FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT IN SUPPORT OF A DRAFT PLAN OF CONDO APPROVAL

3770 Montrose Road Residential Re-Development
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Prepared For:
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Treasure Hill

No.	Revision	Date
8	Common Element Condo Application 3770 Montrose Rd	October 30, 2025
7	Revised as per MTO Comments	May 22, 2024
6	Revised for 2nd DPOC Submission	May 2, 2024
5	Issued for SPA Submission	December 1, 2023
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3	Issued for SPA Submission	March 31, 2023

EXECUTIVE SUMMARY

This Functional Servicing and Stormwater Management Report has been prepared on behalf of Treasure Hill in support of a Draft Plan of Subdivision Approval and Common Element Condominium application for a proposed 5.45ha residential development.

The purpose of this report is to demonstrate that adequate municipal servicing capacity is in place and to outline the servicing and stormwater management strategy for the proposed residential development. The servicing strategy for the proposed development is summarized as follows:

WATER SERVICING:

The proposed watermain network will include 200mm PVC watermain throughout the site. One 250mm PVC watermain connection is proposed to the existing 300mm watermain within Montrose Road. The site has is serviced by internal 200mm watermains and hydrants.

The watermain network will be required to supply a maximum day plus fire flow of approximately 16,382 L/min. Based on hydrant testing completed at the site having flow of 19,178 L/s, there are no anticipated capacity issues.

SANITARY SERVICING:

The proposed site will be serviced by local 200mm sanitary sewers connecting to the existing 250mm sanitary sewer at Montrose Road and Mt. Carmel Boulevard. The existing 250mm sanitary sewer service connection is to be used for the proposed development. The site is serviced by internal 200mm sanitary sewers.

To service the existing south commercial buildings, a portion of the existing sanitary sewer will require re-routing. The realigned sanitary sewer is located within the proposed site along Street B and is connected to the Mount Carmel Boulevard Sanitary Sewer. This realigned sewer will have a 3.0m servicing easement around it in favor of the south commercial development.

The proposed peak sanitary design flow from the Subject Site is 10.69L/s to the existing sanitary system, which will have an increase in sanitary flows from the 4.01L/s under existing conditions.

The downstream sanitary sewer analysis showed that there is capacity to support the proposed re-development site.

The proposed peak sanitary design flow from the Subject Site in addition to the potential future residential development of the south commercial site is 18.93 L/s. The existing sanitary sewer has been analyzed to determine capacity. The downstream sanitary sewer analysis showed that there is capacity to support the proposed re-development site and future residential development of the south commercial site.

STORMWATER SERVICING:

The proposed storm network will convey all flows up to and including the 5-year storm toward the underground stormwater management tank (Greenstorm Chambers). Post-development flow for all storms up to and including the 100-year event are controlled to the existing site release rate.

The system control includes an orifice tube that restricts the flow of water. The water backs up in to the Greenstorm chamber located within the parkette block. Emergency flows more than the 100-year event will be conveyed overland west to Montrose Road and south to the shared driveway thereby, matching the existing conditions.

Quality control will be provided through the use of Greenstorm storm pre-treatment row and EF010 unit cumulatively providing an 80% TSS removal across the site achieving enhanced level treatment.

Water balance is achieved using soakaway pits that have been sized to exceed the infiltration deficit to meet pre to post water balance requirements. Due to site constraints, a best-efforts approach was established to meet the capture/retention of the 5mm target.

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1.0 INTRODUCTION

1.1 BACKGROUND

This Functional Servicing and Stormwater Management Report has been prepared on behalf of Treasure Hill in support of a Draft Plan of Subdivision Approval and Common Element Condominium application applications for a proposed 5.45ha residential development. The purpose of this report is to demonstrate that adequate municipal servicing capacity is in place and to outline the servicing and stormwater management strategy for the proposed residential development.

The site is bordered by Montrose Road to the west, residential homes and Monastery Drive to the North, MTO lands and QEW highway to the east and commercial developments to the south. The site is currently occupied by commercial buildings and associated parking. (Refer to **Figure 1** for the Site Location that illustrates the subject site within the context of its surroundings).

The proposed development scheme has 207 residential units consisting of 257 dwellings and nine private roads. Refer to the **Site Plan** included in **Appendix A** for the proposed site layout.

2.0 STUDY PARAMETERS

This servicing assessment is based on the following background documents and sources:

- City of Niagara Falls Engineering Design Standard, 2016
- Design Guidelines for Drinking-Water Systems, MOE, 2008
- Design Guidelines For Sewage Works, MOE, 2008
- Water Supply for Public Fire Protection (Fire Underwriters Survey), 1999
- Stormwater Management Planning and Design Manual, MOE, 2003
- Correspondence with Agency staff
- Design drawings provided by the City of Niagara Falls
- Hydrant testing completed by Lozzi Aqua Check, June 1st, 2021
- Utility locates completed by Markit Locates, September 14th, 2021
- Topographic survey information provided by J.D. Barnes Limited

3.0 WATERMAIN SERVICING

3.1 EXISTING WATER SUPPLY

The Subject Site is currently serviced with a 250mm municipal watermain connected to the existing 300mm watermain on Montrose Road.

In addition, existing hydrants are located near the site at the following locations:

- 1 hydrant at the southeast limits of the site property;
- 1 hydrant at the southwest quadrant of the site property;
- 1 hydrant at the northwest quadrant of the site property;

These existing watermain and hydrant locations are shown on **Figure F-2 - Existing Site Servicing**.

3.2 PROPOSED WATER SUPPLY

The proposed watermain network will include 200mm PVC watermain throughout the site. One 250mm PVC watermain site service connection is proposed to the existing 300mm watermain within Montrose Road.

Part of the existing watermain within the site is looped between the proposed site and existing commercial areas to the south. With the proposed development of the Subject Site, the existing looping of the system will be removed. The existing watermain will have a dead end installed at the existing hydrant located at the southeast corner of the re-development.

A fire flow capacity analysis has been completed for the existing commercial area to assess the servicing capacity with the removal of the looped system. Fire Underwriter Survey calculations were completed and the system was modeled using EPANET. The model determined that adequate fire flows can be provided in a non-looped system for the existing commercial buildings, refer to **Appendix B** for details.

Refer to **C-01 – Site Servicing Plan** included in **Appendix E** for the proposed watermain layout.

The City of Niagara Falls Design Specifications for Watermains outlines the following normal operating pressure requirements:

- Normal operation pressures 275 kPa (40 psi) to 550 kPa (80 psi)
- Maximum pressure during the minimum hourly demand = 700 kPa (101.5 psi)
- Minimum pressure during maximum hour demand = 275 kPa (40 psi)
- Minimum Fire Flow pressure during simultaneous maximum day demand plus fire flow = 149 kPa

The City of Niagara Falls Design Specifications for Watermains states that governing flows shall be the greater of Maximum Day Demand plus Fire Flow or Maximum Hour Demand. In the case of this development, Maximum Day Demand plus Fire Flow is the governing scenario. Average Daily Demand, Maximum Day Demand and Peak hourly Demand were calculated in accordance with MOECC guidelines as follows:

Residential:

- Average Day Demand = 138.8 L/min
- Maximum Day Demand = 381.7 L/min
- Maximum Hour Demand = 573.3 L/min

Refer to **Appendix B** for Residential Water Demand Calculations.

The Fire Underwriter's Survey (FUS) guidelines were used to calculate the fire flow requirements of the townhouse units. The Maximum Day Demand plus Fire Flow results in a total of 16,382 **L/min** (16,000 L/min Fire Flow + 382 L/min Domestic). Based on the hydrant testing completed, there are no issues with the water supply to meet the above noted design demands. Fire hydrants adjacent to the site were found to have flows of 19,178 L/min. Supporting calculations and the hydrant flow test are provided in **Appendix B**.

4.0 SANITARY SERVICING

4.1 EXISTING SANITARY SERVICING

The Subject Site has an existing 250mm sanitary sewer site service that connects to the existing 250mm sanitary sewer on Montrose Road and Mt. Carmel Boulevard. This sewer currently services the commercial buildings on the proposed redevelopment site and the existing commercial buildings to the south. The existing sanitary sewer locations are shown on **Figure 2 – Existing Servicing Plan.**

4.2 PROPOSED SANITARY SERVICING

The proposed sanitary servicing layout for the Subject Site is shown on **C-01 –Servicing Plan** included in **Appendix E**.

The proposed site will be serviced by local 200mm sanitary sewers connecting to the 250mm sanitary sewer at Montrose Road and Mt. Carmel Boulevard. The existing 250mm sanitary sewer service connection is to be re-used for the proposed development.

Based on the City of Niagara Falls Criteria, the design flow for the previously existing commercial development is **4.01L/s**. The total proposed peak sanitary design flow from the Subject Site to the existing surrounding sanitary system is **10.69 L/s**. Therefore, there will be an increase in the peak design flow as a result of the site re-development. The downstream capacity has been analyzed in section **4.3 Downstream Sanitary Analysis.**

In order to maintain sanitary servicing to the south commercial buildings, a portion of the existing sanitary sewer will require re-routing. The proposed location for these sanitary flows is by running a new sanitary sewer within the proposed site along Street B and making a connection to the Mount Carmel Boulevard Sanitary Sewer. This realigned sewer will have a 3.0m servicing easement around it in favor of the south commercial development. Refer to **C-01–Servicing Plan** included in **Appendix E**.

4.3 DOWNSTREAM SANITARY ANALYSIS

4.3.1 NORTH COMMERCIAL RE-DEVELOPMENT

In order to verify capacity in the downstream sanitary sewer, an analysis was completed to confirm existing flows. The analysis evaluated all sanitary sewers that contribute to the existing 525mm sanitary on Cardinal Drive until it reaches Thorold Stone Road.

The sanitary analysis was completed by summing each contributing area by zoning type to a downstream node as indicated on **SAN-3 – Downstream Sanitary Drainage Analysis.** From this evaluation, a design sheet was developed to calculate design flows based on the population density per zoning type. The downstream sanitary design sheet and calculations can be found in **Appendix C.**

It was determined that the existing 525mm sanitary sewer located on Cardinal Drive is operating at 48% capacity during peak flow. Introducing the flows from the proposed site re-development, the sanitary sewer flow increases by 6% to 54% of pipe capacity. This calculation displays that the existing sanitary system has the capacity available to service the proposed re-development at 3770 Montrose Road.

This sanitary analysis is a conservative estimate. An approximate unit count was completed for the area in order to determine the effective average population per unit. Taking the sanitary flow calculated based on zoning and land use, divided by the unit count results in approximately 5.5 persons per unit (ppu). This value is much higher than the average ppu typical municipal standards. This average ppu calculation was included on the sanitary analysis design sheet located in **Appendix C.**

4.3.2 SOUTH COMMERCIAL DEVELOPMENT

An additional analysis was completed to incorporate the potential future sanitary flows if the 4.53ha south commercial area is redeveloped to a residential development. In this scenario the downstream pipe flow would reach 56% full in the existing 525mm sanitary sewers located within

Cardinal Drive. Based on this estimate, capacity is also available for future redevelopment of the south commercial area.

5.0 STORMWATER MANAGEMENT

5.1 STORMWATER SERVICING

Under the proposed conditions, 4.72ha (ID 201) of the site will be directed to underground detention tanks with an orifice control located at the north of the site. In addition, approximately 0.26ha (ID 301) and 0.14ha (ID 302) of external drainage area will drain uncontrolled to Montrose Road and the adjacent commercial development, respectively. On the east side of the site, the 0.33ha (ID 303) landscaped area within the 14.0m MTO setback will drain at 2.0% east toward an existing swale off site that drains south to the existing watercourse. No servicing or structures are proposed in the 14.0m MTO setback.

Local storm sewers are proposed throughout the re-development. **Refer to C-01 – Servicing Plan** for the proposed storm servicing network and **SWM-2 - Post-Development Drainage Plan** included in **Appendix D**.

5.2 EXISTING CONDITIONS/STORMWATER DRAINAGE

The existing storm sewer infrastructure in the vicinity of the site includes an existing 300mm storm sewer draining north to Monastery Drive. The existing site is serviced by this storm sewer which beyond the Subject Site runs west and outlets to Shriner's Creek.

In pre-development conditions, the 5.45ha site contained multiple commercial buildings and a parking area with an imperviousness of approximately 59%. The stormwater flows are controlled by an existing 200mm orifice located at the north property line within an existing catch basin manhole. The existing site also makes use of a dry pond for stormwater storage located in the northeast corner of the site. Under existing conditions, approximately 4.90ha (ID 101) of the Subject Site is directed towards the orifice control. 0.15ha (ID 102) is directed towards Montrose Road and 0.40ha (Area 103) is directed towards the existing commercial development.

Refer to **Appendix D for SWM-1 - Pre-Development Drainage** for the existing site drainage plan.

5.3 ALLOWABLE RELEASE RATE

The City of Niagara guidelines state that the site is to be controlled to 5-year pre-development release rate, which was determined using the rational formula. However, the existing site conditions include an existing 200mm orifice control at the north property line. Therefore, the proposed site will be controlled to the more restrictive of the two rates.

To determine the existing 200mm orifice capacity to the Monastery Drive sewer, the orifice equation was utilized. The head on the existing system was set to the elevation difference found between the overflow of the dry pond and the existing 200mm orifice elevation. The existing allowable flow rate was determined to be 170L/s. The previous design drawings for the site and calculations for this release rate are found in **Appendix D**.

The corresponding release rates are summarized as follows:

- 5-year pre-development Rational Method – 777l/s (Area 101 – 5-year release rate)
- Existing 200mm orifice capacity to Monastery Drive sewer – 170L/s

Therefore, the site discharge to Monastery Drive will be controlled to **170L/s**.

5.4 QUANTITY CONTROL

The site has proposed catch basins, manholes and storm sewers that have been sized to capture and convey the 5-year storm to proposed detention tanks located at the north property line.

To calculate the proposed design stormwater release rate, the orifice equation was utilized. The orifice calculation established a **164L/s** peak discharge rate utilizing an orifice tube at 200mm (DR18 PVC pipe class) which is less than the existing 170L/s. Refer to **Appendix D** for details on the proposed orifice tube calculations.

As shown in **Table 1**, based on a release rate of 164L/s, **1,257m^3** of on-site storage will need to be provided to attenuate the 100-year post-development flow to the allowable release rate. To achieve this release rate and storage, the storage provided by underground storage in the Greenstorm chambers located near the north property line in the parkette and within on-site storm sewers and storm structures.

The Greenstorm chambers will be wrapped in an impermeable membrane and have an isolator row with inspection/cleaning ports over the entire system for maintenance purposes. The existing and post-development emergency overland flow routes show that the flows travel south to Shriners Creek where they drain west and away from the MTO corridor. The MTO agreed that due to the demonstration of the overland flow draining away from the MTO corridor, the Greenstorm detention chambers would be acceptable. This was confirmed by email on February 28, refer to **Appendix A**.

Underground storage in pipes and structures have been evaluated. The total underground storage provided in the storm sewer system (sewers and manholes below the 100-yr HWL) is **270m^3**, see **Appendix D** for storage calculations. Greenstorm Chambers have been sized for the proposed development that provide approximately **1,033m^3** of underground storage. Therefore, the total on-site underground storage provided is **1,303m^3**.

Table 1 below summarizes the storage requirements along with the associated release rates. Refer to **Appendix D** for the design and calculations of the storage facility system.

Table 1: 100 Year Stormwater Storage and Release Rate Summary

Area I.D.	Area (ha)	Runoff Coefficient	TC (min)	Storage Available (m^3)	Storage Required (m^3)	Designed Release Rate (L/s)
Monastery Drive Outlet (Allowable Release Rate = 170 L/s)						
201 - Site (Controlled)	4.72	0.83*	10	1,303	1,257	164
301+ 302 + 303 (Uncontrolled) (no additional SWM controls further downstream of Area 302 in the existing commercial development)	0.73	0.58*	10	N/A	N/A	87.4 (5-year) 154.7 (100-year)

100-year runoff Coefficient, refer to Drainage areas and Runoff Coefficient Calculations in* ***Appendix D**.*

A conversation was had with the Region of Niagara in April 2024 regarding the uncontrolled drainage toward the Montrose Road Regional ROW. As discussed with the Region, to reduce the regular drainage, an passive drainage interceptor has been proposed along the west property line which will capture and infiltrate water, refer to Plan C-01 for details. The Region has accepted this drainage configuration.

The existing uncontrolled drainage to the shared driveway is shown as ID 103 on Figure SWM-1 and has a CxA product of 0.16. The proposed drainage to the shared driveway is shown as ID 302 on Figure SWM-2 and has a CxA product of 0.09. Therefore, there is less uncontrolled drainage outletting to the shared driveway in the post-development condition.

ID 303 shows the drainage within the 14.0m MTO buffer. There are no structures or drainage features proposed within the MTO buffer. No additional drainage will be directed to the MTO buffer. No rooftop storage is proposed based on the intended residential use and there is no surface ponding storage accounted for.

5.5 EMERGENCY OVERLAND FLOW

In the emergency scenario of storms more than the 100-year storm or due to system blockage, an emergency overflow route has been designed. The catch basin tops have been set a maximum of 0.30m below the local spillover point. The site highwater level will spill out of the site at an elevation of 195.50m. The site is designed such that the emergency spill points will

outlet onto Montrose Road to the west and the shared driveway to the south thereby, matching the existing conditions. Refer to **C-02 – Grading Plan** for additional details.

5.6 QUALITY CONTROL

As per the Niagara Peninsula Conservation Authority, quality control is to be provided for:

- Total Suspended Solids (TSS)
- Temperature
- Total Phosphorus
- Spills

A treatment train approach is proposed to achieve an enhanced level of quality control from the site, which will include:

- Roof-leaders
- Soakaway Pits
- Greenstorm pre-treatment row
- OGS

Roof-leaders – Wherever possible, roof-leader will drain to grade through pervious sodded areas to be pre-treated.

Soakaway Pits – Soakaway Pits will take drainage from Block 21-28 and will be placed in between blocks. The soakaway pits are to be utilized as best-efforts approach to achieve water retention and infiltration of the 5mm water balance target. Benefits of the soakaway pits include TSS and phosphorus removal. Refer to **C-02 – Grading Plan and D-3 – Details Plan** for details on the soakaway pit design. Interceptor soakaways will also be placed at the back of the units on the west property line fronting Montrose Road, will contribute to water retention/infiltration and were not factored into the total site infiltration volume.

Uncontrolled drainage to Montrose Road will consist of roof, sod and low-traffic area runoff which is relatively clean runoff and will not require additional quality control treatment.

OGS unit– an OGS unit will be used to treat the controlled area of the site. The EFO10 was the selected unit given the large drainage area. This unit will be placed downstream of the stormwater management tank and orifice. The EFO unit is ETV certified, please see documentation in **Appendix D.**

5.7 TOTAL SUSPENDED SOLIDS

As per NPCA guidelines, 80% TSS reduction is required for the entire site. A treatment train is utilized on site to reduce the total suspended solids. The treatment train consists of rooftops, grassed swales and an OGS unit. A Stormceptor EFO10 has been sized for the development to provide 80% TSS removal, refer to **Appendix D** for the sizing report.

The rooftops, grassed swales, soakaway pits, Greenstorm storm pre-treatment row and Stormceptor EFO10 will have a removal efficiency of 100%, 50%, 80%, 80% and 80%, respectively. To be conservative, removal efficiencies have only been considered for the Greenstorm storm pre-treatment row (80% removal) and Stormceptor EFO10 unit (80% removal). This unit is ETV certified, please see attached certification in **Appendix D**.

The 4.72ha controlled area of the site will be captured through the proposed storm sewer system, all of which will drain firstly through an Greenstorm chambers equipped with pre-treatment row located downstream just before the Stormceptor EFO10 unit downstream.

Uncontrolled areas of the Subject Site will not receive any SWM quality treatment besides the 14.0m buffer area which consist of landscape area only which is expected to have no TSS. Removal efficiency has not been considered for the uncontrolled areas.

Total TSS removal across the site is **86.5%** therefore, achieving Enhanced Level (80% TSS removal) requirements. See calculation below in **Table 2** for TSS removal calculation. Refer to Drawing **SWM-2** in **Appendix D** for drainage areas.

Table 2: TSS Removal Efficiency

Process	Area	TSS Removal Efficiency
Process 1 (Area 201 Controlled)	4.72 ha	96% (OGS and Greenstorm treatment row)
Process 2 (301/302 Uncontrolled)	0.40 ha	0%
Process 3 (303 Uncontrolled)	0.33 ha	50%
Total	**5.45 ha**	**86.5%**

5.8 TOTAL PHOSPHORUS

As per NPCA guidelines, phosphorus removal targets will be typically provided for in the TSS removal targets. Best efforts shall be employed such that any increase in loading is kept to a minimum.

Under pre-development conditions, the site is categorized as High Intensity Commercial use with a phosphorous coefficient of 1.82kg/ha/yr. Given the entire site area of 5.45ha, the total pre-development loading is **9.92kg/year**.

For the purposes of a phosphorus loading calculation, the proposed development is classified as high intensity residential with a phosphorous coefficient of 1.32kg/ha/yr. The total phosphorous loading without BMP's results in **7.19kg/year**. Under post-development conditions, there is less phosphorous loading than pre-development. Therefore, additional mitigation measures are not needed to achieve net phosphorous loading benefit. Regardless, an OGS is provided as a BMP and assumed to remove 20% phosphorous removal according to LSRCA guidelines. The total phosphorous loading with BMP (OGS unit) results in **5.94 kg/year.**

For the uncontrolled areas, there are no measures in place to mitigate phosphorus other than the natural grass vegetation. Nonetheless, controlled areas are being treated to remove phosphorus loading below pre-development conditions, therefore the uncontrolled areas are deemed as negligible.

5.9 SPILL MANAGEMENT

In the event of a spill, the site has been equipped with an Stormceptor EFO10 at the outlet of the site. Potential spill routes are within the controlled area for drainage such that the spill should be contained and drained into the storm sewer where it will be treated by the OGS.

5.10 WATER BALANCE

Niagara Peninsula Conservation Authority (NPCA) states that the water balance impacts should be evaluated as per SWM Design Manual (MOE, 2003). As specified, a site assessment is required to determine the annual infiltration volume lost from pre- to post-development. Infiltration techniques are required to compensate for the calculated loss of infiltration. The site is to match pre- and post-development infiltration volumes to maintain groundwater recharge. At a minimum, the Niagara Region requires retention of the first 5mm of rainfall. Based on this, the total required development retention volume for the site is **192.4m^3**, see **Appendix F** for details. A best-efforts approach has been established to meet the 5mm target. A best-efforts approach was introduced since the site has the following constraints: limited available space, lot line restrictions, high groundwater levels and utility restrictions.

To achieve this water balance objective, the annual site infiltration volume (pre and post development) was calculated using data outlined in “Toronto and Region Conservation Authority Climate Projections for Niagara Region, 2022” and applying infiltration factors from Table 2 “MOEE Hydrogeological Technical Information Requirements for Land Development Applications”. Evapotranspiration data was taken from “Water Availability Study for the South Niagara Falls and Lower Welland River Watershed Plan Areas Niagara Peninsula Source Protection Area, 2009”. It was determined through the annual assessment that the pre-development and post development infiltration volumes were 5,334m^3/year and 3,856m^3/year respectively. Therefore, there is a deficit of 1,478m3/year before mitigation.

4 Lot level soakaway pits are proposed to retain and infiltrate the stormwater to compensate for the deficit and achieve the 5mm water balance target. The bottom of the soakaway pits have been designed to be at least 1.0m above the seasonal high ground water table. Groundwater levels have been established by nearest borehole to the proposed location of each soakaway,

see geotechnical investigation by Pinchin Ltd. provided in **Appendix F**. Preliminary calculations have been completed for sizing of the bottom area of gallery to meet minimum drawdown time of 48 hours, a percolation rate of 15mm/hr (taken from Table 4.4 in MOE guidelines) was assumed based off the clay loam soil composition outlined in the geotechnical report. The 4 soakaway pits are shown on **C-01 – Servicing Plan** with the further design and sizing details of them provided on **D-3 – Details Plan.** The combined retention volume of the designed soakaway pits is **34.3m3**.

The total infiltration provided by the soakaway pits annually is equal to **1,117m3/year**. Best efforts were applied to reduce the infiltration deficit of 1,478m3/year, but due to site constraints, the infiltration water balance falls short by 361m3/year. See **Appendix F** for water balance calculations.

6.0 CONCLUSIONS

Based on the assessment provided above, the existing adjacent infrastructure can accommodate the proposed change in land use.

- The watermain network will be required to supply approximately 16,382l/min to service the development. Fire hydrants adjacent to the site were found to have flow of 19,178 L/min therefore, there are no capacity issues.
- A water distribution analysis was completed for the existing south commercial development to assess the removal of the looped watermain system. It was determined that the south commercial development will not have capacity issues with the removal of the looped watermain.
- The proposed peak sanitary design flow from the development of the Subject Site is 10.69L/s. An analysis of the existing sewer was completed and found that there are no downstream capacity issues due to the increase in flow rate.
- A dedicated sanitary sewer within a 3.0m servicing easement will service the existing south commercial site and is located on Street B.

- The proposed peak sanitary design flow from the Subject Site including a potential future residential development of the existing south commercial plaza is 18.93L/s. An analysis of the existing sewer was completed and found that there are no downstream capacity issues due to the increase in flow rate.
- The proposed storm network will convey 4.72ha of the total 5.45ha site toward an orifice controlling flows to 164L/s. Detention storage will be provided via underground storage chambers.
- Emergency flows in excess of the 100-year event will be conveyed westward across the Subject Site as overland flow to Montrose Road and south to the shared driveway matching the existing conditions.
- Quality control has been provided for the site to achieve 80% TSS removal.
- The proposed development reduces the total phosphorus from 9.92kg/yr to 5.94kg/yr.
- A total volume of 34.3m3 has been captured and retained by soakaway pits as a best-efforts approach to meet the 5mm target. The total infiltration provided on an annual basis is 1,117m3/year which results in an infiltration deficit of 361m3/year.

We trust the information provided in the report meets your requirements. Should there be any questions or comments, please feel free to contact the undersigned.

Sincerely,

Counterpoint Engineering Inc.



Zachary Schwisberg, P.Eng.
zschwisberg@counterpointeng.com

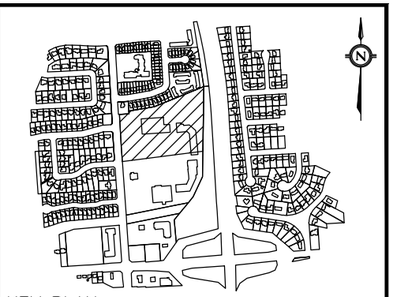
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Cassone Dwellings (BT) Inc.
3770 Montrose Road

Appendix A

Site Plan and Figures





KEY PLAN

counterpoint ENGINEERING

COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

3770 MONTROSE ROAD
NIAGARA FALLS
ONTARIO

SITE LOCATION PLAN

DESIGNED BY: S.C	DATE: DEC 2022
CHECKED BY: P.T	PROJECT No. 21102
DRAWING BY: S.C	
CHECKED BY: P.T	FIGURE No. F-1
SCALE: 1:2000	

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Grading

The City of Niagara Falls requires that all drawings submitted to the Building Division as part of an application for the issuance of a Building Permit shall be certified by the architect or engineer as being in conformity with the site development plan as approved by the City of Niagara Falls

Damages

All damaged areas are to be reinstated with topsoil and sod prior to the release of securities.

All damaged or disturbed areas within municipal right-of-way are to be reinstated at the applicant's expense.

All landscaping and grading within close proximity to the proposed access points is to be designed to ensure that adequate sight distances are available for all approaching and exiting motorists and pedestrians.

The portion of the driveway within the municipal boulevard is to be paved by the applicant. Driveway accesses shall maintain a 1.5m setback from aboveground features such as utilities and trees.

Any above ground utilities located within 1.5m of a proposed access are to be relocated at the applicant's expense.

Signage

Signage shown on the site development plan is for information purposes only. All signs will be subject to the provisions of the signage By-law and a separate sign application will be required through the Building Division.

Acoustical Consultant

The Acoustical Consultant shall certify to the Planning and Building Department that the 'as constructed' buildings, mechanical equipment, and ventilation systems for buildings on site and the off-site Stationary Noise Sources are in compliance with the acoustical report as prepared for the particular building and in compliance with the Ministry of Environment (MOE) guidelines for Stationary Noise Sources.

Grading and Servicing

Site grading and Site servicing plans are to be associated with the site plan.

Grades will be met within a 33% maximum slope of the property lines and within the site.

Hoarding

The owner will make satisfactory arrangements for the erection and maintenance of hoarding adjacent to all adjoining properties throughout all phases of construction. All Utility Companies will be notified for locates prior to the installation of the hoarding that lies within the limits of the City boulevard area.

Existing and Proposed Walkways

a) pedestrian walkways must be raised approximately 15 cm from vehicular traffic to provide definition and protection for pedestrian traffic; b) standard minimum width of a pedestrian walkway is 1.5 m ; c) standard minimum width of a pedestrian walkway adjacent to the end of parking spaces is 1.8 m (6.0 ft.).

Fencing

Any fencing adjacent to municipal lands is to be located 15cm (6.0 in.) inside the property line.

Retaining Walls

The structural design of any retaining wall over 0.6m in height or any retaining wall located on a property line is to be shown on the Site Grading Plan for this project and is to be approved by the Consulting Engineer for the project.

Exterior Stairs and Handrails

All exterior steps and handrails shall be designed per OBC requirements and V.1.3 of the _____ Standards

Exterior Lighting

All exterior lighting will be directed onto the site and shall not infringe upon the adjacent properties.

All portions of exterior accessible routes shall be equipped to provide a level of illumination in accordance with the Illuminating Engineering Society of North America (IESNA) standards.

All exterior lighting shall meet the City-Low and City Standards for Design criteria.

Roof Leaders and additional notes

1. The roof leaders are located in accordance with Transportation and Works standards.
2. The roof leaders are not permitted to discharge onto the driveways and walkways.
3. The lowest floor elevation and/or catchbasin(s) within the site are situated at least 1.0m above the invert of the adjacent municipal storm sewer system.
4. The roof leaders will not be connected directly to the storm sewer system for all units. Roof leaders will discharge onto the lots with the use of moveable concrete splash pads such that the rear yard swales will drain this runoff to the rear lot catchbasins and the front downspouts will drain, where possible, by way of sodded areas to the road.

Rooftop Units

All roof top mechanical units shall be screened from view by the applicant.

NOTE: There are no roof top units for this development

Roadway, driveway & parking surface

Roadway, driveway & parking areas surface materials, refer to site grading and landscape drawings for material finishes.

Fire Access Route

Fire Access Route will be designated as per City By law. The Fire Access Route will be designed to support a load of not less than 11,363 kg. per axle and have a change in gradient of not more than 1 in 12.5 over a minimum distance of 15m.

Accessible Routes

All accessible routes shall have a running slope of not more than 1:25 and and a cross slope not more than 1:50.

The clear width of accessible routes shall be 1220mm minimum.

Where an elevation barrier-free paths of travel lead to a vehicular route and where the pedestrian route is not separated by a curb or other element, a tactile attention indicator shall be installed in accordance with Section 10.4.8 Detectable Warning Surfaces.

Surface drainage

All surface drainage will be self contained collected and discharged at a location approved by the City of Niagara Falls.

Portions of the driveway within the municipal boulevard will be paved by the applicant. At the entrances to the site, the municipal curb and sidewalk will be continuous through the driveway and a curb depression will be provided for each entrance.

Utilities:

The applicant will be responsible for the cost of any utilities relocations necessitated by the Site plan.

Concrete Curbing

Continuous 152 mm high (or greater) barrier type poured concrete curbing will be required in the following areas: a) vehicular access from roads; b) landscaped traffic islands; c) between paved and landscaped areas; and d) between all driveways and service areas.

Concrete Edging (Accessible Routes)

A 75mm concrete edge is required where the change in level from the walkway is 100mm to 600mm below the walkway. The edge shall be installed with a colour contrasting curb (refer to Figure IV.1.4.4). Where the change in level is greater than 600mm, a guard shall be installed per OBC and Brampton Standards.

Concrete Edging Diagram



GENERAL SITE NOTES:

1) INFORMATION SHOWN ON THIS PLAN IS TAKEN FROM PLAN OF SURVEY PREPARED BY _____ DATED ON THE _____

2) REFER TO TENANT STANDARDS FOR ALL BUILDING'S EXTERIOR SITE FURNITURE, ASH RECEPTACLES, WASTE RECEPTACLES, BIKE RACKS, BENCHES, PLANTERS, ETC.
- SEE ARCHITECTURAL STANDARDS (LATEST RELEASE).

3) REFER TO DRAWINGS PREPARED BY _____ FOR HARD LANDSCAPING, SOFT LANDSCAPING AND SITE DETAILS. ANY DUPLICATED INFORMATION SHOWN ON THIS PLAN IS PROVIDED AS A MATTER OF COURTESY. LANDSCAPE DRAWINGS SHALL GOVERN.

4) REFER TO DRAWINGS PREPARED BY _____ FOR ALL MECHANICAL, PLUMBING, ELECTRICAL AND SERVICE CONNECTIONS. ANY DUPLICATED INFORMATION SHOWN ON THIS PLAN IS PROVIDED AS A MATTER OF COURTESY. ENGINEERING DRAWINGS SHALL GOVERN.

5) REFER TO DRAWINGS PREPARED BY _____ FOR ALL SITE ELEVATIONS AND GRADE REFERENCE. THIS INDICATES ARE IN METRIC SCALE AND ESTABLISHED BASED ON GEODETIC ELEVATION.
- CONTRACTOR MUST VERIFY ALL GRADES AND ELEVATIONS PRIOR TO THE COMMENCEMENT OF CONSTRUCTION.

6) ALL EXISTING BENCHMARKS, MONUMENTS AND SURVEY MARKERS SHALL BE PROTECTED DURING CONSTRUCTION. IF ANY ARE DISTURBED OR DESTROYED, THE CONTRACTOR MUST REPLACE THEM AT HIS EXPENSE.

7) ALL SIGNAGE AND INSTALLATION OF THE FIRE ACCESS ROUTE SIGNS MUST ALSO CONFORM TO THE REQUIREMENTS AS OUTLINED IN THE CITY OF NIAGARA FALLS BY-LAW (2019-97) AS AMENDED (FINANCE BY-LAW).

CMB NOTE:

Concrete pad for community mailboxes as per canada post specifications - pad to be at level of sidewalk and be wheelchair accessible.

THE HYDRO TRANSFORMER

Ultimate location to be coordinated with electrical / utility consultants.

SNOW STORAGE :

In the case of heavy snow falls, over capacity of the snow storage spaces provided and available on the property may make it necessary to truck snow off the site at the sole cost of the owner.

FIRE ROUTE

Ensure road is constructed to support expected load imposed by fire trucks. The fire route can only be asphalt or concrete.

Disabled Parking signs

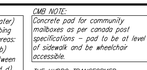
Parking spaces reserved for people with disabilities must comply to the current By-Law and Legislation and must be identified by a sign, installed at the applicant' expense, in accordance with the design specifications of R.R.O. 1990, Regulation 581 under the Highway Traffic Act as amended from time to time.

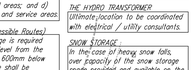
NOTES:

Gas meters shall not be located on building facades that face streets and shall be located discretely, away from pedestrian travel routes and screened from public view.

Gas pipes servicing roof top mechanical equipment shall not be visible to any public view and shall be installed within the wall construction

To ensure that the users have a suitable level of control and less disturbance caused by glare from headlights between the perpendicular residential parking and building #6, residential parking in front of each of units in block #6 shall be designed to the same owners of these unit facing them.





SITE STATISTICS

PARENT BYLAW: ZONING BY-LAW NO. 79-200
SITE SPECIFIC BYLAW: 2022-088
PROPOSED ZONING DESIGNATION: RA(H)1187

STANDARDS REFLECT PARENT BYLAW REQUIREMENTS UNLESS DENOTED OTHERWISE. NUMBERS IN BOLDED BRACKETS (BOLD) DENOTE BYLAW-ASSOCIATED VERY SPECIFIED STANDARD.

1.0 SITE STANDARDS

SITE AREA (LESS BUFFER)	APPROX. 51,266.47 sq.m. (12.67 ac) [5.13 ha]
14m BUFFER AREA	APPROX. 3,254.39 sq.m. (0.8 ac) [0.32 ha]
TOTAL SITE AREA	APPROX. 54,520.86 sq.m. (13.47 ac) [5.45 ha]

	BLOCK	UNITS	GFA (sq.m.)	BUILDING COVERAGE (sq.m.)	AVERAGE UNIT SIZE (sq.m.)	AVG. UNIT WIDTH
STACKEDTOWNS (20')	1	13 (x3)	3566	805/924(x3)	196.29	195.90
	2	12 (x3)	3293	805/924(x3)	196.08	195.89
REAR-LANE TOWNS (20')	3	5	820	452	196.02	196.20
	4	8	1307	360 / 360	195.99	196.28
	5	6	982	541	196.01	196.30
	6	6	982	541	195.92	196.02
	7	6	982	541	195.92	196.02
	8	5	820	452	195.63	195.59
	9	4	657	362	195.80	195.76
	10	5	820	452	195.79	195.89
	11	4	657	362	195.87	195.88
	12	5	820	452	195.68	195.74
	13	6	982	541	195.67	195.74
	14	6	982	541	195.72	195.83
	15	7	1145	270 / 360	195.79	195.80
	16	8	1307	360 / 360	195.77	195.83
	17	5	820	452	195.79	195.80
	18	4	657	362	195.86	195.91
	19	6	982	541	195.86	195.88
	20	5	820	452	195.84	195.88
	21	8	1307	360 / 360	195.79	196.11
	22	8	1307	360 / 360	195.87	196.11
	23	6	982	541	195.88	196.35
	24	6	982	541	195.99	196.43
	25	7	1145	270 / 360	195.85	196.24
	26	7	1145	270 / 360	195.92	196.15
	27	8	1307	360 / 360	195.75	196.00
	28	8	1307	360 / 360	195.84	196.00
	29	7	1145	270 / 360	196.05	196.36
	30	6	982	541	196.05	196.34
	31	5	820	452	196.04	196.21
	32	5	820	452	196.04	196.35
TOTAL:		207	36649	18923		
PROPOSED DWELLINGS:		257				
PROPOSED DENSITY (PER DWELLING):		SITE AREA	20.28 units / ac [50.1 units / ha]			
		TOTAL AREA	19.1 units / ac	47.2 units / ha]		

2.0 BUILDING STANDARDS

ZONING STANDARD		REQUIRED	PROPOSED
MINIMUM LOT AREA:	(STACKED TOWNS TO DWELLINGS)	@ 74 sq.m. / unit = 5 550 sq.m.	15 910,5 sq.m. +212.14 sq.m./unit - whole site
	(TOWNHOUSES 182 UNITS)	@ 189 sq.m. / unit = 34 398 sq.m.	38 609,48 sq.m. +212.14 sq.m./unit - whole site
	TOTAL (257 UNITS)	39 948 sq.m.	54 520,86 sq.m. (site) +212.14 sq.m./unit - whole site
MAXIMUM BUILDING HEIGHT		14.0 m	TBD - 14.0 m
SETBACKS STACKED TOWNS	FRONT YARD (MONTROSE ROAD) (Assuming 12.7m Front Castle Line To ROW)	3.0 m + 13.1m	251,63 m (Blk 2, #207)
	INTERIOR SIDE YARD (SOUTH)	Greater Of 1/2 Bldg Ht, or 5.0m	6,37 m (Blk 1, #193) 20,36 m (Blk 2, #207)
	REAR YARD (QUEEN ELIZABETH WAY)	17.0 m	17.04 m (Blks 1-2)
	FRONT YARD (MONTROSE ROAD) (Assuming 12.7m Front Castle Line To ROW)	36.0 m + 13.1m	5,63m+13.1m (Blk 10)
	INTERIOR SIDE YARD	North 33.0m South 36.5m	6,9 m (Blk 11, #159) 6,0 m (Blk 9, #142)
	REAR YARD (QUEEN ELIZABETH WAY)	55.0 m	17.79 m (Blk 3, #111)
MINIMUM PRIVACY YARD DEPTH	TOWNHOUSE	5.5 m @FRONT	2.4m (Blks 29-32)
	20' UNITS	75 sq.m. / UNIT (19,275 sq.m.)	72.52 sq.m. / UNIT (18,638 sq.m.)
MINIMUM SETBACK FROM Q.E.W.		14.0 m	17.04 m (Blks 1-2)
MAX. COV. (INCL. ALL BLDG'S & PORCHES)	TOTAL SITE	35%	34.7%
PARK AREA:	PARKETTE BLOCK		791,29 sq.m.
	URBAN PARKETTE		246,96 sq.m.
	TOTAL PARK AREA		1038,25 sq.m.
PROJECTION OF ROOFED OVER PORCHES/DECK		2.5 m into Front, Rear, Privacy Yard	Porch Proj. 0.91m From Front Wall
PROJECTION OF BALCONY		2.5 m into Front, Rear, Side Yard	Balcony Proj. 1.22m From Front Wall

3.0 SITE CIRCULATION

ZONING STANDARD	REQUIRED	PROPOSED
VEHICULAR PARKING REQUIREMENTS		
STACKED TOWNS (23 units - 75 dwellings)	105 (@1.4 / unit)	75 (@1.0 / unit)
TOWNHOUSES (182 units)	255 (@1.4 / unit)	364 (@2 / unit)
VISITOR PARKING	N/A	34
TOTAL PARKING SPACE	360	473
MIN. PARKING SPACE DIMENSIONS	2.75 m X 6.0 m	2.75 m X 6.0 m
MIN. PARKING SPACE DIMENSIONS - PARALLEL	2.75 m X 6.7 m	3.0 m X 6.7 m
MIN. ACCESSIBLE PARKING SPACE DIMENSIONS	3.9 m X 6.0 m	3.9 m X 6.0 m
MIN. ACCESS AISLE WIDTH	1.5 m	1.5 m
MINIMUM NUMBER OF ACCESSIBLE PARKING	2 (@ 4% of 34)	2
MIN. WASTE COLLECTION PAD DIMENSIONS	1,0 m X 2,5 m	1,1 m X 2,5 m

AFRZ



VAN ACCESSIBLE PARKING SIGN N.T.S.

SIGNS TO BE PLACED TO BE VISIBLE AND CLEARLY DIRECT USERS TO ACCESSIBLE PARKING AREAS (VAN ACCESSIBLE) THROUGHOUT THE SITE

Rb-93



ACCESSIBLE PARKING SIGN N.T.S.

SIGNS TO BE PERMANENTLY INSTALLED AT THE FRONT AND CENTRE OF THE PARKING STALL AND MOUNTED AT A HEIGHT OF 1.5M TO 1.9M FROM THE GROUND TO THE BOTTOM OF THE SIGN.

Rb-25



KEEP RIGHT SIGN N.T.S.

SIGNS TO BE PERMANENTLY INSTALLED, PLACED TO THE LEFT OF APPROACHING TRAFFIC

WA-33L



OBJECT MARKER SIGN N.T.S.

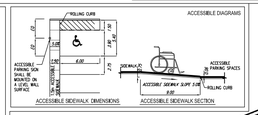
SIGNS TO BE PERMANENTLY INSTALLED, PLACED TO THE LEFT OF APPROACHING TRAFFIC

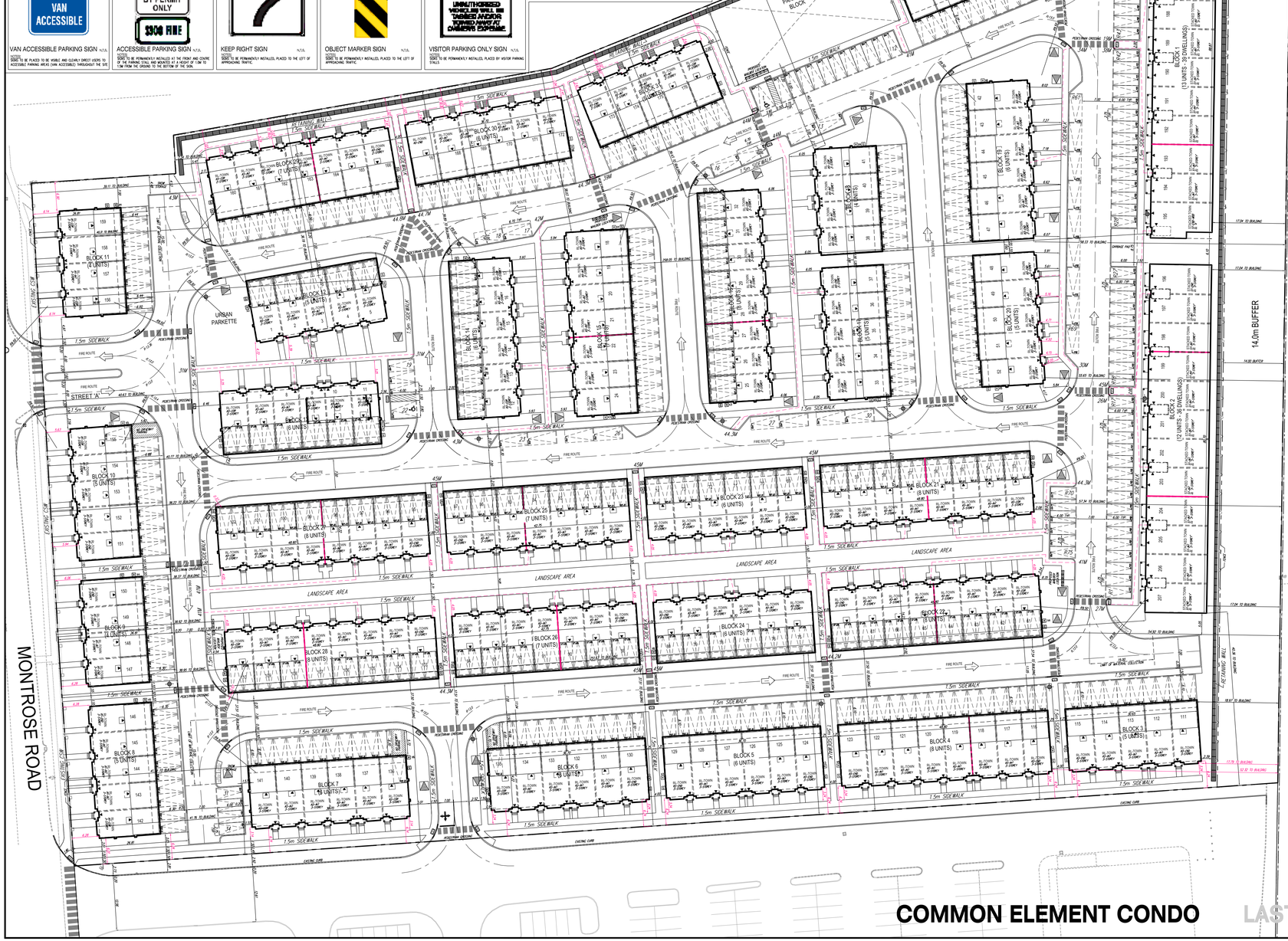
PS-02



VISITOR PARKING ONLY SIGN N.T.S.

SIGNS TO BE PERMANENTLY INSTALLED, PLACED BY VISITOR PARKING STALLS





FR-1



SIGNS TO BE SET AT AN ANGLE OF NOT LESS THAN 30 DEGREES AND NOT MORE THAN 90 DEGREES, TO A LINE PARALLEL TO THE FLOW OF TRAFFIC AND SHOULD ALWAYS BE VISIBLE TO APPROACHING TRAFFIC.
- SIGNS SHALL BE INSTALLED AT THE BEGINNING OF THE FIRE ACCESS ROUTE AT INTERVALS OF NOT MORE THAN 20.0 METRES (100.0 FEET) APART.
- SIGNS SHALL NOT EXCEED 2.0 METRES (7 FEET) AND NOT LESS THAN 1.5 METRES (5 FEET) IN HEIGHT MEASURED FROM THE BOTTOM OF THE SIGN TO THE FINISHED GROUND.
- SIGNS SHALL BE INSTALLED AT A MAXIMUM OF 3 METRES (10 FEET) AND A MINIMUM OF 1.0 METRE (3 FEET) MEASURED HORIZONTALLY FROM THE CURB.
- SIGNS SHALL BE INSTALLED SO THAT THERE ARE NO OBSTRUCTIONS WITHIN 0.5 METRES (20 FEET) OF THE SIGN AND BE VISIBLE TO APPROACHING TRAFFIC.
- SIGNS SHALL DISPLAY SINGLE HEADED ARROWS POINTING IN THE DIRECTION WHICH THE REGULATION IS IN EFFECT. AT INTERMEDIATE POINTS THROUGHOUT THE FIRE ACCESS ROUTE, SIGNS SHALL INDICATE THAT THE PROHIBITION OR RESTRICTION EXISTS IN BOTH DIRECTIONS.
- ALL SIGNAGE AND INSTALLATION OF THE FIRE ACCESS ROUTE SIGNS MUST ALSO CONFORM TO THE REQUIREMENTS AS OUTLINED IN THE CITY OF NIAGARA FALLS BY-LAW (2019-97) AS AMENDED (FINANCE BY-LAW).

*** REFER TO CITY OF NIAGARA FALLS FIRE ROUTE SIGNAGE AND INSTALLATION SPECIFICATIONS (CURRENT VERSION) FOR A COMPLETE LIST OF REQUIREMENTS ***

RA-1



STOP SIGN N.T.S.

SIGNS TO BE PLACED TO BE VISIBLE AND CLEARLY DIRECT USERS TO ASSIGN RIGHT-OF-WAY BETWEEN VEHICLES APPROACHING AN INTERSECTION FROM DIFFERENT DIRECTIONS.

SIGNS:
FR-1 FIRE ROUTE
RA-1 STOP SIGN
AB-VA VAN ACCESSIBLE PARKING
AFRZ ACCESS FOR RESIDENTIAL ZONE

CP-1

COLLECTION PAD
UNIT ##

DESIGNATED COLLECTION PAD SIGN

SIGNS TO BE PERMANENTLY INSTALLED, PLACED IN FRONT OF DESIGNATED COLLECTION PAD.

WC-7

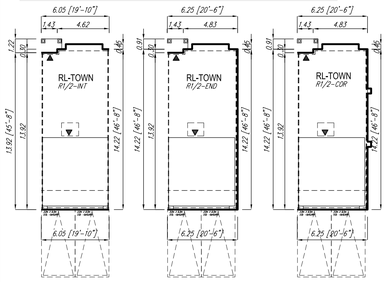


PEDESTRIAN AHEAD SIGN N.T.S.

SIGNS TO BE PERMANENTLY INSTALLED, PLACED IN FRONT OF PEDESTRIAN CROSSING.

UNIT KEY

2-STOREY REAR-LANE TOWNS



R1-INT
3 STOREY – TOWNHOUSE
6.05m x 14.22m
MAX +/- 1850 SQ.FT.

R1-END
3 STOREY – TOWNHOUSE
6.25m x 14.22m
MAX +/- 1890 SQ.FT.

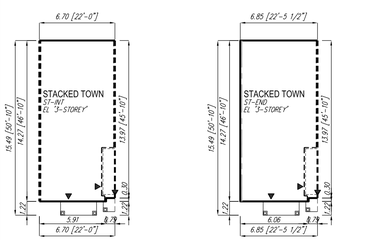
R1-COR
2 STOREY – TOWNHOUSE
6.25m x 14.22m
MAX +/- 1890 SQ.FT.

R2-INT
2 STOREY – TOWNHOUSE
6.05m x 14.22m
MAX +/- 1750 SQ.FT.

R2-END
2 STOREY – TOWNHOUSE
6.25m x 14.22m
MAX +/- 1790 SQ.FT.

R2-COR
2 STOREY – TOWNHOUSE
6.25m x 14.22m
MAX +/- 1790 SQ.FT.

3-STOREY STACKED TOWNS



ST-INT
3 STOREY – STACKED TOWNHOUSE
6.05m x 15.49m
MAX +/- 2940 SQ.FT.

ST-END
3 STOREY – STACKED TOWNHOUSE
6.2m x 15.49m
MAX +/- 3000 SQ.FT.

STACKED @ 25
COUNT W/ 2 BLKS

SCHEME 2-ST

COMMON ELEMENT CONDO

LAST REVISED: OCTOBER 23, 2025 - KC (HDAI)

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APPLICATION NUMBER:

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CONSTRUCTION MUST CONFORM TO ALL APPLICABLE CODES AND REQUIREMENTS OF AUTHORITIES HAVING JURISDICTION.

ALL ARCHITECTURAL STANDARDS INDICATED ARE GRAPHIC REPRESENTATIONS ONLY.

DRAWINGS ARE NOT TO BE SCALED.



GRADING & DRAINAGE NOTES

1. MINIMUM GRADIENT OF GRASS SWALES ALONG SIDE AND REAR LOT LINES SHALL BE 2.0%. MINIMUM GRADIENT OF THE SIDE YARD SWALE AT A MINIMUM OF 0.15m BELOW THE FINISHED GRADE AT THE BUILDING LINE. THE MAXIMUM SWALE GRADIENT SHALL BE 5.0%.
2. TWO LOT REAR YARD GRADE DIFFERENCE USING SLOPES BETWEEN 2.0% AND 5.0% FOR A MAXIMUM OF 70% OF THE REAR YARD AND SLOPES OF 3 HORIZONTAL AND 1 VERTICAL MAXIMUM TO THE REAR LOT LINE.
3. EDGE OF THE DRIVEWAYS ARE A MINIMUM OF 1.0m FROM EDGE OF STREET CATCH BASIN AND STREET FURNITURE. THE BUILDER IS TO VERIFY THE LOCATION AND TO INFORM THE ENGINEER IF THE DIMENSION CANNOT BE MAINTAINED PRIOR TO EXCAVATION FOR THE FOOTINGS.
4. BRICK LINE SHALL BE 0.15m ABOVE SOD ELEVATION.
5. ALL NEW FENCES REQUIRED ABUTTING PUBLIC LANDS AND /OR EXISTING PROPERTIES SHALL BE CONSTRUCTED WITH MATERIAL INCLUDING FOUNDATIONS COMPLETELY ON PRIVATE LANDS AND TOTALLY CLEAR OF ANY 0.3m RESERVES.
6. SOIL CONSULTANTS VERIFICATION REQUIRED FOR FOOTINGS CONSTRUCTED ON ENGINEERED FILL LOTS.
7. THE BUILDER MUST VERIFY THE AS CONSTRUCTED ON SANITARY AND STORM SERVICES INVERTS AND INFORM THE ENGINEER IF THE MINIMUM 2.0% GRADE CANNOT BE MAINTAINED PRIOR TO PLACING OF CONCRETE FOOTING.
8. BUILDER TO VERIFY LOCATION ALL HYDRANTS, STREET LIGHTS, TRANSFORMERS AND OTHER SERVICES. IF MINIMUM DIMENSIONS ARE NOT MAINTAINED BUILDER IS TO RELOCATE AT HIS OWN EXPENSE.
9. BUILDER TO STAKE OUT DRIVEWAY CURB DEPRESSION AT TIME OF TOP CURB INSTALLATION.
10. THE PROPOSED GRADING AND APPURTENANT DRAINAGE WORKS COMPLY WITH SOUND ENGINEERING PRINCIPALS.
11. THE PROPOSED GRADING IS IN CONFORMITY WITH THE GRADING PLANS APPROVED FOR THIS SUBDIVISION AND WILL NOT ADVERSELY AFFECT ADJACENT LANDS.
12. THE PROPOSED BUILDING IS COMPATIBLE WITH THE PROPOSED GRADING.
13. THE BUILDER IS RESPONSIBLE FOR RELOCATION OF ALL UTILITIES ON THE SITE, WHICH ARE NOT 1.0 METERS CLEAR FROM SIDE OF DRIVEWAY, INCLUDING STREET CATCH BASIN.
14. APPROVED PERMIT DRAWINGS AND CONSTRUCTION NOTES MUST BE REVIEWED AND FOLLOWED IN CONJUNCTION WITH THE SITING AND GRADING PLAN. BUILDER TO VERIFY BUILDING ENVELOPE ON SITE PLAN MATCHES APPROVED PERMIT DRAWINGS & CONSTRUCTION NOTES PRIOR TO POURING CONCRETE. IF THERE ARE ANY DISCREPANCIES, THEY ARE TO BE BROUGHT TO THE ATTENTION OF HUNT DESIGN ASSOCIATES INC.
15. UNLESS NOTED ON BUILDING ENVELOPE OR APPROVED PERMIT DRAWINGS AND CONSTRUCTION NOTES, ALL TOP OF FOUNDATION WALLS, INCLUDING GARAGE WALLS ARE TO BE CONSISTENT WITH THE ELEVATION PROVIDED FOR ON SITING AND GRADING PLAN. THE EXTERIOR OF THE FOUNDATION WALL TO BE PROVIDED WITH A PROTECTION IN ACCORDANCE FOR MASONRY VENEER AS REQUIRED.

THE BUILDER / APPLICANT AGREES THAT BY REQUESTING THIS LOT GRADING CERTIFICATION BEFORE THE AVAILABILITY OF INVERT CONSTRUCTION, THE BUILDER / APPLICANT ASSUMES ALL RESPONSIBILITIES, OR ANY POTENTIAL COMPLICATIONS DUE TO THE ULTIMATE SEWER CONNECTION ELEVATIONS AT THE STREET LINE.

ENGINEERED FILL LOTS	SANITARY LINE
STREET TREE	STORM WATER LINE
	WATERLINE
	HYDRO LINE
RETAINING WALL	GAS LINE
CATCH BASIN	CABLE LINE
	BELL
DOUBLE / SINGLE STM & SAN CONNECTION	HYDRO, GAS, BELL, CABLE LINE
SANITARY MANHOLE	DOWNSPOUTS
	WINDOWS PER METRIC
GAS METER	1HR FIRE RATED WALL SEE NBC DISTANCE & LESS Thank 2.0m TO LOT LINE (NO WINDOWS PERMITTED)
HYDRO METER	2HR FIRE RATED WALL
STORM MANHOLE	EXTERIOR DOOR LOCATION
VALVE & CHAMBER	EXTERIOR DOOR LOCATION IF GRADE PERMITS
VALVE & BOX	
HYDRANT	
WATER SERVICE	SUMP PUMP AND SURFACE DISCHARGE LOCATION
HYDRO SERVICE	
SWALE DRAINAGE	UPGRADE ELEVATION
STREET LIGHT PEDESTAL	CHAIN LINK FENCE
STREET LIGHT	FENCE AND GATE
TRAFFIC SIGNAL POWER PEDESTAL	PRIVACY FENCE
	ACOUSTIC FENCE
BELL PEDESTAL	FF FINISHED FLOOR
CABLE PEDESTAL	TFW TOP OF FOUNDATION WALL
HYDRO POLE	BF BASEMENT FLOOR
HYDRO POLE GUY	UF UNDERSIDE OF FOOTING
STREET SIGN	WOD WALKOUT DECK
COMMUNITY MAILBOX	WOB WALKOUT BASEMENT
	MOD MODIFIED
HYDRO TRANSFORMER	REV REVERSED
PADMOUNTED MOTOR	ND NO DOOR
	WSH WALKOUT STAIRS
EXISTING GRADES	2.0% SWALE DIRECTION
190.10 PROPOSED GRADES	EMBANKMENT / BERM MAX 3:1 SLOPE

REVISIONS			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13	REVISED AS PER--		
SUBMITTALS			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13	ISSUED FOR --		
No.	Description	Date	By



THE UNDERSIGNED HAS REVIEWED AND TAKES RESPONSIBILITY FOR THIS DESIGN AND HAS THE QUALIFICATIONS AND MEETS THE REQUIREMENTS SET OUT IN THE ONTARIO BUILDING CODE TO BE A DESIGNER.
QUALIFICATION INFORMATION

NAME SIGNATURE BCIN
REGISTRATION INFORMATION
HUNT DESIGN ASSOCIATES INC. 19699

HUNT DESIGN ASSOCIATES INC.
www.huntdesign.ca
8966 Woodbine Ave, Markham, ON L3R 0J7
T 905.737.5133 email: hda@huntdesign.ca

Title
SITING AND GRADING PLAN
Street Name





KEY PLAN

counterpoint ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

3770 MONTROSE ROAD
NIAGARA FALLS
ONTARIO

EXISTING SITE SERVICING

DESIGNED BY: S.C	DATE: DEC 2022
CHECKED BY: P.T	PROJECT No. 21102
DRAWING BY: S.C	
CHECKED BY: P.T	FIGURE No. F-2
SCALE: 1:1250	

Subject: FW: Request for Comments - Draft Plan of Vacant Land Condominium Application, 3770 Montrose Road, Niagara Falls

Asif, Shahbaz (MTO) <Shahbaz.Asif@ontario.ca>
to Deluca, Peter (MTO), Constantine, Neave (MTO)

You are viewing an attached message. Dillon Consulting Limited Mail can't verify the authenticity of attached messages.

Hi Peter:

I am satisfied with consultant responses and material. I have no further comment and you may proceed with the permit process.

Shahbaz

From: Schwisberg, Zack <zschwisberg@counterpointeng.com>
Sent: February 26, 2024 3:30 PM
To: Deluca, Peter (MTO) <Peter.Deluca@ontario.ca>; Asif, Shahbaz (MTO) <Shahbaz.Asif@ontario.ca>; Constantine, Neave (MTO) <Neave.Constantine@ontario.ca>
Cc: Brandon Rossi <brandonr@treasurehill.com>; 21102@counterpointeng.com
Subject: Re: Request for Comments - Draft Plan of Vacant Land Condominium Application, 3770 Montrose Road, Niagara Falls

CAUTION -- EXTERNAL E-MAIL - Do not click links or open attachments unless you recognize the sender.

Good afternoon all,

Thank you for the productive meeting this morning.

As discussed, please find attached the presented/requested documents. I am summarizing the meeting outcomes below:

- Underground Detention Storage
  - It is proposed to use Greenstorm detention chambers to be wrapped in an impermeable membrane. The chambers are designed to capture and detain all storms up to and including the 100-year storm. The chambers have an isolator row and inspection/
  - The existing and post-development emergency overland flow routes show that the flows travel south to Shriners Creek where it drains west and away from the MTO corridor.
  - The MTO confirmed that due to the demonstration of the overland flow draining away from the MTO corridor, the Greenstorm detention chambers would be acceptable.
- Orifice Control Tube
  - The proposed 200mm PVC DR18 orifice tube will be extended the entire length between Control MH and OGS-1-EFO 10 within the Subject Site. From OGS-1-EFO 10, the site drains directly into the existing downstream 300mm concrete storm sewer.
  - The MTO confirmed that this orifice control configuration would be acceptable.
- No rooftop storage is proposed/provided.
- We confirm that no existing quantity storage for the existing plaza is being kept for the proposed condominium.

Please advise if you have any comments on the above and thanks again for your time.

Regards,

Zack Schwisberg, P.Eng.
Project Manager
Counterpoint Engineering Inc.
Direct: 416-797-3420
www.counterpointeng.com
zschwisberg@counterpointeng.com

NOTE: This e-mail message is intended only for the named recipient(s) above and may contain information that is privileged and/or confidential . If you have received this message in error, or are not the named recipient(s), please immediately notify the sender and delete this e-mail message. Accompanying file(s) are supplied as a matter of courtesy, these files do not include a professional engineer's stamp on the drawings, and only drawings with such stamp are to be considered as true and final as issued by our office. Counterpoint Engineering assumes no liability for any reliance placed on these drawings.

On Fri, Feb 23, 2024 at 9:06 AM Deluca, Peter (MTO) <Peter.Deluca@ontario.ca> wrote:

> Hi Zack,

Cassone Dwellings (BT) Inc.
3770 Montrose Road

Appendix B

Water Demand & Fire Flow Calculations

Project No.: 21102
April 2024

Counterpoint Engineering Inc.

Water Demand Design Calculations

Project: **3770 Montrose Road**
Project No: **21102**
Location: **3770 Montrose Road, Niagara Falls**
Site Area: 5.45 ha

Existing Equivalent Population Calculations
As per Engineering Design Guidelines, City of Niagara Falls 2016

Persons Per Land Use

R1-R1	45.5	Persons/Ha
R3-R4	96.4	Persons/Ha
R5A-R5B	163.1	Persons/Ha
General Industrial	153.2	Persons/Ha
General Commercial	180.4	Persons/Ha

*Applicable to subject site

	Residential	Commercial	Industrial	TOTAL POPULATION
Residential**	526	0	0	526
Total Equivalent Population				**526**

** Population calculated by multiplying R3-R4 zoning density with site area

Per Capita Demand

Average flow	380	litres/person/day

Peaking Factors

Land Use	Minimum Hour	Maximum Hour	Maximum Day
Residential	0.40	4.13	2.75

Water Demand based on Equivalent Population

Land Use	Population	Average Daily Demand (l/min)	Maximum Hour (l/min)	Maximum Day (l/min)	Fire Flow Required (l/min)	Max Day + Fire Flow (l/min)
Townhouse	526	138.8	573.3	381.7	**16000.0**	
Totals	**526**	**138.8**	**573.3**	**381.7**		**16382**

Counterpoint Engineering Inc.

REQUIRED FIRE FLOW WORKSHEET - PROPOSED DEVELOPMENT
Fire Underwriters Survey

Project : **3770 Montrose Road**
Project No: **21102**

Guide for Determination of Required Flow Copyright I.S.O

$$F = 220C\sqrt{A}$$

where

F = the required fire flow in litres per minute.
C = coefficient related to the type of construction.
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior).
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls).
= 0.6 for fire-resistive construction (fully protected frame, floors, roof).
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building being considered.

Type of Construction		Class Factor
WF	Wood Frame	1.5
OC	Ordinary Construction	1.0
NC	Non-Combustible	0.8
FC	Fire-Resistive	0.6

Contents		% Reduction
NC	Non-Combustible	25
LC	Limited Combustible	15
C	Combustible	0
FB	Free Burning	15
RB	Rapid Burning	25

Area Notes for Fire Resistive Buildings (from FUS manual, 1999):

If Vertical Openings are inadequately protected (less than 1-hour fire rating): Area is the total of the two largest adjoining floors (above ground level) plus 50% of the area of each of the next 8 adjoining floors above that.

If Vertical Openings are adequately protected (at least 1-hour fire rating): Area is the total of the largest floor (above ground level) plus 25% of the area of each of the next 2 immediately adjoining floors above that.

1) Fire Flow

Type of Construction:	WF		
C=	1.5		
A*=	1076	m^2	Two Story buildings, Block 24, 6 Units
F=	10,825	**L/min**	

2) Occupancy Reduction/Surcharge

Contents Factor:	LC				
Reduction/Surcharge of	-15%	=	-1,624	L/min	
F=	10825L/min +	-1624	L/min =	9,201	**L/min**

3) System Type Reduction

NFPA 13 Sprinkler:	NO	0%			
Standard Water Supply:	NO	0%			
Fully Supervised:	NO	0%			
Total		0%			
Reduction of	0%	L/min	=	0	L/min
F=	9201L/min -	0	L/min =	9,201	**L/min**

4) Separation Charge

Building Face	Dist(m)	Charge
North	14	15%
East **	4	20%
South	17	15%
West	4	20%
Total		70%

of 9201.1 **L/min** = 6,441 **L/min**
(max exposure charge can be 75%)

Separation	Charge	Separation	Charge
0 to 3m	25%	20.1 to 30 m	10%
3.1 to 10m	20%	30.1 to 45m	5%
10.1 to 20m	15%		

F= 9201L/min + 6441L/min = 15,642 **L/min** (2,000L/min<F<45,000L/min)

F=	16,000	**L/min**
F=	267	**L/s**
F=	4,227	**gpm**

(round to the nearest 1,000L/min)

counterpoint engineering

NFPA Theoretical Flow Calculations

Project Name: **3770 Montrose Road**
Project Number: **21102**

Based on National Fire Protection Association Guidelines, the available flow at the minimum residual pressure of 20psi can be calculated based on the observed flow at the observed pressure readings, as follows:

$$\mathbf{Q_F = 29.83 \times c \times d^2 \times p^{0.5}}$$, where

Q_F = observed flow (US GPM)
c = hydrant nozzle coefficient (0.90 - 0.95)
d = nozzle diameter (in)
p = observed pitot pressure

$$\mathbf{Q_R = Q_F \times h_F^{0.54} / h_R^{0.54}}$$, where

Q_R = available flow
Q_F = observed flow (US GPM)
h_F = drop from measured static to desired baseline pressure
h_R = drop from measured static to measured residual pressure

Based on flow test results obtained by **Lozzi Aqua Check*, June 1, 2021***

c =	0.9	
d =	2.5	in
number of ports =	2	
p =	48	

Q_F = 2325 US GPM

Measured Static Pressure =	75	psi	
Measured Residual Pressure =	62	psi	
Desired Residual Pressure =	20	psi	, minimum per FUS

Q_R = 5066 US GPM per fire conneciton
19,178 L/min

Lozzi Aqua Check

12307 Woodbine Ave, P.O. Box 159

Gormley, ON L0H 1G0

Massimo Lozzi

Phone: (416) 990-2131

E-mail: lozziaquacheck@gmail.com

Hydrant Flow Test Form

Job Location: 3770 Montrose Rd., Niagara Falls

Date: June 1, 2021

Time of Test: 10:00 am

Location of Flow Hydrant: at 3770 Montrose Rd.

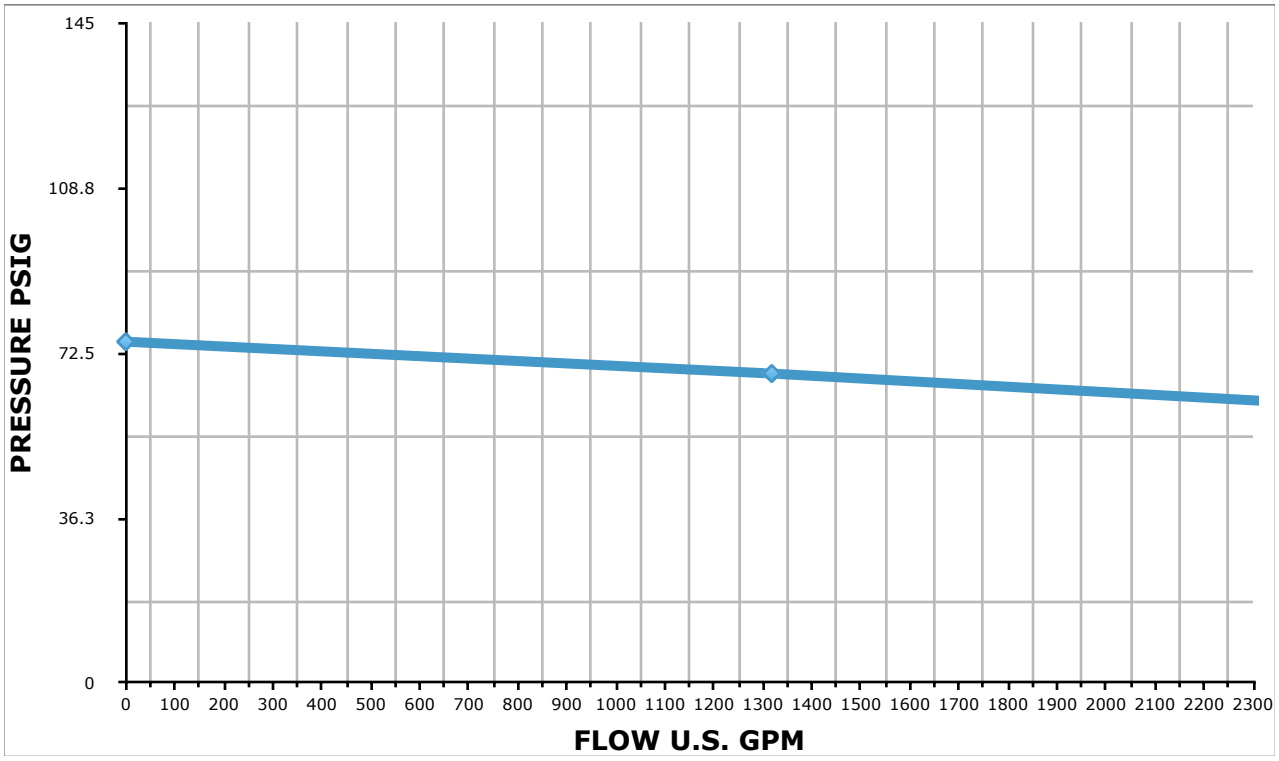
Residual : 3638 Montrose Rd.

Main Size: 300 mm.

Static Pressure: 75 psi

	Number of Outlets & Orifice Size	Pitot Pressure (psi)	Flow (U.S. G.P.M.)	Residual Pressure (psi)
1.	Static	0	0	75
2.	1 x 2 ½	62	1318	68
3.	2 x 2 ½	48	2320	62

Note: Flow test conducted in accordance with NFPA 291



Lozzi Aqua Check

12307 Woodbine Ave, P.O. Box 159

Gormley, ON L0H 1G0

Massimo Lozzi

Phone: (416) 990-2131

E-mail: lozziaquacheck@gmail.com

Site Map:



Counterpoint Engineering Inc.

REQUIRED FIRE FLOW WORKSHEET - PROPOSED DEVELOPMENT
Fire Underwriters Survey

Project : **Montrose South Commercail (Food Basics)**
Project No: **21102**

Guide for Determination of Required Flow Copyright I.S.O

$$F = 220C\sqrt{A}$$

where

F = the required fire flow in litres per minute.
C = coefficient related to the type of construction.
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior).
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls).
= 0.6 for fire-resistive construction (fully protected frame, floors, roof).
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building being considered.

Type of Construction		Class Factor
WF	Wood Frame	1.5
OC	Ordinary Construction	1.0
NC	Non-Combustible	0.8
FC	Fire-Resistive	0.6

Area Notes for Fire Resistive Buildings (from FUS manual, 1999):

If Vertical Openings are inadequately protected (less than 1-hour fire rating): Area is the total of the two largest adjoining floors (above ground level) plus 50% of the area of each of the next 8 adjoining floors above that.

If Vertical Openings are adequately protected (at least 1-hour fire rating): Area is the total of the largest floor (above ground level) plus 25% of the area of each of the next 2 immediately adjoining floors above that.

Contents		% Reduction
NC	Non-Combustible	25
LC	Limited Combustible	15
C	Combustible	0
FB	Free Burning	15
RB	Rapid Burning	25

1) Fire Flow

Type of Construction:	NC
C=	0.8
A*=	3657 m^2
F=	**10,643 L/min**

2) Occupancy Reduction/Surcharge

Contents Factor:		C		
Reduction/Surcharge of		0%	=	0 L/min
F=	**10643L/min +**	**0**	**L/min =**	**10,643 L/min**

3) System Type Reduction

NFPA 13 Sprinkler:		YES	30%		
Standard Water Supply:		YES	10%		
Fully Supervised:		NO	0%		
Total			40%		
Reduction of		40%	L/min	=	4,257 L/min
F=	**10643L/min -**	**4,257**	**L/min**	**=**	**6,386 L/min**

4) Separation Charge

Building Face	Dist(m)	Charge
North	46	0%
East **	18	10%
South	46	0%
West	46	0%
Total		10% **of** 10643 **L/min =** 1,064 **L/min**

(max exposure charge can be 75%)

Separation	Charge	Separation	Charge
0 to 3m	25%	20.1 to 30 m	10%
3.1 to 10m	20%	30.1 to 45m	5%
10.1 to 20m	15%		

F= 6386L/min + 1064L/min = 7,450 **L/min** (2,000L/min<F<45,000L/min)

F=	7,000	**L/min** (round to the nearest 1,000L/min)
F=	117	**L/s**
F=	1,849	**gpm**

Counterpoint Engineering Inc.

REQUIRED FIRE FLOW WORKSHEET - PROPOSED DEVELOPMENT
Fire Underwriters Survey

Project : **Montrose South Commercail (Swiss Chalet)**
Project No: **21102**

Guide for Determination of Required Flow Copyright I.S.O

$$F = 220C\sqrt{A}$$

where

F = the required fire flow in litres per minute.
C = coefficient related to the type of construction.
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior).
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls).
= 0.6 for fire-resistive construction (fully protected frame, floors, roof).
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building being considered.

Type of Construction		Class Factor
WF	Wood Frame	1.5
OC	Ordinary Construction	1.0
NC	Non-Combustible	0.8
FC	Fire-Resistive	0.6

Area Notes for Fire Resistive Buildings (from FUS manual, 1999):

If Vertical Openings are inadequately protected (less than 1-hour fire rating): Area is the total of the two largest adjoining floors (above ground level) plus 50% of the area of each of the next 8 adjoining floors above that.

If Vertical Openings are adequately protected (at least 1-hour fire rating): Area is the total of the largest floor (above ground level) plus 25% of the area of each of the next 2 immediately adjoining floors above that.

Contents		% Reduction
NC	Non-Combustible	25
LC	Limited Combustible	15
C	Combustible	0
FB	Free Burning	15
RB	Rapid Burning	25

1) Fire Flow

Type of Construction:	NC
C=	0.8
A*=	571 m^2
F=	**4,206 L/min**

2) Occupancy Reduction/Surcharge

Contents Factor:		C			
Reduction/Surcharge of		0%	=	0	L/min
F=	**4206L/min +**	**0**	**L/min =**	**4,206**	**L/min**

3) System Type Reduction

NFPA 13 Sprinkler:		YES	30%		
Standard Water Supply:		YES	10%		
Fully Supervised:		NO	0%		
Total			40%		
Reduction of		40%	L/min =	1,682	L/min
F=	**4206L/min -**	**1,682**	**L/min =**	**2,523**	**L/min**

4) Separation Charge

Building Face	Dist(m)	Charge			
North	46	0%			
East **	46	10%			
South	46	0%			
West	46	0%			
Total		10%	**of**	**4205.6 L/min =**	**421 L/min**

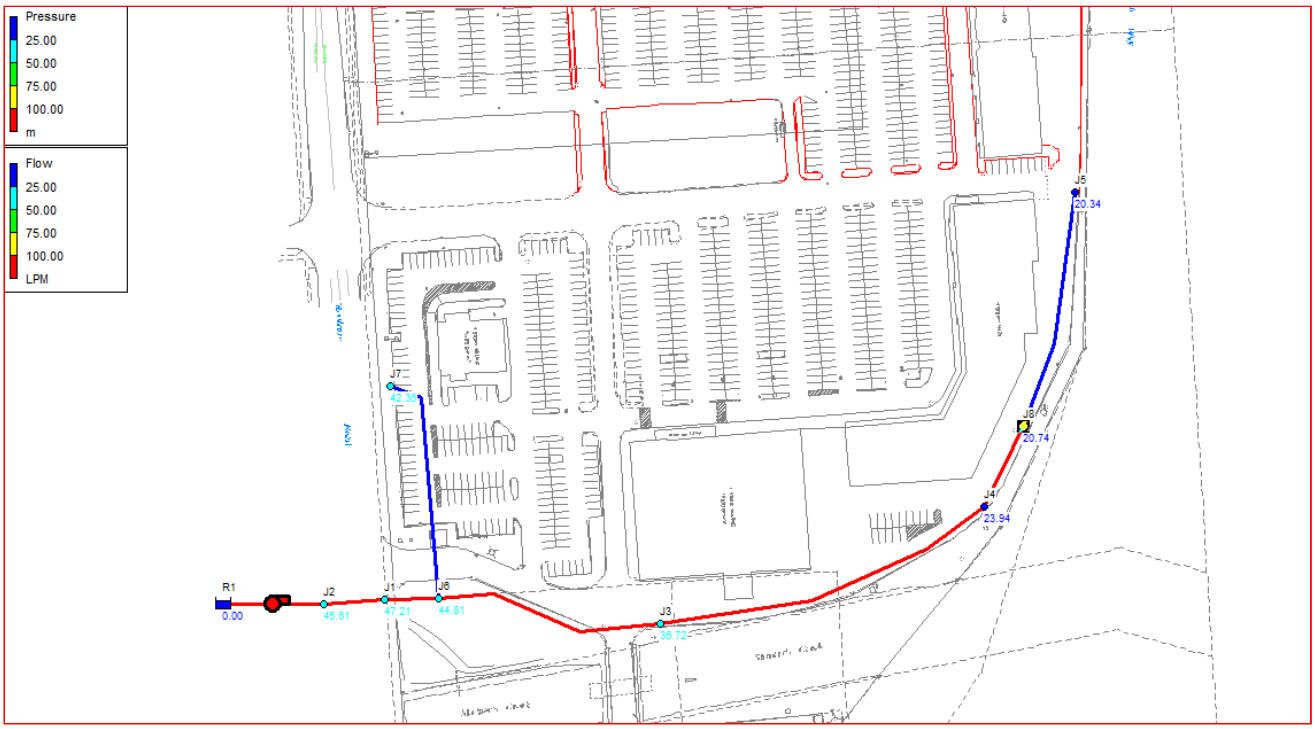
(max exposure charge can be 75%)

Separation	Charge	Separation	Charge
0 to 3m	25%	20.1 to 30 m	10%
3.1 to 10m	20%	30.1 to 45m	5%
10.1 to 20m	15%		

F= **2523L/min +** **421L/min** **=** **2,944 L/min** (2,000L/min<F<45,000L/min)

F=	**3,000**	**L/min**
F=	**50**	**L/s**
F=	**793**	**gpm**

(round to the nearest 1,000L/min)


Pressure
25.00
50.00
75.00
100.00
m
Flow
25.00
50.00
75.00
100.00
LPM
R1
0.00
J2
45.61
J1
47.21
J6
44.81
J7
42.98
J3
36.72
J4
23.94
J8
20.74
J5
20.34

Cassone Dwellings (BT) Inc.
3770 Montrose Road

Appendix C

Sanitary Design

Project No.: 21102
April 2024

MONASTERY DRIVE

MONTROSE ROAD

Solid Field Line

101
A=5.45
P=141

1 STOREY PLAZA

Drive Thru Aisle



KEY PLAN

LEGEND

SANITARY DRAINAGE AREA

200
A= 50
P= 0.25

AREA ID
AREA (HA)
POPULATION

DRAINAGE BOUNDARY

LEGAL & TOPOGRAPHY

PROVIDED BY: J.D BARNES
4318 PORTAGE ROAD UNIT 2,
NIAGARA FALLS, ON, L2F 6A4
PHONE:(905) 358-3693

BENCHMARK AND ELEVATION

ELEVATIONS SHOWN HEREON ARE GEODETIC CGVD-1928:78 AND ARE DERIVED FROM GNSS OBSERVATIONS AND NATIONAL RESOURCES CANADA'S GEOID MODEL HT2.0.
BEARINGS ARE GRID BEARINGS DERIVED FROM REAL-TIME NETWORK OBSERVATIONS (SMARTNET V6-2014), AND ARE REFERRED TO THE CENTRAL MERIDIAN 81°W OF UTM ZONE 17, NAD83 (CSRS2010).

No.	REVISIONS/ISSUED	DATE	BY	CITY
2.	ISSUED FOR SPA SUBMISSION	2022-03-31	PM	
1.	ISSUED FOR CLIENT REVIEW	2022-11-21	PT	

counterpoint ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

ENGINEER'S STAMP

APPLICANT:

CASSONE DWELLINGS (BT) INC.
1681 LANGSTAFF ROAD, UNIT 1
VAUGHAN ONTARIO L4K 5T3

SITE LOCATION:

3770 MONTROSE ROAD
NIAGARA FALLS
ONTARIO

PRE DEVELOPMENT PLAN (SAN)

DESIGNED BY: S.C	CHECKED BY: A.B	DATE: DECEMBER 2022	
DRAWING BY: S.C	CHECKED BY: A.B	PROJECT NO.	21102
SWM BY: P.T	CHECKED BY: A.B		
SCALE: 1:500m	0m 10m 20m 30m	DRAWING NO.	SAN-1

Z:\Shared\Projects\20211102_Treasure Hill_Mount Carmel Niagara\Design\Drawings\Title Block\TB_CPE_C3_24X36.dwg

Sanitary Design Flows:

Service populations have been estimated by applying population equivalent densities for the respective land uses as follows:

Land Use **	Population Density (persons/ha)
Residential	
R1-R2	45.5
R3-R4	96.4
R5A-R5B	163.1
R5C	229.8
R5D-R5E	355.8
Industrial	
General Industrial (I)	153.2
Commercial	
General Commercial (GC)	180.4
Tourist Commercial (TC)	284.2
Institutional	96.4

*** There are many other land use zones within the City of Niagara Falls – please refer to the Zoning By-Laws on the City Website **(https://www.niagarafalls.ca/city-hall/planning/zoning.aspx)** for related explanations.*

Calculate peak sanitary flows by applying an assumed unit flow of **380 L/capita/day** and a 'peaking factor':

Q_P = Peak Population Flow = P * Q_{AVG} * M (L/s)

P = Equivalent Population (in thousands)

Q_{AVG} = Average Daily Domestic Flow (Unit Flow) = **380 Lpcd**

M = Harmon Peaking Factor = $1 + 14/(4+P^{.5})$ (2.0 Min.; 4.0 Max.)

An infiltration allowance shall be factored into the sanitary flow determinations based on the catchment area and a pipe's susceptibility to infiltration, as follows:

Q_I = Infiltration Allowance = A * I (L/s)

A = Area (hectares)

I = Infiltration Allowance = 0.18 L/ha/s (new installations)

= 0.28 L/ha/s (existing installations)

Total sanitary design flow is the sum of the peak population flow and the infiltration allowance:

Q_T = Total Design Flow = Q_{PEAK} + Q_I (L/s)

Counterpoint Engineering Inc.

Project: 3770 Montrose Road
Project No: 21102
Location: Niagara Falls
Site Area: 5.450 ha

Existing Equivalent Population Calculations

As per Engineering Design Guidelines, City of Niagara Falls 2016

Design flow = (Population in Thousands x Average Daily Flow x Peaking Factor)/86.4 + (Infiltration Rate x Area)

Persons Per Land Use

R1-R1	45.5	Persons/Ha
R3-R4	96.4	Persons/Ha
R5A-R5B	163.1	Persons/Ha
General Industrial	153.2	Persons/Ha
General Commercial	180.4	Persons/Ha

	Residential Units		Retail	Office
	# of Houses	Total Units	Area (m^2)	Area (m^2)*
Building 1	-	-	**4640**	-
Building 2	-	-	**3170**	-
TOTAL UNITS / AREA (m^2)	**0**	**0**	**7810**	**0**

	TOTAL POPULATION
Residential	0
Commercial	141
Industrial	0
Total Equivalent Population	**141**

Peak flow Design Parameters

Average flow	380	litres/person/day
Infiltration	0.28	litres/second/ha

Harmon Peaking Factor

PF = 1 + (14/(4+(P/1000)$^{1/2}$))

Total Population	Harmon Peak Factor
141	**4.00**

Average Dry Weather Flow	0.62	**l/s**
Total Peak Wastewater Flow	2.48	**l/s**
Infiltration	1.53	**l/s**
Flow	**4.01**	**l/s**

Counterpoint Engineering Inc.

Project: 3770 Montrose Road
Project No: 21102
Location: Niagara Falls
Site Area: 5.450 ha

Proposed Sanitary Flow Calculations

As per Engineering Design Guidelines, City of Niagara Falls 2016

Design flow = (Population in Thousands x Average Daily Flow x Peaking Factor)/86.4 + (Infiltration Rate x Area)

Persons Per Unit and per Land Use

R1-R1	45.5	Persons/Ha	
R3-R4	96.4	Persons/Ha	*Applicable to subject site
R5A-R5B	163.1	Persons/Ha	
General Industrial	153.2	Persons/Ha	
General Commercial	180.4	Persons/Ha	

	Residential	Commercial	Industrial	TOTAL POPULATION
Residential	526	0	0	526
Total Equivalent Population				**526**

Peak flow Design Parameters

Average flow	380	litres/person/day
Infiltration	0.28	litres/second/ha

Harmon Peaking Factor

PF = 1 + (14/(4+(P/1000)$^{1/2}$))

Residential Population **	Harmon Peak Factor
526	**3.96**

** Population calculated by multiplying R3-R4 zoning density with site area

Residential Flow	9.17	**l/s**
Infiltration	1.53	**l/s**
Total Peak Flow	**10.69**	**l/s**

Counterpoint Engineering Inc.

SANITARY SEWER CALCULATION SHEET
EXISTING CONDITIONS

Project: Montrose Road
Project No: 21102
Client: Forest Gate Group
Location: Niagara Falls, Ontario

Approximate Existing Population Per Unit

Total Residential Population	4615.00	Population
Units Counted in Investigation Area	834	Units
Approximate ppu.	5.5	Persons/Unit

Total Area of existing commercail sites draining north (5.45Ha +4.53Ha)
Commercail population (Area of Buildings 0.77 Ha + 0.78 Ha x Commercail factor 180.4 p/Ha)

LOCATION			RESIDENTIAL AREA AND POPULATION										INFILTRATION		TOTAL	Pipe					
			UNITS BY TYPE OF DEVELOPMENT (ha)				CUMMULATIVE														
STREET	FROM M.H.	TO M.H.	R1-R2	R3-R4	General Commercial	POP.	AREA (ha)	POP.	PEAKING FACTOR (M)	PEAK FLOW (L/s)	FLOW	CUMMULATIVE	TOTAL FLOW	NOM. DIA (mm)	ACT. DIA (mm)	SLOPE (%)	CAPACITY (FULL) Qf (L/s)	VELOCITY (FULL) (m/s)	VELOCITY (ACTUAL) (m/s)	FLOW FULL RATIO Qa/Qf
MT Carmel BLVD.					9.98	280	9.98	280	4.00	4.93	2.79	2.79	7.72	250	251.46	**0.40%**	38.23	0.77	**0.60**	20%
MT Carmel BLVD.						0	0.00	280	4.00	4.93	0.00	2.79	7.72	250	251.46	**0.55%**	44.83	0.90	**0.67**	17%
MT Carmel BLVD.						0	0.00	280	4.00	4.93	0.00	2.79	7.72	250	251.46	**0.28%**	31.98	0.64	**0.53**	24%
MT Carmel BLVD.						0	0.00	280	4.00	4.93	0.00	2.79	7.72	250	251.46	**0.44%**	40.09	0.81	**0.61**	19%
MT Carmel BLVD.			5.88			268	5.88	548	3.95	9.53	1.65	4.44	13.97	250	251.46	**0.47%**	41.44	0.83	**0.75**	34%
MT Carmel BLVD.						0	0.00	548	3.95	9.53	0.00	4.44	13.97	250	251.46	**0.43%**	39.64	0.80	**0.72**	35%
MT Carmel BLVD.						0	0.00	548	3.95	9.53	0.00	4.44	13.97	250	251.46	**0.43%**	39.64	0.80	**0.72**	35%
MT Carmel BLVD.			5.24			239	5.24	787	3.86	13.38	1.47	5.91	19.28	250	251.46	**0.40%**	38.23	0.77	**0.77**	50%
MT Carmel BLVD.						0	0.00	787	3.86	13.38	0.00	5.91	19.28	250	251.46	**0.40%**	38.23	0.77	**0.77**	50%
MT Carmel BLVD.						0	0.00	787	3.86	13.38	0.00	5.91	19.28	250	251.46	**0.40%**	38.23	0.77	**0.77**	50%
Cardinal Drive			62.03	9.43		3732	71.46	4519	3.29	65.30	20.01	20.01	85.31	525	527.99	**0.20%**	195.22	0.89	**0.86**	44%
Cardinal Drive						0	0.00	4519	3.29	65.30	0.00	20.01	85.31	525	527.99	**0.22%**	204.75	0.94	**0.89**	42%
Cardinal Drive			3.10			142	3.10	4661	3.27	67.10	0.87	20.88	87.98	525	527.99	**0.21%**	200.04	0.91	**0.88**	44%
Cardinal Drive			4.00			182	4.00	4843	3.26	69.39	1.12	22.00	91.39	525	527.99	**0.19%**	190.28	0.87	**0.85**	48%
Cardinal Drive			1.13			52	1.13	4895	3.25	70.05	0.32	22.31	92.36	525	527.99	**0.21%**	200.04	0.91	**0.89**	46%

CITY OF NIAGARA FALLS DESIGN CRITERIA

Average Daily Flow:

Domestic Flow = 380 L/p/day

Max. Residential PF = 4.00 (Harmon Equation)
Min. Residential PF = 2.00 (Harmon Equation)

Equivalent Population:

R1-R2	45.5	p/ha *	Industrial Peak Factor =	per MOE Graph
R3-R4	96.4	p/ha *	Extraneous Flow =	0.28 L/s/ha
R5A-R5B	163.1	p/ha *	Minimum Velocity (Actual) =	0.60 m/s
R5C	229.8	p/ha *	Maximum Velocity (Actual) =	4.00 m/s
R5D-R5E	355.8	p/ha *		
General Industrial	153.2	p/ha *	Mannings 'n' =	0.013
General Commercial	180.4	p/ha *		
Tourist Commercial	284.2	p/ha *		

PROJECT INFORMATION

CPE File Number: 21102
Project Name: Montrose Road
Project Location: Niagara Falls, Ontario

Counterpoint Engineering Inc.

SANITARY SEWER CALCULATION SHEET
PROPOSED RE-DEVELOPMENT

Project: Montrose Road
Project No: 21102
Client: Forest Gate Group
Location: Niagara Falls, Ontario

Proposed Contributing Area (Proposed Site Redevelopment Area)
Existing Commercail Site Area
Total Population (Proposed 5.45Ha x 96.4 p/Ha + Existing Buildings 0.78Ha x 180.4 p/Ha)

LOCATION			RESIDENTIAL AREA AND POPULATION								INFILTRATION	TOTAL	Pipe						
			UNITS BY TYPE OF DEVELOPMENT (ha)				CUMMULATIVE												
STREET	FROM M.H.	TO M.H.	R1-R2	R3-R4	General Commercial	POP.	AREA (ha)	POP.	PEAKING FACTOR (M)	PEAK FLOW (L/s)	FLOW	CUMMULATIVE	TOTAL FLOW	NOM. DIA (mm)	ACT. DIA (mm)	SLOPE (%)	CAPACITY (FULL) Qf (L/s)	VELOCITY (FULL) (m/s)	VELOCITY (ACTUAL) (m/s)	FLOW FULL RATIO Qa/Qf
MT Carmel BLVD.				5.45	4.53	665	9.98	665	3.91	11.43	2.79	2.79	14.22	250	251.46	**0.40%**	38.23	0.77	**0.71**	37%
MT Carmel BLVD.						0	0.00	665	3.91	11.43	0.00	2.79	14.22	250	251.46	**0.55%**	44.83	0.90	**0.79**	32%
MT Carmel BLVD.						0	0.00	665	3.91	11.43	0.00	2.79	14.22	250	251.46	**0.28%**	31.98	0.64	**0.62**	44%
MT Carmel BLVD.						0	0.00	665	3.91	11.43	0.00	2.79	14.22	250	251.46	**0.44%**	40.09	0.81	**0.74**	35%
MT Carmel BLVD.			5.88			268	5.88	933	3.82	15.67	1.65	4.44	20.11	250	251.46	**0.47%**	41.44	0.83	**0.83**	49%
MT Carmel BLVD.						0	0.00	933	3.82	15.67	0.00	4.44	20.11	250	251.46	**0.43%**	39.64	0.80	**0.80**	51%
MT Carmel BLVD.						0	0.00	933	3.82	15.67	0.00	4.44	20.11	250	251.46	**0.43%**	39.64	0.80	**0.80**	51%
MT Carmel BLVD.			5.24			239	5.24	1172	3.75	19.35	1.47	5.91	25.26	250	251.46	**0.40%**	38.23	0.77	**0.82**	66%
MT Carmel BLVD.						0	0.00	1172	3.75	19.35	0.00	5.91	25.26	250	251.46	**0.40%**	38.23	0.77	**0.82**	66%
MT Carmel BLVD.						0	0.00	1172	3.75	19.35	0.00	5.91	25.26	250	251.46	**0.40%**	38.23	0.77	**0.82**	66%
Cardinal Drive			62.03	9.43		3732	71.46	4904	3.25	70.16	20.01	25.92	96.07	525	527.99	**0.20%**	195.22	0.89	**0.88**	49%
Cardinal Drive						0	0.00	4904	3.25	70.16	0.00	25.92	96.07	525	527.99	**0.22%**	204.75	0.94	**0.92**	47%
Cardinal Drive			3.10			142	3.10	5046	3.24	71.93	0.87	26.78	98.72	525	527.99	**0.21%**	200.04	0.91	**0.91**	49%
Cardinal Drive			4.00			182	4.00	5228	3.23	74.20	1.12	27.90	102.10	525	527.99	**0.19%**	190.28	0.87	**0.88**	54%
Cardinal Drive			1.13			52	1.13	5280	3.22	74.84	0.32	28.22	103.07	525	527.99	**0.21%**	200.04	0.91	**0.91**	52%

CITY OF NIAGARA FALLS DESIGN CRITERIA

Average Daily Flow:

Domestic Flow = 380 L/p/day

Max. Residential PF = 4.00 (Harmon Equation)
Min. Residential PF = 2.00 (Harmon Equation)

Equivalent Population:

R1-R2	45.5	p/ha *
R3-R4	96.4	p/ha *
R5A-R5B	163.1	p/ha *
R5C	229.8	p/ha *
R5D-R5E	355.8	p/ha *
General Industrial	153.2	p/ha *
General Commercial	180.4	p/ha *
Tourist Commercial	284.2	p/ha *

Industrial Peak Factor =	per MOE Graph	
Extraneous Flow =	0.28	L/s/ha
Minimum Velocity (Actual) =	0.60	m/s
Maximum Velocity (Actual) =	4.00	m/s
Mannings 'n' =	0.013	

PROJECT INFORMATION

CPE File Number: 21102
Project Name: Montrose Road
Project Location: Niagara Falls, Ontario

Sheet No. 2

Counterpoint Engineering Inc.

SANITARY SEWER CALCULATION SHEET
INCLUDING FUTURE RE-DEVELOPMENT

Project: Montrose Road
Project No: 21102
Client: Forest Gate Group
Location: Niagara Falls, Ontario

Proposed and Potential Future Contributing Area (5.45Ha + 4.53Ha)

LOCATION			RESIDENTIAL AREA AND POPULATION								INFILTRATION	TOTAL	Pipe						
			UNITS BY TYPE OF DEVELOPMENT (ha)				CUMMULATIVE				FLOW	CUMMULATIVE TOTAL FLOW							
STREET	FROM M.H.	TO M.H.	R1-R2	R3-R4	General Commercial	POP.	AREA (ha)	POP.	PEAKING FACTOR (M)	PEAK FLOW (L/s)			NOM. DIA (mm)	ACT. DIA (mm)	SLOPE (%)	CAPACITY (FULL) Qf (L/s)	VELOCITY (FULL) (m/s)	VELOCITY (ACTUAL) (m/s)	FLOW FULL RATIO Qa/Qf
MT Carmel BLVD.				9.98		963	9.98	963	3.81	16.14	2.79	2.79	18.93	250	251.46	**0.40%**	38.23	0.77	**0.76**	50%
MT Carmel BLVD.						0	0.00	963	3.81	16.14	0.00	2.79	18.93	250	251.46	**0.55%**	44.83	0.90	**0.86**	42%
MT Carmel BLVD.						0	0.00	963	3.81	16.14	0.00	2.79	18.93	250	251.46	**0.28%**	31.98	0.64	**0.67**	59%
MT Carmel BLVD.						0	0.00	963	3.81	16.14	0.00	2.79	18.93	250	251.46	**0.44%**	40.09	0.81	**0.79**	47%
MT Carmel BLVD.			5.88			268	5.88	1231	3.74	20.25	1.65	4.44	24.69	250	251.46	**0.47%**	41.44	0.83	**0.87**	60%
MT Carmel BLVD.						0	0.00	1231	3.74	20.25	0.00	4.44	24.69	250	251.46	**0.43%**	39.64	0.80	**0.84**	62%
MT Carmel BLVD.						0	0.00	1231	3.74	20.25	0.00	4.44	24.69	250	251.46	**0.43%**	39.64	0.80	**0.84**	62%
MT Carmel BLVD.			5.24			239	5.24	1470	3.69	23.83	1.47	5.91	29.74	250	251.46	**0.40%**	38.23	0.77	**0.85**	78%
MT Carmel BLVD.						0	0.00	1470	3.69	23.83	0.00	5.91	29.74	250	251.46	**0.40%**	38.23	0.77	**0.85**	78%
MT Carmel BLVD.						0	0.00	1470	3.69	23.83	0.00	5.91	29.74	250	251.46	**0.40%**	38.23	0.77	**0.85**	78%
Cardinal Drive			62.03	9.43		3732	71.46	5202	3.23	73.88	20.01	25.92	99.79	525	527.99	**0.20%**	195.22	0.89	**0.89**	51%
Cardinal Drive						0	0.00	5202	3.23	73.88	0.00	25.92	99.79	525	527.99	**0.22%**	204.75	0.94	**0.93**	49%
Cardinal Drive			3.10			142	3.10	5344	3.22	75.64	0.87	26.78	102.42	525	527.99	**0.21%**	200.04	0.91	**0.91**	51%
Cardinal Drive			4.00			182	4.00	5526	3.20	77.88	1.12	27.90	105.79	525	527.99	**0.19%**	190.28	0.87	**0.89**	56%
Cardinal Drive			1.13			52	1.13	5578	3.20	78.52	0.32	28.22	106.74	525	527.99	**0.21%**	200.04	0.91	**0.92**	53%

CITY OF NIAGARA FALLS DESIGN CRITERIA

Average Daily Flow:

Domestic Flow = 380 L/p/day

Max. Residential PF = 4.00 (Harmon Equation)
Min. Residential PF = 2.00 (Harmon Equation)

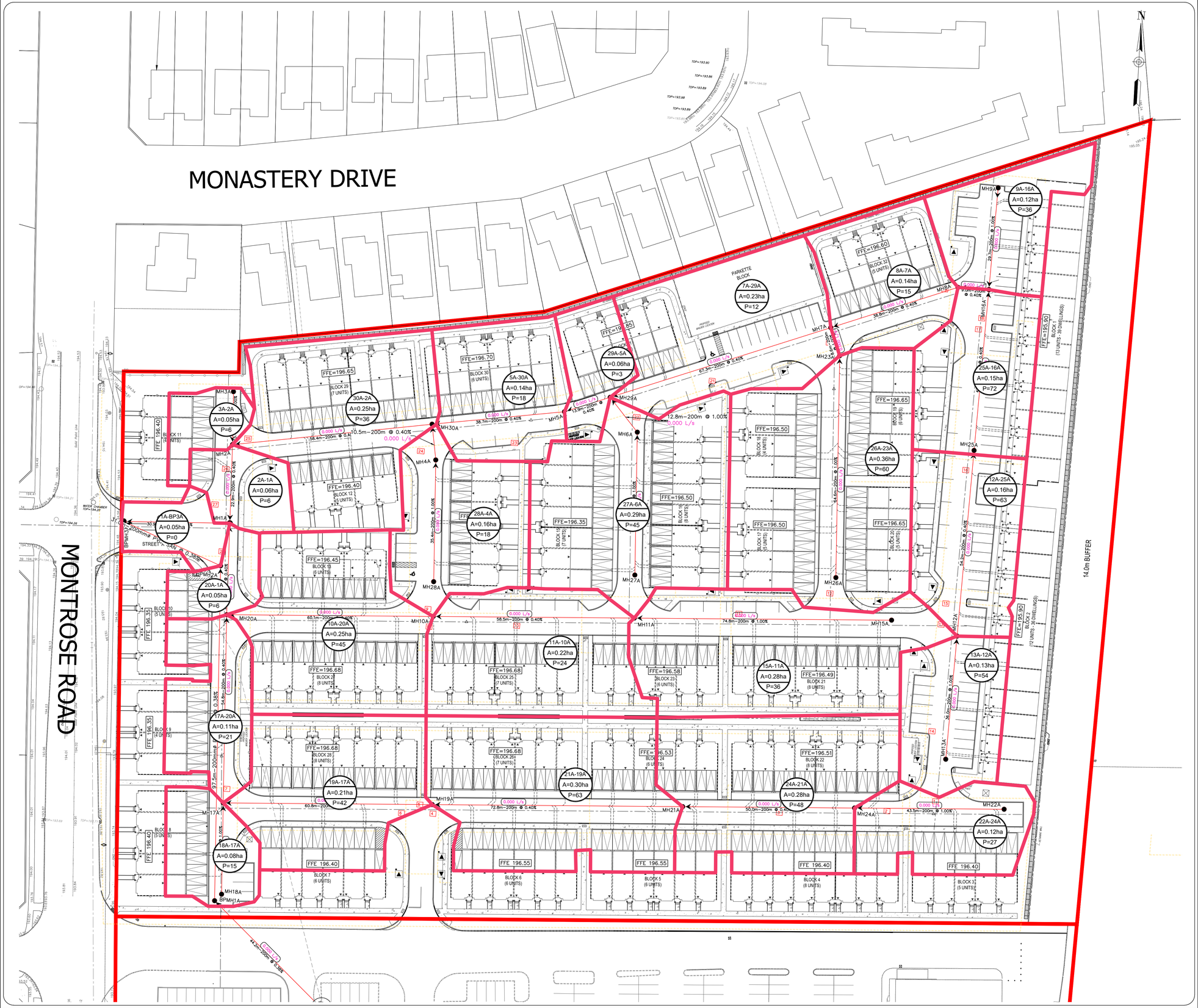
Equivalent Population:

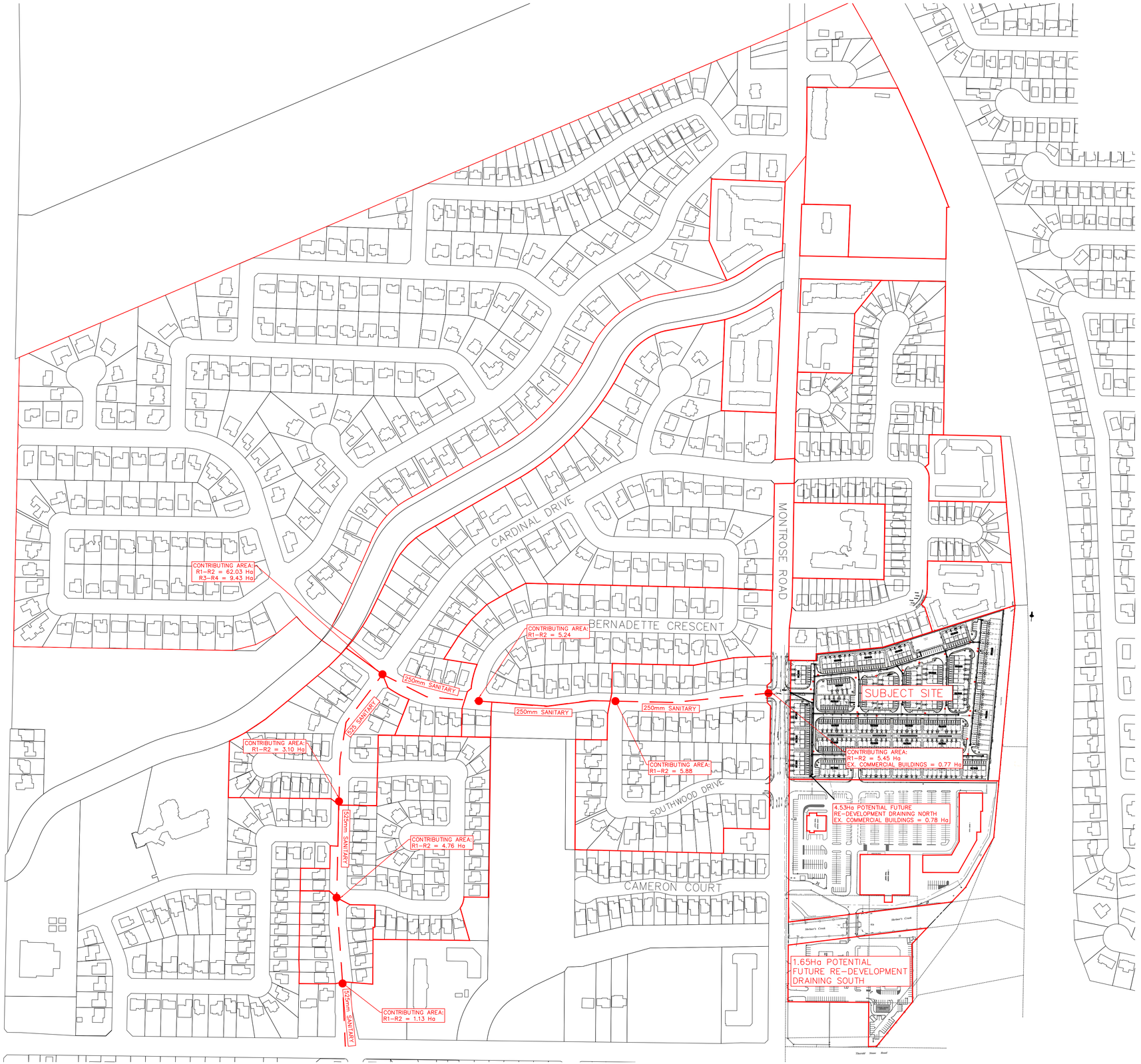
R1-R2	45.5	p/ha *
R3-R4	96.4	p/ha *
R5A-R5B	163.1	p/ha *
R5C	229.8	p/ha *
R5D-R5E	355.8	p/ha *
General Industrial	153.2	p/ha *
General Commercial	180.4	p/ha *
Tourist Commercial	284.2	p/ha *

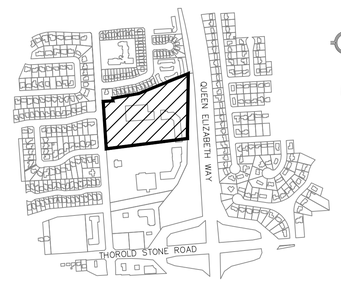
Industrial Peak Factor =	per MOE Graph	
Extraneous Flow =	0.28	L/s/ha
Minimum Velocity (Actual) =	0.60	m/s
Maximum Velocity (Actual) =	4.00	m/s
Mannings 'n' =	0.013	

PROJECT INFORMATION

CPE File Number: 21102
Project Name: Montrose Road
Project Location: Niagara Falls, Ontario


MONASTERY DRIVE
MONTROSE ROAD
14.0m BUFFER
PARVETTE BLOCK
7A-29A A=0.23ha P=12
8A-7A A=0.14ha P=15
9A-16A A=0.12ha P=36
29A-5A A=0.06ha P=3
5A-30A A=0.14ha P=18
30A-2A A=0.25ha P=36
3A-2A A=0.05ha P=6
2A-1A A=0.06ha P=6
1A-BP3A A=0.05ha P=0
28A-4A A=0.16ha P=18
27A-6A A=0.29ha P=45
26A-23A A=0.36ha P=60
25A-16A A=0.15ha P=72
12A-25A A=0.16ha P=63
20A-1A A=0.05ha P=6
10A-20A A=0.25ha P=45
11A-10A A=0.22ha P=24
15A-11A A=0.28ha P=36
13A-12A A=0.13ha P=54
17A-20A A=0.11ha P=21
19A-17A A=0.21ha P=42
21A-19A A=0.30ha P=63
24A-21A A=0.28ha P=48
22A-24A A=0.12ha P=27
18A-17A A=0.08ha P=15
MH1A
MH2A
MH3A
MH4A
MH5A
MH6A
MH7A
MH8A
MH9A
MH10A
MH11A
MH12A
MH13A
MH15A
MH16A
MH17A
MH18A
MH19A
MH20A
MH21A
MH22A
MH23A
MH24A
MH25A
MH26A
MH27A
MH28A
MH29A
MH30A
BPMH1A
BPMH2A
STREET 'A' SAN
STREET 'A' STM
BLOCK 29 (7 UNITS)
BLOCK 30 (6 UNITS)
BLOCK 12 (6 UNITS)
BLOCK 19 (6 UNITS)
BLOCK 18 (4 UNITS)
BLOCK 17 (5 UNITS)
BLOCK 20 (6 UNITS)
BLOCK 11 (4 UNITS)
BLOCK 10 (5 UNITS)
BLOCK 9 (4 UNITS)
BLOCK 8 (5 UNITS)
BLOCK 28 (8 UNITS)
BLOCK 25 (7 UNITS)
BLOCK 23 (6 UNITS)
BLOCK 21 (8 UNITS)
BLOCK 26 (7 UNITS)
BLOCK 24 (6 UNITS)
BLOCK 22 (6 UNITS)
BLOCK 13 (6 UNITS)
BLOCK 7 (6 UNITS)
BLOCK 6 (6 UNITS)
BLOCK 5 (6 UNITS)
BLOCK 4 (6 UNITS)
BLOCK 3 (5 UNITS)
BLOCK 27 (13 UNITS - 39 DWELLINGS)
PROPOSED BRICK DUPLEX
PROPOSED BRICK TOWNHOUSE
FFE=196.65
FFE=196.70
FFE=196.60
FFE=196.40
FFE=196.45
FFE=196.35
FFE=196.68
FFE=196.58
FFE=196.49
FFE=196.53
FFE=196.51
FFE=196.50
FFE=196.55
FFE 196.40
FFE 196.35
FFE=195.90
0.000 L/s
0.000 L/s
0.000 L/s





KEY PLAN

LEGEND

DRAINAGE BOUNDARY

LEGAL & TOPOGRAPHY

PROVIDED BY: J.D BARNES
4318 PORTAGE ROAD UNIT 2,
NIAGARA FALLS, ON, L2F 6A4
PHONE:(905) 358-3693

BENCHMARK AND ELEVATION

ELEVATIONS SHOWN HEREON ARE GEODETIC CGVD-1928:78 AND ARE DERIVED FROM GNSS OBSERVATIONS AND NATIONAL RESOURCES CANADA'S GEOID MODEL HT2.0.
BEARINGS ARE GRID BEARINGS DERIVED FROM REAL-TIME NETWORK OBSERVATIONS (SMARTNET V6-2014), AND ARE REFERRED TO THE CENTRAL MERIDIAN 81°W OF UTM ZONE 17, NAD83 (CSRS2010).

No.	REVISIONS/ISSUED	DATE	BY	CITY
14.	RE-ISSUED FOR SERVICING PERMIT	2025-10-09	BB	
13.	ISSUED FOR MATERIAL ORDERING	2025-09-12	ZS	
12.	RE-ISSUED FOR SERVICING PERMIT (REVISED)	2025-06-27	ZS	
11.	RE-ISSUED FOR SERVICING PERMIT	2025-06-10	ZS	
10.	REVISED PAVEMENT STRUCTURE	2025-02-07	ZS	
9.	REVISED NORTH EAST SIDEWALK	2024-11-27	ZS	
8.	ISSUED FOR 4TH DPOC SUBMISSION	2024-09-17	ZS	
7.	REVISED FOR DPOC AND SERVICING PERMIT	2024-08-22	JY	
6.	ISSUED FOR SERVICING PERMIT	2024-08-01	JY	

counterpoint ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

APPLICANT:

CASSONE DWELLINGS (BT) INC.
1681 LANGSTAFF ROAD, UNIT 1
VAUGHAN ONTARIO L4K 5T3

SITE LOCATION:

3770 MONTROSE ROAD
NIAGARA FALLS
ONTARIO

DOWNSTREAM DRAINAGE ANALYSIS (SAN)

DESIGNED BY: Z.S.	CHECKED BY: Z.S.	DATE: APRIL 2024	
DRAWING BY: S.C	CHECKED BY:	PROJECT NO.	21102
SWM BY: Z.S.	CHECKED BY:		
SCALE: 1:2500m	0m 50m 10m 150m	DRAWING NO.	SAN-3

Cassone Dwellings (BT) Inc.
3770 Montrose Road

Appendix D

Stormwater Design and Quality

Project No.: 21102
April 2024

EXISTING RESIDENTIAL

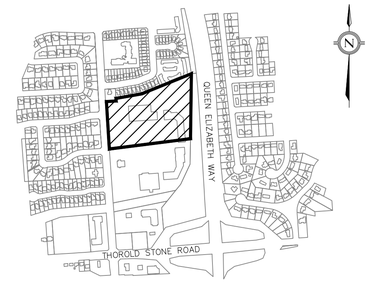
EXISTING MINOR STORM OUTLET

101
A=4.90
C=0.68

102
A=0.15
C=0.25

103
A=0.40
C=0.40

EXISTING COMMERCIAL
PLAZA TO REMAIN



KEY PLAN

LEGEND

100 / A=.50 / C=0.25 — DRAINAGE ID, AREA, RUNOFF COEFFICIENT

OVERLAND FLOW ROUTE

DRAINAGE BOUNDARY

LEGAL & TOPOGRAPHY

PROVIDED BY: J.D BARNES
4318 PORTAGE ROAD UNIT 2,
NIAGARA FALLS, ON, L2F 6A4
PHONE: (905) 358-3693

BENCHMARK AND ELEVATION

ELEVATIONS SHOWN HEREON ARE GEODETIC CGVD-1928:78 AND ARE DERIVED FROM GNSS OBSERVATIONS AND NATIONAL RESOURCES CANADA'S GEOID MODEL HT2.0. BEARINGS ARE GRID BEARINGS DERIVED FROM REAL-TIME NETWORK OBSERVATIONS (SMARTNET V6-2014), AND ARE REFERRED TO THE CENTRAL MERIDIAN 81°W OF UTM ZONE 17, NAD83 (CSRS2010).

No.	REVISIONS/ISSUED	DATE	BY	CITY
7.	REVISED FOR MTO PERMIT	2023-12-14	ZS	
6.	ISSUED FOR SPA SUBMISSION	2023-12-01	ZS	
5.	REVISED FOR EARTHWORKS TENDER	2023-10-31	ZS	
4.	REVISED FOR EARTHWORKS TENDER	2023-10-04	ZS	
3.	ISSUED FOR REVIEW	2023-09-13	ZS	
2.	ISSUED FOR SPA SUBMISSION	2023-09-08	ZS	
1.	ISSUED FOR CLIENT REVIEW	2022-11-21	PT	

counterpoint ENGINEERING
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

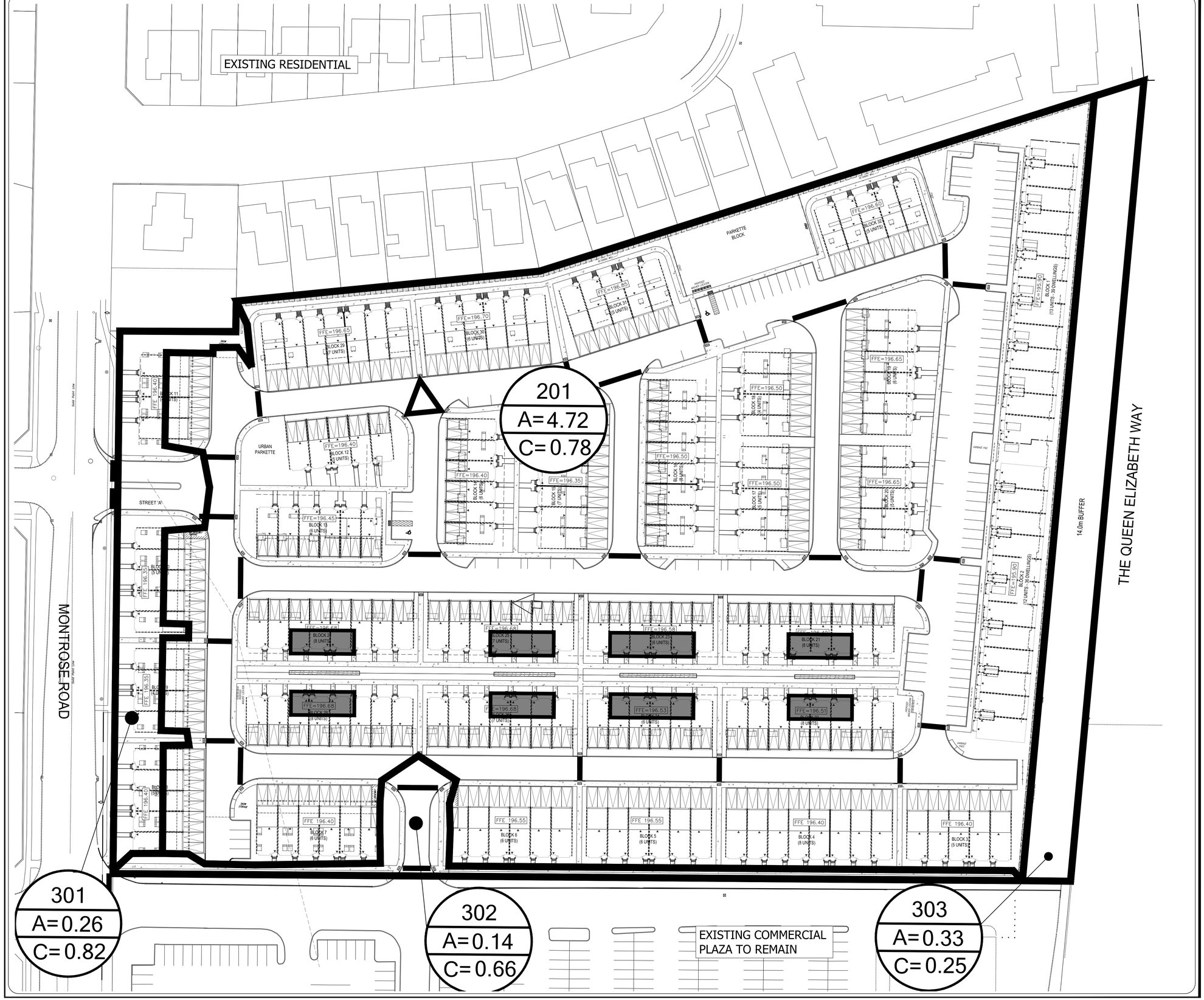
ENGINEER'S STAMP

APPLICANT:
CASSONE DWELLINGS (BT) INC.
1681 LANGSTAFF ROAD, UNIT 1
VAUGHAN ONTARIO L4K 5T3

SITE LOCATION:
3770 MONTROSE ROAD
NIAGARA FALLS
ONTARIO

PRE DEVELOPMENT PLAN (STM)

DESIGNED BY: Z.S.	CHECKED BY: Z.S.	DATE: APRIL 2024
DRAWING BY: S.C	CHECKED BY:	PROJECT NO. 21102
SWM BY: Z.S.	CHECKED BY:	
SCALE:		DRAWING NO. SWM-1


EXISTING RESIDENTIAL
PARKETTE BLOCK
URBAN PARKETTE
STREET 'A'
MONTROSE ROAD
THE QUEEN ELIZABETH WAY
14.0m BUFFER
EXISTING COMMERCIAL PLAZA TO REMAIN
201
A=4.72
C=0.78
301
A=0.26
C=0.82
302
A=0.14
C=0.66
303
A=0.33
C=0.25
BLOCK 1 (5 UNITS)
BLOCK 2 (6 UNITS)
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BLOCK 49 (6 UNITS)
BLOCK

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SWM DESIGN CALCULATIONS
Tube Orifice Calculation

Project Name: Forest Gate Group
Municipality: Niagara Falls
Project No.: 21102
Date: 30-Apr-24

Prepared by: P.T
Last Revised: 30-Apr-24

Input Data:

Orifice Diameter (mm):	200
High Water Level (m) =	194.48
Orifice Invert El. or TWE (m) =	192.47
Total Head (m) =	2.01
Allowable Flow (m^3/s) =	0.170

Orifice Equation:

$Q = C_d A(2gh)^{1/2}$

Cd=0.82

(Allowable flow to Monastery Drive sewer
)

PVC Pipe Class	Nominal Pipe Diameter	Orifice Diameter (m)	Acting Head (m)	Orifice Opening Area (m^2)	Flow through Orifice (m^3/s)
DR 14	0.100	0.104	1.96	0.0085	0.043
DR 18	0.100	0.108	1.96	0.0092	0.047
DR 25	0.100	0.112	1.95	0.0098	0.050
DR 14	0.150	0.149	1.94	0.0174	0.088
DR 18	0.150	0.155	1.93	0.0189	0.095
DR 25	0.150	0.161	1.93	0.0203	0.103
DR 14	0.200	0.194	1.91	0.0295	0.148
DR 18	0.200	0.204	1.91	0.0327	0.164
DR 25	0.200	0.212	1.90	0.0353	0.177
DR 14	0.250	0.242	1.89	0.0460	0.229
DR 18	0.250	0.250	1.88	0.0491	0.245
DR 25	0.250	0.260	1.88	0.0531	0.264
DR 14	0.300	0.287	1.87	0.0647	0.321
DR 18	0.300	0.297	1.86	0.0692	0.343
DR 25	0.300	0.309	1.86	0.0750	0.371
DR 14	0.350	0.333	1.84	0.0870	0.429
DR 18	0.350	0.345	1.84	0.0937	0.461
DR 25	0.350	0.358	1.83	0.1003	0.493
DR 41	0.350	0.370	1.83	0.1073	0.526
DR 14	0.400	0.379	1.82	0.1126	0.552
DR 18	0.400	0.393	1.81	0.1212	0.593
DR 25	0.400	0.407	1.81	0.1298	0.634
DR 41	0.400	0.420	1.80	0.1387	0.676
DR 18	0.450	0.440	1.79	0.1522	0.740
DR 25	0.450	0.456	1.78	0.1630	0.790
DR 41	0.450	0.471	1.77	0.1742	0.843
DR 51	0.450	0.476	1.77	0.1778	0.860
DR 18	0.500	0.488	1.77	0.1866	0.901
DR 25	0.500	0.505	1.76	0.2000	0.963
DR 41	0.500	0.522	1.75	0.2137	1.027
DR 51	0.500	0.527	1.75	0.2180	1.046
DR 18	0.600	0.583	1.72	0.2664	1.268
DR 25	0.600	0.603	1.71	0.2853	1.355
DR 32.5	0.600	0.615	1.70	0.2969	1.407
DR 41	0.600	0.623	1.70	0.3050	1.444
DR 51	0.600	0.630	1.70	0.3112	1.472

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SWM DESIGN CALCULATIONS
DRAINAGE AREAS AND RUNOFF COEFFICIENT CALCULATIONS

Project Name: 3770 Montrose Road
Municipality: Niagara Falls,ON
Project No.: 21102
Date: 2-May-24

Prepared by: P.T
Last Revised: 2-May-24

Adjustment Ratio:	1	1.1	1.2	1.25
Runoff Coefficients:	**1 to 10-year**	**25-year**	**50-year**	**100-year**
Landscaped/Grass:	0.25	0.28	0.30	0.31
Pavement:	0.95	1.00	1.00	1.00
Roof:	0.95	1.00	1.00	1.00

Runoff Coefficients based on NPCA Design Standards

POST DEVELOPMENT CONDITIONS

Area 201:

Storm Event:	Grass (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)	Runoff Coefficient
2 to 10-year:	11522	12615	23110	47247	4.72	0.78
25-year:	11522	12615	23110	47247	4.72	0.82
50-year:	11522	12615	23110	47247	4.72	0.83
100-year:	11522	12615	23110	47247	4.72	0.83

Area 301:

Storm Event:	Grass (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)	Runoff Coefficient
2 to 10-year:	657	471	1472	2600	0.26	0.77
25-year:	657	471	1472	2600	0.26	0.82
50-year:	657	471	1472	2600	0.26	0.82
100-year:	657	471	1472	2600	0.26	0.83

Area 302:

Storm Event:	Grass (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)	Runoff Coefficient
2 to 10-year:	586	346	468	1400	0.14	0.66
25-year:	586	346	468	1400	0.14	0.70
50-year:	586	346	468	1400	0.14	0.71
100-year:	586	346	468	1400	0.14	0.71

Area 303:

Storm Event:	Grass (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)	Runoff Coefficient
2 to 10-year:	3253	0	0	3253	0.33	0.25
25-year:	3253	0	0	3253	0.33	0.28
50-year:	3253	0	0	3253	0.33	0.30
100-year:	3253	0	0	3253	0.33	0.31

Post-Development Imperviousness:

Grass (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)	Imperviousness
0.00	1.00	1.00			
16018	13432	25050	54500	5.45	0.71

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Rational Method

Pre-Development Release Rates - Area 101

Project No: 21102
Project Name: 3770 Montrose Road
Date: 2024-05-02 11:00

Event:		2	years
ABC's:	a	521.97	
	b	5.28	
	c	0.7588	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.68	
Site Area	A	4.90	ha
Intensity [$i=a/(t+b)^c$]	i	65.94	mm/hr
Flow [Q=CiA/360]	Q	0.61	m^3/s
		610.3	l/s

Event:		5	years
ABC's:	a	719.5	
	b	6.34	
	c	0.7687	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.68	
Site Area	A	4.90	ha
Intensity [$i=a/(t+b)^c$]	i	84.02	mm/hr
Flow [Q=CiA/360]	Q	0.78	m^3/s
		777.7	l/s

Event:		10	years
ABC's:	a	577.93	
	b	2.483	
	c	0.669	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.68	
Site Area	A	4.90	ha
Intensity [$i=a/(t+b)^c$]	i	106.77	mm/hr
Flow [Q=CiA/360]	Q	0.99	m^3/s
		988.2	l/s

Event:		25	years
ABC's:	a	1020.69	
	b	7.29	
	c	0.779	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.68	
Site Area	A	4.90	ha
Intensity [$i=a/(t+b)^c$]	i	110.83	mm/hr
Flow [Q=CiA/360]	Q	1.03	m^3/s
		1025.8	l/s

Event:		100	years
ABC's:	a	1264.57	
	b	7.72	
	c	0.7814	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.68	
Site Area	A	4.90	ha
Intensity [$i=a/(t+b)^c$]	i	133.78	mm/hr
Flow [Q=CiA/360]	Q	1.24	m^3/s
		1238.2	l/s

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Rational Method

Pre-Development Release Rates - Area 102

Project No: 21102
Project Name: 3770 Montrose Road
Date: 2024-05-02 11:00

Event:	2	years
ABC's: a	521.97	
ABC's: b	5.28	
ABC's: c	0.7588	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.25	
Site Area A	0.15	ha
Intensity [i=a/(t+b)^c] i	65.94	mm/hr
Flow [Q=CiA/360] Q	0.01	m^3/s
	6.9	l/s

Event:	5	years
ABC's: a	719.5	
ABC's: b	6.34	
ABC's: c	0.7687	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.25	
Site Area A	0.15	ha
Intensity [i=a/(t+b)^c] i	84.02	mm/hr
Flow [Q=CiA/360] Q	0.01	m^3/s
	8.8	l/s

Event:	10	years
ABC's: a	577.93	
ABC's: b	2.483	
ABC's: c	0.669	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.25	
Site Area A	0.15	ha
Intensity [i=a/(t+b)^c] i	106.77	mm/hr
Flow [Q=CiA/360] Q	0.01	m^3/s
	11.1	l/s

Event:	25	years
ABC's: a	1020.69	
ABC's: b	7.29	
ABC's: c	0.779	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.25	
Site Area A	0.15	ha
Intensity [i=a/(t+b)^c] i	110.83	mm/hr
Flow [Q=CiA/360] Q	0.01	m^3/s
	11.5	l/s

Event:	100	years
ABC's: a	1264.57	
ABC's: b	7.72	
ABC's: c	0.7814	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.25	
Site Area A	0.15	ha
Intensity [i=a/(t+b)^c] i	133.78	mm/hr
Flow [Q=CiA/360] Q	0.01	m^3/s
	13.9	l/s

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Rational Method

Pre-Development Release Rates - Area 103

Project No: 21102
Project Name: 3770 Montrose Road
Date: 2024-05-02 11:00

Event:	2	years
ABC's: a	521.97	
ABC's: b	5.28	
ABC's: c	0.7588	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.40	
Site Area A	0.40	ha
Intensity [$i=a/(t+b)^c$] i	65.94	mm/hr
Flow [Q=CiA/360] Q	0.03	m^3/s
	29.3	l/s

Event:	5	years
ABC's: a	719.5	
ABC's: b	6.34	
ABC's: c	0.7687	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.40	
Site Area A	0.40	ha
Intensity [$i=a/(t+b)^c$] i	84.02	mm/hr
Flow [Q=CiA/360] Q	0.04	m^3/s
	37.3	l/s

Event:	10	years
ABC's: a	577.93	
ABC's: b	2.483	
ABC's: c	0.669	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.40	
Site Area A	0.40	ha
Intensity [$i=a/(t+b)^c$] i	106.77	mm/hr
Flow [Q=CiA/360] Q	0.05	m^3/s
	47.5	l/s

Event:	25	years
ABC's: a	1020.69	
ABC's: b	7.29	
ABC's: c	0.779	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.40	
Site Area A	0.40	ha
Intensity [$i=a/(t+b)^c$] i	110.83	mm/hr
Flow [Q=CiA/360] Q	0.05	m^3/s
	49.3	l/s

Event:	100	years
ABC's: a	1264.57	
ABC's: b	7.72	
ABC's: c	0.7814	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.40	
Site Area A	0.40	ha
Intensity [$i=a/(t+b)^c$] i	133.78	mm/hr
Flow [Q=CiA/360] Q	0.06	m^3/s
	59.5	l/s

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SWM DESIGN CALCULATIONS
Storage Calculations for 5-Year Storm Event

Project Name: 3770 Montrose Road
Municipality: Niagara Falls
Project No.: 21102
Date: 2-May-24

Prepared by: P.T.
Last Revised: 2-May-24

Rainfall Data

Location:	Niagara Falls	a	719.5
Event	5-Year	b	6.34
		c	0.7687

Site Data

Area (ha)	4.72
Runoff Coefficient	0.78
AC	3.68
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	**164**
Storage Required (m^3)	**542**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	84	0.86	516	98	418	
15	68	0.70	630	148	483	
20	58	0.60	715	197	518	
25	51	0.52	782	246	536	
30	45	0.47	837	295	542	********
35	41	0.42	885	344	540	
40	38	0.39	926	394	533	
45	35	0.36	963	443	520	
50	32	0.33	996	492	504	
55	30	0.31	1027	541	485	
60	29	0.29	1055	590	464	
65	27	0.28	1080	640	441	
70	26	0.26	1104	689	416	
75	24	0.25	1127	738	389	
80	23	0.24	1148	787	361	
85	22	0.23	1168	836	332	
90	21	0.22	1187	886	302	
95	21	0.21	1206	935	271	
100	20	0.20	1223	984	239	
105	19	0.20	1239	1033	206	
110	19	0.19	1255	1082	173	
115	18	0.18	1271	1132	139	
120	17	0.18	1285	1181	105	

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SWM DESIGN CALCULATIONS
Storage Calculations for 10-Year Storm Event

Project Name: 3770 Montrose Road
Municipality: Niagara Falls
Project No.: 21102
Date: 2-May-24

Prepared by: P.T.
Last Revised: 2-May-24

Rainfall Data

Location:	Niagara Falls	a	577.93
Event	5-Year	b	2.483
		c	0.669

Site Data

Area (ha)	4.72
Runoff Coefficient	0.78
AC	3.68
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	**164**
Storage Required (m^3)	**764**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	107	1.09	656	98	557	
15	85	0.87	785	148	638	
20	72	0.74	885	197	688	
25	63	0.64	967	246	721	
30	56	0.58	1037	295	742	
35	51	0.52	1100	344	755	
40	47	0.48	1156	394	762	
45	44	0.45	1207	443	764	********
50	41	0.42	1254	492	762	
55	38	0.39	1298	541	757	
60	36	0.37	1339	590	749	
65	35	0.35	1378	640	739	
70	33	0.34	1415	689	726	
75	31	0.32	1450	738	712	
80	30	0.31	1483	787	696	
85	29	0.30	1515	836	679	
90	28	0.29	1546	886	660	
95	27	0.28	1575	935	640	
100	26	0.27	1603	984	619	
105	25	0.26	1631	1033	597	
110	25	0.25	1657	1082	575	
115	24	0.24	1683	1132	551	
120	23	0.24	1708	1181	527	

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SWM DESIGN CALCULATIONS
Storage Calculations for 25-Year Storm Event

Project Name: 3770 Montrose Road
Municipality: Niagara Falls
Project No.: 21102
Date: 2-May-24

Prepared by: P.T.
Last Revised: 2-May-24

Rainfall Data

Location:	Niagara Falls	a	1020.690
Event	5-Year	b	7.29
		c	0.779

Site Data

Area (ha)	4.72
Runoff Coefficient	0.82
AC	3.89
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	**164**
Storage Required (m^3)	**923**

Multiply 1.1 Safety Factor

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	111	1.20	719	98	621	
15	91	0.98	885	148	737	
20	78	0.84	1008	197	811	
25	68	0.74	1105	246	859	
30	61	0.66	1185	295	890	
35	55	0.60	1254	344	909	
40	51	0.55	1313	394	920	
45	47	0.51	1366	443	923	********
50	44	0.47	1414	492	922	
55	41	0.44	1457	541	916	
60	38	0.42	1497	590	906	
65	36	0.39	1533	640	894	
70	35	0.37	1568	689	879	
75	33	0.36	1599	738	861	
80	31	0.34	1629	787	842	
85	30	0.33	1658	836	821	
90	29	0.31	1685	886	799	
95	28	0.30	1710	935	775	
100	27	0.29	1734	984	750	
105	26	0.28	1758	1033	724	
110	25	0.27	1780	1082	698	
115	24	0.26	1801	1132	670	
120	23	0.25	1822	1181	641	

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SWM DESIGN CALCULATIONS
Storage Calculations for 100-Year Storm Event

Project Name: 3770 Montrose Road
Municipality: Niagara Falls
Project No.: 21102
Date: 2-May-24

Prepared by: P.T.
Last Revised: 2-May-24

Rainfall Data

Location:	Niagara Falls	a	1264.57
Event	100-year	b	7.72
		c	0.7814

Site Data

Area (ha)	4.72
Runoff Coefficient	0.83
AC	3.93
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	164
Storage Required (m^3)	**1257**

Multiply 1.25 Safety Factor

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	134	1.46	878	98	779	
15	110	1.20	1084	148	936	
20	94	1.03	1237	197	1040	
25	83	0.91	1359	246	1113	
30	74	0.81	1459	295	1164	
35	67	0.74	1544	344	1200	
40	62	0.67	1619	394	1225	
45	57	0.62	1685	443	1242	
50	53	0.58	1744	492	1252	
55	50	0.54	1798	541	1256	
60	47	0.51	1847	590	1257	********
65	44	0.49	1892	640	1253	
70	42	0.46	1935	689	1246	
75	40	0.44	1974	738	1236	
80	38	0.42	2012	787	1225	
85	37	0.40	2047	836	1210	
90	35	0.39	2080	886	1194	
95	34	0.37	2112	935	1177	
100	33	0.36	2142	984	1158	
105	32	0.34	2171	1033	1137	
110	30	0.33	2198	1082	1116	
115	29	0.32	2225	1132	1093	
120	29	0.31	2250	1181	1069	

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TEL: (905) 326-1404 FAX: (905) 326-1405
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Rational Method
Post-Development Release Rates (Area 301 Uncontrolled)

\ 21102
Project Name: 3770 Montrose Road
Date: 2024-05-02 11:00

Event:		2	years
ABC's:	a	521.97	
	b	5.28	
	c	0.7588	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.77	
Site Area	A	0.26	ha
Intensity [$i=a/(t+b)^c$]	i	65.94	mm/hr
Flow [Q=CiA/360]	Q	0.04	m^3/s
		36.8	l/s

Event:		5	years
ABC's:	a	719.5	
	b	6.34	
	c	0.7687	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.77	
Site Area	A	0.26	ha
Intensity [$i=a/(t+b)^c$]	i	84.02	mm/hr
Flow [Q=CiA/360]	Q	0.05	m^3/s
		46.9	l/s

87.4

Event:		10	years
ABC's:	a	577.93	
	b	2.483	
	c	0.669	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.77	
Site Area	A	0.26	ha
Intensity [$i=a/(t+b)^c$]	i	106.77	mm/hr
Flow [Q=CiA/360]	Q	0.06	m^3/s
		59.6	l/s

Event:		25	years
ABC's:	a	1020.69	
	b	7.29	
	c	0.779	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.82	
Site Area	A	0.26	ha
Intensity [$i=a/(t+b)^c$]	i	110.83	mm/hr
Flow [Q=CiA/360]	Q	0.07	m^3/s
		65.4	l/s

Event:		100	years
ABC's:	a	1264.57	
	b	7.72	
	c	0.7814	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.83	
Site Area	A	0.26	ha
Intensity [$i=a/(t+b)^c$]	i	133.78	mm/hr
Flow [Q=CiA/360]	Q	0.08	m^3/s
		79.8	l/s

154.7

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Rational Method

Post-Development Release Rates (Area 302 Uncontrolled)

\	21102
Project Name:	3770 Montrose Road
Date:	2024-05-02 11:00

Event:		2	years
ABC's:	a	521.97	
	b	5.28	
	c	0.7588	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.66	
Site Area	A	0.14	ha
Intensity [$i=a/(t+b)^c$]	i	65.94	mm/hr
Flow [Q=CiA/360]	Q	0.02	m^3/s
		16.8	l/s

Event:		5	years
ABC's:	a	719.5	
	b	6.34	
	c	0.7687	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.66	
Site Area	A	0.14	ha
Intensity [$i=a/(t+b)^c$]	i	84.02	mm/hr
Flow [Q=CiA/360]	Q	0.02	m^3/s
		21.5	l/s

Event:		10	years
ABC's:	a	577.93	
	b	2.483	
	c	0.669	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.66	
Site Area	A	0.14	ha
Intensity [$i=a/(t+b)^c$]	i	106.77	mm/hr
Flow [Q=CiA/360]	Q	0.03	m^3/s
		27.3	l/s

Event:		25	years
ABC's:	a	1020.69	
	b	7.29	
	c	0.779	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.70	
Site Area	A	0.14	ha
Intensity [$i=a/(t+b)^c$]	i	110.83	mm/hr
Flow [Q=CiA/360]	Q	0.03	m^3/s
		30.0	l/s

Event:		100	years
ABC's:	a	1264.57	
	b	7.72	
	c	0.7814	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.71	
Site Area	A	0.14	ha
Intensity [$i=a/(t+b)^c$]	i	133.78	mm/hr
Flow [Q=CiA/360]	Q	0.04	m^3/s
		37.1	l/s

counterpoint engineering

Rational Method

Post-Development Release Rates (Area 303 Uncontrolled)

\ 21102
Project Name: 3770 Montrose Road
Date: 2024-05-02 11:00

Event:	2	years
ABC's: a	521.97	
ABC's: b	5.28	
ABC's: c	0.7588	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.25	
Site Area A	0.33	ha
Intensity [i=a/(t+b)^c] i	65.94	mm/hr
Flow [Q=CiA/360] Q	0.01	m^3/s
	14.9	l/s

Event:	5	years
ABC's: a	719.5	
ABC's: b	6.34	
ABC's: c	0.7687	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.25	
Site Area A	0.33	ha
Intensity [i=a/(t+b)^c] i	84.02	mm/hr
Flow [Q=CiA/360] Q	0.02	m^3/s
	19.0	l/s

Event:	10	years
ABC's: a	577.93	
ABC's: b	2.483	
ABC's: c	0.669	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.25	
Site Area A	0.33	ha
Intensity [i=a/(t+b)^c] i	106.77	mm/hr
Flow [Q=CiA/360] Q	0.02	m^3/s
	24.1	l/s

Event:	25	years
ABC's: a	1020.69	
ABC's: b	7.29	
ABC's: c	0.779	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.28	
Site Area A	0.33	ha
Intensity [i=a/(t+b)^c] i	110.83	mm/hr
Flow [Q=CiA/360] Q	0.03	m^3/s
	27.5	l/s

Event:	100	years
ABC's: a	1264.57	
ABC's: b	7.72	
ABC's: c	0.7814	
Time of Concentration: t	10	min
Runoff Coefficient: C	0.31	
Site Area A	0.33	ha
Intensity [i=a/(t+b)^c] i	133.78	mm/hr
Flow [Q=CiA/360] Q	0.04	m^3/s
	37.8	l/s

counterpoint ENGINEERING

SWM DESIGN CALCULATIONS
Provided Storage Calculations

Project Name: 3770 Montrose Road
Municipality: Niagara Falls
Project No.: 21102
Date: 30-Oct-25

Prepared by: P.T
Last Revised: 30-Oct-25

Available Storage Underground in Sewer

UPSTREAM OF THE ORIFICE TUBE AT CONTROL MH AND OGS (BELOW HWL of 194.50) :

From	To	Length Below HWL (m)	Diameter (mm)	Volume (m^3)
RYCB01	MH05	29.5	200	0.93
RYCB02	STM	29.9	200	0.94
RYCB04	Chamber	6.2	200	0.19
RYCB05	Chamber	6.3	200	0.20
RYCB07	STM	27.7	200	0.87
Infiltration Trench	CBMH20AA	10.8	200	0.34
RYCB10	MH30	27.9	200	0.88
RYCB11	STM	27.9	200	0.88
RYCB12	STM	28.6	200	0.90
RYCB13	CBMH20AA	28.0	200	0.88
CB1	MH10	20.4	200	0.64
CB2	MH10	19.6	200	0.62
CB02	STM	1.5	200	0.05
CB03	STM	5.2	200	0.16
CB04	STM	1.5	200	0.05
CB05	STM	1.5	200	0.05
CB07	STM	6.2	200	0.19
CB09	STM	1.5	200	0.05
CB10	STM	1.5	200	0.05
CB11	STM	1.5	200	0.05
CB12	STM	1.5	200	0.05
CB13	STM	1.5	200	0.05
CB14	STM	1.5	200	0.05
CB15	STM	12.1	200	0.38
CB16	STM	20.4	200	0.64
CB18	STM	1.5	200	0.05
CB19	STM	1.5	200	0.05
CB20	STM	1.5	200	0.05
CB22	CBMH32	30.0	200	0.94
CB23	STM	1.5	200	0.05
CB24	STM	1.5	200	0.05
CB26	STM	1.5	200	0.05
CB29	STM	28.2	200	0.89
CBMH30	MH16	21.6	200	0.68
CB51	STM	10.6	200	0.33
CB54	STM	23.1	200	0.73
CB55	CBMH12	15.1	200	0.47
CB56	MH25	18.2	200	0.57
CB57	STM	13.9	200	0.44
CB58	STM	15.1	200	0.47
CB59	MH27	15.4	200	0.48
CB60	MH27	19.2	200	0.60
CB61	MH28	9.3	200	0.29
CB62	MH28	4.5	200	0.14
CB63	MH29	19.6	200	0.62
CB270	CBMH27	33.0	200	1.04
MH28	MH30	28.2	200	0.89
CBMH12	STM	18.9	200	0.59
Chamber	Control MH	0.7	200	0.02
CB64	MH25	13.5	200	0.42
CBMH20AA	MH19	28.0	300	1.98
MH29	MH25	26.6	300	1.88
CBMH27	MH03	16.0	300	1.13
CBMH13	CBMH32	28.4	300	2.01
MH26	MH06	18.7	300	1.32
CBMH08	CBMH100	25.8	300	1.82
MH30	MH20	58.8	375	6.49
MH25	CBMH25	15.7	375	1.73
CBMH25	MH15	13.1	375	1.45
CBMH10	MH07	14.3	375	1.58
CBMH09	CBMH10	25.6	375	2.83
CBMH100	CBMH31	14.2	375	1.57
CBMH31	CBMH09	14.2	375	1.57
MH10	MH27	26.6	375	2.94
MH20	MH19	41.8	450	6.65
MH14	MH02	7.9	450	1.25
MH07	MH06	21.1	450	3.36
MH27	CBMH32	28.1	450	4.47
MH19	MH18	66.0	525	14.30
MH15	MH14	75.0	525	16.24
MH11	MH05	46.6	525	10.09
CBMH32	MH11	7.5	525	1.62
MH06	MH05	59.6	525	12.90
MH17	MH16	6.2	600	1.75
MH18	MH17	81.2	600	22.97
MH16	MH02	45.3	675	16.21
MH04	MH03	20.2	675	7.23
MH05	MH04	41.1	675	14.71
MH03	MH02	56.7	750	25.05
MH02	Chamber	8.8	900	5.60
Total Storage Underground in Sewers (m^3):				**216**

Available Storage Underground in Sewer Catchbasins & Manholes

UPSTREAM OF THE ORIFICE TUBE AT CONTROL MH AND OGS (BELOW HWL of 194.50) :

MH	Manhole Top Elevation or HWL (m)	Low Invert Elevation (m)	Diameter (m)	Volume (m^3)
Manholes and Catch Basin Manholes				
MH02	194.50	192.57	2.40	8.73
MH03	194.50	193.30	1.80	3.05
MH04	194.50	192.67	1.80	4.66
MH05	194.50	193.15	1.80	3.44
MH06	194.50	193.36	1.50	2.01
MH07	194.50	193.52	1.20	1.11
CBMH10	194.50	193.62	1.20	1.00
CBMH09	194.50	193.76	1.20	0.84
CBMH31	194.50	193.83	1.20	0.76
CBMH100	194.50	193.90	1.20	0.68
CBMH08	194.50	194.05	1.20	0.51
MH26	194.50	193.78	1.20	0.81
MH16	194.50	192.80	1.80	4.33
CBMH30	194.50	193.35	1.20	1.30
MH17	194.50	192.91	1.50	2.81
MH18	194.50	193.24	1.20	1.43
MH14	194.50	193.06	1.50	2.54
MH15	194.50	193.35	1.50	2.03
MH25	194.50	193.63	1.20	0.98
MH29	194.50	193.80	1.20	0.79
CBMH27	194.50	193.45	1.20	1.19
MH11	194.50	193.45	1.20	1.19
CBMH32	194.50	193.53	1.20	1.10
MH27	194.50	193.70	1.20	0.90
MH10	194.50	191.79	1.20	3.06
MH19	194.50	193.52	1.20	1.11
CBMH20AA	194.50	193.83	1.20	0.76
MH20	194.50	193.73	1.20	0.87
MH30	194.50	194.00	1.20	0.57
MH28	194.50	194.25	1.20	0.28
Total Storage Underground in CB's & MH's (m^3):				**54.8**

Total Available Underground Storage (m^3): (In Sewer, Manholes and Catchbasins)	**270**
Total Required Stormwater Storage (m^3):	**1257**
Stormwater Management Tank Storage needed (m^3):	**986**

Ontario
MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: 3770 Montrose Road
Subwatershed: Lovers Creek

Total Pre-Development Area (ha):	**5.45**	Total Pre-Development Phosphorus Load (kg/yr):	**9.92**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
High Intensity - Comm/Industrial	5.45	1.82	9.92

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	0.73	1.32	NONE	0%	0.96

Uncontrolled area: Area 301 + 302 + 303 = 0.73 ha. See Storm Drainage plan (SWM-2) for details.

High Intensity - Residential	4.72	1.32	Other	20%	4.98

OGS to treat entire site for TSS removal. Credited only 20% according LSRCA guidelines

		P Load (kg/yr)
Post-Development Area Altered:	**5.45**	
Total Pre-Development Area:	**5.45**	
Unaffected Area:	**0**	
Pre-Development:		**9.92**
Post-Development:		**7.19**
Change (Pre - Post):		**2.72**
27% Net Reduction in Load		
Post-Development (with BMPs):		**5.95**
Change (Pre - Post):		**3.97**
40% Net Reduction in Load		

DEVELOPMENT: **3770 Montrose Road**
Subwatershed: **Lovers Creek**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**9.92**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**5.95**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**3.97**
Conclusion:	**40% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

EX. CBMH - Storm sewer outlet at the property line.



GENERAL

1. ALL DIMENSIONS AND INVERTS MUST BE VERIFIED PRIOR TO CONSTRUCTION, IF THERE IS ANY DISCREPANCY THE CONTRACTOR IS TO NOTIFY THE ENGINEER PROMPTLY.
2. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING AND PROTECTING ALL UTILITIES DURING CONSTRUCTION GAS, HYDRO, TELEPHONE OR ANY OTHER UTILITIES THAT MAY EXIST ON THE SITE OR WITHIN THE STREET LINES AND MUST BE LOCATED BY ITS OWN UTILITIES AND VERIFIED PRIOR TO CONSTRUCTION.
4. TOPSOIL IN FILL AREA TO BE STRIPPED AND CLEAN FILL TO BE PLACED, AND COMPACTED TO 95% STANDARD PROCTOR DENSITY.
5. ALL GRADES TO BE WITHIN 33% MAX. SLOPE AT PROPERTY LINE AND WITHIN THE SITE.
6. ALL UNDERGROUND SERVICES MATERIALS AND INSTALLATIONS TO BE IN ACCORDANCE WITH THE LATEST STANDARDS AND CODES OF THE MUNICIPALITY.
7. ALL SURFACE DRAINAGE SHALL BE SELF CONTAINED, COLLECTED AND DISCHARGED AT A LOCATION TO BE APPROVED PRIOR TO THE ISSUANCE OF A BUILDING PERMIT.
8. ALL DISTURBED AREAS TO BE RESTORED TO ORIGINAL CONDITION OR BETTER UNLESS OTHERWISE SPECIFIED.
9. WHEREVER PIPES ARE PASSING THROUGH UNCOMPACTED FILL AREA, THE BEDDING TRENCH SHALL BE EXCAVATED TO THE UNDISTURBED GROUND LEVEL AND BACKFILLED WITH GRANULAR "A" COMPACTED TO 100% STANDARD PROCTOR DENSITY.
10. SIDEWALKS AND CURBS TO BE MAINTAINED TO MUNICIPAL STANDARDS.
11. FINISHED LOT GRADING WILL NOT ADVERSELY AFFECT DRAINAGE PATTERNS OF ADJACENT LANDS.
12. ALL STORM SEWERS WITHIN ASPHALT AREAS WHERE NOTED SHALL BE INULATED AS PER DETAIL 2-A01S.

STORM SEWERS

1. ALL STORM SEWER MATERIALS AND CONSTRUCTION METHODS MUST CORRESPOND TO ONTARIO PROVINCIAL STANDARD SPECIFICATIONS.
2. ALL CATCHBASIN MANHOLES AND MANHOLES SHALL BE PRECAST AND CONFORM TO OPSD 701.01 AND 701.02
3. ALL DOUBLE CATCHBASIN MANHOLES SHALL BE PRECAST AND CONFORM TO OPSD 705.01.
4. ALL CATCHBASINS SHALL BE PRECAST AND CONFORM TO OPSD 705.02.
5. ALL CATCHBASIN MANHOLES, CATCHBASINS AND MANHOLES TO HAVE A MINIMUM 0.3m SUMP AND TOP AS PER OPSD UNLESS OTHERWISE NOTED.
6. THE CATCHBASIN FRAME AND GRATE SHALL CONFORM TO OPSD 400.02.
7. STORM SEWER SHALL BE CONCRETE CL III WITH TYPE "B" BEDDING OR PVC PIPE SUR 35 THROUGHOUT EXCEPT AT RISERS, UNLESS OTHERWISE NOTED, AS PER ONTARIO PROVINCIAL STANDARD SPECIFICATIONS.
8. ALL CATCHBASINS CONSTRUCTED IN FILL AREAS TO BE SUPPORTED ON 14 MPa CONCRETE TO SOLID GROUND.
9. ALL PROPOSED FOUNDATION DRAINS SHALL BE CONNECTED TO STORM STORM IF AVAILABLE, OR PUMPED TO SURFACE IF STORM SEWER NOT AVAILABLE.

WATERMAINS

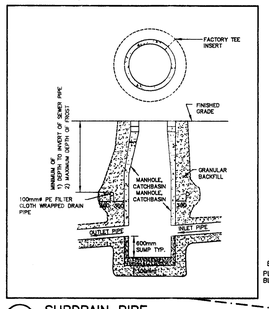
1. ALL WATERMAINS AND WATER SERVICE MATERIALS AND CONSTRUCTION METHODS MUST CORRESPOND TO CURRENT SPECIFATIONS FOR THE MUNICIPALITY.
2. WATERMAIN MUST HAVE A MINIMUM VERTICAL CLEARANCE OF 0.15m OVER AND 0.50m UNDER SEWERS AND ALL OTHER UTILITIES WHEN CROSSING.
3. WATERMAINS AND/OR WATER SERVICE ARE TO HAVE A MINIMUM COVER OF 1.5m WITH A MINIMUM HORIZONTAL SPACING OF 2.0m FROM THEMSELVES AND OTHER UTILITIES.
4. WATERMAINS TO BE INSTALLED TO GRADE AS SHOWN, COPY OF GRADE SHEET MUST BE SUPPLIED TO INSPECTOR PRIOR TO COMMENCEMENT OF WORK WHERE REQUESTED BY THE INSPECTOR.
5. PROVISIONS FOR FLUSHING THE LINES PRIOR TO TESTING ETC. MUST BE PROVIDED WITH AT LEAST A 50ø OUTLET ON A 100ø AND LARGER PIPES, COPPER LINES ARE TO HAVE FLUSHING POINTS AT THE END, SAME SIZE AS THE LINES, THEY MUST ALSO BE HOSED OR PIPED TO ALLOW THE WATER TO DRAIN ONTO A PARKING LOT, SODDED AREA OR DITCH. FLUSHING OUTLET TO BE 100ø OR A HYDRANT.
   NOTE: PUBLIC WORKS DEPARTMENT TO BE CONTACTED 24 HOURS PRIOR TO FLUSHING.
6. ALL CURB STOPS TO BE 1.5m OFF THE FACE OF THE BUILDING UNLESS OTHERWISE NOTED.
7. ALL PVC WATERPIPE SHALL CONFORM TO A.W.W.A. STD. C-900 AND SHALL MEET AND/OR EXCEED O.P.S.S. 701.05.5 AND 18-1, WITH CAST IRON FITTINGS.
8. ALL VALVES TO OPEN COUNTER-CLOCKWISE AND COMPLY WITH A.W.W.A. SPEC C-500 VALVE BOXES TO BE 'FERGUSON' SCREW TYPE.
9. FIRE HYDRANTS TO BE CENTURY MODEL B1 CANADA VALVE LIMITED OR CONCORD ORANGE CENTERIRON OR MUELLER MET C/W 150 DIA. PVC CONNECTION TO "STORZ" WATERMAIN, TWO 65mm NOZZELS AT 180° AND ONE 100mm STEAMER CONNECTION ON THE FRONT SIDE OF THE HYDRANT C/W GATE VALVE AND BOX AS PER O.P.S.D. 1105.01
10. THRUST BLOCKS TO BE PLACED AS DIRECTED AND POURED WITH 25 MPa. CONCRETE TO PROVIDE A MINIMUM 0.40m² EFFECTIVE BEARING AREA TO UNDISTURBED NATIVE SOIL (AT ALL ENDS, BENDS (11¼DS AND TEES FOR NON-RESTRAINED WATER PIPE), PER O.P.S.D. 1103.01

SANITARY SEWERS

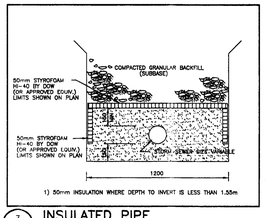
1. ALL SANITARY SEWER MATERIALS AND CONSTRUCTION METHODS MUST CORRESPOND TO CURRENT MUNICIPAL STANDARDS AND SPECIFICATIONS, AND OPSD.
2. SANITARY SEWERS AND CONNECTIONS 150ø AND SMALLER TO BE PVC SDR 28.
3. SANITARY SEWERS AND CONNECTIONS 200ø AND LARGER TO BE PVC SDR 35 ASTM D3034-81 WITH TYPE "B" BEDDING THROUGHOUT EXCEPT AT RISERS, UNLESS OTHERWISE NOTED.
4. ALL MANHOLES SHALL BE PRECAST AND CONFORM TO O.P.S.D. 707.01 AND 701.03 AND FRAME AND COVER SHALL ONFORM TO 401.01 TYPE A.

PARKING AREAS AND ROADWORKS

1. MEDIUM DUTY ASPHALT PAVEMENT FOR PARKING AREAS SHALL CONSIST OF 150mm SUB-BASE GRANULAR "B" MATERIAL, 100mm BASE COURSE GRANULAR "A" MATERIAL, 50mm BINDER COURSE ASPHALT AND 25mm SURFACE COURSE ASPHALT.
2. HEAVY DUTY ASPHALT PAVEMENT WHERE SHOWN ON DRAWING A01S SHALL CONSIST OF 200mm SUB-BASE GRANULAR "B" MATERIAL, 150mm BASE COURSE GRANULAR "A" MATERIAL, 75 mm BINDER COURSE ASPHALT AND 25mm SURFACE COURSE ASPHALT.

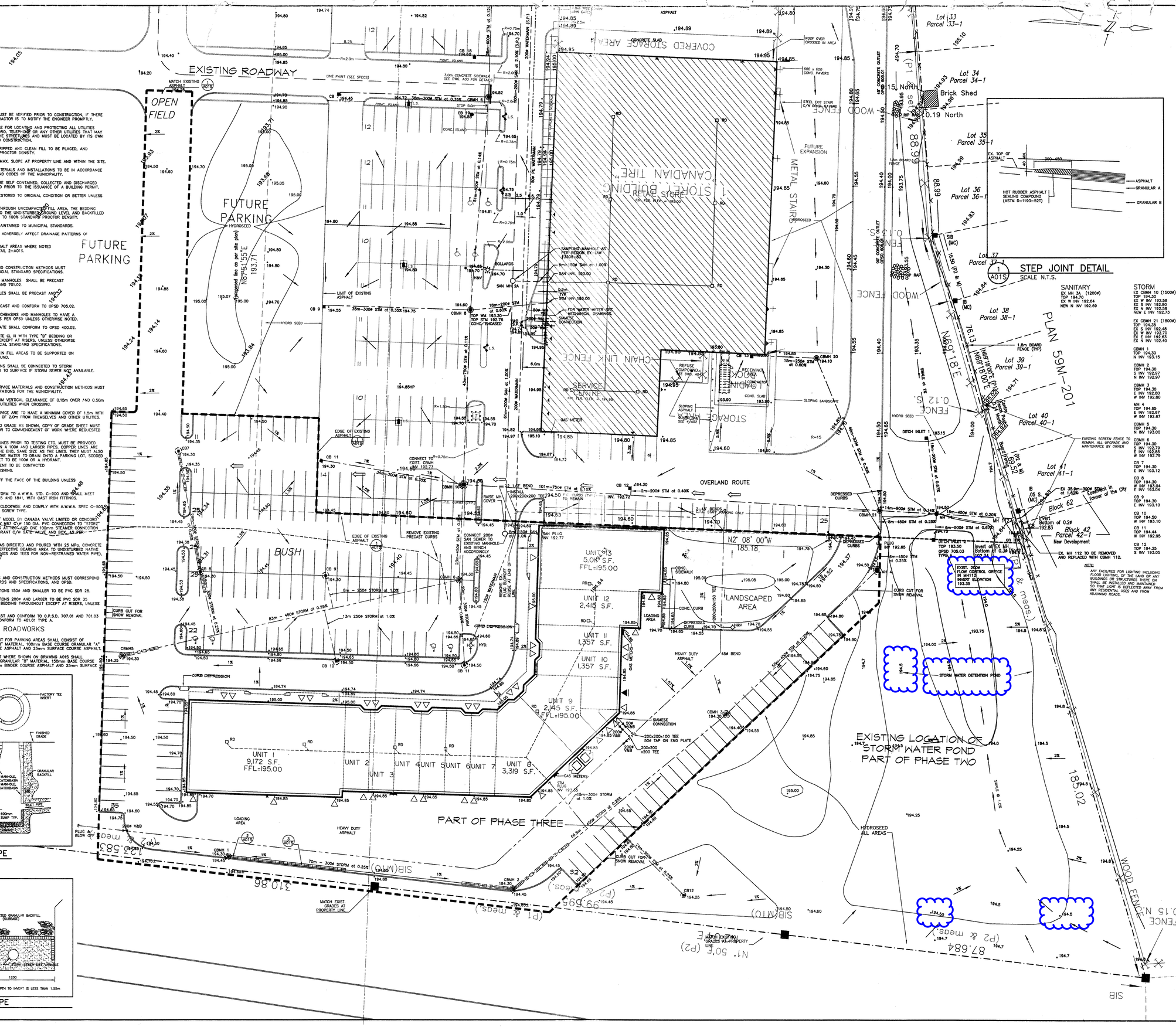


2 A01S SUBDRAIN PIPE
NTS



1) 50mm INSULATION WHERE DEPTH TO INVERT IS LESS THAN 1.55m

3 A01S INSULATED PIPE
SCALE N.T.S.


EXISTING ROADWAY
OPEN FIELD
FUTURE PARKING
HYDROSEED
FUTURE PARKING
HYDRO SEED
BUSH
CANADIAN TIRE
RETAIL STORE
FIN. FLR. ELEV. = 195.00
SERVICE CENTRE
FIN. FLR. ELEV. = 194.80
COVERED STORAGE AREA
CONCRETE SLAB
ROOF OVER CROSSED IN AREA
600 x 600 CONC. PAVERS
STEEL EXIT STAIR C/W GRING GUARDS
FUTURE EXPANSION
METAL STAIRS
PROPOSED
WOOD FENCE
CHAIN LINK FENCE
LIMIT OF EXISTING ASPHALT
EDGE OF EXISTING ASPHALT
REMOVE EXISTING PRECAST CURBS
CURB DEPRESSION
CURB CUT FOR SNOW REMOVAL
LOADING AREA
HEAVY DUTY ASPHALT
SLOPING LANDSCAPE
SLOPING ASPHALT RAMP SEE 4/A02
REFUSE COMPOUND SEE DWG. A02
RECEIVING AREA
CONCRETE SLAB
GAS METER
DEPRESSED CURBS
OVERLAND ROUTE
LANDSCAPED AREA
CONC. SIDEWALK
CONC. CURB
UNIT 13 5,014 S.F. FFL=195.00
UNIT 12 2,415 S.F.
UNIT 11 1,357 S.F.
UNIT 10 1,357 S.F.
UNIT 9 2,145 S.F. FFL=195.00
UNIT 1 9,172 S.F. FFL=195.00
UNIT 2
UNIT 3
UNIT 4
UNIT 5
UNIT 6
UNIT 7
UNIT 8 3,319 S.F.
PART OF PHASE THREE
STORM WATER DETENTION POND
EXISTING LOCATION OF STORM WATER POND PART OF PHASE TWO
HYDROSEED ALL AREAS
SAMPLING MANHOLE AS PER REGION BY-LAW #3308-83
SAN MH 2A
SAN MH 3A
SAN MH 4
SAN MH 5
SAN MH 6
SAN MH 7
SAN MH 8
SAN MH 9
SAN MH 10
SAN MH 11
SAN MH 12
SAN MH 13
SAN MH 14
SAN MH 15
SAN MH 16
SAN MH 17
SAN MH 18
SAN MH 19
SAN MH 20
SAN MH 21
SAN MH 22
CB 9
CB 10
CB 11
CB 12
CB 13
CBMH 1
CBMH 2
CBMH 3
CBMH 4
CBMH 5
CBMH 6
CBMH 7
CBMH 8
CBMH 20
CBMH 21
CBMHS
BOLLARDS
HYD.
RAISE MH COVER
CONNECT TO EXIST. CBMH
CONNECT 200ø SAN SEWER TO EXISTING MANHOLE AND BENCH ACCORDINGLY
ROMVE EX. CONCRETE CURB AT ENTRANCE REUSE AT END OF LINES
SIAMESE CONNECTION
FOR WATER METER SEE MECHANICAL DRAWINGS
SAMPLE CONNECTION
200x200x100 TEE 50ø TAP ON END PLATE
200x200 x200 TEE
200ø VaB
50ø VaB
STM PLUG INV 193.55
PLUG & BLOW OFF
MATCH EXIST. GRADES AT PROPERTY LINE
MATCH EXISTING ASPHALT
STOP SIGN
3.0m CONCRETE SIDEWALK SEE DWG. A03 FOR DETAILS
LINE PAINT (SEE SPECS)
200ø WATERMAIN (S.C.)
200ø PE WATERMAIN
200ø WATERMAIN
30m-600ø STM at 0.12%
35m-300ø STM at 0.35%
51m-600ø STM at 0.14%
18m-200ø STM at 0.60%
43m-750ø STM at 0.11%
34m-300ø STM at 0.33%
101m-750ø STM at 0.10%
2m-200ø STM at 0.40%
14m-900ø STM at 0.14%
8m-150ø SAN at 1.00%
8m-250ø STORM at 1.0%
83m-450ø STORM at 0.25%
13m-250ø STORM at 1.0%
70m-300ø STORM at 0.25%
40m-300ø STM at 0.25%
6m-900ø STM at 0.67%
6m-450ø STM at 0.25%
15m-250ø STM at 0.60%
15m-300ø STORM at 1.0%
40m-300ø STORM at 0.25%
45° BEND
22 1/2° BEND
200x200x200 TEE
P.C. CURBS (TYP.)
CONC. ISLAND
R=0.75m
R=1.50m
R=2.0m
R=2.00m
R=15
N2° 08' 00"W 185.18'
N69° 18' E
N69° 18' 00"E
N69° 18' 00"E 76.13'
N69° 18' 00"E 76.13'
N69° 18' 00"E 185.02'
N69° 18' 00"E 185.02'
N69° 18' 00"E 99.595'
N69° 18' 00"E 87.684'
N69° 18' 00"E 210.86'
N69° 18' 00"E 102.583'
N1° 50' E (P2)
SIB(MTO)
SIB
(P1 & meas.)
(P2 & meas.)
(P2 & meas.)
(P2

3770 MONTROSE ROAD
NIAGARA FALLS, ON

DRAWING INDEX

TITLE	SHEET NO
COVER SHEET	1 OF 7
SYSTEM LAYOUT, SECTIONS & CALCULATION SHEET	2-5 OF 7
SYSTEM OVERLAY SHEET	6 OF 7
DETAIL SHEET	7 OF 7

PROJECT INFORMATION			
SITE CONTACT	PHIL ALLEN	416-286-5990	PHILALLEN@STORMCON.CA
ENGINEER / TECHNICAL SPECIALIST	ERIC CUMISKEY	289-380-3742	ECUMISKEY@STORMCON.CA
PROJECT NO:	2023-169		

COMMENTS:

REVISION	DATE	COMMENT	BY
01	08/07/2024	REVISED PER LATEST SERVICING PLAN	JD
02	05/22/2025	REVISED PER LATEST SERVICING PLAN	JD
03	06/03/2025	REVISED PER LATEST DESIGN	JD
04	08/27/2025	REVISED PER LATEST SERVICING PLAN & STANDARDS	JD

GENERAL NOTES

1. COORDINATE WITH MANUFACTURER'S REPRESENTATIVE/DISTRIBUTOR FOR PRE-CONSTRUCTION MEETING AND SITE INSPECTION DURING INSTALLATION.
2. ENGINEERING DRAWINGS SUPERSEDE ALL PROVIDED DOCUMENTATION. REFER TO SITE ENGINEERS FOR ADDITIONAL INSTRUCTIONS.
3. COORDINATE GREENSTORM INSTALLATION ACTIVITIES WITH OTHER SITE ACTIVITIES.
4. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
5. PRESENCE OF GROUND WATER ABOVE THE BASE OF THE SYSTEM MUST BE IDENTIFIED TO STORMCON. ALL PUBLISHED MAXIMUM AND MINIMUM INSTALLATION DEPTHS ASSUME THE GROUND WATER IS AT OR BELOW THE BASE OF THE SYSTEM UNLESS OTHERWISE NOTED.
6. CONFIRM GEOTECHNICAL SOIL EVALUATION BY A QUALIFIED ENGINEER TO DETERMINE SUITABILITY OF STRUCTURAL INSTALLATION.
7. CONFIRM FOR BURIED UNDERGROUND UTILITIES INCLUDING GAS, ELECTRICAL, PIPELINES OR CONDUITS.
8. ROOTS FROM SURROUNDING TREES MAY DAMAGE THE SYSTEM. PROJECT ENGINEER OF RECORD TO ENSURE ADEQUATE SEPARATION FROM ALL TREES.
9. PROTECT THE INSTALLATION AGAINST DAMAGE WITH CONSTRUCTION TAPE, FENCING OR OTHER MEANS TILL THE CONSTRUCTION IS COMPLETE.
10. ENSURE THAT CONSTRUCTION FOLLOWS APPLICABLE FEDERAL, PROVINCIAL, LOCAL, MUNICIPAL AND LOCAL LAWS, ORDINANCES, REGULATIONS AND SAFETY REQUIREMENTS.
11. VEHICULAR LOADING IS PROHIBITED UNTIL BACKFILLED AS PER MANUFACTURER'S INSTALLATION GUIDELINES. THE USE OF EQUIPMENT OVER GREENSTORM CHAMBERS IS LIMITED:
    - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
    - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE CONSTRUCTION GUIDE.
    - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE CONSTRUCTION GUIDE.

CHECK - REQUIRED MATERIALS AND EQUIPMENT

12. ALL GREENSTORM CHAMBERS AND ACCESSORIES AS SPECIFIED IN THE ENGINEER'S PLANS INCLUDING NON-WOVEN GEOTEXTILE, CONNECTORS, QUADS, SIDEWALLS ADAPTER, RISER AND LINER WHERE APPLICABLE.
13. RECIPROCATING SAW OR ROUTER.
14. TRANSIT OR LASER LEVEL MEASURING DEVICE.
15. COMPACTION EQUIPMENT WITH MAXIMUM GROSS VEHICLE WEIGHT OF 12,000 LBS (5,440 KGS).
16. ACCEPTABLE FILL MATERIAL AS SHOWN IN INSTALLATION INSTRUCTIONS.
17. QUANTITIES FOR GEOSYNTHETIC ARE APPROXIMATE AND MAY VARY BASED ON OVERLAP, WASTAGE.
18. CHECK GREENSTORM CHAMBERS FOR DAMAGE PRIOR TO INSTALLATION. DO NOT USE DAMAGED CHAMBERS, CONTACT YOUR SUPPLIER IMMEDIATELY TO REPORT DAMAGE OR PACKING-LIST DISCREPANCIES.

NOTES FOR BIDDING AND INSTALLATIONS

1. CONTRACTORS ARE EXPECTED TO COMPREHEND AND USE THE MOST CURRENT INSTALLATION INSTRUCTIONS PRIOR TO BEGINNING A SYSTEM INSTALLATION. FOR THE MOST CURRENT INSTRUCTIONS, CONTACT STORMCON AT (289) 380-3742 OR VISIT WWW.STORMCON.CA.
2. CONTACT STORMCON AT LEAST TWO WEEKS PRIOR TO SYSTEM INSTALLATION TO ARRANGE FOR A PRE-CONSTRUCTION MEETING.
3. USE GREENSTORM INSTALLATION INSTRUCTIONS AS A GUIDELINE ONLY FOR MINIMUM/MAXIMUM REQUIREMENTS. ACTUAL DESIGN MAY VARY. REFER TO APPROVED CONSTRUCTION DRAWINGS FOR JOB-SPECIFIC DETAILS. ENGINEERING DRAWINGS SUPERSEDE ALL PROVIDED DOCUMENTATION.
4. THE FOUNDATION STONE SHALL BE LEVEL AND COMPACTED PRIOR TO CHAMBER INSTALLATION.
5. ANY DISCREPANCIES WITH THE SYSTEM SUB-GRADE SOIL'S BEARING CAPACITY MUST BE REPORTED TO THE GEOTECHNICAL ENGINEER.
6. CONTRACTOR TO REFER TO GREENSTORM INSTALLATION INSTRUCTIONS CONCERNING VEHICULAR TRAFFIC. RESPONSIBILITY FOR PREVENTING VEHICLES THAT EXCEED REQUIREMENTS SPECIFIED FROM TRAVELING ACROSS OR PARKING OVER THE CHAMBER SYSTEM LIES SOLELY WITH THE CONTRACTOR THROUGHOUT THE ENTIRE SITE CONSTRUCTION PROCESS. THE PLACEMENT OF WARNING TAPE, TEMPORARY FENCING, AND/OR APPROPRIATELY LOCATED SIGNS IS HIGHLY RECOMMENDED.
7. TRAFFIC OF INSTALLATION EQUIPMENT OR OTHER VEHICULAR TRAFFIC OVER TOP OF THE GREENSTORM STORMWATER SYSTEM IS STRICTLY RESTRICTED AND PROHIBITED UNTIL SATISFACTORY COVER AND COMPACTION IS ACHIEVED ACCORDING TO MANUFACTURER'S INSTALLATION INSTRUCTIONS.
8. EROSION AND SEDIMENT-CONTROL MEASURES MUST MEET LOCAL CODES AND THE DESIGN ENGINEER'S SPECIFICATIONS THROUGHOUT THE ENTIRE SITE CONSTRUCTION PROCESS.
9. GREENSTORM SYSTEMS MUST BE DESIGNED AND INSTALLED IN ACCORDANCE WITH STORMCON'S MINIMUM REQUIREMENTS. FAILURE TO DO SO WILL VOID THE LIMITED WARRANTY.

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NOTE: THESE SHOP DRAWINGS MAY CONTAIN COMPONENTS INCLUDING BUT NOT LIMITED TO MANHOLES, CATCH BASINS, STORM PIPES AND FITTINGS, MANIFOLDS, CASTINGS AND OTHER NECESSARY APPURTENANCES THAT MAY NOT BE SUPPLIED BY STORMCON. IT IS THE RESPONSIBILITY OF THE CONTRACTOR AND/OR SUPPLIER TO CONFIRM THE MATERIALS PROVIDED.

THIS DRAWING WAS PREPARED TO SUPPORT THE PROJECT ENGINEER OF RECORD FOR THE PROPOSED SYSTEM. IT IS THE ULTIMATE RESPONSIBILITY OF THE PROJECT ENGINEER OF RECORD TO ENSURE THAT THE SYSTEM IS DESIGN IN FULL COMPLIANCE WITH ALL APPLICABLE LAWS AND REGULATIONS. IT IS THE CONTRACTOR OF RECORD'S RESPONSIBILITY TO ENSURE THAT THE STORMCON PRODUCTS ARE INSTALLED IN ACCORDANCE WITH STORMCON'S MINIMUM REQUIREMENTS. STORMCON DOES NOT APPROVE PLANS, SIZING, OR SYSTEM DESIGNS.

PROPOSED SYSTEM ELEVATIONS (4-LAYERS)

(TO BE APPROVED BY ENGINEER)
***ENGINEER TO CONFIRM MINIMUM AND MAXIMUM BURIAL REQUIREMENTS ARE MET**

196.00	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
195.70	MINIMUM ALLOWABLE GRADE (LANDSCAPED/NO TRAFFIC)
195.10	GREENSTORM STORAGE TOP ELEVATION LEVEL 4
194.44	GREENSTORM STORAGE TOP ELEVATION LEVEL 3
193.78	GREENSTORM STORAGE TOP ELEVATION LEVEL 2
193.12	GREENSTORM STORAGE TOP ELEVATION LEVEL 1
192.46	GREENSTORM BASE ELEVATION
192.31	BOTTOM OF EXCAVATION
<192.90	SEASONAL HIGH GROUNDWATER ELEVATION

PROPOSED SYSTEM ELEVATIONS (3-LAYERS)

(TO BE APPROVED BY ENGINEER)
***ENGINEER TO CONFIRM MINIMUM AND MAXIMUM BURIAL REQUIREMENTS ARE MET**

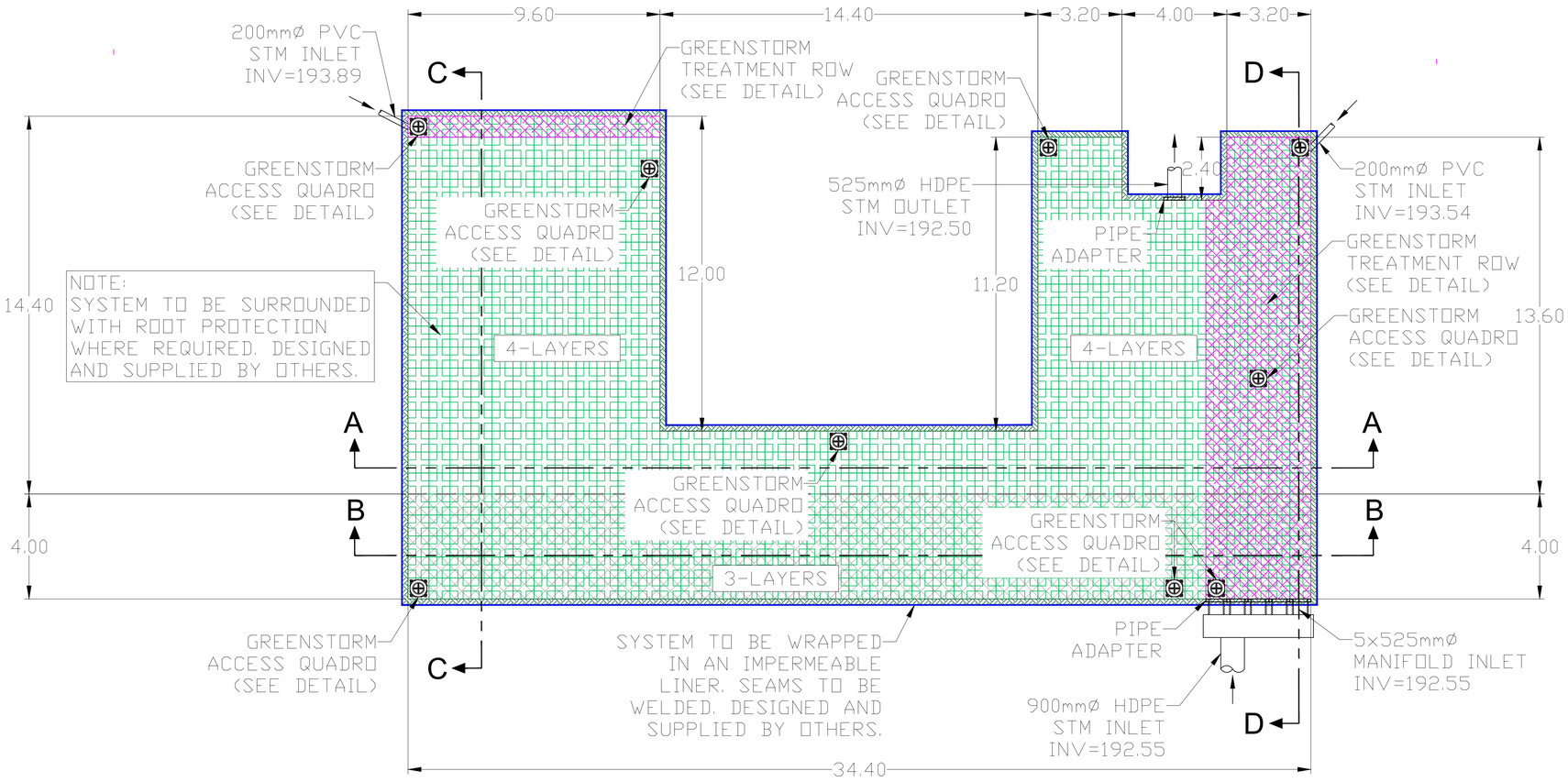
196.00	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
195.24	MINIMUM ALLOWABLE GRADE
194.44	GREENSTORM STORAGE TOP ELEVATION LEVEL 3
193.78	GREENSTORM STORAGE TOP ELEVATION LEVEL 2
193.12	GREENSTORM STORAGE TOP ELEVATION LEVEL 1
192.46	GREENSTORM BASE ELEVATION
192.31	BOTTOM OF EXCAVATION
<192.90	SEASONAL HIGH GROUNDWATER ELEVATION

GREENSTORM STORMWATER MANAGEMENT SYSTEM

TOTAL STORAGE PROVIDED: 1033.63 m^3
STORAGE VOID RATIO: 0.96
SYSTEM AREA: 442.24 m^2
DEPTH OF EMBEDMENT STONE: 0.00 m
DEPTH OF BEDDING STONE: 0.00 m
STONE PERIMETER: 0.00 m

GREENSTORM LEGEND

- GREENSTORM ST BLOCK
- GREENSTORM SIDEWALL GRID WITH 8 OZ NON-WOVEN GEOTEXTILE
- GREENSTORM TREATMENT ROW
- GREENSTORM ACCESS QUADRO
- IMPERMEABLE LINER. SEAMS TO BE WELDED. DESIGNED AND SUPPLIED BY OTHERS.
- PIPE ADAPTER



1 SYSTEM LAYOUT PLAN
NTS

NOTE:*ALL EXTERNAL SYSTEM STRUCTURES, INLET/OUTLET PIPES, AND PROPOSED ELEVATIONS MUST BE DESIGNED AND APPROVED BY PROJECT ENGINEER OF RECORD. PROJECT ENGINEER OF RECORD MUST ENSURE CHAMBER BURIAL REQUIREMENTS ARE MET.

MATERIALS LIST SUPPLIED BY STORMCON
(SYSTEM MATERIALS LIST - SEE COVER SHEET FOR COMBINED PROJECT MATERIALS LIST)

GREENSTORM-ST	5041	PIECES
SINGLE LAYER CONNECTOR	1300	PIECES
MULTI LAYER CONNECTOR	3500	PIECES
SIDEWALL GRID	654	PIECES
HALF BLOCK SIDEWALL GRID	0	PIECES
HALF BLOCK COVER PLATE	0	PIECES
HALF BLOCK COVER PLATE QUADRO CONTROL	0	PIECES
QUADRO CONTROL	57	PIECES
QUADRO ADAPTERS	9	PIECES
EXTENSION PIPE	18	METER
CAST IRON COVER	9	PIECES
NO. OF 525mmØ PIPE ADAPTER	6	PIECES
NO. OF 450mmØ PIPE ADAPTER	0	PIECES
MIDDLE GRID	0	PIECES
MIDDLE GRID QUADRO CONTROL	0	PIECES
8 OZ NON-WOVEN GEOTEXTILE	3220	SQ. METER
IMPERMEABLE LINER. SEAMS TO BE WELDED. DESIGNED AND SUPPLIED BY OTHERS.	0	SQ. METER
LINER TAPE BY OTHERS	0	METER
GREENSTORM FULL TREATMENT ROW	31	PIECES
GREENSTORM HALF TREATMENT ROW	0	PIECES
100MM SUBDRAIN	0	METER

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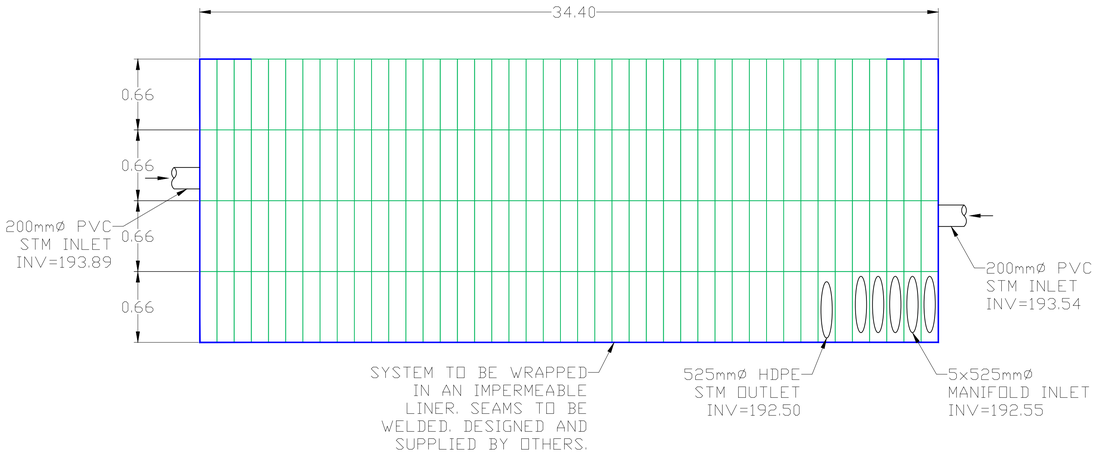
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3770 MONTROSE ROAD
NIAGARA FALLS, ON

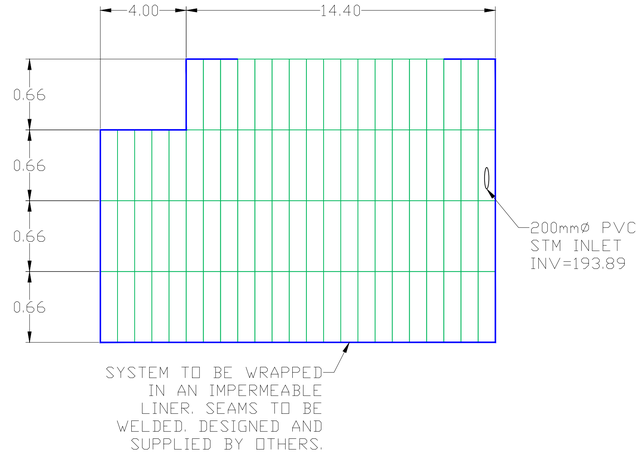
SYSTEM LAYOUT SHEET STORAGE TANK

GREENSTORM STORMWATER CHAMBER

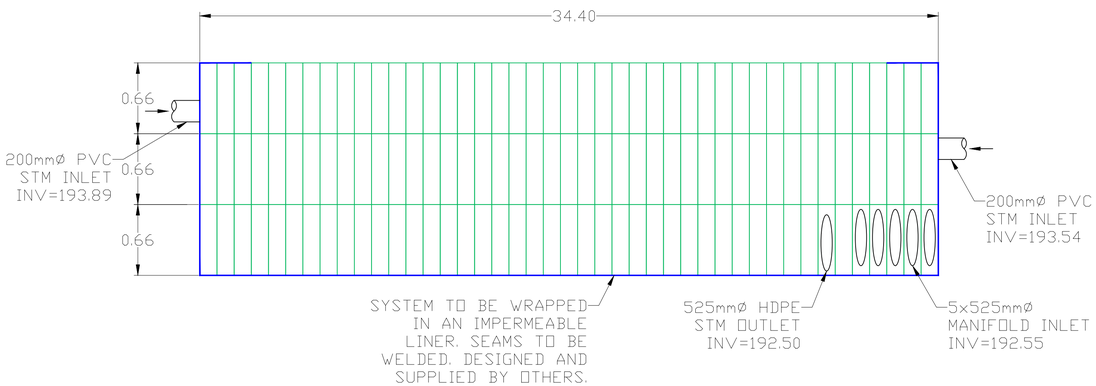
PROJECT NO:	2023-169	DATE:	11/17/2023
DESIGNED BY:	JD	CHECKED BY:	EC
SCALE:	N.T.S.	SHEET NO:	2 OF 7



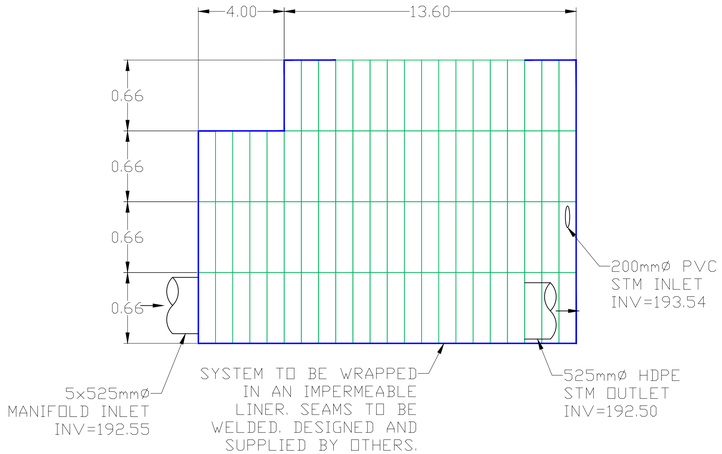
② 4.0 LAYER SYSTEM PROFILE (SECTION A-A)
NTS



② 3.0 & 4.0 LAYER SYSTEM PROFILE (SECTION C-C)
NTS



③ 3.0 LAYER SYSTEM PROFILE (SECTION B-B)
NTS



② 3.0 & 4.0 LAYER SYSTEM PROFILE (SECTION D-D)
NTS

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3770 MONTROSE ROAD
NIAGARA FALLS, ON

SYSTEM SECTIONS

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2023-169	DATE:	11/17/2023
DESIGNED BY:	JD	CHECKED BY:	EC
SCALE:	N.T.S.	SHEET NO:	3 OF 7

GREENSTORM Stage Storage Calculations

Project Details

Project Name	Cassone Dwellings (BT) Inc.
Address	3770 Montrose Road
City	Niagara Falls, ON
Country	Canada
Date	August 27, 2025

System Details

Chamber Model	GreenStorm-ST	
Number of Layers	**4.0**	
Height of Chambers	2.64	m
Storage Void Ratio	96%	
GreenStorm Perimeter	**124.80**	m
System Perimeter	**124.80**	
GreenStorm Area	**304.64**	m^2
System Area	**304.64**	m^2
GreenStorm Base Elevation	**192.46**	m

Top Stone	**0.00**	m
Bottom Stone	**0.00**	m
Perimeter Stone	**0.00**	m
Stone Qty.	0.00	m^3
Stone Void Ratio	40%	
Impermeable Liner	**Yes**	
Middle Grids	**No**	
Highest Finished Grade	**195.99**	m
Lowest Finished Grade	**195.30**	m

Stage Storage

Height of System	GreenStorm Volume	Top Stone Volume	Bottom Stone Volume	Perimeter Stone Volume	Cumulative Storage Volume	Elevation
mm	m^3	m^3	m^3	m^3	m^3	m
2640	11.70	0.00	0.00	0.00	772.08	195.100
2600	7.31	0.00	0.00	0.00	760.38	195.060
2575	7.31	0.00	0.00	0.00	753.07	195.035
2550	7.31	0.00	0.00	0.00	745.76	195.010
2525	7.31	0.00	0.00	0.00	738.45	194.985
2500	7.31	0.00	0.00	0.00	731.14	194.960
2475	7.31	0.00	0.00	0.00	723.82	194.935
2450	7.31	0.00	0.00	0.00	716.51	194.910
2425	7.31	0.00	0.00	0.00	709.20	194.885
2400	7.31	0.00	0.00	0.00	701.89	194.860
2375	7.31	0.00	0.00	0.00	694.58	194.835
2350	7.31	0.00	0.00	0.00	687.27	194.810
2325	7.31	0.00	0.00	0.00	679.96	194.785
2300	7.31	0.00	0.00	0.00	672.65	194.760
2275	7.31	0.00	0.00	0.00	665.33	194.735
2250	7.31	0.00	0.00	0.00	658.02	194.710
2225	7.31	0.00	0.00	0.00	650.71	194.685
2200	7.31	0.00	0.00	0.00	643.40	194.660
2175	7.31	0.00	0.00	0.00	636.09	194.635
2150	7.31	0.00	0.00	0.00	628.78	194.610
2125	7.31	0.00	0.00	0.00	621.47	194.585
2100	7.31	0.00	0.00	0.00	614.15	194.560
2075	7.31	0.00	0.00	0.00	606.84	194.535
2050	7.31	0.00	0.00	0.00	599.53	194.510
2025	7.31	0.00	0.00	0.00	592.22	194.485
2000	7.31	0.00	0.00	0.00	584.91	194.460
1975	7.31	0.00	0.00	0.00	577.60	194.435
1950	7.31	0.00	0.00	0.00	570.29	194.410
1925	7.31	0.00	0.00	0.00	562.97	194.385
1900	7.31	0.00	0.00	0.00	555.66	194.360
1875	7.31	0.00	0.00	0.00	548.35	194.335
1850	7.31	0.00	0.00	0.00	541.04	194.310
1825	7.31	0.00	0.00	0.00	533.73	194.285
1800	7.31	0.00	0.00	0.00	526.42	194.260
1775	7.31	0.00	0.00	0.00	519.11	194.235
1750	7.31	0.00	0.00	0.00	511.80	194.210
1725	7.31	0.00	0.00	0.00	504.48	194.185
1700	7.31	0.00	0.00	0.00	497.17	194.160
1675	7.31	0.00	0.00	0.00	489.86	194.135
1650	7.31	0.00	0.00	0.00	482.55	194.110
1625	7.31	0.00	0.00	0.00	475.24	194.085
1600	7.31	0.00	0.00	0.00	467.93	194.060
1575	7.31	0.00	0.00	0.00	460.62	194.035
1550	7.31	0.00	0.00	0.00	453.30	194.010
1525	7.31	0.00	0.00	0.00	445.99	193.985
1500	7.31	0.00	0.00	0.00	438.68	193.960
1475	7.31	0.00	0.00	0.00	431.37	193.935
1450	7.31	0.00	0.00	0.00	424.06	193.910
1425	7.31	0.00	0.00	0.00	416.75	193.885
1400	7.31	0.00	0.00	0.00	409.44	193.860
1375	7.31	0.00	0.00	0.00	402.12	193.835
1350	7.31	0.00	0.00	0.00	394.81	193.810
1325	7.31	0.00	0.00	0.00	387.50	193.785
1300	7.31	0.00	0.00	0.00	380.19	193.760
1275	7.31	0.00	0.00	0.00	372.88	193.735
1250	7.31	0.00	0.00	0.00	365.57	193.710
1225	7.31	0.00	0.00	0.00	358.26	193.685
1200	7.31	0.00	0.00	0.00	350.95	193.660
1175	7.31	0.00	0.00	0.00	343.63	193.635
1150	7.31	0.00	0.00	0.00	336.32	193.610
1125	7.31	0.00	0.00	0.00	329.01	193.585
1100	7.31	0.00	0.00	0.00	321.70	193.560
1075	7.31	0.00	0.00	0.00	314.39	193.535
1050	7.31	0.00	0.00	0.00	307.08	193.510
1025	7.31	0.00	0.00	0.00	299.77	193.485
1000	7.31	0.00	0.00	0.00	292.45	193.460
975	7.31	0.00	0.00	0.00	285.14	193.435
950	7.31	0.00	0.00	0.00	277.83	193.410
925	7.31	0.00	0.00	0.00	270.52	193.385
900	7.31	0.00	0.00	0.00	263.21	193.360
875	7.31	0.00	0.00	0.00	255.90	193.335
850	7.31	0.00	0.00	0.00	248.59	193.310
825	7.31	0.00	0.00	0.00	241.27	193.285
800	7.31	0.00	0.00	0.00	233.96	193.260
775	7.31	0.00	0.00	0.00	226.65	193.235
750	7.31	0.00	0.00	0.00	219.34	193.210
725	7.31	0.00	0.00	0.00	212.03	193.185
700	7.31	0.00	0.00	0.00	204.72	193.160
675	7.31	0.00	0.00	0.00	197.41	193.135
650	7.31	0.00	0.00	0.00	190.10	193.110
625	7.31	0.00	0.00	0.00	182.78	193.085
600	7.31	0.00	0.00	0.00	175.47	193.060
575	7.31	0.00	0.00	0.00	168.16	193.035
550	7.31	0.00	0.00	0.00	160.85	193.010
525	7.31	0.00	0.00	0.00	153.54	192.985
500	7.31	0.00	0.00	0.00	146.23	192.960
475	7.31	0.00	0.00	0.00	138.92	192.935
450	7.31	0.00	0.00	0.00	131.60	192.910
425	7.31	0.00	0.00	0.00	124.29	192.885
400	7.31	0.00	0.00	0.00	116.98	192.860
375	7.31	0.00	0.00	0.00	109.67	192.835
350	7.31	0.00	0.00	0.00	102.36	192.810
325	7.31	0.00	0.00	0.00	95.05	192.785
300	7.31	0.00	0.00	0.00	87.74	192.760
275	7.31	0.00	0.00	0.00	80.42	192.735
250	7.31	0.00	0.00	0.00	73.11	192.710
225	7.31	0.00	0.00	0.00	65.80	192.685
200	7.31	0.00	0.00	0.00	58.49	192.660
175	7.31	0.00	0.00	0.00	51.18	192.635
150	7.31	0.00	0.00	0.00	43.87	192.610
125	7.31	0.00	0.00	0.00	36.56	192.585
100	7.31	0.00	0.00	0.00	29.25	192.560
75	7.31	0.00	0.00	0.00	21.93	192.535
50	7.31	0.00	0.00	0.00	14.62	192.510
25	7.31	0.00	0.00	0.00	7.31	192.485
0	0.00	0.00	0.00	0.00	0.00	192.460

4.0-LAYER GREENSTORM CALCULATION SHEET (SYSTEM STAGE-STORAGE TABLE)

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3770 MONTROSE ROAD
NIAGARA FALLS, ON

SYSTEM CALCULATION SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2023-169	DATE:	11/17/2023
DESIGNED BY:	JD	CHECKED BY:	EC
SCALE:	N.T.S.	SHEET NO:	4 OF 7

GREENSTORM Stage Storage Calculations

Project Details

Project Name	Cassone Dwellings (BT) Inc.
Address	3770 Montrose Road
City	Niagara Falls, ON
Country	Canada
Date	August 27, 2025

System Details

Chamber Model	**GreenStorm-ST**	
Number of Layers	**3.0**	
Height of Chambers	1.98	m
Chamber Length	34.40	m
Chamber Width	4.00	m
Storage Void Ratio	96%	
System Perimeter	76.80	m
GreenStorm Area	137.60	m^2
System Area	137.60	m^2
GreenStorm Base Elevation	**192.46**	m

Top Stone	**0.00**	m
Bottom Stone	**0.00**	m
Perimeter Stone	**0.00**	m
Stone Qty.	0.00	m^3
Stone Void Ratio	40%	
Impermeable Liner	**Yes**	
Middle Grids	**No**	
Highest Finished Grade	**195.99**	m
Lowest Finished Grade	**195.30**	m

Stage Storage

Height of System	GreenStorm Volume	Top Stone Volume	Bottom Stone Volume	Perimeter Stone Volume	Cumulative Storage Volume	Elevation
mm	m^3	m^3	m^3	m^3	m^3	m
1980	3.96	0.00	0.00	0.00	261.55	194.440
1950	3.30	0.00	0.00	0.00	257.59	194.410
1925	3.30	0.00	0.00	0.00	254.28	194.385
1900	3.30	0.00	0.00	0.00	250.98	194.360
1875	3.30	0.00	0.00	0.00	247.68	194.335
1850	3.30	0.00	0.00	0.00	244.38	194.310
1825	3.30	0.00	0.00	0.00	241.08	194.285
1800	3.30	0.00	0.00	0.00	237.77	194.260
1775	3.30	0.00	0.00	0.00	234.47	194.235
1750	3.30	0.00	0.00	0.00	231.17	194.210
1725	3.30	0.00	0.00	0.00	227.87	194.185
1700	3.30	0.00	0.00	0.00	224.56	194.160
1675	3.30	0.00	0.00	0.00	221.26	194.135
1650	3.30	0.00	0.00	0.00	217.96	194.110
1625	3.30	0.00	0.00	0.00	214.66	194.085
1600	3.30	0.00	0.00	0.00	211.35	194.060
1575	3.30	0.00	0.00	0.00	208.05	194.035
1550	3.30	0.00	0.00	0.00	204.75	194.010
1525	3.30	0.00	0.00	0.00	201.45	193.985
1500	3.30	0.00	0.00	0.00	198.14	193.960
1475	3.30	0.00	0.00	0.00	194.84	193.935
1450	3.30	0.00	0.00	0.00	191.54	193.910
1425	3.30	0.00	0.00	0.00	188.24	193.885
1400	3.30	0.00	0.00	0.00	184.93	193.860
1375	3.30	0.00	0.00	0.00	181.63	193.835
1350	3.30	0.00	0.00	0.00	178.33	193.810
1325	3.30	0.00	0.00	0.00	175.03	193.785
1300	3.30	0.00	0.00	0.00	171.72	193.760
1275	3.30	0.00	0.00	0.00	168.42	193.735
1250	3.30	0.00	0.00	0.00	165.12	193.710
1225	3.30	0.00	0.00	0.00	161.82	193.685
1200	3.30	0.00	0.00	0.00	158.52	193.660
1175	3.30	0.00	0.00	0.00	155.21	193.635
1150	3.30	0.00	0.00	0.00	151.91	193.610
1125	3.30	0.00	0.00	0.00	148.61	193.585
1100	3.30	0.00	0.00	0.00	145.31	193.560
1075	3.30	0.00	0.00	0.00	142.00	193.535
1050	3.30	0.00	0.00	0.00	138.70	193.510
1025	3.30	0.00	0.00	0.00	135.40	193.485
1000	3.30	0.00	0.00	0.00	132.10	193.460
975	3.30	0.00	0.00	0.00	128.79	193.435
950	3.30	0.00	0.00	0.00	125.49	193.410
925	3.30	0.00	0.00	0.00	122.19	193.385
900	3.30	0.00	0.00	0.00	118.89	193.360
875	3.30	0.00	0.00	0.00	115.58	193.335
850	3.30	0.00	0.00	0.00	112.28	193.310
825	3.30	0.00	0.00	0.00	108.98	193.285
800	3.30	0.00	0.00	0.00	105.68	193.260
775	3.30	0.00	0.00	0.00	102.37	193.235
750	3.30	0.00	0.00	0.00	99.07	193.210
725	3.30	0.00	0.00	0.00	95.77	193.185
700	3.30	0.00	0.00	0.00	92.47	193.160
675	3.30	0.00	0.00	0.00	89.16	193.135
650	3.30	0.00	0.00	0.00	85.86	193.110
625	3.30	0.00	0.00	0.00	82.56	193.085
600	3.30	0.00	0.00	0.00	79.26	193.060
575	3.30	0.00	0.00	0.00	75.96	193.035
550	3.30	0.00	0.00	0.00	72.65	193.010
525	3.30	0.00	0.00	0.00	69.35	192.985
500	3.30	0.00	0.00	0.00	66.05	192.960
475	3.30	0.00	0.00	0.00	62.75	192.935
450	3.30	0.00	0.00	0.00	59.44	192.910
425	3.30	0.00	0.00	0.00	56.14	192.885
400	3.30	0.00	0.00	0.00	52.84	192.860
375	3.30	0.00	0.00	0.00	49.54	192.835
350	3.30	0.00	0.00	0.00	46.23	192.810
325	3.30	0.00	0.00	0.00	42.93	192.785
300	3.30	0.00	0.00	0.00	39.63	192.760
275	3.30	0.00	0.00	0.00	36.33	192.735
250	3.30	0.00	0.00	0.00	33.02	192.710
225	3.30	0.00	0.00	0.00	29.72	192.685
200	3.30	0.00	0.00	0.00	26.42	192.660
175	3.30	0.00	0.00	0.00	23.12	192.635
150	3.30	0.00	0.00	0.00	19.81	192.610
125	3.30	0.00	0.00	0.00	16.51	192.585
100	3.30	0.00	0.00	0.00	13.21	192.560
75	3.30	0.00	0.00	0.00	9.91	192.535
50	3.30	0.00	0.00	0.00	6.60	192.510
25	3.30	0.00	0.00	0.00	3.30	192.485
0	0.00	0.00	0.00	0.00	0.00	192.460

3.0-LAYER GREENSTORM CALCULATION SHEET (SYSTEM STAGE-STORAGE TABLE)

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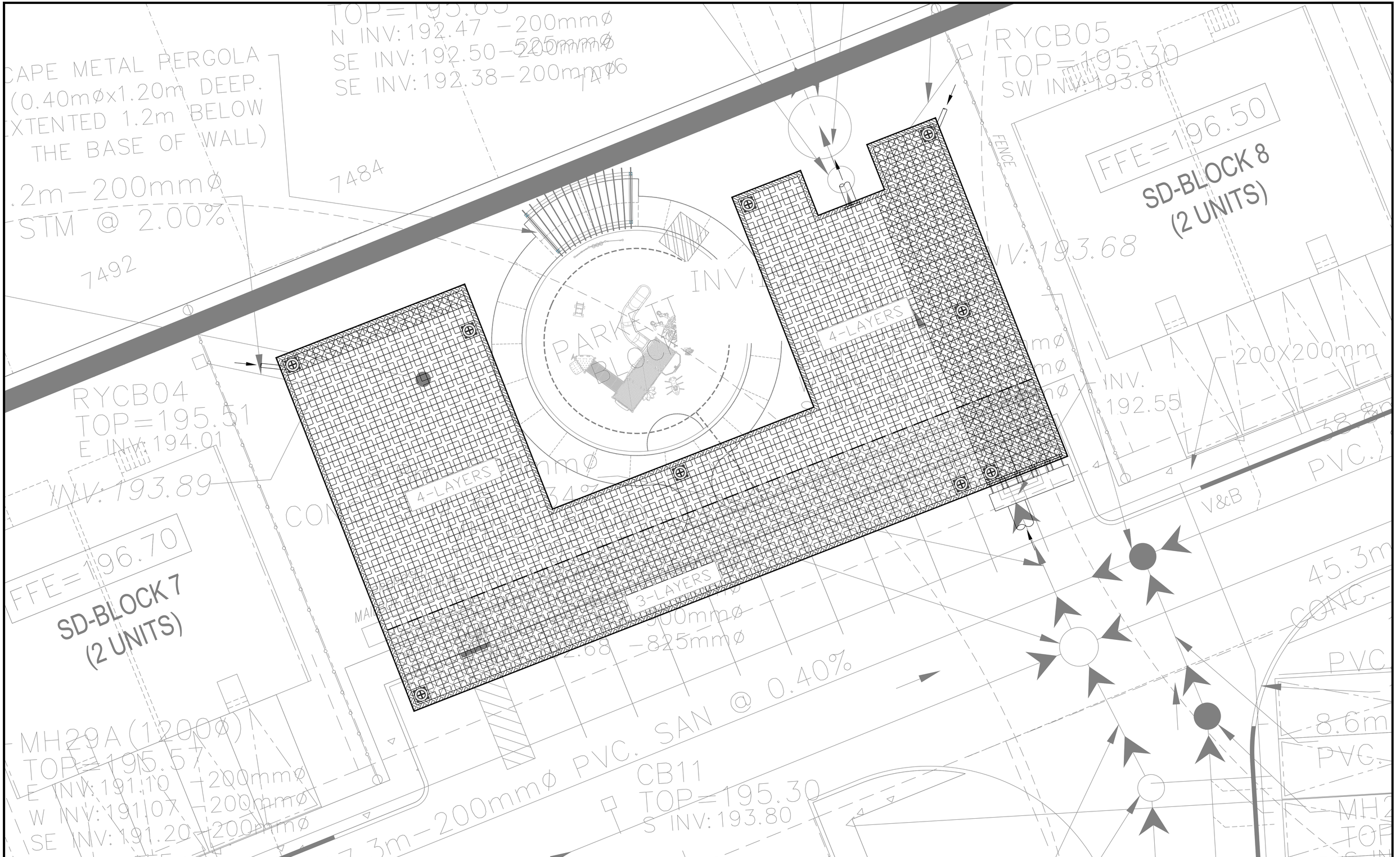
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3770 MONTROSE ROAD
NIAGARA FALLS, ON

SYSTEM CALCULATION SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2023-169	DATE:	11/17/2023
DESIGNED BY:	JD	CHECKED BY:	EC
SCALE:	N.T.S.	SHEET NO:	5 OF 7



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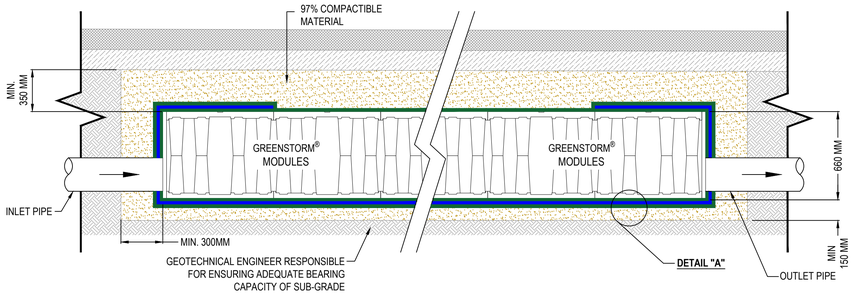
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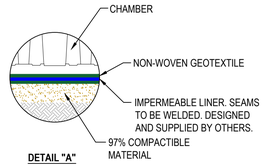
3770 MONTROSE ROAD
NIAGARA FALLS, ON

SYSTEM OVERLAY SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2023-169	DATE:	11/17/2023
DESIGNED BY:	JD	CHECKED BY:	EC
SCALE:	N.T.S.	SHEET NO:	6 OF 7





BEDDING & BACKFILL REQUIREMENTS:

BEDDING:

NON-COHESIVE, NON-FROZEN EARTHWORK MATERIAL WITH A MAXIMUM GRAIN SIZE OF 32mm. DEGREE OF COMPACTION D_p SHOULD BE LARGER THAN OR EQUAL TO 97%. BELOW TRAFFIC AREAS, EV2 SHOULD BE LARGER THAN OR EQUAL TO 45 MN/m^2 OR CBR SHOULD BE LARGER THAN OR EQUAL TO 12% AT THE TOP EDGE OF THE BEARING. PREFERABLY MADE OF CRUSHED STONES (e.g. 2/5mm), GRAVEL OR SAND.

LATERAL BACKFILL AND COVER:

NON-COHESIVE, NON-FROZEN EARTHWORK MATERIAL WITH A MAXIMUM GRAIN SIZE OF 32mm. DISTRIBUTED EVENLY AND COMPACTED IN LAYERS OF MAX. 0.30m. DEGREE OF COMPACTION D_p SHOULD BE LARGER THAN OR EQUAL TO 97%. BELOW TRAFFIC AREAS, EV2 SHOULD BE LARGER THAN OR EQUAL TO 45 MN/m^2 OR CBR SHOULD BE LARGER THAN OR EQUAL TO 12% AT THE TOP EDGE OF THE BEARING.

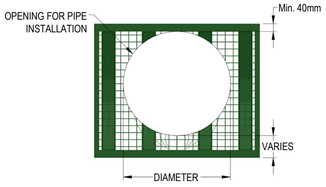
LEGEND

- IMPERMEABLE LINER. SEAMS TO BE WELDED. DESIGNED AND SUPPLIED BY OTHERS.
- 8 OZ NON-WOVEN GEOTEXTILE

TYPICAL ONE LAYER GREENSTORM CROSS SECTION

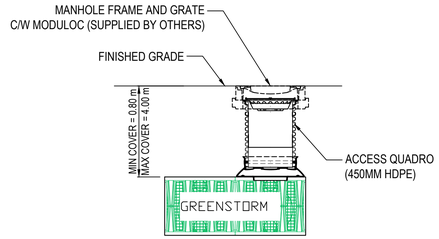
FULL CONNECTION OPTIONS
Dia 100mm, 150 mm, 200 mm, 250 mm, 300 mm AND 375 mm

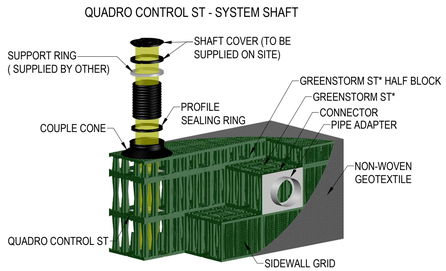




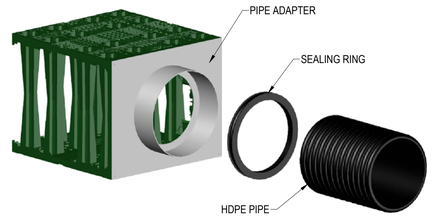
SIDE PANEL WITH DIRECT PIPE CUT

STANDARD SIDE PANEL WITH DIRECT PIPE CUT

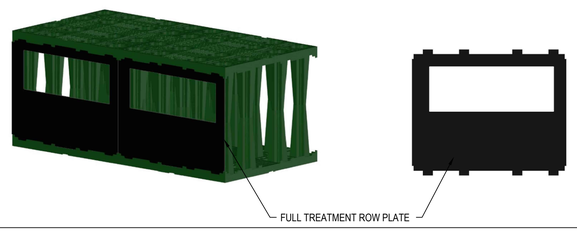


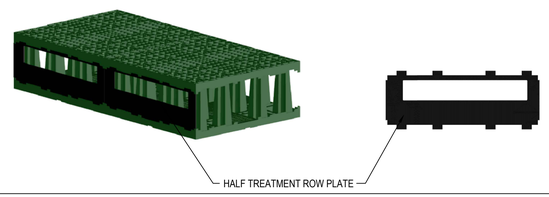


GREENSTORM ACCESS QUADRO DETAIL(WHERE APPLICABLE)

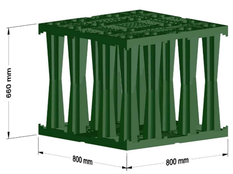


STANDARD ADAPTER PANEL WITH DIA 450 AND 525

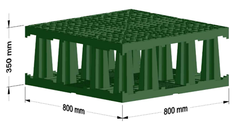




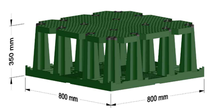
STANDARD TREATMENT ROW DETAIL (WHERE APPLICABLE)



FULL BLOCK



HALF BLOCK



MIDDLE GRID

STANDARD GREENSTORM BLOCK DETAIL

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3770 MONTROSE ROAD
NIAGARA FALLS, ON

DETAILS SHEET

GREENSTORM STORMWATER CHAMBER

PROJECT NO:	2023-169	DATE:	11/17/2023
DESIGNED BY:	JD	CHECKED BY:	EC
SCALE:	N.T.S.	SHEET NO:	7 OF 7

Counterpoint Engineering Inc.

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Project: Treasure Hill
Project No: 21102
Client: 0
Location: City of St. Catharines

Prepared by: BB
Checked by: JY
Date: September 15, 2025

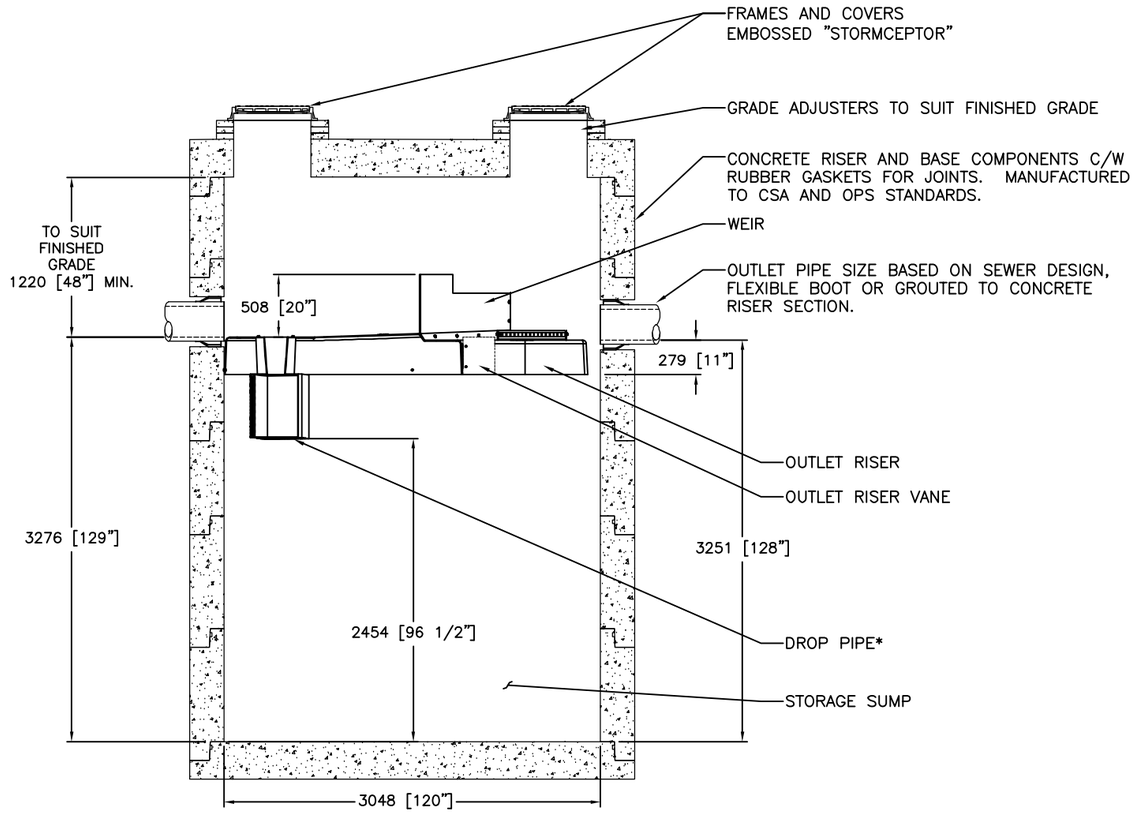
Rainfall Data: a, b, c Values

	5-Year
a	664.00
b	4.70
c	0.74

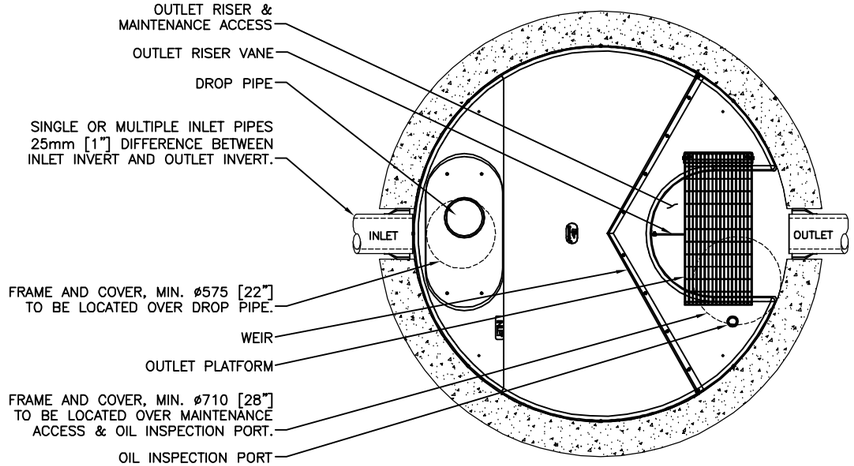
Manning's Roughness Coefficient (All pipes)= 0.013

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Location	From Node	To Node	Diam. (nominal) (mm)	Length Pipe (m)	Slope Pipe (%)	Area (ha)	C	A x C (ha)	Accum AxC (ha)	Rainfall Intensity mm/hr	Time of Conc. (Tc) (min)	Area Flow Q (l/s)	Other Flows (l/s)	Total Flow (l/s)	Diameter Actual (m)	Pipe Area (sq.m)	Hydraulic Radius (m)	Pipe Mat.	Pipe Capacity (l/s)	Velocity (m/s)	Time of Flow (min)	Ratio Q/Q full	Cap. Check
Street I	MH17	MH16	600	6.2	0.32	0.00	--	0.000	1.253	73.8	14.47	256.8	0.0	256.8	610	0.292	0.152	RCP	362.6	1.24	0.08	0.71	OK
Street I	MH18	MH17	600	81.2	0.31	0.41	0.90	0.367	1.253	77.1	13.36	268.4	0.0	268.4	610	0.292	0.152	RCP	355.2	1.22	1.11	0.76	OK
Street I	MH19	MH18	525	66.0	0.30	0.26	0.90	0.234	0.886	80.5	12.36	198.0	0.0	198.0	533	0.223	0.133	RCP	246.9	1.10	1.00	0.80	OK
Street E	MH20	MH19	450	41.8	0.31	0.17	0.90	0.155	0.483	83.0	11.66	111.4	0.0	111.4	448	0.158	0.112	PVC	157.0	1.00	0.70	0.71	OK
Street E	MH30	MH20	450	58.8	0.31	0.31	0.90	0.275	0.329	87.0	10.67	79.4	0.0	79.4	448	0.158	0.112	PVC	155.7	0.99	0.99	0.51	OK
0	MH28	MH30	300	28.2	0.32	0.00	--	0.000	0.054	89.6	10.06	13.4	0.0	13.4	299	0.070	0.075	PVC	54.3	0.77	0.61	0.25	OK
0	MH20AA	MH19	300	28.0	1.00	0.12	0.90	0.109	0.109	89.9	10.00	27.1	0.0	27.1	299	0.070	0.075	PVC	96.2	1.37	0.34	0.28	OK
Street H	MH14	MH02	450	7.9	0.38	0.00	--	0.000	0.566	81.1	12.18	127.6	0.0	127.6	448	0.158	0.112	PVC	173.7	1.10	0.12	0.73	OK
Street H	MH15	MH14	450	75.0	0.32	0.31	0.90	0.282	0.566	85.8	10.94	135.0	0.0	135.0	448	0.158	0.112	PVC	159.3	1.01	1.24	0.85	OK
Street C	MH02	Structure - (256)	900	8.8	0.34	0.00	--	0.000	4.228	72.0	15.13	845.1	0.0	845.1	914	0.657	0.229	RCP	1102.6	1.68	0.09	0.77	OK
Street C	MH16	MH02	675	45.3	0.31	0.34	0.90	0.308	1.561	73.5	14.55	318.9	0.0	318.9	686	0.369	0.171	RCP	487.8	1.32	0.57	0.65	OK
Street C	MH03	MH02	825	56.7	0.32	0.28	0.90	0.252	2.101	75.9	13.74	443.2	0.0	443.2	838	0.552	0.210	RCP	843.4	1.53	0.62	0.53	OK
Street C	MH04	MH03	750	20.2	0.35	0.26	0.90	0.236	1.849	76.6	13.51	393.7	0.0	393.7	762	0.456	0.190	RCP	684.3	1.50	0.22	0.58	OK
Street C	MH05	MH04	675	41.1	0.32	0.26	0.90	0.235	1.613	78.3	13.00	350.7	0.0	350.7	686	0.369	0.171	RCP	493.0	1.33	0.51	0.71	OK
Street C	MH06	MH05	525	59.6	0.30	0.18	0.90	0.165	0.585	81.4	12.10	132.2	0.0	132.2	533	0.223	0.133	RCP	246.6	1.10	0.90	0.54	OK
Street B	MH26	MH06	300	18.7	0.32	0.07	0.90	0.059	0.059	89.9	10.00	14.7	0.0	14.7	299	0.070	0.075	PVC	54.4	0.77	0.40	0.27	OK
Street B	MH07	MH06	450	21.1	0.33	0.04	0.90	0.037	0.361	82.6	11.76	82.8	0.0	82.8	448	0.158	0.112	PVC	162.3	1.03	0.34	0.51	OK
0	CBMH10	MH07	450	14.3	0.35	0.02	0.90	0.016	0.324	83.5	11.53	75.0	0.0	75.0	448	0.158	0.112	PVC	166.5	1.06	0.23	0.45	OK
0	CBMH09	CBMH10	450	25.6	0.31	0.08	0.90	0.069	0.308	85.2	11.10	72.9	0.0	72.9	448	0.158	0.112	PVC	157.2	1.00	0.43	0.46	OK
Street B	CBMH100	CBMH09	375	28.4	0.32	0.13	0.90	0.121	0.239	87.4	10.57	58.1	0.0	58.1	366	0.105	0.092	PVC	92.8	0.88	0.54	0.63	OK
0	CBMH08	CBMH100	300	25.8	0.31	0.13	0.90	0.119	0.119	89.9	10.00	29.6	0.0	29.6	299	0.070	0.075	PVC	53.5	0.76	0.57	0.55	OK
0	MH11	MH05	600	46.6	0.30	0.00	--	0.000	0.793	85.3	11.08	187.7	0.0	187.7	610	0.292	0.152	RCP	351.0	1.20	0.65	0.53	OK
Street F	MH09	MH11	525	7.5	0.40	0.21	0.90	0.190	0.793	85.7	10.98	188.6	0.0	188.6	533	0.223	0.133	RCP	283.4	1.27	0.10	0.67	OK
0	MH27	MH09	450	28.1	0.32	0.21	0.90	0.186	0.386	87.6	10.52	94.0	0.0	94.0	448	0.158	0.112	PVC	159.3	1.01	0.46	0.59	OK
Street F	MH10	MH27	375	26.6	0.30	0.22	0.90	0.200	0.200	89.9	10.00	49.9	0.0	49.9	366	0.105	0.092	PVC	90.4	0.86	0.52	0.55	OK
Street F	CBMH25	MH15	300	28.8	1.01	0.17	0.90	0.157	0.285	87.3	10.59	69.0	0.0	69.0	299	0.070	0.075	PVC	96.4	1.37	0.35	0.72	OK
0	MH29	CBMH25	300	26.6	0.30	0.14	0.90	0.127	0.127	89.9	10.00	31.8	0.0	31.8	299	0.070	0.075	PVC	52.7	0.75	0.59	0.60	OK
0	CBMH13	MH09	300	28.4	0.32	0.11	0.90	0.098	0.098	89.9	10.00	24.5	0.0	24.5	299	0.070	0.075	PVC	54.1	0.77	0.62	0.45	OK

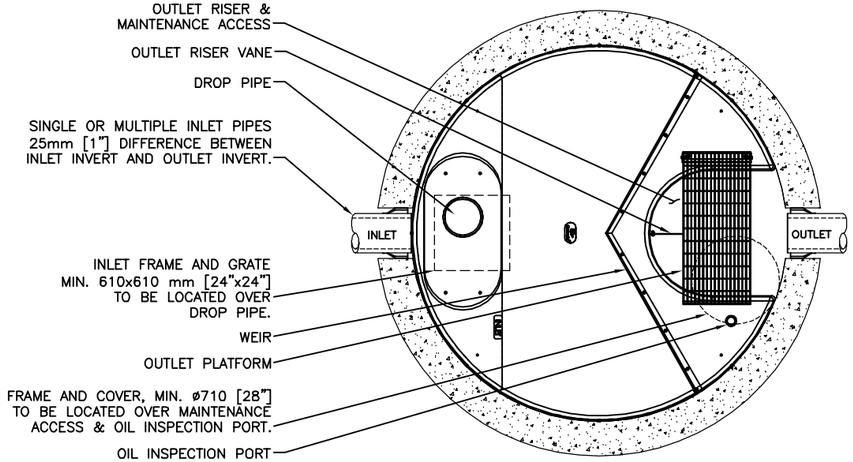
DRAWING NOT TO BE USED FOR CONSTRUCTION



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF10 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO10 (OIL CAPTURE CONFIGURATION).

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EF10				
STRUCTURE ID					*
WATER QUALITY FLOW RATE (L/s)					*
PEAK FLOW RATE (L/s)					*
RETURN PERIOD OF PEAK FLOW (yrs)					*
DRAINAGE AREA (HA)					*
DRAINAGE AREA IMPERVIOUSNESS (%)					*
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

MARK	DATE	REVISION DESCRIPTION	BY
1	6/8/18	OUTLET PLATFORM	JSK
0	5/26/17	INITIAL RELEASE	JSK

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Stormceptor® EF

SCALE = NTS

imbrium®
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TF 800-565-4501 CA 416-665-8600 INTL +1-416-665-8600

THE STORMCEPTOR SYSTEM IS PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 5,498,323; 5,725,760; 5,753,115; 6,068,765; 6,371,690; 6,511,595; 6,649,048; 6,991,114; 7,186,058; 7,296,692; 7,297,266; 7,390,410; 7,425,262; 7,470,369; 7,563,363; 7,582,211; 7,704,393; 7,905,367; 8,287,728; 8,470,173; 8,673,157; 8,771,511; 8,852,436; 9,032,677; 9,366,035; 9,481,990; 9,546,478; 9,616,357; 9,714,501; 9,764,254; 9,885,188; 9,890,528; 9,938,708; 9,951,505; 10,053,858; 10,132,071; 10,174,496; 10,214,894; 10,227,762; 10,240,329; 10,329,756; 10,329,757; 10,329,758; 10,329,759; 10,329,760; 10,329,761; 10,329,762; 10,329,763; 10,329,764; 10,329,765; 10,329,766; 10,329,767; 10,329,768; 10,329,769; 10,329,770; 10,329,771; 10,329,772; 10,329,773; 10,329,774; 10,329,775; 10,329,776; 10,329,777; 10,329,778; 10,329,779; 10,329,780; 10,329,781; 10,329,782; 10,329,783; 10,329,784; 10,329,785; 10,329,786; 10,329,787; 10,329,788; 10,329,789; 10,329,790; 10,329,791; 10,329,792; 10,329,793; 10,329,794; 10,329,795;

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Stormceptor® EF4 and EFO4 Oil-Grit Separators

Developed by Imbrium Systems, Inc.,
Whitby, Ontario, Canada

In accordance with

ISO 14034:2016

Environmental management —
Environmental technology verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

November 10, 2017
Vancouver, BC, Canada

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Technology description and application

The Stormceptor® EF4 and EFO4 are treatment devices designed to remove oil, sediment, trash, debris, and pollutants attached to particulates from Stormwater and snowmelt runoff. The device takes the place of a conventional manhole within a storm drain system and offers design flexibility that works with various site constraints. The EFO4 is designed with a shorter bypass weir height, which accepts lower surface loading rate into the sump, thereby reducing re-entrainment of captured free floating light liquids.

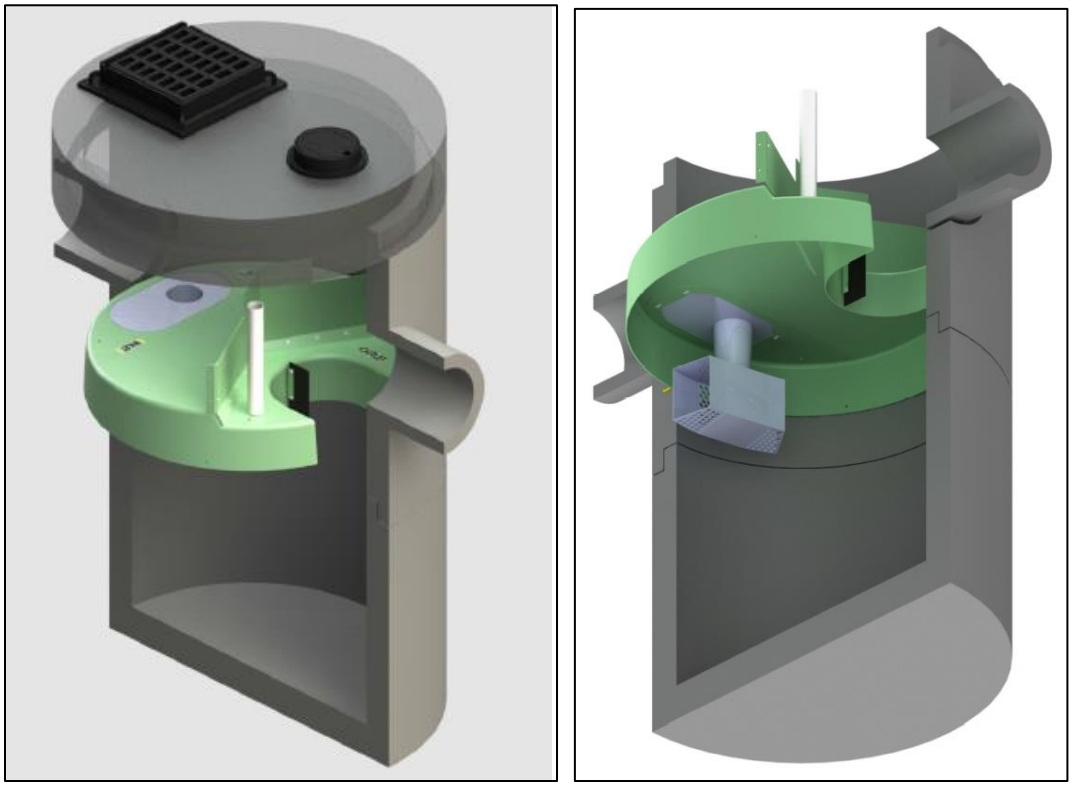


Figure 1. Graphic of typical inline Stormceptor® unit and core components.

Stormwater and snowmelt runoff enters the Stormceptor® EF/EFO's upper chamber through the inlet pipe(s) or a surface inlet grate. An insert divides the unit into lower and upper chambers and incorporates a weir to reduce influent velocity and separate influent (untreated) from effluent (treated) flows. Influent water ponds upstream of the insert's weir providing driving head for the water flowing downwards into the drop pipe where a vortex pulls the water into the lower chamber. The water diffuses at lower velocities in multiple directions through the drop pipe outlet openings. Oil and other floatables rise up and are trapped beneath the insert, while sediments undergo gravitational settling to the sump's bottom. Water from the sump can exit by flowing upward to the outlet riser onto the top side of the insert and downstream of the weir, where it discharges through the outlet pipe.

Maximum flow rate into the lower chamber is a function of weir height and drop pipe orifice diameter. The Stormceptor® EF and EFO are designed to allow a surface loading rate of 1135 L/min/m^2 (27.9 gal/min/ft^2) and 535 L/min/m^2 (13.1 gal/min/ft^2) into the lower chamber, respectively. When prescribed surface loading rates are exceeded, ponding water can overtop the weir height and bypass the lower treatment chamber, exiting directly through the outlet pipe. Hydraulic testing and scour testing demonstrate that the internal bypass effectively prevents scour at all bypass flow rates. Increasing the bypass flow rate does not increase the orifice-controlled flow rate into the lower treatment chamber where sediment is stored. This internal bypass feature allows for in-line installation, avoiding the cost of

additional bypass structures. During bypass, treatment continues in the lower chamber at the maximum flow rate. The Stormceptor® EFO's lower design surface loading rate is favorable for minimizing re-entrainment and washout of captured light liquids. Inspection of Stormceptor® EF and EFO devices is performed from grade by inserting a sediment probe through the outlet riser and an oil dipstick through the oil inspection pipe. The unit can be maintained by using a vacuum hose through the outlet riser.

Performance conditions

The data and results published in this Technology Fact Sheet were obtained from the testing program conducted on the Imbrium Systems Inc.'s Stormceptor® OGS device, in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014). The Procedure was prepared by the Toronto and Region Conservation Authority (TRCA) for Environment Canada's Environmental Technology Verification (ETV) Program. A copy of the Procedure may be accessed on the Canadian ETV website at www.etvcanada.ca.

Performance claim(s)

Capture test[a]:

During the capture test, the Stormceptor® EF OGS device, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removes 70, 64, 54, 48, 46, 44, and 49 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

Stormceptor® EFO, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removes 70, 64, 54, 48, 42, 40, and 34 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

Scour test[a]:

During the scour test, the Stormceptor® EF and Stormceptor® EFO OGS devices, with 10.2 cm (4 inches) of test sediment pre-loaded onto a false floor reaching 50% of the manufacturer's recommended maximum sediment storage depth, generate corrected effluent concentrations of 4.6, 0.7, 0, 0.2, and 0.4 mg/L at 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Light liquid re-entrainment test[a]:

During the light liquid re-entrainment test, the Stormceptor® EFO OGS device with surrogate low-density polyethylene beads preloaded within the lower chamber oil collection zone, representing a floating light liquid volume equal to a depth of 50.8 mm over the sedimentation area, retained 100, 99.5, 99.8, 99.8, and 99.9 percent of loaded beads by mass during the 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2.

[a] The claim can be applied to other units smaller or larger than the tested unit as long as the untested units meet the scaling rule specified in the Procedure for Laboratory of Testing of Oil Grit Separators (Version 3.0, June 2014)

Performance results

The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the testing procedure. The *Procedure for Laboratory Testing of Oil Grit Separators* requires that the three sample average of the test sediment particle size distribution (PSD) meet the specified PSD percent less than values within a boundary threshold of 6%. The comparison of the average test sediment PSD to the CETV specified PSD in Figure 2 indicates that the test sediment used for the capture and scour tests met this condition.

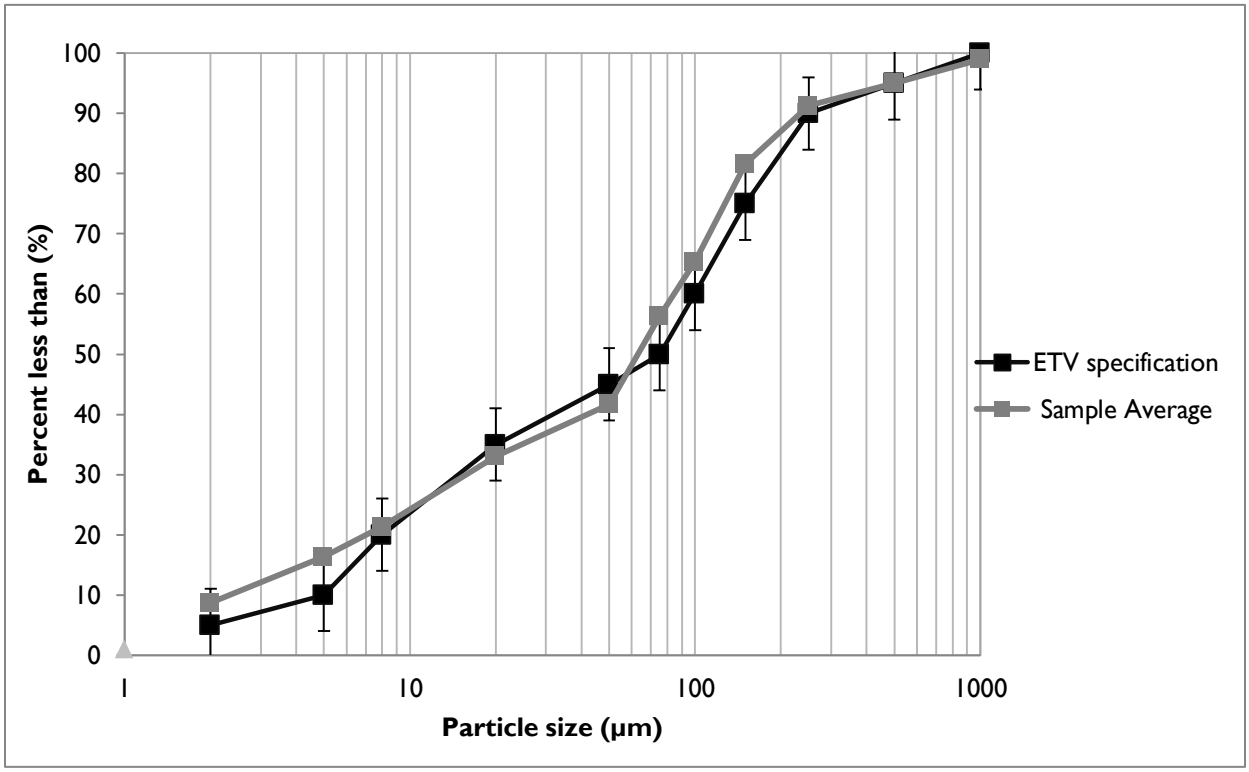


Figure 2. The three sample average particle size distribution (PSD) of the test sediment used for the capture and scour test compared to the specified PSD.

The capacity of the device to retain sediment was determined at seven surface loading rates using the modified mass balance method. This method involved measuring the mass and particle size distribution of the injected and retained sediment for each test run. Performance was evaluated with a false floor simulating the technology filled to 50% of the manufacturer's recommended maximum sediment storage depth. The test was carried out with clean water that maintained a sediment concentration below 20 mg/L. Based on these conditions, removal efficiencies for individual particle size classes and for the test sediment as a whole were determined for each of the tested surface loading rates (Table 1). Since the EF and EFO models are identical except for the weir height, which bypasses flows from the EFO model at a surface loading rate of 535 L/min/m^2 (13.1 gpm/ft^2), sediment capture tests at surface loading rates from 40 to 400 L/min/m^2 were only performed on the EF unit. Surface loading rates of 600, 1000, and 1400 L/min/m^2 were tested on both units separately. Results for the EFO model at these higher flow rates are presented in Table 2.

In some instances, the removal efficiencies were above 100% for certain particle size fractions. These discrepancies are not unique to any one test laboratory and may be attributed to errors relating to the blending of sediment, collection of representative samples for laboratory submission, and laboratory

analysis of PSD. Due to these errors, caution should be exercised in applying the removal efficiencies by particle size fraction for the purposes of sizing the tested device (see Bulletin # CETV 2016-11-0001). The results for "all particle sizes by mass balance" (see Table 1 and 2) are based on measurements of the total injected and retained sediment mass, and are therefore not subject to blending, sampling or PSD analysis errors.

Table 1. Removal efficiencies (%) of the EF4 at specified surface loading rates

Particle size fraction (µm)	**Surface loading rate (L/min/m²)**						
	40	80	200	400	600	1000	1400
>500	90	58	58	100*	86	72	100*
250 - 500	100*	100*	100	100*	100*	100*	100*
150 - 250	90	82	26	100*	100*	67	90
105 - 150	100*	100*	100*	100*	100*	100*	100
75 - 105	100*	92	74	82	77	68	76
53 - 75	Undefined [a]	56	100*	72	69	50	80
20 - 53	54	100*	54	33	36	40	31
8 - 20	67	52	25	21	17	20	20
5 – 8	33	29	11	12	9	7	19
<5	13	0	0	0	0	0	4
All particle sizes by mass balance	**70.4**	**63.8**	**53.9**	**47.5**	**46.0**	**43.7**	**49.0**

[a] An outlier in the feed sample sieve data resulted in a negative removal efficiency for this size fraction.
* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 101 and 171% (average 128%). See text and Bulletin # CETV 2016-11-0001 for more information.

Table 2. Removal efficiencies (%) of the EFO4 at surface loading rates above the bypass rate of 535 L/min/m²

Particle size fraction (µm)	**Surface loading rate (L/min/m²)**		
	600	1000	1400
>500	89	83	100*
250 - 500	90	100*	92
150 - 250	90	67	100*
105 - 150	85	92	77
75 - 105	80	71	65
53 - 75	60	31	36
20 - 53	33	43	23
8 - 20	17	23	15
5 – 8	10	3	3
<5	0	0	0
All particle sizes by mass balance	**41.7**	**39.7**	**34.2**

* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 103 and 111% (average 107%). See text and Bulletin # CETV 2016-11-0001 for more information.

Figure 3 compares the particle size distribution (PSD) of the three sample average of the test sediment to the PSD of the sediment retained by the EF4 at each of the tested surface loading rates. Figure 4 shows the same graph for the EFO4 unit at surface loading rates above the bypass rate of 535 L/min/m².

As expected, the capture efficiency for fine particles in both units was generally found to decrease as surface loading rates increased.

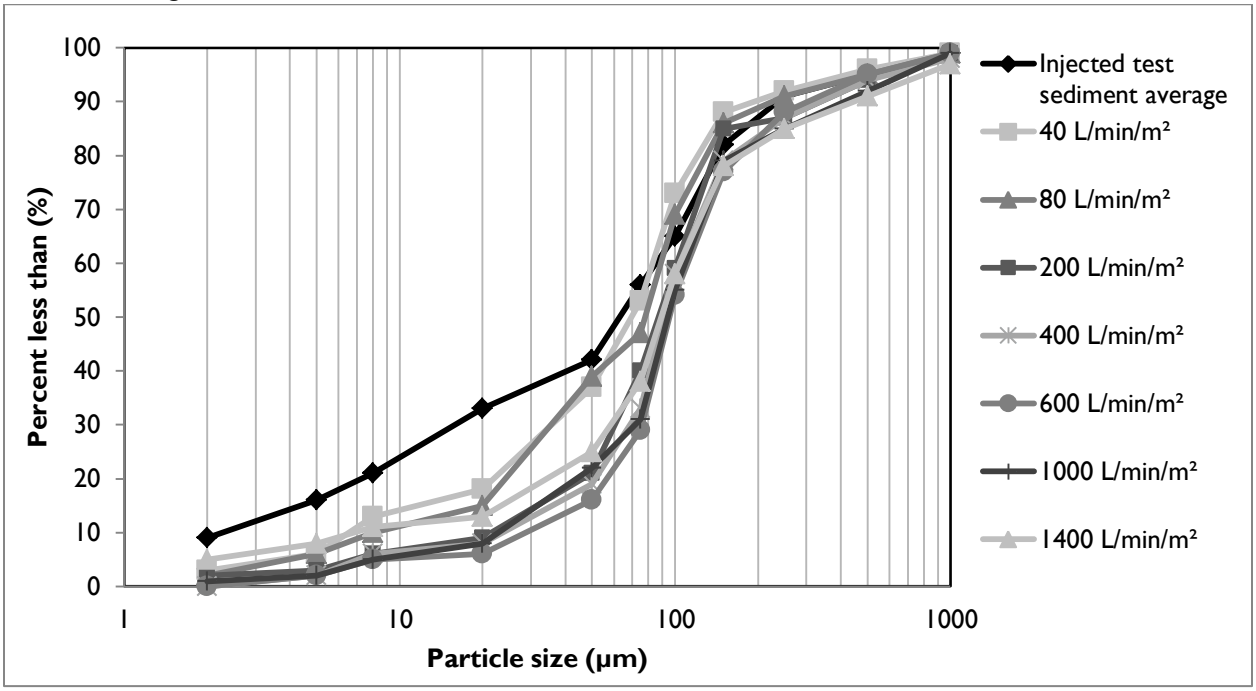


Figure 3. Particle size distribution of sediment retained in the EF4 in relation to the injected test sediment average.

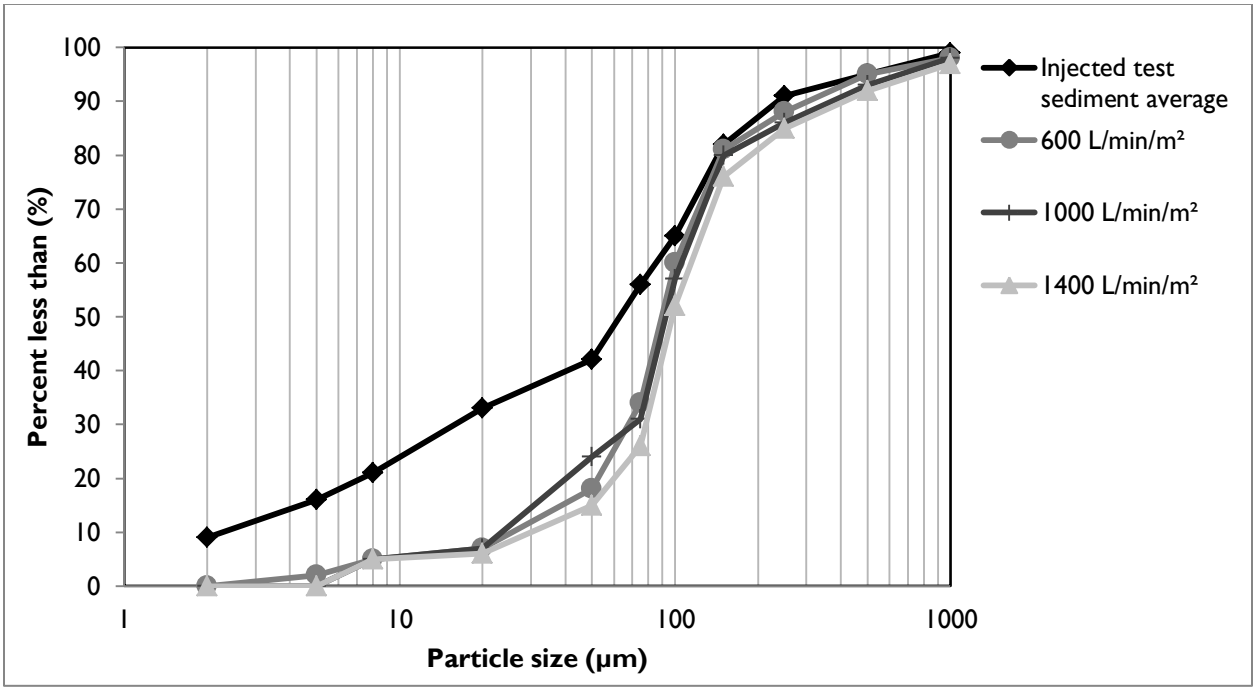


Figure 4. Particle size distribution of sediment retained in the EFO4 in relation to the injected test sediment average at surface loading rates above the bypass rate of 535 L/min/m²

Table 4 shows the results of the sediment scour and re-suspension test for the EF4 unit. The EFO4 was not tested as it was reasonably assumed that scour rates would be lower given that flow bypass occurs at a lower surface loading rate. The scour test involved preloading 10.2 cm of fresh test sediment into

the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth. Clean water was run through the device at five surface loading rates over a 30 minute period. Each flow rate was maintained for 5 minutes with a one minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC) and PSD by recognized methods. The effluent samples were subsequently adjusted based on the background concentration of the influent water. Typically, the smallest 5% of particles captured during the 40 L/min/m^2 sediment capture test is also used to adjust the concentration, as per the method described in Bulletin # CETV 2016-09-0001. However, since the composites of effluent concentrations were below the Reporting Detection Limit of the Laser Diffraction PSD methodology, this adjustment was not made. Results showed average adjusted effluent sediment concentrations below 5 mg/L at all tested surface loading rates.

It should be noted that the EF4 starts to internally bypass water at 1135 L/min/m^2, potentially resulting in the dilution of effluent concentrations, which would not normally occur under typical field conditions because the field influent concentration would contain a much higher sediment concentration than during the lab test. Recalculation of effluent concentrations to account for dilution at surface loading rates above the bypass rate showed sediment effluent concentrations to be below 1.6 mg/L.

Table 4. Scour test adjusted effluent sediment concentration.

Run	Surface loading rate (L/min/m^2)	Run time (min)	Background sample concentration (mg/L)	Adjusted effluent suspended sediment concentration (mg/L) [a]	Average (mg/L)
1	200	1:00	<RDL	11.9	4.6
		2:00		7.0	
		3:00		4.4	
		4:00		2.2	
		5:00		1.0	
		6:00		1.2	
2	800	7:00	<RDL	1.1	0.7
		8:00		0.9	
		9:00		0.6	
		10:00		1.4	
		11:00		0.1	
		12:00		0	
3	1400	13:00	<RDL	0	0
		14:00		0.1	
		15:00		0	
		16:00		0	
		17:00		0	
		18:00		0	
4	2000	19:00	1.2	0.2	0.2
		20:00		0	
		21:00		0	
		22:00		0.7	
		23:00		0	

		24:00		0.4	
5	2600	25:00	1.6	0.3	0.4
		26:00		0.4	
		27:00		0.7	
		28:00		0.4	
		29:00		0.2	
		30:00		0.4	

[a] The adjusted effluent suspended sediment concentration represents the actual measured effluent concentration minus the background concentration. For more information see Bulletin # CETV 2016-09-0001.

The results of the light liquid re-entrainment test used to evaluate the unit's capacity to prevent re-entrainment of light liquids are reported in Table 5. The test involved preloading 58.3 L (corresponding to a 5 cm depth over the collection sump area of 1.17m^2) of surrogate low-density polyethylene beads within the oil collection skirt and running clean water through the device continuously at five surface loading rates (200, 800, 1400, 2000, and 2600 L/min/m^2). Each flow rate was maintained for 5 minutes with approximately 1 minute transition time between flow rates. The effluent flow was screened to capture all re-entrained pellets throughout the test.

Table 5. Light liquid re-entrainment test results for the EFO4.

Surface Loading Rate (L/min/m2)	Time Stamp	Amount of Beads Re-entrained			
		Mass (g)	Volume (L)[a]	% of Pre-loaded Mass Re-entrained	% of Pre-loaded Mass Retained
200	62	0	0	0.00	100
800	247	168.45	0.3	0.52	99.48
1400	432	51.88	0.09	0.16	99.83
2000	617	55.54	0.1	0.17	99.84
2600	802	19.73	0.035	0.06	99.94
Total Re-entrained		295.60	0.525	0.91	--
Total Retained		32403	57.78	--	99.09
Total Loaded		32699	58.3	--	--

[a] Determined from bead bulk density of 0.56074 g/cm^3

Variances from testing Procedure

The following minor deviations from the *Procedure for Laboratory Testing of Oil-Grit Separators* (Version 3.0, June 2014) have been noted:

1. During the capture test, the 40 L/min/m^2 and 80 L/min/m^2 surface loading rates were evaluated over 3 and 2 days respectively due to the long duration needed to feed the required minimum of 11.3 kg of test sediment into the unit at these lower flow rates. Pumps were shut down at the end of each intermediate day, and turned on again the following morning. The target flow rate was re-established within 30 seconds of switching on the pump. This procedure may have allowed sediments to be captured that otherwise may have exited the unit if the test was

continuous. On the basis of practical considerations, this variance was approved by the verifier prior to testing.

2. During the scour test, the coefficient of variation (COV) for the lowest flow rate tested (200 L/min/m^2) was 0.07, which exceeded the specified limit of 0.04 target specified in the OGS Procedure. A pump capable of attaining the highest flow rate of 3036 L/min had difficulty maintaining the lowest flow of 234 L/min but still remained within +/- 10% of the target flow and is viewed as having very little impact on the observed results. Similarly, for the light liquid re-entrainment test the COV for the flow rate of the 200 L/min/m^2 run was 0.049, exceeding the limit of 0.04, but is believed to introduce negligible bias.

3. Due to pressure build up in the filters, the runs at 1000 L/min/m^2 for the Stormceptor® EF4 and 1000 and 1400 L/min/m^2 for the Stormceptor® EFO4 were slightly shorter than the target. The run times were 54, 59 and 43 minutes respectively, versus targets of 60 and 50 minutes. The final feed samples were timed to coincide with the end of the run. Since >25 lbs of sediment was fed, the shortened time did not invalidate the runs.

Verification

The verification was completed by the Verification Expert, Toronto and Region Conservation Authority, contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Imbrium Systems Inc. to support the performance claim included the following: Performance test report prepared by Good Harbour Laboratories, and dated September 8, 2017; the report is based on testing completed in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014).

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

For more information on the Stormceptor® EF4 and EFO4 please contact:

Imbrium Systems, Inc.
407 Fairview Drive
Whitby, ON
L1N 3A9, Canada
Tel: 416-960-9900
info@imbriumsystems.com

For more information on ISO 14034:2016 / ETV please contact:

GLOBE Performance Solutions
World Trade Centre
404 – 999 Canada Place
Vancouver, BC
V6C 3E2 Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com

Limitation of verification
GLOBE Performance Solutions and the Verification Expert provide the verification services solely on the basis of the information supplied by the applicant or vendor and assume no liability thereafter. The responsibility for the information supplied remains solely with the applicant or vendor and the liability for the purchase, installation, and operation (whether consequential or otherwise) is not transferred to any other party as a result of the verification.

Stormceptor®

Rinker MATERIALS™

Stormceptor® EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

04/19/2024

Province:	Ontario
City:	Niagara Falls
Nearest Rainfall Station:	ST CATHARINES AP
Climate Station Id:	6137287
Years of Rainfall Data:	33

Site Name:	3770 Montrose Road

Drainage Area (ha):	4.74
Runoff Coefficient 'c':	0.78

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	114.96
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	Yes
Upstream Orifice Control Flow Rate to Stormceptor (L/s):	170.00
Peak Conveyance (maximum) Flow Rate (L/s):	
Influent TSS Concentration (mg/L):	
Estimated Average Annual Sediment Volume (L/yr):	3389

Project Name:	3770 Montrose Road
Project Number:	21102
Designer Name:	Prince Trinidad
Designer Company:	Counterpoint Engineering
Designer Email:	ptrinidad-rhodius@counterpointeng.com
Designer Phone:	416-884-8047
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	46
EFO6	63
EFO8	74
EFO10	81
EFO12	88

Recommended Stormceptor EFO Model: EFO10

Estimated Net Annual Sediment (TSS) Load Reduction (%): 81

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

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

PERFORMANCE

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

PARTICLE SIZE DISTRIBUTION (PSD)

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

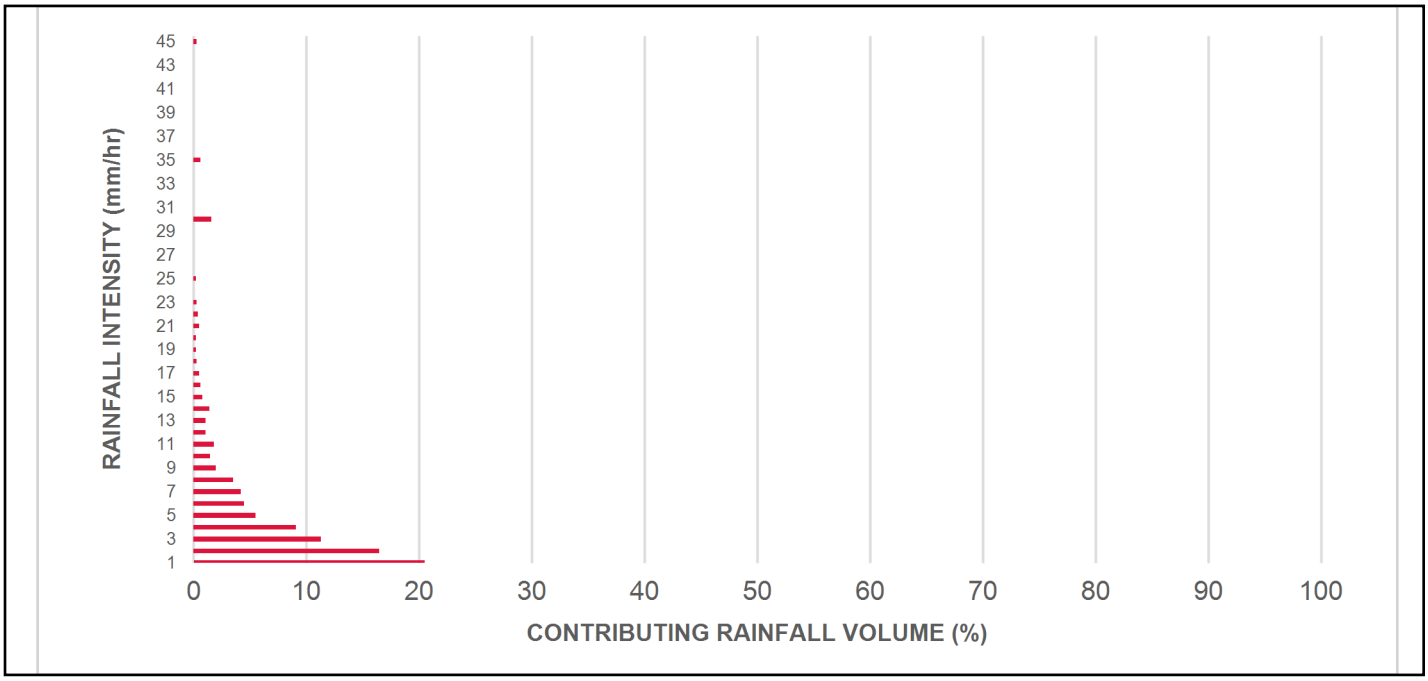
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Upstream Flow Controlled Results

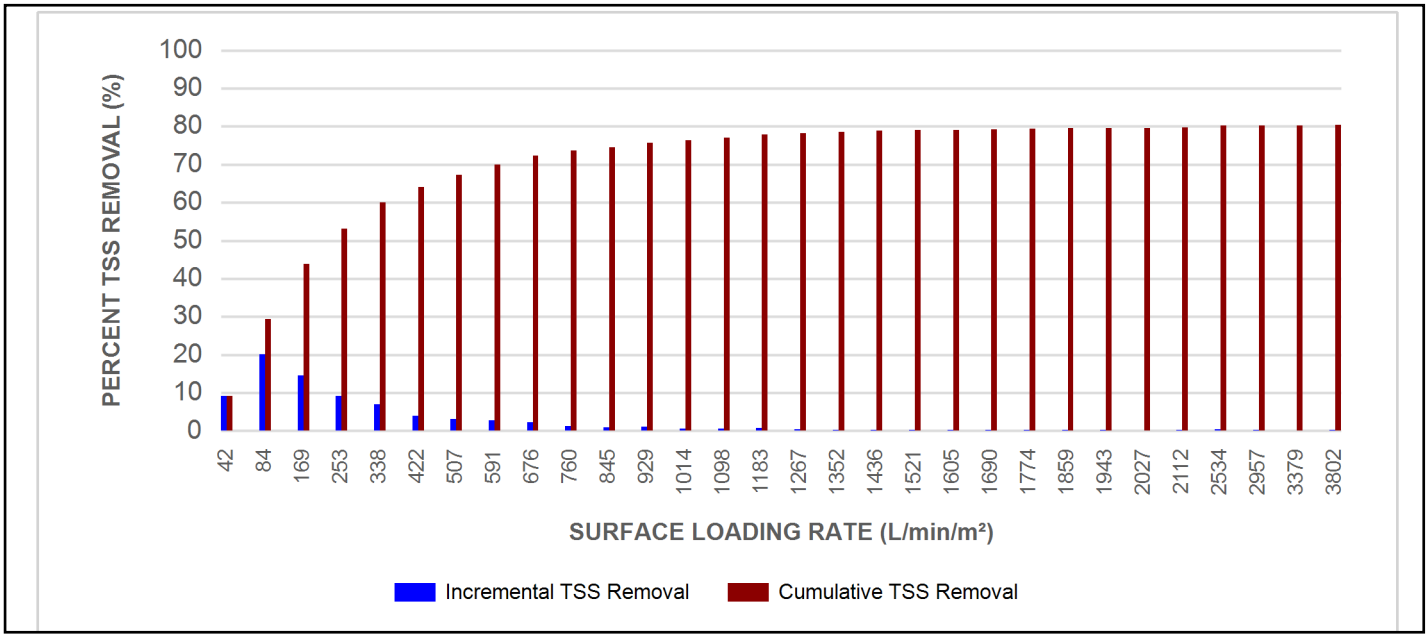
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	9.2	9.2	5.14	308.0	42.0	100	9.2	9.2
1.00	20.5	29.7	10.28	617.0	84.0	98	20.2	29.4
2.00	16.5	46.2	20.56	1233.0	169.0	88	14.6	43.9
3.00	11.3	57.5	30.83	1850.0	253.0	81	9.2	53.1
4.00	9.1	66.7	41.11	2467.0	338.0	77	7.0	60.1
5.00	5.5	72.2	51.39	3083.0	422.0	73	4.0	64.1
6.00	4.5	76.7	61.67	3700.0	507.0	69	3.1	67.3
7.00	4.2	80.9	71.95	4317.0	591.0	65	2.8	70.0
8.00	3.5	84.4	82.23	4934.0	676.0	64	2.3	72.3
9.00	2.0	86.5	92.50	5550.0	760.0	63	1.3	73.6
10.00	1.5	88.0	102.78	6167.0	845.0	63	0.9	74.5
11.00	1.8	89.8	113.06	6784.0	929.0	62	1.1	75.6
12.00	1.1	90.9	123.34	7400.0	1014.0	61	0.7	76.3
13.00	1.1	92.0	133.62	8017.0	1098.0	59	0.6	77.0
14.00	1.4	93.4	143.90	8634.0	1183.0	57	0.8	77.8
15.00	0.8	94.2	154.17	9250.0	1267.0	56	0.4	78.2
16.00	5.8	100.0	164.45	9867.0	1352.0	53	3.1	81.3
17.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
18.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
19.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
20.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
21.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
22.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
23.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
24.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
25.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
30.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
35.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
40.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
45.00	0.0	100.0	170.00	10200.0	1397.0	53	0.0	81.3
Estimated Net Annual Sediment (TSS) Load Reduction =								**81 %**

Climate Station ID: 6137287 *Years of Rainfall Data*: 33

RAINFALL DATA FROM ST CATHARINES AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

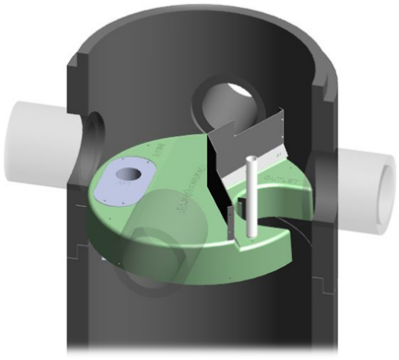
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test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

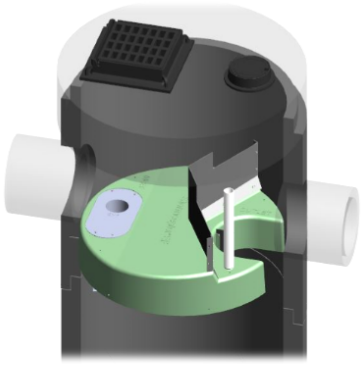
DESIGN FLEXIBILITY

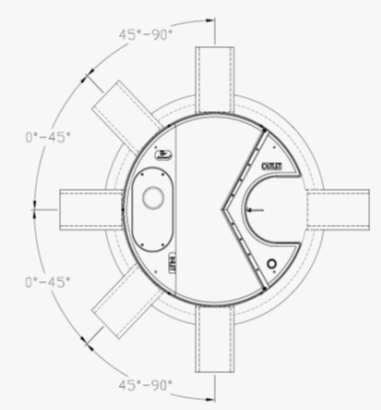
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend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

OIL CAPTURE AND RETENTION

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







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.
0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.
45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

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

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity
** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

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

STANDARD STORMCEPTOR EF/EFO DRAWINGS

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

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

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

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

PART 1 – GENERAL

1.1 WORK INCLUDED

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

1.2 REFERENCE STANDARDS & PROCEDURES

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

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

1.3 SUBMITTALS

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

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

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

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

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

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

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

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

3.2 SIZING METHODOLOGY

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

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

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

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

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

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

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

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

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

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

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

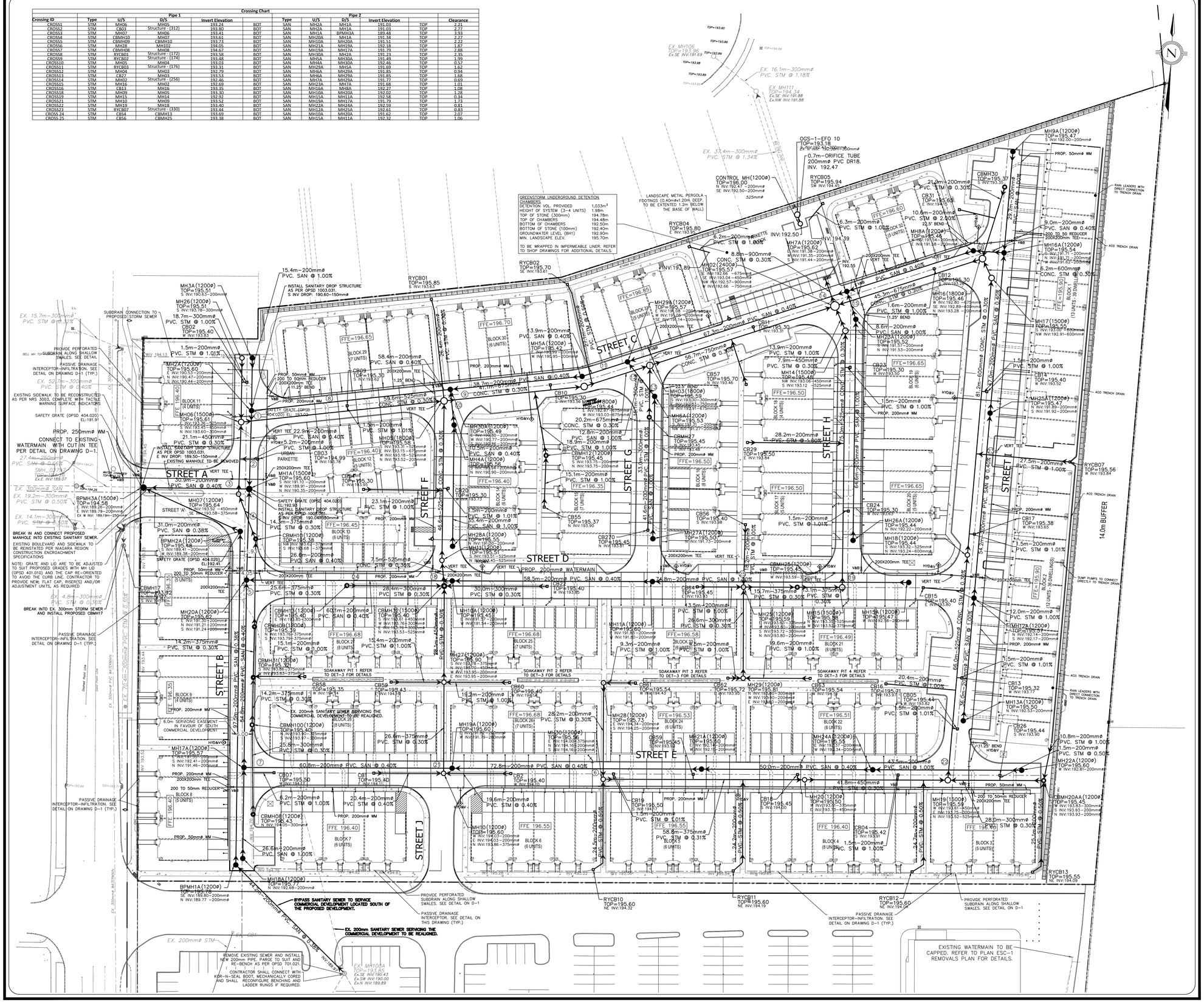
Cassone Dwellings (BT) Inc.
3770 Montrose Road

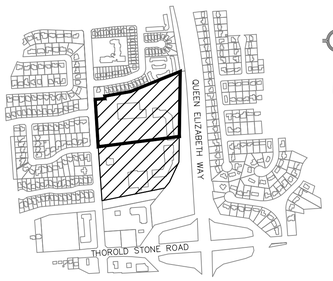
Appendix E

Engineering Figures

Project No.: 21102
April 2024

Crossing Chart											
	Pipe 1					Pipe 2					
Crossing ID	Type	U/S	D/S	Invert Elevation		Type	U/S	D/S	Invert Elevation		Clearance
CROSS1	STM	MH08	MH05	193.24	BOT	SAN	MH2A	MH1A	191.03	TOP	2.71
CROSS2	STM	CB03	Structure - (312)	193.80	BOT	SAN	MH2A	MH1A	191.03	TOP	2.77
CROSS3	STM	MH07	MH08	193.41	BOT	SAN	MH1A	BPMH3A	189.48	TOP	3.93
CROSS4	STM	CBMH10	MH07	193.01	BOT	SAN	MH30A	MH1A	191.58	TOP	1.43
CROSS5	STM	CBMH09	CBMH10	193.73	BOT	SAN	MH10A	MH20A	191.51	TOP	2.22
CROSS6	STM	MH28	MH102	194.05	BOT	SAN	MH10A	MH20A	191.36	TOP	2.69
CROSS7	STM	CBMH08	MH08	194.67	BOT	SAN	MH15A	MH17A	191.79	TOP	2.88
CROSS8	STM	RYCB01	Structure - (172)	193.58	BOT	SAN	MH30A	MH32A	191.25	TOP	2.33
CROSS9	STM	RYCB02	Structure - (174)	193.48	BOT	SAN	MH5A	MH30A	191.40	TOP	1.99
CROSS10	STM	MH05	MH04	193.01	BOT	SAN	MH4A	MH30A	192.46	TOP	0.57
CROSS11	STM	RYCB03	Structure - (176)	192.33	BOT	SAN	MH29A	MH5A	191.69	TOP	0.62
CROSS12	STM	MH04	MH03	192.79	BOT	SAN	MH6A	MH29A	191.85	TOP	0.04
CROSS13	STM	CB27	MH03	193.43	BOT	SAN	MH6A	MH29A	191.85	TOP	1.68
CROSS14	STM	MH02	Structure - (256)	192.66	BOT	SAN	MH7A	MH29A	191.72	TOP	0.60
CROSS15	STM	MH16	MH02	192.69	BOT	SAN	MH28A	MH7A	191.68	TOP	1.01
CROSS16	STM	CB13	MH16	193.35	BOT	SAN	MH16A	MH8A	191.27	TOP	1.08
CROSS18	STM	MH09	MH01	193.30	BOT	SAN	MH10A	MH20A	192.02	TOP	1.28
CROSS19	STM	MH15	MH08	192.52	BOT	SAN	MH15A	MH11A	191.79	TOP	0.73
CROSS22	STM	MH19	MH28	193.40	BOT	SAN	MH22A	MH28A	192.59	TOP	0.81
CROSS23	STM	RYCB07	Structure - (330)	193.44	BOT	SAN	MH12A	MH29A	192.61	TOP	0.83
CROSS24	STM	CB54	CBMH13	193.69	BOT	SAN	MH10A	MH20A	191.62	TOP	2.07
CROSS25	STM	CB56	CBMH25	193.38	BOT	SAN	MH15A	MH11A	192.32	TOP	1.06





KEY PLAN

LEGEND

- EXISTING HYDRANT
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING WATERMAIN
- PROPOSED STORM SEWER AND MH
- PROPOSED CATCHBASIN
- PROPOSED SANITARY SEWER AND MH
- H&V PROPOSED HYDRANT AND VALVE
- V&B PROPOSED VALVE AND BOX
- PROPOSED WATERMAIN
- PROPERTY LINE
- PROPOSED TRENCH DRAIN BY ACO SYSTEMS LTD.
- SANITARY LATERAL
- WATER LATERAL
- STORM LATERAL
- SUMP PUMP AND OUTLET LOCATION DISCHARGING TO GRADE
- PIPE INSULATION
- PERFORATED SUBDRAIN

NOTES:

- REFER TO D–3 FOR A TYPICAL 3–STOREY TOWNHOUSE UNIT SERVICING LATERAL DETAIL.
- REFER TO D–3 FOR A TYPICAL 2–PLEX UNIT SERVICING LATERAL DETAIL.
- WATERMAINS TO HAVE A MINIMUM 1.8m OF COVER BETWEEN THE FINISHED GRADE AND OBVERT. WATERMAINS TO HAVE A MINIMUM VERTICAL CLEARANCE OF 0.5m ABOVE OR BELOW ANY OTHER UTILITY.
- EACH BLOCK OF UNITS TO HAVE A SUMP PUMP THAT DISCHARGES TO GRADE. THE WATER TO FLOW OVERLAND TO STREETS.
- ALL UNITS TO BE PROVIDED WITH INDIVIDUAL WATER METERS SUPPLIED BY THE CITY OF NIAGARA FALLS AT OWNER'S COST.
- REAR YARD CB LEADS, TRENCH DRAINS AND STORM PIPES WITHIN 2.0m OF FOUNDATIONS TO BE CONCRETE ENCASED. SEE DRAWING D–2 FOR DETAIL.
- RAINWATER LEADERS TO BE CONNECTED TO SOAKAWAY PITS IN FRONT OF THE RESPECTIVE UNITS
- REFER TO REMOVALS PLAN ESC–1 FOR FURTHER REMOVAL DETAILS

NOTE: REFER TO REMOVALS PLAN ESC–1 FOR DETAILS ON EXISTING SITE SERVICING AND EXTENTS OF SERVICING REMOVALS.

LEGAL & TOPOGRAPHY

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BENCHMARK AND ELEVATION

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12.	RE–ISSUED FOR SERVICING PERMIT (REVISED)	2025–06–27	ZS	
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9.	REVISED NORTH EAST SIDEWALK	2024–11–27	ZS	
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7.	REVISED FOR DPOC AND SERVICING PERMIT	2024–08–22	JY	

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LICENSED PROFESSIONAL ENGINEER
B.S. BABAYAN
100151059
Oct 30, 2025
PROVINCE OF ONTARIO

APPLICANT:

CASSONE DWELLINGS (BT) INC.
1681 LANGSTAFF ROAD, UNIT 1
VAUGHAN ONTARIO L4K 5T3

SITE LOCATION:

3770 MONTROSE ROAD
NIAGARA FALLS
ONTARIO

SERVICING PLAN

DESIGNED BY: Z.S.	CHECKED BY: Z.S.	DATE: APRIL 2024	
DRAWING BY: S.C	CHECKED BY:	PROJECT NO.	21102
SWM BY: Z.S.	CHECKED BY:		
SCALE: 1:500m 0m 10m 20m 30m		DRAWING NO.	C-1

GENERAL GRADING NOTES

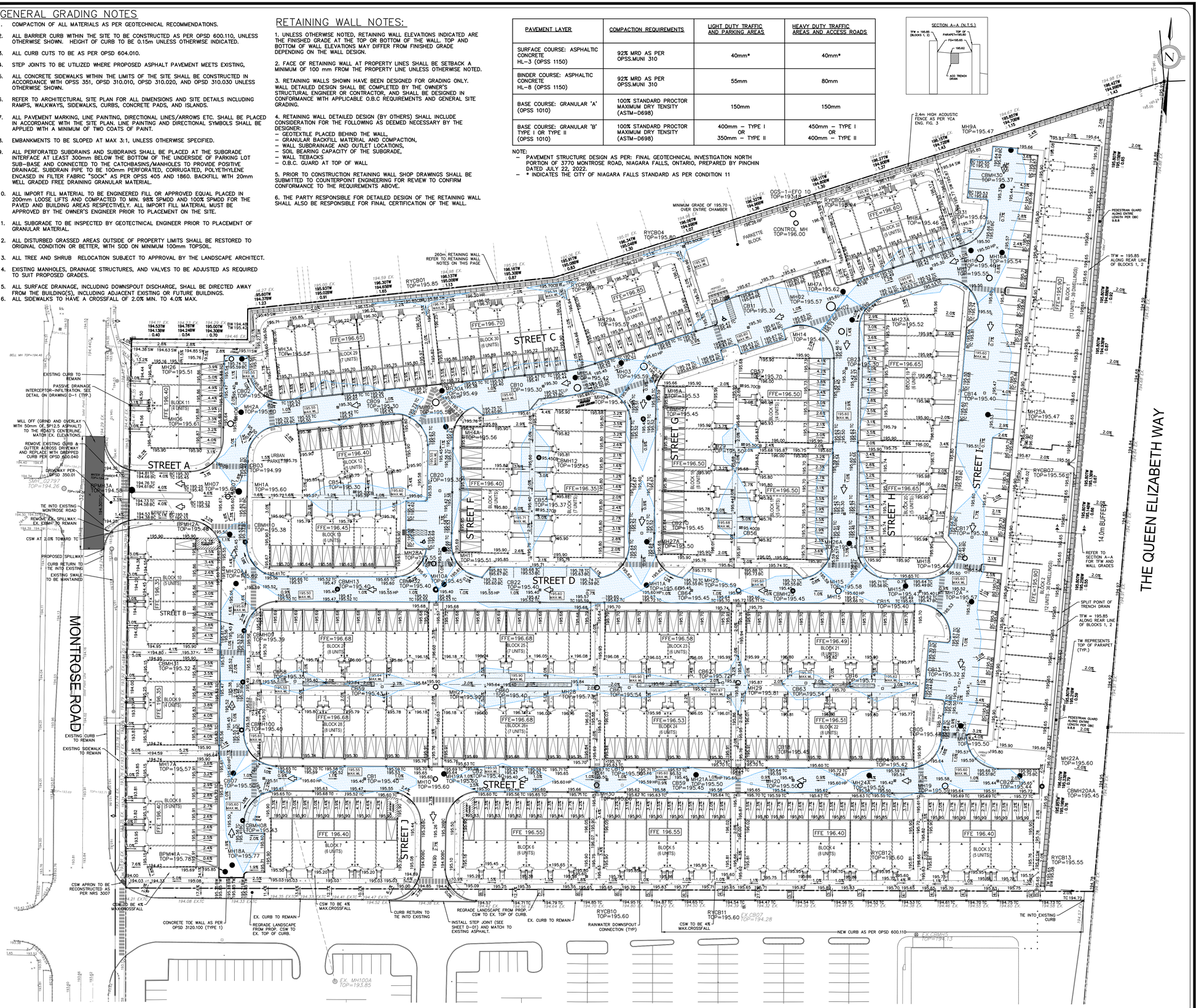
1. COMPACTION OF ALL MATERIALS AS PER GEOTECHNICAL RECOMMENDATIONS.
2. ALL BARRIER CURB WITHIN THE SITE TO BE CONSTRUCTED AS PER OPSD 600.110, UNLESS OTHERWISE SHOWN. HEIGHT OF CURB TO BE 0.15m UNLESS OTHERWISE INDICATED.
3. ALL CURB CUTS TO BE AS PER OPSD 604.010.
4. STEP JOINTS TO BE UTILIZED WHERE PROPOSED ASPHALT PAVEMENT MEETS EXISTING,
5. ALL CONCRETE SIDEWALKS WITHIN THE LIMITS OF THE SITE SHALL BE CONSTRUCTED IN ACCORDANCE WITH OPSS 351, OPSD 310.010, OPSD 310.020, AND OPSD 310.030 UNLESS OTHERWISE SHOWN.
6. REFER TO ARCHITECTURAL SITE PLAN FOR ALL DIMENSIONS AND SITE DETAILS INCLUDING RAMPS, WALKWAYS, SIDEWALKS, CURBS, CONCRETE PADS, AND ISLANDS.
7. ALL PAVEMENT MARKING, LINE PAINTING, DIRECTIONAL LINES/ARROWS ETC. SHALL BE PLACED IN ACCORDANCE WITH THE SITE PLAN. LINE PAINTING AND DIRECTIONAL SYMBOLS SHALL BE APPLIED WITH A MINIMUM OF TWO COATS OF PAINT.
8. EMBANKMENTS TO BE SLOPED AT MAX 3:1, UNLESS OTHERWISE SPECIFIED.
9. ALL PERFORATED SUBDRAINS AND SUBDRAINS SHALL BE PLACED AT THE SUBGRADE INTERFACE AT LEAST 300mm BELOW THE BOTTOM OF THE UNDERSIDE OF PARKING LOT SUB-BASE AND CONNECTED TO THE CATCHBASINS/MANHOLES TO PROVIDE POSITIVE DRAINAGE. SUBDRAIN PIPE TO BE 100mm PERFORATED, CORRUGATED, POLYETHYLENE ENCASED IN FILTER FABRIC "SOCK" AS PER OPSS 405 AND 1860. BACKFILL WITH 20mm WELL GRADED FREE DRAINING GRANULAR MATERIAL.
10. ALL IMPORT FILL MATERIAL TO BE ENGINEERED FILL OR APPROVED EQUAL PLACED IN 200mm LOOSE LIFTS AND COMPACTED TO MIN. 98% SPMDD AND 100% SPMDD FOR THE PAVED AND BUILDING AREAS RESPECTIVELY. ALL IMPORT FILL MATERIAL MUST BE APPROVED BY THE OWNER'S ENGINEER PRIOR TO PLACEMENT ON THE SITE.
11. ALL SUBGRADE TO BE INSPECTED BY GEOTECTNICAL ENGINEER PRIOR TO PLACEMENT OF GRANULAR MATERIAL.
12. ALL DISTURBED GRASSED AREAS OUTSIDE OF PROPERTY LIMITS SHALL BE RESTORED TO ORIGINAL CONDITION OR BETTER, WITH SOD ON MINIMUM 100mm TOPSOIL.
13. ALL TREE AND SHRUB RELOCATION SUBJECT TO APPROVAL BY THE LANDSCAPE ARCHITECT.
14. EXISTING MANHOLES, DRAINAGE STRUCTURES, AND VALVES TO BE ADJUSTED AS REQUIRED TO SUIT PROPOSED GRADES.
15. ALL SURFACE DRAINAGE, INCLUDING DOWNSPOUT DISCHARGE, SHALL BE DIRECTED AWAY FROM THE BUILDING(S), INCLUDING ADJACENT EXISTING OR FUTURE BUILDINGS.
16. ALL SIDEWALKS TO HAVE A CROSSFALL OF 2.0% MIN. TO 4.0% MAX.

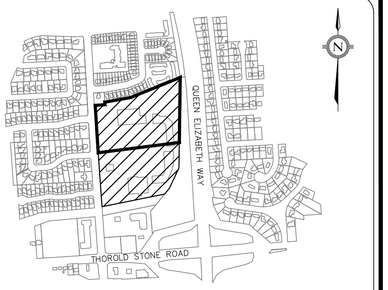
RETAINING WALL NOTES:

1. UNLESS OTHERWISE NOTED, RETAINING WALL ELEVATIONS INDICATED ARE THE FINISHED GRADE AT THE TOP OR BOTTOM OF THE WALL. TOP AND BOTTOM OF WALL ELEVATIONS MAY DIFFER FROM FINISHED GRADE DEPENDING ON THE WALL DESIGN.
2. FACE OF RETAINING WALL AT PROPERTY LINES SHALL BE SETBACK A MINIMUM OF 100 mm FROM THE PROPERTY LINE UNLESS OTHERWISE NOTED.
3. RETAINING WALLS SHOWN HAVE BEEN DESIGNED FOR GRADING ONLY. WALL DETAILED DESIGN SHALL BE COMPLETED BY THE OWNER'S STRUCTURAL ENGINEER OR CONTRACTOR, AND SHALL BE DESIGNED IN CONFORMANCE WITH APPLICABLE O.B.C REQUIREMENTS AND GENERAL SITE GRADING.
4. RETAINING WALL DETAILED DESIGN (BY OTHERS) SHALL INCLUDE CONSIDERATION FOR THE FOLLOWING AS DEEMED NECESSARY BY THE DESIGNER:
   - GEOTEXTILE PLACED BEHIND THE WALL,
   - GRANULAR BACKFILL MATERIAL AND COMPACTION,
   - WALL SUBDRAINAGE AND OUTLET LOCATIONS,
   - SOIL BEARING CAPACITY OF THE SUBGRADE,
   - WALL TIEBACKS
   - O.B.C. GUARD AT TOP OF WALL
5. PRIOR TO CONSTRUCTION RETAINING WALL SHOP DRAWINGS SHALL BE SUBMITTED TO COUNTERPOINT ENGINEERING FOR REVIEW TO CONFIRM CONFORMANCE TO THE REQUIREMENTS ABOVE.
6. THE PARTY RESPONSIBLE FOR DETAILED DESIGN OF THE RETAINING WALL SHALL ALSO BE RESPONSIBLE FOR FINAL CERTIFICATION OF THE WALL.

PAVEMENT LAYER	COMPACTION REQUIREMENTS	LIGHT DUTY TRAFFIC AND PARKING AREAS	HEAVY DUTY TRAFFIC AREAS AND ACCESS ROADS
SURFACE COURSE: ASPHALTIC CONCRETE HL-3 (OPSS 1150)	92% MRD AS PER OPSS.MUNI 310	40mm*	40mm*
BINDER COURSE: ASPHALTIC CONCRETE HL-8 (OPSS 1150)	92% MRD AS PER OPSS.MUNI 310	55mm	80mm
BASE COURSE: GRANULAR 'A' (OPSS 1010)	100% STANDARD PROCTOR MAXIMUM DRY TENSITY (ASTM-D698)	150mm	150mm
BASE COURSE: GRANULAR 'B' TYPE I OR TYPE II (OPSS 1010)	100% STANDARD PROCTOR MAXIMUM DRY TENSITY (ASTM-D698)	400mm – TYPE I OR 350mm – TYPE II	450mm – TYPE I OR 400mm – TYPE II

NOTE:
- PAVEMENT STRUCTURE DESIGN AS PER: FINAL GEOTECHNICAL INVESTIGATION NORTH PORTION OF 3770 MONTROSE ROAD, NIAGARA FALLS, ONTARIO, PREPARED BY PINCHIN DATED JULY 22, 2022.
- * INDICATES THE CITY OF NIAGARA FALLS STANDARD AS PER CONDITION 11





KEY PLAN

LEGEND

×113.50 / ×114.54EX / ×112.22	PROPOSED/EXISTING/SURVEYED ELEVATION
×100.50 TW/BW/TC/BC	TOP/BOTTOM OF WALL/CURB
×100.50SW / —135.00—	SWALE BED & ELEVATION / CONTOUR GRADE
	ROAD CENTERLINE
	PROPOSED STORM/SANITARY MH/CB/TWIN CB/CBMH
	TACTILE PLATE
H&V / V&B	PROPOSED HYDRANT & VALVE/ VALVE & BOX
	EMERGENCY OVERLAND FLOW
	PROPOSED RETAINING WALL
	PROPERTY LINE
	STREET LINE
	PASSIVE DRAINAGE INTERCEPTOR–INFILTRATION
	BARRIER CURB (OPSD 600.110)
	SEMI MOUNTABLE CURB (OPSD 600.060)
	CURB & GUTTER (OPSD 600.040)
	FIRE RATED WALL
195.67 MAX.WL	EMERGENCY POND OUTLINE / MAX. PONDING ELEV.
	INFILTRATION BED
	ACOUSTIC FENCE
	PROPOSED TRENCH DRAIN BY ACO SYSTEMS LTD.
	STEEL BEAM BARRICADE AS PER OPSD 973.130

NOTE:
REFER TO THE ARCHITECTURAL PLAN FOR SIGNAGE PLAN
REFER TO D-01 FOR THE SWALE DETAIL
REFER TO D-01 FOR THE PASSIVE DRAINAGE INTERCEPTOR DETAIL
REFER TO PLAN ESC-1 FOR EX. SEWER LAYOUT AND REMOVALS

LEGAL & TOPOGRAPHY

PROVIDED BY: J.D BARNES
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PHONE:(905) 358–3693

BENCHMARK AND ELEVATION

ELEVATIONS SHOWN HEREON ARE GEODETIC CGVD–1928:78 AND ARE DERIVED FROM GNSS OBSERVATIONS AND NATIONAL RESOURCES CANADA'S GEOID MODEL HT2.0.
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13.	ISSUED FOR MATERIAL ORDERING	2025–09–12	ZS	
12.	RE–ISSUED FOR SERVICING PERMIT (REVISED)	2025–06–27	ZS	
11.	RE–ISSUED FOR SERVICING PERMIT	2025–06–10	ZS	
10.	REVISED PAVEMENT STRUCTURE	2025–02–07	ZS	
9.	REVISED NORTH EAST SIDEWALK	2024–11–27	ZS	
8.	ISSUED FOR 4TH DPOC SUBMISSION	2024–09–17	ZS	
7.	REVISED FOR DPOC AND SERVICING PERMIT	2024–08–22	JY	

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LICENSED PROFESSIONAL ENGINEER
B.S. BABAYAN
100151059
Oct 30, 2025
PROVINCE OF ONTARIO

APPLICANT:
CASSONE DWELLINGS (BT) INC.
1681 LANGSTAFF ROAD, UNIT 1
VAUGHAN ONTARIO L4K 5T3

SITE LOCATION:
3770 MONTROSE ROAD
NIAGARA FALLS
ONTARIO

GRADING PLAN

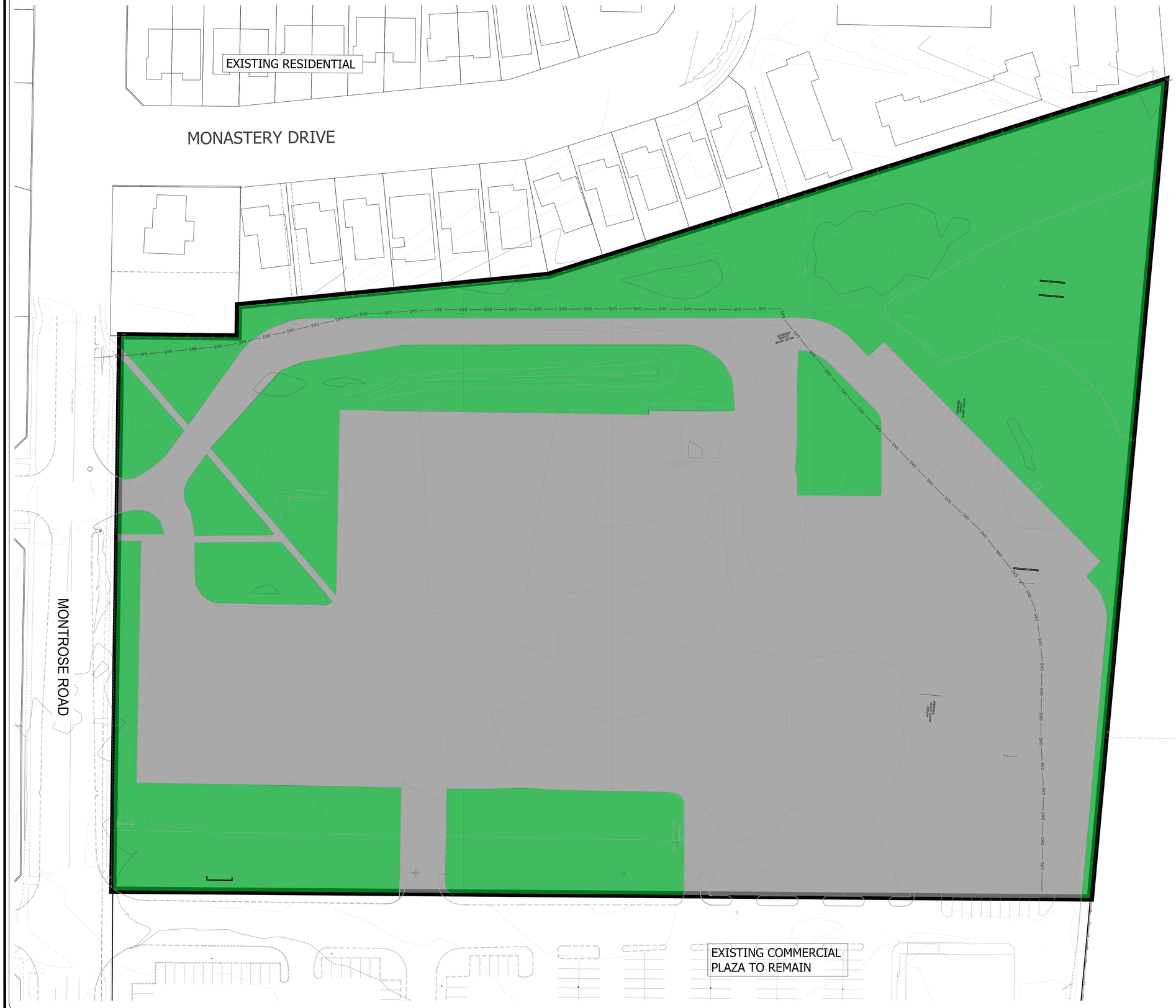
DESIGNED BY: Z.S.	CHECKED BY: Z.S.	DATE: APRIL 2024	
DRAWING BY: S.C	CHECKED BY:	PROJECT NO.	21102
SWM BY: Z.S.	CHECKED BY:		
SCALE: 1:500m (0m 10m 20m 30m)		DRAWING NO.	C-2

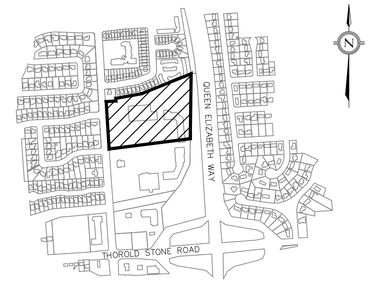
Cassone Dwellings (BT) Inc.
3770 Montrose Road

Appendix F

Water Balance

Project No.: 21102
April 2024





KEY PLAN

LEGEND

EX PERVIOUS AREAS

EX IMPERVIOUS PAVEMENT

	TOTAL
EX. PERVIOUS AREAS (i=0%)	22150 sq.m.
EX. IMPERVIOUS AREAS (i=100%)	32350 sq.m.
TOTAL	54500 sq.m. (i=59.35%)

LEGAL & TOPOGRAPHY

PROVIDED BY: J.D BARNES
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No.	REVISIONS/ISSUED	DATE	BY	CITY
7.	REVISED FOR MTO PERMIT	2023-12-14	ZS	
6.	ISSUED FOR SPA SUBMISSION	2023-12-01	ZS	
5.	REVISED FOR EARTHWORKS TENDER	2023-10-31	ZS	
4.	REVISED FOR EARTHWORKS TENDER	2023-10-04	ZS	
3.	ISSUED FOR REVIEW	2023-09-13	ZS	
2.	ISSUED FOR SPA SUBMISSION	2023-09-08	ZS	
1.	ISSUED FOR CLIENT REVIEW	2022-11-21	PT	

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ENGINEER'S STAMP

APPLICANT:

CASSONE DWELLINGS (BT) INC.
1681 LANGSTAFF ROAD, UNIT 1
VAUGHAN ONTARIO L4K 5T3

SITE LOCATION:

3770 MONTROSE ROAD
NIAGARA FALLS
ONTARIO

PRE DEVELOPMENT WATER BALANCE PLAN

DESIGNED BY: Z.S.	CHECKED BY: Z.S.	DATE: SEPTEMBER 2023	
DRAWING BY: S.C	CHECKED BY:	PROJECT NO.	21102
SWM BY: Z.S.	CHECKED BY:		
SCALE: 1: 500		DRAWING NO.	WB-1

ROOFS OUTLINED IN RED WILL DRAIN TO PROPOSED GALLERIES TO ACHIEVE WATER BALANCE RETENTION REQUIREMENT (TYP.)

N

THE QUEEN ELIZABETH WAY

MONTROSE ROAD

STREET 'A'

14.0m BUFFER

PARKETTE BLOCK

URBAN PARKETTE

BLOCK 1 (13 UNITS - 39 SEMI-DET. UNITS) FFE=195.90

BLOCK 2 (12 UNITS - 36 TOWNHOUSES) FFE=195.90

BLOCK 3 (5 UNITS) FFE 196.40

BLOCK 4 (8 UNITS) FFE 196.40

BLOCK 5 (6 UNITS) FFE 196.55

BLOCK 6 (6 UNITS) FFE 196.55

BLOCK 7 (6 UNITS) FFE 196.40

BLOCK 8 (6 UNITS) FFE=196.68

BLOCK 9 (4 UNITS) FFE 196.35

BLOCK 10 (5 UNITS) FFE 196.35

BLOCK 11 (4 UNITS) FFE 196.40

BLOCK 12 (5 UNITS) FFE=196.40

BLOCK 13 (6 UNITS) FFE=196.45

BLOCK 14 (6 UNITS) FFE=196.40

BLOCK 15 (6 UNITS) FFE=196.35

BLOCK 16 (4 UNITS) FFE=196.50

BLOCK 17 (5 UNITS) FFE=196.50

BLOCK 18 (6 UNITS) FFE=196.50

BLOCK 19 (6 UNITS) FFE=196.65

BLOCK 20 (5 UNITS) FFE=196.65

BLOCK 21 (6 UNITS) FFE=196.68

BLOCK 22 (6 UNITS) FFE=196.68

BLOCK 23 (7 UNITS) FFE=196.65

BLOCK 24 (8 UNITS) FFE=196.40

BLOCK 25 (6 UNITS) FFE=196.58

BLOCK 26 (6 UNITS) FFE=196.53

BLOCK 27 (6 UNITS) FFE=196.54

BLOCK 28 (6 UNITS) FFE=196.68

BLOCK 29 (6 UNITS) FFE=196.68

BLOCK 30 (6 UNITS) FFE=196.70

BLOCK 31 (6 UNITS) FFE=196.85

BLOCK 32 (6 UNITS) FFE=196.60

WATER CHAMBER TOP=194.28

TOP=194.26

TOP=193.69

TOP=193.90

TOP=193.86

TOP=193.89

TOP=193.98

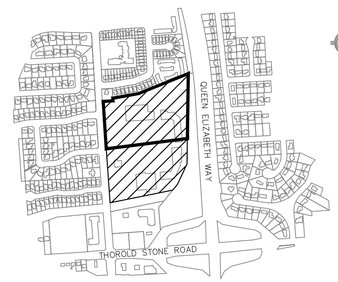
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TOP=193.85

TOP=194.08

TOP=194.44

TOP=194.46



KEY PLAN

LEGEND

- PROP ROOF AREAS
- PROP GRASS AREAS
- PROP PAVED AREAS

	TOTAL
PROP ROOF AREAS (i=100%)	22062 sq.m.
PROP GRASS AREAS (i=0%)	16013 sq.m.
PROP PAVED AREAS (i=100%)	16425 sq.m.
TOTAL	54500 sq.m. (i=70.62%)

LEGAL & TOPOGRAPHY

PROVIDED BY: J.D BARNES
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NIAGARA FALLS, ON, L2F 6A4
PHONE:(905) 358-3693

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11.	RE-ISSUED FOR SERVICING PERMIT	2025-06-10	ZS	
10.	REVISED PAVEMENT STRUCTURE	2025-02-07	ZS	
9.	REVISED NORTH EAST SIDEWALK	2024-11-27	ZS	
8.	ISSUED FOR 4TH DPOC SUBMISSION	2024-09-17	ZS	
7.	REVISED FOR DPOC AND SERVICING PERMIT	2024-08-22	JY	
6.	ISSUED FOR SERVICING PERMIT	2024-08-01	JY	

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APPLICANT:

CASSONE DWELLINGS (BT) INC.
1681 LANGSTAFF ROAD, UNIT 1
VAUGHAN ONTARIO L4K 5T3

SITE LOCATION:

3770 MONTROSE ROAD
NIAGARA FALLS
ONTARIO

POST DEVELOPMENT WATER BALANCE PLAN

DESIGNED BY: Z.S.	CHECKED BY: Z.S.	DATE: OCTOBER 2025	
DRAWING BY: S.C	CHECKED BY:	PROJECT NO.	21102
SWM BY: Z.S.	CHECKED BY:		
SCALE: 1:500		DRAWING NO.	WB-2

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Summary of Inputs for Water Balance Calculation

Pre-Development		
Precipitation (mm/yr)	**1135**	As per Toronto and Region Conservation Authority Climate Projections for Niagara Region (2022)
Evapotranspiration (mm/yr)	**533**	As per Water Availability Study for the South Niagara Falls and Lower Welland River Watershed Plan Areas Niagara Peninsula Source Protection Area (2009)
Topography Infiltration Factor	**0.2**	Pre-development site (Grass- Table 2 below, Rolling Land)
Soil Infiltration Factor	**0.1**	Pre-development site (Grass- Table 2 below- clay and loam)
Land Cover Infiltration Factor	**0.1**	Pre-development site (Grass- Table 2 below, cultivated land)
MOE Infiltration Factor	**0.4**	Pre-development site (Grass- Table 2 below)
Post-Development		
Precipitation (mm/yr)	**1135**	As per Toronto and Region Conservation Authority Climate Projections for Niagara Region (2022)
Evapotranspiration (mm/yr)	**533**	As per Water Availability Study for the South Niagara Falls and Lower Welland River Watershed Plan Areas Niagara Peninsula Source Protection Area (2009)
Topography Infiltration Factor	**0.20**	Post- Development (Grass-Table 2 below, rolling land))
Soil Infiltration Factor	**0.10**	Post- Development (Grass-Table 2 below, accounts for compaction))
Land Cover Infiltration Factor	**0.10**	Post- Development (Grass-Table 2 below))
MOE Infiltration Factor	**0.40**	Post- Development (Grass-Table 2 below))

Table 2: Infiltration Factors

Description of Area/Development Site	Value of Infiltration Factor
TOPOGRAPHY	
■ Flat land, average slope not exceeding 0.6 m per km	0.30
■ Rolling land, average slope of 2.8 m to 3.8 m per km	0.20
■ Hilly land, average slope of 28 m to 47 m per km	0.10
SOIL	
■ Tight impervious clay	0.10
■ Medium combinations of clay and loam	0.20
■ Open sandy loam	0.4
COVER	
■ Cultivated lands	0.1
■ Woodland	0.2

Annual Water Budget Assessment

Summary Table

Project: 21102

October 29, 2025

Catchment Designation	Pre-Development	Post-Development	Change (Pre- to Post-)	Post-Development with Mitigation	Change (Pre- to Post- with Mitigation)
			Site		
Inputs (Volumes)					
Precipitation (m^3/yr)	61,858	61,858	0.0%	61,858	0.0%
Run-on (m^3/yr)	0	0	0.0%	0	0.0%
Other Inputs (m^3/yr)	0	0	0.0%	0	0.0%
Total Inputs (m3/yr)	61,858	61,858	**0.0%**	61,858	**0.0%**
Outputs (Volumes)					
Precipitation Surplus (m^3/yr)	46,380	48,954	5.6%	48,954	5.6%
Evapotranspiration (m^3/yr)	15,478	12,903	-16.6%	12,903	-16.6%
Infiltration (m^3/yr)	5,334	3,856	-27.7%	3,856	-27.7%
Infiltration Measures (m^3/yr)	0	0	0.0%	1,117	-79.1%
Total Infiltration (m^3/yr)	5,334	3,856	-27.7%	4,973	-6.8%
Runoff Pervious Areas (m^3/yr)	8,001	5,784	-27.7%	5,784	-27.7%
Runoff Impervious Areas (m^3/yr)	33,046	39,314	N/A	38,198	N/A
Total Runoff (m^3/yr)	41,046	45,098	9.9%	43,981	7.2%
Total Outputs (m^3/yr)	**61,858**	**61,858**	**0.0%**	**61,858**	**0.0%**

Annual Water Budget Assessment

Pre-Development Summary (No Mitigation) Refer to Figure WB-1

Project: 21102

October 30, 2025

Catchment Designation	Pervious	Impervious	Total
Area (m^2)	22,150	32350	**54,500**
Pervious Area (m2)	22,150	0	**22150**
Impervious Area (m2)	0	32,350	**32,350**
Inputs (per Unit Area)			
Precipitation (mm/yr)	1135	1135	**1135**
Run-on (mm/yr)	0	0	**0**
Other Inputs (mm/yr)	0	0	**0**
Outputs (per Unit Area)			
Precipitation Surplus (mm/yr)	602	1,022	**851**
Evapotranspiration (mm/yr)	533	114	**284**
Infiltration (mm/yr)	241	0	**98**
Infiltration Measures (mm/yr)	0	0	**0**
Total Infiltration (mm/yr)	241	0	**98**
Runoff Pervious Areas (mm/yr)	361	0	**147**
Runoff Impervious Areas (mm/yr)	0	1,022	**606**
Total Runoff (mm/yr)	361	1,022	**753**
Total Outputs (mm/yr)	**1135**	**1135**	**1135**
Difference (Inputs-Outputs)	**0**	**0**	**0**
Inputs (Volumes)			
Precipitation (m^3/yr)	25,140	36,717	**61,858**
Run-on (m^3/yr)	0	0	**0**
Other Inputs (m^3/yr)	0	0	**0**
Total Inputs (m3/yr)	**25,140**	**36,717**	**61,858**
Outputs (Volumes)			
Precipitation Surplus (m^3/yr)	13,334	33,046	**46,380**
Net Surplus (m^3/yr)	13,334	33,046	**46,380**
Evapotranspiration (m^3/yr)	11,806	3,672	**15,478**
Infiltration (m^3/yr)	5,334	0	**5,334**
Infiltration Measures (m^3/yr)	0	0	**0**
Total Infiltration (m^3/yr)	5,334	0	**5,334**
Runoff Pervious Areas (m^3/yr)	8,001	0	**8,001**
Runoff Impervious Areas (m^3/yr)	0	33,046	**33,046**
Total Runoff (m^3/yr)	8,001	33,046	**41,046**
Total Outputs (m^3/yr)	**25,140**	**36,717**	**61,858**
Difference (Inputs-Outputs)			**0**

As per Water Availability Study for the South Niagara Falls and Welland River Watershed Plan Areas Niagara Peninsula Source Protection Area (2009)
*MOE factor of 0.4

Note:
- Evaporation from impervious area assumed to be 10% of precipitation based on Cole SWM Report

Annual Water Budget Assessment

Post-Development Summary (No Mitigation) Refer to Figure WB-2

Project: 21102

October 30, 2025

Catchment Designation	Pervious	Impervious	Total
Area (m^2)	16,013	38,487	**54,500**
Pervious Area (m2)	16,013	0	**16013**
Impervious Area (m2)	0	38,487	**38,487**
Inputs (per Unit Area)			
Precipitation (mm/yr)	1135	1135	**1135**
Run-on (mm/yr)	0	0	**0**
Other Inputs (mm/yr)	0	0	**0**
Outputs (per Unit Area)			
Precipitation Surplus (mm/yr)	602	1,022	**898**
Evapotranspiration (mm/yr)	533	114	**237**
Infiltration (mm/yr)	241	0	**71**
Infiltration Measures (mm/yr)	0	0	**0**
Total Infiltration (mm/yr)	241	0	**71**
Runoff Pervious Areas (mm/yr)	361	0	**106**
Runoff Impervious Areas (mm/yr)	0	1,022	**721**
Total Runoff (mm/yr)	361	1,022	**827**
Total Outputs (mm/yr)	**1135**	**1135**	1135
Difference (Inputs-Outputs)	**0**	**0**	**0**
Inputs (Volumes)			
Precipitation (m^3/yr)	18,175	43,683	**61,858**
Run-on (m^3/yr)	0	0	**0**
Other Inputs (m^3/yr)	0	0	**0**
Total Inputs (m3/yr)	**18,175**	**43,683**	61,858
Outputs (Volumes)			
Precipitation Surplus (m^3/yr)	9,640	39,314	**48,954**
Net Surplus (m^3/yr)	9,640	39,314	**48,954**
Evapotranspiration (m^3/yr)	8,535	4,368	**12,903**
Infiltration (m^3/yr)	3,856	0	**3,856**
Infiltration Measures (m^3/yr)	0	0	**0**
Total Infiltration (m^3/yr)	3,856	0	**3,856**
Runoff Pervious Areas (m^3/yr)	5,784	0	**5,784**
Runoff Impervious Areas (m^3/yr)	0	39,314	**39,314**
Total Runoff (m^3/yr)	5,784	39,314	**45,098**
Total Outputs (m^3/yr)	**18,175**	**43,683**	61,858
Difference (Inputs-Outputs)			**0**

As per Water Availability Study for the South Niagara Falls and Lower Welland River Watershed Plan Areas Niagara Peninsula Source Protection Area (2009)
*MOE factor of 0.4

Note:
- Evaporation from impervious area assumed to be 10% of precipitation

SWM DESIGN CALCULATIONS
Water Budget - Post-Development (With Mitigation)

Project Name: 3770 Montrose Road
Municipality: Niagara Falls, Ontario
Project No.: 21102
Date: 19-Apr-24

Prepared by: 0
Last Revised: 30-Oct-25

Catchment Designation	Area 201 (Drainage to Soakaways)			Area 202 (Remaining Site Area)			
	Pervious	Impervious	Total Area 201	Pervious	Impervious	Total Area 203	Total
Area (m^2)	0	1,093	**1,093**	16,013	37,394	53,407	**54,500**
Pervious Area (m^2)	0	0	**0**	16,013	0	16013	**16,013**
Impervious Area (m^2)	0	1,093	**1,093**	0	37,394	37,394	**38,487**
Infiltration Factors							
MOE Infiltration Factor	0.40			0.40			
Run-off from Impervious Surfaces							
Inputs (per Unit Area)							
Precipitation (mm/yr)	1135	1135	1135	1135	1135	1135	**1135**
Run-on (mm/yr)	0	0	0	0	0	0	**0**
Other Inputs (mm/yr)	0	0	0	0	0	0	**0**
Outputs (per Unit Area)							
Precipitation Surplus (mm/yr)	602	1,022	1,022	602	1,022	896	**898**
Evapotranspiration (mm/yr)	533	114	114	533	114	239	**237**
Infiltration (mm/yr)	421	0	0	241	0	72	**71**
Infiltration Measures (mm/yr)	0	1,022	1,022	0	0	0	**20**
Total Infiltration (mm/yr)	421	1,022	1,022	241	0	72	**91**
Runoff Pervious Areas (mm/yr)	181	0	0	361	0	108	**106**
Runoff Impervious Areas (mm/yr)	0	0	0	0	1,022	715	**701**
Total Runoff (mm/yr)	181	0	0	361	1,022	824	**807**
Total Outputs (mm/yr)	**1135**	**1135**	1,135	**1135**	**1135**	1,135	**1,135**
Difference (Inputs-Outputs)	**0**	0	0	0	0	0	**0**
Inputs (Volumes)							
Precipitation (m^3/yr)	0	1,241	1,241	18,175	42,442	60,616	**61,858**
Run-on (m^3/yr)	0	0	0	0	0	0	**0**
Other Inputs (m^3/yr)	0	0	0	0	0	0	**0**
Total Inputs (m3/yr)	**0**	**1,241**	**1,241**	**18,175**	**42,442**	**60,616**	**61,858**
Outputs (Volumes)							
Precipitation Surplus (m^3/yr)	0	1,117	1,117	9,640	38,198	47,837	**48,954**
Net Surplus (m^3/yr)	0	1,117	1,117	9,640	38,198	47,837	**48,954**
Evapotranspiration (m^3/yr)	0	124	124	8,535	4,244	12,779	**12,903**
Infiltration (m^3/yr)	0	0	0	3,856	0	3,856	**3,856**
Infiltration Measures (m^3/yr)	0	1,117	1,117	0	0	0	**1,117**
Total Infiltration (m^3/yr)	0	1,117	1,117	3,856	0	3,856	**4,973**
Runoff Pervious Areas (m^3/yr)	0	0	0	5,784	0	5,784	**5,784**
Runoff Impervious Areas (m^3/yr)	0	0	0	0	38,198	38,198	**38,198**
Total Runoff (m^3/yr)	0	0	0	5,784	38,198	43,981	**43,981**
Total Outputs (m^3/yr)	**0**	**1,241**	1,241	**18,175**	**42,442**	**60,616**	**61,858**
Difference (Inputs-Outputs)			**0**			**0**	**0**

Note:
- Evaporation from impervious area assumed to be 15% of precipitation

Counterpoint Engineering

5mm Target

As per City of Niagara Falls Standards

21102_3770 Montrose Road

Initial Abstraction Asphalt/Roof, I	0	mm
Initial Abstraction Pervious and Gravel, P	5	mm
As per MOE guidelines		

Type of Area	Area	Units	% Redevelopment Area
Impervious Asphalt/Paved Area/Roof	3.85	ha	71%
Pervious Grass/Landscaped/Gravel	1.60	ha	29%
Total Area	5.45	ha	

Initial Abstraction (credit)= 1.5 mm

Required Development Retention = (Excess Rainfall- Initial Abstraction) * (Total Development Area)
Required Development Retention = (5mm- 1.1mm) * (3.63ha)

Required Development Retention (debit)= 192.4 m^3

SOAKAWAY PITS 1-4 (CONTROLLED SITE AREA)

SOAKAWAY PIT NO.	TRIBUTARY BLOCKS	ROOF TRIBUTARY AREA (m2)	SOAKAWAY WATER VOLUME (m3)	SOAKAWAY STONE VOLUME (m3)	Rainfall Depth Capture (mm)	NEAREST MW	GWL (m)	GROUND ELEV. (m)	SOAKAWAY BOTTOM ELEV. (m)	CLEARANCE ABOVE GWL (m)	SOAKAWAY FOOTPRINT (m2)	SOAKAWAY Depth (m)
1	27,28	253	9.1	22.7	35.8	BH5	192.10	195.60	194.10	2.00	22.6	1.0
2	25,26	253	7.8	19.5	30.7	BH101*	DRY	195.80	194.30	-	19.5	1.0
3	23,24	334	9.9	24.7	29.6	BH101*	DRY	195.80	194.30	-	24.7	1.0
4	21,22	253	7.6	19.0	30.0	BH101*	DRY	195.70	194.20	-	19.0	1.0
Totals		**1,093**	**34.3**								**85.7**	

NOTES

1 40% Stone voids (19mm Clearstone).
2 Final Geotechnical Investigation - North Portion of 3770 Montrose Road, Pinchin, dated July 22, 2022.
3 1m Soakaway pit stone depth
4 All Soakaways have 0.5m clearance below Ground Elevation

SWM DESIGN CALCULATIONS
Water Balance Daily Event Rainfall Target Depth Calculation (Controlled Area Soakaways)

Project Name: 3770 Montrose Road
Municipality: Niagara Falls, Ontario
Project No.: 21102
Date: 19-Apr-24

Prepared by: P.T.
Checked by:
Last Revised: 30-Oct-25

Input Parameters:

Daily Rainfall Depth (mm)	**31**
Total Annual Precipitation (mm)	**1135**

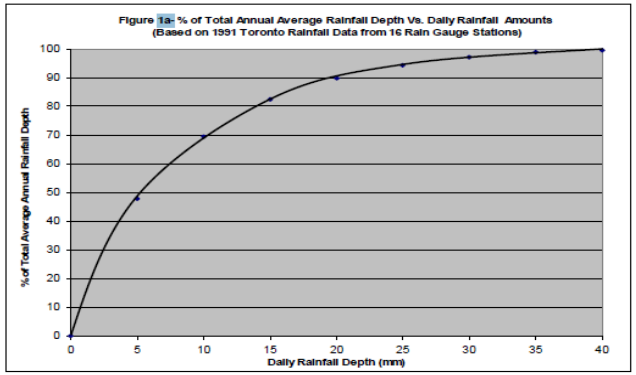
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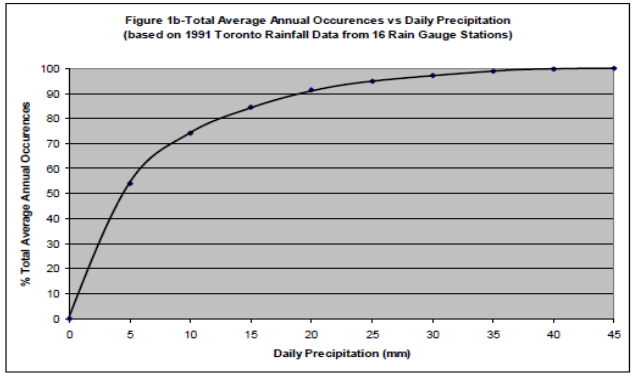
Portion of Total Annual Rainfall Depth (%)	**97**
Portion of Total Annual Rainfall Depth (mm)	**1104**
Total Average Annual Occurrences (%)	**98**

Daily Rainfall Depth (mm)	% of Total Annual Rainfall Depth	% Total Average Annual Occurrences
0.0	0	0
5.0	49	55
10.0	70	75
15.0	82	85
20.0	90	91
25.0	95	95
30.0	97	97
35.0	98	99
40.0	100	100

Source: Wet Weather Flow Management Guidelines, City of Toronto **Figure 1a, 1b**

City of Toronto 8





Wet Weather Flow Management Guidelines November 2006

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TEL: (905) 326-1404 FAX: (905) 326-1405
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SWM DESIGN CALCULATIONS
Soakaway Retention Time (Controlled Area)

Project Name: 3770 Montrose Road
Municipality: Niagara Falls, Ontario
Project No.: 21102
Date: 19-Apr-24

Prepared by: P.T.
Last Revised: 30-Oct-25

Input:

Runoff volume to be infiltrated	34.3	m^3
Percolation rate of surrounding native soil, P	15	mm/hr
Porosity of the storage media	0.40	
Total Bottom Area of Soakaways	85.7	m^2

	Required	Provided
Retention Time	**48 hrs**	**66.7 hrs**

$$A = \frac{1{,}000V}{Pn\triangle t}$$

Equation 4.3: Infiltration Trench Bottom Area

where A = bottom area of the trench (m^2)
V = runoff volume to be infiltrated (Table 3.2)
P = percolation rate of surrounding native soil (mm/h)
n = porosity of the storage media (0.4 for clear stone)
$\triangle t$ = retention time (24 to 48 hours)

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Soakaways (Uncontrolled Area)

Pervious Contributing Area:	0	m^2
Impervious Contributing Area:	925	m^2
Total Contributing Area:	925	m^2
Imperviousness =	100%	
Number of units serviced:	25	
Average Area per unit =	37.0	m^2

Soakaways shall target the capture the 5mm event from incoming drainage.

Total Water Quality target Volume (WQV) to achieve 80% TSS as per MOE Table 3.2:

= 45 m^3/ha*0.093 ha = 4 m^3

Metrics:

Dimensions for each Rain Garden:

Average length =	3.0	m
Average width =	0.7	m
Depth =	0.3	m
Void Ratio =	0.4	
Percolation rate =	**15**	**mm/hr**
Volume per Soakaway pit =	0.21	m^3
Number of Soakaway pits =	25	
Total Volume =	**5.3**	**m^3**
Adequate capacity to capture =	**5.7**	**mm storm event for total contributing area**

Estimated clearance from water table = 1.0 m

Maximum depth calculation:

$d_{c\,max} = i \times (t_S - d_p / i) / V_r$ = 15 x (48 - 0 / 15) / 0.4

= **1800 mm**

Proposed LID depth = **250 mm**

Therefore max depth requirement is met.

Minimum Surface Area of LID for Water Quality:

A_f = WQV / (d_c x V_r) = 41.6 m^2

Proposed total Soakaway Area = 25 x 3 x 0.7

52.5 m^2

Therefore area requirements are met.

$A_f = WQV / (d_c * V_r)$

Where:

- A_f = Footprint surface area (m^2)
- WQV = Water quality volume (m^3)
- d_c = Bioretention cell depth (m)
- V_r = Void space ratio for filter bed and gravel storage layer (assume 0.4)

The ratio of impervious drainage area to footprint surface area of the practice should be between 5:1 and 15:1 to limit the rate of accumulation of fine sediments and thereby prevent clogging.

Where:

- $d_{c\,max}$ = Maximum bioretention cell depth (mm)
- i = Infiltration rate for native soils (mm/hr)
- V_r = Void space ratio for filter bed and gravel storage layer (assume 0.4)
- t_s = Time to drain (design for 48 hour time to drain is recommended)
- d_p = Maximum surface ponding depth (mm)

For designs that include an underdrain, the filter media bed should be 1 to 1.25 metres in depth. The following equation can be used to determine the maximum depth of the stone reservoir below the invert of the underdrain pipe:

$d_{r\,max} = i * t_s / V_r$

Where:

- $d_{r\,max}$ = Maximum depth of stone reservoir below the underdrain pipe

Note: See detail provided in **Drawing C-2** (Grading Plan)
(Passive Drainage Interceptor Detail)

(Percolation rate has been assumed as **15 mm/hr** for Loam baseds off of Table 4.4 in MOE guidelines (2004)

Note: all Soakaways on lots have been assessed and confirmed for groundwater clearance of minimum of 1m.

SWM DESIGN CALCULATIONS
Water Balance Daily Event Rainfall Target Depth (Uncontrolled Area Soakaways)

Project Name: Montrose
Municipality: Niagara
Project No.: 21102
Date: 30-Oct-25

Prepared by: P.T.
Checked by:
Last Revised: 30-Oct-25

Input Parameters:

Daily Rainfall Depth (mm)	**6**
Total Annual Precipitation (mm)	**855**

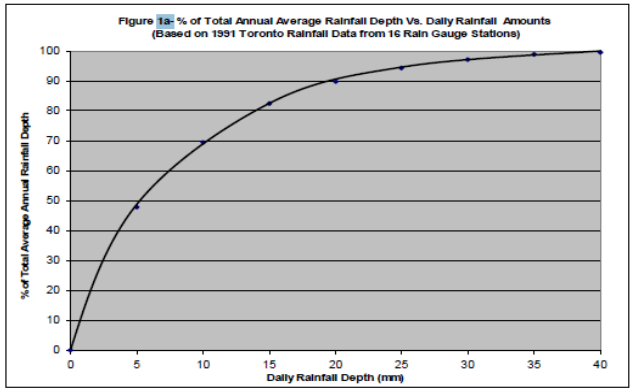
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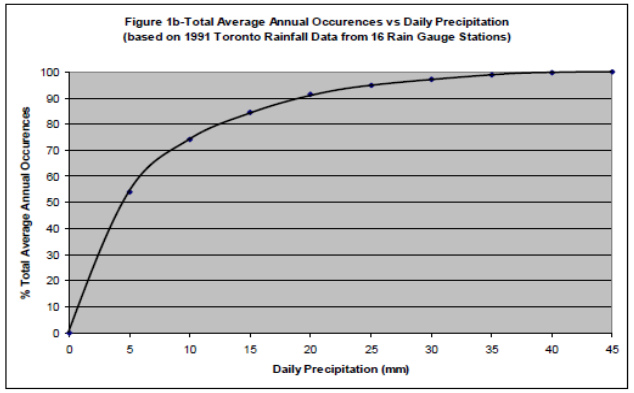
Portion of Total Annual Rainfall Depth (%)	**52**
Portion of Total Annual Rainfall Depth (mm)	**441**
Total Average Annual Occurrences (%)	**57**

Daily Rainfall Depth (mm)	% of Total Annual Rainfall Depth	% Total Average Annual Occurrences
0.0	0	0
5.0	49	55
10.0	70	75
15.0	82	85
20.0	90	91
25.0	95	95
30.0	97	97
35.0	98	99
40.0	100	100

Source: Wet Weather Flow Management Guidelines, City of Toronto **Figure 1a, 1b**

City of Toronto 8





Wet Weather Flow Management Guidelines November 2006

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SWM DESIGN CALCULATIONS
Soakaway Retention Time (Uncontrolled Area)

Project Name: Montrose
Municipality: Niagara
Project No.: 21102
Date: 30-Oct-25

Prepared by: P.T.
Last Revised: 30-Oct-25

Input:

Runoff volume to be infiltrated	5.25	m^3
Percolation rate of surrounding native soil, P	15	mm/hr
Porosity of the storage media	0.40	
Bottom Area of Gallery	53	m^2

	Required	Provided
Retention Time	**48 hrs**	**16.7 hrs**

$$A = \frac{1{,}000V}{Pn\triangle t}$$

Equation 4.3: Infiltration Trench Bottom Area

where A = bottom area of the trench (m^2)
V = runoff volume to be infiltrated (Table 3.2)
P = percolation rate of surrounding native soil (mm/h)
n = porosity of the storage media (0.4 for clear stone)
△t = retention time (24 to 48 hours)

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FINAL

Geotechnical Investigation

North Portion of 3770 Montrose Road, Niagara Falls, Ontario

Prepared for:

Forest Gate Advisors Inc.
100 Tesma Way, Suite 6
Vaughan, Ontario L4K 0J9

July 22, 2022

Pinchin File: 296292.002

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1.0 INTRODUCTION AND SCOPE

Pinchin Ltd. (Pinchin) was retained by Forest Gate Advisors Inc. (Client) to conduct a Geotechnical Investigation and provide subsequent geotechnical design recommendations for the proposed redevelopment to be located at the North Portion of 3770 Montrose Road, Niagara Falls, Ontario (Site). The Site location is shown in Figure 1.

Pinchin understands that the Site is currently occupied by a former Canadian Tire retail store and automotive service centre and a multi-tenant commercial building (collectively referred to as the "Site Buildings") and that the Client intends to redevelop the Site for residential land use.

Pinchin reviewed the drafts of the Site Plan provided by the Client. Based on the review of the latest Site Plan (April 2022) provided, it is Pinchin's understanding that the proposed redevelopment consists of three-story slab-on-grade (no basement) buildings, along with the access roads (driveways), and parking areas.

Pinchin's geotechnical comments and recommendations are based on the results of the Geotechnical Investigation and our understanding of the project scope.

The purpose of the Geotechnical Investigation was to delineate the subsurface conditions and soil engineering characteristics by advancing a total of ten (10) sampled boreholes (Boreholes BH1 to BH10) at the Site. Concurrent to the geotechnical investigation fieldwork, Pinchin also completed fieldwork for a Phase II Environmental Site Assessment at the Site. Two of the boreholes for that investigation (Borehole MW101, and Borehole BH106) were completed to also obtain geotechnical information, and are included in the borehole logs for this report. Boreholes BH1, BH3, BH5, BH6, BH9, and MW101 were completed as groundwater monitoring wells.

Based on a desktop review and the results of the Geotechnical Investigation, the following geotechnical data and engineering design recommendations are provided herein:

- A review of relevant area geology and Site background information
- A detailed description of the soil and groundwater conditions;
- Anticipated groundwater management;
- Foundation design recommendations including soil bearing resistances at Ultimate Limit States (ULS) and Serviceability Limit States (SLS) design;
- Potential total and differential settlements;
- Foundation frost protection and engineered fill specifications and installation;
- Seismic Site classification for seismic Site response;
- Concrete slab-on-grade support recommendations;

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- Asphaltic concrete pavement structure design for parking areas and access roadways; and
- Potential construction concerns.

Abbreviations, terminology, and principle symbols commonly used throughout the report, borehole logs, and appendices are enclosed in Appendix I.

2.0 CONCURRENT INVESTIGATIONS

As previously mentioned, Pinchin has concurrently carried out a Phase Two Environmental Assessment at the Site. The report for the Phase Two Environmental Assessment was issued under a separate cover.

3.0 SITE DESCRIPTION AND GEOLOGICAL SETTING

As indicated in Figure 1 (Key Map), the Site is located on the east side of Montrose Road and is approximately 300 meters (m) north of intersection of Montrose Road and Thorold Stone Road in Niagara Falls, Ontario. The Site is approximately 6.0 hectares (approximately 14.0 acres) in area and is bounded by a multi-tenant commercial shopping plaza to the south (i.e., south portion of 3770 Montrose Road), a vegetated area followed by the Queen Elizabeth Way (QEW) highway to the east, residential land use to the north, and Montrose Road followed by residential land use to the west.

Data obtained from the Ontario Geological Survey (OGS) GIS-based map[1], as published by the Ontario Ministry of Natural Resources, indicates that the overburden soil at the Site consists of fine-textured glaciolacustrine massive to well laminated silt and clay deposits with minor sand and gravel.

Based on the review of the regional geology maps[2 3 (GIS-based)] and the available well records, the overburden soils are underlain by bedrock at approximately 13.0 metres below ground surface (mbgs). The underlying bedrock at this Site is expected to consist of shale, dolostone (argillaceous), limestone of the Lockport Formation.[4 5 (GIS-based)]

[1]Ontario Geological Survey 2010. Surficial geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 128 – Revised

[2]Feenstra, B.H. 1981. Bedrock topography of the Niagara and Niagara-on-the-Lake area, southern Ontario; Ontario Geological Survey, Preliminary Map P.2400, scale 1:50 000.

[3]Gao, C., Shirota, J., Kelly, R. I., Brunton, F.R., van Haaften, S. 2006. Bedrock topography and overburden thickness mapping, southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 207. ISBN 1-4249-2550-9

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[4]Liberty, B.A., Feenstra, B.H. and Telford, P.G. 1976. Paleozoic geology, Niagara, southern Ontario; Ontario Division of Mines, Map 2344, 1:50 000.

[5]Armstrong, D.K. and Dodge, J.E.P. 2007. Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 219

4.0 GEOTECHNICAL FIELD INVESTIGATION AND METHODOLOGY

Pinchin completed drilling field investigations at the Site between December 6 and 9, 2021 by advancing a total of twelve (12) sampled boreholes throughout the Site. The boreholes were advanced to depths of approximately 5.2 to 6.7 mbgs. The approximate spatial locations of the boreholes advanced at the Site are shown on Figure 2.

The boreholes were advanced with the use of a Geoprobe® 7822DT track mounted geotechnical drill rig which was equipped with standard soil sampling equipment. Soil samples were collected at 0.76 and 1.52 m intervals using a 51 mm outside diameter (OD) split spoon barrel in conjunction with Standard Penetration Tests (SPT) “N” values (ASTM D1586). The SPT “N” values were used to assess the compactness condition of the non-cohesive soil and are presented on the appended borehole logs.

Monitoring wells were installed in Boreholes BH1, BH3, BH5, BH6, BH9, and MW101 to allow measurement of groundwater levels. The monitoring wells were constructed using flush-threaded 50 mm diameter Trilock pipe with 3.0 meter long 10-slot well screens, delivered to the Site in pre-cleaned individually sealed plastic bags. The screen and riser pipes were not allowed to come into contact with the ground or drilling equipment prior to installation.

A completed well record was submitted to the property owner and the Ministry of the Environment, Conservation and Parks for Ontario (MECP) as per Ontario Regulation 903, as amended. A licensed well technician must properly decommission the monitoring wells prior to construction according to Regulation 903 of the Ontario Water Resources Act.

Groundwater observations and measurements were obtained from the open boreholes during and upon completion of drilling. Groundwater levels were measured in the monitoring wells on January 12, 2022. The groundwater observations and measurements recorded are included on the appended borehole logs.

The borehole locations and ground surface elevations were surveyed by Pinchin using a Sokkia Model GRX 2 Global Navigation Satellite System (GNSS) rover. The ground surface elevations are geodetic, based on GNSS and local base station telemetry with a precision static of less than 20 mm.

The field investigation was monitored by experienced Pinchin personnel. Pinchin logged the drilling operations and identified the soil samples as they were retrieved. The recovered soil samples were sealed into plastic bags and carefully transported to Pinchin’s accredited materials testing laboratory in

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Waterloo, Ontario for further analysis and testing. All soil samples were classified according to visual and index properties by the project engineer.

The field logging of the soil and groundwater conditions was performed to collect geotechnical engineering design information. The borehole logs include textural descriptions of the subsoil in accordance with a modified Unified Soil Classification System (USCS) and indicate the soil boundaries inferred from non-continuous sampling and observations made during the borehole advancement. These boundaries reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The modified USCS classification is explained in further detail in Appendix I. Details of the soil and groundwater conditions encountered within the boreholes are included on the Borehole Logs within Appendix II.

Select soil samples collected from Boreholes BH3 (SS4) and BH8 (SS4) were tested to determine the particle size distribution. A copy of the laboratory analytical reports is included in Appendix III. In addition, the collected samples were compared against previous geotechnical information from the area, for consistency and calibration of results.

5.0 SUBSURFACE CONDITIONS

5.1 Borehole Soil Stratigraphy

In general, the stratigraphy at the Site comprises pavement structure, topsoil, cement concrete, and fill underlain by native silt to the maximum borehole termination depths of approximately 5.2 to 6.7 mbgs. The appended borehole logs provide detailed soil descriptions and stratigraphies, results of SPT, moisture content profiles, details of monitoring wells installation, and groundwater measurements.

Topsoil – A 180 mm thick surficial layer of topsoil was encountered in Borehole BH1. The topsoil comprised of clayey silt with trace of organics and sand. At the time of sampling, the topsoil material was in wet state of wetness.

Cement Concrete – A concrete slab approximately 140 mm in thickness was encountered at the surface of Borehole MW101, which was completed inside an existing building.

Pavement Structure – The pavement structure was encountered in Boreholes BH4, BH6, BH8, and BH9 and was observed to comprise approximately 100 to 130 mm of asphaltic concrete overlying approximately 325 to 700 mm of granular (sand and gravel) fill material. The granular fill was grey in color and at the time of sampling was in moist to saturated state of wetness.

Fill – Fill material was encountered surficially in Boreholes BH2, BH3, BH5, BH7, BH10, BH106, below the pavement structure in Boreholes BH4 and BH8, and below the concrete slab in Borehole BH101. The fill material extended to depths of approximately 0.8 to 2.3 mbgs. The fill material generally consisted of silt, and sand/silty sand. Some clay, trace to some gravel, and organic matter were also noted in the fill.

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The fill material had a very loose to compact relative density based on SPT 'N' values of 2 to 11 blows per 300 mm penetration of a split spoon sampler. At the time of sampling, the fill material was in moist to wet state of wetness, and typically had moisture contents greater than 20%.

Native Soils – Native silt deposit was encountered underlying the topsoil, fill material, concrete slab, and pavement structure within all boreholes and extended to the borehole termination depths of approximately 5.2 to 6.7 mbgs. The native silt deposit generally contained trace to some clay, trace to some sand, and trace gravel. Organic material within the native silt was noted in Borehole BH106 (SS2) between depths of approximately 0.8 and 1.4 mbgs.

The native silt deposit had a variable very loose to very dense (generally loose to compact) relative density based on SPT 'N' values of 2 to 53 blows per 300 mm penetration of a split spoon sampler. The dense to very dense portions of the silt were more than 3.0 mbgs. At the time of sampling, the fill material was in wet to saturated state of wetness, and had moisture contents ranging from 17 to 30%.

The results of particle size distribution analysis completed on two samples (Borehole BH3, SS4 and Borehole BH8, SS4) of the native silt deposit are provided in Appendix III and indicate that the sample contains no gravel, approximately 1% sand, 93-95% silt, and 4-6% clay.

5.2 Groundwater Conditions

Groundwater observations and measurements were obtained in the open boreholes at the completion of drilling and are summarized on the appended borehole logs. In addition, groundwater levels were measured in the monitoring wells installed in in the boreholes on January 12, 2022. The measured groundwater levels are summarized below:

Borehole No.	Ground Surface Elevation (masl)	Water Level (mbgs)	Groundwater Elevation (masl)
BH1	194.18	1.3	192.9
BH3	194.68	1.7	193.0
BH5	194.07	2.0	192.1
BH6	194.69	2.7	192.0
BH9	194.61	3.0	191.6
MW101	194.95	Dry	Dry

Seasonal variations in the water table should be expected, with higher levels occurring during wet weather conditions in the spring and fall and lower levels occurring during dry weather conditions.

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6.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

6.1 General Information

The recommendations presented in the following sections of this report are based on the information available regarding the proposed construction, the results obtained from the Geotechnical Investigation, and Pinchin's experience with similar projects. Since the investigation only represents a portion of the subsurface conditions, it is possible that conditions may be encountered during construction that are substantially different than those encountered during the investigation. If these situations are encountered, adjustments to the design may be necessary.

A qualified geotechnical engineer should be on-Site during the foundation preparation to ensure the subsurface conditions are the same/similar to what was observed during the investigation.

It is Pinchin's understanding that the proposed redevelopment consists of three-story slab-on-grade (no basement) buildings, along with the access roads, and parking areas (driveways).

6.2 Site Preparation

The existing topsoil, pavement structure, fill, and existing building foundations and floor slabs are not considered suitable to remain below the proposed buildings and will need to be removed. The existing inorganic fill can remain below proposed access road and parking lots subject to proof rolling, inspection by a geotechnical engineer, and acceptance of the potential for future settlements by the owner. In calculating the approximate quantity of topsoil, pavement structure, and fill to be stripped, we recommend that the thicknesses provided on the individual borehole logs be increased by 50 mm to account for variations and some stripping of the mineral soil below.

Pinchin recommends that any engineered fill required at the Site be compacted in accordance with the criteria stated in the following table:

Type of Engineered Fill	Maximum Loose Lift Thickness (mm)	Compaction Requirements	Moisture Content (Percent of Optimum)
Structural fill to support foundations and floor slabs	200	100% SPMDD*	Plus 2 to minus 4
Subgrade fill beneath parking lots and access roadways	300	98% SPMDD	Plus 2 to minus 4

*SPMDD - Standard Proctor Maximum Dry Density

Engineered fill must extend at least 1 m beyond the proposed edges of buildings, and then down and outwards to competent subgrade at 1 horizontal to 1 vertical. Prior to placing any fill material at the Site, the subgrade should be inspected by a qualified geotechnical engineer and loosened/soft pockets should be sub excavated and replaced with engineered fill.

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The native mineral soils should be suitable for use as engineered fill and subgrade fill provided the grading work is carried out during periods of time with warmer weather with limited precipitation, and time is provided to allow the material to dry. Wet portions of the native soils will likely need to be placed in thin lifts over large areas and allowed to dry. It is recommended that any additional material imported to Site to raise grades below the proposed buildings comprise imported Ontario Provincial Standard Specification (OPSS) 1010 Granular 'B' Type I material or Select Subgrade Material (SSM). If the work is carried out during very dry weather, water may have to be added to the material to imported sandy materials to improve compaction. Other types of imported soil may be suitable for use on Site but should be approved by a geotechnical engineer prior to import.

A qualified geotechnical engineering technician should be on Site to observe fill placement operations and perform field density tests at random locations throughout each lift, to indicate the specified compaction is being achieved.

Where grade raises occur, it is recommended to let the completed engineered fill sit for at least 3 months prior to construction of buildings.

6.3 Open Cut Excavations and Anticipated Groundwater Management

It is anticipated that the foundations will be constructed below conventional frost depths at approximately 1.2 m below finished grade; and services will be installed at conventional depths of 2 to 4 m . As higher bearing pressures are available at deeper depths, there is potential that excavation for foundations may extend deeper than 1.2 m.

Based on the subsurface information obtained from within the boreholes, it is anticipated that the excavated material will predominately consist of topsoil, pavement structure, fill, and native silt soils. The groundwater was measured to be approximately 1.3 to 3.3 mbgs (Elevation 194.2 to 194.6 masl) on January 12, 2022. Hydrogeological study would be needed to determine the stabilized high groundwater levels across the site. For preliminary geotechnical design purposes, the groundwater level may be taken at 2.1 mbgs/192.3 masl.

Where workers must enter trench excavations deeper than 1.2 m, the trench excavations should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act (OHSA), Ontario Regulation 213/91, Construction Projects, July 1, 2011, Part III - Excavations, Section 226. Alternatively, the excavation walls may be supported by either closed shoring, bracing, or trench boxes complying with sections 235 to 239 and 241 under O. Reg. 231/91, s. 234(1).

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Based on the OHSA, the soils encountered at the Site would be classified as Type 3 soils and all excavations through these soils must be cut back at 1 horizontal to 1 vertical from the base of the excavation. Excavations extending below the groundwater table should be classified as a Type 4 soil and temporary excavations will have to be sloped back at 3 horizontals to 1 vertical from the base of the excavation. Excavations through multiple soil types must be sloped as per the requirements for the highest numbered soil type.

In addition to compliance with the OHSA, the excavation procedures must also be in compliance to any potential other regulatory authorities, such as federal and municipal safety standards.

Alternatively, the excavation walls may be supported by either closed shoring, or bracing, complying with sections 235 to 239 and 241 under O. Reg. 231/91, s. 234(1).

Minor to moderate groundwater inflow through the silt is expected where the excavations extend less than 0.6 m below the groundwater table. It is believed that this groundwater inflow can be controlled using a gravity dewatering system with perimeter interceptor ditches and high-capacity pumps. It is not expected that the dewatering volumes will trigger a submission to the Environmental Activity and Sector Registry (EASR) or Permit to Take Water (PTTW) by exceeding 50,000 L/day or 400,000 L/day, respectively.

For excavations extending more than 0.6 m below the stabilized groundwater table, a dewatering system installed by a specialist dewatering contractor may be required to lower the groundwater level prior to excavation. The design of the dewatering system should be left to the contractor’s discretion, and the system should meet a performance specification to maintain and control the groundwater at least 0.30 m below the excavation base. It is recommended that Pinchin review the final grading plan to confirm this recommendation.

Seasonal variations in the water table should be expected, with higher levels occurring during wet weather conditions in the spring and fall and lower levels occurring during dry weather conditions. If construction commences during wet periods (typically spring or fall), there is a greater potential that the groundwater elevation could be higher and/or perched groundwater may be present. Any potential precipitation of perched groundwater should be able to be controlled from pumping from filtered sumps and should be pumped away immediately (not allowed to pond).

Prior to commencing excavations, it is critical that all existing surface water and potential surface water is controlled and diverted away from the Site to prevent infiltration and subgrade softening. At no time should excavations be left open for a period of time that will expose them to precipitation and cause subgrade softening.

All collected water is to discharge a sufficient distance away from the excavation to prevent re-entry. Sediment control measures, such as a silt fence should be installed at the discharge point of the dewatering system. The utmost care should be taken to avoid any potential impacts on the environment.

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6.4 Foundation Recommendations

6.4.1 Shallow Foundation Design

The native mineral soils or engineered fill are considered suitable to support the proposed building, provided site preparation is carried out as noted above in Section 6.2.

Conventional shallow strip footings (and conventional isolated pad/spread footings established on the inorganic native soils at frost depth, may be designed using a bearing resistance for 25 mm of settlement at Serviceability Limit States of 75 kPa, and a factored geotechnical bearing resistance of 110 kPa at Ultimate Limit States (ULS).

Conventional shallow footings established on engineered fill placed as specified in Section 6.2 of this report, may be designed using a bearing resistance for 25 mm of settlement at Serviceability Limit States of 150 kPa, and a factored geotechnical bearing resistance of 225 kPa at Ultimate Limit States (ULS), provided there is a minimum of 1 m of engineered fill below the underside of footings.

Higher bearing pressures are available on the compact to very dense native soils more than about 2.0 to 2.5 mbgs. Locally, the upper limit of compact soil is 3.8 to 5.4 mbgs near the south-central to southeast portion of site (Boreholes BH7 and BH9). Conventional shallow strip footings (maximum footing width of 2.0 m) and conventional isolated pad/spread footings (maximum footing width of 2.5 m) established on the compact inorganic native soils may be designed using a bearing resistance for 25 mm of settlement at Serviceability Limit States of 180 kPa, and a factored geotechnical bearing resistance of 270 kPa at Ultimate Limit States (ULS). It is recommended that foundation plans be reviewed by Pinchin to confirm the suitability of use of these higher bearing pressures.

As the actual service loads were not known at the time of this report, these should be reviewed by the project structural engineer to determine if SLS or ULS governs the footing design.

Higher bearing resistances may be available for foundations placed on the deeper native soils; however, as the actual building designs are unknown, Pinchin should be consulted to confirm the design bearing resistances provided are suitable for the design footing elevations. Higher bearing pressures would also be available on bedrock. Bedrock was not encountered during this investigation but is expected to be around 13 mbgs based on available mapping.

Foundations installed in accordance with the recommendations outlined above are not expected to exceed total settlements of 25 mm and differential settlements of 19 mm. All foundations are to be designed and constructed to the minimum widths as detailed in the 2012 OBC.

It is noted that there is a potential for weaker subgrade soil to be encountered between the investigation locations. Pinchin presumes that any areas of weaker subgrade soil will consist of small pockets of soft/loose natural soil. Any soft/loose areas are to be removed and replaced with a low-strength concrete.

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Pinchin notes that a qualified geotechnical engineering consultant should be on-Site during the proof roll and foundation preparation activities to verify the recommended level of compaction is achieved and to verify the design assumptions and recommendations. This is especially critical with respect to the recommended soil bearing pressures. If variations occur in the soil conditions between the borehole locations, Site verification and Site review by Pinchin is recommended to provide appropriate recommendations at that time.

The natural subgrade soil is sensitive to change in moisture content and can become loose/soft if subjected to additional water or precipitation. As well, it could be easily disturbed if travelled on during construction. Once it becomes disturbed it is no longer considered adequate to support the recommended design bearing pressures. It is recommended that a working slab of lean concrete (mud slab) be placed in the footing areas immediately after excavation and inspection to protect the founding soils during placement of formwork and reinforcing steel.

In addition, to ensure and protect the integrity of the subgrade soil during construction operations, the following is recommended:

- Prior to commencing excavations, it is critical that all existing surface water, potential surface water and perched groundwater are controlled and diverted away from the work Site to prevent infiltration and subgrade softening. At no time should excavations be left open for a period of time that will expose them to inclement weather conditions and cause subgrade softening;
- The subgrade should be sloped to a sump outside the excavation to promote surface drainage and the collected water pumped out of the excavation. Any potential precipitation or seepage entering the excavations should be pumped away immediately (not allowed to pond);
- The footing areas should be cleaned of all deleterious materials such as topsoil, asphaltic concrete, organics, fill, disturbed and caved materials;
- Any potential large cobbles or boulders (i.e., greater than 200 mm in diameter) within the subgrade material are to be removed and replaced with a similar soil type not containing particles greater than 200 mm in diameter. It is critical that particles greater than 200 mm in diameter are not in contact with the foundation to prevent point loading and overstressing; and
- If the excavated subgrade soil remains open to weather conditions and groundwater seepage, sidewall stability and suitability of the subgrade soil will need to be verified prior to construction.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the footing bases and concrete must be provided and maintained above freezing at all times.

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6.4.2 Site Classification for Seismic Site Response & Soil Behaviour

The following information has been provided to assist the building designer from a geotechnical perspective only. These geotechnical seismic design parameters should be reviewed in detail by the structural engineer and be incorporated into the design as required.

The seismic site classification has been based on the 2012 OBC. The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4.A of the OBC. The site classification is based on the average shear wave velocity in the top 30 m of the site stratigraphy. If the average shear wave velocity is not known, the site class can be estimated from energy corrected Standard Penetration Resistance (N60) and/or the average undrained shear strength of the soil in the top 30 m.

The boreholes advanced at this Site extended to approximately 5.2 to 6.7 mbgs and were terminated in the very loose to very dense native silt deposit. SPT “N” values within the native silt deposits ranged between 2 and greater than 50 blows per 300 mm. As such, based on Table 4.1.8.4.A of the OBC, this Site has been classified as Class D. A Site Class D has an average shear wave velocity (Vs) of between 180 and 360 m/s.

Consideration may be given to completing shear wave velocity soundings at the Site once the final design and depths of foundations are known as a higher Site Classification (Site Class ‘C) may be available for foundations supported at depths 2.5 mbgs or lower.

6.4.3 Foundation Transition Zones

Excessive differential settlements can occur where the subgrade support material types differ below the underside of continuous strip footings, (e.g., engineered fill to native soils). As such, where strip footings transition from one material to another the transition between the materials should be suitably sloped or benched to mitigate differential settlements.

Pinchin also recommends the following transition precautions to mitigate/accommodate potential differential settlements:

- For strip footings, the transition zones should be adequately reinforced with additional reinforced steel lap lengths or widened footings;
- Steel reinforced poured concrete foundation walls; and
- Control joints throughout the transition zone(s).

The above recommendations should be reviewed by the structural engineer and incorporated into the design as necessary.

Where strip footings are founded at different elevations, the subgrade soil is to have a maximum slope of 2 H to 1 V, with the concrete footing having a maximum rise of 600 mm and a minimum run of 600 mm

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between each step, as detailed in the 2012 Ontario Building Code (OBC). The lower footing should be installed first to mitigate the risk of undermining the upper footing.

Individual spread footings are to be spaced a minimum distance of one and a half times the largest footing width apart from each other to avoid stress bulb interaction between footings. This assumes the footings are at the same elevation.

Foundations may be placed at a higher elevation relative to one another provided that the slope between the outside face of the foundations are separated at a minimum slope of 2H: 1V with an imaginary line drawn from the underside of the foundations. The lower footing should be installed first to mitigate the risk of undermining the upper footing.

6.4.4 Building Drainage

To assist in maintaining the building dry from surface water seepage, it is recommended that exterior grades around the buildings be sloped away at a 2% gradient or more, for a distance of at least 2.0 m. Roof drains should discharge a minimum of 1.5 m away from the structure to a drainage swale or appropriate storm drainage system.

Exterior perimeter foundations drains are not required, where the finished floor elevation is established a minimum of 150 mm above the exterior final grades or that the exterior gradient is properly sloped to divert surface water away from the building

6.4.5 Shallow Foundations Frost Protection & Foundation Backfill

In the Niagara Falls, Ontario area, exterior perimeter foundations for heated buildings require a minimum of 1.2 m of soil cover above the underside of the footing to provide soil cover for frost protection.

Where the foundations for heated buildings do not have the minimum 1.2 m of soil cover frost protection, they should be protected from frost with a combination of soil cover and rigid polystyrene insulation, such as Dow Styrofoam or equivalent product. If required, Pinchin can provide appropriate foundation frost protection recommendations as part of the design review.

To minimize potential frost movements from soil frost adhesion, the perimeter foundation backfill should consist of a free draining granular material, such as a Granular ‘B’ Type I (OPSS 1010) or an approved sand fill, extending a minimum lateral distance of 600 mm beyond the foundation. The backfill material used against the foundation must be brought up evenly on both sides of walls not designed to resist lateral earth pressure. All granular material is to be placed in maximum 300 mm thick lifts compacted to a minimum of 100% SPMDD below the building floor slab and below exterior hard landscaping areas; and 95% SPMDD in exterior soft landscaping areas. It is recommended that inspection and testing be carried out during construction to confirm backfill quality, thickness and to ensure compaction requirements are achieved.

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6.5 Slab-on-Grade

Prior to the installation of the engineered fill, all topsoil, in-situ fill, existing building foundations and floor slabs, and organics and deleterious materials should be removed to the underlying organic free in-situ soil. The natural subgrade soil is to be proof roll compacted with a minimum 10 tonne non-vibratory steel drum roller to observe for weak/soft spots. It is noted that some locations will not be accessible by the steel drum roller; as such, these locations can be proof roll compacted with a minimum 450 kg vibratory plate compactor.

The in-situ inorganic native silt deposit or properly placed engineered fill are considered adequate for the support of the concrete slab-on-grade subject to inspection by a geotechnical engineer. Any soft area(s) encountered during the inspection should be excavated and replaced with a similar soil type.

Once the subgrade soil is exposed it is to be inspected and approved by a qualified geotechnical engineering consultant to ensure that the material conforms to the soil type and consistency observed during the subsurface investigation work.

Based on the in-situ soil conditions, it is recommended to establish the concrete slab-on-grade on a minimum 200 mm thick layer of Granular “A” (OPSS 1010) compacted to at least 100% SPMDD. Alternatively, consideration may also be given to using a 200 mm thick layer of uniformly compacted 19 mm clear stone placed over the approved subgrade. Any required upfill should consist of a Granular “B” Type I or Type II (OPSS 1010).

The following table provides the unfactored modulus of subgrade reaction values:

Material Type	Modulus of Subgrade Reaction (kN/m^3)
Granular A (OPSS 1010)	85,000
Granular “B” Type I (OPSS 1010)	75,000
Granular “B” Type II (OPSS 1010)	85,000
On-Site Native Silt Deposit or Engineered Fill	20,000

The above-noted values are for loaded areas of 0.3 m by 0.3 m.

6.6 Asphaltic Concrete Pavement Structure Design for Parking Lot and Driveways

6.6.1 Discussion

Parking areas and access roads will be constructed around the proposed building. The existing inorganic fill may be suitable to remain below proposed access road and parking lots subject to proof rolling, inspection by a geotechnical engineer, and acceptance of potential for any future settlements by the owner.

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The in-situ native subgrade is considered a sufficient bearing material for an asphaltic concrete pavement structure provided all topsoil, organics, existing footings and concrete slabs, and deleterious materials are removed prior to placement of subgrade fill to raise grades, where needed.

At this time Pinchin is unaware of the proposed final grades for the parking lot and access roadways. As such, provided the pavement structure overlies the in-situ inorganic fill (meeting the limitations/conditions above) and native soils, the following pavement structure is recommended.

6.6.2 Pavement Structure

The following table presents the minimum specifications for a flexible asphaltic concrete pavement structure:

Pavement Layer	Compaction Requirements	Light Duty Traffic and Parking Areas	Heavy Duty Traffic Areas and Access Roads
Surface Course: Asphaltic Concrete HL-3 (OPSS 1150)	92% MRD as per OPSS.MUNI 310	35 mm	35 mm
Binder Course: Asphaltic Concrete HL-8 (OPSS 1150)	92% MRD as per OPSS.MUNI 310	55 mm	80 mm
Base Course: Granular “A” (OPSS 1010)	100% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm	150 mm
Subbase Course: Granular “B” Type I or Type II (OPSS 1010)	100% Standard Proctor Maximum Dry Density (ASTM D698)	400 mm – Type I or 350 mm – Type II	450 mm – Type I or 400 mm – Type II
		590mm (Type II) 640mm (Type I)	665mm (Type II) 715mm (Type I)

Notes:

i) Prior to placing the pavement structure, the subgrade soil is to be proof rolled with a smooth drum roller without vibration to observe weak spots and the deflection of the soil;

ii) The recommended pavement structure may have to be adjusted according to the City of Niagara Falls municipal standards. Also, if construction takes place during times of substantial precipitation and the subgrade soil becomes wet and disturbed, the granular thickness may have to be increased to compensate for the weaker subgrade soil. In addition, the granular fill material thickness may have to be temporarily increased to allow heavy construction equipment access the Site, in order to avoid the subgrade from “pumping” up into the granular material; and

iii) Performance grade PG 58-28 asphaltic concrete should be specified for Marshall mixes. Consideration should be given to increasing the grade to 64-28 in areas designed for heavy truck traffic

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6.6.3 Pavement Structure Subgrade Preparation and Granular up Fill

The proper placement of base and subbase fill materials becomes very important in addressing the proper load distribution to provide a durable pavement structure. The pavement subgrade materials should be thoroughly proof-rolled prior to placement of the Granular 'B' subbase course. If any unstable areas are noted, then the Granular 'B' thickness may need to be increased to support pavement construction traffic. This should be left as a field decision by a qualified geotechnical engineer at the time of construction, but it is recommended that additional Granular 'B' be carried as a provisional item under the construction contract.

Where fill material is required to increase the grade to the underside of the pavement structure it should consist of either Granular "B" Type I or Type II (OPSS 1010), or the on-Site inorganic natural soils. The up-fill material is to be placed in maximum 300 mm thick lifts compacted to 98% SPMDD within 4% of the optimum moisture content.

Samples of both the Granular 'A' and Granular 'B' Type I or Type II aggregates should be tested for conformance to OPSS 1010 prior to utilization on Site and during construction. All stockpiled material should be protected from deleterious materials, additional moisture and be kept from freezing.

Post compaction settlement of fine-grained soil can be expected, even when placed to compaction specifications. As such, fill material should be installed as far in advance as possible before finishing the parking lot and access roadways for best grade integrity.

Where the subgrade material types differ below the underside of the pavement structure, the transition between the materials should be sloped as per frost heave taper OPSD 205.060.

6.6.4 Drainage

Control of surface water is a critical factor in achieving good pavement structure life. The pavement thickness designs are based on a drained pavement subgrade via sub-drains or ditches.

The on-site silt soils have poor natural drainage and, therefore, it is recommended that pavement subdrains be installed in the lower areas and be connected to the catch basins. The subdrains should comprise 150 mm diameter perforated pipe in filter sock, bedded in concrete sand. The upper limit of the concrete sand bedding should be at the lower limit of the subbase, with subgrade below the subbase sloped towards the subdrains.

The surface of the roadways should be free of depressions and be sloped at a minimum grade of 1% in order to drain to appropriate drainage areas. Subgrade soil should slope a minimum of 3% toward stormwater collection points. Positive slopes are very important for the proper performance of the drainage system. The granular base and subbase materials should extend horizontally to any potential ditches or swales.

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In addition, routine maintenance of the drainage systems will assist with the longevity of the pavement structure. Ditches, culverts, sewers and catch basins should be regularly cleared of debris and vegetation.

7.0 SITE SUPERVISION & QUALITY CONTROL

It is recommended that all geotechnical aspects of the project be reviewed and confirmed under the appropriate geotechnical supervision, to routinely check such items. This includes but is not limited to inspection and confirmation of the undisturbed natural subgrade material prior to subgrade preparation, pouring any foundations or footings, backfilling, or engineered fill installation to ensure that the actual conditions are not markedly different than what was observed at the borehole locations and geotechnical components are constructed as per Pinchin's recommendations. Compaction quality control of engineered fill material (full-time monitoring) is recommended as standard practice, as well as regular sampling and testing of aggregates, asphaltic concrete, and concrete to ensure that physical characteristics of materials for compliance during installation and satisfies all specifications presented within this report.

8.0 TERMS AND LIMITATIONS

This Geotechnical Investigation was performed for the exclusive use of Forest Gate Advisors Inc. (Client) in order to evaluate the subsurface conditions at North Portion of 3770 Montrose Road, Niagara Falls, Ontario. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practises in the field of geotechnical engineering for the Site. Classification and identification of soil, and geologic units have been based upon commonly accepted methods employed in professional geotechnical practice. No warranty or other conditions, expressed or implied, should be understood. Conclusions derived are specific to the immediate area of study and cannot be extrapolated extensively away from sample locations.

Performance of this Geotechnical Investigation to the standards established by Pinchin is intended to reduce, but not eliminate, uncertainty regarding the subgrade soil at the Site, and recognizes reasonable limits on time and cost.

Regardless how exhaustive a Geotechnical Investigation is performed; the investigation cannot identify all the subsurface conditions. Therefore, no warranty is expressed or implied that the entire Site is representative of the subsurface information obtained at the specific locations of our investigation. If during construction, subsurface conditions differ from then what was encountered within our test location and the additional subsurface information provided to us, Pinchin should be contacted to review our recommendations. This report does not alleviate the contractor, owner, or any other parties of their respective responsibilities.

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This report has been prepared for the exclusive use of the Client and their authorized agents. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of the third parties. If additional parties require reliance on this report, written authorization from Pinchin will be required. Pinchin disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs. No other warranties are implied or expressed. Furthermore, this report should not be construed as legal advice.

Pinchin makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and these interpretations may change over time. Please refer to Appendix V, Report Limitations and Guidelines for Use, which pertains to this report.

Specific limitations related to the legal and financial and limitations to the scope of the current work are outlined in our proposal, the attached Methodology and the Authorization to Proceed, Limitation of Liability and Terms of Engagement which accompanied the proposal.

Information provided by Pinchin is intended for Client use only. Pinchin will not provide results or information to any party unless disclosure by Pinchin is required by law. Any use by a third party of reports or documents authored by Pinchin or any reliance by a third party on or decisions made by a third party based on the findings described in said documents, is the sole responsibility of such third parties. Pinchin accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted. No other warranties are implied or expressed.

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Template: Master Geotechnical Investigation Report – Ontario, GEO, September 2, 2021

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FIGURES



PINCHIN

PROJECT NAME:	GEOTECHNICAL INVESTIGATION
CLIENT NAME:	FOREST GATE ADVISORS INC.
PROJECT LOCATION:	NORTH PORTION OF 3770 MONTROSE ROAD, NIAGARA FALLS, ONTARIO
FIGURE NAME:	KEY MAP
FIGURE NUMBER	1

PROJECT NUMBER:	SCALE:	DRAWN BY:	REVIEWED BY:	DATE:
296202.002	1:15,000	SR	SA	MARCH 2022



N

LEGEND

- SITE BOUNDARY
- BOREHOLE
- MONITORING WELL

LEGEND IS COLOUR DEPENDENT.
NON-COLOUR COPIES MAY ALTER INTERPRETATION.

PINCHIN

PROJECT NAME:
GEOTECHNICAL INVESTIGATION

CLIENT NAME:
FOREST GATE ADVISORS INC.

PROJECT LOCATION:
NORTH PORTION OF
3770 MONTROSE ROAD,
NIAGARA FALLS, ONTARIO

FIGURE NAME:
BOREHOLE/ MONITORING WELL LOCATION PLAN

PROJECT NUMBER:	SCALE:
296202.002	AS SHOWN
DRAWN BY:	REVIEWED BY:
SR	SA
DATE:	FIGURE NUMBER:
MARCH 2022	2

APPENDIX I

Abbreviations, Terminology and Principle Symbols used in Report and Borehole Logs

ABBREVIATIONS, TERMINOLOGY & PRINCIPAL SYMBOLS USED

Sampling Method

AS	Auger Sample	**w**	Washed Sample
SS	Split Spoon Sample	**HQ**	Rock Core (63.5 mm diam.)
ST	Thin Walled Shelby Tube	**NQ**	Rock Core (47.5 mm diam.)
BS	Block Sample	**BQ**	Rock Core (36.5 mm diam.)

In-Situ Soil Testing

Standard Penetration Test (SPT), "N" value is the number of blows required to drive a 51 mm outside diameter spilt barrel sampler into the soil a distance of 300 mm with a 63.5 kg weight free falling a distance of 760 mm after an initial penetration of 150 mm has been achieved. The SPT, "N" value is a qualitative term used to interpret the compactness condition of cohesionless soils and is used only as a very approximation to estimate the consistency and undrained shear strength of cohesive soils.

Dynamic Cone Penetration Test (DCPT) is the number of blows required to drive a cone with a 60 degree apex attached to "A" size drill rods continuously into the soil for each 300 mm penetration with a 63.5 kg weight free falling a distance of 760 mm.

Cone Penetration Test (CPT) is an electronic cone point with a 10 cm2 base area with a 60 degree apex pushed through the soil at a penetration rate of 2 cm/s.

Field Vane Test (FVT) consists of a vane blade, a set of rods and torque measuring apparatus used to determine the undrained shear strength of cohesive soils.

Soil Descriptions

The soil descriptions and classifications are based on an expanded Unified Soil Classification System (USCS). The USCS classifies soils on the basis of engineering properties. The system divides soils into three major categories; coarse grained, fine grained and highly organic soils. The soil is then subdivided based on either gradation or plasticity characteristics. The classification excludes particles larger than 75 mm. To aid in quantifying material amounts by weight within the respective grain size fractions the following terms have been included to expand the USCS:

Soil Classification		Terminology	Proportion
Clay	< 0.002 mm		
Silt	0.002 to 0.06 mm	“trace”, trace sand, etc.	1 to 10%
Sand	0.075 to 4.75 mm	“some”, some sand, etc.	10 to 20%
Gravel	4.75 to 75 mm	Adjective, sandy, gravelly, etc.	20 to 35%
Cobbles	75 to 200 mm	And, and gravel, and silt, etc.	>35%
Boulders	>200 mm	Noun, Sand, Gravel, Silt, etc.	>35% and main fraction

Notes:

- Soil properties, such as strength, gradation, plasticity, structure, etcetera, dictate the soils engineering behaviour over grain size fractions; and
- With the exception of soil samples tested for grain size distribution or plasticity, all soil samples have been classified based on visual and tactile observations. The accuracy of visual and tactile observation is not sufficient to differentiate between changes in soil classification or precise grain size and is therefore an approximate description.

The following table outlines the qualitative terms used to describe the compactness condition of cohesionless soil:

Cohesionless Soil	
Compactness Condition	**SPT N-Index (blows per 300 mm)**
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

The following table outlines the qualitative terms used to describe the consistency of cohesive soils related to undrained shear strength and SPT, N-Index:

Cohesive Soil		
Consistency	**Undrained Shear Strength (kPa)**	**SPT N-Index (blows per 300 mm)**
Very Soft	<12	<2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

Note: Utilizing the SPT, N-Index value to correlate the consistency and undrained shear strength of cohesive soils is only very approximate and needs to be used with caution.

Soil & Rock Physical Properties

General

W Natural water content or moisture content within soil sample

γ Unit weight

γ' Effective unit weight

γ_d Dry unit weight

γ_{sat} Saturated unit weight

ρ Density

ρ_s Density of solid particles

ρ_w Density of Water

ρ_d Dry density

ρ_{sat} Saturated density e Void ratio

n Porosity

S_r Degree of saturation

E_{50} Strain at 50% maximum stress (cohesive soil)

Consistency

W_L	Liquid limit
W_P	Plastic Limit
I_P	Plasticity Index
W_S	Shrinkage Limit
I_L	Liquidity Index
I_C	Consistency Index
e_{max}	Void ratio in loosest state
e_{min}	Void ratio in densest state
I_D	Density Index (formerly relative density)

Shear Strength

C_u, S_u	Undrained shear strength parameter (total stress)
C'_d	Drained shear strength parameter (effective stress)
r	Remolded shear strength
τ_p	Peak residual shear strength
τ_r	Residual shear strength
ø’	Angle of interface friction, coefficient of friction = tan ø’

Consolidation (One Dimensional)

C_C	Compression index (normally consolidated range)
C_r	Recompression index (over consolidated range)
C_S	Swelling index
m_V	Coefficient of volume change
c_V	Coefficient of consolidation
T_V	Time factor (vertical direction)
U	Degree of consolidation
σ'_O	Overburden pressure
σ'_p	Preconsolidation pressure (most probable)
OCR	Overconsolidation ratio

Permeability

The following table outlines the terms used to describe the degree of permeability of soil and common soil types associated with the permeability rates**:**

Permeability (k cm/s)	Degree of Permeability	Common Associated Soil Type
$> 10^{-1}$	Very High	Clean gravel
10^{-1} to 10^{-3}	High	Clean sand, Clean sand and gravel
10^{-3} to 10^{-5}	Medium	Fine sand to silty sand
10^{-5} to 10^{-7}	Low	Silt and clayey silt (low plasticity)
$>10^{-7}$	Practically Impermeable	Silty clay (medium to high plasticity)

Rock Coring

Rock Quality Designation (RQD) is an indirect measure of the number of fractures within a rock mass, Deere et al. (1967). It is the sum of sound pieces of rock core equal to or greater than 100 mm recovered from the core run, divided by the total length of the core run, expressed as a percentage. If the core section is broken due to mechanical or handling, the pieces are fitted together and if 100 mm or greater included in the total sum**.**

RQD is calculated as follows:

$$\text{RQD (\%)} = \frac{\Sigma \text{ Length of core pieces} > 100 \text{ mm} \times 100}{\text{Total length of core run}}$$

The following is the Classification of Rock with Respect to RQD Value:

RQD Classification	RQD Value (%)
Very poor quality	**<25**
Poor quality	25 to 50
Fair quality	50 to 75
Good quality	75 to 90
Excellent quality	90 to 100

APPENDIX II

Pinchin's Borehole Logs

Log of Borehole: BH1

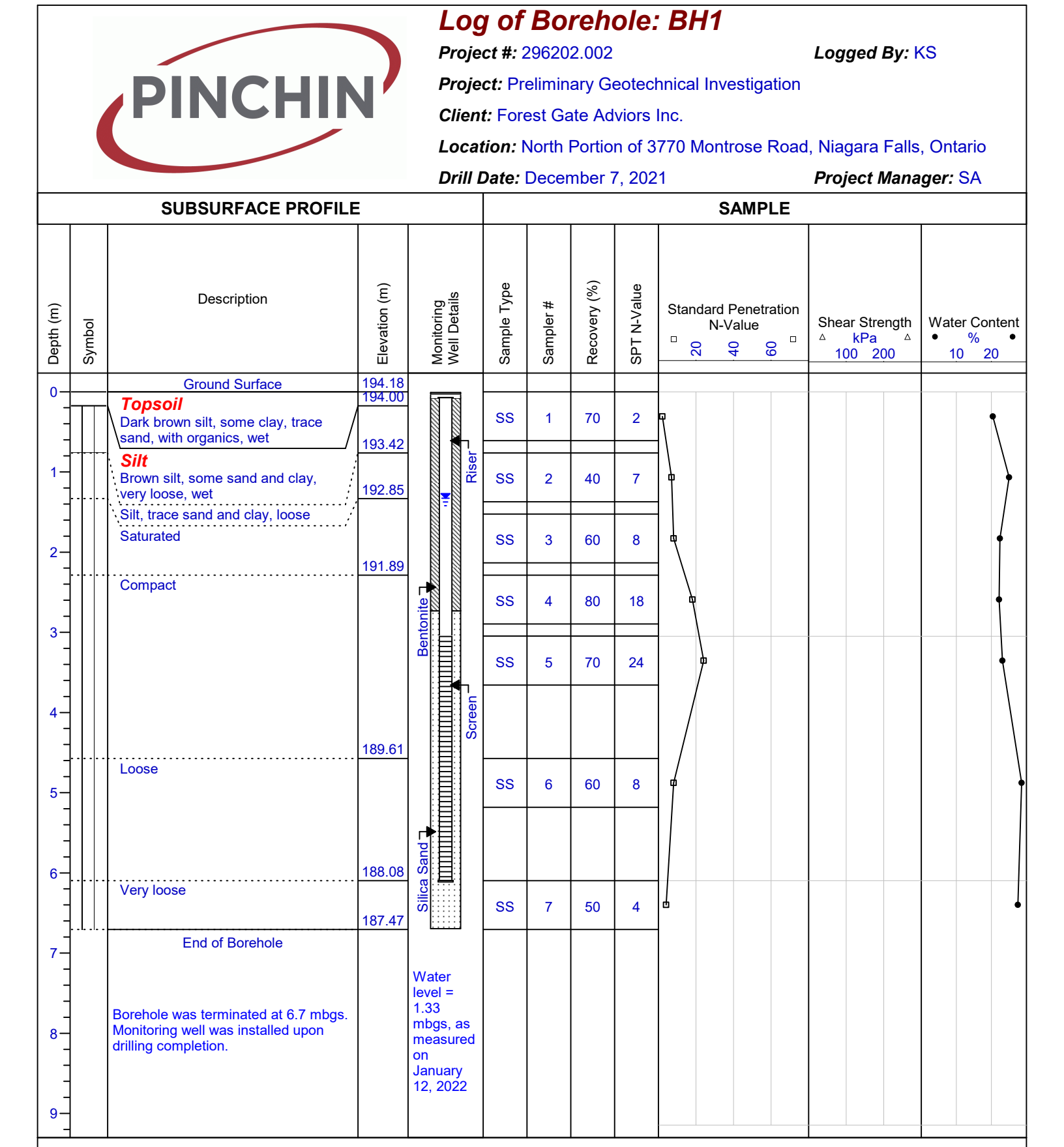
Project #: 296202.002 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: Forest Gate Adviors Inc.

Location: North Portion of 3770 Montrose Road, Niagara Falls, Ontario

Drill Date: December 7, 2021 **Project Manager:** SA



Contractor: Strata Drilling Inc.

Grade Elevation: 194.18 masl

Drilling Method: Hollow Stem Augers

Top of Casing Elevation: 194.95masl

Well Casing Size: 2 Inches

Sheet: 1 of 1

Log of Borehole: BH2

Project #: 296202.002 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

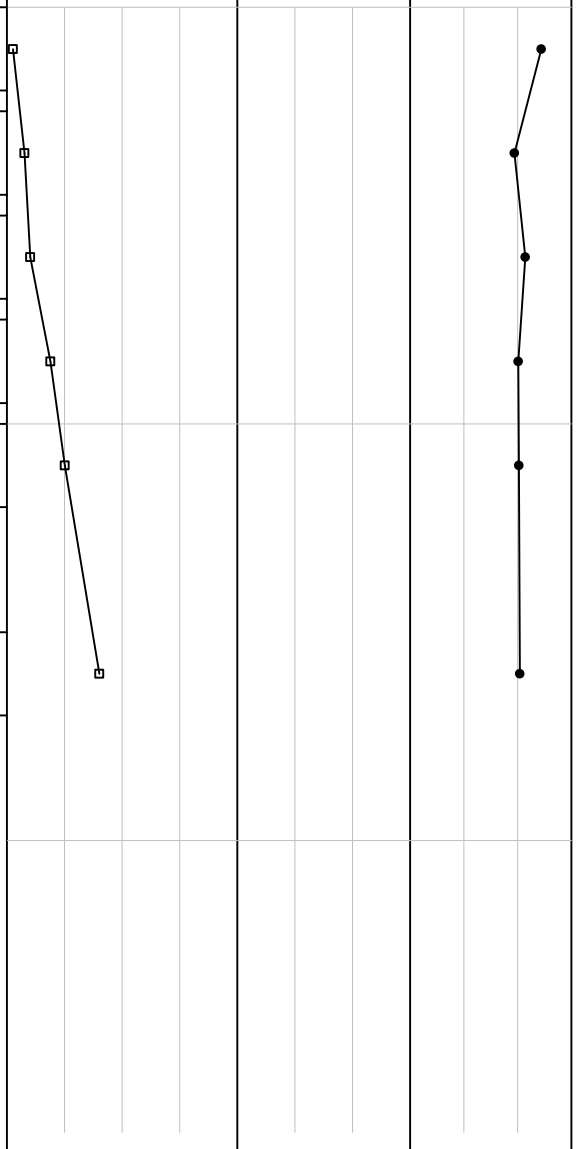
Client: Forest Gate Adviors Inc.

Location: North Portion of 3770 Montrose Road, Niagara Falls, Ontario

Drill Date: December 7, 2021 **Project Manager:** SA

SUBSURFACE PROFILE | **SAMPLE**

Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value
0		Ground Surface	194.96	No Monitoring Well Installed				
		Fill Dark brown silt, some clay, trace sand and gravel, very loose, wet	194.20		SS	1	70	2
1		Loose	193.44		SS	2	70	6
		Silt Brown silt, some clay, trace sand and gravel, loose, wet	192.67		SS	3	80	8
2		Silt trace sand and clay, compact, wet			SS	4	90	15
3					SS	5	80	20
4								
5			189.78		SS	6	60	32
		End of Borehole						
6		Borehole was terminated at 5.2 mbgs. At drilling completion the borehole was open and dry.						
7								
8								



Contractor: Strata Drilling Inc.

Grade Elevation: 194.96 masl

Drilling Method: Hollow Stem Augers

Top of Casing Elevation: N/A

Well Casing Size: 2 Inches

Sheet: 1 of 1

Log of Borehole: BH3

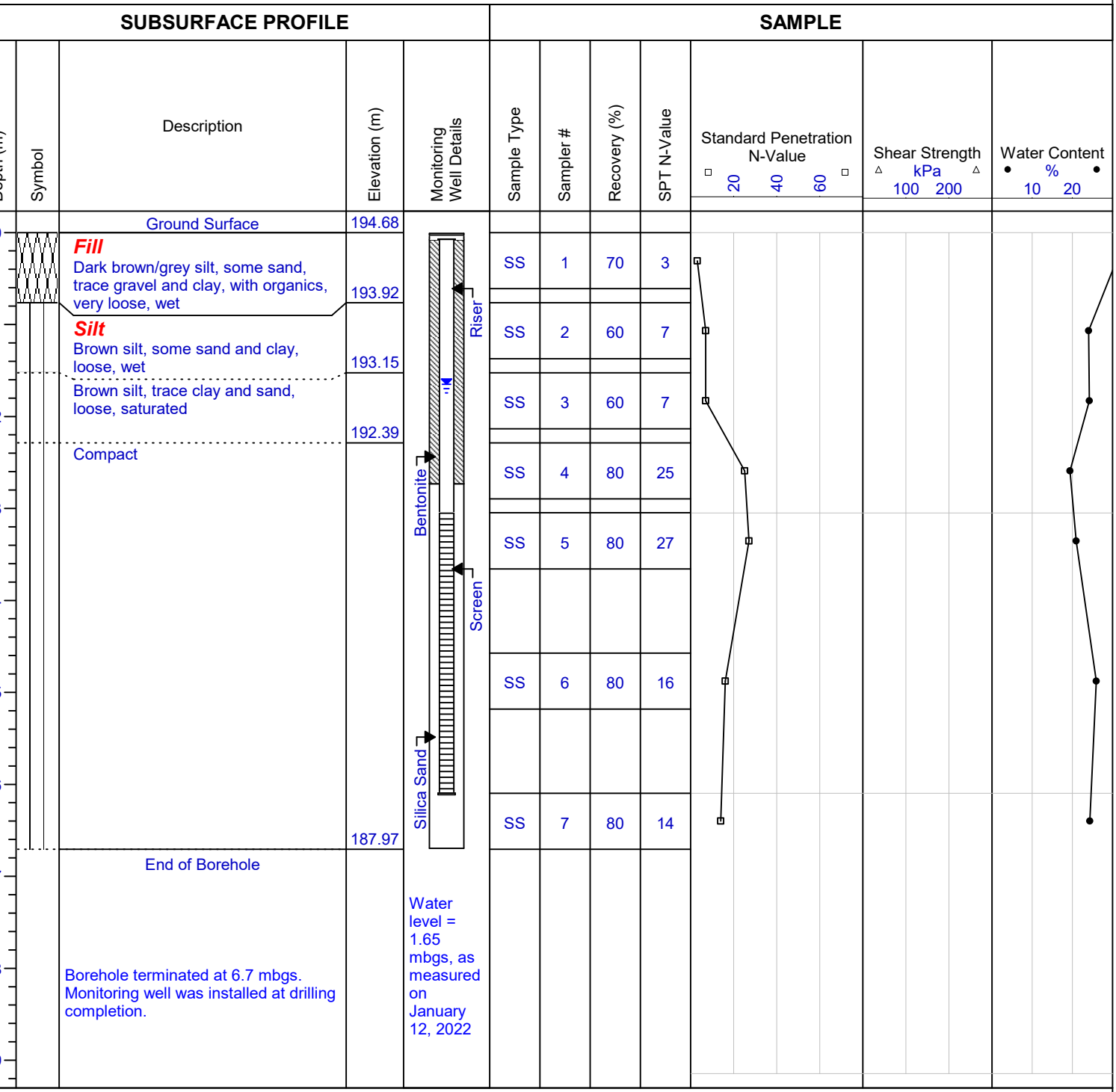
Project #: 296202.002 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: Forest Gate Adviors Inc.

Location: North Portion of 3770 Montrose Road, Niagara Falls, Ontario

Drill Date: December 7, 2021 **Project Manager:** SA



Contractor: Strata Drilling Inc. **Grade Elevation:** 194.68 masl

Drilling Method: Hollow Stem Augers **Top of Casing Elevation:** 195.53 masl

Well Casing Size: 2 Inches **Sheet:** 1 of 1

Log of Borehole: BH4

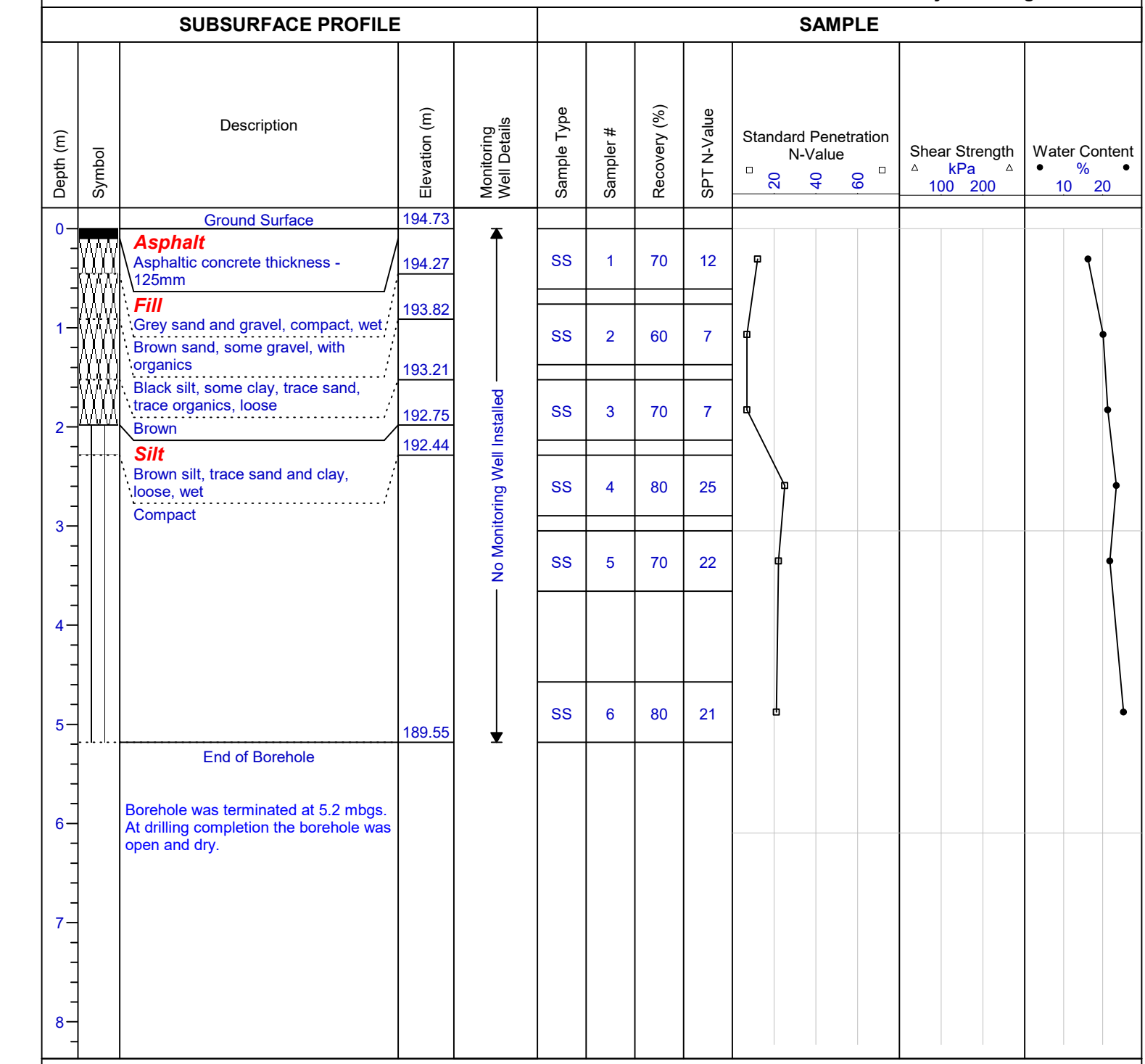
Project #: 296202.002 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: Forest Gate Adviors Inc.

Location: North Portion of 3770 Montrose Road, Niagara Falls, Ontario

Drill Date: December 9, 2021 **Project Manager:** SA



Contractor: Strata Drilling Inc.

Grade Elevation: 194.73 masl

Drilling Method: Hollow Stem Augers

Top of Casing Elevation: N/A

Well Casing Size: 2 Inches

Sheet: 1 of 1

Log of Borehole: BH5

Project #: 296202.002 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: Forest Gate Adviors Inc.

Location: North Portion of 3770 Montrose Road, Niagara Falls, Ontario

Drill Date: December 8, 2021 **Project Manager:** SA

SUBSURFACE PROFILE

SAMPLE

Depth (m)	Symbol	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value	Standard Penetration N-Value (20, 40, 60)	Shear Strength kPa (100, 200)	Water Content % (10, 20)
0		Ground Surface	194.07								
		Fill Dark brown silt, some clay, trace sand and gravel, with organics, wet	193.31		SS	1	10	3			
1		**Silt** Brown silt, some clay, trace sand and gravel, loose, wet	192.55		SS	2	70	7			
		Compact	192.05		SS	3	70	10			
2		Saturated	191.78								
		Sandy silt, trace clay and gravel	191.02		SS	4	80	12			
3		Silt, some clay, trace sand			SS	5	80	18			
4			189.50								
		silt, trace sand and clay, loose			SS	6	80	8			
5											
6			187.97								
		Dense	187.36		SS	7	50	41			
7		End of Borehole		Water level = 2.02 mbgs, as measured on January 12, 2022							
8		Borehole was terminated at 6.7 mbgs. Monitoring well was installed upon drilling completion.									
9											

Monitoring Well Details: Riser, Bentonite, Screen, Silica Sand

Contractor: Strata Drilling Inc.

Grade Elevation: 194.07 masl

Drilling Method: Hollow Stem Augers

Top of Casing Elevation: 194.97 masl

Well Casing Size: 2 Inches

Sheet: 1 of 1

Log of Borehole: BH6

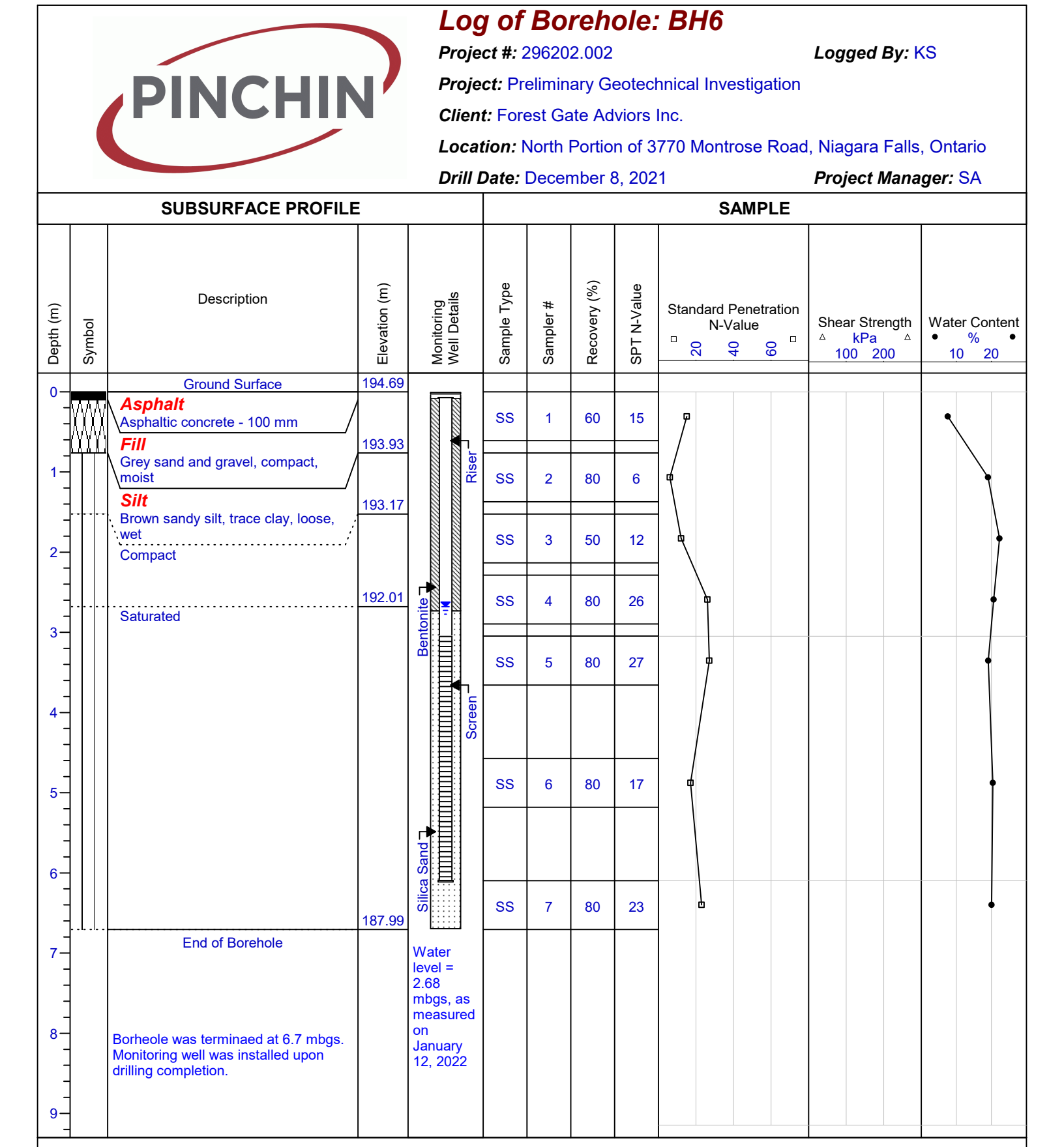
Project #: 296202.002 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: Forest Gate Adviors Inc.

Location: North Portion of 3770 Montrose Road, Niagara Falls, Ontario

Drill Date: December 8, 2021 **Project Manager:** SA



Contractor: Strata Drilling Inc.

Grade Elevation: 194.69 masl

Drilling Method: Hollow Stem Augers

Top of Casing Elevation: 194.55 masl

Well Casing Size: 2 Inches

Sheet: 1 of 1

Log of Borehole: BH7

Project #: 296202.002 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: Forest Gate Adviors Inc.

Location: North Portion of 3770 Montrose Road, Niagara Falls, Ontario

Drill Date: December 8, 2021 **Project Manager:** SA

Depth (m)	Description	Elevation (m)	Sample Type	Sampler #	Recovery (%)	SPT N-Value
0	Ground Surface	194.48				
	Fill Dark brown silt, some clay, trace sand, with organics, very loose, wet	193.72	SS	1	80	3
1	Loose	193.41	SS	2	80	7
	Silt Brown sandy silt, trace clay, loose, wet	192.19	SS	3	80	8
2	Very loose	191.43	SS	4	80	4
3	Loose	190.67	SS	5	80	7
	Dense	189.91	SS	6	70	35
4	Very dense	189.30	SS	7	50	53
5	End of Borehole					
	Borehole was terminated at 5.2 mbgs. At drilling completion the borehole was open and dry.					
6						
7						
8						

Monitoring Well Details: No Monitoring Well Installed

Standard Penetration N-Value: 20, 40, 60

Shear Strength: kPa, 100, 200

Water Content: %, 10, 20

Contractor: Strata Drilling Inc.

Grade Elevation: 194.48 masl

Drilling Method: Hollow Stem Augers

Top of Casing Elevation: N/A

Well Casing Size: 2 Inches

Sheet: 1 of 1

Log of Borehole: BH8

Project #: 296202.002 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: Forest Gate Adviors Inc.

Location: North Portion of 3770 Montrose Road, Niagara Falls, Ontario

Drill Date: December 9, 2021 **Project Manager:** SA

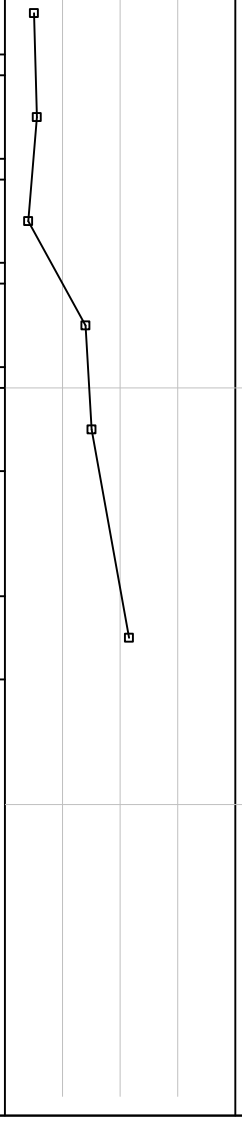
SUBSURFACE PROFILE

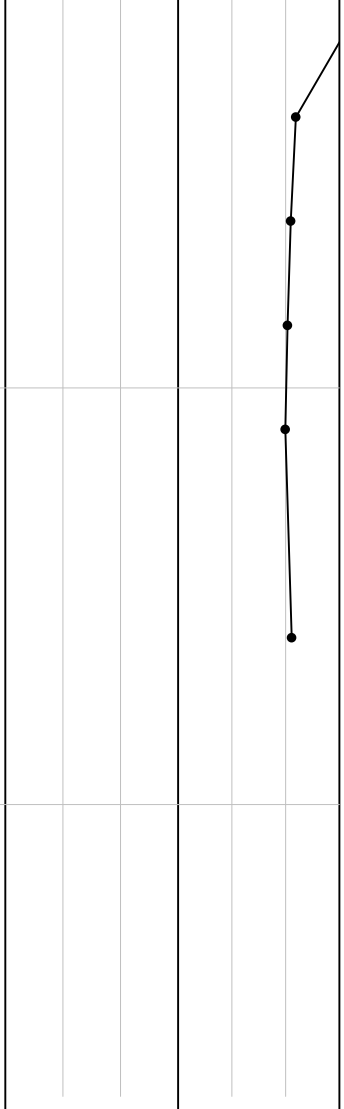
Depth (m)	Description	Elevation (m)
0	Ground Surface	194.67
	Asphalt Asphaltic concrete thickness - 130 mm	193.91
1	**Fill** Grey sand and gravel, compact, saturated	193.45
	Dark brown sand, some silt, with organics, compact, wet	193.15
2	**Silt** Brown silt, trace clay and sand, compact, wet	192.38
	Loose	
	Compact	
3	Dense	191.62
4		
5		189.49
	End of Borehole	
6	Borehole was terminated at 5.2 mbgs. At drilling completion the borehole was open and dry.	
7		
8		

Monitoring Well Details: No Monitoring Well Installed

SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	70	10
SS	2	90	11
SS	3	60	8
SS	4	90	28
SS	5	80	30
SS	6	80	43





Contractor: Strata Drilling Inc. **Grade Elevation:** 194.67 masl

Drilling Method: Hollow Stem Augers **Top of Casing Elevation:** N/A

Well Casing Size: 2 Inches **Sheet:** 1 of 1

Log of Borehole: BH9

Project #: 296202.001 **Logged By:** KS

Project: Geotechnical Investigation

Client: Forest Gate Financial Corp.

Location: 3770 Montrose Road, Niagara Falls, Ontario

Drill Date: December 9, 2021 **Project Manager:** SA

SUBSURFACE PROFILE

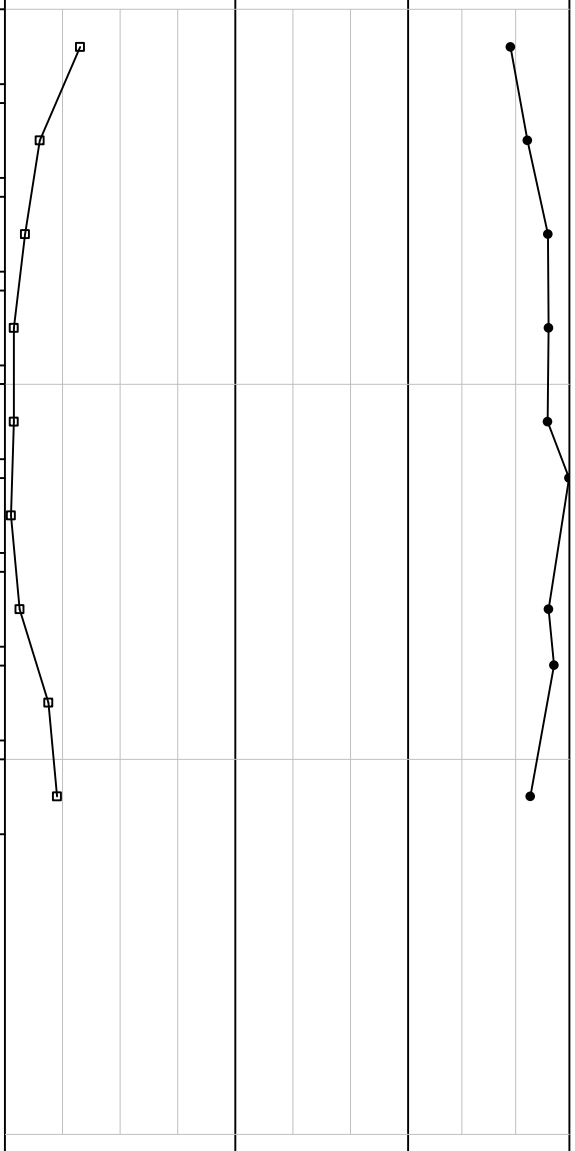
Depth (m)	Description	Elevation (m)
0	Ground Surface	194.61
	Asphalt Asphaltic concrete thickness - 100 mm	193.85
1	**Fill** Grey sand and gravel, compact, wet	193.08
	Silt Brown sandy silt, trace clay, compact, wet	
2	Loose	192.32
	very loose	191.57
3	Saturated	
4		190.04
	Loose	
5		189.27
	Compact	
6		187.90
7	End of Borehole	
8	Borehole was terminated at 6.7 mbgs. Monitoring well was installed upon drilling completion.	
9		

Monitoring Well Details: Riser, Bentonite, Screen, Silica Sand

Water level = 3.04 mbgs, as measured on January 12, 2022

SAMPLE

Sample Type	Sampler #	Recovery (%)	SPT N-Value
SS	1	70	26
SS	2	70	12
SS	3	80	7
SS	4	50	3
SS	5	70	3
SS	6	60	2
SS	7	60	5
SS	8	50	15
SS	9	50	18



Contractor: Strata Drilling Inc.

Grade Elevation: 194.61 masl

Drilling Method: Hollow Stem Augers

Top of Casing Elevation: 194.54 masl

Well Casing Size: 2 Inches

Sheet: 1 of 1

Log of Borehole: BH10

Project #: 296202.002 **Logged By:** KS

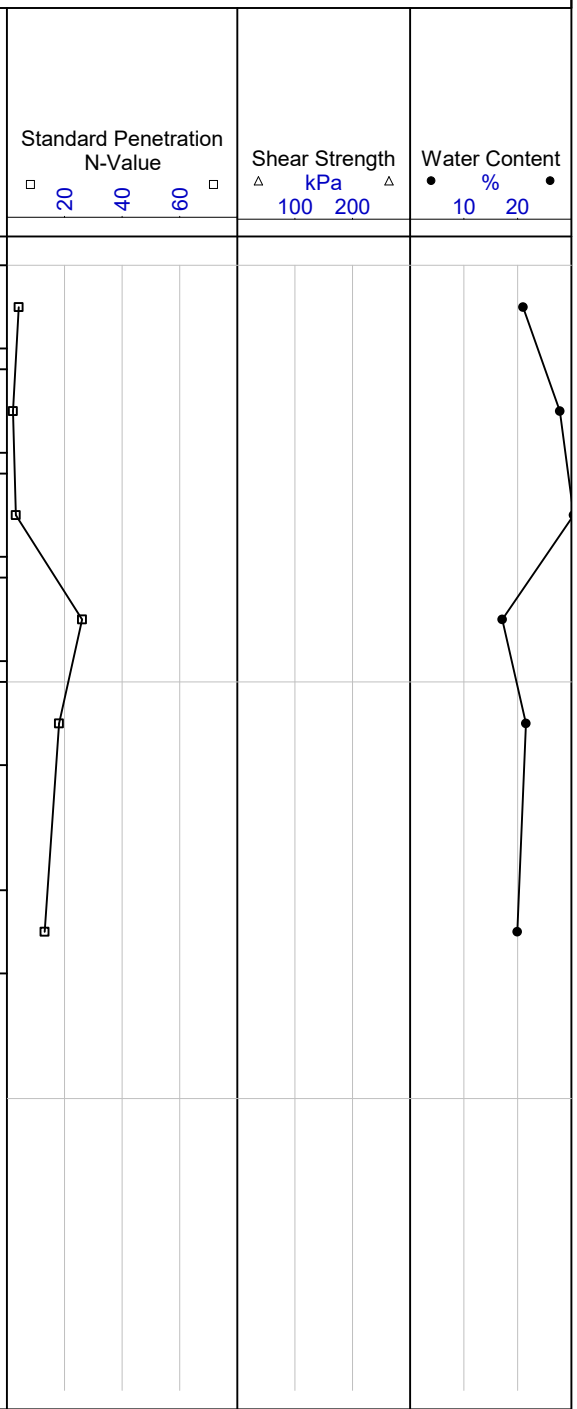
Project: Preliminary Geotechnical Investigation

Client: Forest Gate Adviors Inc.

Location: North Portion of 3770 Montrose Road, Niagara Falls, Ontario

Drill Date: December 9, 2021 **Project Manager:** SA

Depth (m)	Description	Elevation (m)	Monitoring Well Details	Sample Type	Sampler #	Recovery (%)	SPT N-Value
0	Ground Surface	194.17					
	Fill Dark brown silt, some sand, with organics, very loose, wet	193.41	No Monitoring Well Installed	SS	1	20	4
1	Brown silty sand	192.34		SS	2	50	2
2	Dark brown silt, some clay, trace sand, with pieces of wire	191.88		SS	3	70	3
	Silt Brown silt, trace sand and clay, compact, wet			SS	4	70	26
3				SS	5	70	18
4							
5		188.99		SS	6	70	13
	End of Borehole						
6	Borehole was terminated at 5.2 mbgs. At drilling completion the borehole was open and dry.						
7							
8							



Contractor: Strata Drilling Inc.

Grade Elevation: 194.17 masl

Drilling Method: Hollow Stem Augers

Top of Casing Elevation: N/A

Well Casing Size: 2 Inches

Sheet: 1 of 1

Log of Borehole: MW101

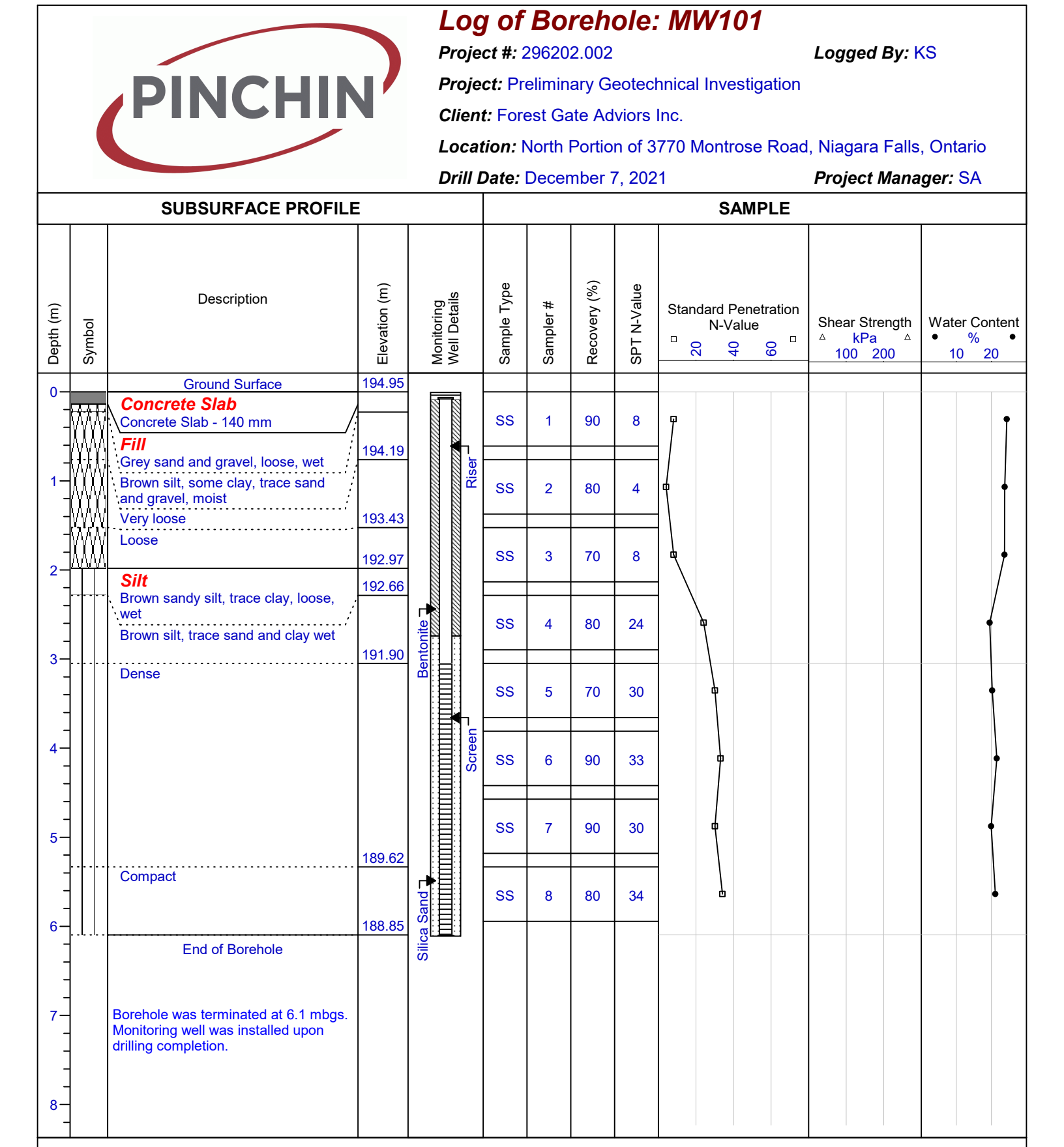
Project #: 296202.002 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: Forest Gate Adviors Inc.

Location: North Portion of 3770 Montrose Road, Niagara Falls, Ontario

Drill Date: December 7, 2021 **Project Manager:** SA



Contractor: Strata Drilling Inc.

Grade Elevation: 194.95 masl

Drilling Method: Hollow Stem Augers

Top of Casing Elevation: 194.95 masl

Well Casing Size: 2 Inches

Sheet: 1 of 1

Log of Borehole: BH106

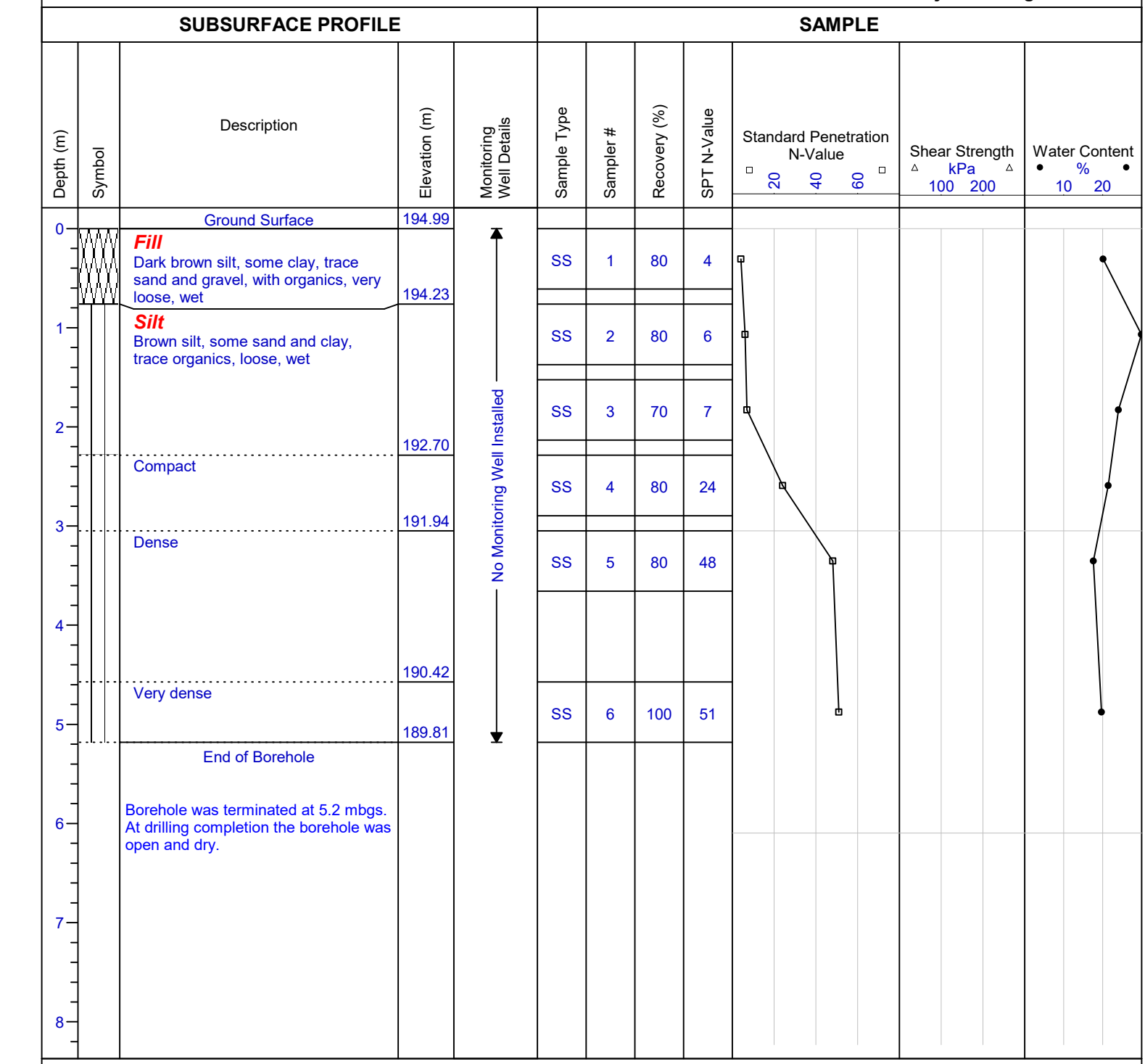
Project #: 296202.002 **Logged By:** KS

Project: Preliminary Geotechnical Investigation

Client: Forest Gate Adviors Inc.

Location: North Portion of 3770 Montrose Road, Niagara Falls, Ontario

Drill Date: December 8, 2021 **Project Manager:** SA



Contractor: Strata Drilling Inc.

Grade Elevation: 194.99 masl

Drilling Method: Hollow Stem Augers

Top of Casing Elevation: N/A

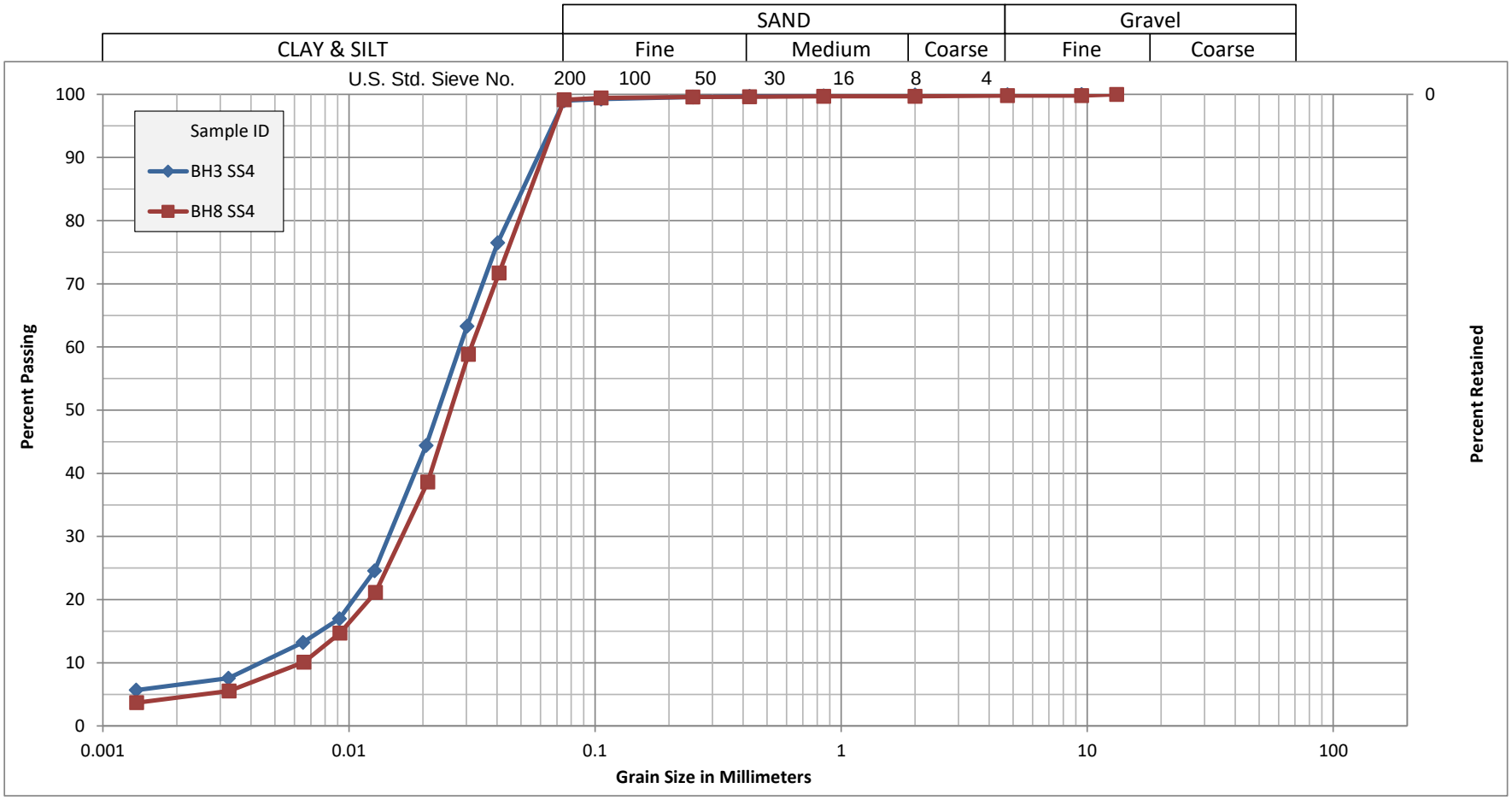
Well Casing Size: 2 Inches

Sheet: 1 of 1

APPENDIX III

Laboratory Testing Reports for Soil Samples

Unified Soil Classification System



Sample ID	Depth (ft)	% Gravel	% Sand	% Silt	% Clay
BH3 SS4	7.5-9.5	0.0	1.0	93.0	6.0
BH8 SS4	7.5-9.5	0.0	0.9	95.1	4.0

PINCHIN

Pinchin Waterloo - 225 Labrador Drive,
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PARTICLE SIZE DISTRIBUTION ANALYSIS

Geotechnical Investigation - 3770 Montrose Rd, Niagara Falls, ON
Forest Gate Financial Corp.

Figure No. **1**

296202.002

Reviewed By:

More information available upon request

APPENDIX IV

Report Limitations and Guidelines for Use

REPORT LIMITATIONS & GUIDELINES FOR USE

This information has been provided to help manage risks with respect to the use of this report.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS

This report was prepared for the exclusive use of the Client and their authorized agents, subject to the conditions and limitations contained within the duly authorized work plan. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of the third parties. If additional parties require reliance on this report, written authorization from Pinchin will be required. Pinchin disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs. No other warranties are implied or expressed. Furthermore, this report should not be construed as legal advice.

SUBSURFACE CONDITIONS CAN CHANGE

This geotechnical report is based on the existing conditions at the time the study was performed, and Pinchin's opinion of soil conditions are strictly based on soil samples collected at specific test hole locations. The findings and conclusions of Pinchin's reports may be affected by the passage of time, by manmade events such as construction on or adjacent to the Site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations.

LIMITATIONS TO PROFESSIONAL OPINIONS

Interpretations of subsurface conditions are based on field observations from test holes that were spaced to capture a 'representative' snap shot of subsurface conditions. Site exploration identifies subsurface conditions only at points of sampling. Pinchin reviews field and laboratory data and then applies professional judgment to formulate an opinion of subsurface conditions throughout the Site. Actual subsurface conditions may differ, between sampling locations, from those indicated in this report.

LIMITATIONS OF RECOMMENDATIONS

Subsurface soil conditions should be verified by a qualified geotechnical engineer during construction. Pinchin should be notified if any discrepancies to this report or unusual conditions are found during construction.

Sufficient monitoring, testing and consultation should be provided by Pinchin during construction and/or excavation activities, to confirm that the conditions encountered are consistent with those indicated by the test hole investigation, and to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated. In addition, monitoring, testing and consultation by Pinchin should be completed to evaluate whether or not earthwork activities are completed in

accordance with our recommendations. Retaining Pinchin for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions. However, please be advised that any construction/excavation observations by Pinchin is over and above the mandate of this geotechnical evaluation and therefore, additional fees would apply.

MISINTERPRETATION OF GEOTECHNICAL ENGINEERING REPORT

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having Pinchin confer with appropriate members of the design team after submitting the report. Also retain Pinchin to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering or geologic report. Reduce that risk by having Pinchin participate in pre-bid and preconstruction conferences, and by providing construction observation. Please be advised that retaining Pinchin to participation in any 'other' activities associated with this project is over and above the mandate of this geotechnical investigation and therefore, additional fees would apply.

CONTRACTORS RESPONSIBILITY FOR SITE SAFETY

This geotechnical report is not intended to direct the contractor's procedures, methods, schedule or management of the work Site. The contractor is solely responsible for job Site safety and for managing construction operations to minimize risks to on-Site personnel and to adjacent properties. It is ultimately the contractor's responsibility that the Ontario Occupational Health and Safety Act is adhered to, and Site conditions satisfy all 'other' acts, regulations and/or legislation that may be mandated by federal, provincial and/or municipal authorities.

SUBSURFACE SOIL AND/OR GROUNDWATER CONTAMINATION

This report is geotechnical in nature and was not performed in accordance with any environmental guidelines. As such, any environmental comments are very preliminary in nature and based solely on field observations. Accordingly, the scope of services do not include any interpretations, recommendations, findings, or conclusions regarding the, assessment, prevention or abatement of contaminants, and no conclusions or inferences should be drawn regarding contamination, as they may relate to this project. The term "contamination" includes, but is not limited to, molds, fungi, spores, bacteria, viruses, PCBs, petroleum hydrocarbons, inorganics, pesticides/insecticides, volatile organic compounds, polycyclic aromatic hydrocarbons and/or any of their by-products.

Pinchin will not be responsible for any consequential or indirect damages. Pinchin will only be held liable for damages resulting from the negligence of Pinchin. Pinchin will not be liable for any losses or damage if the Client has failed, within a period of two years following the date upon which the claim is discovered within the meaning of the Limitations Act, 2002 (Ontario), to commence legal proceedings against Pinchin to recover such losses or damage.