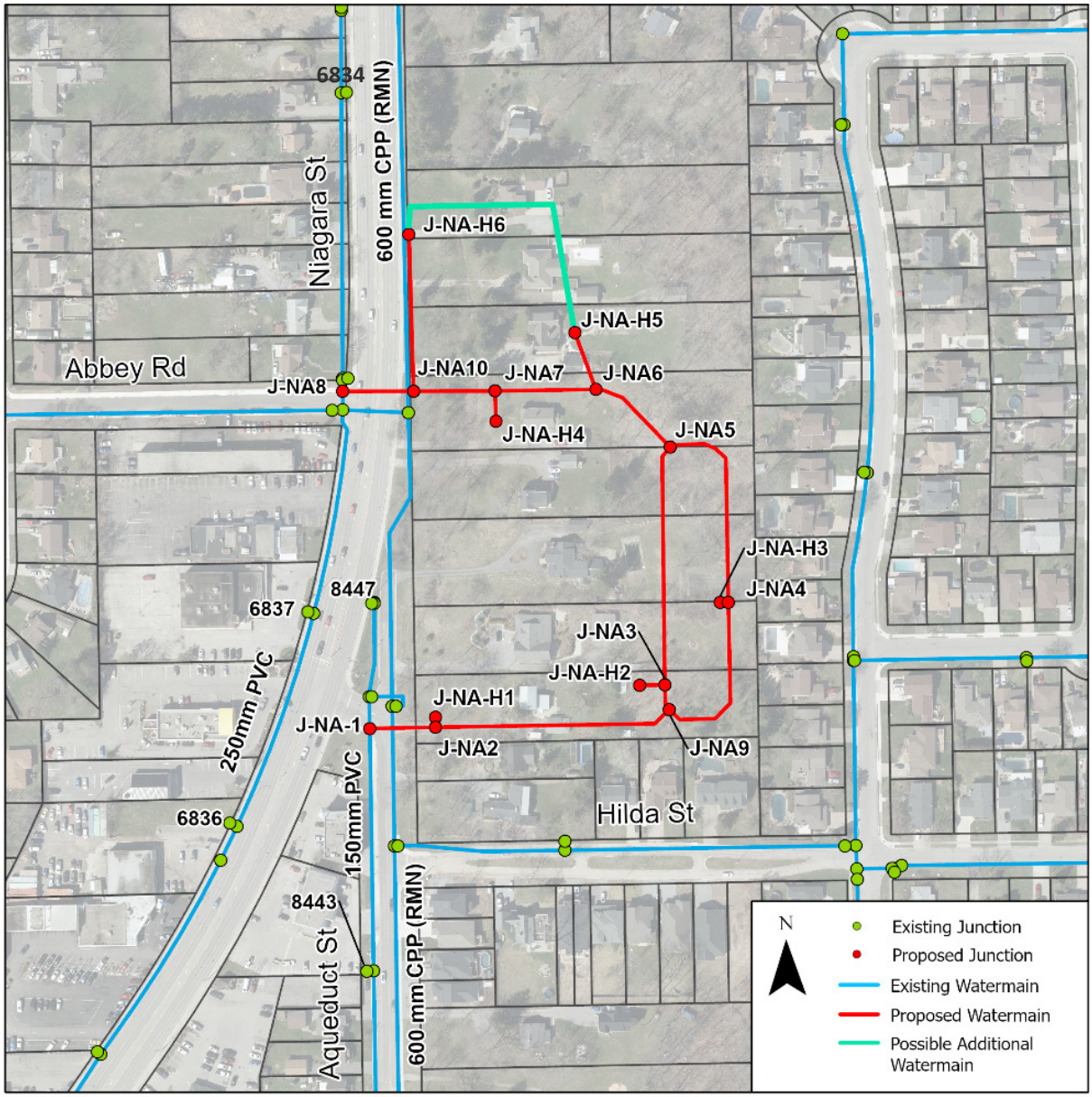


Figure 2-1 Proposed Water Servicing for 418-430 Aqueduct Street and 650-678 Niagara Street

All proposed watermain was assigned a C-Factor of 135 in the model, consistent with the C-Factor for plastic pipe established when the City's model was originally calibrated in 2015. Refer to Section 3.2 for the watermain sizing options that were assessed.

Additionally, a minor loss coefficient of 12 was assigned to each of the two service feeds to the development to represent the loss associated with the backflow preventers that will be required on these connections.

2.3 418-430 Aqueduct Street and 650-678 Niagara Street Demands

Water demands for 418-430 Niagara Street and 650-678 Niagara Street were determined using the following criteria:

- Populations were estimated assuming 2.75 people per unit for residential units and 50 m^2 per employee for commercial areas
- Average day demands (ADD) were calculated using a per capita demand of 240 L/cap-day (as per a 2022 review of historic per capita demand rates for the City by land use type)
- Maximum day demands (MDD) were calculated using a peaking factor of 1.5 (as per a 2022 review of historic daily usage)
- Peak hour demands (PHD) were calculated using a peaking factor of 2.81 (as per the MDD EPS demand patterns developed by the Region of Niagara in the preparation of their Master Servicing Plan)

Table 2-1 summarizes the demands for the proposed 418-430 Aqueduct Street and 650-678 Niagara Street development. Note that only junctions that were assigned demand are included in this table.

Table 2-1: 418-430 Aqueduct Street and 650-678 Niagara Street Demands

Junction	# of Units	Commercial Area (m^2)	Population	ADD (L/s)	MDD (L/s)	PHD (L/s)
J-NA-3	219	0	603	1.678	2.510	4.710
J-NA-4	13	0	36	0.100	0.150	0.280
J-NA-5	13	0	36	0.100	0.150	0.280
J-NA-6	591	692	1626	4.560	6..840	12.810
J-NA-7	360	429	990	2.778	4.170	7.810
Total	**1,196**	**1,121**	**1,121**	**9.213**	**13.820**	**25.890**

A fire flow was also required to assess the MDD + Fire Flow condition. Required fire flows by building were calculated in the Functional Servicing Repot (FSR) prepared by RJ Burnside (dated November 2023). Additionally, the City has a minimum fire flow requirement of 133 L/s for multi-unit dwellings. Table 2-2 summarizes the required fire flow by building and the model ID of the hydrants that are within 90 m of each building. Note that the servicing drawings also include fire mains to the three high-rise buildings (Buildings A, B, and C), and the expectation is that fire department connections will be provided at these buildings to supplement the use of hydrants for fire fighting, since it would be difficult to draw the identified required fire flows for these buildings through a single hydrant connection.

Table 2-2: Required Fire Flow by Building/Hydrant

Building ID	Hydrants within 90m of Building	Required Fire Flow per FSR (L/s)	City Minimum Fire Flow (L/s)	Required Fire Flow (L/s)
A	J-NA-H1, J-NA-H2	205	133	205
B	J-NA-H4	314	133	314
C	J-NA-H4, J-NA-H5, J-NA-H6	195	133	195
D	J-NA-H2, J-NA-H3	58	133	133
E	J-NA-H2, J-NA-H3	62	133	133

2.4 Model Validation

Hydrant flow testing was completed by L&D Waterworks Inc. on August 20, 2021, with the results summarized in the FSR prepared by RJ Burnside. The existing ADD model scenario was used to compare the model predicted pressure to the pressures recorded during flow testing for the purpose of validating the existing model. Table 2-3 summarizes the field and model results.

Table 2-3: Hydrant Flow Test Field and Model Results

Hydrant Model ID	Hydrant Asset ID	Description	Value
6836	**120H002**	Test Static Pressure (psi)	50
		Test Residual Pressure (psi)	45
		Model Static Pressure (psi)	48
		Model Residual Pressure (psi)	42
		Difference Static (psi)	2
		Difference Residual (psi)	3
8443	**120H015**	Test Static Pressure (psi)	52
		Test Residual Pressure (psi)	46
		Model Static Pressure (psi)	47
		Model Residual Pressure (psi)	44
		Difference Static (psi)	5
		Difference Residual (psi)	2

The results summarized in Table 2-3, show that the model produced marginally lower static and residual pressures than the field tests. Both the static and residual differences are within 5 psi, which is the preferred range. As such, the model is well calibrated for use for this assessment.

3 HYDRAULIC ANALYSIS

3.1 Pressure Requirements

The following pressure requirements were used for the hydraulic analysis, per City of Welland design standards and the MECP Design Guidelines for Drinking Water Systems:

- Preferred system pressure between 350 to 550 kPa (50 to 80 psi)
- Minimum system pressure during normal operating conditions to be greater than 275 kPa (40 psi)
- Maximum system pressure during normal operating conditions to be less than 700 kPa (100 psi)
- System pressure with 133 L/s fire flow during MDD to be greater than 140 kPa (20 psi)

3.2 Servicing Scenarios

The following scenarios were assessed:

- **Scenario A:** North watermain connection 250 mm diameter, south watermain connection 150 mm diameter (from Junction J-NA1 to Junction J-NA9), hydrant leads 150 mm diameter, and remainder of onsite watermain 250 mm diameter (as per submitted servicing drawings)
- **Scenario B:** All onsite watermain 250 mm diameter, with short hydrant leads 150 mm diameter.
- **Scenario C:** All onsite watermain 250 mm diameter, with short hydrant leads 150 mm diameter, and addition of 250 mm watermain loop shown as "possible additional watermain" on Figure 2-1.

3.3 Normal Condition Results

3.3.1 Average Day

Table 3-1 summarizes the minimum pressure during ADD EPS at the proposed 418-430 Aqueduct Street and 650-678 Niagara Street junctions, as well as at three existing adjacent junctions, for each of the scenarios outlined in Section 3.2. Refer to Figure 2-1 for the location of these junctions.

As shown in Table 3-1, all servicing scenarios result in the same minimum pressure during ADD, with pressures all above the minimum requirement of 275 kPa.

Table 3-1: Minimum Pressure during ADD EPS

Junction	Scenario A Min Pressure (kPa)	Scenario B Min Pressure (kPa)	Scenario C Min Pressure (kPa)
6834	348	348	348
6837	332	332	332
8447	332	332	332
J-NA-1	329	329	329
J-NA-10	328	328	328
J-NA-2	325	325	325
J-NA-3	326	326	326
J-NA-4	328	328	328
J-NA-5	328	328	328
J-NA-6	329	329	329
J-NA-7	328	328	328
J-NA-8	334	334	334
J-NA-9	327	327	327
J-NA-H1	325	325	325
J-NA-H2	326	326	326
J-NA-H3	328	328	328
J-NA-H4	328	328	328
J-NA-H5	330	330	330
J-NA-H6	333	333	333

3.3.2 Maximum day

Table 3-2 summarizes the minimum pressure during MDD EPS at the proposed 418-430 Niagara Street and 650-678 Niagara Street junctions, as well as at three existing adjacent junction, for each of the scenarios outlined in Section 3.2. Refer to Figure 2-1 for the location of these junctions.

Table 3-2: Minimum Pressure during MDD EPS

Junction	Scenario A Min Pressure (kPa)	Scenario B Min Pressure (kPa)	Scenario C Min Pressure (kPa)
6834	347	347	347
6837	331	331	331
8447	331	330	331
J-NA-1	328	328	328
J-NA-10	327	327	327
J-NA-2	324	324	324
J-NA-3	325	325	325
J-NA-4	327	327	327
J-NA-5	327	327	327
J-NA-6	328	328	328
J-NA-7	327	327	327
J-NA-8	333	333	333
J-NA-9	326	326	326
J-NA-H1	324	324	324
J-NA-H2	325	325	325
J-NA-H3	327	327	327
J-NA-H4	327	327	327
J-NA-H5	328	328	329
J-NA-H6	331	331	331

As shown in Table 3-2, all servicing scenarios result in the same minimum pressure during MDD. Additionally, all pressures are above the minimum requirement of 275 kPa.

3.4 Fire

Table 3-3 summarizes the available fire flow on the 418-430 Aqueduct Street and 650-678 Niagara Street site, as well as at three existing adjacent hydrants, for each of the scenarios outlined in Section 3.2. Refer to Figure 2-1 for the location of the junctions referenced in Table 3-3. Note that the available fire flows shown represent the maximum available flow during MDD with a system residual pressure of 140 kPa (20 psi). Table 3-3 also indicates the required fire flow at each hydrant based on the requirements of adjacent buildings (refer to Table 2-2). Locations where the available fire flow does not match the required fire flow are identified in red.

Table 3-3 Available Fire Flow during MDD

Junction	Required Fire Flow (L/s)	Scenario A Available Fire Flow (L/s)	Scenario B Available Fire Flow (L/s)	Scenario C Available Fire Flow (L/s)
6834	133	417	417	417
6837	133	356	356	356
8447	133	143	143	143
J-NA-H1	205	160	271	276
J-NA-H2	205	194	230	234
J-NA-H3	133	221	273	280
J-NA-H4	314	275	342	344
J-NA-H5	195	165	306	336
J-NA-H6	195	120	288	329

As shown in Table 3-3, both Scenario B and C can provide the required fire flow, while the available fire flow at several hydrants is below the identified required fire flow at several locations. Note that, as previously identified, the expectation is that fire department connections will be provide at the high-rise buildings to supplement the use of hydrants, since it may be difficult to draw the required fire flows for these buildings through a single hydrant connection.

4 CONCLUSIONS AND RECOMMENDATIONS

Three servicing scenarios were assessed for the proposed 418-430 Aqueduct Street and 650-678 Niagara Street development. These scenarios included: A) watermain sizing as proposed in the submitted servicing plans (mix of 250 mm and 150 mm diameter watermain), B) increased on site watermain sizing (all watermain 250 mm diameter, with the exception of short hydrant leads, which were kept as 150 mm diameter), and C) the same increased watermain sizing as Scenario B, with an additional internal watermain loop.

All scenarios assessed will provide pressures above the minimum requirement of 275 kPa but only Scenarios B and C will provide the required fire flow identified for each proposed building. As such, use of either Scenario B or Scenario C is required. Also, note that the expectation is that fire department connections will be provide at the high-rise buildings, particularly where there is only one hydrant within distance of a building, since it may be difficult to draw the required fire flows for these buildings through a single hydrant connection.

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix C

Stormwater Calculations

Composite Runoff Coefficient Calculations

Controlled Site Area

Area ID	Area (ha)	RC	Area x RC
Rooftop	0.200	0.90	0.180
Controlled Landscape	3.285	0.25	0.821
Controlled Hardscape	0.393	0.90	0.354
Total:	3.878		1.355

Composite RC: 0.35

Composite Runoff Coefficient Calculations

Controlled Site Area - Drainage Area 1 (to 1200 mm storm sewer in Niagara St)

Area ID	Area (ha)	RC	Area x RC
Rooftop	0.200	0.90	0.180
Controlled Landscape	2.481	0.25	0.620
Controlled Hardscape	0.393	0.90	0.354
Total:	3.074		1.154

Composite RC: 0.38

Composite Runoff Coefficient Calculations

Controlled Site Area - Drainage Area 2 (to existing woodland)

Area ID	Area (ha)	RC	Area x RC
Rooftop	0.000	0.90	0.000
Controlled Landscape	0.265	0.25	0.066
Controlled Hardscape	0.000	0.90	0.000
Total:	0.265		0.066

Composite RC: 0.25

Composite Runoff Coefficient Calculations

Controlled Site Area - Drainage Area 3 (to existing CB adjacent to easement)

Area ID	Area (ha)	RC	Area x RC
Rooftop	0.000	0.90	0.000
Controlled Landscape	0.539	0.25	0.135
Controlled Hardscape	0.000	0.90	0.000
Total:	0.539		0.135

Composite RC: 0.25

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

2-year Pre-Development Flow

Existing Site

A	755	
B	0.789	
C	8.0	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.35	77.19	3.88	**290.5**
TOTAL			3.88	**290.5**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

290.50 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

5-year Pre-Development Flow

Existing Site

A	830	
B	0.777	
C	7.3	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.35	90.60	3.88	**341.0**
TOTAL			3.88	**341.0**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

341.00 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

10-year Pre-Development Flow

Existing Site

A	860	
B	0.763	
C	6.5	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.35	101.29	3.88	**381.2**
TOTAL			3.88	**381.2**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

381.20 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

25-year Pre-Development Flow

Existing Site

A	900	
B	0.745	
C	5.2	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.35	118.51	3.88	**446.0**
TOTAL			3.88	**446.0**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

446.00 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

50-year Pre-Development Flow

Existing Site

A	960	
B	0.736	
C	5.1	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.35	130.18	3.88	**489.9**
TOTAL			3.88	**489.9**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

489.90 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

100-year Pre-Development Flow

Existing Site

A	1020	
B	0.731	
C	4.7	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.35	142.99	3.88	**538.1**
TOTAL			3.88	**538.1**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

538.10 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

2-year Pre-Development Flow

Site to Niagara Street (1200 mm)

A	755	
B	0.789	
C	8.0	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.38	77.19	3.07	**247.4**
TOTAL			3.07	**247.4**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

247.40 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

5-year Pre-Development Flow

Site to Niagara Street (1200 mm)

A	830	
B	0.777	
C	7.3	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.38	90.60	3.07	**290.4**
TOTAL			3.07	**290.4**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

290.40 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

10-year Pre-Development Flow

Site to Niagara Street (1200 mm)

A	860	
B	0.763	
C	6.5	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.38	101.29	3.07	**324.7**
TOTAL			3.07	**324.7**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

324.70 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

25-year Pre-Development Flow

Site to Niagara Street (1200 mm)

A	900	
B	0.745	
C	5.2	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.38	118.51	3.07	**379.9**
TOTAL			3.07	**379.9**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

379.90 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

50-year Pre-Development Flow

Site to Niagara Street (1200 mm)

A	960	
B	0.736	
C	5.1	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.38	130.18	3.07	**417.3**
TOTAL			3.07	**417.3**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

417.30 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

100-year Pre-Development Flow

Site to Niagara Street (1200 mm)

A	1020	
B	0.731	
C	4.7	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.38	142.99	3.07	**458.3**
TOTAL			3.07	**458.3**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

458.30 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

2-year Pre-Development Flow

Woodland Area

A	755	
B	0.789	
C	8.0	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.25	77.19	0.27	**14.2**
TOTAL			0.27	**14.2**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

14.20 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

5-year Pre-Development Flow

Woodland Area

A	830	
B	0.777	
C	7.3	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.25	90.60	0.27	**16.7**
TOTAL			0.27	**16.7**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

16.70 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

10-year Pre-Development Flow

Woodland Area

A	860	
B	0.763	
C	6.5	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.25	101.29	0.27	**18.7**
TOTAL			0.27	**18.7**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

18.70 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

25-year Pre-Development Flow

Woodland Area

A	900	
B	0.745	
C	5.2	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.25	118.51	0.27	**21.8**
TOTAL			0.27	**21.8**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

21.80 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

50-year Pre-Development Flow

Woodland Area

A	960	
B	0.736	
C	5.1	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.25	130.18	0.27	**24.0**
TOTAL			0.27	**24.0**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

24.00 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

100-year Pre-Development Flow

Woodland Area

A	1020	
B	0.731	
C	4.7	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.25	142.99	0.27	**26.3**
TOTAL			0.27	**26.3**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

26.30 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Pre-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

100-year Post-Development Flow — **IAL DRAINAGE AREA 1 (to the h**

A	1020	
B	0.731	
C	4.7	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.25	142.99	0.04	**4.5**
TOTAL			0.04	**4.5**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

4.50 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Post-Development Flows** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

100-Year Post-Development Flow — **TERNAL DRAINAGE AREA 1 (to**

A	1020	
B	0.731	
C	4.7	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Site Area	0.25	142.99	0.06	**6.1**
TOTAL			0.06	**6.1**

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

6.10 **L/s**

Composite Runoff Coefficient Calculations

Controlled Site Area

Area ID	Area (ha)	RC	Area x RC
Rooftop	0.73	0.90	0.661
Green Roof	0.37	0.50	0.187
Controlled Landscape	0.77	0.25	0.193
Controlled Hardscape	1.17	0.90	1.052
Total:	3.049		2.093

Composite RC: 0.69

Composite Runoff Coefficient Calculations

Uncontrolled Site Area

Area ID	Area (ha)	RC	Area x RC
Uncontrolled Landscape	0.080	0.25	0.020
Uncontrolled Hardscape	0.038	0.90	0.034
Total:	0.118		0.054

Composite RC: 0.46

Composite Runoff Coefficient Calculations

CONTROLLED SITE AREA + EX DRAINAGE AREA COMING INTO SITE

Area ID	Area (ha)	RC	Area x RC
Rooftop	1.109	0.90	0.998
Green Roof	0.374	0.50	0.187
Controlled Landscape	0.877	0.25	0.219
Controlled Hardscape	1.169	0.90	1.052
Total:	3.529		2.456

Composite RC: 0.70

Composite Runoff Coefficient Calculations

CB DRAINAGE AREAS

Area ID	Area (ha)	RC	Area x RC
Rooftop	0.000	0.90	0.000
Controlled Landscape	1.488	0.25	0.372
Controlled Hardscape	2.104	0.90	1.893
Total:	3.592		2.265

Composite RC: 0.63

Composite Runoff Coefficient Calculations

UNCONTROLLED EXTERNAL DRAINAGE AREA 1 (NE)

Area ID	Area (ha)	RC	Area x RC
Uncontrolled Landscape	0.071	0.25	0.018
Uncontrolled Hardscape	0.000	0.90	0.000
Total:	0.071		0.018

Composite RC: 0.25

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street**	Prepared by:	**JS**
	Task: **Post-Development**	Checked by:	**PM**
	Date: **5-Jun-23**	Project no.:	**052233**

2-Year Post-Development Flows — **Modified Site**

A	755	
B	0.789	
C	8.0	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Rooftop	0.90	77.19	0.73	141.7
Green Roof	0.50	77.19	0.37	40.1
Landscape	0.25	77.19	0.77	41.3
Hardscape	0.90	77.19	1.17	225.6
TOTAL			3.05	**448.7**

Uncontrolled Flows

Uncontrolled	0.46	77.19	0.12	11.6

$Q_{Allowable\ Release} = \frac{CiA}{0.36}$

460.3 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street**	Prepared by:	**JS**
	Task: **Post-Development**	Checked by:	**PM**
	Date: **5-Jun-23**	Project no.:	**052233**

5-Year Post-Development Flows — **Modified Site**

A	830	
B	0.777	
C	7.3	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Rooftop	0.90	90.60	0.73	166.3
Green Roof	0.50	90.60	0.37	47.1
Landscape	0.25	90.60	0.77	48.5
Hardscape	0.90	90.60	1.17	264.8
TOTAL			3.05	**526.7**

Uncontrolled Flows

Uncontrolled	0.46	90.60	0.12	13.6

$Q_{Allowable\ Release} = \frac{CiA}{0.36}$

540.3 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Post-Development** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

10-Year Post-Development Flows — **Modified Site**

A	860	
B	0.763	
C	6.5	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Rooftop	0.90	101.29	0.73	185.9
Green Roof	0.50	101.29	0.37	52.7
Landscape	0.25	101.29	0.77	54.2
Hardscape	0.90	101.29	1.17	296.0
TOTAL			3.05	**588.9**

Uncontrolled Flows

Uncontrolled	0.46	101.29	0.12	15.2

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

604.1 L/s

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Post-Development** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

25-Year Post-Development Flows — **Modified Site**

A	900	
B	0.745	
C	5.2	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Rooftop	0.90	118.51	0.73	217.5
Green Roof	0.50	118.51	0.37	61.6
Landscape	0.25	118.51	0.77	63.5
Hardscape	0.90	118.51	1.17	346.4
TOTAL			3.05	**689.0**

Uncontrolled Flows

Uncontrolled	0.46	118.51	0.12	17.8

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

706.8 L/s

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Post-Development** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

50-Year Post-Development Flows — **Modified Site**

A	960	
B	0.736	
C	5.1	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Rooftop	0.90	130.18	0.73	238.9
Green Roof	0.50	130.18	0.37	67.7
Landscape	0.25	130.18	0.77	69.7
Hardscape	0.90	130.18	1.17	380.5
TOTAL			3.05	**756.8**

Uncontrolled Flows

Uncontrolled	0.46	130.18	0.12	19.6

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

776.4 **L/s**

BURNSIDE	Project: **418-430 Aqueduct and 650-678 Niagara Street** Task: **Post-Development** Date: **5-Jun-23**	Prepared by: **JS** Checked by: **PM** Project no.: **052233**

100-Year Post-Development Flows — **Modified Site**

A	1020	
B	0.731	
C	4.7	
T	10.00	min

Land Use Description	Runoff Coefficient	Intensity (mm/hr)	Area (ha)	Runoff (L/s)
Rooftop	0.90	142.99	0.73	262.4
Green Roof	0.50	142.99	0.37	74.3
Landscape	0.25	142.99	0.77	76.6
Hardscape	0.90	142.99	1.17	417.9
TOTAL			3.05	**831.3**

Uncontrolled Flows

Uncontrolled	0.46	142.99	0.12	21.5

$$Q_{Allowable\ Release} = \frac{CiA}{0.36}$$

852.8 **L/s**

EXTENDED DETENTION VOLUME CALCULATIONS

Project: 418-430 Aqueduct and 650-678 Niagara Street
Project No.: 052233
Designed by: JS
Checked by: PM
Date: 5-Jun-23

Q = **(P-IA)^2/P-(IA-S)**
S = **-254+25400/CN**
T IMP = **61.7** %

Pervious Area			**Impervious Area**		
P =	25	mm	P =	25	mm
IA =	5	mm	IA =	1	mm
CN =	69		CN =	99	
S =	114.1		S =	2.6	
Q =	3.0	mm	Q =	21.7	mm

	per	**imp**	**total**	
SCS Runoff Volume	3.0	21.7		mm
Drainage Area	1.2	2.0	3.17	ha
Runoff Volume	36	423	460	cu.m
Extended Detention Required			**460**	cu.m

Orifice Sizing per MOE 2003 SWM Manual - Falling Head Equation

t = 2*Ap*(h1^0.5-h2^0.5)/(C*Ao*(g*2)^0.5)

t =	drawdown time	**86400**	seconds	
Ao =	cross sectional area of orifice		sq.m	*to be calculated
h1 =	Starting water elevation above orifice	**0.76**	m	
h2=	Ending water elevation above orifice	**0.00**	m	
h=	Depth of ED	0.76		
C =	discharge coefficient	0.64		
Ap =	average pond surface area for extended detention	**550.00**	sq.m	*based on pond design

Ao =	0.0039 sq.m	d =	71	mm	
Actual Diameter		d =	**70**	mm	Ao = 0.004
Actual Drawdown Time			24.4	hrs	

STAGE STORAGE DISCHARGE CURVE CALCULATIONS

Project: 418-430 Aqueduct and 650-678 Niagara Street
File: 052233
Designed by JS
Checked by: PM
Date: 6/5/2023

Storage - Outflow Relationship for SWM Pond

Bottom of Active Storage Elevation:	180.00	m
Extended Detention Elevation:	180.76	m
Extended Detention Orifice Size:	70	mm
Orifice Area	0.0038	m2
Computational Increment	0.025	m
Extended Detention Orifice Elevation:	180.00	m

Orifice Outlets:

	Orifice #1	
Flood Control Orifice Diameter	0.305	m
Flood Control Inlet	0	m above pp (ED Elev)
Flood Control Orifice Area	0.07	m2
Flood Control Inlet Elevation	180.00	
Flood Control Orifice Elevation	180.76	m
Flood Control Orifice Coeff	0.64	

	Water Surface Elevation m	Depth above Bottom of Active Tank m	Depth of ED Orifice m	Depth of Flood Orifice m	Tank Storage Volume cum	ED Orifice Outflow cms	Flood Control Orifice #1 cms	Total Orifice Flow cms	Total Tank Outflow cms	Tank Storage Volume ha m
1	180.000	0.000	0.000	0.000	0.00	0.0000		0.000	0.000	0.000
2	180.025	0.025	0.025	0.025	15.91	0.0003		0.000	0.000	0.002
3	180.050	0.050	0.050	0.050	31.82	0.0023		0.002	0.002	0.003
4	180.075	0.075	0.075	0.075	47.73	0.0028		0.003	0.003	0.005
5	180.100	0.100	0.100	0.100	63.64	0.0032		0.003	0.003	0.006
6	180.125	0.125	0.125	0.125	79.37	0.0036		0.004	0.004	0.008
7	180.150	0.150	0.150	0.150	95.10	0.0040		0.004	0.004	0.010
8	180.175	0.175	0.175	0.175	110.66	0.0043		0.004	0.004	0.011
9	180.200	0.200	0.200	0.200	126.22	0.0046		0.005	0.005	0.013
10	180.225	0.225	0.225	0.225	141.78	0.0049		0.005	0.005	0.014
11	180.250	0.250	0.250	0.250	157.34	0.0051		0.005	0.005	0.016
12	180.275	0.275	0.275	0.275	172.72	0.0054		0.005	0.005	0.017
13	180.300	0.300	0.300	0.300	188.10	0.0056		0.006	0.006	0.019
14	180.325	0.325	0.325	0.325	203.47	0.0058		0.006	0.006	0.020
15	180.350	0.350	0.350	0.350	218.84	0.0061		0.006	0.006	0.022
16	180.375	0.375	0.375	0.375	234.04	0.0063		0.006	0.006	0.023
17	180.400	0.400	0.400	0.400	249.25	0.0065		0.006	0.006	0.025
18	180.425	0.425	0.425	0.425	264.28	0.0067		0.007	0.007	0.026
19	180.450	0.450	0.450	0.450	279.31	0.0069		0.007	0.007	0.028
20	180.475	0.475	0.475	0.475	294.17	0.0070		0.007	0.0070	0.029
21	180.500	0.500	0.500	0.500	309.02	0.0072		0.007	0.007	0.031
22	180.525	0.525	0.525	0.525	323.88	0.0074		0.007	0.007	0.032
23	180.550	0.550	0.550	0.550	338.57	0.0076		0.008	0.008	0.034
23	180.575	0.575	0.575	0.575	353.26	0.0078		0.008	0.008	0.035
24	180.600	0.600	0.600	0.600	367.94	0.0079		0.008	0.008	0.037
25	180.625	0.625	0.625	0.625	382.45	0.0081		0.008	0.008	0.038
26	180.650	0.650	0.650	0.650	396.97	0.0082		0.008	0.008	0.040
27	180.675	0.675	0.675	0.675	411.31	0.0084		0.008	0.008	0.041
28	180.700	0.700	0.700	0.700	425.64	0.0086		0.009	0.009	0.043

STAGE STORAGE DISCHARGE CURVE CALCULATIONS

Project: 418-430 Aqueduct and 650-678 Niagara Street
File: 052233
Designed by JS
Checked by: PM
Date: 6/5/2023

Storage - Outflow Relationship for SWM Pond

Bottom of Active Storage Elevation:	**180.00**	m
Extended Detention Elevation:	180.76	m
Extended Detention Orifice Size:	70	mm
Orifice Area	0.0038	m2
Computational Increment	**0.025**	m
Extended Detention Orifice Elevation:	**180.00**	m

Orifice Outlets:

	Orifice #1	
Flood Control Orifice Diameter	**0.305**	m
Flood Control Inlet	**0**	m above pp (ED Elev)
Flood Control Orifice Area	0.07	m2
Flood Control Inlet Elevation	180.00	
Flood Control Orifice Elevation	**180.76**	m
Flood Control Orifice Coeff	**0.64**	

	Water Surface Elevation m	Depth above Bottom of Active Tank m	Depth of ED Orifice m	Depth of Flood Orifice m	Tank Storage Volume cum	ED Orifice Outflow cms	Flood Control Orifice #1 cms	Total Orifice Flow cms	Total Tank Outflow cms	Tank Storage Volume ha m
29	180.725	**0.725**	0.725	0.725	**439.82**	0.0087		0.009	0.009	0.044
30	180.750	**0.750**	0.750	0.750	**453.81**	0.0089		0.009	0.009	0.045
31	180.775	**0.775**	0.775	0.775	**467.64**	0.0090	0.000	0.009	0.009	0.047
32	180.800	**0.800**	0.800	0.800	**481.29**	0.0091	0.002	0.011	0.011	0.048
33	180.825	**0.825**	0.825	0.825	**494.94**	0.0093	0.005	0.014	0.014	0.049
34	180.850	**0.850**	0.850	0.850	**508.42**	0.0094	0.009	0.018	0.018	0.051
35	180.875	**0.875**	0.875	0.875	**521.72**	0.0096	0.014	0.024	0.024	0.052
36	180.900	**0.900**	0.900	0.900	**534.69**	0.0097	0.020	0.030	0.030	0.053
37	180.925	**0.925**	0.925	0.925	**547.48**	0.0098	0.023	0.033	0.033	0.055
38	180.950	**0.950**	0.950	0.950	**560.10**	0.0100	0.040	0.050	0.050	0.056
39	180.975	**0.975**	0.975	0.975	**572.37**	0.0101	0.052	0.062	0.062	0.057
40	181.000	**1.000**	1.000	1.000	**584.65**	0.0102	0.061	0.071	0.071	0.058
41	181.025	**1.025**	1.025	1.025	**596.40**	0.0104	0.069	0.080	0.080	0.060
42	181.050	**1.050**	1.050	1.050	**607.82**	0.0105	0.077	0.087	0.087	0.061
43	181.075	**1.075**	1.075	1.075	**618.88**	0.0106	0.083	0.094	0.094	0.062
44	181.100	**1.100**	1.100	1.100	**629.27**	0.0107	0.090	0.100	0.100	0.063
45	181.125	**1.125**	1.125	1.125	**638.96**	0.0108	0.095	0.106	0.106	0.064
46	181.150	**1.150**	1.150	1.150	**647.78**	0.0110	0.101	0.112	0.112	0.065
47	181.175	**1.175**	1.175	1.175	**656.27**	0.0111	0.106	0.117	0.117	0.066
48	181.200	**1.200**	1.200	1.200	**664.23**	0.0112	0.111	0.122	0.122	0.066
49	181.225	**1.225**	1.225	1.225	**671.84**	0.0113	0.116	0.127	0.127	0.067
50	181.250	**1.250**	1.250	1.250	**679.45**	0.0114	0.120	0.132	0.132	0.068
51	181.275	**1.275**	1.275	1.275	**687.06**	0.0115	0.125	0.136	0.136	0.069
52	181.300	**1.300**	1.300	1.300	**694.67**	0.0117	0.129	0.141	0.141	0.069
53	181.325	**1.325**	1.325	1.325	**702.28**	0.0118	0.133	0.145	0.145	0.070
54	181.350	**1.350**	1.350	1.350	**709.89**	0.0119	0.137	0.149	0.149	0.071
55	181.375	**1.375**	1.375	1.375	**717.50**	0.0120	0.141	0.153	0.153	0.072
56	181.400	**1.400**	1.400	1.400	**725.11**	0.0121	0.145	0.157	0.157	0.073
57	181.425	**1.425**	1.425	1.425	**732.72**	0.0122	0.148	0.160	0.160	0.073
58	181.450	**1.450**	1.450	1.450	**740.33**	0.0123	0.152	0.164	0.164	0.074

STAGE STORAGE DISCHARGE CURVE CALCULATIONS

Project: 418-430 Aqueduct and 650-678 Niagara Street
File: 052233
Designed by JS
Checked by: PM
Date: 6/5/2023

Storage - Outflow Relationship for SWM Pond

Bottom of Active Storage Elevation:	**180.00**	m
Extended Detention Elevation:	180.76	m
Extended Detention Orifice Size:	70	mm
Orifice Area	0.0038	m2
Computational Increment	**0.025**	m
Extended Detention Orifice Elevation:	**180.00**	m

Orifice Outlets:

	Orifice #1	
Flood Control Orifice Diameter	**0.305**	m
Flood Control Inlet	**0**	m above pp (ED Elev)
Flood Control Orifice Area	0.07	m2
Flood Control Inlet Elevation	180.00	
Flood Control Orifice Elevation	**180.76**	m
Flood Control Orifice Coeff	**0.64**	

	Water Surface Elevation m	Depth above Bottom of Active Tank m	Depth of ED Orifice m	Depth of Flood Orifice m	Tank Storage Volume cum	ED Orifice Outflow cms	Flood Control Orifice #1 cms	Total Orifice Flow cms	Total Tank Outflow cms	Tank Storage Volume ha m
59	181.475	**1.475**	1.475	1.475	**747.94**	0.0124	0.155	0.168	0.168	0.075
60	181.500	**1.500**	1.500	1.500	**755.55**	0.0125	0.159	0.171	0.171	0.076
61	181.525	**1.525**	1.525	1.525	**763.16**	0.0126	0.162	0.175	0.175	0.076
62	181.550	**1.550**	1.550	1.550	**770.77**	0.0127	0.165	0.178	0.178	0.077
63	181.575	**1.575**	1.575	1.575	**778.38**	0.0128	0.169	0.181	0.181	0.078
64	181.600	**1.600**	1.600	1.600	**785.99**	0.0129	0.172	0.185	0.185	0.079
65	181.63	**1.63**	1.63	1.63	**793.61**	0.0130	0.175	0.188	0.188	0.079
66	181.65	**1.65**	1.65	1.65	**801.22**	0.0131	0.178	0.191	0.191	0.080
67	181.68	**1.68**	1.68	1.68	**808.83**	0.0132	0.181	0.194	0.194	0.081
68	181.70	**1.70**	1.70	1.70	**816.44**	0.0133	0.184	0.197	0.197	0.082
69	181.73	**1.73**	1.73	1.73	**824.05**	0.0134	0.187	0.200	0.200	0.082
70	181.75	**1.75**	1.75	1.75	**831.66**	0.0135	0.190	0.203	0.203	0.083
71	181.78	**1.78**	1.78	1.78	**839.27**	0.0136	0.192	0.206	0.206	0.084
72	181.80	**1.80**	1.80	1.80	**846.88**	0.0137	0.195	0.209	0.209	0.085
73	181.83	**1.83**	1.83	1.83	**854.49**	0.0138	0.198	0.212	0.212	0.085
74	181.85	**1.85**	1.85	1.85	**862.10**	0.0139	0.201	0.214	0.214	0.086
75	181.88	**1.88**	1.88	1.88	**869.71**	0.0140	0.203	0.217	0.217	0.087
76	181.90	**1.90**	1.90	1.90	**877.32**	0.0141	0.206	0.220	0.220	0.088
77	181.93	**1.93**	1.93	1.93	**884.93**	0.0142	0.208	0.223	0.223	0.088
78	181.95	**1.95**	1.95	1.95	**892.54**	0.0143	0.211	0.225	0.225	0.089
79	181.98	**1.98**	1.98	1.98	**900.15**	0.0144	0.213	0.228	0.228	0.090
80	182.00	**2.00**	2.00	2.00	**907.76**	0.0145	0.216	0.230	0.230	0.091
81	182.03	**2.03**	2.03	2.03	**915.37**	0.0146	0.218	0.233	0.233	0.092
82	182.05	**2.05**	2.05	2.05	**922.98**	0.0146	0.221	0.236	0.236	0.092
83	182.08	**2.08**	2.08	2.08	**930.59**	0.0147	0.223	0.238	0.238	0.093

BURNSIDE	Project:	**418-430 Aqueduct and 650-678 Niagara Street**	Prepared by: **JS**
	Task:	**Retention Volume Calculations**	Checked by: **PM**
	Date:	**6/5/2023**	Project no.: **052233**

Retention Volume Calculations

Redevelopment Area		
Area =	31664	m^2
Rainfall depth =	5.00	mm
Required volume =	**158.32**	m^3

Redevelopment Area		
Area =	31664	m^2
Rainfall depth =	25.00	mm
Required volume =	**791.61**	m^3

Initial Abstraction Calculations			
	Infiltration (m)	Area (m2)	Volume (m3)
IMPERVIOUS ROOF	0.001	7341.30	7.34
GREEN ROOF	0.005	3743.80	18.72
HARDSCAPE	0.001	12071.74	12.07
LANDSCAPE	0.005	8507.48	42.54
Total		**31664.32**	**80.67**

Required retention volume = (Total vol) - (Total IA)

77.65

TSS Removal Efficiency - Treatment Train

Catchment Area Description	Treated Drainage Area (m2)	RC	% Impervious	Annual TSS Loading (m^3/ha)*	Annual TSS Loading (m^3)	Removal Efficiency						
						Step 1		Step 2		Step 3		Total Efficiency
						Surface type**	TSS Remaining (m^3)	Cultec Isolator Row	TSS Remaining (m^3)	TSS Removal Using Runoff Reduction***	TSS Remaining (m^3)	
Controlled Hardscape	11691.1	0.90	100%	4.8	5.61	0%	5.61	50%	2.81	50%	1.40	**75%**
Controlled Landscape	7711.9	0.25	7%	0.001	0.00	80%	0.00	50%	0.00	50%	0.00	**95%**
Rooftop	7341.3	0.90	100%	4.8	3.52	80%	0.70	50%	0.35	50%	0.18	**95%**
Green Roof	3743.8	0.50	43%	1.1	0.41	80%	0.08	50%	0.04	50%	0.02	**95%**
Uncontrolled Landscape	795.6	0.25	7%	0.001	0.00	80%	0.00	0%	0.00	0%	0.00	**80%**
Uncontrolled Hardscape	380.6	0.90	100%	4.8	0.18	0%	0.18	0%	0.18	0%	0.18	**0%**
Total	**31664.3**				**9.73**		**6.58**		**3.38**		**1.78**	**82%**

* As per Table 6.3 Annual Sediment Loadings (shown below) in the SWM Planning & Design Manual, MOE, 2003
** As per City of Toronto standards (shown below), the TSS removal rates shown above can be applied
***Runoff reduction using 5mm retention, based on WWFMG 50% of rainfall will be infiltrated on site and removed as runoff by annually removing the 5mm event

Table 6.3: Annual Sediment Loadings

Catchment Imperviousness	Annual Loading (kg/ha)	Wet Density (kg/m^3)	Annual Loading (m^3/ha)
35%	770	1,230	0.6
55%	2,300	1,230	1.9
70%	3,495	1,230	2.8
85%	4,680	1,230	3.8

7% Impervious Extrapolated to be 0.001 m^3/ha
43% Impervious Extrapolated to be 1.1 m^3/ha
100% ImperviousExtrapolated to be 4.8 m^3/ha

Table Provided by the City of Toronto:

Surface Type	Initial Abstraction	TSS Removal	Runoff Coefficient
Impervious roof	1mm	80%	0.90
Asphalt pavement	1mm	0%	0.90
Landscape	5mm	80%	0.25
Green Roof	7mm max for intensive roofs otherwise 5mm	80%	0.45-0.5
Permeable Pavers	5mm	80% with storage bed otherwise 50%	0.40
Concrete pavers	1mm	0%	0.9
Grassed swale	5mm	50% for a min length of 16m	0.25

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

****
Element Count
****
Number of rain gages 8
Number of subcatchments ... 1
Number of nodes 2
Number of links 1
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Name	Data Source	Data Type	Recording Interval
AES_Southern_Ontario_25mm	AES_Southern_Ontario_25mm	INTENSITY	5 min.
Chicago_4h_100yr	Chicago_4h_100yr	INTENSITY	10 min.
Chicago_4h_10yr	Chicago_4h_10yr	INTENSITY	10 min.
Chicago_4h_25yr	Chicago_4h_25yr	INTENSITY	10 min.
Chicago_4h_2yr	Chicago_4h_2yr	INTENSITY	10 min.
Chicago_4h_50yr	Chicago_4h_50yr	INTENSITY	10 min.
Chicago_4h_5yr	Chicago_4h_5yr	INTENSITY	10 min.
SCS_Type_II_25mm	SCS_Type_II_25mm	INTENSITY	6 min.

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
S2	3.17	904.69	61.10	2.0000	Chicago_4h_100yr	SU1

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
OF1	OUTFALL	0.00	0.00	0.0	
SU1	STORAGE	0.00	5.00	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	% Slope	Roughness

```
  ------------------------------------------------------------------------------
------------
  OL1              SU1              OF1              OUTLET


  *********************
  Cross Section Summary
  *********************
                                        Full     Full     Hyd.     Max.   No. of
Full
  Conduit          Shape               Depth     Area     Rad.    Width  Barrels
Flow
  ------------------------------------------------------------------------------
------


  ********************************************************
  NOTE: The summary statistics displayed in this report are
  based on results found at every computational time step,
  not just on results from each reporting time step.
  ********************************************************

  ****************
  Analysis Options
  ****************
  Flow Units ............... CMS
  Process Models:
    Rainfall/Runoff ........ YES
    RDII ................... NO
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... YES
    Ponding Allowed ........ NO
    Water Quality .......... NO
  Infiltration Method ...... CURVE_NUMBER
  Flow Routing Method ...... DYNWAVE
  Surcharge Method ......... EXTRAN
  Starting Date ............ 11/01/2023 00:00:00
  Ending Date .............. 11/03/2023 00:00:00
  Antecedent Dry Days ...... 0.0
  Report Time Step ......... 00:01:00
  Wet Time Step ............ 00:05:00
  Dry Time Step ............ 00:05:00
  Routing Time Step ........ 5.00 sec
  Variable Time Step ....... YES
  Maximum Trials ........... 8
  Number of Threads ........ 1
  Head Tolerance ........... 0.001500 m


  *************************        Volume         Depth
  Runoff Quantity Continuity     hectare-m            mm
  *************************     ---------       -------
  Total Precipitation ......         0.232        73.210
  Evaporation Loss .........         0.000         0.000
  Infiltration Loss ........         0.040        12.610
```

Surface Runoff	0.190	59.935
Final Storage	0.003	0.945
Continuity Error (%)	-0.382	

Flow Routing Continuity	Volume hectare-m	Volume 10^6 ltr
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.190	1.898
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.188	1.882
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.002	0.016
Continuity Error (%)	0.000	

Time-Step Critical Elements

None

Highest Flow Instability Indexes

All links are stable.

Routing Time Step Summary

Minimum Time Step	:	4.50 sec
Average Time Step	:	5.00 sec
Maximum Time Step	:	5.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.00
Percent Not Converging	:	0.00
Time Step Frequencies	:	
5.000 - 3.155 sec	:	100.00 %
3.155 - 1.991 sec	:	0.00 %
1.991 - 1.256 sec	:	0.00 %
1.256 - 0.792 sec	:	0.00 %
0.792 - 0.500 sec	:	0.00 %

Subcatchment Runoff Summary

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
S2	73.21	0.00	0.00	12.61	44.37	15.56	59.93	1.90	0.99	0.819

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
OF1	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
SU1	STORAGE	0.27	2.08	2.08	0 01:49	2.08

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
OF1	OUTFALL	0.000	0.236	0 01:43	0	1.88	0.000
SU1	STORAGE	0.991	0.991	0 01:30	1.9	1.9	0.000

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
SU1	0.156	9	0	0	0.926	51	0 01:49	0.236

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
OF1	74.92	0.015	0.236	1.882
System	74.92	0.015	0.236	1.882

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
OL1	DUMMY	0.236	0 01:43			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet

```
  ------------------------------------------------------------------------------
----


  *************************
  Conduit Surcharge Summary
  *************************

  No conduits were surcharged.


  Analysis begun on:  Fri Nov 17 13:51:35 2023
  Analysis ended on:  Fri Nov 17 13:51:35 2023
  Total elapsed time: < 1 sec
```

STORM SEWER DESIGN SHEET: (100 Year Storm)

418-430 Aqueduct and 650-678 Niagara Street

BURNSIDE

Project #: 052233
Date: 5-Jun-24
Designed: JS
Checked: PM

Min. Diameter = 300 mm
Mannings 'n'= 0.013
Starting Tc = 10 min
Factor of Safety = 10 %

Rainfall Intensity = $\frac{A}{(Tc+B)^{c}}$ *where Tc is in minutes*

A = 1020
B = 4.7
C = 0.731
(100 Yr)

NOMINAL PIPE SIZE USED

DESCRIPTION	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
HW 1	HW 1	MH 15	0.04	0.90	0.04	0.04	143.0	0.016			0.016	4.7	2.00	300	0.137	1.93	10.00	0.04	10.04	12%
CB 14	CB 14	MH 15	0.02	0.90	0.01	0.01	143.0	0.006			0.006	3.4	2.00	300	0.137	1.93	10.00	0.03	10.03	4%
	MH 15	MH 14		0.90		0.05	142.7	0.022			0.022	57.2	0.40	300	0.061	0.87	10.04	1.10	11.14	36%
CB 13	CB 13	MH 14	0.20	0.67	0.13	0.13	143.0	0.052			0.052	3.4	2.00	300	0.137	1.93	10.00	0.03	10.03	38%
	MH 14	MH 13		0.90		0.19	135.4	0.070			0.070	44.4	0.40	375	0.111	1.00	11.14	0.74	11.88	63%
	MH 13	BLIND 1		0.90		0.19	130.9	0.068			0.068	9.9	0.40	375	0.111	1.00	11.88	0.16	12.04	61%
BUILDING E1	STUB E1	BLIND 1	0.03	0.90	0.02	0.02	143.0	0.009			0.009	14.1	2.00	300	0.137	1.93	10.00	0.12	10.12	7%
	BLIND 1	MH 12		0.90		0.21	130.0	0.076			0.076	5.8	0.40	375	0.111	1.00	12.04	0.10	12.14	68%
AD 1	AD 1	STUB A	0.04	0.73	0.03	0.03	143.0	0.013			0.013	1.0	1.00	300	0.097	1.37	10.00	0.01	10.01	13%
AD 3	AD 2	STUB A	0.06	0.81	0.05	0.05	143.0	0.020			0.020	1.0	1.00	300	0.097	1.37	10.00	0.01	10.01	20%
	AD 3	STUB A	0.04	0.77	0.03	0.03	143.0	0.013			0.013	1.0	1.00	300	0.097	1.37	10.00	0.01	10.01	13%
BUILDING A	STUB A	MH 12	0.25	0.90	0.22	0.34	142.9	0.134			0.134	12.5	2.00	375	0.248	2.25	10.01	0.09	10.11	54%
CB 12	CB 12	MH 12	0.06	0.90	0.05	0.05	143.0	0.021			0.021	4.7	2.00	300	0.137	1.93	10.00	0.04	10.04	16%
	MH 12	MH 11		0.90		0.60	129.5	0.216			0.216	40.8	0.40	525	0.272	1.26	12.14	0.54	12.68	79%
CB 11	CB 11	MH 11	0.10	0.74	0.07	0.07	143.0	0.029			0.029	8.1	2.00	300	0.137	1.93	10.00	0.07	10.07	21%
CB 10	CB 10	MH 11	0.11	0.89	0.10	0.10	143.0	0.039			0.039	4.6	2.00	300	0.137	1.93	10.00	0.04	10.04	28%
	MH 11	BLIND 2		0.90		0.77	126.5	0.270			0.270	15.2	0.40	600	0.388	1.37	12.68	0.18	12.87	70%
BUILDING D1	STUB D1	BLIND 2	0.03	0.90	0.03	0.03	143.0	0.011			0.011	14.0	2.00	300	0.137	1.93	10.00	0.12	10.12	8%
	BLIND 2	BLIND 3		0.90		0.80	125.5	0.278			0.278	26.8	0.40	600	0.388	1.37	12.87	0.32	13.19	72%
CB 9	CB 9	BLIND 3	0.13	0.79	0.11	0.11	143.0	0.042			0.042	4.6	2.00	300	0.137	1.93	10.00	0.04	10.04	31%
	BLIND 3	MH 10		0.90		0.90	123.9	0.310			0.310	11.8	0.40	600	0.388	1.37	13.19	0.14	13.33	80%
AD 4	AD 4	STUB B	0.17	0.86	0.14	0.14	143.0	0.057			0.057	1.0	1.00	300	0.097	1.37	10.00	0.01	10.01	59%
BUILDING B	STUB B	MH 10	0.50	0.90	0.45	0.59	142.9	0.234			0.234	12.3	2.00	450	0.403	2.54	10.01	0.08	10.09	58%
	MH 10	MH 9		0.90		1.49	123.1	0.511			0.511	12.0	0.40	750	0.704	1.59	13.33	0.13	13.46	73%
BUILDING E2	STUB E2	MH 20	0.03	0.90	0.02	0.02	143.0	0.009			0.009	11.0	2.00	300	0.137	1.93	10.00	0.09	10.09	7%
CB 17	CB 17	MH 20	0.09	0.70	0.06	0.06	143.0	0.025			0.025	4.4	2.00	300	0.137	1.93	10.00	0.04	10.04	19%
	MH 20	MH 19		0.90		0.09	142.3	0.034			0.034	59.1	0.40	300	0.061	0.87	10.09	1.14	11.23	56%
CB 16	CB 16	MH 19	0.11	0.79	0.09	0.09	143.0	0.036			0.036	4.4	2.00	300	0.137	1.93	10.00	0.04	10.04	26%
	MH 19	BLIND 4		0.90		0.18	134.8	0.066			0.066	1.9	0.40	375	0.111	1.00	11.23	0.03	11.26	60%
BUILDING D2	STUB D2	BLIND 4	0.03	0.90	0.03	0.03	143.0	0.011			0.011	10.9	2.00	300	0.137	1.93	10.00	0.09	10.09	8%
	BLIND 4	MH 18		0.90		0.20	134.6	0.076			0.076	46.4	0.40	375	0.111	1.00	11.26	0.77	12.03	68%

STORM SEWER DESIGN SHEET: (100 Year Storm)

418-430 Aqueduct and 650-678 Niagara Street

Project #: 052233
Date: 5-Jun-24
Designed: JS
Checked: PM

Min. Diameter = 300 mm
Mannings 'n'= 0.013
Starting Tc = 10 min
Factor of Safety = 10 %

Rainfall Intensity = $\frac{A}{(Tc+B)^{c}}$ *where Tc is in minutes*

A = 1020
B = 4.7
C = 0.731
(100 Yr)

NOMINAL PIPE SIZE USED

DESCRIPTION	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
CB 15	CB 15	CBMH 1	0.05	0.25	0.01	0.01	143.0	0.005			0.005	3.9	2.00	300	0.137	1.93	10.00	0.03	10.03	3%
	CBMH 1	MH 18		0.90		0.01	142.7	0.005			0.005	4.0	2.00	300	0.137	1.93	10.03	0.03	10.07	3%
	MH 18	MH 17		0.90		0.22	130.1	0.078			0.078	10.5	0.40	375	0.111	1.00	12.03	0.17	12.21	70%
	MH 17	MH 16		0.90		0.22	129.1	0.077			0.077	18.1	0.40	375	0.111	1.00	12.21	0.30	12.51	70%
	MH 16	MH 9		0.90		0.22	127.4	0.076			0.076	12.8	0.40	375	0.111	1.00	12.51	0.21	12.72	69%
	MH 9	MH 6		0.90		1.71	122.5	0.581			0.581	27.5	0.50	750	0.787	1.78	13.46	0.26	13.72	74%
CB 5	CB 5	MH 6	0.01	0.25	0.00	0.00	143.0	0.001			0.001	9.2	2.00	300	0.137	1.93	10.00	0.08	10.08	1%
CB 8	CB 8	MH 8	0.07	0.87	0.06	0.06	143.0	0.026			0.026	10.7	2.00	300	0.137	1.93	10.00	0.09	10.09	19%
CB 7	CB 7	MH 8	0.05	0.83	0.04	0.04	143.0	0.017			0.017	12.3	2.00	300	0.137	1.93	10.00	0.11	10.11	13%
	MH 8	MH 7		0.90		0.11	142.2	0.043			0.043	30.5	1.00	300	0.097	1.37	10.11	0.37	10.48	44%
CB 6	CB 6	MH 7	0.19	0.72	0.14	0.14	143.0	0.055			0.055	10.7	2.00	300	0.137	1.93	10.00	0.09	10.09	40%
	MH 7	MH 6		0.90		0.25	139.7	0.096			0.096	34.1	1.00	375	0.175	1.59	10.48	0.36	10.84	55%
	MH 6	MH 5		0.90		1.96	121.3	0.659			0.659	32.6	0.40	825	0.908	1.70	13.72	0.32	14.04	73%
CB 4	CB 4	MH 5	0.05	0.71	0.03	0.03	143.0	0.014			0.014	4.7	2.00	300	0.137	1.93	10.00	0.04	10.04	10%
	MH 5	MH 4		0.90		1.99	119.7	0.662			0.662	39.3	0.40	825	0.908	1.70	14.04	0.39	14.42	73%
CB 3	CB 3	MH 4	0.03	0.90	0.03	0.03	143.0	0.010			0.010	3.6	2.00	300	0.137	1.93	10.00	0.03	10.03	7%
	MH 4	MH 3		0.90		2.02	118.0	0.661			0.661	18.8	0.40	825	0.908	1.70	14.42	0.18	14.61	73%
	MH 3	TANK 1		0.90		2.02	117.2	0.656			0.656	3.5	0.40	825	0.908	1.70	14.61	0.03	14.64	72%
CB 2	CB 2	TANK 1	0.06	0.88	0.05	0.05	143.0	0.021			0.021	1.0	1.00	300	0.097	1.37	10.00	0.01	10.01	22%
	TANK 1	TANK 2		0.90		2.07	117.0	0.673			0.673	1.0	0.40	825	0.908	1.70	14.64	0.01	14.65	74%
CB 1	CB 1	TANK 2	0.07	0.90	0.06	0.06	143.0	0.025			0.025	1.0	1.00	300	0.097	1.37	10.00	0.01	10.01	26%
CB 19	CB 19	STUB C	0.06	0.90	0.05	0.05	143.0	0.021			0.021	13.9	2.00	300	0.137	1.93	10.00	0.12	10.12	16%
BUILDING C	STUB C	MH 2	0.23	0.90	0.20	0.26	142.1	0.102			0.102	2.0	2.00	300	0.137	1.93	10.12	0.02	10.14	74%
	MH 2	TANK 2		0.90		0.26	142.0	0.101			0.101	1.1	2.00	300	0.137	1.93	10.14	0.01	10.15	74%
CB-SW	CB-SW	TANK 2	0.03	0.25	0.01	0.01	143.0	0.002			0.002	13.9	2.00	300	0.137	1.93	10.00	0.12	10.12	2%
	TANK 2C	OGS1		0.90			143.0		0.236	0.236	0.236	2.4	1.00	450	0.285	1.79	10.00	0.02	10.02	83%
	OGS1	MH1		0.90			142.8			0.236	0.236	2.9	1.00	450	0.285	1.79	10.02	0.03	10.05	83%
	MH1	EX STORM		0.90			142.6			0.236	0.236	7.0	2.00	450	0.403	2.54	10.05	0.05	10.10	59%

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix D

Sanitary Servicing Calculations

BURNSIDE

CALCULATION SHEET

Project:	**418-430 Aqueduct and 650-678 Niagara Welland, Ontario**	Prepared by:	JS
		Checked by:	PM
		Project No:	300052233
	Sanitary Servicing Analysis	Date:	8/29/2024

Existing Site Flows

Residential - To North Sanitary Sewer

Unit Type	Number of Units	Pop/Unit	Population
Single family dwelling	4	3.5	14

$$Q=\frac{PxQxM}{86400}+AxI$$

P=	14	persons
Q=	320	L/cap/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	4.40	
I=	0.280	l/s/ha
A=	3.90	ha

$Q_{Existing\ -\ North}$ = 1.32 L/s

Residential - To South Sanitary Sewer

Unit Type	Number of Units	Pop/Unit	Population
Single family dwelling	4	3.5	14

$$Q=\frac{PxQxM}{86400}+AxI$$

P=	14	persons
Q=	320	L/cap/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	4.40	
I=	0.280	l/s/ha
A=	3.90	ha

$Q_{Existing\ -\ South}$ = 1.32 L/s

$Q_{Existing\ Total}$= 2.64 L/s

City of Toronto Design Criteria for Sewers and Watermains (January 2021) was referenced for equivalent population densities due to lack of guidelines from Niagara Region and the City of Welland

BURNSIDE

CALCULATION SHEET

Project:	**418-430 Aqueduct and 650-678 Niagara Welland, Ontario**	Prepared by:	JS
		Checked by:	PM
		Project No:	300052233
	Sanitary Servicing Analysis	Date:	8/29/2024

Proposed Site Flows - Building A

Residential - Building A

Population based on number of units

Unit Type	Number of Units	Pop/Unit	Population
Bachelor	14	1.4	20
1B	98	2.1	206
2B/1B+D	67	3.1	208
3B/2B+D	11	3.7	41
Total	190		474

Commercial (Indoor Amenity and Retail/Commercial Space)

GFA (m^2)	GFA (ha)	P/ha	Population
449	0.045	110	5

$$Q=\frac{PxQxM}{86400}+AxI$$

P=	479	persons
Q=	320	L/cap/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	3.98	
I=	0.280	l/s/ha
A=	0.25	ha

$Q_{Proposed\ -\ Building\ A}$ = 7.13 L/s

Proposed Site Flows - Building B

Residential - Building B

Population based on number of units

Unit Type	Number of Units	Pop/Unit	Population
Bachelor	75	1.4	105
1B	156	2.1	328
2B/1B+D	109	3.1	338
3B/2B+D	12	3.7	44
Total	352		815

Commercial (Indoor Amenity and Retail/Commercial Space)

GFA (m^2)	GFA (ha)	P/ha	Population
1,642	0.164	110	19

$$Q=\frac{PxQxM}{86400}+AxI$$

P=	834	persons
Q=	320	L/cap/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	3.85	
I=	0.280	l/s/ha
A=	0.50	ha

$Q_{Proposed\ -\ Building\ B}$ = 12.03 L/s

City of Toronto Design Criteria for Sewers and Watermains (January 2021) was referenced for equivalent population densities due to lack of guidelines from Niagara Region and the City of Welland

BURNSIDE

CALCULATION SHEET

Project:	**418-430 Aqueduct and 650-678 Niagara Welland, Ontario**	Prepared by:	JS
		Checked by:	PM
		Project No:	300052233
	Sanitary Servicing Analysis	Date:	8/29/2024

Proposed Site Flows - Building C

Residential - Building C

Population based on number of units

Unit Type	Number of Units	Pop/Unit	Population
Bachelor	30	1.4	42
1B	134	2.1	281
2B/1B+D	147	3.1	456
3B/2B+D	0	3.7	0
Total	311		779

Commercial (Indoor Amenity and Retail/Commercial Space)

GFA (m^2)	GFA (ha)	P/ha	Population
995	0.100	110	11

$$Q = \frac{PxQxM}{86400} + AxI$$

P=	790	persons
Q=	320	L/cap/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	3.86	
I=	0.280	l/s/ha
A=	0.23	ha

$Q_{Proposed\ -\ Building\ C}$ = 11.37 L/s

Proposed Site Flows - Building D

Residential - Building D

Unit Type	Number of Units	Pop/Unit	Population
Townhouses	14	2.7	38

$$Q = \frac{PxQxM}{86400} + AxI$$

P=	38	persons
Q=	320	L/cap/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	4.34	
I=	0.280	l/s/ha
A=	0.03	ha

$Q_{Proposed\ -\ Building\ D}$ = 0.62 L/s

City of Toronto Design Criteria for Sewers and Watermains (January 2021) was referenced for equivalent population densities due to lack of guidelines from Niagara Region and the City of Welland

BURNSIDE

CALCULATION SHEET

Project:	**418-430 Aqueduct and 650-678 Niagara Welland, Ontario**	Prepared by:	JS
		Checked by:	PM
		Project No:	300052233
	Sanitary Servicing Analysis	Date:	8/29/2024

Proposed Site Flows - Building E

Residential - Building E

Unit Type	Number of Units	Pop/Unit	Population
Townhouses	12	2.7	32

$$Q = \frac{PxQxM}{86400} + AxI$$

P=	32	persons
Q=	320	L/cap/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	4.35	
I=	0.280	l/s/ha
A=	0.03	ha

$Q_{Proposed - Building E}$ = 0.53 L/s

$Q_{Proposed Total}$ = 31.68 L/s

City of Toronto Design Criteria for Sewers and Watermains (January 2021) was referenced for equivalent population densities due to lack of guidelines from Niagara Region and the City of Welland

Service Connection					
Diameter	Slope	Velocity	Capacity	Spare Capacity	Percent Full
(mm)	(%)	(m/s)	(L/s)	(L/s)	%
250	2.00	1.71	84.10	52.42	37.67%
250	2.00	1.71	84.10	84.10	37.67%

BURNSIDE

CALCULATION SHEET

Project:	**418-430 Aqueduct and 650-678 Niagara Welland, Ontario**	Prepared by:	JS
		Checked by:	PM
		Project No:	300052233
	Sanitary Servicing Analysis	Date:	8/29/2024

Existing Site Flows

Residential - To North Sanitary Sewer

Unit Type	Number of Units	Pop/Unit	Population
Single family dwelling	4	3.5	14

$$Q = \frac{PxQxM}{86400} + AxI$$

P=	14	persons
Q=	320	L/cap/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	4.40	
I=	0.280	l/s/ha
A=	3.90	ha

$Q_{Existing\ -\ North}$ = 1.32 L/s

Residential - To South Sanitary Sewer

Unit Type	Number of Units	Pop/Unit	Population
Single family dwelling	4	3.5	14

$$Q = \frac{PxQxM}{86400} + AxI$$

P=	14	persons
Q=	320	L/cap/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	4.40	
I=	0.280	l/s/ha
A=	3.90	ha

$Q_{Existing\ -\ South}$ = 1.32 L/s

$Q_{Existing\ Total}$ = 2.64 L/s

City of Toronto Design Criteria for Sewers and Watermains (January 2021) was referenced for equivalent population densities due to lack of guidelines from Niagara Region and the City of Welland

BURNSIDE

CALCULATION SHEET

Project:	**418-430 Aqueduct and 650-678 Niagara Welland, Ontario**	Prepared by:	JS
		Checked by:	PM
		Project No:	300052233
	Sanitary Servicing Analysis	Date:	8/29/2024

Proposed Site Flows - Building A

Residential - Building A

Population based on number of units

Unit Type	Number of Units	Pop/Unit	Population
Bachelor	14	1.2	17
1B	98	1.2	118
2B/1B+D	67	2.1	141
3B/2B+D	11	2.2	25
Total	190		300

$$Q = \frac{PxQxM}{86400} + AxI$$

P=	300	persons
Q=	255	L/cap/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	4.08	
I=	0.280	l/s/ha
A=	0.25	ha

$Q_{\text{Proposed Residential - Building A}}$ = 3.69 L/s

Commercial (Indoor Amenity and Retail/Commercial Space)

GFA (m^2)	GFA (ha)	P/ha	Population
449	0.045	110	5

Peak Commercial Flow=	5	L/m2/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	4.00	

$Q_{\text{Proposed Commercial - Building A}}$ = 0.10 L/s

$Q_{\text{Proposed Total - Building A}}$ = 3.79 L/s

Calculations based on Table 1 of City of Welland 678 Niagara Street & 418-430 Aqueduct Street Modelling, Analysis and Engineering Services Report - Welland Standards

BURNSIDE

CALCULATION SHEET

Project:	**418-430 Aqueduct and 650-678 Niagara Welland, Ontario**	Prepared by:	JS
		Checked by:	PM
		Project No:	300052233
	Sanitary Servicing Analysis	Date:	8/29/2024

Proposed Site Flows - Building B

Residential - Building B

Population based on number of units

Unit Type	Number of Units	Pop/Unit	Population
Bachelor	75	1.2	90
1B	156	1.2	187
2B/1B+D	109	2.1	230
3B/2B+D	12	2.2	27
Total	352		534

$$Q = \frac{PxQxM}{86400} + AxI$$

P= 534 persons
Q= 255 L/cap/day
M= $1 + \frac{14}{4+(P/1000)^{1/2}}$
M= 3.96
I= 0.280 l/s/ha
A= 0.50 ha

$Q_{\text{Proposed Residential - Building B}}$ = 6.38 L/s

Commercial (Indoor Amenity and Retail/Commercial Space)

GFA (m^2)	GFA (ha)	P/ha	Population
1,642	0.164	110	19

Peak Commercial Flow= 5 L/m2/day
M= $1 + \frac{14}{4+(P/1000)^{1/2}}$
M= 4.00
$Q_{\text{Proposed Commercial - Building B}}$ = 0.38 L/s

$Q_{\text{Proposed Total - Building B}}$ = 6.76 L/s

Calculations based on Table 1 of City of Welland 678 Niagara Street & 418-430 Aqueduct Street Modelling, Analysis and Engineering Services Report - Welland Standards

BURNSIDE

CALCULATION SHEET

Project:	**418-430 Aqueduct and 650-678 Niagara Welland, Ontario**	Prepared by:	JS
		Checked by:	PM
		Project No:	300052233
	Sanitary Servicing Analysis	Date:	8/29/2024

Proposed Site Flows - Building C

Residential - Building C

Population based on number of units

Unit Type	Number of Units	Pop/Unit	Population
Bachelor	30	1.2	36
1B	134	1.2	161
2B/1B+D	147	2.1	310
3B/2B+D	0	2.2	0
Total	311		507

$$Q = \frac{PxQxM}{86400} + AxI$$

P= 507 persons
Q= 255 L/cap/day
M= $1 + \frac{14}{4+(P/1000)^{1/2}}$
M= 3.97
I= 0.280 l/s/ha
A= 0.23 ha

$Q_{\text{Proposed Residential - Building C}}$ = 6.01 L/s

Commercial (Indoor Amenity and Retail/Commercial Space)

GFA (m^2)	GFA (ha)	P/ha	Population
995	0.100	110	11

Peak Commercial Flow= 5 L/m2/day
M= $1 + \frac{14}{4+(P/1000)^{1/2}}$
M= 4.00

$Q_{\text{Proposed Commercial - Building C}}$ = 0.23 L/s

$Q_{\text{Proposed Total - Building C}}$ = 6.24 L/s

Calculations based on Table 1 of City of Welland 678 Niagara Street & 418-430 Aqueduct Street Modelling, Analysis and Engineering Services Report - Welland Standards

SANITARY SEWER DESIGN SHEET

418-430 Aqueduct and 650-678 Niagara Street
418-430 Aqueduct and 650-678 Niagara Street, Welland

BURNSIDE

Project #: 052233
Date: 29-Aug-24
Designed: JS
Checked: PM

Min Diameter = 200 mm
Mannings 'n'= 0.013
Min. Velocity = 0.60 m/s
Max. Velocity = 3.00 m/s

Avg. Domestic Flow = 320.0 l/c/d
Infiltration = 0.280 l/s/ha
Max. Peaking Factor = 4.00
Min. Peaking Factor= 2.00

Factor of Safety = 10 %

NOMINAL PIPE SIZE USED

DESCRIPTION	FROM MH	TO MH	RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS							PIPE DATA					
			AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENSITY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	POP. FLOW (l/s)	CONSTANT COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)	PERCENT FULL (%)
BUILDING D (1/2)	STUBD	MH9A	0.02	0.02	7		2.7	19	19							0.0	19	4.00	0.6			0.60	2.00	200	46.4	1.48	0.46	1%
BUILDING A	STUBA	MH9A	0.25	0.25	190		2.5	479	479	0.05	0.05	110		5	5	0.1	484	3.98	7.1			7.22	2.00	200	46.4	1.48	1.08	16%
	MH9A	MH8A		0.27					498		0.05				5	0.1	503	3.97	7.4			7.5	0.50	200	23.2	0.74	0.64	32%
	MH8A	MH7A		0.27					498		0.05				5	0.1	503	3.97	7.4			7.5	0.50	200	23.2	0.74	0.64	32%
BUILDING E (1/2)	STUBE	MH7A	0.02	0.02	6		2.7	17	17							0.0	17	4.00	0.6			0.6	2.00	200	46.4	1.48	0.46	1%
	MH7A	MH6A		0.28					515		0.05				5	0.1	520	3.97	7.6			7.7	0.50	200	23.2	0.74	0.64	33%
BUILDING B	STUBB	MH6A	0.50	0.50	352		2.4	834	834	0.16	0.16	110		18	18	0.2	852	3.84	12.1			12.3	2.00	200	46.4	1.48	1.23	27%
	MH6A	MH5A		0.78					1349		0.21				23	0.3	1372	3.71	18.8			19.1	0.50	200	23.2	0.74	0.81	82%
BUILDING D (1/2)	STUBD2	MH14A	0.02	0.02	7		2.7	19	19							0.0	19	4.00	0.6			0.6	2.00	200	46.4	1.48	0.46	1%
	MH14A	MH13A		0.02					19							0.0	19	4.00	0.6			0.6	0.50	200	23.2	0.74	0.29	3%
	MH13A	MH12A		0.02					19							0.0	19	4.00	0.6			0.6	0.50	200	23.2	0.74	0.29	3%
BUILDING E (1/2)	STUBE2	MH12A	0.02	0.02	6		2.7	17	17							0.0	17	4.00	0.6			0.6	2.00	200	46.4	1.48	0.46	1%
	MH12A	MH11A		0.03					36							0.0	36	4.00	0.6			0.6	0.50	200	23.2	0.74	0.29	3%
	MH11A	MH10A		0.03					36							0.0	36	4.00	0.6			0.6	0.50	200	23.2	0.74	0.29	3%
	MH10A	MH5A		0.03					36							0.0	36	4.00	0.6			0.6	0.50	200	23.2	0.74	0.29	3%
	MH5A	MH4A		0.81					1385		0.21				23	0.3	1408	3.70	19.3			19.6	0.50	200	23.2	0.74	0.81	84%
	MH4A	MH3A		0.81					1385		0.21				23	0.3	1408	3.70	19.3			19.6	0.50	200	23.2	0.74	0.81	84%
BUILDING C	STUBC	MH3A	0.23	0.23	311		2.540193	790	790	0.10	0.10	110		11	11	0.1	801	3.86	11.5			11.5	2.00	200	46.4	1.48	1.20	25%
	MH3A	MH2A		1.04					2175		0.31				34	0.4	2209	3.55	29.1			29.4	0.50	250	42.0	0.86	0.92	70%
	MH2A	MH1A		1.04					2175		0.31				34	0.4	2209	3.55	29.1			29.4	0.50	250	42.0	0.86	0.92	70%
	MH1A	EX.MH004A		1.04					2175		0.31				34	0.4	2209	3.55	29.1			29.4	2.00	250	84.1	1.71	1.54	35%

BURNSIDE

CALCULATION SHEET

Project:	**418-430 Aqueduct and 650-678 Niagara Welland, Ontario**	Prepared by:	JS
		Checked by:	PM
		Project No:	300052233
	Sanitary Servicing Analysis	Date:	8/29/2024

Proposed Site Flows - Building D

Residential - Building D

Unit Type	Number of Units	Pop/Unit	Population
Townhouses	14	2.2	31

$$Q=\frac{PxQxM}{86400}+AxI$$

P=	31	persons
Q=	255	L/cap/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	4.35	
I=	0.280	l/s/ha
A=	0.03	ha
$Q_{Proposed\ -\ Building\ D}$ =	**0.41**	**L/s**

Proposed Site Flows - Building E

Residential - Building E

Unit Type	Number of Units	Pop/Unit	Population
Townhouses	12	2.2	27

$$Q=\frac{PxQxM}{86400}+AxI$$

P=	27	persons
Q=	255	L/cap/day
M=	$1+\frac{14}{4+(P/1000)^{1/2}}$	
M=	4.36	
I=	0.280	l/s/ha
A=	0.03	ha
$Q_{Proposed\ -\ Building\ E}$ =	**0.35**	**L/s**
$Q_{Proposed\ Total}$ =	**17.55**	**L/s**

Calculations based on Table 1 of City of Welland 678 Niagara Street & 418-430 Aqueduct Street Modelling, Analysis and Engineering Services Report - Welland Standards

Modelling, Analysis, and Engineering Services

678 Niagara Street & 418-430 Aqueduct Street

Submitted to:
Samantha McCauley
City of Welland

Submitted by:
GEI Consultants Canada Ltd.
1266 South Service Road, Unit C31
Stoney Creek, ON L8E 5R9
905-643-6688

May 10, 2024
Project No. 620137-31
Assignment 31

Joy Liu, M.A.Sc
Technical Specialist

Julien Bell, P.Eng
Vice-President, Senior Project Manager

Table of Contents

List of Tables

List of Figures

Certification

PREPARED BY:
GEI Consultants Canada Ltd.

Joy Liu, M.A.Sc
Technical Specialist

PREPARED BY:
GEI Consultants Canada Ltd.

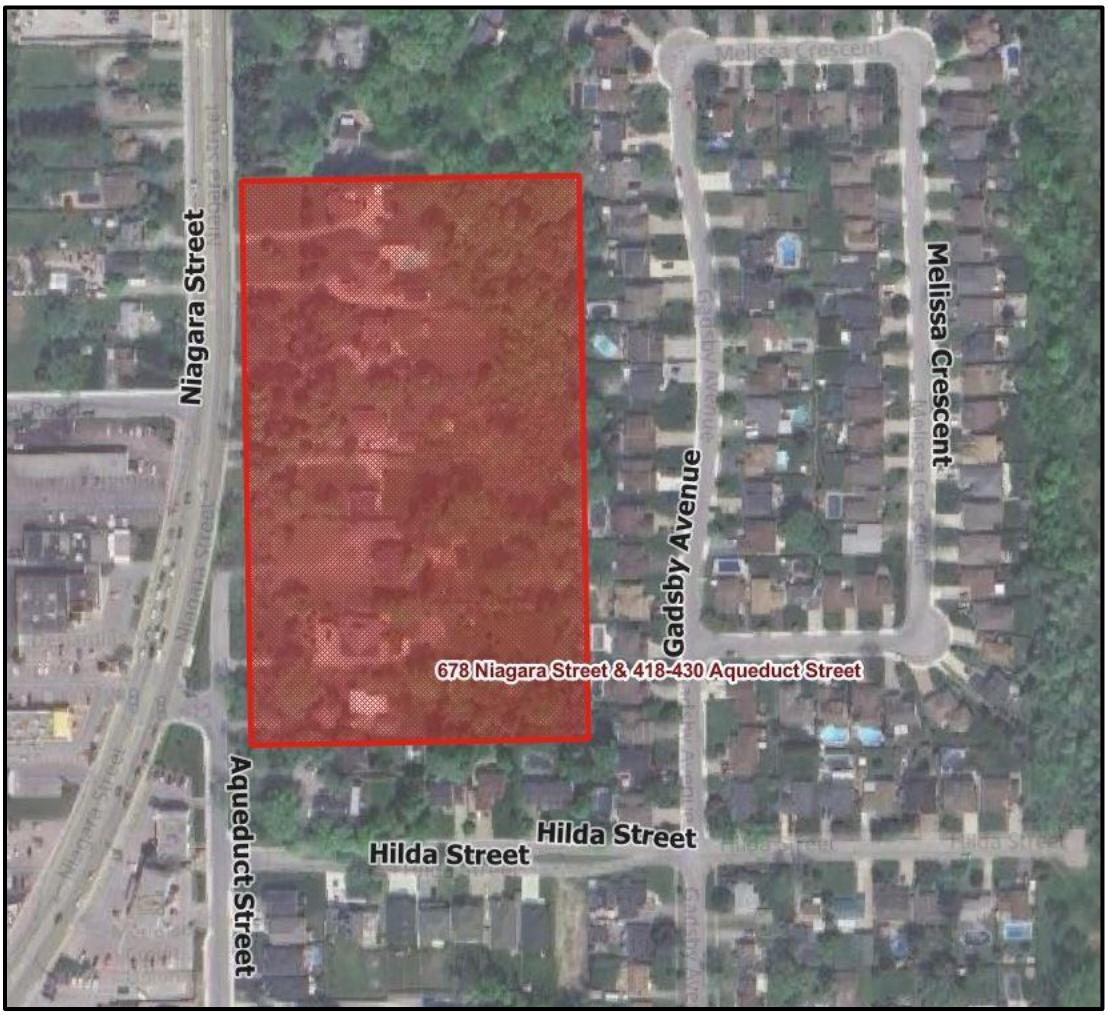
Julien Bell, P.Eng
Vice-President, Senior Project Manager

1. Project Scope

The City of Welland retained GM BluePlan Engineering to assess the impacts of a proposed development on 678 Niagara Street & 418-430 Aqueduct Street on the City's existing wastewater system. See **Figure 1**. The proposed development consists of mixed-use development, consisting of 1196 units and 7,349 m2 of commercial space across five buildings.

It is noted that partial areas of the 678 Niagara Street & 418-430 Aqueduct Street development were not included in the growth considered in the Pollution Prevention Control Plan and Wastewater Master Servicing Plan Update (2020).

Figure 1. Development Location



The wastewater system was assessed using the City's updated model that was the basis of the City's Pollution Prevention Control Plan (PPCP) (2020), updated as part of the Region's Master Servicing Plan Update (2021), and most recently updated from the City's 2020-2021 flow monitoring program data (2022).

2. Sanitary System Performance Objectives

2.1. Sanitary Sewer Hydraulic Performance

For existing sewer capacities, sewer performance criteria were assessed using the following conditions:

- Maintain depth of flow in pipe equal to or less than obvert elevation ($d/D \leq 1$); and, if failing to do so then:
- Maintain system hydraulic grade line (HGL) of a surcharging sewer below the basement protection freeboard of 2.1 meters below grade.
- Performance is based on the 10-year design storm as defined in the PPCP.

2.2. Sanitary Overflow Performance

Through the PPCP, the following overflow criteria were identified:

- No overflows during dry weather.
- 90% volumetric capture and treatment of wet weather flows during a 7-month period commencing within 15 days of April of an average year.
- Maximize the use of the collection system for the storage of wet weather flows when capacity is unavailable.
- No growth-related net increase in system overflows under an average year.

To meet the above overflow objectives, the PPCP identified a net city-wide target of reducing wet weather flows by 10%. Further, with the goal of removing wet weather flows at a rate equal to or greater than new development flows.

Additionally for the City's permanent overflows, it is understood that provided there is sufficient downstream sewer capacity, wet weather reduction projects do not need to be targeted in the same catchment as the growth areas provided that the city-wide wet weather flow reduction rate is equal to or greater than new development flows.

3. Sanitary System Review

3.1. Local System

The City has identified that the proposed development will be serviced via a single service connection. Due to the magnitude of the development relative to the local City sewer sizes, 3 potential connections will be evaluated, consisting of:

- The City's 250 mm sewer on Niagara Street.
- The City's 300 mm sewer south of the Cemetery.
- The Region's trunk sewer on Aqueduct Street.

Flows would follow the sewer alignment as shown on **Figure 2**, before conveyance to the Welland Wastewater Treatment Plant via:

Option A (Green) - 250 mm sewer on Niagara Street

- 250 m of 250 mm sewer on Niagara Street.
- Discharging into the 1500 mm to 1800 mm Region-owned trunk sewer on Aqueduct Street.

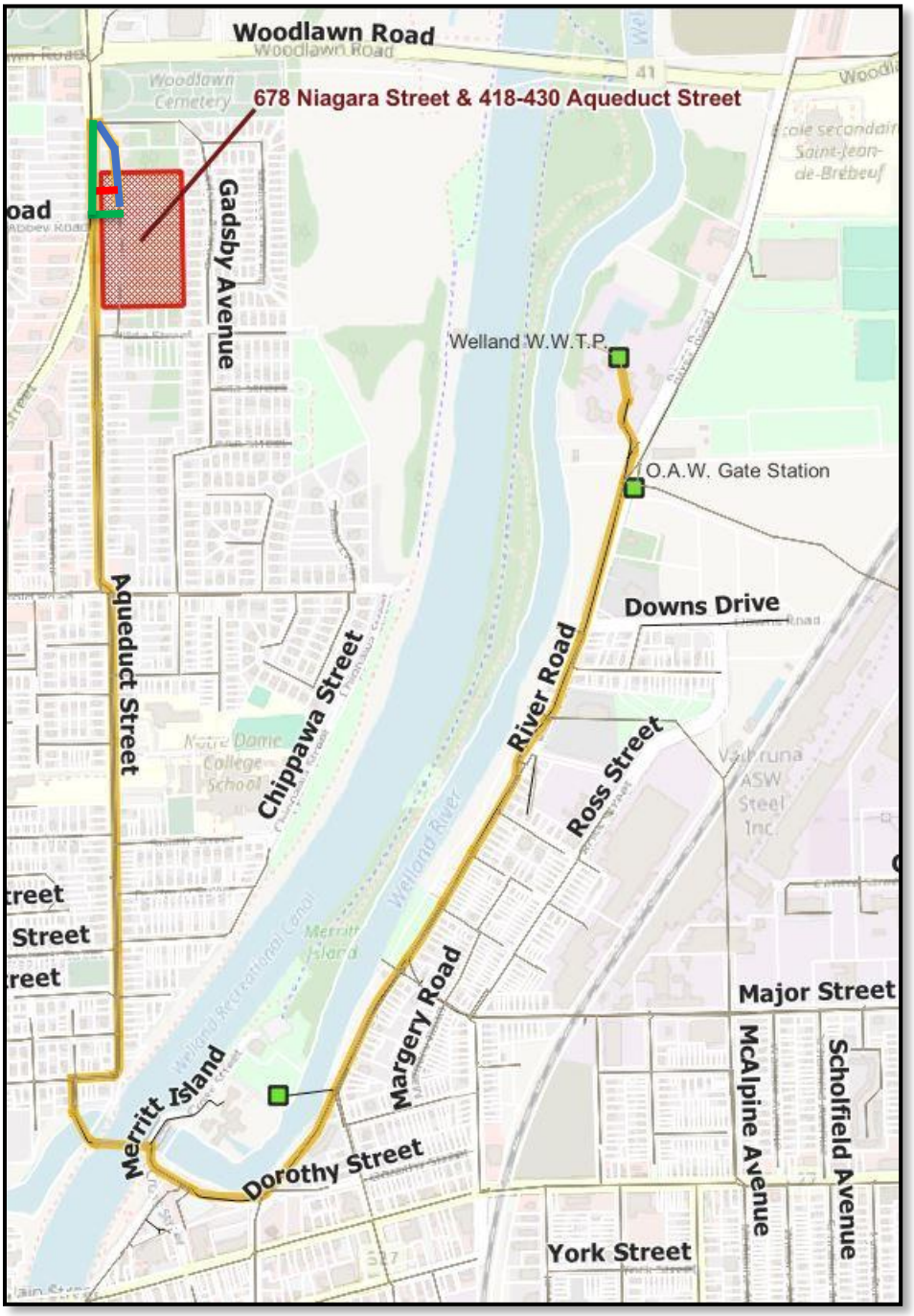
Option B (Blue) - 300 mm sewer south of the Cemetery

- 80 m of 300 mm sewer south of the Cemetery.
- Discharging into the 1500 mm to 1800 mm Region-owned trunk sewer on Aqueduct Street.

Option C (Red) - Region Trunk Sewer

- Tie-in directly into the 1500 mm to 1800 mm Region-owned trunk sewer on Aqueduct Street.

Figure 2. Sanitary Flow Route showing tie-in Options A (green), Option B (Blue), and Option C (Red), and downstream flow (yellow)



3.2. Wastewater Flow Analysis

The system was evaluated under both existing and post-development conditions to gauge the development impact on the sanitary system holistically.

> **9.2.1 Design Flows**
>
> Calculation of sewage design flows shall conform to the latest editions of the Regional Municipality of Niagara, Public Works Department's "Guidelines for the Design and Construction of Sewer and Water Main Systems", and the Ontario Ministry of the Environment's "Guidelines for the Design of Water Storage Facilities, Water Distribution Systems, Sanitary Sewage Systems and Storm Sewers".

The City currently uses the 2021 Niagara Region MSPU methodology for flow generation which is 255 L/c/d for people and 310 L/c/d for jobs. This value is updated from the previous Regional MSP and the City's 2020 Pollution Prevention and Control Plan and Master Servicing Plan Study.

Table 1 below summarizes the calculated flows for 678 Niagara Street & 418-430 Aqueduct Street development based on the methodology outlined in the City's Design Standards. It follows that the proposed development will add **23.13 L/s** to the existing system.

Table 1 Sanitary Flows from the 678 Niagara Street & 418-430 Aqueduct Street

	R.J. Burnside & Associates Limited FSR		City of Welland Standards		Units
Development	**South (Building A and E)**	**North (Building B, C, D)**	**South (Building A and E)**	**North (Building B, C, D)**	
Lot Area	3.879		3.879		ha
Residential Population	611 15@1.4 ppu Bachelor 94@2.1 ppu 1-BR 82@3.1ppu -2BR 28@3.7 ppu -3BR 13@2.7 ppu townhouses	2481 69@1.4 ppu Bachelor 429@2.1 ppu 1-BR 379@3.1ppu -2BR 74@3.7 ppu -3BR 13@2.7 ppu townhouses	396 15@1.2 ppu Bachelor 94@1.2 ppu 1-BR 82@2.11ppu -2BR 28@2.24 ppu -3BR 13@2.24 ppu townhouses	1592 69@1.2 ppu Bachelor 429@1.2 ppu 1-BR 379@2.11ppu -2BR 74@2.24 ppu -3BR 13@2.24 ppu townhouses	people
Commercial Population	11 *@ 110 people/ha* *@0.0962 ha*	71 *@ 110 people/ha* *@0.643 ha*	N/A		
Residential Per Capita flow	320		255		L/c/d
Commercial Per Capita Flow	320		N/A		L/c/d
Average Residential Flow	2.26	9.19	1.17	4.70	L/s
Average Commercial	0.04	0.26	Calculated using commercial area below		
Peaking Factor	3.96 effective corrected to 3.94 ***(Harmon's Peaking Factor)***	3.73 effective ***(Harmon's Peaking Factor)***	3.588 ***(Harmon's Peaking Factor)***		
Peak Residential Flow	8.9	34.3	21.05		L/s
Sanitary Flow Criteria (Employment)	N/A		5L/m^2/day		
Peak Commercial Flow	0.15	0.98	1.7 *@7,349 m^2* *and Harmon's PF = 4.0*		*L/s*
Infiltration Allowance	0.286		0.286		L/s/ha
Contributing Area	1.04		1.3*		ha
RDII	0.30		0.37*		L/s
Total Design Flow	**44.62 (Corrected)**		**23.13***		L/s

Notes:

1. *Partial lot area is included in existing modelled sewershed, as such only additional contributing areas used to calculate RDII contributions.

3.3. Impact on Sanitary Sewer System Performance

The system performance was reviewed under 2-year, 5-year, and 10-year design storms using the City's existing wastewater model in line with the City's PPCP capacity assessment. **Table 2** below summarizes the existing sewer system performance.

Table 2 Peak d/D Capacity Results in Sewers from the Tie-in Point to the Welland River Siphon

		Option A Tie-in to Niagara Street (250mm City sewer)		Option B Tie-in to sewer south of the Cemetery (300mm City Sewer)		Option C Tie-in to Region Trunk Sewer on Aqueduct Street	
Scenario		d/D	Freeboard (m)	d/D	Freeboard (m)	d/D	Freeboard (m)
1:2 Year	Pre-Dev	0.22	Within Obvert	0.36	Within Obvert	0.75	Within Obvert
	Post-Dev	0.47		0.58		0.75	
1:5 Year	Pre-Dev	0.25		0.40		0.85	
	Post-Dev	0.50		0.62		0.85	
1:10 Year	Pre-Dev	0.27		0.43		0.93	
	Post-Dev	0.53		0.64		0.93	

As seen in **Table 2**, the existing sewers have sufficient capacity to safely convey existing and post-development flows under the city's targeted 10-year design storm. Further, model results show that:

- Both City-owned 250 mm and 300 mm sewers downstream of tie-in Option A and B, have sufficient capacity to accommodate the 10-year design storm without surcharging.
- The proposed development flows have negligible impacts to the performance of the Region trunk sewer, with the sewer having sufficient capacity to accommodate the 10-year design storm without surcharging.

4. Summary and Recommendations

Based on the analysis of flows:

- Both City owned 250 mm and 300 mm sewers downstream of tie-in Option A and B, have sufficient capacity to accommodate the 10-year design storm without surcharging.
- The proposed development flows have negligible impacts to the performance of the Region trunk sewer, with the sewer having sufficient capacity to accommodate the 10-year design storm without surcharging.

R.J. Burnside & Associates Limited