FUNCTIONAL SERVICING & STORMWATER MANAGEMENT STUDY

IN SUPPORT OF SITE PLAN APPLICATION

Project: 571 Welham Road – Proposed Industrial Facility
Location: 571 Welham Road, Barrie, ON

CPE Project #: 20005

8395 Jane Street, Suite 100
Vaughan, Ontario L4K 5Y2
Tel: (905) 326-1404

Prepared For:

Environmental 360 Solutions Inc.

No.	Revision	Date
2	Re-issued for Site Plan Approval	November 19, 2020
1	Issued for Site Plan Approval	June 25, 2020

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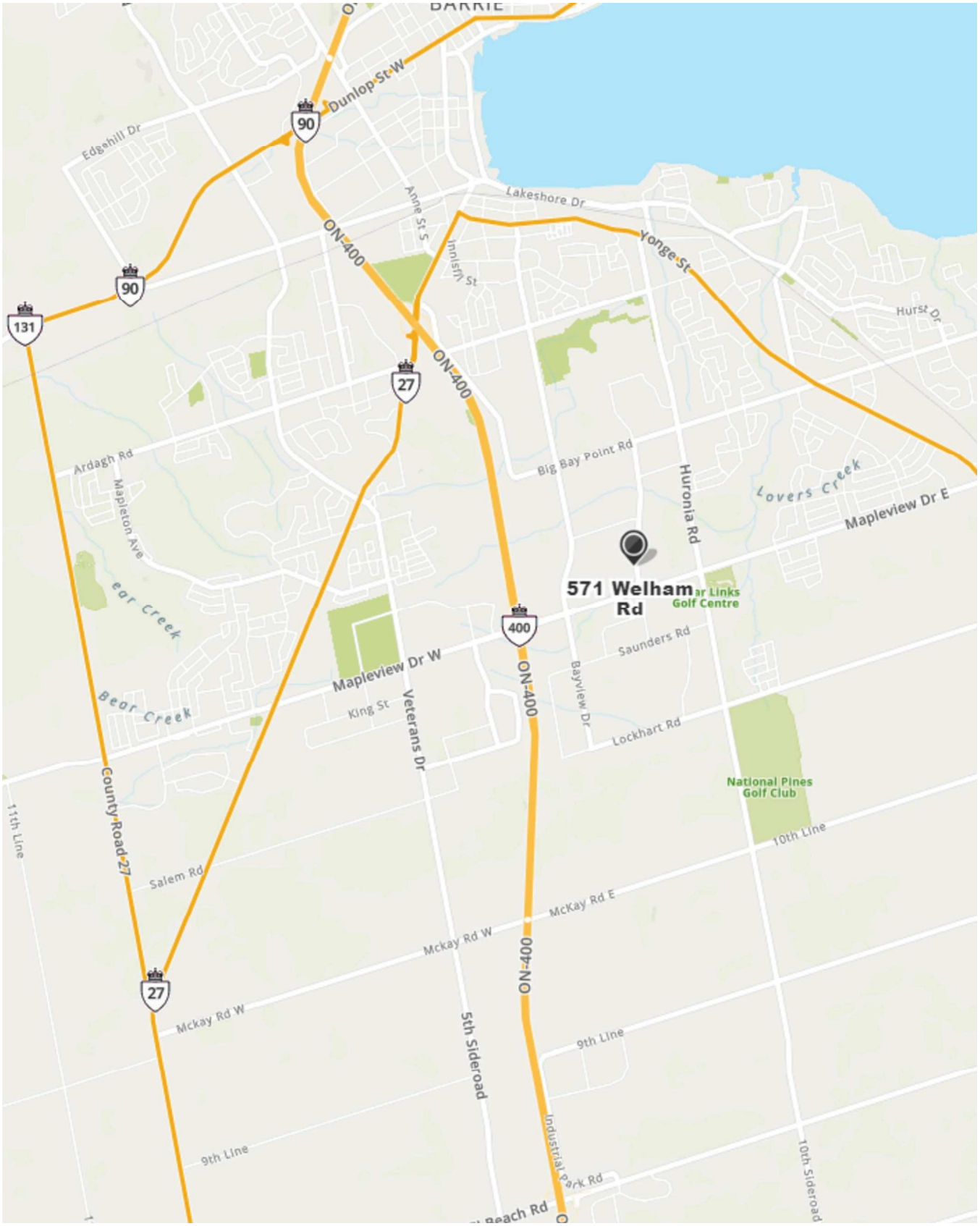

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COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

FIGURE 1: SITE LOCATION

INDUSTRIAL DEVELOPMENT
571 WELHAM ROAD
BARRIE, ON

DESIGNED BY: BJ	DATE: JUNE 2020
CHECKED BY: JY	PROJECT No. 20005
DRAWING BY: BJ	
CHECKED BY: JY	FIGURE No. 1
SCALE: NTS	

1.0 INTRODUCTION

1.1 BACKGROUND

Counterpoint Engineering (CPE) has been retaining by Environmental 360 Solutions Inc. to prepare this Functional Servicing and Stormwater Management Study ('Servicing Study') in support of an application for site plan approval ('SPA') for the proposed development project located at 571 Welham Road in the City of Barrie ('City'). The 2.46 ha subject site is bound by Welham Road along the west, LSRCA lands adjacent to Mapleview Drive to the south, and CNR lands to the east.

The proposed development includes the construction of an industrial building and associated driveways, parking and loading areas. The proposed works will include the regrading of 1.62 ha area ('disturbed area') directly south of the existing industrial building. Refer to **Figure 1** for a key plan of the proposed site. A parking area is proposed around the west and south of the proposed building, with a loading area to the east. The industrial development concept includes for +/- 4900 square meters of gross floor area ('GFA'). Refer to **Table 1** for a summary of site statistics.

Table 1: Site Statistics

Statistic	Area (+/-)
Ex. Building Area	0.14 ha
Proposed Building area	0.49 ha
Disturbed (Regraded) Area	1.62 ha
Site Area	2.46 ha

This Servicing Study has been prepared to address the site servicing strategy (stormwater, sanitary, and water servicing) in support of the previously noted development applications.

1.2 STUDY PARAMETERS

The background documents listed below have been considered in the preparation of this Servicing Study:

- Various architectural plans and inputs prepared by Joseph N. Campitelli Architects Inc.
- Topographic and Underground Survey by Rudy Mak Surveying Ltd.

- City of Barrie Development Storm Stormwater Management Policies and Design Guidelines ('Barrie DSSMPDG'), 2017;
- City of Barrie Development Sanitary Sewage Collection System Policies and Design Guidelines, 2017;
- City of Barrie Water Transmission and Distribution Policies and Design Guidelines, 2017;
- LSRCA Technical Guidelines for Stormwater Management Submissions ('LSRCA Guidelines'), September 2016;
- Geotechnical Report, "Proposed Industrial Development" by Terraprobe, June 5, 2020;
- Hydrogeological Assessment, "Proposed Industrial Development" by Terraprobe, June 16, 2020;
- Report on test results, "In-Situ Guelph Permeameter Tests, Proposed Infiltration Gallery, 571 Welham Road, Barrie, Ontario" by Terraprobe Inc., November 2, 2020;
- Stormwater Management Planning and Design Manual ('MECP Design Manual'), MECP, 2003;
- Fire Underwriters Survey Manual, 1999.

For the purpose of this report, we have referenced site and building statistics from the architectural site plan.

2.0 STORMWATER MANAGEMENT

The Stormwater Management for the subject land has been prepared in accordance with the criteria of the City of Barrie and the Lake Simcoe and Region Conservation Authority ('LSRCA')..

2.1 EXISTING CONDITIONS

The subject lands are occupied by a 1 storey industrial building with associated parking and storage area. It does not appear that any stormwater infrastructure exists on the subject site, so all stormwater drains overland to 3 different locations; (1) CNR Lands to the east, (2) LSRCA Environmental Protection Zone ('LSRCA EP Zone') to the south, and (3) Welham Road to the west. Stormwater flowing to Welham Road is captured by catchbasins and conveyed south via a 600 mmø storm sewer to the existing CSP culvert, flowing east in the ditch on the northside of Mapleview Drive before passing under the roadway

through an existing 2.55m box culvert. Stormwater that drains south to existing LSRCA EP Zone also contributes to the same ditch that eventually flows under Mapleview Drive. The contributing areas to each outlet are summarized in **Table 2** below, refer to **Figure 2** for a visual representation:

Table 2: Pre-Development Areas and Runoff Coefficients

Outlet (Area I.D.)	Area (ha)	Runoff Coefficient
Welham Road (100)	0.912	0.47
LSRCA lands/Culvert (101)	0.695	0.33
CNR Lands (102)	0.848	n/a

2.2 STORMWATER MANAGEMENT DESIGN CRITERIA

This report has been prepared in accordance with the criteria of the City of Barrie, Lake Simcoe Regional Conservation Authority, and the Ministry of the Environment Conservation and Parks ('MECP'). The criteria as it applies to this development is as follows:

- **Quantity Control:**
    - Underground storm sewers are to be designed to convey a minimum of the 1:5-year storm using the rational method (Barrie SDSMPDG, page 7)
    - Post-development peak flow rates shall not exceed corresponding pre-development rates for the 1:2-year, 1:5-year, 1:10-year, 1:25-year, 1:50-year, 1:100-year design storm events (confirmed via email by City Staff on February 28, 2020).
    - Manually calculated hydraulic modelling (rational or modified rational) is acceptable for sites less than 5 hectares (page C5, LSRCA Guidelines).
- **Quality Control:**
    - As per Ontario Regulation 219/09, all new SWM facilities shall provide as a minimum the Enhanced level protection as specified in the *Stormwater Planning and Design Manual* (MOE, 2003).
- **Water Balance and Phosphorous Control:** the subject site is located above a Highly Vulnerable Aquifer as designated by the City of Barrie and is therefore generally unsuitable for infiltration. However, through consultation with the LSRCA, it is agreed that clean runoff from roofs and landscaped areas can be infiltrated in order to adhere to LSRCA criteria.

- As per LSRCA Technical Guidelines, a SWM plan must make every feasible effort to maintain the pre-development infiltration rate (page 15). The proposed building is greater than 500 m^2 and therefore is classified as a *major development*.
- As per LSRCA Technical Guidelines, all major developments must remove a minimum of 80% of the annual Total Phosphorus (page 11).

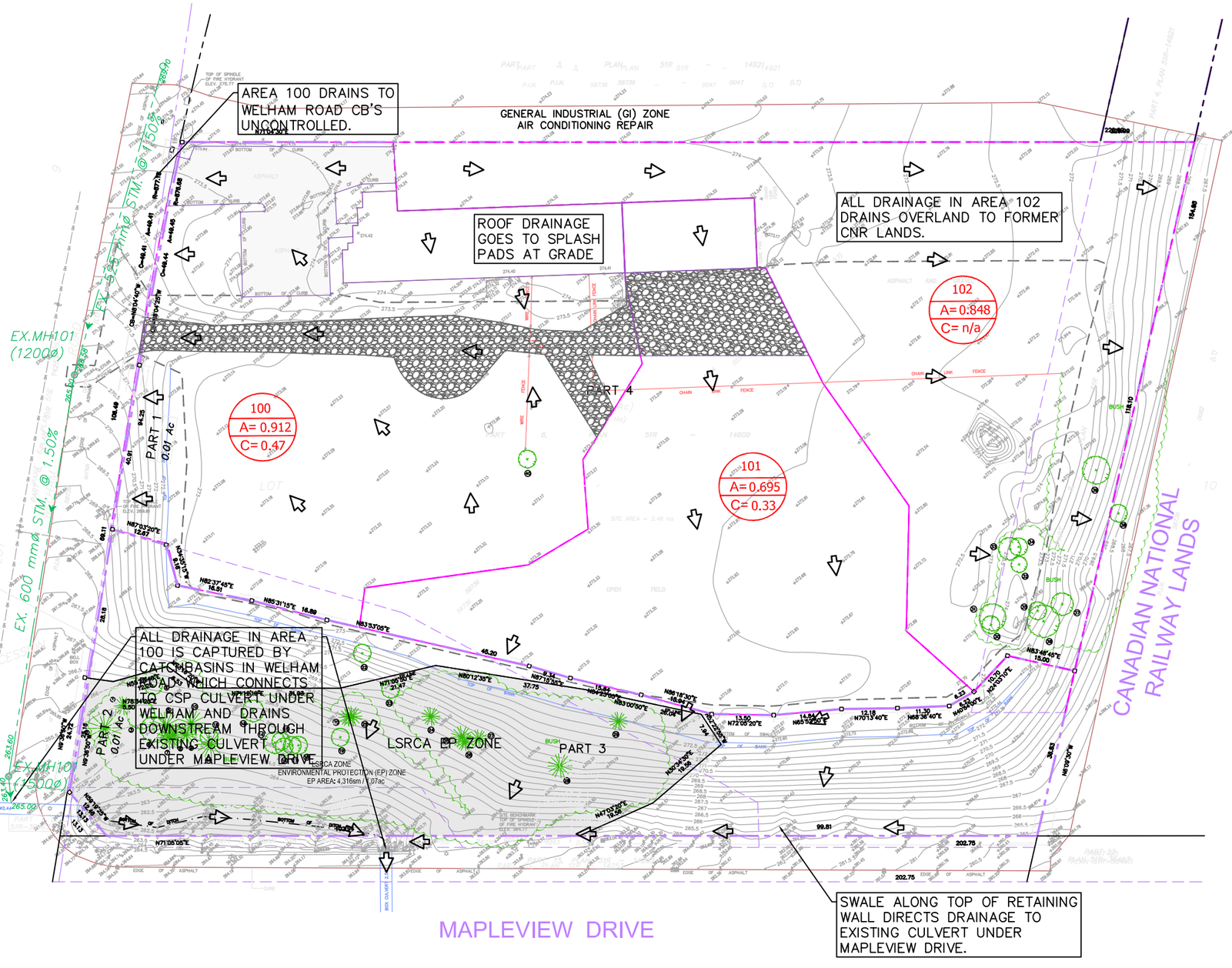
2.3 PRE-DEVELOPMENT CONDITION (WATER QUANTITY CONTROL)

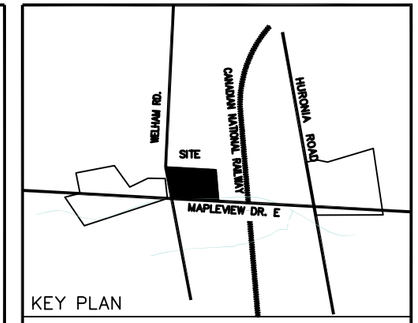
The subject site contains an existing 1-storey building with a building area of 1,376 m^2. In existing conditions, the subject site drains overland to the east (CNR lands), south (LSRCA EP lands), and west (Welham Road) without any identified controls (refer to **Figure 2**).

The preferred outlet for the subject site in the post-development condition is Welham Road, which conveys stormwater to the culvert under Mapleview Drive. Stormwater flows from Area 100 (0.912 ha) shown in **Figure 2** drain overland to Welham Road under pre-development conditions. The pre-development release rates during various storm events to Welham Road are summarized in **Table 3** below (see calculations in **Appendix B1**).

Table 3: Allowable release rates for storm events between 2 and 100 years

Storm Event	Area (ha)	Runoff Coefficient	Release Rate (l/s)
2-year	0.912	0.47	99.0
5-year	0.912	0.47	129.7
10-year	0.912	0.47	150.7
25-year	0.912	0.52	194.0
50-year	0.912	0.56	234.6
100-year	0.912	0.59	268.1





KEY PLAN

LEGEND

EXISTING STORM SEWER

100 / A= 0.912 / C= 0.47 — TRIBUTARY NAME AREA RUNOFF COEFFICIENT

PROPERTY LINE

OVERLAND FLOW ROUTE

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

571 WELHAM ROAD
BARRIE, ONTARIO

PRE-DEVELOPMENT SWM

DESIGNED BY: GR	DATE: NOV. 2020
CHECKED BY: JH	PROJECT No. 20005
DRAWING BY: GR	
CHECKED BY: JH	FIGURE No. 2
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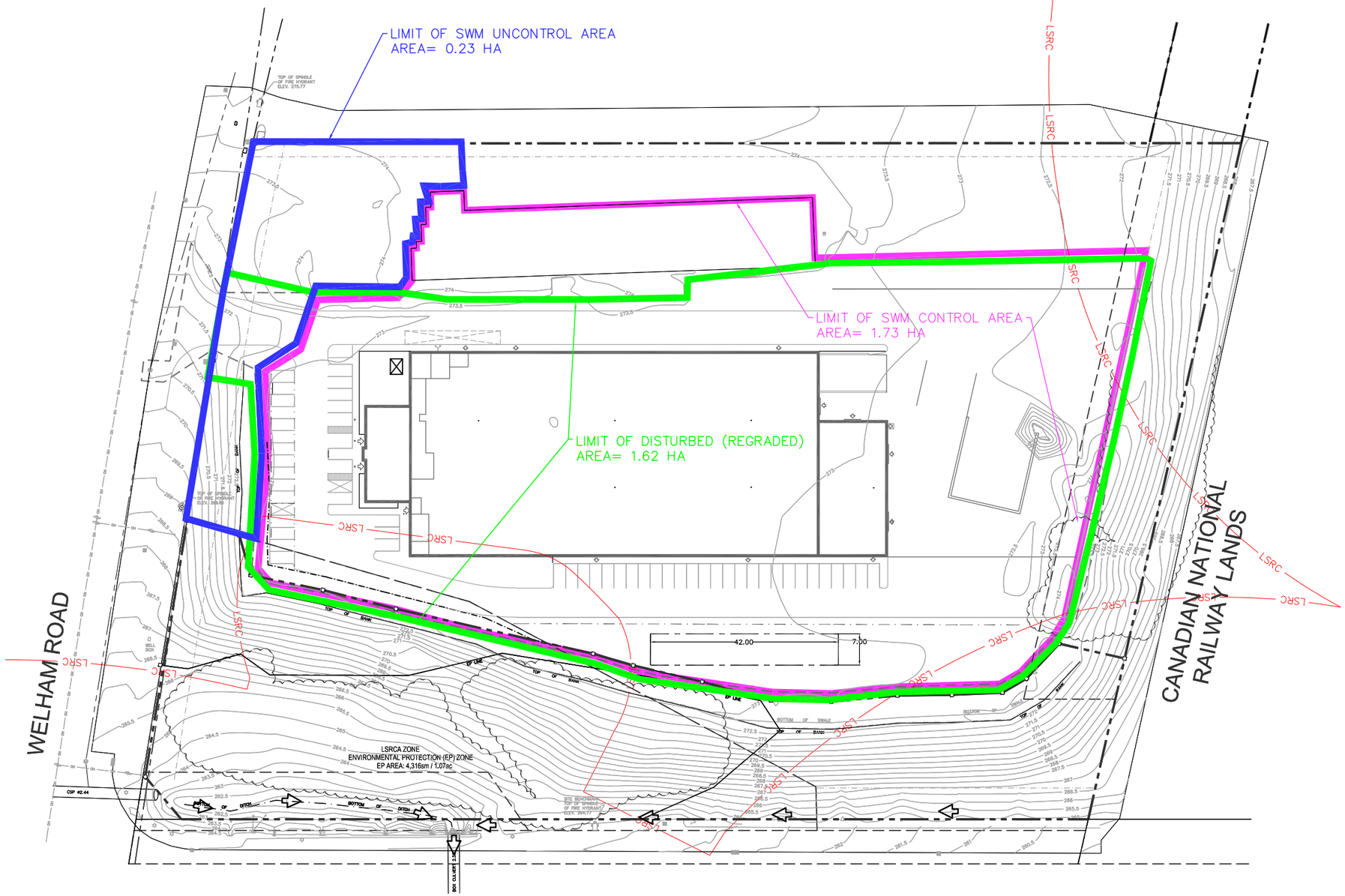

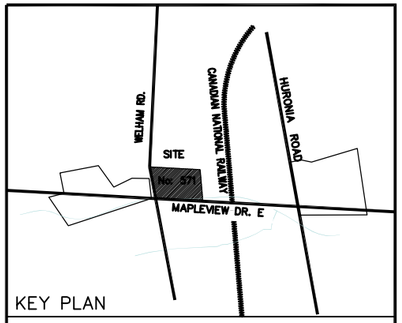

KEY PLAN

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

571 WELHAM ROAD
BARRIE, ONTARIO

POST-DEVELOPMENT AREAS

DESIGNED BY: GR	DATE: NOV. 2020
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SCALE: 1:1000	

2.4 POST-DEVELOPMENT CONDITION AREAS

As a result of the nature of the proposed development in which a proposed building and its associated paved and landscape areas are to be constructed within the same property where an existing building is located, and where a significant area of site is to remain undisturbed, the areas used to calculated quantity and quality controls are different according to the criteria of the requirement to be met.

The area for quantity control calculations, for example, includes all the area which in post-development conditions will have stormwater flows conveyed to Welham Road, including some undisturbed areas (existing building roof, driveway to existing building, undisturbed areas draining uncontrolled to Welham Road). For the TSS removal calculations all areas draining to the StormFilter unit (1.73 ha) plus the disturbed entrance area (0.05 ha) were considered as the areas to be treated. For the phosphorous removal calculations only disturbed (regraded) areas are included in the calculations.

Table 4 below summarizes the areas used in the calculation of different quantity and quality controls to meet City and LSRCA requirements. See **Figure 3** for location of the controlled, uncontrolled and disturbed area.

Table 4: Post-development Areas Used for SWM Control Calculations

#	Description	Area (+/-)	Comments
1	**Ex. Building Area (Uncontrolled Roof Within Controlled Site Area)**	0.14 ha	
2	**Undisturbed Site area with Controlled Area**	0.02 ha	
3	**Proposed Building Area Controlled Roof**	0.49 ha	
4	**Total Disturbed Area (=5+6)**	1.62 ha	Used for **Phosphorous Capture** calculations
5	**Uncontrolled Disturbed Entrance Area**	0.05 ha	
6	**Controlled Disturbed Area**	1.57 ha	
7	**Controlled Site (Including Controll Roof) Area to Welham Road (=1+2+6)**	1.73 ha	
8	**Controlled Area plus Disturbed Entrance Area (=5+7)**	1.78 ha	Used for **Water Quality** (TSS removal calculations)
9	**Uncontrolled Area to Welham Road**	0.23 ha	
10	**Total Drainage Area to Welham Road (=7+8)**	1.96 ha	Used **Quantity Control** and **Water Budget** Calculations
11	**New Impervious Area (within Disturbed Area)**	1.33 ha	Used for **Volume Control** Calculations
12	**Total Site Area**	2.46 ha	

2.5 POST-DEVELOPMENT CONDITION (WATER QUANTITY CONTROL)

The stormwater management for the site under proposed conditions will consist in safely conveying to Welham Road stormwater flows from all the areas to be developed during the proposed works (1.96 ha). All stormwater flows for all storm events from the 2-year to the 100-year event will be attenuated to the pre-development flows shown in **Table 3** in accordance with the City of Barrie criteria for Stormwater Management. Welham Road will be the sufficient outlet for the site as per sections 2.2.3 and 2.2.4 of the LSRCA Technical Guidelines for Stormwater Management Submissions. Uncontrolled areas (0.23 ha) stormwater flows will be conveyed overland to Welham Road, while controlled area (1.73 ha) flows will be conveyed to the existing municipal storm sewer on Welham Road through the

minor system. The attenuation of flows from the controlled areas will be achieved by the use of an orifice plate and stormwater storage in underground pipe, sewer structures (manholes and catchbasins) and an underground storage unit. No surface ponding is included in the calculations stormwater storage. Refer to **Figure 3** for location of post-development SWM areas.

As per the Site Servicing Plan (SW-S), the proposed site will convey all flows captured by the minor system to a single 450 mm diameter PVC storm connection to the existing storm MH101. The minor system has been designed to convey storm events runoff up to the 5-year event under free flow conditions (see **Appendix B2** for storm design sheet, and **Figure 4** for drainage areas). All storm events up to the 100-year storm will be captured and conveyed through the minor system to the municipal sewer on Welham Road, with flows controlled to the allowable release rates in **Table 3**. Inlet capacity calculation for the 100-year storm are presented in **Appendix B9**. The 100-year maximum water level is the spill point for DCB1 to the CNR lands on the east side of the site (elevation 272.03). No surface ponding storage volumes were considered in the storage calculations. **Table 5** below summarizes the modified rational method calculations of stormwater storage required and provided for post-development conditions, and also compares pre-development (allowable) and post-development release rates. See **Appendix B3** for uncontrolled area release rate calculations, and **Appendix B4** for modified rational method calculations including roof storage and release rates, site release rate summaries, storage requirements, storage available and orifice release rates calculations for the 2, 5, 10, 25, 50, and 100-year storm events.

As per **Table 5** below, total post-development release rates (including uncontrolled flows) have been controlled to below pre-development (allowable) release rates for each design storm event. Based on the Modified Rational method calculations, the area upstream of the orifice plate provides up to **433 m3** of underground storage during the 100-year storm event. A 180 mm orifice plate located at MH102 is proposed to attenuate flows to 133.0 L/s during 100-year storm event for the controlled area of the site. The majority of the storage will be provided through a 328 m3 StormTrap underground storage tank. **Table 5** indicates that the total release rate for the subject site is less than pre-development levels. Therefore, the proposed design satisfies the requirement that flows from the site be controlled

so that all post-development peak flows reaching Welham Road in the 2-year to the 100-year storm events will be equal or less to pre-development flows.

Table 5: Release Rate to Welham Road and Storage Comparison for the Subject Site

Storm Event	2 -Year	5-year	10-year	25-Year	50-Year	100-Year
Allowable Release Rate (l/s)	99.0	129.7	150.7	194.0	234.6	268.1
Uncontrolled Release Rate	40.4	52.9	61.4	79.1	95.7	109.3
Roof Release Rate (l/s)	18.2	24.3	28.4	33.5	37.2	41.1
Roof Storage Used (m^3)	71	95	111	131	145	161
Orifice Release Rate	58.5	68.5	74.9	92.2	105.5	133.0
Total Release Rate from Site (l/s)	98.8	121.4	136.4	171.3	201.2	242.3
Water Elevation U/S of Orifice	269.11	269.37	269.56	270.15	270.69	272.03
Required Underground Storage (m^3)	178	259	318	366	397	399
Underground Storage Available (m^3)	179	259	318	366	397	433

Drainage areas to the LSRCA EP zone and to the CNR lands will be reduced in the post-development condition and for the areas remaining the existing pervious surface cover will be maintained. Therefore, the release rates in the post-development conditions to the LSRCA EP zone and to the CNR lands will decrease and no additional controls are necessary.

2.6 PROPOSED LID MEASURES

In order to meet the LSRCA requirements for volume control, water balance and phosphorous capture three different BMP's are proposed in this site: an infiltration trench, a filtration only bioswale and filtration only permeable pavers.

Infiltration Trench

An infiltration trench is proposed for this site to provide stormwater retention and water quality treatment to help meet the water balance, volume control and phosphorous removal objectives. The filtration volume that provided has the purpose of maximizing the storm water retention for volume control taking into account the size of the roof and the area available for the infiltration trench. The proposed infiltration trench provides best efforts to meet the volume control objective of retaining 25mm rainfall on site.

In-situ Guelph Permeameter testing was completed by Terraprobe Inc. in November 2020 with the aim of determining the expected infiltration rate of the soil in which the infiltration trench is intended to be located (refer to **Appendix B8**). The results of the three tests performed at elevations 269.60, 269.10 and 268.60 were infiltration rates of 50 mm/hr, 75 mm/hr and 75 mm/hr respectively. Using a safety factor of 2.5 we obtain a design infiltration rate of 20 mm/hr. Also, no groundwater was found in the test pits during the test nor in any borehole performed on-site during the geotechnical investigation, which indicates deep groundwater.

The underground infiltration trench proposed will receive flows from storm drainage from the roof of the proposed building. The dimensions will be 42.0 m long by 7.0 m wide, with a total depth of 0.96 m. The total volume of granular material with a minimum 40% voids will be 282.2 m^3, with a total effective volume of voids of 112.9 m^3 . The time to drain is calculated as by the following formula (based on the section 4.4.2 of the Low Impact Development Stormwater Management Planning and Design Guide by TRCA):

ts = (Vr * dr)/ i= (0.4 * 960 mm)/(20 mm/hr) = 19.2 hrs. (less than the minimum recommended 48 hrs)

The bottom of the infiltration trench will be at an elevation of 269.16 and the top will be at 270.12. The infiltration trench will receive flows through a 450mm perforated pipe. In case of obstruction or excessive flows, a by-pass pie of the same diameter is proposed above the infiltration trench. Please refer to drawing **SW-S** for the location of the infiltration trench and to drawing **SW-D2** for detail.

Filtration Only Bioswale

A filtration only bioswale is proposed to be located adjacent to parking lot area south of the proposed building. It will have an approximate area of 225 m2. It will receive flows from the drive aisles to the south and east of the proposed building through a series of 1.0 m curb cuts. The bioswale is designed with 0.150 m maximum surface ponding depth before ponding water starts to spill into catch basins in the bioswale itself. The bioswale structure will consist of a 0.20m deep layer of permeable soil, a 1.00 m deep engineered layer of soil filter media bed, and a 0.30 m granular storage layer with minimum 40% voids and subdrain pipe for drainage. The bottom of the bio-retention structure will be separated from the native soil below by an impervious liner which will not allow for infiltration to take place, impede groundwater to percolate into the pavement structure, and will block the movement of native soils or granular material. Please refer to drawing **SW-S** for the location of the infiltration trench and to drawing **SW-D2** for detail.

Permeable Pavers

The proposed permeable pavers (227 m^2) will be located in the parking area west of the proposed building. The permeable pavers will consist of interlocking concrete pavers (Permacom "Boulevard Drain" or approved equivalent) to be used in place of conventional asphalt and concrete paving in parking areas. The permeable pavers will have a thickness of 100mm and will have 12% of pervious openings between pavers. The bedding of the permeable pavers will be 26mm thick and will consist of 2-5mm limestone or granite chip gravel (ASTM C33 No. 8). The base course will be a 250 mm layer of 18-20mm clear angular limestone or granite (ASTM C33 No. 57). The sub-base course will be a 450mm layer of 50mm clear stone angular limestone or granite (ASTM D2940 No. 2) with minimum 40% minimum voids. The bottom of the permeable paver structure will be separated from the native soil below by an impervious liner which will not allow for infiltration to take place, impede groundwater to percolate into the pavement structure, and will block the movement of native soils or granular material. The permeable pavement will capture direct precipitation, as well as runoff from adjacent impermeable surfaces. The captured stormwater will be filtrated and will flow out through subdrains which will convey these flows to a catch basin. The flows will then be discharged to the storm sewer system. Please refer to drawing **SW-S** for the location of the infiltration trench and to drawing **SW-D2** for detail.

2.7 WATER QUALITY

LSRCA Technical Guidelines (section 2.3.1, page 11) and Barrie DSSMPDG (section 4.1.1, page 20) indicate that 80% removal of TSS is required on an average annual loading basis from all runoff leaving the proposed development. For the purpose of TSS removal, the subject site is the controlled area which conveys stormwater flows to the treatment unit (1.73 ha) plus the disturbed uncontrol area of the proposed entrance to the site (0.05 ha) with a total area of 1.78 ha (includes drainage from the existing building roof). A SFPD0818 Storm Filter unit with thirty four (34) 27" high cartridges by Contech Stormwater Systems is proposed downstream of the orifice plate. The unit is sized to provide 80% TSS removal for 90% runoff (NJDEP certified December 14, 2016). See design calculations and details provided by the manufacturer in **Appendix B5**. A portion of the 1.78 ha area is covered by the existing and proposed rooftops which is considered clean water (0.49 ha +0.14 ha = 0.63 ha), and therefore the effective total suspended solids removal for the subject site is:

$$\frac{(1.73\ ha - 0.63\ ha) * 0.80 + (0.63\ ha) * (0.80 + (1 - 0.80) * 0.80)}{1.78\ ha} = 83\%$$

Since the effective TSS removal is 83% for the subject site, the City of Barrie and LSRCA criteria for water quality are met.

2.8 VOLUME CONTROL

As per the LSRCA technical guidelines for stormwater management, the site is considered a major development and should meet the requirement of capturing and retaining/treating the 25 mm rainfall event from the total impervious area of the site. With the aim of achieving this objective, the amount of infiltration BMP'S has been maximized taking into account the City's ICA restrictions which only allow for roof drainage to be infiltrated in this area for land with industrial use. The LID measures proposed include an infiltration trench to capture and infiltrate storm drainage from the roof to meet water balance and volume control targets. In order to enhance the volume of storm run-off being treated the filtration only bioswale is proposed to captures and filtrates an area of run-off from paved areas. Also, filtration only permeable pavers are proposed to be installed in the parking area west of the proposed building. Both the bioswales and the permeable pavers will have infiltration blocked by an

impervious membrane at the bottom of the storage layer, and all flows collected by subdrains and conveyed to catchbasins connected to the minor system. It should be noted that the proposed StormFilter unit fitted with sorbtive media which will provide additional filtration treatment to 1.73 ha of the site.

The proposed infiltration and filtration measures would result in the following volumes infiltrated or treated during the 25 mm storm event:

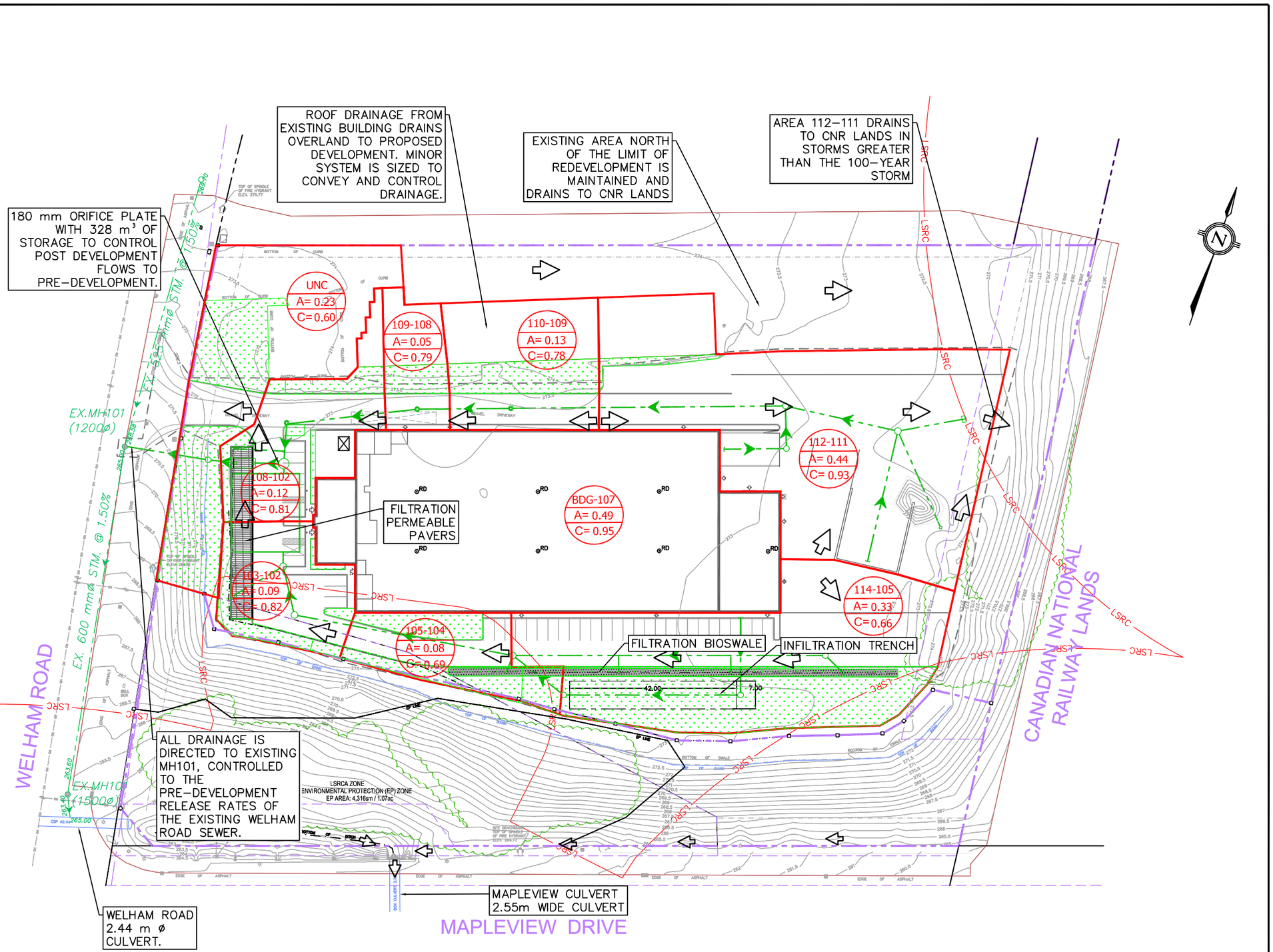
Impervious area directed to infiltration trench (building roof) = 4,900 m2
mm of rain infiltrated from roof area = 23.0 mm
Volume captured by infiltration trench= 112.9m3

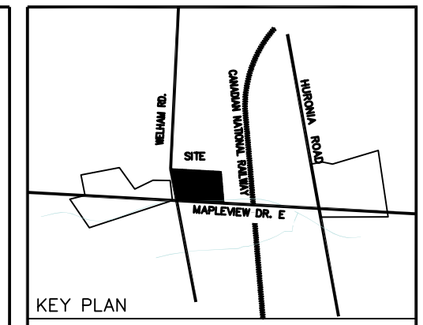
Impervious area directed to filtration bioswale = 2,450 m2
mm of rain treated by filtration bioswale = 14.4 mm
Volume capture treated by filtration bioswale = 35.4 m3 (including surface and U/G storage volume)

Impervious area directed to filtration permeable pavers = 1,200 m2
mm of rain treated by filtration permeable pavers = 25.0 mm
Volume capture treated by filtration bioswale = 30.0 m3

Total proposed new or regraded impervious area = 13,305 m2
Impervious area flows retained/treated by BMP's = 8,550 m2
Volume capture and retained/treated by BMP's = 178.6 m3
mm of rain treated by filtration by BMP's over total impervious area = 13.4 mm

The reasons for not been unable to infiltrate the 25 mm event is the result of the ICA requirements applying to this area for industrial sites. Site plan restrictions impedes the construction of additional LID measures to capture and treat the proposed paved areas north and northeast of the proposed building as well as the existing building roof area.





KEY PLAN

LEGEND

- EXISTING STORM SEWER
- PROPOSED STORM SEWER
- BDG-107 A= 0.49 C= 0.95 — TRIBUTARY NAME AREA RUNOFF COEFFICIENT
- PROPERTY LINE
- EMERGENCY OVERLAND FLOW
- PROPOSED LANDSCAPE AREAS

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

571 WELHAM ROAD
BARRIE, ONTARIO

POST-DEVELOPMENT SWM

DESIGNED BY: GR	DATE: NOV. 2020
CHECKED BY: JH	PROJECT No. 20005
DRAWING BY: GR	
CHECKED BY: JH	FIGURE No. 4
SCALE: 1:1000	

As a result of the site restrictions mentioned, the Flexible Treatment Alternatives for Sites with Restrictions as defined on Section 2.2.2.2 of the LSRCA Technical Guidelines for Stormwater Management Submissions should apply, in particular Alternative #1 i. for sites that will achieve the retention/treatment of storm events greater than the 12.5 mm storm event.

2.9 WATER BALANCE

Based on LSRCA Technical Guidelines for Stormwater Management Submissions ('LSRCA Technical Guidelines'), the applicant must make every feasible effort to maintain the pre-development infiltration conditions. A water balance assessment was prepared to calculate the pre-development infiltration rate and size a proposed infiltration trench, if required (*Note: A Hydrogeological Assessment has been prepared for the subject site by Terraprobe, dated June 16, 2020 with a water balance assessment beginning on page 17. For further details regarding this assessment, please refer to this report provided under separate cover).*

To determine pre-development infiltration rates and volumes, inputs and factors based on the topography and location of site are determined using criteria from Table 2 of the *MOEE Hydrogeological Technical Information Requirements for Land Development Applications.* The proposed site is in the Lovers Creek subwatershed. Based on the Environmental Canada Climatic Normals for the Barrie WPCC weather station, the mean annual precipitation is considered **933 mm/yr** (Hydrogeological Assessment, page 17). Based on the soil sampling data in the Hydrogeological Assessment, the hydrologic soil group is "fine sandy loam" (Group B, **Appendix B6**) in the Urban Lawns subcategory. As a result, the evapotranspiration can be estimated as approximately **571 mm/yr** (see **Lake Simcoe Climate Data**, **Appendix B6**). Infiltration factors are estimated by site slope, vegetation, and soils, and summarized below and in **Appendix B6-1**:

- Topography Factor: 0.30 (flat)
- Soil: 0.40 (open sandy loam)
- Cover: 0.10 (grass)

- MOE Infiltration Factor: 0.8 (summary of above)

Utilizing these factors, the pre-development infiltration rate for the subject site is **290 mm/yr** (MOE infiltration factor * precipitation surplus [933-571=362 mm/yr]) over the existing pervious area (1.56 ha) within the area of the site conveyed to Welham Road (1.96 ha), including proposed areas to be disturbed, the existing building and existing uncontrolled areas draining to Welham Road. This equates to a total infiltration volume of **4,505 m^3/yr**. The calculations in **Appendix B6** show that the post-development site will infiltrate a minimum 4,505 m^3/yr with the proposed infiltration trench.

In post-development conditions, the area of the site to be conveyed to Welham Road is 1.96 ha of which 0.38 ha will be pervious and 1.58 ha and areas. Infiltration only occurs in pervious areas, so the infiltration rate without mitigation measures is the following:

$$\frac{Pervious\ Area * 290\ mm/yr}{Total\ Area} = 56\ mm/yr$$

Over the entire site area, this equates to 1,098 m^3/yr (**Appendix B6**).

As shown in the Site Servicing Plan (SW-S), one (1) infiltration trench is provided for the remaining groundwater recharge that is required. The infiltration trench will utilize clean roof drainage with an area of 0.4904 ha. The infiltration trench must provide the difference between the pre-development infiltration volume (4,505 m^3/yr) and the post-development scenario without mitigation (1,098 m^3/yr), equalling 3,407 m^3/yr. Over the impervious roof area, this equates to 752 mm/yr (Refer to **Appendix B6**):

$$\frac{3{,}407\ \frac{m^3}{\mathrm{yr}}}{4904\ m^2} = 0.695\ \frac{m}{yr}$$

In order to size an infiltration trench for 752 mm/yr, Figure 1a from the *City of Toronto Wet Weather Flow Management Guidelines* is used to determine the annual average rainfall depth for the contributing area (4,904 m^2). Evapotranspiration (93 mm/yr or 10% of total rainfall) and surface

infiltration (0 mm/yr) account for the first 10.0% ((93+0) / 933) of the average annual rainfall. Incorporating the required infiltration of 695 mm/yr results in the infiltration trench being sized to capture 84.5% ((93+0+695) / 933) of the average annual rainfall minus the volume of the first 10.0% (i.e. 84.5% - 10.0% = 84.5%). Using **Figure 1a** presented in **Appendix B6**, **19.3mm** over the contributing area is to be infiltrated through the infiltration trench. Capturing 19.3 mm across the rooftop area of 4,904 m^2, equates to a total volume of 75.0 m^3.

One infiltration trench is to be constructed on the site south of the proposed building as shown in the **SW-S** plan. The infiltration rate for the LID has been determined by conducting three in-situ Guelph Permeameter Tests at a test pit at the proposed location for the infiltration trench. The result obtained at elevation 269.60, 269.10 and 269.60 were 50 mm/hr, 75 mm/hr and 75 mm/hr respectively. Using a safety factor of 2.5, the infiltration trench has an infiltration rate of 20 mm/hr. Using a void ratio of 40%, the infiltration trench has been sized with a depth of 0.96 m, and a total infiltration volume provided of 112.9 m^3. Therefore, the proposed site infiltrates more volume (112.9 m^3) than required (94.6 m^3) and is compliant with the water balance requirements of the LSRCA technical guidelines. Please refer to the site servicing plan **SW-S**, and details plan **SW-D2** for infiltration trench details.

Construction measures during the installation of the infiltration trench are to take place to minimize compaction and sedimentation on the infiltration areas to reduce clogging. The provided Erosion and Sediment Control plans outline construction measures to take place.

2.10 PHOSPHORUS CONTROL

The LSRCA requires a phosphorus loading study to be completed for all major developments. The study is required to determine the phosphorus loading under pre-development conditions, construction phase loading, and post-development conditions with and without quality controls. Best efforts shall be employed such that any increase in loading is kept to a minimum. The MECP phosphorus loading tool ('P Tool') was used to complete the study and the output can be found in **Appendix B7.**

Under pre-development conditions, the site is categorized as hay-pasture land use with a phosphorus coefficient of 0.07 kg/ha/yr. Given the affected site area of **1.62 ha** (area to be disturbed by the proposed works), the total pre-development loading is 0.11 kg/yr.

In the proposed condition the site employs four Best Management Practices (BMPs) for phosphorus removal ('P removal'). As per section 2.5, all stormwater from the disturbed controlled area (1.57 ha) is conveyed to the SFPD0818 Storm Filter structure with thirty-four (34) 27" high cartridges by Contech Stormwater System. As per the details provided in **Appendix B5,** the stormfilter structure provides phosphorus removal with an efficiency of 79% for a site area of 1.73 ha (additional area from rooftop of existing building to the north and adjacent undisturbed areas) and a runoff coefficient of 0.85. A portion of the 0.05 ha area consists of the proposed entrance which, given grading requirements, flows untreated to Welham Road. The roof area (0.49 ha) passes through an infiltration trench, while 0.246 ha pass through a bioswale filter media and 0.120 ha pass through a permeable paver structure for a total of 0.366 ha that pass through a filter media. The effective total phosphorous removal for the subject site is:

For the 0.49 ha roof area treated by the StormFilter unit (see drawing **SW-S**) and the proposed infiltration trench, the treatment train approach results in P removal of 92%:

0.79 [StormFilter] + (0.60x (1 - 0.79)) [Infiltration trench] = 0.92 = 92%

For the 0.36 ha of paved area treated by the StormFilter structure (see SW-S) and the proposed bioswales or permeable pavers, the treatment train approach results in P removal of 88%:

0.79 [stormfilter] + (0.45x (1 - 0.79)) [filtration media] = 0.884 = 88.4%

For the 0.72 ha treated only by the StormFilter unit the P removal efficiency is 79%. Therefore, the total P Load Reduction with BMP's under post-development conditions is 82.4% for the post-development condition:

$$\frac{(0.49ha) * 0.92 + (0.36\ ha) * 0.88 + (0.72\ ha) * 0.79}{1.62\ ha} = 0.824 = 82.4\%$$

The site has a post-development P-Load of 2.95 kg/yr without BMP's and 0.52 kg/yr with the BMP's described above.

Construction of the development produces phosphorus as well and is included in the P-Tool calculations. Based on the topography of the land, the construction phase phosphorus load is 0.93 kg with no BMP's. To reduce this value, double silt fence with hay bales (LSRCA ESC-5 detail) shall be installed around the perimeter of site for a P-removal efficiency of 91 % (70% + [100%-70%] * 70% = 91%). The total construction phase P-load with BMP's is 0.08 kg, and 0.01 kg when amortized over 8 years.

In summary, the 2.95 kg/yr P-load of the proposed site has been reduced to 0.53 kg/yr for a net reduction of **82.0%** (including amortized construction load). Pre to post increase of 0.41 Kg/yr. Please refer to **Appendix B7** for supporting calculations and P-Tool documentation.

Since the phosphorous load from the site will not be reduced to zero, the LSRCA Phosphorous Offsetting Policy will be applied for this site. As per the Phosphorous Offsetting Policy document prepared by the LRCA, dated September 2017, updated May 2019, section 4.43, the phosphorous offsetting will include the following:

Offset Ratio = 2.5:1
Offset Value = $35,000/kg of phosphorous loading
Offset Calculation = (ratio (2.5) x P deficit in kg x $35,000) = 2.5 x 0.41 kg/yr x $35,000 = $35,875.

Therefore, an estimated Phosphorous Offsetting Fee of $35,875 plus administration fees (15%) will be applied.

2.11 SALT AND TEMPERATURE CONTROL

High salt content in stormwater drainage is detrimental to freshwater aquatic species. The South Georgian Bay Lake Simcoe Lake Protection Plan identified road salt as a prescribed drinking water threat. Measures to reduce use road salt during the design process of proposed contributing roads and parking lots would be analyzed.

Water that is too warm can have a negative impact on aquatic life. Since the site will not have a SWM pond, it will outlet to a municipal sewer and the SWM storage chamber is below ground, significant problems with warm stormwater effluent are not to be expected.

2.12 CONTROL OF OTHER POLLUTANTS

The proposed StormFilter unit is expected to be effective in capturing oil and grease and heavy metals which may be present in the stormwater effluent from the site before it reaches the municipal sewer. Regular inspection and maintenance, including cleaning and timely replacement of the cartridges of the proposed StormFilter unit will contribute in the maintaining the efficiency of the unit for capturing pollutants.

3.0 SANITARY SERVICING

3.1 EXISTING SANITARY SERVICING

The existing building located north of the proposed development is serviced by a 150 mm diameter sanitary sewer that conveys sanitary flows to Welham Road at existing sanitary MHA (see drawing SW-S). The manhole conveys sanitary flows north along Welham Road via a 750mm diameter sanitary sewer running at 0.50 %. The sanitary sewer has a full-flow capacity of 787.2 L/s based on a manning roughness coefficient 0.013.

The peak sanitary discharge from the existing building was calculated using a general industrial design flow rate of 35 m^3/ha/day (per City of Barrie Sanitary Design Guidelines, p. 9). Based on a floor area of 0.14 ha and an estimated peaking factor of 3 (per City of Barrie Sanitary Design Guidelines, p. 10) the existing peak dry flow was calculated to be 0.17 l/s. To calculate peak wet weather flow, an infiltration rate of 0.10 l/s/ha was used and was applied over the 2.46 ha site area (per City of Barrie Sanitary Design Guidelines, p. 10). This produced a total pre-development wet weather peak flow rate of 0.41 l/s. The existing development conveys 0.052 % of the full flow capacity based on the size and slope of the receiving 750 mm diameter sewer, refer to **Appendix C** for supporting calculations.

3.2 PROPOSED SANITARY RELEASE RATE AND SERVICING

The proposed design connects a new 150 mm diameter sewer to the existing sanitary manhole between the existing and proposed buildings (see SW-S for layout).

The peak sanitary discharge from the proposed development (including the existing building) was calculated using a general industrial design flow rate of 35 m^3/ha/day (per City of Barrie Sanitary Design Guidelines, p. 9). Based on a floor area of **0.6280** Ha and an estimated peaking factor of 3 (per City of Barrie Sanitary Design Guidelines, p. 10) the proposed peak dry flow was calculated to be **0.76 l/s**. With an infiltration rate of 0.25 l/s (same as pre-development), the total post-development wet weather peak flow rate is **1.01 l/s.**

Pre-Development Peak Sanitary Discharge Rate: ***0.41 l/s***
Post-development Peak Sanitary Discharge Rate: ***1.01 l/s***
Net Increase: ***0.60 l/s***
Pre-development Rate (% Capacity of the Receiving Sewer): ***0.052 %***
Post-development Rate (% Capacity of the Receiving Sewer): ***0.128 %***
Net Increase (% Capacity of the Receiving Sewer): ***0.076 %***

With a post-development peak sanitary release rate of 1.01 l/s, the property conveys 0.128% of the receiving sanitary sewers' full-flow capacity (an increase of 0.076%). As this is a minimal increase in

sanitary flow to the large sanitary sewer in Welham Road, a hydraulic analysis is not required (per email from City of Barrie Development Services dated March 3, 2020).

4.0 WATERMAIN SERVICING

4.1 EXISTING WATER SERVICING STRATEGY

The existing building is currently serviced by a watermain of unknown size connected to the 300 mm diameter watermain on the east side of Welham Road.

4.2 PROPOSED WATER SERVICING STRATEGY

For ease of metering the proposed development, new 200 mm diameter PVC fire and 50 mm PEX domestic connections are provided for the proposed industrial building to the municipal 300 mm watermain. A meter will be provided on the domestic line within the mechanical room as shown on SW-S, and backflow preventers will be installed for both fire and domestic watermain connections. A private hydrant is proposed within 22 meters of the fire department connection on the north side of the proposed building.

The expected domestic water usage rate for the post-development condition of the site was calculated using the City of Barrie's industrial demand of 35 m^3/ha/day. Using a floor area of 0.4902 ha, the industrial demand is **17,157 l/day**. Applying a maximum day factor of 2.0 (estimated based on water usage as per MOECC guidelines for Drinking Water systems, section 3.4.4), the Total Maximum Daily water demand is **34,314 l/day** or **51 l/min**. Refer to **Appendix D1** for domestic usage calculations.

Fire flow demand was estimated using the Fire Underwriters Survey ('FUS') guidelines (**Appendix D2**). Using an area of 4900 m^2 (largest building area) the fire flow was calculated as **13,000 l/min** before reductions. System Type charges total 25% (Occupancy Charge) and reductions total 60% due to the design of the proposed construction, results in a total Fire Flow demand of **10,000 l/min**.

As per the *MECP General Design Consideration and Source Development* section 3.4.1, the water demand for this construction is maximum day demand plus fire flow, resulting in a total demand of **10,051 l/min** or **2,655 USGPM.**

Refer to **Appendix D2** for supporting FUS calculations. The FUS parameters for reductions utilized in this report must be re-visited during detailed building design to confirm any changes that may be required to the FUS calculations.

A hydrant flow and pressure test was conducted on the existing 300mm watermain on Welham Road, at the nearest hydrant to the west of the subject site in order verify the available level of service within the municipal system in relation to the expected demand calculated for the site. Corix Services conducted hydrant testing on this main on June 4, 2020 with results presented in **Appendix D3**. Based on these results, and utilizing the calculation method of the National Fire Protection Agency ('NFPA'), we have determined that the available flow from this main at the minimum residual pressure of 20 psi (~140kPa) would be approximately **4967 USGPM**, which is greater than the governing maximum day plus fire flow demand. As such, the existing municipal system should provide a sufficient level of service to meet the water demand of the proposed development. The fire protection designer for the proposed industrial building will be required to confirm this upon detailed design of the fire suppression system. Refer to **Appendix D2** for Fire Underwriter Survey calculations and NFPA theoretical flow calculations.

5.0 CONCLUSIONS

This report presents a site servicing strategy for the proposed development that addresses the requirements of the applicable design guidelines and provides the basis for detailed servicing design. The key points are summarized as follows:

Stormwater Management:

- The development proposed a new 450 mm diameter stormwater connection to existing MH101 in Welham Road.
- Storm sewers within the proposed development area have been sized to accommodate the 5-year storm event.
- Storm flows to Welham Road will be attenuated to pre-development flows for all storms from the 2-year to 100-year storm event. All flows from an area of 1.73 ha of the site will be captured and controlled up to the 100-year storm . The quantity control will be achieved by the installation of a 180 mm diameter orifice plate at the storm outlet from the site and the use of roof storage, pipe and manhole storage, and the installation of 328 m3 of underground storage StormTrap storage unit.
- A proposed infiltration trench with an effective storage volume of 112.9 m3 will infiltrate roof water from the proposed building to meet pre-development infiltration volumes.
- A bioswale for filtration only is proposed on-site to provide water treatment through filtration media to meet volume control and phosphorous removal targets on-site
- Permeable paver for filtration only are to be installed on the site for quality control including phosphorous removal.
- Through the LID measures proposed it is possible to retain/filtrate 13.4 mm of annual rainfall on site.
- The infiltration trench provides sufficient infiltration to maintain the pre-development infiltration level.
- An end-of-series StormFilter unit with phosphorous media filters provides the required TSS and phosphorus removal for the subject site.

- Through the LID measures and the proposed stormFilter unit proposed, approximately 82.0% of the post-development phosphorous load is removed.

Sanitary Servicing:

- The development proposes a 150 mm diameter connection to the existing on-site sanitary sewer. This sewer connects to a manhole that conveys flows downstream via a 750 mm diameter sanitary sewer in Welham Road.
- The proposed building conveys an estimated 0.60 l/s of flows, which is 0.076% of the capacity of the receiving municipal sanitary sewer.
- The minimal increase in sanitary flow to the large sanitary sewer in Welham Road does not require a hydraulic analysis.

Water Servicing:

- New 50 mm domestic and 200 mm fire connections are proposed for the new industrial building.
- A new hydrant is proposed near the fire department connection on the north side of the proposed building.
- Water demand calculations estimate maximum day plus fire flow of 10,051 l/min or 2,655 USGPM.
- Single port fire flow testing of a nearby hydrant resulted in a calculated flow rate at the minimum pressure (20psi/140kPa) of approximately 4967 USGPM.

We trust this report sufficiently addresses the site servicing requirements in support of the proposed site plan control application associated with the subject site. Please contact the undersigned with any questions or comments.

Sincerely,

Counterpoint Engineering Inc.

Jake Howkins, P.Eng.
Direct: (905) 326-3092
Email: jhowkins@counterpointeng.com

Gherard Rouby, P.Eng.
Direct: 926-326-3080
E-mail: grouby@counterpointeng.com

APPENDICES

Appendix A

Site Plan Prepared by JNC Architects Inc.
Topo prepared by Rudy Mak Surveying Ltd.

SKETCH SHOWING TOPOGRAPHIC INFORMATION OF

PART OF LOTS 9 AND 10
CONCESSION 12

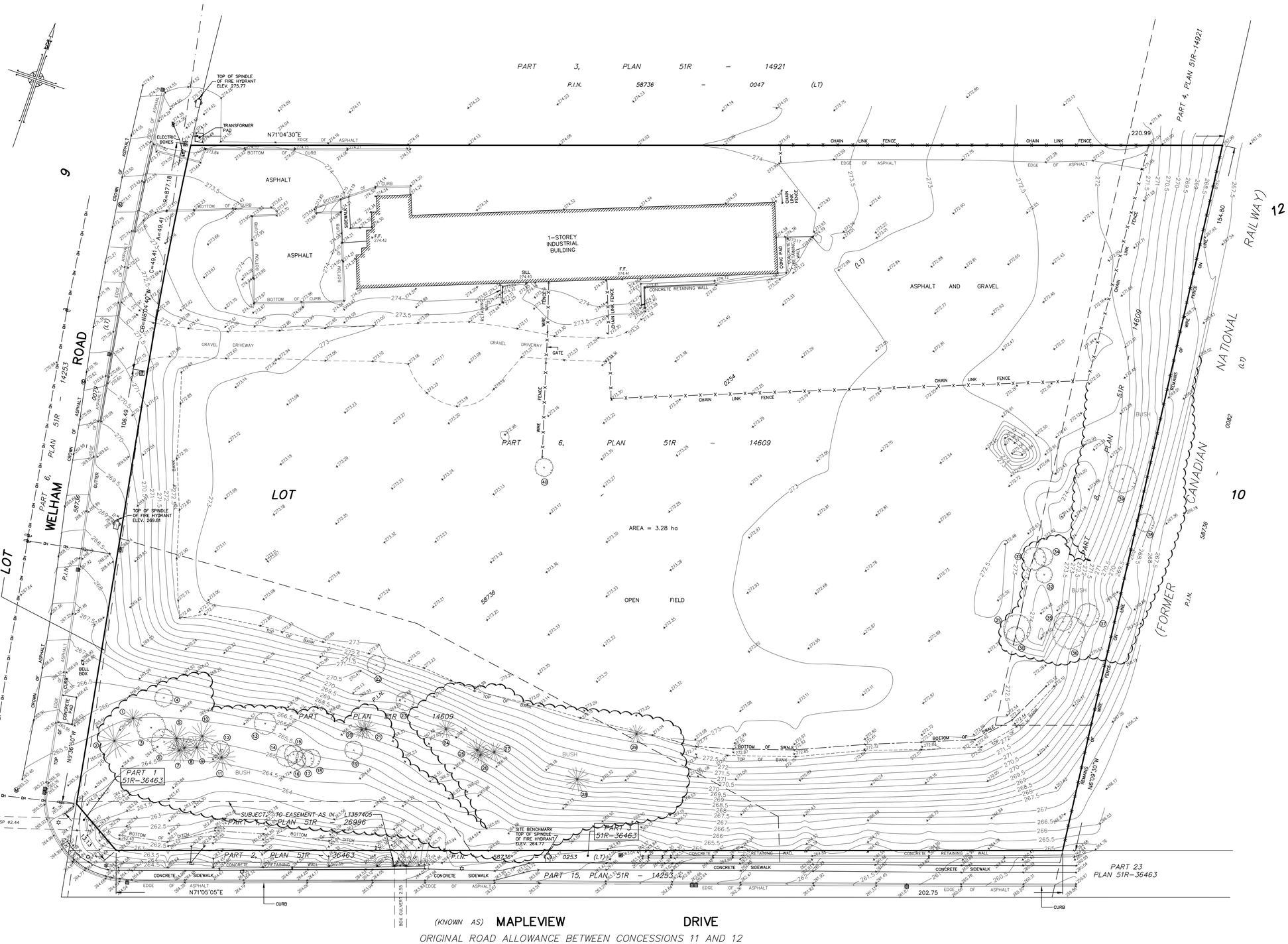
GEOGRAPHIC TOWNSHIP OF INNISFIL

CITY OF BARRIE
COUNTY OF SIMCOE

SCALE 1 : 400

5 0 5 20 40
metres

RUDY MAK SURVEYING LTD.



BOUNDARY NOTE:

BEARINGS AND DISTANCES WERE TAKEN FROM PLAN OF SURVEY BY R.C. RAIKES, O.L.S., DATED JULY 1, 1986.

CAUTION:

THIS IS NOT A PLAN OF SURVEY AND SHALL NOT BE USED EXCEPT FOR THE PURPOSE INDICATED IN THE TITLE BLOCK.

ELEVATION

ELEVATION ARE GEODETIC IN ORIGIN AND WERE DERIVED FROM SPECIFIED CONTROL POINTS 0011971:3848 (ELEVATION=261.68, CGVD–1928:1978) AND 03120030030 (ELEVATION=287.04, CGVD–1928:1978).

BENCHMARK

SITE BENCHMARK IS THE TOP OF SPINDLE OF THE THE FIRE HYDRANT AT THE NORTH SIDE OF MAPLEVIEW DRIVE HAVING AN ELEVATION OF 264.77.

NOTES:

THIS TOPOGRAPHIC SURVEY PLAN DELINEATES THE FEATURES AS SHOWN AND VISIBLE, GIVEN THE SITE CONDITIONS. CONSTRUCTION ACTIVITY, FROZEN GROUND, SNOW COVER, ETC. MAY HAVE HIDDEN FEATURES OTHERWISE VISIBLE. THE LOCATION OF UNDERGROUND SERVICES, IF SHOWN, WAS DERIVED FROM PLANS OBTAINED FROM OTHER AGENCIES. RUDY MAK SURVEYING CANNOT BE HELD RESPONSIBLE FOR THE LOCATION AND ACCURACY OF UNDERGROUND SERVICES. THE LOCATION OF ALL SERVICES MUST BE VERIFIED ON SITE. ONLY A SIGNED AND SEALED PAPER COPY OF THIS SURVEY IS AN ORIGINAL COPY. NO DIGITAL VERSION OF THIS PLAN IS TO BE CONSIDERED "ORIGINAL" AND MAY HAVE BEEN ALTERED BY OTHERS.

LEGEND

–x–x–	DENOTES FENCING
Ⓜ	DENOTES MANHOLE
▣	DENOTES COMMUNICATIONS BOX
☼	DENOTES LIGHT STANDARD
○	DENOTES UTILITY POLE
⟶	DENOTES GUY WIRE
—OH—	DENOTES OVERHEAD WIRES
▤	DENOTES CATCH BASIN
	DENOTES FIRE HYDRANT
FF	DENOTES FINISHED FLOOR
	DENOTES DECIDUOUS TREE
	DENOTES CONIFEROUS TREE

NOTE:

SEE TREE INVENTORY PROVIDED BY P & A URBAN FORESTRY CONSULTING LTD. DATED FEBRUARY, 2020 FOR TREES ① TO ㊷ .

METRIC

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

REVISION	BY	DATE
FIRST ISSUE	HFD	FEB. 19/20

RUDY MAK SURVEYING LTD.
ONTARIO LAND SURVEYORS
89 BIG BAY POINT ROAD
BARRIE, ONTARIO L4N 8M5 (705) 722–3845
E–MAIL MAIL@MAKSURVEYING.COM

DRAWN BY: HFD | CHECK BY: RAP | FILE No. 14123

SURVEY INFORMATION

INFORMATION FOR THIS SITE PLAN WAS TAKEN FROM THE FOLLOWING SURVEY:

PART OF LOTS 9 AND 10, CONCESSION 12,
TOWNSHIP OF INNISFIL CITY OF BARRIE
COUNTY OF SIMCOE

RUDY MAC SURVEYING LTD.
ONTARIO LAND SURVEYORS
89 BIG BAY POINT ROAD BARRIE,
ONTARIO L4N 8M5
(705) 722-3845

OBSERVED REFERENCE POINTS (ORPs) DERIVED FROM GPS OBSERVATIONS USING THE LEICA SMARTNET NETWORK,UTM ZONE 17, NAD 83 (CSRS) (2010 EPOCH).
COORDINATES TO URBAN ACCURACY PER SEC. 14 (2) OF O.REG. 216/10

POINT ID	NORTHING	EASTING
ORP A	606019.35	4910543.31
ORP B	606228.38	4910614.97

COORDINATES CANNOT, IN THEMSELVES, BE USED TO RE-ESTABLISH CORNERS OR BOUNDARIES SHOWN ON THE PLAN.

DEVELOPMENT STATISTICS

	PRE-CONSTRUCTION SITE	POST-CONSTRUCTION SITE
BUILDING AREA/ COVERAGE	1,376sm	6,280sm
IMPERVIOUS AREA	7,043sm	12,659sm
LANDSCAPE AREA	16,145sm	5,625sm
SITE AREA TOTAL: GI ZONE 24,564sm	24,564sm	24,564sm

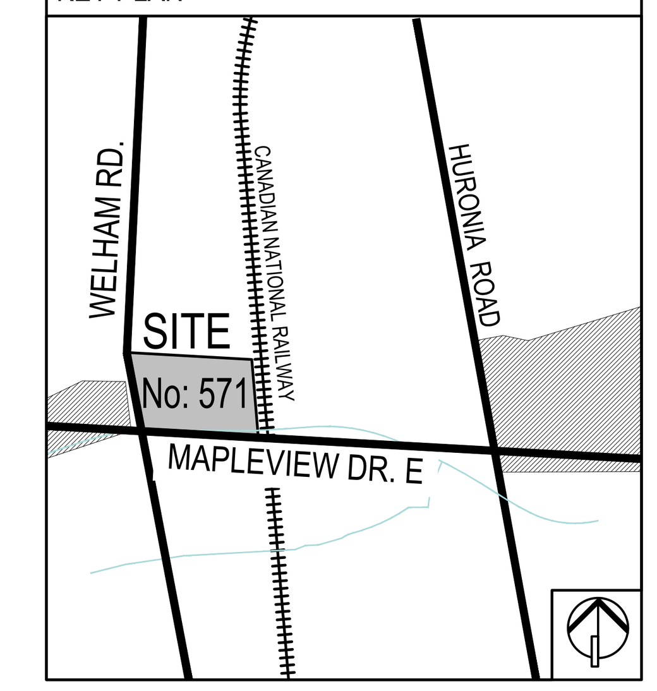
PROPOSED BUILDING STATISTICS / OBC

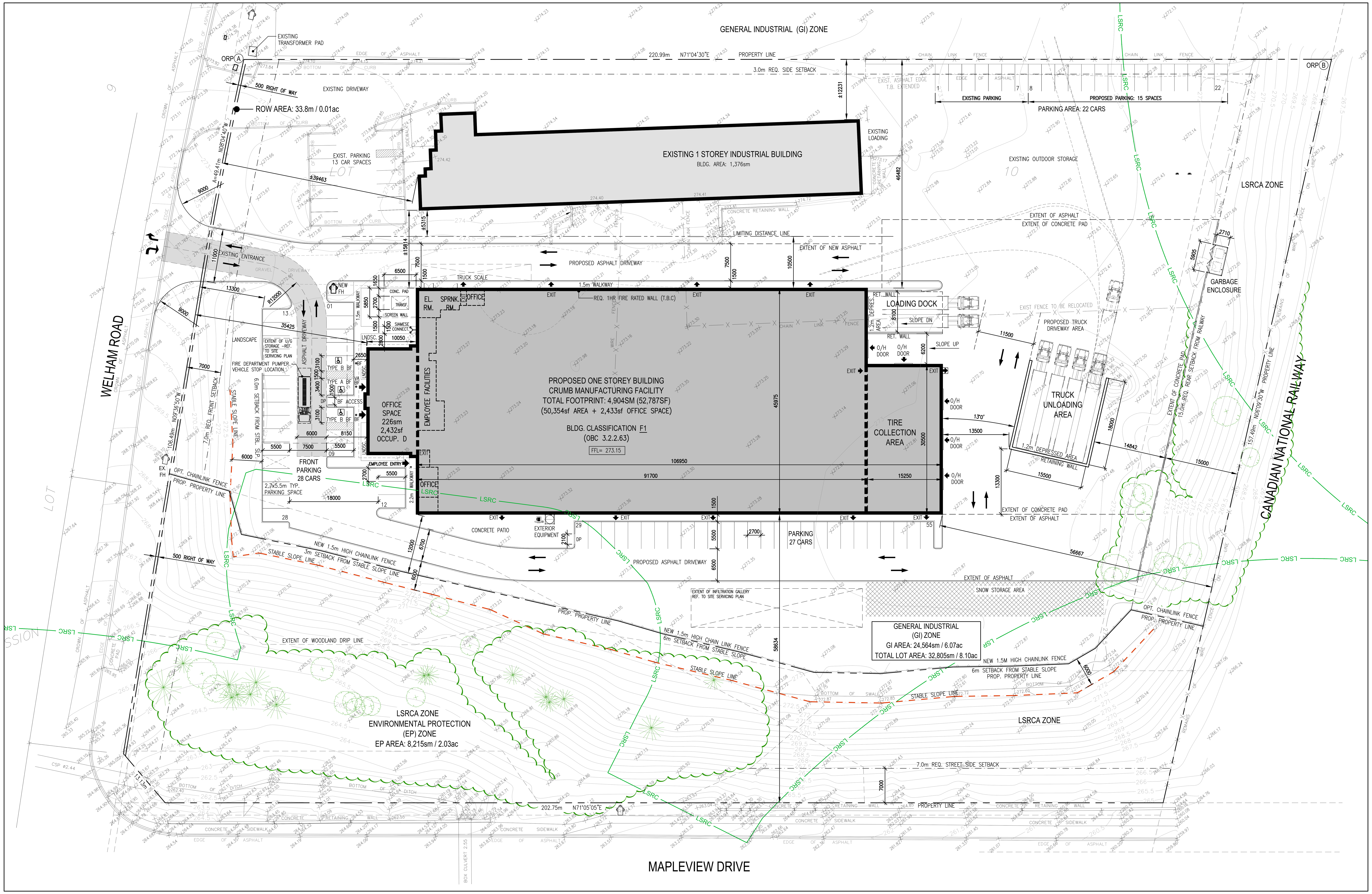
- BLDG. CLASSIFICATION: OBC 3.2.2.63: GROUP F, DIVISION 1, ONE STOREY
- ACCESSORY CLASSIFICATION – OCCUPANCY D (OFFICES)
- NONCOMBUSTIBLE CONSTRUCTION
- SPRINKLERED BUILDING

ZONING STANDARDS MATRIX

	ZONING BY-LAW 2009-141	EXISTING	PROPOSED
1. ZONING	GENERAL INDUSTRIAL (GI) w/ PORTION ENVIRONMENTAL PROTECTION (EP)	EXISTING INDUSTRIAL BUILDING	PROPOSED CRUMB MANUFACTURING FACILITY – GI ZONE
2. SITE AREA	MIN. 700sm	32,805sm /8.10ac	24,564sm /6.07ac
3. LOT FRONTAGE	MIN. 30m	155.91m	85.5m
4. SETBACKS	NORTH (INTERIOR SIDE YARD)– 3.0m SOUTH (EXTERIOR SIDE YARD)– 10.0m WEST (FRONT YARD)– 7.0m EAST (REAR YARD)– 15.0m	NORTH SIDE YARD– ±12.23m WEST (FRONT YARD)– ±39.46m	NORTH (INTERIOR SIDE YARD)– 46.48m SOUTH (INTERIOR SIDE YARD)– 12.00m WEST (FRONT YARD)– 35.42m EAST (REAR YARD)– 56.66m
5. COVERAGE	MAX. 60%	EXIST. BLDG. AREA –1,376sm (14,811sf)	25.6% (6,280sm) – COVERAGE EXIST. BUILDING – 1,376sm (14,811sf) PROP. MANUFAC. FACILITY – 4,904sm (52,787sf) TOTAL COVERED AREA – 6,280sm (67,598sf)
6. BUILDING HEIGHT	NO LIMIT	EXIST. 1 STOREY BLDG, BLDG. HEIGHT: ±5.2m	PROPOSED 1 STOREY BLDG. HEIGHT: 8.9m
7. GFA	N/A	BLDG. GFA – 1,376sm (14,811sf)	EXIST. BLDG. GFA – 1,376sm (14,811sf) PROP. MANUFAC. FACILITY – 4,904sm (52,787sf) PROP. STORAGE MEZZANINE – 165sm (1,776sf) TOTAL PROP. GFA – 6,445sm (69,374sf)
8. PARKING	EXIST. INDUSTRIAL BUILDING: 1 SPACE /70sm PARKING REQUIRED: 19.6 SPACES BF PARKING – 1 SPACE (INC.) PROPOSED BUILDING: MANUFACTURING FACILITY 1 SPACE / 70sm PARKING REQUIRED – 70 SPACE (4,904sm / 70sm = 70) BF PARKING – 3 SPACES (INCL.)	EXISTING PARKING: 20 SPACES BF PARKING – 1 SPACE (EXIST.)	EXIST. PARKING: 20 SPACES PARKING PROVIDED: 70 SPACES **TOTAL SITE PARKING PROVIDED: 90 SPACES** BF PARKING: EXISTING: 1 SPACE (INCL.) PROPOSED: 3 SPACES (INCL.)
9. LOADING	B/W 3,000sm–7,499sm OF GFA: REQ. 2 LOADING SPACES		PROVIDED – 6 SPACES

KEY PLAN





LEGEND

- EXISTING BUILDING
- PROP. BUILDING
- PROPERTY LINE
- ZONING ENVELOPE
- LSRC — EXTENT OF LSRCA ZONE
- STABLE SLOPE LINE
- PROP. FIRE ROUTE 6m (W) x 64.5m (L)
- TWO-WAY TRAFFIC
- DP — CURB DEPRESSION BARRIE FREE ACCESS
- BF — BARRIER FREE PARKING SIGN
- VA — "VAN ACCESSIBLE" BF PARKING SIGN

SURVEY INFORMATION

PLAN OF SURVEY
PART OF LOT 9 & 10,
CONCESSION 12
CITY OF BARRIE

DATED: OCT.02.2020
RUDY MAK SURVEYING
ONTARIO LAND SURVEYORS

89 BIG BAY POINT ROAD
BARRIE, ONTARIO L4N 8M5
TEL: (705) 722-3845
E-MAIL: MAIL@MAKSURVEYING.COM

GENERAL NOTES

1. ALL DRAWING DOCUMENTS LISTED IN THIS SET ARE FOR INFORMATION PURPOSES ONLY.
2. ALL SITE BOUNDARY AND PERIMETER INFORMATION INDICATED IN THIS SITE PLAN WAS TAKEN FROM SURVEY DRAWING AS NOTED.
3. EXISTING BUILDING INFORMATION USED IN THIS DOCUMENTATION WAS TAKEN FROM ARCHITECT. DRAWINGS, PREPARED BY: IAN S. MALCOLM ARCHITECT, DATED MARCH 1989
4. THESE DRAWINGS ARE NOT TO BE USED FOR CONSTRUCTION. ALL AREAS AND DIMENSIONS TO BE SITE VERIFIED PRIOR TO ANY WORK.

PROJECT
INDUSTRIAL DEVELOPMENT
PROPOSED
CRUMB MANUFACTURING FACILITY
571 WELHAM RD.
BARRIE, ON

CLIENT
E360S ENVIRONMENTAL 360 SOLUTIONS
Trusted Environmental Management

CONSULTANTS

ARCHITECT

JOSEPH N CAMPITELLI
ARCHITECT INC.
10 Bur Oak Avenue, Unit 3, Markham, ON L6C 0A2
tel: 905-887-8900 fax: 905-887-9400
e-mail: info@jnc-architect.com

LEGAL

COUNTERSIGNED
Joseph N. Campitelli, Architect
B.ARCH., O.A.A., M.R.A.I.C.

DATE

DWG. ISSUES

1.	FEB.11.2020	DS ISSUED FOR COORDINATION	RD
2.	MAY.15.2020	DS RE-ISSUED FOR COORDINATION	RD
3.	MAY.22.2020	ISSUED FOR STABLE SLOPE REVIEW	RD
4.	MAY.26.2020	ISSUED FOR COORDINATION	RD
5.	JUN.01.2020	ISSUED FOR COORDINATION	RD
6.	JUL.07.2020	ISSUED FOR SPA APPLICATION	RD
7.	OCT.14.2020	REVISED FOR SPA APPLICATION	RD

DESCRIPTION
PRE-CON FILE NO: D28-043-2019

LEGAL

INFO
PROJECT ARCHITECT: J. CAMPITELLI
ASSISTANT DESIGNER:
DRAWN BY: RD
CHECKED BY: J.C.

DWG. TITLE
PROPOSED SITE PLAN

SCALE	DATE PRINTED	PROJECT NO.
1:400	OCT.14.2020	270.19.D

SHEET NO.
A.100

Appendix B1

2-100 year Allowable Release Rate to Welham Road (Rational Method)

counterpoint engineering

Allowable Release Rate to Culvert

Project Name: 571 Welham Road

Project Number: 20005

Rational Method - 2 Year Predevelopment

Event:		2	years
ABC's:	A	678.085	
	B	4.699	
	C	0.781	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.47	
Site Area	A	0.91	ha
Intensity $i=A/(T)^c$	i	83.11	mm/hr
Flow Q=CiA/360	Q	0.099	m^3/s
		99.0	**l/s**

Rational Method - 5 Year Predevelopment

Event:		5	years
ABC's:	A	853.608	
	B	4.699	
	C	0.766	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.47	
Site Area	A	0.91	ha
Intensity $i=A/(T)^c$	i	108.92	mm/hr
Flow Q=CiA/360	Q	0.13	m^3/s
		129.7	l/s

Rational Method - 10 Year Predevelopment

Event:		10	years
ABC's:	A	975.865	
	B	4.699	
	C	0.76	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.47	
Site Area	A	0.91	ha
Intensity $i=A/(T)^c$	i	126.55	mm/hr
Flow Q=CiA/360	Q	0.15	m^3/s
		150.7	l/s

Rational Method - 25 Year Predevelopment

Event:		25	years
ABC's:	A	1146.275	
	B	4.922	
	C	0.757	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.52	
Site Area	A	0.91	ha
Intensity $i=A/(T)^c$	i	148.15	mm/hr
Flow Q=CiA/360	Q	0.19	m^3/s
		194.0	l/s

Rational Method - 50 Year Predevelopment

Event:		50	years
ABC's:	A	1236.152	
	B	4.699	
	C	0.751	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.56	
Site Area	A	0.91	ha
Intensity $i=A/(T)^c$	i	164.22	mm/hr
Flow Q=CiA/360	Q	0.23	m^3/s
		234.6	l/s

Rational Method - 100 Year Predevelopment

Event:		100	years
ABC's:	A	1426.408	
	B	5.273	
	C	0.759	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.59	
Site Area	A	0.91	ha
Intensity $i=A/(T)^c$	i	180.15	mm/hr
Flow Q=CiA/360	Q	0.27	m^3/s
		268.1	l/s

Pre-development Area 100

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.62	0.25	0.1550
Building/Impervious Area	0.29	0.95	0.2774
	0.91	Total	0.4324
		Divided by Total Area	0.47

max 0.95

Appendix B2

Storm Design Sheet

Counterpoint Engineering Inc.

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Project: 571 Welham Road
Project No: 20005
Location: Barrie, ON
Prepared by: GR
Checked by: JH
Date: November 19, 2020

Rainfall Data: a, b, c Values

	5 year
a	853.61
b	4.699
c	0.766

Manning's Roughness Coefficient (All pipes)= 0.013

1	2	4	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Notes	From Node	To Node	Diam. (nominal)	Length Pipe	Slope Pipe	Area	C	A x C	Accum AxC	Rainfall Intensity	Time of Conc. (Tc)	Area Flow Q	Controlled Flows	Total Flow	Diameter Actual	Pipe Area	Hydraulic Radius	Pipe Mat.	Pipe Capacity	Velocity	Time of Flow	Ratio Q/Q full	Cap. Check
			(mm)	(m)	(%)	(ha)		(ha)	(ha)	mm/hr	(min)	(l/s)	(l/s)	(l/s)	(m)	(sq.m)	(m)		(l/s)	(m/s)	(min)		
112-111	MH112	MH111	450	29.0	0.50%	0.439	0.93	0.407	0.407	108.9	10.00	123.0	0.0	123.0	0.448	0.16	0.112	PVC	199.2	1.26	0.38	0.62	OK
	MH111	CBMH110	450	69.1	0.50%	0.000	0.00	0.000	0.407	106.8	10.38	120.6	0.0	120.6	0.448	0.16	0.112	PVC	199.2	1.26	0.91	0.61	OK
110-109	CBMH110	CBMH109	450	23.6	0.50%	0.125	0.78	0.097	0.503	102.1	11.29	142.8	0.0	142.8	0.448	0.16	0.112	PVC	199.2	1.26	0.31	0.72	OK
109-108	CBMH109	CBMH108	450	33.0	1.00%	0.052	0.79	0.041	0.545	100.6	11.60	152.3	0.0	152.3	0.448	0.16	0.112	PVC	281.7	1.79	0.31	0.54	OK
108-102	CBMH108	MH102	450	10.0	2.00%	0.117	0.81	0.094	0.639	99.2	11.91	176.0	0.0	176.0	0.448	0.16	0.112	PVC	398.4	2.53	0.07	0.44	OK
114-105	CBMH114	MH105	375	78.6	0.50%	0.330	0.66	0.217	0.217	108.9	10.00	65.7	0.0	65.7	0.381	0.11	0.095	PVC	129.3	1.13	1.15	0.51	OK
BDG-107	BDLG	MH107	375	19.4	2.00%	0.490	0.95	0.466	0.000	108.9	10.00	0.0	24.3	24.3	0.381	0.11	0.095	PVC	258.7	2.27	0.14	0.09	OK
	MH107	MH106	450	43.5	0.40%	0.000	0.00	0.000	0.000	108.1	10.14	0.0	24.3	24.3	0.448	0.16	0.112	PVC	178.2	1.13	0.64	0.14	OK
	MH106	MH105	450	16.2	0.50%	0.000	0.00	0.000	0.000	104.7	10.78	0.0	24.3	24.3	0.448	0.16	0.112	PVC	199.2	1.26	0.21	0.12	OK
105-104	MH105	MH104	525	55.9	0.50%	0.084	0.69	0.058	0.275	102.8	11.15	78.6	24.3	102.9	0.533	0.22	0.133	CONC	317.2	1.42	0.66	0.32	OK
	MH104	MH103	525	12.6	0.50%	0.000	0.00	0.000	0.275	99.6	11.81	76.2	24.3	100.5	0.533	0.22	0.133	CONC	317.2	1.42	0.15	0.32	OK
103-102	MH103	Storage Tank	525	1.9	1.00%	0.093	0.82	0.076	0.351	99.0	11.96	96.6	24.3	120.9	0.533	0.22	0.133	CONC	448.7	2.01	0.02	0.27	OK
103-102	Storage Tank	MH102	525	2.6	1.00%	0.000	0.00	0.000	0.351	98.9	11.97	96.6	24.3	120.9	0.533	0.22	0.133	CONC	448.7	2.01	0.02	0.27	OK
	MH102	Stormfilter	450	7.1	0.50%	0.000	0.00	0.000	0.000	99.0	11.96	0.0	68.5	68.5	0.448	0.16	0.112	PVC	199.2	1.26	0.09	0.34	OK
	Stormfilter	MH101	450	6.4	0.50%	0.000	0.00	0.000	0.000	98.5	12.05	0.0	68.5	68.5	0.448	0.16	0.112	PVC	199.2	1.26	0.08	0.34	OK
	MH101	*EX.MH101*	450	20.6	2.00%	0.000	0.00	0.000	0.000	98.2	12.14	0.0	68.5	68.5	0.448	0.16	0.112	PVC	398.4	2.53	0.14	0.17	OK

Note: MH102 to MH101 controlled "Other Flows" is the design controlled flow downstream of the orifice plate at MH102 during the 5-year storm event.

Appendix B3

Post Development Uncontrolled Release Rate to Welham Road

counterpoint engineering

Uncontrolled Release Rate to Welham Road

Project Name: 571 Welham Road

Project Number: 20005

Rational Method - 2 Year Predevelopment

Event:		2	years
ABC's:	A	678.085	
	B	4.699	
	C	0.781	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.76	
Site Area	A	0.230	ha
Intensity $i=A/(T)^c$	i	83.11	mm/hr
Flow	Q	0.040	m^3/s
Q=CiA/360		**40.4**	**l/s**

Rational Method - 5 Year Predevelopment

Event:		5	years
ABC's:	A	853.608	
		4.699	
	C	0.766	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.76	
Site Area	A	0.23	ha
Intensity $i=A/(T)^c$	i	108.92	mm/hr
Flow	Q	0.05	m^3/s
Q=CiA/360		52.9	l/s

Rational Method - 10 Year Predevelopment

Event:		10	years
ABC's:	A	975.865	
		4.699	
	C	0.76	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.76	
Site Area	A	0.23	ha
Intensity $i=A/(T)^c$	i	126.55	mm/hr
Flow	Q	0.06	m^3/s
Q=CiA/360		61.4	l/s

Rational Method - 25 Year Predevelopment

Event:		25	years
ABC's:	A	1146.275	
		4.922	
	C	0.757	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.84	
Site Area	A	0.23	ha
Intensity $i=A/(T)^c$	i	148.15	mm/hr
Flow	Q	0.08	m^3/s
Q=CiA/360		79.1	l/s

Rational Method - 50 Year Predevelopment

Event:		50	years
ABC's:	A	1236.152	
		4.699	
	C	0.751	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.91	
Site Area	A	0.23	ha
Intensity $i=A/(T)^c$	i	164.22	mm/hr
Flow	Q	0.10	m^3/s
Q=CiA/360		95.7	l/s

Rational Method - 100 Year Predevelopment

Event:		100	years
ABC's:	A	1426.408	
		5.273	
	C	0.759	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.95	
Site Area	A	0.23	ha
Intensity $i=A/(T)^c$	i	180.15	mm/hr
Flow	Q	0.11	m^3/s
Q=CiA/360		109.3	l/s

Appendix B4

Modified Rational Calculations for 2 to 100 year Storm Events

Project: **Welham Road**
Project No: **20005**
Location: **City of Barrie, Ontario**
Prepared by: **GR**
Date: **November 18,2020.**

Proposed Building Welham Road
Roof Control Calculations

Area= 4,901 m^2

PROPOSED BUILDING ROOF CONTROL						
Type of Drain	Roof Slope (%)	# of Roof Drains	Max. Ponding Depth (m)	Max. Storage (m^3)	Storage Volume at 100-year Event (m^3)	Estimated Drawdown Time (hrs)
7 units of Zurn Z-105 "Control-Flo" with 4 notches each	0.76%	7	0.100	163.4	161	9.00

Parameters:

Total Area	4,901	m2	
Type of Drain	Zurn Z-105 "Control-Flo"		
# Drains	7		
Area per Drain	700	m2	
Depth to Spill	0.100	m2	
Flow per cm of Depth per Notch	0.1494	l/s/cm head	
Average Side Length	13.23	m	
Slope	0.76%		
Vo Max. Roof	163.4	m3	
$V_{100\text{ -year}}$	161.0	m3	
$V_{100\text{ -year}}$/drain	23.0	m3	
Drawdown Time	9.00	hrs	(Pro-rated as per Zurn tables)
Number of Notches	28.00		(4 notches per drain)
Max. Flow for Roof (10 cm, 28 Notches)	41.794	l/s	
Max. Flow per ha (28 Notches)	85.276	l/s	

Storage and Flows for Different Depths of Ponding

Event	Storage	Depth	Flow
0.01m Depth	16	0.01	4.18
0.02m Depth	33	0.02	8.37
0.03m Depth	49	0.03	12.55
0.04m Depth	65	0.04	16.73
0.05m Depth	82	0.05	20.92
0.06m Depth	98	0.06	25.10
0.07m Depth	114	0.07	29.28
0.08m Depth	131	0.08	33.46
0.09m Depth	147	0.09	37.65
0.10m Depth	163	0.10	41.83
2-year	71	0.044	18.24
5-year	95	0.058	24.26
10-year	111	0.068	28.44
25-year	131	0.080	33.46
50-year	145	0.089	37.23
100-year	161	0.098	41.10

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Proposed Release Rate and Storage Requirement

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	678.085
Event	2 year	b	4.699
		c	0.781

Area ID	Area (ha)	Runoff Coefficient	t_c (min)	Storage Available (m^3)	Storage Required (m^3)	Release Rate (L/s)	Description	Release Rate (L/s)	Orifice Size (mm)
UNC	0.23	0.76	10			**40.4**	Uncontrolled	40.4	
Roof	0.49	1.00	10	71	71	18.2	Controlled Roof	18.2	
Controlled Site	1.24	0.95	12	179	178	**58.5**	Controlled Site	58.5	180
Totals:	**1.96**				**250**	**98.8**			

Allowable Release Rate = **99.0**

Run-off Coefficient Calculations

Controlled Site

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.26	0.25	0.0650
Building/Impervious Area	0.98	0.95	0.9310
	1.24	Total	0.9960
Divided by Total Area*1.25 =			0.95

max 0.95

UNC

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.112	0.25	0.0279
Impervious Area	0.114	0.95	0.1086
	0.226	Total	0.1365
Divided by Total Area*1.25 =			0.76

max 0.95

counterpoint engineering

Modified Rational **Area:** **0.49** **Roof**

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	678.085
Event	2 year	b	4.699
		c	0.781

Site Data		
Area	0.490	ha
Runoff Coefficient	1.00	
AC	0.49	
Tc	12	
Time Increment	10	
Release Rate	18.2	l/s
Storage Required	71	m^3

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
12.42	74	0.10	75	14	61	
22.42	52	0.07	94	24	70	
32.42	40	0.05	107	35	71	********
42.42	33	0.05	116	46	70	
52.42	29	0.04	123	57	66	
62.42	25	0.03	129	68	61	
72.42	23	0.03	135	79	56	
82.42	21	0.03	139	90	49	
92.42	19	0.03	144	101	43	
102.42	18	0.02	147	112	36	

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Modified Rational **Area:** **1.24** **Controlled Area (Without Controlled Roof)**

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	678.085
Event	2 year	b	4.699
		c	0.781

Site Data		
Area	1.240	ha
Runoff Coefficient	0.95	
AC	1.18	
Tc	12	
Time Increment	10	
Release Rate	58.5	l/s
Storage Required	178	m^3

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Roof Release Volume	Total Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	
12.42	74	0.24	180	14	194	44	150	
22.42	52	0.17	227	24	251	79	173	
32.42	40	0.13	257	35	292	114	178	********
42.42	33	0.11	279	46	325	149	176	
52.42	29	0.09	297	57	354	184	170	
62.42	25	0.08	311	68	379	219	160	
72.42	23	0.07	324	79	403	254	149	
82.42	21	0.07	335	90	425	289	136	
92.42	19	0.06	345	101	446	324	122	
102.42	18	0.06	355	112	466	359	107	

SWM DESIGN CALCULATIONS
Provided Storage Calculations (2-year Storm)

counterpoint engineering
Orifice Control & Detention Storage

Project Name.: 571 Welham Road
Project No.: 20005

Available Storage Underground in Sewer

UPSTREAM OF THE ORIFICE CONTROL AT MH 102 WATER ELEVATION= 269.11

From	To	Length Below HWL (m)	Diameter (mm)	Volume (m^3)
DCB 1	MH112	17.3	375	0.00
CB6	MH112	26.5	200	0.00
PLUG	MH112	33.7	200	0.00
MH112	MH111	29.0	450	0.00
PLUG	MH113	15.7	200	0.00
MH113	MH111	10.7	300	0.00
MH111	CBMH110	69.1	450	0.00
CBMH110	CBMH109	23.6	450	0.00
CBMH109	CBMH108	33.0	450	0.00
CB5	Pipe	13.4	200	0.00
CBMH109	MH102	10.0	450	1.59
CB8	MH114	6.3	200	0.00
CB2	Pipe	4.1	200	0.00
CB3	Pipe	4.0	200	0.00
MH114	MH105	78.6	375	0.00
MH106	MH105	16.2	450	0.00
CB8	MH105	4.5	200	0.00
MH105	MH104	55.9	525	0.00
MH104	MH103	12.6	525	0.00
CB4	MH103	15.2	200	0.00
MH103	StormTrap	3.7	525	0.00
StormTrap	MH102	2.6	525	0.56
Total Storage Underground in Sewers (m^3):				**2.2**

Available Storage Underground in Sewer Catchbasins & Manholes

UPSTREAM OF THE ORIFICE CONTROL AT MH 102 WATER ELEVATION= 269.11

MH	Manhole Top Elevation (m)	Low Invert Elevation (m)	Diameter (m)	Volume (m^3)
MH112	272.04	269.85	1.20	0.00
MH111	272.64	269.65	1.20	0.00
CBMH110	272.80	269.27	1.20	0.00
CBMH109	272.85	269.12	1.20	0.00
CBMH108	272.45	268.70	1.20	0.46
MH102	272.63	268.41	1.50	1.24
MH114	272.55	270.27	1.20	0.00
MH106	272.83	270.12	1.20	0.00
MH105	272.60	269.73	1.50	0.00
MH114	272.52	269.40	1.50	0.00
MH114	272.64	268.76	1.50	0.62
DCB 1	271.75	270.28	(1.2x 0.6)	0.00
CB 2	272.45	270.70	(0.6 x 0.6)	0.00
CB 3	272.37	270.62	(0.6 x 0.6)	0.00
CB 4	272.25	270.50	(0.6 x 0.6)	0.00
CB 5	272.30	270.55	(0.6 x 0.6)	0.00
CB 6	272.30	270.55	(0.6 x 0.6)	0.00
CB 7	272.34	270.59	(0.6 x 0.6)	0.00
CB 8	272.33	270.58	(0.6 x 0.6)	0.00
Total Storage Underground in CB's & MH's (m^3):				**2.3**

StormTrap Underground Storage Unit (Bottom Elevation 268.53)

Unit	Water Level	Area (m2)	Water Level Depth m	Volume (m3)
StormTrap	269.11	300	0.58	174

Total Available Underground Storage (m^3): 179
(In Sewer, Manholes and Catchbasins)

Surface Storage Used 0

Total Available Stormwter Storage (m^3): 179

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Orifice Control & Detention Storage

Project Name.: 571 Welham Road
Project No.: 20005

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

Orifice Diameter: 180 mm
Area: 0.025 m^2
g = 9.81 m/s^2
C_d = 0.62

	Stage	Head (m)	Storage (m3)	Discharge (L/s)
Invert E.L.	268.41	0.00	0	0.00
2-year W.L. Elevation	269.11	0.70	179	0.058

counterpoint engineering

Proposed Release Rate and Storage Requirement

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	853.608
Event	5 year	b	4.699
		c	0.766

Area ID	Area (ha)	Runoff Coefficient	t_c (min)	Storage Available (m^3)	Storage Required (m^3)	Release Rate (L/s)	Description	Release Rate (L/s)	Orifice Size (mm)
UNC	0.23	0.76	10			**52.9**	Uncontrolled	52.9	
Roof	0.49	1.00	10	95	95	24.3	Controlled Roof	24.3	Cont. Roof Drains
Controlled Site	1.24	0.95	12	259	259	**68.5**	Controlled Site	68.5	180
Totals:	**1.96**				**354**	**121.4**			

Allowable Release Rate = **129.7**

Run-off Coefficient Calculations

Controlled Site

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.26	0.25	0.0650
Building/Impervious Area	0.98	0.95	0.9310
	1.24	Total	0.9960
Divided by Total Area*1.25 =			0.95

max 0.95

UNC

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.112	0.25	0.0279
Impervious Area	0.114	0.95	0.1086
	0.226	Total	0.1365
Divided by Total Area*1.25 =			0.76

max 0.95

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Modified Rational **Area:** **0.49** **Roof**

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	853.608
Event	5 year	b	4.699
		c	0.766

Site Data		
Area	0.490	ha
Runoff Coefficient	1.00	
AC	0.49	
Tc	12	
Time Increment	10	
Release Rate	24.3	l/s
Storage Required	95	m^3

0

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
12.42	97	0.13	98	18	80	
22.42	68	0.09	125	33	92	
32.42	54	0.07	142	47	95	********
42.42	45	0.06	155	62	93	
52.42	39	0.05	165	76	89	
62.42	34	0.05	174	91	83	
72.42	31	0.04	181	105	76	
82.42	28	0.04	188	120	68	
92.42	26	0.03	194	135	59	
102.42	24	0.03	199	149	50	

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Modified Rational **Area:** **1.24** **Controlled Area (Without Controlled Roof)**

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	853.608
Event	5 year	b	4.699
		c	0.766

Site Data		
Area	1.240	ha
Runoff Coefficient	0.95	
AC	1.18	
Tc	12	
Time Increment	10	
Release Rate	68.5	l/s
Storage Required	259	m^3

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Roof Release Volume	Total Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	
12.42	97	0.32	237	18	255	51	204	
22.42	68	0.22	300	33	333	92	241	
32.42	54	0.18	341	47	388	133	255	
42.42	45	0.15	372	62	434	174	259	********
52.42	39	0.13	397	76	473	215	258	
62.42	34	0.11	417	91	508	256	252	
72.42	31	0.10	435	105	541	298	243	
82.42	28	0.09	451	120	571	339	233	
92.42	26	0.08	466	135	600	380	221	
102.42	24	0.08	479	149	628	421	207	

SWM DESIGN CALCULATIONS
Provided Storage Calculations (5-year Storm)

counterpoint engineering
Orifice Control & Detention Storage

Project Name.: 571 Welham Road
Project No.: 20005

Available Storage Underground in Sewer

UPSTREAM OF THE ORIFICE CONTROL AT MH 102 WATER ELEVATION= 269.37

From	To	Length Below HWL (m)	Diameter (mm)	Volume (m^3)
DCB 1	MH112	17.3	375	0.00
CB6	MH112	26.5	200	0.00
PLUG	MH112	33.7	200	0.00
MH112	MH111	29.0	450	0.00
PLUG	MH113	15.7	200	0.00
MH113	MH111	10.7	300	0.00
MH111	CBMH110	69.1	450	0.00
CBMH110	CBMH109	23.6	450	0.00
CBMH109	CBMH108	33.0	450	0.00
CB5	Pipe	13.4	200	0.00
CBMH109	MH102	10.0	450	1.59
CB8	MH114	6.3	200	0.00
CB2	Pipe	4.1	200	0.00
CB3	Pipe	4.0	200	0.00
MH114	MH105	78.6	375	0.00
MH106	MH105	16.2	450	0.00
CB8	MH105	4.5	200	0.00
MH105	MH104	55.9	525	0.00
MH104	MH103	12.6	525	0.00
CB4	MH103	15.2	200	0.00
MH103	StormTrap	3.7	525	0.80
StormTrap	MH102	2.6	525	0.56
Total Storage Underground in Sewers (m^3):				**3.0**

Available Storage Underground in Sewer Catchbasins & Manholes

UPSTREAM OF THE ORIFICE CONTROL AT MH 102 WATER ELEVATION= 269.37

MH	Manhole Top Elevation (m)	Low Invert Elevation (m)	Diameter (m)	Volume (m^3)
MH112	272.04	269.85	1.20	0.00
MH111	272.64	269.65	1.20	0.00
CBMH110	272.80	269.27	1.20	0.11
CBMH109	272.85	269.12	1.20	0.28
CBMH108	272.45	268.70	1.20	0.76
MH102	272.63	268.41	1.50	1.70
MH114	272.55	270.27	1.20	0.00
MH106	272.83	270.12	1.20	0.00
MH105	272.60	269.73	1.50	0.00
MH114	272.52	269.40	1.50	0.00
MH114	272.64	268.76	1.50	1.08
DCB 1	271.75	270.28	(1.2x 0.6)	0.00
CB 2	272.45	270.70	(0.6 x 0.6)	0.00
CB 3	272.37	270.62	(0.6 x 0.6)	0.00
CB 4	272.25	270.50	(0.6 x 0.6)	0.00
CB 5	272.30	270.55	(0.6 x 0.6)	0.00
CB 6	272.30	270.55	(0.6 x 0.6)	0.00
CB 7	272.34	270.59	(0.6 x 0.6)	0.00
CB 8	272.33	270.58	(0.6 x 0.6)	0.00
Total Storage Underground in CB's & MH's (m^3):				**3.9**

StormTrap Underground Storage Unit (Bottom Elevation 268.53)

Unit	Water Level	Area (m2)	Water Level Depth m	Volume (m3)
StormTrap	269.37	300	0.84	**252**

Total Available Underground Storage (m^3): 259
(In Sewer, Manholes and Catchbasins)

Surface Storage Used 0

Total Available Stormwter Storage (m^3): 259

counterpoint engineering

Orifice Control & Detention Storage

Project Name.: 571 Welham Road
Project No.: 20005

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

Orifice Diameter:	180	mm
Area:	0.025	m^2
g =	9.81	m/s^2
C_d =	0.62	

	Stage	Head (m)	Storage (m3)	Discharge (L/s)
Invert E.L.	268.41	0.00	0	0.00
5-year W.L. Elevation	269.37	0.96	259.3	0.068

counterpoint engineering

Proposed Release Rate and Storage Requirement

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	975.865
Event	10 year	b	4.699
		c	0.76

Area ID	Area (ha)	Runoff Coefficient	t_c (min)	Storage Available (m^3)	Storage Required (m^3)	Release Rate (L/s)	Description	Release Rate (L/s)	Orifice Size (mm)
UNC	0.23	0.76	10	0	0	**61.4**	Uncontrolled	61.4	
Roof	0.49	1.00	10	111	111	28.4	Controlled Roof	28.4	Cont. Roof Drains
Controlled Site	1.24	0.95	12	318	318	**74.9**	Controlled Site	74.9	180
Totals:	**1.96**				**429**	**136.4**			

Allowable Release Rate = **150.7**

Run-off Coefficient Calculations

Controlled Site

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.26	0.25	0.0650
Building/Impervious Area	0.98	0.95	0.9310
	1.24	Total	0.9960
Divided by Total Area*1.25 =			0.95

max 0.95

UNC

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.112	0.25	0.0279
Impervious Area	0.114	0.95	0.1086
	0.226	Total	0.1365
Divided by Total Area*1.25 =			0.76

max 0.95

counterpoint engineering

Modified Rational **Area:** **0.49** **Roof**

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	975.865
Event	10 year	b	4.699
		c	0.760

Site Data		
Area	0.490	ha
Runoff Coefficient	1.00	
AC	0.49	
Tc	12	
Time Increment	10	
Release Rate	28.4	l/s
Storage Required	111	m^3

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
12.42	113	0.15	114	21	93	
22.42	79	0.11	146	38	107	
32.42	63	0.09	166	55	111	********
42.42	52	0.07	181	72	109	
52.42	45	0.06	193	89	104	
62.42	40	0.05	204	107	97	
72.42	36	0.05	213	124	89	
82.42	33	0.04	220	141	80	
92.42	30	0.04	228	158	70	
102.42	28	0.04	234	175	59	

counterpoint engineering

Modified Rational **Area:** **1.24** **Controlled Area (Without Controlled Roof)**

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	975.865
Event	10 year	b	4.699
		c	0.760

Site Data		
Area	1.240	ha
Runoff Coefficient	0.95	
AC	1.18	
Tc	12	
Time Increment	10	
Release Rate	74.9	l/s
Storage Required	318	m^3

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Roof Release Volume	Total Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	
12.42	113	0.37	275	21	296	56	240	
22.42	79	0.26	350	38	388	101	287	
32.42	63	0.20	399	55	454	146	308	
42.42	52	0.17	435	72	508	191	317	
52.42	45	0.15	465	89	554	236	318	********
62.42	40	0.13	489	107	596	281	315	
72.42	36	0.12	511	124	634	326	309	
82.42	33	0.11	530	141	671	371	300	
92.42	30	0.10	547	158	705	416	289	
102.42	28	0.09	563	175	738	461	277	

SWM DESIGN CALCULATIONS
Provided Storage Calculations (10-year Storm)

counterpoint engineering
Orifice Control & Detention Storage

Project Name.: 571 Welham Road
Project No.: 20005

Available Storage Underground in Sewer

UPSTREAM OF THE ORIFICE CONTROL AT MH 102 WATER ELEVATION= 269.56

From	To	Length Below HWL (m)	Diameter (mm)	Volume (m^3)
DCB 1	MH112	17.3	375	0.00
CB6	MH112	26.5	200	0.00
PLUG	MH112	33.7	200	0.00
MH112	MH111	29.0	450	0.00
PLUG	MH113	15.7	200	0.00
MH113	MH111	10.7	300	0.00
MH111	CBMH110	69.1	450	0.00
CBMH110	CBMH109	23.6	450	0.00
CBMH109	CBMH108	33.0	450	0.00
CB5	Pipe	13.4	200	0.00
CBMH109	MH102	10.0	450	1.59
CB8	MH114	6.3	200	0.00
CB2	Pipe	4.1	200	0.00
CB3	Pipe	4.0	200	0.00
MH114	MH105	78.6	375	0.00
MH106	MH105	16.2	450	0.00
CB8	MH105	4.5	200	0.00
MH105	MH104	55.9	525	0.00
MH104	MH103	12.6	525	0.00
CB4	MH103	15.2	200	0.00
MH103	StormTrap	3.7	525	0.80
StormTrap	MH102	2.6	525	0.56
Total Storage Underground in Sewers (m^3):				**3.0**

Available Storage Underground in Sewer Catchbasins & Manholes

UPSTREAM OF THE ORIFICE CONTROL AT MH 102 WATER ELEVATION= 269.56

MH	Manhole Top Elevation (m)	Low Invert Elevation (m)	Diameter (m)	Volume (m^3)
MH112	272.04	269.85	1.20	0.00
MH111	272.64	269.65	1.20	0.00
CBMH110	272.80	269.27	1.20	0.33
CBMH109	272.85	269.12	1.20	0.50
CBMH108	272.45	268.70	1.20	0.97
MH102	272.63	268.41	1.50	2.03
MH114	272.55	270.27	1.20	0.00
MH106	272.83	270.12	1.20	0.00
MH105	272.60	269.73	1.50	0.00
MH114	272.52	269.40	1.50	0.28
MH114	272.64	268.76	1.50	1.41
DCB 1	271.75	270.28	(1.2x 0.6)	0.00
CB 2	272.45	270.70	(0.6 x 0.6)	0.00
CB 3	272.37	270.62	(0.6 x 0.6)	0.00
CB 4	272.25	270.50	(0.6 x 0.6)	0.00
CB 5	272.30	270.55	(0.6 x 0.6)	0.00
CB 6	272.30	270.55	(0.6 x 0.6)	0.00
CB 7	272.34	270.59	(0.6 x 0.6)	0.00
CB 8	272.33	270.58	(0.6 x 0.6)	0.00
Total Storage Underground in CB's & MH's (m^3):				**5.5**

StormTrap Underground Storage Unit (Bottom Elevation 268.53)

Unit	Water Level	Area (m2)	Water Level Depth m	Volume (m3)
StormTrap	269.56	300	1.03	309

Total Available Underground Storage (m^3): **318**
(In Sewer, Manholes and Catchbasins)

Surface Storage Used **0**

Total Available Stormwter Storage (m^3): **318**

counterpoint engineering

Orifice Control & Detention Storage

Project Name.: 571 Welham Road
Project No.: 20005

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

Orifice Diameter: 180 mm
Area: 0.025 m^2
g = 9.81 m/s^2
C_d = 0.62

	Stage	Head (m)	Storage (m3)	Discharge (L/s)
Invert E.L.	268.41	0.00	0	0.00
10-year W.L. Elevation	269.56	1.15	318.0	0.075

counterpoint engineering

Proposed Release Rate and Storage Requirement

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	1146.275
Event	25 year	b	4.922
		c	0.757

Area ID	Area (ha)	Runoff Coefficient	t_c (min)	Storage Available (m^3)	Storage Required (m^3)	Release Rate (L/s)	Description	Release Rate (L/s)	Orifice Size (mm)
UNC	0.23	0.84	10	0	0	**79.1**	Uncontrolled	79.1	
Roof	0.49	1.00	10	131	131	33.5	Controlled Roof	33.5	Cont. Roof Drains
Controlled Site	1.24	0.95	12	366	366	**92.2**	Controlled Site	92.2	185
Totals:	**1.96**				**497**	**171.3**			

Allowable Release Rate = **194.0**

Run-off Coefficient Calculations

Controlled Site

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.26	0.25	0.0650
Building/Impervious Area	0.98	0.95	0.9310
	1.24	Total	0.9960
Divided by Total Area*1.25 =			0.95

max 0.95

UNC

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.112	0.25	0.0279
Impervious Area	0.114	0.95	0.1086
	0.226	Total	0.1365
Divided by Total Area*1.25 =			0.76

0.84 (RC*1.1)

counterpoint engineering

Modified Rational **Area:** **0.49** **Roof**

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	1146.275
Event	25 year	b	4.922
		c	0.757

Site Data		
Area	0.490	ha
Runoff Coefficient	1.00	
AC	0.49	
Tc	12	
Time Increment	10	
Release Rate	33.5	l/s
Storage Required	131	m^3

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
12.42	132	0.18	134	25	109	
22.42	94	0.13	172	45	127	
32.42	74	0.10	196	65	131	********
42.42	62	0.08	214	85	129	
52.42	53	0.07	229	105	124	
62.42	47	0.06	242	125	116	
72.42	43	0.06	252	145	107	
82.42	39	0.05	262	165	96	
92.42	36	0.05	271	186	85	
102.42	33	0.05	278	206	73	

counterpoint engineering

Modified Rational **Area:** **1.24** **Controlled Area (Without Controlled Roof)**

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	1146.275
Event	25 year	b	4.922
		c	0.757

Site Data		
Area	1.240	ha
Runoff Coefficient	0.95	
AC	1.18	
Tc	12	
Time Increment	10	
Release Rate	92.2	l/s
Storage Required	366	m^3

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Roof Release Volume	Total Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	
12.42	132	0.43	323	25	348	69	279	
22.42	94	0.31	413	45	458	124	334	
32.42	74	0.24	471	65	536	179	357	
42.42	62	0.20	515	85	600	235	366	
52.42	53	0.18	551	105	656	290	366	********
62.42	47	0.16	581	125	706	345	361	
72.42	43	0.14	607	145	752	401	352	
82.42	39	0.13	630	165	795	456	339	
92.42	36	0.12	651	186	836	511	325	
102.42	33	0.11	669	206	875	566	309	

SWM DESIGN CALCULATIONS
Provided Storage Calculations (25-year Storm)

counterpoint engineering
Orifice Control & Detention Storage

Project Name.: 571 Welham Road
Project No.: 20005

Available Storage Underground in Sewer

UPSTREAM OF THE ORIFICE CONTROL AT MH 102 WATER ELEVATION= 270.15

From	To	Length Below HWL (m)	Diameter (mm)	Volume (m^3)
DCB 1	MH112	17.3	375	0.00
CB6	MH112	26.5	200	0.00
PLUG	MH112	33.7	200	0.00
MH112	MH111	29.0	450	0.00
PLUG	MH113	15.7	200	0.00
MH113	MH111	10.7	300	0.00
MH111	CBMH110	69.1	450	10.99
CBMH110	CBMH109	23.6	450	3.75
CBMH109	CBMH108	33.0	450	5.25
CB5	Pipe	13.4	200	0.00
CBMH109	MH102	10.0	450	1.59
CB8	MH114	6.3	200	0.00
CB2	Pipe	4.1	200	0.00
CB3	Pipe	4.0	200	0.00
MH114	MH105	78.6	375	0.00
MH106	MH105	16.2	450	0.00
CB8	MH105	4.5	200	0.00
MH105	MH104	55.9	525	0.00
MH104	MH103	12.6	525	2.73
CB4	MH103	15.2	200	0.00
MH103	StormTrap	3.7	525	0.80
StormTrap	MH102	2.6	525	0.56
Total Storage Underground in Sewers (m^3):				**25.7**

Available Storage Underground in Sewer Catchbasins & Manholes

UPSTREAM OF THE ORIFICE CONTROL AT MH 102 WATER ELEVATION= 270.15

MH	Manhole Top Elevation or HWL (m)	Low Invert Elevation (m)	Diameter (m)	Volume (m^3)
MH112	272.04	269.85	1.20	0.34
MH111	272.64	269.65	1.20	0.57
CBMH110	272.80	269.27	1.20	1.00
CBMH109	272.85	269.12	1.20	1.16
CBMH108	272.45	268.70	1.20	1.64
MH102	272.63	268.41	1.50	3.07
MH114	272.55	270.27	1.20	0.00
MH106	272.83	270.12	1.20	0.03
MH105	272.60	269.73	1.50	0.74
MH114	272.52	269.40	1.50	1.33
MH114	272.64	268.76	1.50	2.46
DCB 1	271.75	270.28	(1.2x 0.6)	0.00
CB 2	272.45	270.70	(0.6 x 0.6)	0.00
CB 3	272.37	270.62	(0.6 x 0.6)	0.00
CB 4	272.25	270.50	(0.6 x 0.6)	0.00
CB 5	272.30	270.55	(0.6 x 0.6)	0.00
CB 6	272.30	270.55	(0.6 x 0.6)	0.00
CB 7	272.34	270.59	(0.6 x 0.6)	0.00
CB 8	272.33	270.58	(0.6 x 0.6)	0.00
Total Storage Underground in CB's & MH's (m^3):				**12.3**

StormTrap Underground Storage Unit (Bottom Elevation 268.53)

Unit	Water Level	Area (m2)	Water Level Depth m	Volume (m3)
StormTrap	270.15	300	1.09	328

Total Available Underground Storage (m^3): 366
(In Sewer, Manholes and Catchbasins)

Surface Storage Used 0

Total Available Stormwter Storage (m^3): 366

counterpoint engineering

Orifice Control & Detention Storage

Project Name.: 571 Welham Road
Project No.: 20005

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

Orifice Diameter: 180 mm
Area: 0.025 m^2
g = 9.81 m/s^2
C_d = 0.62

	Stage	Head (m)	Storage (m3)	Discharge (L/s)
Invert E.L.	268.41	0.00	0	0.00
25-year W.L. Elevation	270.15	1.74	366	0.092

counterpoint engineering

Proposed Release Rate and Storage Requirement

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	1236.15
Event	50 year	b	4.699
		c	0.751

Area ID	Area (ha)	Runoff Coefficient	t_c (min)	Storage Available (m^3)	Storage Required (m^3)	Release Rate (L/s)	Description	Release Rate (L/s)	Orifice Size (mm)
UNC	0.23	0.91	10	0	0	**95.7**	Uncontrolled	95.7	
Roof	0.49	1.00	10	145	145	37.2	Controlled Roof	37.2	Cont. Roof Drains
Controlled Site	1.24	0.95	12	397	397	**105.5**	Controlled Site	105.5	180
Totals:	**1.96**				**541**	**201.2**			

Allowable Release Rate = **234.6**

Run-off Coefficient Calculations

Controlled Site

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.26	0.25	0.0650
Building/Impervious Area	0.98	0.95	0.9310
	1.24	Total	0.9960
Divided by Total Area*1.25 =			0.95

max 0.95

UNC

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.112	0.25	0.0279
Impervious Area	0.114	0.95	0.1086
	0.226	Total	0.1365
Divided by Total Area*1.25 =			0.76

0.91 (RC*1.20)

counterpoint engineering

Modified Rational **Area:** **0.49** **Roof**

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	1236.150
Event	50 year	b	4.699
		c	0.751

Site Data		
Area	0.490	ha
Runoff Coefficient	1.00	
AC	0.49	
Tc	12	
Time Increment	10	
Release Rate	37.2	l/s
Storage Required	145	m^3

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
12.42	146	0.20	149	28	121	
22.42	104	0.14	190	50	140	
32.42	82	0.11	217	72	145	********
42.42	68	0.09	237	95	143	
52.42	59	0.08	254	117	137	
62.42	52	0.07	268	139	128	
72.42	47	0.06	280	162	118	
82.42	43	0.06	291	184	107	
92.42	40	0.05	300	206	94	
102.42	37	0.05	309	229	81	

counterpoint engineering

Modified Rational **Area:** **1.24** **Controlled Area (Without Controlled Roof)**

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	1236.150
Event	50 year	b	4.699
		c	0.751

Site Data		
Area	1.240	ha
Runoff Coefficient	0.95	
AC	1.18	
Tc	12	
Time Increment	10	
Release Rate	105.5	l/s
Storage Required	397	m^3

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Roof Release Volume	Total Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	
12.42	146	0.48	357	28	385	79	307	
22.42	104	0.34	457	50	507	142	365	
32.42	82	0.27	522	72	594	205	389	
42.42	68	0.22	571	95	665	269	397	********
52.42	59	0.19	610	117	727	332	396	
62.42	52	0.17	644	139	783	395	388	
72.42	47	0.15	673	162	835	459	376	
82.42	43	0.14	699	184	883	522	361	
92.42	40	0.13	722	206	929	585	344	
102.42	37	0.12	744	229	972	648	324	

SWM DESIGN CALCULATIONS
Provided Storage Calculations (50-year Storm)

counterpoint engineering
Orifice Control & Detention Storage

Project Name.: 571 Welham Road
Project No.: 20005

Available Storage Underground in Sewer

UPSTREAM OF THE ORIFICE CONTROL AT MH 102 WATER ELEVATION= 270.69

From	To	Length Below HWL (m)	Diameter (mm)	Volume (m^3)
DCB 1	MH112	17.3	375	1.91
CB6	MH112	26.5	200	0.00
PLUG	MH112	33.7	200	1.06
MH112	MH111	29.0	450	4.61
PLUG	MH113	15.7	200	0.00
MH113	MH111	10.7	300	0.76
MH111	CBMH110	69.1	450	10.99
CBMH110	CBMH109	23.6	450	3.75
CBMH109	CBMH108	33.0	450	5.25
CB5	Pipe	13.4	200	0.00
CBMH109	MH102	10.0	450	1.59
CB8	MH114	6.3	200	0.00
CB2	Pipe	4.1	200	0.00
CB3	Pipe	4.0	200	0.00
MH114	MH105	78.6	375	0.00
MH106	MH105	16.2	450	2.58
CB8	MH105	4.5	200	0.00
MH105	MH104	55.9	525	12.10
MH104	MH103	12.6	525	2.73
CB4	MH103	15.2	200	0.00
MH103	StormTrap	3.7	525	0.80
StormTrap	MH102	2.6	525	0.56
Total Storage Underground in Sewers (m^3):				**48.7**

Available Storage Underground in Sewer Catchbasins & Manholes

UPSTREAM OF THE ORIFICE CONTROL AT MH 102 WATER ELEVATION= 270.69

MH	Manhole Top Elevation (m)	Low Invert Elevation (m)	Diameter (m)	Volume (m^3)
MH112	272.04	269.85	1.20	0.95
MH111	272.64	269.65	1.20	1.18
CBMH110	272.80	269.27	1.20	1.61
CBMH109	272.85	269.12	1.20	1.78
CBMH108	272.45	268.70	1.20	2.25
MH102	272.63	268.41	1.50	4.03
MH114	272.55	270.27	1.20	0.48
MH106	272.83	270.12	1.20	0.64
MH105	272.60	269.73	1.50	1.70
MH114	272.52	269.40	1.50	2.28
MH114	272.64	268.76	1.50	3.41
DCB 1	271.75	270.28	(1.2x 0.6)	0.30
CB 2	272.45	270.70	(0.6 x 0.6)	0.00
CB 3	272.37	270.62	(0.6 x 0.6)	0.03
CB 4	272.25	270.50	(0.6 x 0.6)	0.07
CB 5	272.30	270.55	(0.6 x 0.6)	0.05
CB 6	272.30	270.55	(0.6 x 0.6)	0.05
CB 7	272.34	270.59	(0.6 x 0.6)	0.04
CB 8	272.33	270.58	(0.6 x 0.6)	0.04
Total Storage Underground in CB's & MH's (m^3):				**20.9**

StormTrap Underground Storage Unit (Bottom Elevation 268.53)

Unit	Water Level	Area (m2)	Water Level Depth m	Volume (m3)
StormTrap	270.69	300	1.09	328

Total Available Underground Storage (m^3): **397**
(In Sewer, Manholes and Catchbasins)

Surface Storage Used **0**

Total Available Stormwter Storage (m^3): **397**

counterpoint engineering

Orifice Control & Detention Storage

Project Name.: 571 Welham Road
Project No.: 20005

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

Orifice Diameter: 180 mm
Area: 0.025 m^2
g = 9.81 m/s^2
C_d = 0.62

	Stage	Head (m)	Storage (m3)	Discharge (L/s)
Invert E.L.	268.41	0.00	0	0.00
50-year W.L. Elevation	270.69	2.28	397	0.106

counterpoint engineering

Proposed Release Rate and Storage Requirement

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	1426.408
Event	100 year	b	5.273
		c	0.759

Area ID	Area (ha)	Runoff Coefficient	t_c (min)	Storage Available (m^3)	Storage Required (m^3)	Release Rate (L/s)	Description	Release Rate (L/s)	Orifice Size (mm)
UNC	0.23	0.95	10			**109.3**	Uncontrolled	109.3	
Roof	0.49	1.00	10	161	161	41.1	Controlled Roof	41.1	
Controlled Site	1.24	0.95	12	433	399	**133.0**	Site	133.0	185
Totals:	**1.96**				**560**	**242.3**			

Allowable Release Rate = **268.1**

Run-off Coefficient Calculations

Controlled Site

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.26	0.25	0.0650
Building/Impervious Area	0.98	0.95	0.9310
	1.24	Total	0.9960
Divided by Total Area*1.25 =			0.95

max 0.95

UNC

Composite RC Value	Area [ha]	RC	RC * Area
Landscaping	0.112	0.25	0.0279
Impervious Area	0.114	0.95	0.1086
	0.226	Total	0.1365
Divided by Total Area*1.25 =			0.76

0.95 (RC*1.25)

counterpoint engineering

Modified Rational **Area:** **0.49** **Roof**

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	1426.408
Event	100 year	b	5.273
		c	0.759

Site Data		
Area	0.490	ha
Runoff Coefficient	1.00	
AC	0.49	
Tc	12	
Time Increment	10	
Release Rate	41.1	l/s
Storage Required	161	m^3

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
12.42	161	0.22	164	31	133	
22.42	115	0.16	210	55	155	
32.42	91	0.12	240	80	161	********
42.42	76	0.10	263	105	159	
52.42	66	0.09	281	129	152	
62.42	58	0.08	297	154	143	
72.42	52	0.07	310	179	132	
82.42	48	0.07	322	203	119	
92.42	44	0.06	333	228	105	
102.42	41	0.06	342	253	90	

counterpoint engineering

Modified Rational **Area:** **1.24** **Controlled Area (Without Controlled Roof)**

Project Name: 571 Welham Road
Project Number: 20005

Rainfall Data			
Location:	Barrie	a	1426.408
Event	100 year	b	5.273
		c	0.759

Site Data		
Area	1.240	ha
Runoff Coefficient	0.95	
AC	1.18	
Tc	12	
Time Increment	10	
Release Rate	133.0	l/s
Storage Required	399	m^3

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Roof Release Volume	Total Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	
12.42	161	0.53	393	31	424	99	325	
22.42	115	0.38	505	55	560	179	382	
32.42	91	0.30	578	80	658	259	399	********
42.42	76	0.25	633	105	737	338	399	
52.42	66	0.22	677	129	806	418	388	
62.42	58	0.19	714	154	868	498	370	
72.42	52	0.17	746	179	924	578	347	
82.42	48	0.16	774	203	978	658	320	
92.42	44	0.14	800	228	1028	737	291	
102.42	41	0.13	823	253	1076	817	259	

SWM DESIGN CALCULATIONS
Provided Storage Calculations (100-year Storm)

counterpoint engineering
Orifice Control & Detention Storage

Project Name.: 571 Welham Road
Project No.: 20005

Available Storage Underground in Sewer

UPSTREAM OF THE ORIFICE CONTROL AT MH 102 WATER ELEVATION= 272.03

From	To	Length Below HWL (m)	Diameter (mm)	Volume (m^3)
DCB 1	MH112	17.3	375	1.91
CB6	MH112	26.5	200	0.83
PLUG	MH112	33.7	200	1.06
MH112	MH111	29.0	450	4.61
PLUG	MH113	15.7	200	0.49
MH113	MH111	10.7	300	0.76
MH111	CBMH110	69.1	450	10.99
CBMH110	CBMH109	23.6	450	3.75
CBMH109	CBMH108	33.0	450	5.25
CB5	Pipe	13.4	200	0.42
CBMH109	MH102	10.0	450	1.59
CB8	MH114	6.3	200	0.20
CB2	Pipe	4.1	200	0.13
CB3	Pipe	4.0	200	0.13
MH114	MH105	78.6	375	8.68
MH106	MH105	16.2	450	2.58
CB8	MH105	4.5	200	0.14
MH105	MH104	55.9	525	12.10
MH104	MH103	12.6	525	2.73
CB4	MH103	15.2	200	0.48
MH103	StormTrap	3.7	525	0.80
StormTrap	MH102	2.6	525	0.56
Total Storage Underground in Sewers (m^3):				**60.2**

Available Storage Underground in Sewer Catchbasins & Manholes

UPSTREAM OF THE ORIFICE CONTROL AT MH 102 WATER ELEVATION= 272.03

MH	Manhole Top Elevation (m)	Low Invert Elevation (m)	Diameter (m)	Volume (m^3)
MH112	272.04	269.85	1.20	2.47
MH111	272.64	269.65	1.20	2.69
CBMH110	272.80	269.27	1.20	3.12
CBMH109	272.85	269.12	1.20	3.29
CBMH108	272.45	268.70	1.20	3.77
MH102	272.63	268.41	1.50	6.40
MH114	272.55	270.27	1.20	1.99
MH106	272.83	270.12	1.20	2.16
MH105	272.60	269.73	1.50	4.06
MH114	272.52	269.40	1.50	4.65
MH114	272.64	268.76	1.50	5.78
DCB 1	271.75	270.28	(1.2x 0.6)	1.06
CB 2	272.45	270.70	(0.6 x 0.6)	0.48
CB 3	272.37	270.62	(0.6 x 0.6)	0.51
CB 4	272.25	270.50	(0.6 x 0.6)	0.55
CB 5	272.30	270.55	(0.6 x 0.6)	0.53
CB 6	272.30	270.55	(0.6 x 0.6)	0.53
CB 7	272.34	270.59	(0.6 x 0.6)	0.52
CB 8	272.33	270.58	(0.6 x 0.6)	0.52
Total Storage Underground in CB's & MH's (m^3):				**45.1**

StormTrap Underground Storage Unit (Bottom Elevation 268.53)

Unit	Water Level	Area (m2)	Water Level Depth m	Volume (m3)
StormTrap	272.03	300	1.09	327.5

Total Available Underground Storage (m^3): **433**
(In Sewer, Manholes and Catchbasins)

Surface Storage Used **0**

Total Available Stormwter Storage (m^3): **433**

counterpoint engineering

Orifice Control & Detention Storage

Project Name.: 571 Welham Road
Project No.: 20005

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

Orifice Diameter: 180 mm
Area: 0.025 m^2
g = 9.81 m/s^2
C_d = 0.62

	Stage	Head (m)	Storage (m3)	Discharge (L/s)
Invert E.L.	268.41	0.00	0	0.00
100-year Spill Elevation	272.03	3.62	432.8	0.133

Appendix B5

StormFilter sizing calculations and detail

Determining Number of Cartridges for Flow Based Systems

Date	**18/11/2020**	**Black Cells =**	**Calculation**

Site Information

Project Name	**571 Welham Road**		
Project Location	**Barrie, ON**		
OGS ID	**OGS**		
Drainage Area, Ad	**4.27**	ac	(1.73 ha)
Impervious Area, Ai	**3.94**	ac	
Pervious Area, Ap	**0.33**		
% Impervious	**92%**		
Runoff Coefficient, Rc	**0.85**		
Treatment storm flow rate, Q_{treat}	**0.85**	cfs	(24 L/s)
Peak storm flow rate, Q_{peak}	**4.70**	cfs	(133 L/s)

Filter System

Filtration brand	**StormFilter**	
Cartridge height	**27**	in
Specific Flow Rate	**1.00**	gpm/ft^2
Flow rate per cartridge	**11.25**	gpm

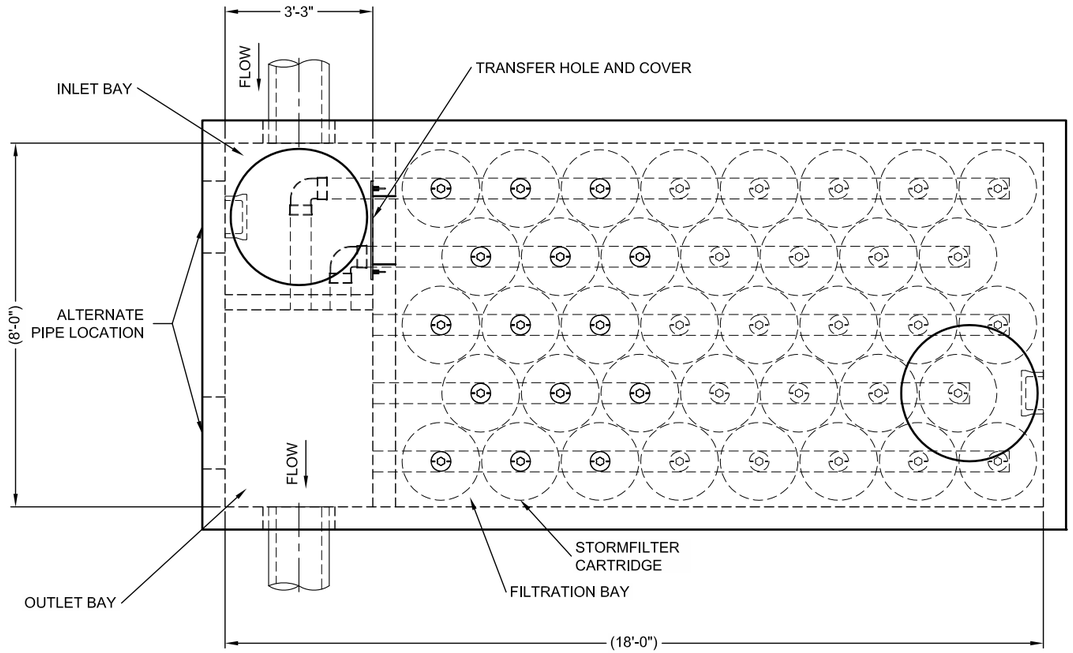
SUMMARY

Number of Cartridges	34
Media Type	Phosphosorb

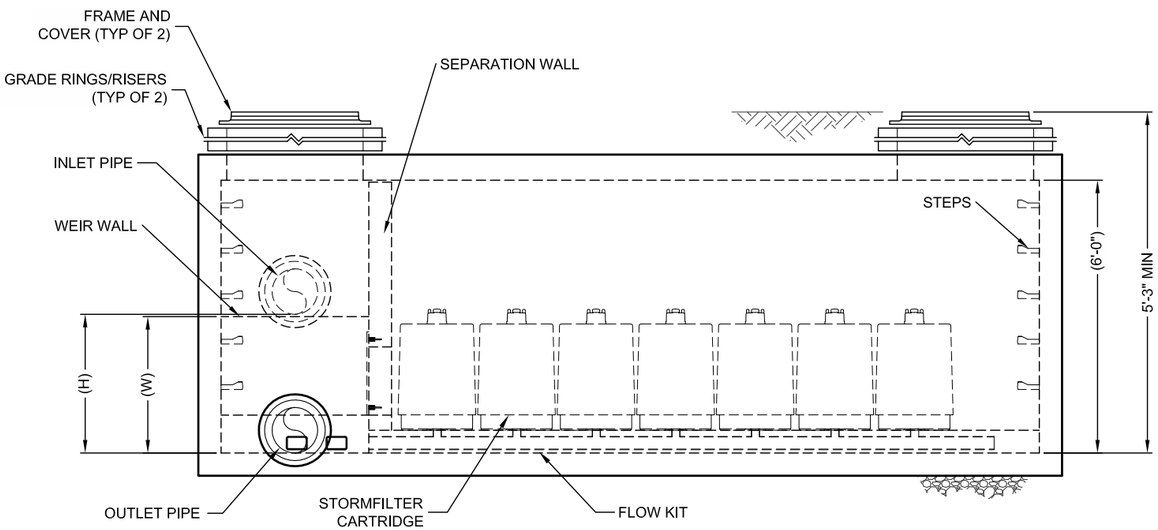
Event Mean Concentration (EMC)	**150**	mg/L
Annual TSS Removal	**80%**	
Percent Runoff Capture	**90%**	

Recommend SFPD0818 vault or CIP

200 Enterprise Drive
Scarborough, ME 04074
Phone 877-907-8676
Fax 207-885-9825



PLAN



ELEVATION

The Stormwater Management StormFilter®

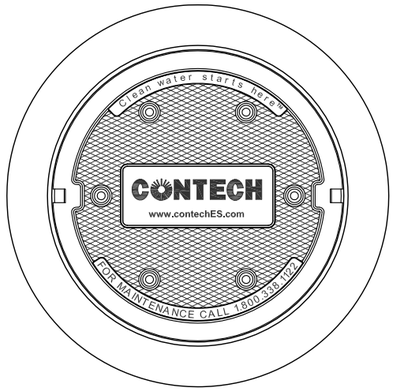
STORMFILTER DESIGN NOTES

- THE 8' x 18' PEAK DIVERSION STORMFILTER TREATMENT CAPACITY VARIES BY CARTRIDGE COUNT AND LOCALLY APPROVED SURFACE AREA SPECIFIC FLOW RATE. PEAK CONVEYANCE CAPACITY TO BE DETERMINED BY ENGINEER OF RECORD.
- THE PEAK DIVERSION STORMFILTER IS AVAILABLE IN A LEFT INLET (AS SHOWN) OR RIGHT INLET CONFIGURATION.
- ALL PARTS AND INTERNAL ASSEMBLY PROVIDED BY CONTECH UNLESS OTHERWISE NOTED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			LOW DROP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			1.8'		
HEIGHT OF WEIR (W)	3.00'			2.25'			1.75'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	10	8.35	5

* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB ® (PSORB) MEDIA ONLY



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (cfs)	*
PEAK FLOW RATE (cfs)	*
RETURN PERIOD OF PEAK FLOW (yrs)	*
CARTRIDGE HEIGHT (27", 18", LOW DROP(LD))	*
NUMBER OF CARTRIDGES REQUIRED	*
CARTRIDGE FLOW RATE	*
MEDIA TYPE (PERLITE, ZPG, PSORB)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE	*	*	*
OUTLET PIPE	*	*	*

UPSTREAM RIM ELEVATION	*
DOWNSTREAM RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

PERFORMANCE SPECIFICATION

FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. **RADIAL MEDIA DEPTH SHALL BE 7-INCHES**. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST **38 SECONDS**. SPECIFIC FLOW RATE SHALL BE **2 GPM/SF (MAXIMUM)**. SPECIFIC FLOW RATE IS THE MEASURE OF THE FLOW (GPM) DIVIDED BY THE MEDIA SURFACE CONTACT AREA (SF). MEDIA VOLUMETRIC FLOW RATE SHALL BE **6 GPM/CF OF MEDIA (MAXIMUM).**

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH REPRESENTATIVE. www.ContechES.com
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.

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 STORMFILTER STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
F. CONTRACTOR TO REMOVE THE TRANSFER HOLE COVER WHEN THE SYSTEM IS BROUGHT ONLINE.

CONTECH® ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

THE STORMWATER MANAGEMENT STORMFILTER 8' x 18' PEAK DIVERSION STORMFILTER STANDARD DETAIL

Appendix B6

Excerpt from LSRCA Climate Data for Lovers Creek
Water Balance Calculations
City of Toronto WWFMG Table of Average Rainfall Depth

Lovers Creek Subwatershed

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	1.69	914	537	377
Fine Sandy Loam	B		914	571	343
Silt Loam	C		914	585	329
Clay	D		-	-	-
Forest					
Fine Sand	A	8.05	914	574	340
Fine Sandy Loam	B		914	557	357
Silt Loam	C		914	593	321
Clay	D		914	560	354
Pasture & Shrubs					
Fine Sand	A	1.66	914	566	348
Fine Sandy Loam	B		914	582	332
Silt Loam	C		914	658	256
Clay	D		-	-	-
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	3.89	914	571	343
Fine Sandy Loam	B		914	608	306
Silt Loam	C		914	650	264
Clay	D		-	-	-
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	16.20	914	589	325
Fine Sandy Loam	B		914	623	291
Silt Loam	C		914	646	268
Clay	D		914	523	391
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	0.20	914	493	421
Fine Sandy Loam	B		914	529	385
Silt Loam	C		-	-	-
Clay	D		-	-	-
Mean Annual			**914**	**545**	**369**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

Appendix B6-1
Summary of Inputs for Water Balance Calculation

Precipitation (mm/yr)	**933**	As per pg 17 of Hydrogeological Report
Evapotranspiration (mm/yr)	**571**	Data Provided by TRCA
Topography Infiltration Factor	**0.3**	Flat
Soil Infiltration Factor	**0.4**	Open Sandy Loam
Land Cover Infiltration Factor	**0.1**	Cultivated
MOE Infiltration Factor	**0.8**	Pre-development site (Grass)

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

Table extracted from chapter 4 of "MOEE Hydrogeological technical Information requirements for Land Development Applications" MOE, April 1995.

Appendix B6 - 2
Water Budget - Pre-Development
Water Balance/Water Budget Assessment

Catchment Designation	Site Pervious	Site IMP	Site Total
Area (m^2)	15,555	4,005	19,560
Pervious Area (m2)	15,555	0	15,555
Impervious Area (m2)	0	4,005	4,005
Infiltration Factors			
Topography Infiltration Factor	0.30	0	
Soil Infiltration Factor	0.40	0	
Land Cover Infiltration Factor	0.10	0	
MOE Infiltration Factor	0.80	0	
Run-off Coefficient	0.25	0.9	
Run-off from Impervious Surfaces	0	1	
Inputs (per Unit Area)			
Precipitation (mm/yr)	933	933	933
Run-on (mm/yr)	0	0	0
Other Inputs (mm/yr)	0	0	0
Outputs (per Unit Area)			
Precipitation Surplus (mm/yr)	362	840	
Net Surplus (mm/yr)	362	840	
Evapotranspiration (mm/yr)	571	93	
Infiltration (mm/yr)	290	0	
Infiltration Gallery (mm/yr)	0	0	
Total Infiltration (mm/yr)	290	0	
Runoff Pervious Areas (mm/yr)	72	0	
Runoff Impervious Areas (mm/yr)	0	840	
Total Runoff (mm/yr)	72	840	
Total Outputs (mm/yr)	**933**	933	
Difference (Inputs-Outputs)	**0**	0	
Inputs (Volumes)			
Precipitation (m^3/yr)	14,513	3,737	18,249
Run-on (m^3/yr)	0	0	0
Other Inputs (m^3/yr)	0	0	0
Total Inputs (m3/yr)	**14,513**	**3,737**	18,249
Outputs (Volumes)			
Precipitation Surplus (m^3/yr)	5,631	3,363	8,994
Net Surplus (m^3/yr)	5,631	3,363	8,994
Evapotranspiration (m^3/yr)	8,882	374	9,256
Infiltration (m^3/yr)	4,505	0	4,505
Infiltration Gallery(m^3/yr)	0	0	0
Total Infiltration (m^3/yr)	4,505	0	4,505
Runoff Pervious Areas (m^3/yr)	1,126	0	1,126
Runoff Impervious Areas (m^3/yr)	0	3,363	3,363
Total Runoff (m^3/yr)	1,126	3,363	4,489
Total Outputs (m^3/yr)	**14,513**	**3,737**	18,249
Difference (Inputs-Outputs)	**0**	0	0

Appendix B6 - 3
Water Budget - Post-Development
Water Balance/Water Budget Assessment

Catchment Designation	To Gallery (INF 1)			Uncontrolled			Totals
	G1 p - Pervious	G1 i - Impervious	Total Gallery	UNC p - Pervious	UNC i - Impervious	Totals Uncontrolled	Site
Area (m^2)	0	4,900	**4,900**	3,791	10,869	**14,660**	**19,560**
Pervious Area (m2)	0	0	**0**	3,791	0	**3,791**	**3,791**
Impervious Area (m2)	0	4,900	**4,900**	0	10,869	**10,869**	**15,769**
Infiltration Factors							
Topography Infiltration Factor	0.30	0.3		0.30	0.3		
Soil Infiltration Factor	0.40	0		0.40	0		
Land Cover Infiltration Factor	0.10	0		0.10	0		
MOE Infiltration Factor	0.80	0		0.80	0		
Run-off Coefficient	0.25	1		0.25	1		
Run-off from Impervious Surfaces	0.00	1		0.00	1		
Inputs (per Unit Area)							
Precipitation (mm/yr)	933	933	**933**	933	933	**933**	**933**
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)	362	840	**840**	362	840	**716**	**747**
Net Surplus (mm/yr)	362	840	**840**	362	840	**716**	**747**
Evapotranspiration (mm/yr)	571	93	**93**	571	93	**217**	**186**
Infiltration (mm/yr)	290	0	**0**	290	0	**75**	**56**
Infiltration Gallery (mm/yr)	0	0	**0**	0	0	**0**	**0**
Total Infiltration (mm/yr)	290	0	**0**	290	0	**75**	**56**
Runoff Pervious Areas (mm/yr)	72	0	**0**	72	0	**19**	**14**
Runoff Impervious Areas (mm/yr)	0	840	**840**	0	840	**623**	**677**
Total Runoff (mm/yr)	72	840	**840**	72	840	**641**	**691**
Total Outputs (mm/yr)	**933**	**933**	**933**	**933**	**933**	**933**	**933**
Difference (Inputs-Outputs)	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Inputs (Volumes)							
Precipitation (m^3/yr)	0	4,572	**4,572**	3,537	10,141	**13,678**	**18,249**
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**	**4,572**	**4,572**	**3,537**	**10,141**	**13,678**	**18,249**
Outputs (Volumes)							
Precipitation Surplus (m^3/yr)	0	4,115	**4,115**	1,372	9,127	**10,499**	**14,614**
Net Surplus (m^3/yr)	0	4,115	**4,115**	1,372	9,127	**10,499**	**14,614**
Evapotranspiration (m^3/yr)	0	457	**457**	2,165	1,014	**3,179**	**3,636**
Infiltration (m^3/yr)	0	0	**0**	1,098	0	**1,098**	**1,098**
Infiltration Gallery (m^3/yr)	0	0	**0**	0	0	**0**	**0**
Total Infiltration (m^3/yr)	0	0	**0**	1,098	0	**1,098**	**1,098**
Runoff Pervious Areas (m^3/yr)	0	0	**0**	274	0	**274**	**274**
Runoff Impervious Areas (m^3/yr)	0	4,115	**4,115**	0	9,127	**9,127**	**13,241**
Total Runoff (m^3/yr)	0	4,115	**4,115**	274	9,127	**9,401**	**13,516**
Total Outputs (m^3/yr)	**0**	**4,572**	**4,572**	**3,537**	**10,141**	**13,678**	**18,249**
Difference (Inputs-Outputs)	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Appendix B6 - 4
Water Budget - Post-Development with Mitigation
Water Balance/Water Budget Assessment

Catchment Designation	To Gallery (INF 1)			Uncontrolled			Totals
	G1 p - Pervious	G1 i - Impervious	Total Gallery	UNC p - Pervious	UNC i - Impervious	Totals Uncontrolled	Site
Area (m^2)	0	4,900	**4,900**	3,791	10,869	**14,660**	**19,560**
Pervious Area (m2)	0	0	**0**	3,791	0	**3,791**	**3,791**
Impervious Area (m2)	0	4,902	**4,902**	0	10,869	**10,869**	**15,771**
Infiltration Factors							
Topography Infiltration Factor	0.30	0.3		0.30	0.3		
Soil Infiltration Factor	0.40	0		0.40	0		
Land Cover Infiltration Factor	0.10	0		0.10	0		
MOE Infiltration Factor	0.80	0		0.80	0		
Run-off Coefficient	0.25	1		0.25	1		
Run-off from Impervious Surfaces	0.00	1		0.00	1		
Inputs (per Unit Area)							
Precipitation (mm/yr)	933	933	**933**	933	933	**933**	**933**
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)	362	840	**840**	362	840	**716**	**747**
Net Surplus (mm/yr)	362	840	**840**	362	840	**716**	**747**
Evapotranspiration (mm/yr)	571	93	**93**	571	93	**217**	**186**
Infiltration (mm/yr)	290	0	**0**	290	0	**75**	**56**
Infiltration Gallery (mm/yr)	0	695	**695**	0	0	**0**	**174**
Total Infiltration (mm/yr)	290	695	**695**	290	0	**75**	**230**
Runoff Pervious Areas (mm/yr)	72	0	**0**	72	0	**19**	**14**
Runoff Impervious Areas (mm/yr)	0	145	**145**	0	840	**623**	**503**
Total Runoff (mm/yr)	72	145	**145**	72	840	**641**	**517**
Total Outputs (mm/yr)	**933**	**933**	**933**	**933**	**933**	**933**	**933**
Difference (Inputs-Outputs)	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Inputs (Volumes)							
Precipitation (m^3/yr)	0	4,572	**4,572**	3,537	10,141	**13,678**	**18,249**
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**	**4,572**	**4,572**	**3,537**	**10,141**	**13,678**	**18,249**
Outputs (Volumes)							
Precipitation Surplus (m^3/yr)	0	4,115	**4,115**	1,372	9,127	**10,499**	**14,614**
Net Surplus (m^3/yr)	0	4,115	**4,115**	1,372	9,127	**10,499**	**14,614**
Evapotranspiration (m^3/yr)	0	457	**457**	2,165	1,014	**3,179**	**3,636**
Infiltration (m^3/yr)	0	0	**0**	1,098	0	**1,098**	**1,098**
Infiltration Gallery (m^3/yr)	0	3,405	**3,405**	0	0	**0**	**3,405**
Total Infiltration (m^3/yr)	0	3,405	**3,405**	1,098	0	**1,098**	**4,502**
Runoff Pervious Areas (m^3/yr)	0	0	**0**	274	0	**274**	**274**
Runoff Impervious Areas (m^3/yr)	0	710	**710**	0	9,127	**9,127**	**9,837**
Total Runoff (m^3/yr)	0	710	**710**	274	9,127	**9,401**	**10,111**
Total Outputs (m^3/yr)	**0**	**4,572**	**4,572**	**3,537**	**10,141**	**13,678**	**18,249**
Difference (Inputs-Outputs)	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Appendix B6 - 5
Water Budget Summary
Water Balance/Water Budget Assessment

Catchment Designation	Site				
	Pre-Development	Post-Development	Change (Pre- to Post-)	Post- Development with Mitigation	Change (Pre- to Post- with Mitigation)
Inputs (Volumes)					
Precipitation (m^3/yr)	18,249	18,249	0.0%	18,249	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)	**18,249**	**18,249**	**0.0%**	**18,249**	**0.0%**
Outputs (Volumes)					
Precipitation Surplus (m^3/yr)	5,631	14,614	159.5%	14,614	159.5%
Net Surplus (m^3/yr)	5,631	14,614	159.5%	14,614	159.5%
Evapotranspiration (m^3/yr)	8,882	3,636	-59.1%	3,636	-59.1%
Infiltration (m^3/yr)	4,505	1,098	-75.6%	1,098	-75.6%
Infiltration Gallery (m^3/yr)	0	0	0.0%	3,405	N/A
Total Infiltration (m^3/yr)	4,505	1,098	-75.6%	4,502	-0.1%
Runoff Pervious Areas (m^3/yr)	1,126	274	-75.6%	274	-75.6%
Runoff Impervious Areas (m^3/yr)	0	13,241	N/A	9,837	N/A
Total Runoff (m^3/yr)	1,126	13,516	1100.1%	10,111	797.8%
Total Outputs (m^3/yr)	**18,249**	**18,249**	**0.0%**	18,249	**0.0%**

Appendix B6 - 6
Calculations for Infiltration Galleries

Information from Table 4: Post Development with Mitigation Spreadsheet

A	P	Precipitation (mm/yr)	933
B	ET	Evapotranspiration (mm/yr)	93
C	I	Infiltration (mm/yr)	0
D	IG	Infiltration Gallery (mm/yr)	695

% ET&I=	(B+C)/A	10.0%
% IG=	D/A	74.5%
% ET&I&IG=	(ET+I+IG)/A	84.5%

Total depth determined from Figure 1a: 15.3
Catchment Area: 4,904

Total volume required for loss of infiltration mitigation for site= 15.3mm x 4,904m^2 = **75.0** Required for water balance

Total size provided: **112.9** **m^3** **Oversized for Volume Control**

Dimensions: **Infiltration Volume below Subdrain**

Length=	42.00	m
Width =	7.00	m
Depth=	0.96	m
Voids=	0.40	
Volume=	**112.9**	**m^3**

Actual volume larger than 75.0 m^3 required for water balance.

Drawdown Time:

Safety factor of 2.5 applied to infiltration rates as per Appendix C of the TRCA/CVC Low Impact Development Stormwater Management Planning and Design Guide

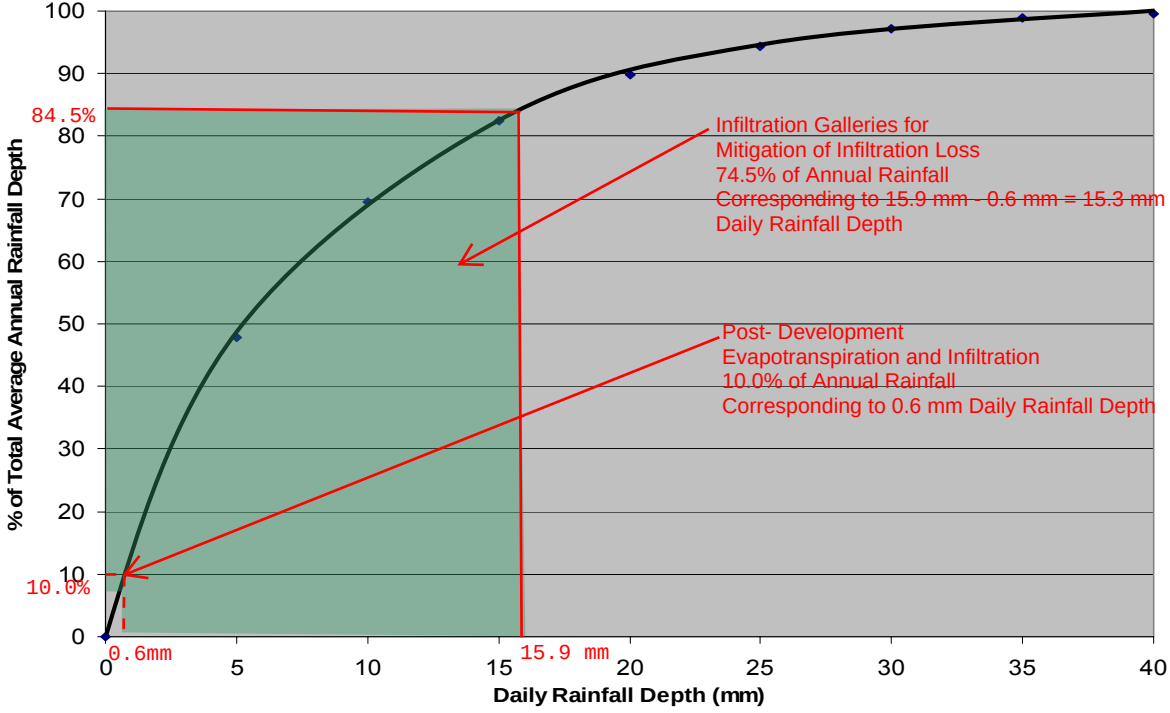
Gallery:	Rate (mm/hr.)	Safety Factor	Adjusted Rate (mm/hr.)
Infiltration rate based on infiltration test results: *Golder Associates, Guelph Permeameter, Nov 15 2016*	50	2.5	20

Drawdown Time=(Depth*Void Space)/Infiltration Rate As per CVC/TRCA Design Guide

Drawdown Time= (960mm*0.4)/20mm/hr. **19.2**

Drawdown time is less the 48hrs, therefore MOECC/TRCA/LSRCA requirements are being met.

Figure 1a- % of Total Annual Average Rainfall Depth Vs. Daily Rainfall Amounts
(Based on 1991 Toronto Rainfall Data from 16 Rain Gauge Stations)



Appendix B7

Phosphorus Development Summary

Ontario
MINISTRY OF THE ENVIRONMENT

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

Project DEVELOPMENT Summary

DEVELOPMENT: 571 Welham Road
Subwatershed: Lovers Creek

Total Pre-Development Area (ha):	**1.6200**	Total Pre-Development Phosphorus Load (kg/yr):	**0.11**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Hay-Pasture	1.62	0.07	0.11

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 - Comm/Industrial	0.05	1.82	NONE	0%	0.09
Entrance asphalt pavement not treated					
High Intensity - Comm/Industrial	0.49	1.82	Treatment Train Approach	92%	0.07
*Soak-away infiltration trench (60% Phosphorus removed) is additionally treated by the stormfilter. Efficiency: 79% [Stormfilter] + (1-0.79)*60% (Infiltration Trench) = 92%*					
High Intensity - Comm/Industrial	0.72	1.82	Sorbtive media interceptors	79%	0.28
Phosphorous Media interceptor as part of the stormfilter provided by contech provides 79% phosphorus removal.					
High Intensity - Comm/Industrial	0.36	1.82	Sand or Media Filters	**88%**	0.08
*Filtration permeable pavers and bioswale area with sand filtration and underground storage and then passing through Stornfilter unit. Efficiency = 79% + (1-0.79)*0.45 = 88%*					

NOTE: BMP efficiency has been adjusted from the reference provided value by 43% (from 45% to 88%)

Post-Development Area Altered:	**1.62**
Total Pre-Development Area:	**1.62**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**0.11**
Post-Development:	**2.95**
Change (Pre - Post):	**-2.84**
2500% Net Increase in Load	
Post-Development (with BMPs):	**0.52**
Change (Pre - Post):	**-0.41**
358.31% Net Increase in Load	

DEVELOPMENT: 571 Welham Road
Subwatershed: Lovers Creek

CONSTRUCTION PHASE LOAD

Site-Specific Input:		Constant / Lookup:	
		Calculation:	

Sub Area: 571 Welham road Construction

Duration of Construction (months):	4	R (rainfall / runoff for Lake Simcoe)	90
Duration of Exposed Soil (months):	1	K (soil erodability factor):	0.13
Surface Slope Gradient (%):	0.5	NN (determined by slope):	0.2
Length of Slope (m):	90	BMP prevention Efficiency:	0%
Slope Area (ha):	1.6	BMP capture Efficiency:	91%
% slope erosion prevention applied to:	1	LS (slope length gradient factor):	*0.67*
% slope runoff capture applied to:	1	C (portion of year of exposed soil):	*0.25*
Subwatershed Soil [P] (kg/kg):	0.0004	P (prevention + capture):	*0.09*
		Soil Loss (kg/year):	*625.3555*
		Phosphorus Load (kg):	*0.08*

Developed AREA (ha): 1.60000002384

	Total
Construction Phase Phosphorus Load with BMPs (kg):	0.08
Construction Phase Phosphorus Load no BMPs (kg):	0.93

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**0.11**
Construction Phase Amortized Over 8 Years :	0.01
Post-Development:	**0.52**
Post-Development + Amortized Construction:	**0.53**
Pre-Development Load - Post-Development Load:	**-0.41**
Conclusion:	**358% Increase in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**-0.42**
Conclusion:	**367% Increase in Load**

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:

Not approve development as site specific appropriate

Appendix B8

In-Situ Guelph Permeameter Tests
Prepared by Terraprobe

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

November 2, 2020

File No. 1-19-0792-02
Brampton Office

Environmental 360 Solutions Ltd.
1815 Ironstone Manor, Unit # 8
Pickering, Ontario
L1W 3W9

Attention: Mr. Joseph Campitelli

RE: IN-SITU GUELPH PERMEAMETER TESTS
PROPOSED INFILTRATION GALLERY
571 WELHAM ROAD
BARRIE, ONTARIO

Dear Mr. Campitelli:

This letter presents the result of the in-situ Guelph Permeameter tests carried out in the vicinity of the proposed infiltration gallery to be constructed on the southeast portion of the property for the above noted site.

Terraprobe recently completed several studies for the above noted site. The results of these studies were reported under separate covers. Subsequently, Terraprobe was retained to conduct the in-situ Guelph Permeameter tests in the vicinity of the proposed infiltration gallery and provide soil infiltration rate for the gallery.

Infiltration Rates

The field work was conducted on October 20, 2020 and consisted of Test Pit Excavation and In-Situ Guelph Permeameter Tests. One (1) test pit (TP1) was excavated to about 3.4, 3.9 and 4.4 m depths, respectively, in order to conduct In-Situ Guelph Permeameter Tests on the above noted depths (Elev. 269.60, 269.10 and 268.60 m, respectively). A total of three (3) In-Situ Guelph Permeameter Tests (GP1, GP2 and GP3) were conducted in the vicinity of the proposed infiltration gallery at approximate location shown on Figure 2. The tests were performed using a Guelph Permeameter (Model 2800).

The soil type, estimated hydraulic conductivity and infiltration rate measured at the test locations/depths during the field tests are summarized below:

Test Location	General Soil Type	Test Depth/Elevation Below Existing Ground Level	Estimated Hydraulic Conductivity	Infiltration Rate
GP1	Sand, some silt, trace clay, trace gravel	3.4 m/269.60 m	2.0×10^{-4} cm/sec	50 mm/hr
GP2	Sand, trace silt, trace clay, trace gravel	3.9 m/269.10 m	1.7×10^{-3} cm/sec	75 mm/hr
GP3	Sand, trace silt, trace clay, trace gravel	4.4 m/268.60 m	2.5×10^{-3} cm/sec	75 mm/hr

*Note: Based on the in-situ hydraulic conductivity test result, the infiltration rate is estimated as per the TRCA Low Impact Development Stormwater Management Planning and Design Guide, Table C1.

The design infiltration rates for the site should be evaluated based on applicable safety correction factor(s), as per the above referenced document.

No ground water was encountered within the test depths (up to about 4.4 m depth below existing grade).

We trust the foregoing information is sufficient for your present requirements. If you have any questions, please do not hesitate to contact us.

Yours truly,

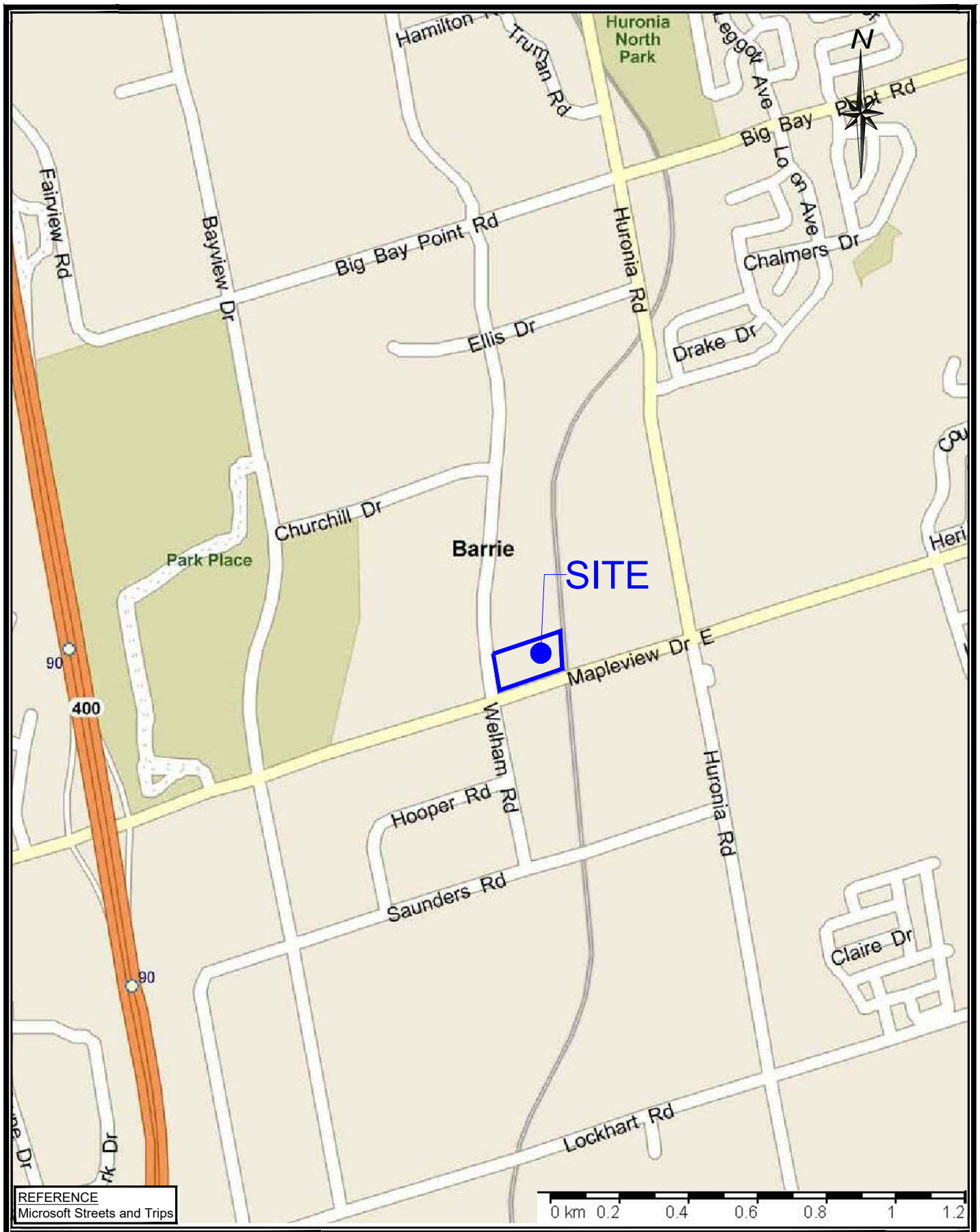
Terraprobe Inc.

LICENSED PROFESSIONAL ENGINEER
1-19-0792-02
A. SOBAHAN
100104282
NOV 2,2020
PROVINCE OF ONTARIO

Abdus Sobahan, M. Eng., P. Eng.
Geotechnical Engineer

Madan Talukdar, P. Eng.
Associate

encls. Figure 1 - Site Location Plan
Figure 2 - Guelph Permeameter Test Location and Site Features Plan



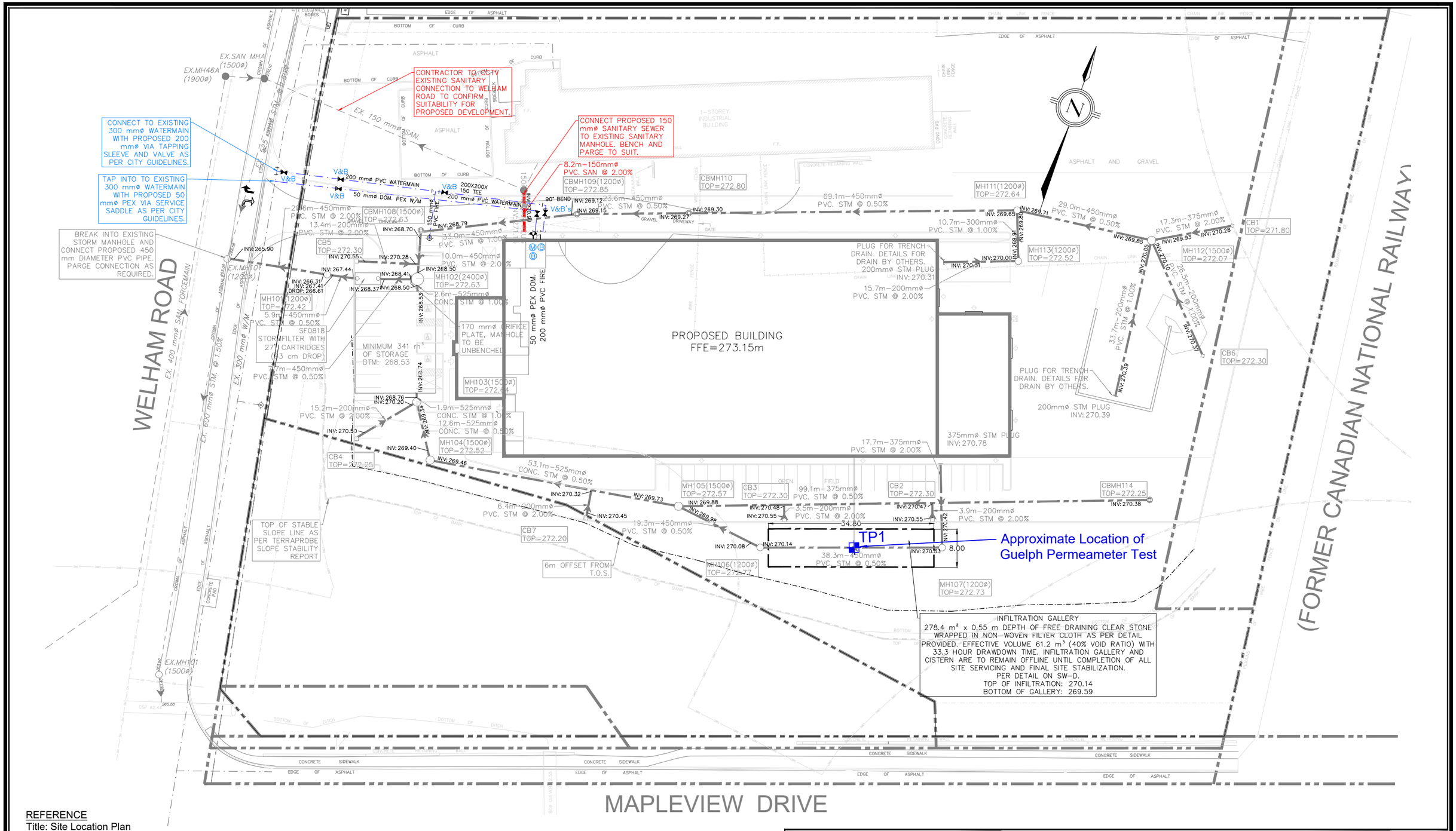
Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: **SITE LOCATION PLAN**

File. No.: 1-19-0762-01

FIGURE : 1

Z:\1-Project Files\2019\1-19-0792 - 571 Welham Road, Barrie\01-GEO Investigation\A_Dwgs, Logs\AutoCAD\1-19-0792-01 Figure 1.dwg, Kamal



REFERENCE
Title: Site Location Plan
Project no.: 20005
Drawing No.: SW-S
Date: January 2020
By: Counterpoint Engineering Inc.

LEGEND
Approximate Test Pit Location

Scale 0m 10m 20m 30m

Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: **GUELPH PERMEAMETER TEST LOCATION AND SITE FEATURE PLAN**

File No. 1-16-0456-03

FIGURE : 2

Z:\1-Project Files\2019\1-19-0792 - 571 Welham Road, Barrie\02- In-Situ Guelph Permeameter Test\A Dwgs Logs\AutoCAD\1-19-0792-02 FIG 2 2020-10-28.dwg, DWG To PDF.pc3, Kamal, Kamal

Appendix B9

Inlet Capacity Calculations

Catchbasin Inlet Capacity Summary Table

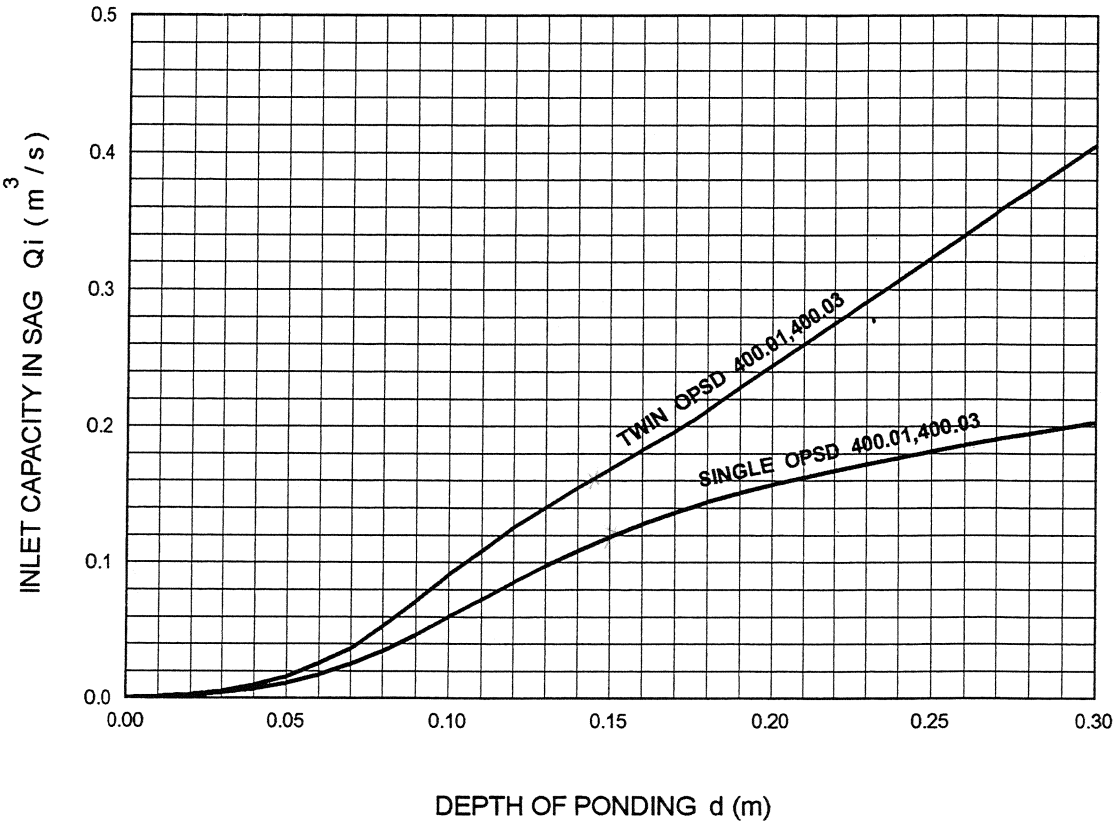
Catchbasin Name	Drainage Area (ha)	100-year Peak Flow (l/s)	Max. Spill (m)	Single/Double CB	CB Inlet Capacity (l/s)	Capacity Check	Capacity Check
DCB1	0.37	167	0.28	Double	370	OK	
CB2	0.09	32	0.07	Single	12	NDG	Spills 20 L/S to CB2
CB3	0.08	32	0.15	Single	120	OK	Receives 20 l/s from CB2
CB7	0.10	45	0.16	Single	130	OK	OK
CB8	0.15	60	0.19	Single	150	OK	OK
CB6	0.04	18	0.25	Single	180	OK	OK
CBMH110	0.12	54	0.15	Single	120	OK	OK
CBMH109	0.06	27	0.10	Single	60	OK	OK
CBMH108	0.07	32	0.09	Single	44	OK	OK
CB4	0.09	41	0.25	Single	180	OK	OK
CB5	0.06	27	0.10	Single	60	OK	OK

Inlet capacities for catchbasins and double catchbasins as per MTO Drainage Manual Design Chart 4.19

Event:		100	years					
			DCB1	CB2	CB3	CB7	CB8	CB6
		a	1426.408	1426.408	1426.408	1426.408	1426.408	1426.408
	ABC's:	b	5.273	5.273	5.273	5.273	5.273	5.273
		c	0.759	0.759	0.759	0.759	0.759	0.759
Time of Concentration:		t	10	10	10	10	10	10 min
Runoff Coefficient:		C	0.90	0.70	0.80	0.90	0.80	0.90
Drainage Area		A	0.37	0.09	0.08	0.10	0.15	0.04 ha
Intensity	[i=a/(t+b)^c]	i	180.15	180.15	180.15	180.15	180.15	180.15 mm/hr
Flow	[Q=CiA/360]	Q	0.167	0.032	0.032	0.045	0.060	0.02 m^3/s
			167	**32**	**32**	**45**	**60**	**18** l/s

			CBMH110	CBMH109	CBMH108	CB4	CB5
		a	1426.408	1426.408	1426.408	1426.408	1426.408
	ABC's:	b	5.273	5.273	5.273	5.273	5.273
		c	0.759	0.759	0.759	0.759	0.759
Time of Concentration:		t	10	10	10	10	10
Runoff Coefficient:		C	0.90	0.90	0.90	0.90	0.90
Drainage Area		A	0.12	0.06	0.07	0.09	0.06
Intensity	[i=a/(t+b)^c]	i	180.15	180.15	180.15	180.15	180.15
Flow	[Q=CiA/360]	Q	0.05	0.03	0.03	0.04	0.03
			54	**27**	**32**	**41**	**27**

Design Chart 4.19: Inlet Capacity at Road Sag



Appendix C1

Pre Development Sanitary Discharge Calculations

Counterpoint Engineering Inc.
Pre-development Sanitary Design Flows Calculations

Project:	571 Welham Road	
Project No:	20005	
Location:	571 Welham Road, Barrie	
Site Area:	2.46	ha
Floor Area:	0.14	ha

Average Flow

Industrial	35	m^3 / ha / day

per City of Barrie Sanitary Design Guidelines p.9

Land Use	m^3 / ha / day	Area (ha)	Sanitary Flow (m^3/day)	Sanitary Flow (L/s)
Industrial	35.0	0.14	**4.816**	**0.06**

Peaking Factor **3.00**

Estimated per City of Barrie Sanitary Design Guidelines p.10

Extraneous Flows **0.10** l/s/ha

per City of Barrie Sanitary Design Guidelines p.10

Design Sanitary Flow**

Peak Industrial Flow NIC Infiltration:	0.17	**l/s**
Total Infiltration:	0.25	**l/s**
Total Peak Flow + Infiltration:	0.41	**l/s**

Appendix C2

Post Development Sanitary Discharge Calculations

Counterpoint Engineering Inc.
Post-development Sanitary Design Flows Calculations

Project:	571 Welham Road	
Project No:	20005	
Location:	571 Welham Road, Barrie	
Site Area:	2.46	ha
Floor Area:	0.63	ha

Average Flow

Industrial	35	m^3 / ha / day

per City of Barrie Sanitary Design Guidelines p.9

Land Use	m^3 / ha / day	Area (ha)	Sanitary Flow (m^3/day)	Sanitary Flow (L/s)
Industrial	35.0	0.63	**21.98**	**0.25**

Peaking Factor **3.00**

Estimated per City of Barrie Sanitary Design Guidelines p.9

Extraneous Flows **0.10** l/s/ha

per City of Barrie Sanitary Design Guidelines p.10

Design Sanitary Flow**

Peak Industrial Flow NIC Infiltration:	0.76	**l/s**
Total Infiltration:	0.25	**l/s**
Total Peak Flow + Infiltration:	1.01	**l/s**

Appendix C3

Sanitary Capacity Calculations

Counterpoint Engineering Inc.

Existing Municipal Sanitary Sewer Pipe Capacity Calculations

	TOTAL FLOW 1+2+3 (m^3/sec)	LENGTH (m)	PIPE DIAMETER (mm)	GRADIENT (%)	CAPACITY (m^3/sec)	VELOCITY (m/sec)	CAPACITY (%)	Flow (m^3/s)*	Coefficient of Roughness, n	Pipe Radius (m)	Af (m^2)	Pw (m)	Hydraulic Radius, R (m)	Slope, S (m/m)	Cross sectional area of flow, A (m^2)
Pre-Development	0.00041	50.0	750	0.5	0.787	1.78	0.052	0.787206	0.013	0.375	0.441786	2.356194	0.1875	0.01	0.441786
Post-Development	0.00101	50.0	750	0.5	0.787	1.78	0.128	0.787206	0.013	0.375	0.441786	2.356194	0.1875	0.01	0.441786

Appendix D1

Water Demand Calculations

counterpoint engineering

Water Demand Calculations

Project Name: 571 Welham Road
Project Number: 20005

City of Barrie Watermain Design Guidelines
Water Demand = Maximum Day Flow + Fire Flow or Peak Hour Flow

Industrial Demand

Industrial (Light)	35,000	L / ha / day
Peak Hour Factor	2	
Maximum Day Factor	2	

Fire Demand

Fire Flow	10,000	L / min	- See FUS calculations.
Fire Flow Duration	2	hours	

Institutional, Commercial, Industrial Area:	0.49	ha	- See Sanitary Flow Calculations
Industrial Demand:	17157	L / day	
Peak Hour Water Demand - Industrial:	34,314	L / day	
Peak Hour Water Demand + ICI:	38,549	L / day	
Total Peak Hour Demand:	**72,863**	**L / day**	
, or	**51**	**L / min**	
Maximum Day Water Demand - Industrial:	34,314	L / day	
Maximum Day Water Demand + ICI:	38,549	L / day	
Total Maximum Day Water Demand:	72,863	L / day	
, or	51	L / min	
Total Fire Flow:	10,000	L / min	
Maximum Day + Fire Flow:	**10,051**	**L / min**	
	or		
	2,655	**USGPM**	

- Since the Maximum Day + Fire Flow demand is the highest demand value, this is the one that governs the site requirements.

Appendix D2

FUS Calculations

counterpoint engineering

Fire Underwriter Survey Fire Flow Calculation

Project Name: 571 Welham Road
Project Number: 20005

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

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.

Legend

Construction Class		Contents Factor	
WF	wood frame construction	NC	non-combustible
OC	ordinary construction	LC	limited combustible
NC	non-combustible construction	C	combustible
FC	fire-resistive construction	FB	free burning
		RB	rapid burning

Contents Factor:

Non-Combustible	-25%	Free Burning	+15%
Limited Combustible	-15%	Rapid Burning	+25%
Combustible	No Charge		

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%		

1) Fire Flow

Type of Construction: NC
C = 0.8
A = 4900 m^2 - Area of largest floor plus 25% of floor above and below.
F = 13,000 L/min

2) Occupancy Reduction

Contents Factor: RB
Occupancy Charge = 25%

25% of 13,000 L/min = 3,250 L/min
F = 13000 L/min + 3250 L/min = 16,250 L/min

3) System Type Reduction (to be reduced from result of Step 2)

NFPA 13 Sprinkler:	30%	YES
Standard Water Supply:	10%	YES
Fully Supervised:	10%	YES
Total System Type Reduction =	**50%**	

50% of **16,250 L/min** = **8,125 L/min**
(to be reduced from result of Step 2)

4) Separation Charge (to be added to result of Step 2)

Building Face	Distance	Charge	
North	22	10%	
East	>45m	0%	
South	>45m	0%	
West	>45m	0%	
Total		**10%**	(max exposure charge can be 75%)

10% of **16,250 L/min** = **1,625 L/min**
(to be added to result of Step 2)

F = 10,000 L/min (round to the nearest 1,000 L/min) (2,000 L/min < F < 45,000 L/min)
F = 2,642 GPM

Appendix D3

Hydrant Flow Tests

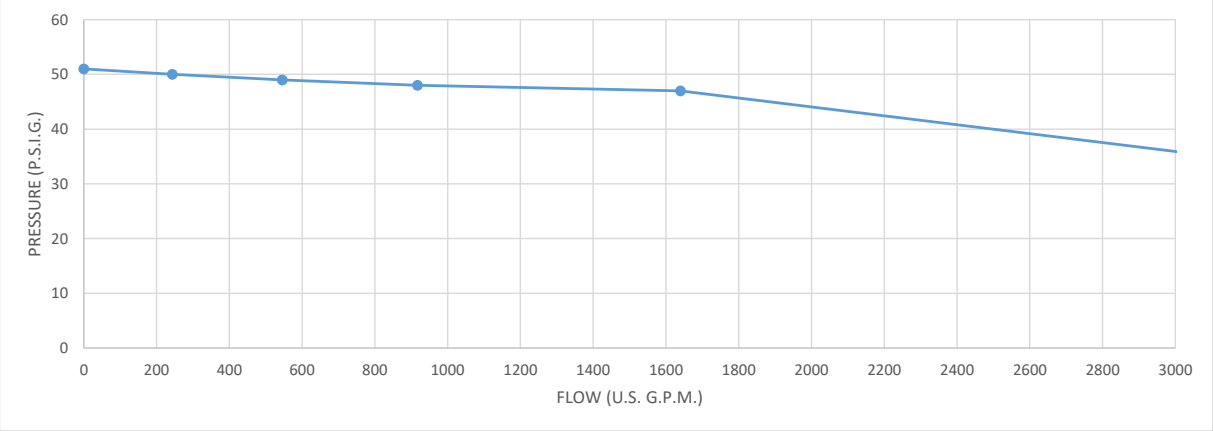
10 Estate Drive
Toronto, Ontario
Canada M1H 2Z1

T 416.282.1665
F 416.282.7702
www.corix.com

FLOW TEST REPORT

Date	JUNE 4TH 2020
Customer	COUNTERPOINT ENGINEERING
Job Location	571 WELHAM ROAD, BARRIE
Time of Test	1:00PM
Location of test (flow)	D67M HYDRANT, 571 WELHAM ROAD, BARRIE
Location of test (residual)	CV 3PORT HYDRANT, 1ST HYD SOUTH OF 571 WELHAM RD, BARRIE
Main Size (mm)	300
Static Pressure (psi)	51

	Number of Outlets & Orifice Size	PITOT Pressure (psi)	Flow (U.S. G.P.M.)	Residual Pressure (psi)
#1	1 x 1 1/8	42	243	50
#2	1 x 1 3/4	36	545	49
#3	1 x 2 1/2	30	917	48
#4	2 x 2 1/2	24	1640	47
#5			4956	20
Colour code	Blue			



Comments	PERFORMED ONE COMPLETE NFPA 291 FLOW TEST ON WELHAM ROAD, BARRIE
Crew Member	JEFF COWAN

counterpoint engineering

NFPA Theoretical Flow Calculations

Project Name: 571 Welham Road
Project Number: 20005

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 Corix Water Services, June 4, 2020:

c =	0.9	
d =	2.5	in
number of ports =	2	
p =	24	

Q_F = 1644 USGPM

Measured Static Pressure =	51	psi	
Measured Residual Pressure =	47	psi	
Desired Residual Pressure =	20	psi	, minimum per City of Barrie design criteria

Q_R = 4967 USGPM