Stormwater Management Report

Sean Mason Homes (Vet Lane Inc.)
339 Veteran's Drive
& 341 Veteran's Lane

City of Barrie
County of Simcoe

PEARSON ENGINEERING
PEARSONENG.COM

(Revised April 2021)
January 2021
18079

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Stormwater Management Report
339 Veteran's Dr. & 341 Veteran's Lane, Barrie

1. Introduction

PEARSON Engineering Ltd. has been retained by Sean Mason Homes (Vet Lane Inc.) (Client) to prepare a Stormwater Management Report (SWM Report) in support of the proposed residential development at 339 Veteran's Drive and 341 Veteran's Lane (Project) located on the east and west sides of Veteran's Lane in the City of Barrie (City). The subject lands are located north of Veteran's Drive and south of Montserrand Street and can be seen on Figure 1.

The Project site consists of two parcels of land separated by Veteran's Lane with a combined area of approximately 0.88 ha in size. The east parcel has an existing house and the west parcel is an undeveloped lot. The east parcel drains from west to east across the adjacent residential properties and is bound by Veteran's Lane to the west and existing single detached residential homes to the north, east and south. The west triangular parcel drains from south to north towards Montserrand Street and is bound by Veteran's Drive to the south, Montserrand Street to the west and north and Veteran's Lane to the east. The Project proposes converting the two separate properties as well as the existing Veteran's Lane road into one single property and construct a 38 unit apartment building and 35 townhouse units.

1.1. Terms of Reference

The intent of this SWM Report is to:

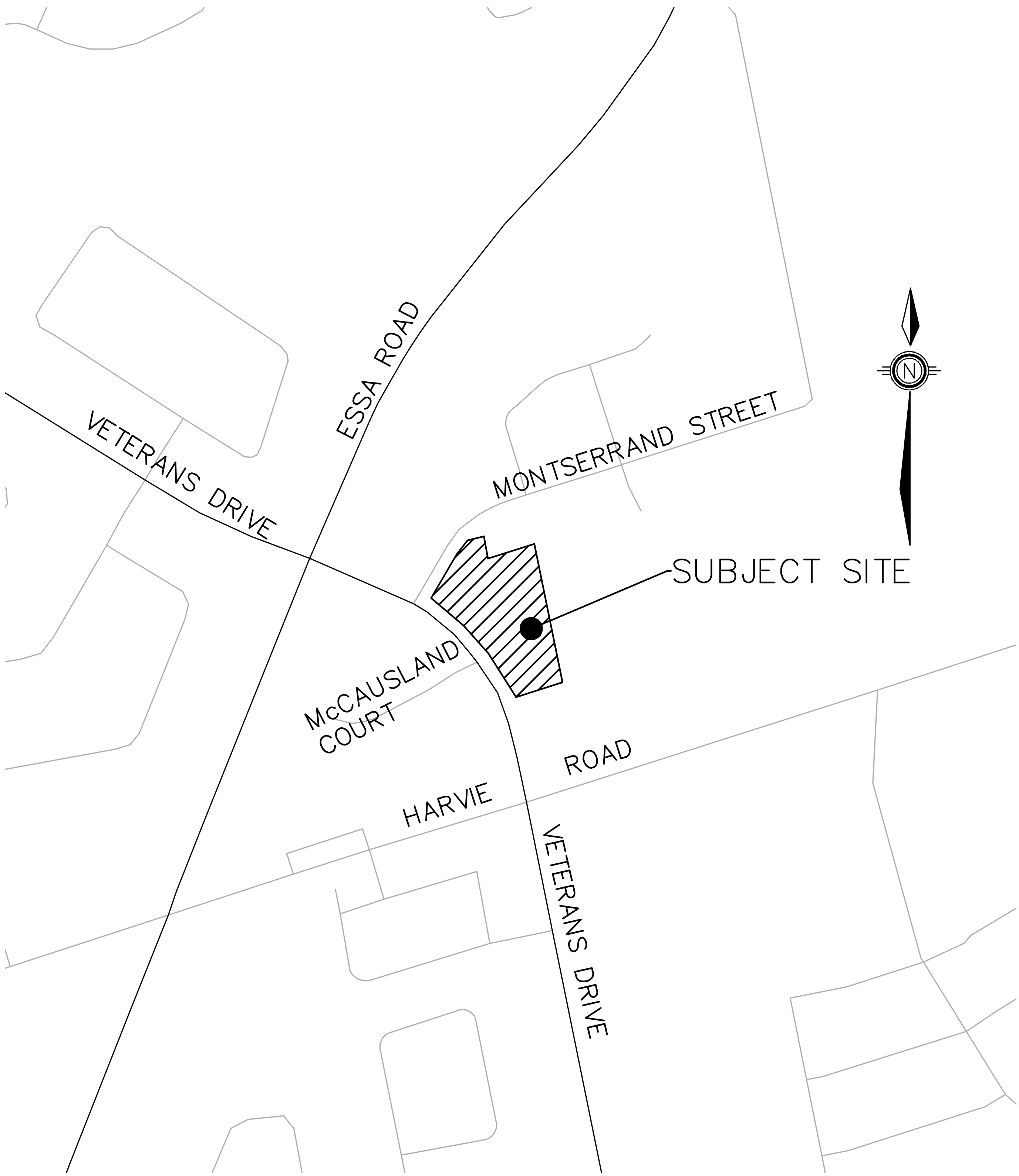
- Identify the existing site characteristics including any external drainage conditions;
- Illustrate the design of the stormwater conveyance system, capable of accommodating both minor and major storm flows from the site;
- Incorporate the appropriate Best Management Practices for controlling on-site erosion and sedimentation during construction while ultimately ensuring that the post-development release of stormwater is of adequate quality; and
- Summarize this design in a technically comprehensive and concise manner.

2. Stormwater Management

A key component of the development is the need to address environmental and related SWM issues. These are examined in a framework aimed at meeting the City, Lake Simcoe Region Conservation Authority (LSRCA) and Ministry of the Environment, Conservation and Parks (MECP) requirements. SWM parameters have evolved from an understanding of the location and sensitivity of the site's natural systems. This SWM Report focuses on the necessary measures to satisfy the MECP's SWM requirements.

It is understood the objectives of the SWM plan are to:

- Protect life and property from flooding and erosion
- Maintain water quality for ecological integrity, recreational opportunities etc.
- Protect and maintain groundwater flow regime(s).
- Protect aquatic and fishery communities and habitats.
- Maintain and protect significant natural features.



SEAN MASON HOMES
VET. LANE INC.
BARRIE, ON

SITE LOCATION PLAN

PEARSON ENGINEERING LTD.
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AMC	HORIZ SCALE	NTS	PROJECT #	18079
DRAWN BY	AMC	VERT SCALE	NTS	DRAWING #	FIG-1
CHECKED BY	MWD	DATE	APRIL 2019	REVISION #	0

2.1. Analysis Methodology

The design of the SWM Facilities for this site has been conducted in accordance with:

- The Ministry of the Environment Stormwater Management Planning and Design Manual, March 2003
- City of Barrie, Storm Drainage and Stormwater Management Policies and Design Guidelines – December 2017
- Lake Simcoe Region Conservation Authority Technical Guidelines for Stormwater Management Submissions, September 2016

2.2. Existing Conditions

The existing Project site is comprised of an existing residential lot on the east side of Veteran's Lane, Veteran's Lane and an existing vacant subdivision lot between Veteran's Lane, Veteran's Drive and Montserrand Street. Topographic survey of the site identifies that the existing vacant lot drains from south to north towards Montserrand Street infrastructure and the front portion of the existing residential lot drains to the ditch on Veterans Lane and out to Montserrand, with the eastern portion draining east via overland flow. Details of existing drainage conditions are shown on drawing STM-1 in Appendix G.

According to the Geotechnical Investigation completed by Soil Engineers Ltd. dated June 2019, the majority of the project site is comprised of Silty Sand Till with a layer of Silt on the western property. The Silty Sand Till is a frictional soil with relatively low permeability with an estimated coefficient of permeability of 10^{-5} to 10^{-6}.

Allowable peak flows for the site were calculated using the site's current conditions and can be seen in Table 1 below. Detailed calculations for the existing drainage conditions can be found in Appendix A.

Table 1: Pre-Development Peak Flows (m^3/s)

	2 year	5 year	10 year	25 year	50 year	100 year
Total Site Peak Flow (m^3/s)	0.05	0.07	0.08	0.11	0.13	0.15

2.3. Proposed Storm Drainage System

The post development drainage for the development will generally follow pre-development conditions. The majority of the project will drain towards the proposed road which includes a 1.5 m wide strip of permeable pavers. A portion of the rooftop area and the amenity space will drain to rain gardens. The permeable pavers and rain gardens have been sized to provide storage volume for the 25 mm storm over the catchment's impervious area. In the event of a storm greater than the 25 mm storm, storm runoff will be conveyed to a catchbasin and storm sewer system sized to the convey the minor storm, defined as all storm events up to the 5 year storm. The storm sewer will ultimately be conveyed northerly to the existing storm sewer on Montserrand Street.

In the event of a major storm, defined as any storm event greater than the 5 year storm, the proposed storm sewer will surcharge, forcing stormwater to the surface. The project's roadways have been graded to provide an overland flow route northerly towards the driveway entrance to Montserrand Street. Post development storm drainage patterns are shown on drawing STM-2.

An analysis of the existing storm sewer on Montserrand Street was completed to analyze the capacity of the existing downstream storm sewer from the Project site. Using as-built storm catchment plans for the area, a storm sewer design sheet was created and it was determined that significant portions of the downstream sewer system is currently over capacity. This can be attributed to the fact that the storm sewer was designed in 1995 using smaller IDF curves than the current City of Barrie standards. The post development peak flows from the development increase peak flows to the existing storm sewer by about 2% which is considered nominal. The storm sewer design sheet can be seen in Appendix B.

2.4. Stormwater Quantity Control

The proposed development will increase the imperviousness of the site and as such the post-development peak flows will increase. Quantity controls will be implemented to attenuate the increase in runoff prior to leaving the site.

Considerations were taken to reduce post-development peak flows to pre-development values. Given the size of the site, the Modified Rational Method will be used to determine the SWM release rates. A 100 mm diameter orifice tube is proposed downstream of CBMH1, causing stormwater to back up into the proposed StormTech storage units. Calculations in Appendix A demonstrate that 196 m^3 is required to control the 100-year storm event to pre-development values. Underground storage chambers containing a total of 196 m^3 are proposed, located below the central amenity space.

Table 2 below summarizes post-development peak flows for the development. By comparing Table 1 and Table 2, it can be seen that the post development peak flow for the site are smaller than pre development for all storm events. Detailed quantity control calculations can be seen in Appendix A.

Table 2: Post Development Peak Flows

	2 year (m^3/s)	5 year (m^3/s)	10 year (m^3/s)	25 year (m^3/s)	50 year (m^3/s)	100 year (m^3/s)
Controlled Flow (m^3/s)	0.03	0.03	0.03	0.04	0.07	0.09
Uncontrolled Flow (m^3/s)	0.02	0.02	0.03	0.04	0.04	0.05
Total Site Peak Flow (m^3/s)	**0.05**	**0.05**	**0.06**	**0.08**	**0.11**	**0.14**

2.5. Stormwater Quality Control

The Ministry of the Environment, Conservation and Parks (MECP) in March 2003 issued a “Stormwater Management Planning and Design Manual”. This manual has been adopted by a variety of agencies including the City of Barrie. The Stormwater Quality Control objective will be to ensure Enhanced Protection quality control as stated in the MECP manual. To achieve enhanced protection, permanent and temporary control of erosion and sediment transport are proposed.

2.5.1. Permanent Quality Control

The development’s active parking facilities pose a risk to stormwater quality through the collection of grit, salt, sand and oils on the impervious surfaces. The majority of stormwater from the site will receive pretreatment from the proposed permeable pavers by filtering through and draining into a perforated pipe located within the pavers. Stormwater from a portion of the townhouse blocks will drain to rain gardens located adjacent to the building. The permeable paver areas have been designed with an impermeable liner.

The catchbasins include sumps which will settle larger sediment particles. Heavy metals have an affinity to adsorb to sediment particles in runoff and the OGS unit is proposed to remove accumulated sediment from the stormwater. Stormwater will be conveyed by the storm sewer system and will flow through an oil/grit separator (OGS) unit prior to draining to the existing storm sewer on Montserrand Street. A CDS treatment unit is the proposed OGS which will treat the post-development flows to the MECP criteria.

Regular inspections and proper maintenance of the proposed OGS unit will ensure the TSS removal rate will be achieved as well as protect the downstream watercourse from oil, grease, and heavy metals. Detailed information and sizing for the OGS unit can be seen in Appendix F.

The MECP standard stipulates a Total Suspended Solids (TSS) removal of at least 80% for the enhanced protection level according to Table 3.2 in the MECP SWM Planning & Design Manual. The LSRCA guidelines state that an OGS unit can only provide a maximum of 50% TSS removal, leaving the remaining 30% to be treated using LID features. The majority of the site's impervious areas are conveyed to permeable pavers and rain gardens which have been sized for the 25 mm storm, exceeding the MECP criteria for Enhanced Quality control. Therefore, the quality control objective for the project has been met. Refer to calculations in Appendix A for more details.

2.5.2. During Construction Activities

During construction, earth grading and excavation will create the potential for soil erosion and sedimentation. It is imperative that effective environmental and sedimentation controls are in place and maintained throughout the duration of construction activities to ensure stormwater runoff's quality.

Therefore, the following recommendations shall be implemented and maintained during construction to achieve acceptable stormwater runoff quality:

- Installation of silt fence along the entire perimeter of the site to reduce sediment migration onto surrounding properties.
- Installation of a construction entrance mat to minimize transportation of sediment onto roadways.
- Restoration of exposed surfaces with vegetative and non-vegetative material as soon as construction schedules permit, the duration of which is not to exceed 30 days.
- Reduce stormwater drainage velocities where possible.
- Minimize the amount of existing vegetation removed.

2.6. Volume Control

As the project site meets the definition of Major Development as per LSRCA Guidelines, considerations were taken to meet the volume control criteria detailed in section 2.2.2. The LSRCA guidelines state that the 25 mm over the impervious area of the site is to be infiltrated, with flexible alternatives if this criteria cannot be met.

Therefore it is proposed to provide on-site storage to achieve a combination of infiltration and filtration of the 25 mm storm event over the impervious area of each catchment area, which results in a total volume of approximately 143 m^3. Approximately 30 m^3 of infiltration will be provided in the proposed rain gardens. The remaining 113 m^3 will be provided via filtration through proposed permeable pavers. Refer to Appendix A for detailed sizing calculations for the LID features.

3. Water Balance

Since the post development state will increase the imperviousness of the site, considerations were taken in regards to groundwater recharge. Under pre-development conditions, the project site had an annual recharge volume of 2,003 m^3. With the increased imperviousness of the site, this recharge will be reduced to 693 m^3, resulting in a deficit volume of 1,310 m^3.

In order to infiltrate the deficit of 1,310 m^3, typically rooftop areas would be conveyed to an infiltration gallery. However, as per the Seasonal Groundwater Level Monitoring report completed by Soil Engineers Ltd. Dated September 15, 2020, the seasonally high groundwater elevation is approximately 1.3 m to 1.44 m below existing ground. As such, the minimum MECP separation of 1.0 m to the groundwater could not be achieved for an underground infiltration gallery.

The rain gardens located throughout the site have been designed to infiltrate the 25 mm storm from the rooftop area for a total storage volume of 30 m^3. Given the site constraints, no additional infiltration measures are proposed. Water balance calculations can be found in Appendix C.

4. Phosphorus

Local conservation authorities have determined the importance of reducing phosphorus levels in water courses in this area. As such, best efforts are to be employed in order to reduce phosphorus levels being contributed from the site.

Under pre-development conditions, the majority of the existing site drains uncontrolled to Veteran's Lane, with a portion of the existing residential lot on the east side of Veteran's Lane draining to the east. The existing vacant subdivision lot on the west side of Veteran's Lane as well as the roadway area of Veteran's Lane were previously included in a plan of subdivision which typically would not be included in phosphorous budget calculations. Therefore, the phosphorous budget was completed considering just the existing residential lot on the east side of Veteran's Lane.

The existing residential lot area generates approximately 0.07 kg of phosphorus annually. With the increased impervious area of the site, this will be increased to approximately 0.69 kg of phosphorus annually if uncontrolled. Best efforts will be used in order to reduce the phosphorus loading as much as is reasonably possible with a treatment train approach. Rooftop runoff from the proposed townhouse units on the eastern property will be conveyed to splash pads via roof leader which will drain towards rain gardens and permeable pavers located throughout the site. Excess runoff will flow to the proposed road to a catchbasin system complete with 600 mm deep sediment sump to capture larger sediment particles. The following Table 3 details the anticipated phosphorus loadings for the pre and post development conditions.

Table 3: Phosphorus Loadings

	Total P (kg)
Pre-Development	0.07
Uncontrolled Post Development	0.69
Controlled Post Development	0.26

Detailed calculations can be found in Appendix D.

5. Conclusions

Quantity control for the development is provided in the StormTech underground storage units allowing post-development peak flows to be released at pre-development values through an orifice tube.

Quality control will be provided with the use of an oil/grit separator and LID treatment train approach to satisfy the MECP Enhanced level requirements.

The proposed low impact development features will promote groundwater recharge for water balance and reduce post development phosphorous loading for the site.

All of which is respectfully submitted,
Pearson Engineering Ltd.

Taylor Arkell, P. Eng
Project Engineer

Mike Dejean, P.Eng.
Manager of Engineering Services

Appendix A

Stormwater Management Calculations

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Sean Homes - Veteran's Lane
Calculation of Runoff Coefficients

Runoff Coefficient	=	0.16	0.95	0.95	0.08	0.95	Weighted
Surface Cover	=	Grass	Asphalt	Building	Forest	Conc.	Runoff Coefficient
Pre Development	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	
1	8827	7668	1012	147	0	0	0.26
Pre Total	8827	7668	1012	147	0	0	0.26
Post Development	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	
1	6937	1841	2234	2528	0	334	0.74
2	1890	1256	89	468	0	78	0.43
Post Total	8827	3097	2323	2996	0	412	0.67

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Sean Homes - Veteran's Lane
Pre-Development Peak Flows

City of Barrie

Storm (yrs)	Coeff A	Coeff B	Coeff C
2	**678.09**	**4.70**	**0.78**
5	**853.61**	**4.70**	**0.77**
10	**975.87**	**4.70**	**0.76**
25	**1146.28**	**4.92**	**0.76**
50	**1236.15**	**4.70**	**0.75**
100	**1426.41**	**5.27**	**0.76**

Modified Rational Method
Q = CiCIA / 360

Where:

Q -	Flow Rate (m^3/s)
C -	Runoff Coefficient
I -	Storm Intensity (mm/hr)
A -	Area (ha.)
Ci -	Peaking Coefficient

Area Number	1	
Area	0.88	ha
Runoff Coefficient	0.26	
Time of Concentration	10	min
Return Rate	2	year
Peaking Coefficient (Ci)	1.00	
Rainfall Intensity	83.1	mm/hr
Pre Development Peak Flow	0.05	m^3/s
Return Rate	5	year
Peaking Coefficient (Ci)	1.00	
Rainfall Intensity	108.9	mm/hr
Pre Development Peak Flow	0.07	m^3/s
Return Rate	10	year
Peaking Coefficient (Ci)	1.00	
Rainfall Intensity	126.5	mm/hr
Pre Development Peak Flow	0.08	m^3/s
Return Rate	25	year
Peaking Coefficient (Ci)	1.10	
Rainfall Intensity	148.2	mm/hr
Pre Development Peak Flow	0.11	m^3/s
Return Rate	50	year
Peaking Coefficient (Ci)	1.20	
Rainfall Intensity	164.2	mm/hr
Pre Development Peak Flow	0.13	m^3/s
Return Rate	100	year
Peaking Coefficient (Ci)	1.25	
Rainfall Intensity	180.2	mm/hr
Pre Development Peak Flow	0.15	m^3/s

PEARSON ENGINEERING

Sean Homes - Veteran's Lane
Post-Development Peak Flows

City of Barrie

Storm (yrs)	Coeff A	Coeff B	Coeff C
2	678.09	4.70	0.78
5	853.61	4.70	0.77
10	975.87	4.70	0.76
25	1146.28	4.92	0.76
50	1236.15	4.70	0.75
100	1426.41	5.27	0.76

Modified Rational Method
Q = CiCIA / 360

Where:

Q -	Flow Rate (m^3/s)
C -	Runoff Coefficient
I -	Storm Intensity (mm/hr)
A -	Area (ha.)
Ci -	Peaking Coefficient

	Controlled	Uncontrolled
Area Number	1	2
Area	0.69 ha	0.19 ha
Runoff Coefficient	0.74	0.43
Time of Concentration	10 min	10 min
Return Rate	2 year	2 year
Peaking Coefficient (Ci)	1.00	1.00
Rainfall Intensity	83.1 mm/hr	83.1 mm/hr
Post Development Peak Flow	0.12 m^3/s	0.02 m^3/s
Return Rate	5 year	5 year
Peaking Coefficient (Ci)	1.00	1.00
Rainfall Intensity	108.9 mm/hr	108.9 mm/hr
Post Development Peak Flow	0.16 m^3/s	0.02 m^3/s
Return Rate	10 year	10 year
Peaking Coefficient (Ci)	1.00	1.00
Rainfall Intensity	126.5 mm/hr	126.5 mm/hr
Post Development Peak Flow	0.18 m^3/s	0.03 m^3/s
Return Rate	25 year	25 year
Peaking Coefficient (Ci)	1.10	1.10
Rainfall Intensity	148.2 mm/hr	148.2 mm/hr
Post Development Peak Flow	0.23 m^3/s	0.04 m^3/s
Return Rate	50 year	50 year
Peaking Coefficient (Ci)	1.20	1.20
Rainfall Intensity	164.2 mm/hr	164.2 mm/hr
Post Development Peak Flow	0.28 m^3/s	0.04 m^3/s
Return Rate	100 year	100 year
Peaking Coefficient (Ci)	1.25	1.25
Rainfall Intensity	180.2 mm/hr	180.2 mm/hr
Post Development Peak Flow	0.32 m^3/s	0.05 m^3/s

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Sean Homes - Veteran's Lane
Quantity Control Volume Calculations

DATE:	26-Apr-21
FILE:	18079
CONTRACT/PROJECT:	Sean Mason Homes - Veterans
COMPLETED BY:	AMC

Modified Rational Method Parameters

Pre Development Area (ha)	Post Development Area (ha)	Time of Concentration (min)	Time Increments (min)	Pre Development Runoff Coefficient	Post Development Runoff Coefficient
0.883	0.694	10	2	0.26	0.74

Note: Refer to page Calculation of Runoff Coefficients for detailed calculations of Modified Rational Method parameters.

Pre-Development Runoff Rate

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
C	0.26	0.26	0.26	0.29	0.32	0.33
I	83.11	108.92	126.55	148.15	164.22	180.15
A	0.88	0.88	0.88	0.88	0.88	0.88
Q	0.05	0.07	0.08	0.11	0.13	0.15

Note: Q= 0.00278CIA

Rainfall Station	Barrie

SWM Pond Design Input

Storm (yrs)	Chicago Storm Coefficient A	Chicago Storm Coefficient B	Chicago Storm Coefficient C	Allowable Outflow (m3/s)	Post Development Runoff Coefficient
2	678.085	4.699	0.781	0.03	0.74
5	853.608	4.699	0.766	0.03	0.74
10	975.865	4.699	0.760	0.03	0.74
25	1146.275	4.922	0.757	0.04	0.81
50	1236.150	4.699	0.751	0.07	0.89
100	1426.408	5.273	0.759	0.09	0.93

Results

Storm Event	Storage m^3	Time min
2	75	40
5	113	54
10	140	62
25	196	74
50	196	50
100	196	40

Note: Storage volume calculated as per Hydrology Handbook, Second Edition, American Society of Civil Engineers, 1996

Time (min)	2 Year Intensity mm/hr	2 Year Inflow m^3/s	2 Year Outflow m^3/s	2 Year Storage m^3	Difference	5 Year Intensity mm/hr	5 Year Inflow m^3/s	5 Year Outflow m^3/s	5 Year Storage m^3	Difference
2	153.52	0.219	0.029	16	15	198.85	0.284	0.032	23	20
4	125.19	0.179	0.029	31	10	162.79	0.232	0.032	42	14
6	106.50	0.152	0.029	41	7	138.93	0.198	0.032	56	10
8	93.16	0.133	0.029	48	6	121.83	0.174	0.032	66	8
10	83.11	0.119	0.029	54	4	108.92	0.155	0.032	74	6
12	75.23	0.107	0.029	58	3	98.78	0.141	0.032	80	5
14	68.86	0.098	0.029	61	3	90.58	0.129	0.032	86	4
16	63.61	0.091	0.029	64	2	83.80	0.120	0.032	90	4
18	59.19	0.085	0.029	67	2	78.08	0.111	0.032	94	3
20	55.41	0.079	0.029	68	2	73.19	0.104	0.032	97	3
22	52.14	0.074	0.029	70	1	68.95	0.098	0.032	99	2
24	49.28	0.070	0.029	71	1	65.24	0.093	0.032	102	2
26	46.76	0.067	0.029	72	1	61.96	0.088	0.032	104	2
28	44.51	0.064	0.029	73	1	59.04	0.084	0.032	105	1
30	42.49	0.061	0.029	74	1	56.41	0.080	0.032	107	1
32	40.67	0.058	0.029	74	0	54.04	0.077	0.032	108	1
34	39.02	0.056	0.029	75	0	51.89	0.074	0.032	109	1
36	37.51	0.054	0.029	75	0	49.92	0.071	0.032	110	1
38	36.13	0.052	0.029	75	0	48.12	0.069	0.032	111	1
40	34.87	0.050	0.029	75	0	46.47	0.066	0.032	111	1
42	33.69	0.048	0.029	75	0	44.93	0.064	0.032	112	0
44	32.61	0.047	0.029	75	0	43.51	0.062	0.032	112	0
46	31.60	0.045	0.029	75	0	42.19	0.060	0.032	113	0
48	30.66	0.044	0.029	75	0	40.96	0.058	0.032	113	0
50	29.78	0.043	0.029	75	0	39.81	0.057	0.032	113	0
52	28.96	0.041	0.029	74	0	38.73	0.055	0.032	113	0
54	28.18	0.040	0.029	74	0	37.71	0.054	0.032	113	0
56	27.45	0.039	0.029	74	0	36.76	0.052	0.032	113	0
58	26.77	0.038	0.029	73	-1	35.86	0.051	0.032	113	0
60	26.12	0.037	0.029	73	-1	35.00	0.050	0.032	113	0
62	25.51	0.036	0.029	72	-1	34.20	0.049	0.032	113	0
64	24.92	0.036	0.029	71	-1	33.43	0.048	0.032	112	0
66	24.37	0.035	0.029	71	-1	32.70	0.047	0.032	112	0
68	23.85	0.034	0.029	70	-1	32.01	0.046	0.032	112	0
70	23.35	0.033	0.029	69	-1	31.35	0.045	0.032	111	0
72	22.87	0.033	0.029	69	-1	30.73	0.044	0.032	111	0
74	22.41	0.032	0.029	68	-1	30.13	0.043	0.032	111	0
76	21.98	0.031	0.029	67	-1	29.55	0.042	0.032	110	-1
78	21.56	0.031	0.029	67	-1	29.00	0.041	0.032	110	-1

Time (min)	10 Year Intensity mm/hr	10 Year Inflow m^3/s	10 Year Outflow m^3/s	10 Year Storage m^3	Difference	25 Year Intensity mm/hr	25 Year Inflow m^3/s	25 Year Outflow m^3/s	25 Year Storage m^3	Difference
2	229.94	0.328	0.033	27	23	264.99	0.416	0.038	36	30
4	188.54	0.269	0.033	50	16	218.67	0.343	0.038	66	21
6	161.10	0.230	0.033	67	12	187.63	0.294	0.038	88	16
8	141.42	0.202	0.033	79	9	165.20	0.259	0.038	104	13
10	126.55	0.181	0.033	88	8	148.15	0.232	0.038	117	10
12	114.85	0.164	0.033	96	6	134.69	0.211	0.038	127	9
14	105.39	0.150	0.033	102	5	123.77	0.194	0.038	136	7
16	97.56	0.139	0.033	108	5	114.71	0.180	0.038	143	6
18	90.95	0.130	0.033	112	4	107.05	0.168	0.038	149	5
20	85.30	0.122	0.033	116	3	100.48	0.158	0.038	155	5
22	80.40	0.115	0.033	119	3	94.78	0.149	0.038	160	4
24	76.10	0.109	0.033	122	3	89.77	0.141	0.038	164	4
26	72.31	0.103	0.033	125	2	85.34	0.134	0.038	168	3
28	68.92	0.098	0.033	127	2	81.39	0.128	0.038	171	3
30	65.88	0.094	0.033	129	2	77.83	0.122	0.038	174	3
32	63.13	0.090	0.033	131	2	74.62	0.117	0.038	177	2
34	60.64	0.087	0.033	132	1	71.70	0.113	0.038	179	2
36	58.36	0.083	0.033	134	1	69.03	0.108	0.038	181	2
38	56.27	0.080	0.033	135	1	66.58	0.104	0.038	183	2
40	54.35	0.078	0.033	136	1	64.32	0.101	0.038	185	2
42	52.57	0.075	0.033	137	1	62.24	0.098	0.038	186	1
44	50.92	0.073	0.033	138	1	60.30	0.095	0.038	188	1
46	49.38	0.070	0.033	138	1	58.50	0.092	0.038	189	1
48	47.95	0.068	0.033	139	0	56.82	0.089	0.038	190	1
50	46.61	0.067	0.033	139	0	55.25	0.087	0.038	191	1
52	45.36	0.065	0.033	140	0	53.77	0.084	0.038	192	1
54	44.18	0.063	0.033	140	0	52.38	0.082	0.038	193	1
56	43.07	0.061	0.033	140	0	51.08	0.080	0.038	193	1
58	42.02	0.060	0.033	140	0	49.84	0.078	0.038	194	0
60	41.03	0.059	0.033	140	0	48.68	0.076	0.038	195	0
62	40.09	0.057	0.033	140	0	47.57	0.075	0.038	195	0
64	39.20	0.056	0.033	140	0	46.52	0.073	0.038	195	0
66	38.36	0.055	0.033	140	0	45.52	0.071	0.038	196	0
68	37.55	0.054	0.033	140	0	44.58	0.070	0.0383	196	0
70	36.78	0.052	0.033	140	0	43.67	0.069	0.0383	196	0
72	36.05	0.051	0.033	140	0	42.81	0.067	0.0383	196	0
74	35.36	0.050	0.033	140	0	41.99	0.066	0.0383	196	0
76	34.69	0.049	0.033	139	0	41.20	0.065	0.0383	196	0
78	34.05	0.049	0.033	139	0	40.44	0.063	0.0383	196	0

Time (min)	50 Year Intensity mm/hr	50 Year Inflow m^3/s	50 Year Outflow m^3/s	50 Year Storage m^3	Difference	100 Year Intensity mm/hr	100 Year Inflow m^3/s	100 Year Outflow m^3/s	100 Year Storage m^3	Difference
2	296.30	0.507	0.066	37	35	316.38	0.564	0.095	34	39
4	243.52	0.417	0.066	72	24	263.10	0.469	0.095	73	27
6	208.47	0.357	0.066	97	18	226.85	0.405	0.095	100	20
8	183.29	0.314	0.066	115	14	200.41	0.357	0.095	120	16
10	164.22	0.281	0.066	129	11	180.15	0.321	0.095	136	12
12	149.22	0.255	0.066	141	9	164.09	0.293	0.095	148	10
14	137.07	0.235	0.066	150	8	151.00	0.269	0.095	158	8
16	127.00	0.217	0.066	157	6	140.09	0.250	0.095	166	7
18	118.50	0.203	0.066	164	5	130.86	0.233	0.095	173	5
20	111.22	0.190	0.066	169	5	122.92	0.219	0.095	178	4
22	104.90	0.180	0.066	174	4	116.02	0.207	0.095	182	4
24	99.36	0.170	0.066	178	3	109.95	0.196	0.095	186	3
26	94.46	0.162	0.066	181	3	104.57	0.186	0.095	189	2
28	90.09	0.154	0.066	184	2	99.76	0.178	0.095	191	2
30	86.16	0.147	0.066	187	2	95.44	0.170	0.095	193	1
32	82.61	0.141	0.066	189	2	91.53	0.163	0.095	194	1
34	79.38	0.136	0.066	190	1	87.97	0.157	0.095	195	1
36	76.43	0.131	0.066	192	1	84.71	0.151	0.095	196	0
38	73.73	0.126	0.066	193	1	81.73	0.146	0.095	196	0
40	71.24	0.122	0.066	194	1	78.97	0.141	0.095	196	0
42	68.93	0.118	0.066	195	1	76.42	0.136	0.095	196	0
44	66.79	0.114	0.066	195	0	74.05	0.132	0.095	195	-1
46	64.81	0.111	0.066	196	0	71.85	0.128	0.095	195	-1
48	62.95	0.108	0.066	196	0	69.80	0.124	0.095	194	-1
50	61.21	0.105	0.066	196	0	67.87	0.121	0.095	193	-1
52	59.58	0.102	0.066	196	0	66.06	0.118	0.095	192	-1
54	58.05	0.099	0.066	196	0	64.36	0.115	0.095	190	-1
56	56.61	0.097	0.066	196	0	62.76	0.112	0.095	189	-2
58	55.25	0.095	0.066	195	-1	61.25	0.109	0.095	187	-2
60	53.96	0.092	0.066	195	-1	59.82	0.107	0.095	185	-2
62	52.74	0.090	0.066	194	-1	58.47	0.104	0.095	184	-2
64	51.58	0.088	0.066	193	-1	57.18	0.102	0.095	182	-2
66	50.48	0.086	0.066	192	-1	55.96	0.100	0.095	179	-2
68	49.44	0.085	0.066	192	-1	54.80	0.098	0.095	177	-2
70	48.44	0.083	0.066	191	-1	53.69	0.096	0.095	175	-175
72	47.49	0.081	0.066	190	-1	52.63	0.094	0.000	0	0
74	46.58	0.080	0.066	188	-1	51.62	0.092	0.000	0	0
76	45.71	0.078	0.066	187	-1	50.65	0.090	0.000	0	0
78	44.88	0.077	0.066	186	-1	49.73	0.089	0.000	0	0

: Maximum Storage Volume

Q= 0.0028*C*I*A (cms)
C=RUNOFF COEFFICIENT
I-RAINFALL INTENSITY= A/(Time+B)^C
A=AREA (ha)

Sean Homes - Veteran's Lane
Storm Sewer Design
5-year

DATE:	26-Apr-21
FILE:	18079
CONTRACT/PROJECT	Sean Homes

Areas	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	S	D	Q FULL	V FULL
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)
Area 1	CBMH3	CBMH2	30.5	0.74	0.69	0.51	0.51	10.00	0.23	113.21	0.16	1.0	600.0	0.61	2.17
-	CBMH2	CBMH1	41.5	0.00	0.00	0.00	0.51	10.23	0.32	111.72	0.16	1.0	600.0	0.61	2.17
-	STM TANKS	CBMH4	2.8	0.00	0.00	0.00	0.51	10.55	0.02	109.76	0.16	2.0	300.0	0.14	1.94
-	CBMH4	CBMH1	32.9	0.00	0.00	0.00	0.51	10.58	0.40	109.62	0.16	1.0	300.0	0.10	1.37
-	STM CAP	CBMH1	5.8	0.00	0.00	0.00	0.51	10.98	0.09	107.27	0.15	1.0	200.0	0.03	1.04
-	CBMH1	STM OGS	24.6	0.00	0.00	0.00	0.51	11.07	0.18	106.75	0.15	2.9	300.0	0.16	2.33
Area 2	STM OGS	MH1	5.0	0.43	0.19	0.08	0.59	11.25	0.04	105.76	0.17	2.8	300.0	0.16	2.29
-	MH1	EX. STM1	11.8	0.00	0.00	0.00	0.59	11.28	0.09	105.56	0.17	2.8	300.0	0.16	2.29

Sean Homes - Veteran's Lane
Permeable Pavers Sizing Calculations

Required storage volume calculated over 25 mm of the total impervious area on the site for LSRCA Volume Control:

Storage Volume	=	5,731	x	0.025
Area Storage Volume Required	=	143.3	m^3	

Note: Rain gardens provide 30 m^3 of storage, therefore the pavers will be sized to provide the remaining 113 m^3.

Find Storage Volume provided in Permeable Pavers:

Total Area of Pavers (A)	=	565.0	m^2
Depth of Stone Trench (d)	=	0.50	m
Storage Volume (V)	=	0.4 (A x d)	
	=	113.0	m^3

The site has a total area of pavers of 596 m^2, therefore volume control criteria have been met.

Sean Homes - Veteran's Lane
Rain Garden Sizing Calculations

Infiltration volumes from MOE Stormwater Management Planning and Design Manual to size Bioretention Filter Table 3.2 Water Quality Storage Requirements are as follows:

Townhouse Block 1 Area	=	0.01	ha	
Total Imperviousness	=	100%		
Storage Volume	=	44.2	m^3/ha	(Enhanced 80% long-term S.S. removal)
Area 1 Storage Volume Required	=	0.01	x	44.2
	=	0.5	m^3	
Townhouse Block 2 Area	=	0.03	ha	
Total Imperviousness	=	75%		
Storage Volume	=	36.6	m^3/ha	(Enhanced 80% long-term S.S. removal)
Area 2 Storage Volume Required	=	0.03	x	36.6
	=	1.2	m^3	
Townhouse Block 3 Area	=	0.03	ha	
Total Imperviousness	=	90%		
Storage Volume	=	41.2	m^3/ha	(Enhanced 80% long-term S.S. removal)
Area 3 Storage Volume Required	=	0.03	x	41.2
	=	1.2	m^3	
Townhouse Block 5 Area	=	0.02	ha	
Total Imperviousness	=	100%		
Storage Volume	=	44.2	m^3/ha	(Enhanced 80% long-term S.S. removal)
Area 4 Storage Volume Required	=	0.02	x	44.2
	=	1.0	m^3	
Townhouse Block 6 Area	=	0.02	ha	
Total Imperviousness	=	100%		
Storage Volume	=	44.2	m^3/ha	(Enhanced 80% long-term S.S. removal)
Area 5 Storage Volume Required	=	0.02	x	44.2
	=	1.0	m^3	

Infiltration volumes using 25 mm over the impervious area as per LSRCA guidelines is as follows:

Townhouse Block 1	=	2.98	m^3
Townhouse Block 2	=	7.98	m^3
Townhouse Block 3	=	7.10	m^3
Townhouse Block 5	=	5.85	m^3
Townhouse Block 6	=	5.83	m^3

Note: Therefore, the storage required with 25 mm of the total impervious area on the site governs.

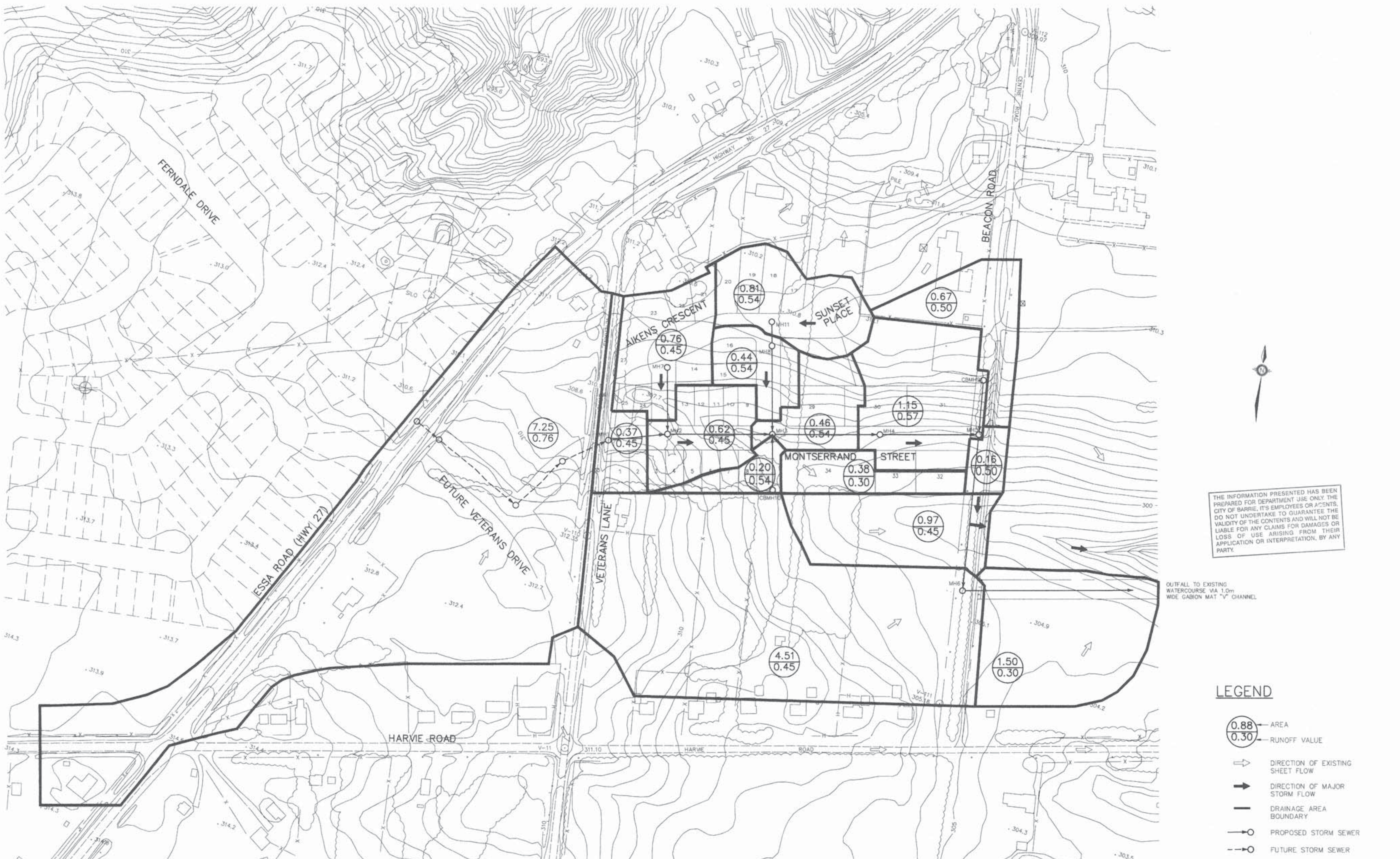
Find Storage Volume provided in Rain Gardens:

Rain Garden 1	=	3.2	m^2
Depth of Trench (d)	=	0.50	m
Surface Ponding Depth (h)	=	0.10	m
Storage Volume (V)	=	0.4 (A x d) + (h x A)	
	=	1.0	m^3

Rain Garden 2	=	3.2	m^2
Depth of Trench (d)	=	0.50	m
Surface Ponding Depth (h)	=	0.10	m
Storage Volume (V)	=	0.4 (A x d) + (h x A)	
	=	1.0	m^3
Rain Garden 3	=	3.2	m^2
Depth of Trench (d)	=	0.50	m
Surface Ponding Depth (h)	=	0.10	m
Storage Volume (V)	=	0.4 (A x d) + (h x A)	
	=	1.0	m^3
Rain Garden 5	=	2.4	m^2
Depth of Trench (d)	=	0.50	m
Surface Ponding Depth (h)	=	0.10	m
Storage Volume (V)	=	0.4 (A x d) + (h x A)	
	=	0.7	m^3
Rain Garden 6	=	2.4	m^2
Depth of Trench (d)	=	0.50	m
Surface Ponding Depth (h)	=	0.10	m
Storage Volume (V)	=	0.4 (A x d) + (h x A)	
	=	0.7	m^3

Appendix B

Existing Storm Sewer Analysis



Notes

LICENSED PROFESSIONAL ENGINEER — H.C.D. GLAVIC — PROVINCE OF ONTARIO

BENCHMARK:

NO.	REVISIONS	DATE	INITIAL
4	AS CONSTRUCTED	FEB 06	R.P.
3	ADD MEDIUM DENSITY BLOCK SERVICING	MAY 97	S.N.
2	THIRD SUBMISSION	MAR. 96	H.G.
1	FIRST SUBMISSION COMMENTS	FEB. 96	H.G.

Approved

CITY OF BARRIE
APPROVED
DATE. . . . .
DIRECTOR OF MUNICIPAL WORKS

Approved

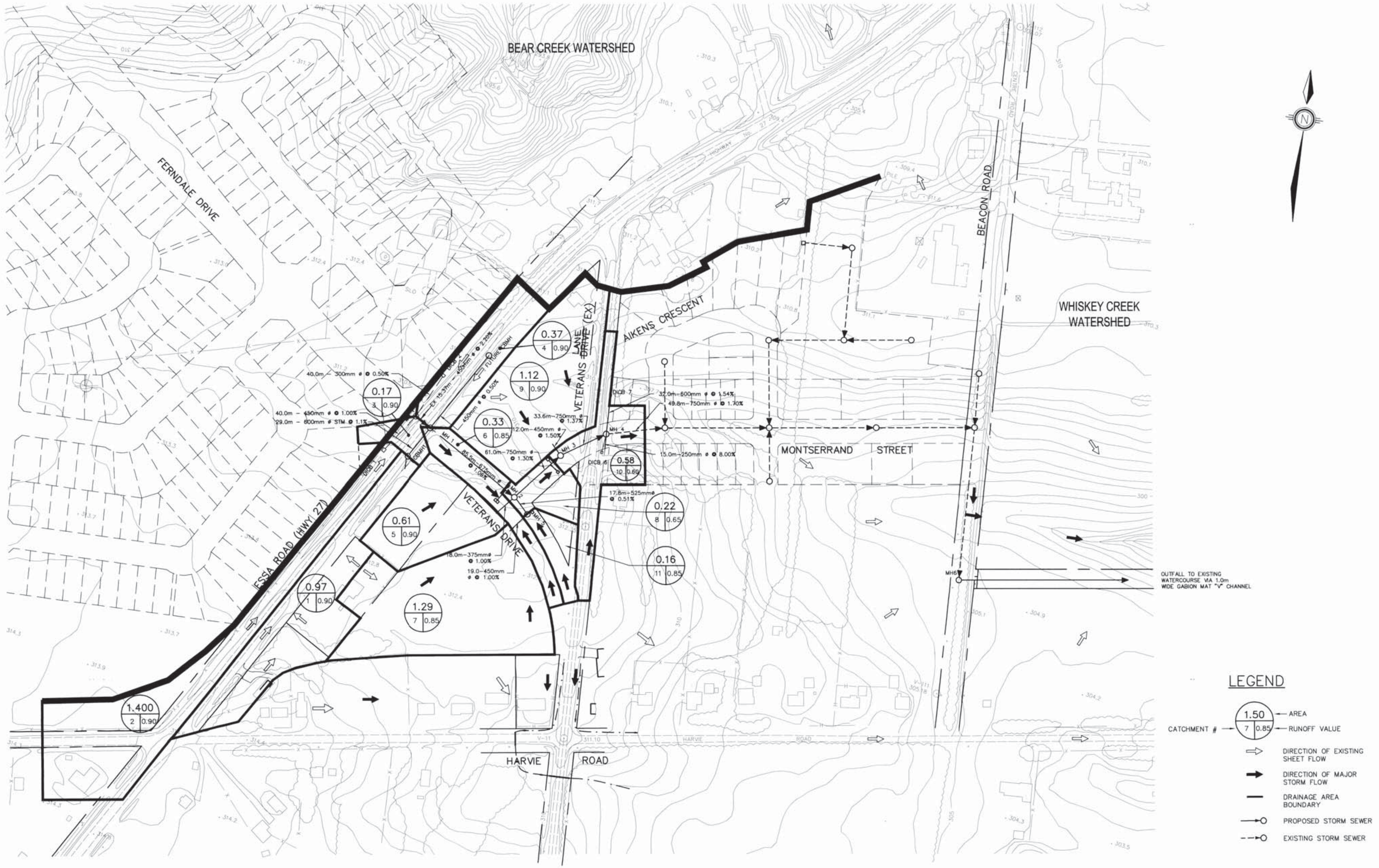
BEACON ROAD SUBDIVISION

STORM DRAINAGE AREA PLAN

RG ROBINSON AND ASSOCIATES (BARRIE) LTD — CONSULTING ENGINEERS
10 High Street, Suite 200, Barrie, Ontario (705) 721-9222

SCALE: 1:1500 — 322-91014-21/26
DESIGN HG — CHECKED HG
DRAWN MR — DATE DEC. 95 — DWG. № G-4

Sub 202 1995 - 081 - 007



L:\LandProjects\0201640\dwg\G-2_AC.dwg, Model, 26/11/2003 11:59:34 AM, ssmith

Notes

M. A. TATARYN — PROVINCE OF ONTARIO

BENCHMARK:

NO.	REVISIONS	DATE	INITIAL
3.	AS CONSTRUCTED	02/10/03	MAT
2.	REVISIONS	MAR/02	GR
1.	2ND SUBMISSION: CATCHMENTS 3,5,7,8 MOD. – FUTURE ESSA ROAD SEWERS ADDED	APR 16/01	GR

Approved

Approved

ESSA /FERNDALE DEVELOPMENT

STORM DRAINAGE AREA PLAN

RG ROBINSON AND ASSOCIATES (BARRIE) LTD — CONSULTING ENGINEERS AND PLANNERS
10 High Street, Suite 200, Barrie, Ontario (705) 721-9222

SCALE: 1:1500 — 874-02016-20

DESIGN DSM/GR — CHECKED GR
DRAWN LK/BJC — DATE 04/24/96
DWG. Nº G-2

2003-068-003 2003-68

PEARSON ENGINEERING LTD.

Q= 0.0028*C*I*A (cms)

C=RUNOFF COEFFICIENT

I-RAINFALL INTENSITY= A/(Time+B)^C

A=AREA (ha)

Veteran's Lane
Storm Sewer Design
Pre Development

DATE: 7-Oct-19

FILE: 18079

CONTRACT/PROJECT VETERAN'S LANE

Areas	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	S	D	Q FULL	V FULL	% FULL
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)	(%)
2	DICB1	MH1	40.0	0.90	1.40	1.26	1.26	10.00	0.37	101.72	0.36	1.00	450	0.29	1.79	125%
4	DICB2	MH1	40.0	0.90	0.37	0.33	0.33	10.00	0.69	101.72	0.09	0.50	300	0.07	0.97	138%
3	MH1	MH1	15.4	0.90	0.17	0.15	1.75	10.69	0.10	101.72	0.49	2.20	450	0.42	2.66	117%
1	CBMH1	MH1	29.0	0.90	0.97	0.87	0.87	10.00	0.21	101.72	0.25	1.10	600	0.64	2.28	38%
	FUTURE CBMH	MH1										0.50	450	0.20	1.27	
5, 6	MH1	MH2	85.5	0.88	0.94	0.83	3.45	10.79	0.59	101.72	0.97	1.06	675	0.87	2.42	113%
7, 11	MH5	MH2	17.8	0.85	1.45	1.23	1.23	10.00	0.21	101.72	0.35	0.51	525	0.31	1.42	113%
8	MH2	MH3	61.0	0.65	0.22	0.14	4.82	11.37	0.35	103.42	1.39	1.30	750	1.27	2.87	109%
9	MH3	MH4	33.6	0.90	1.12	1.01	5.83	11.73	0.19	101.72	1.65	1.37	750	1.30	2.95	126%
10	DICB6	MH4/MH1	15.0	0.60	0.58	0.35	0.35	10.00	0.07	110.69	0.11	8.00	250	0.17	3.43	64%
	MH1	MH2	49.8	0.0	0.0	0.00	6.18	11.92	0.25	100.84	1.73	1.70	750	1.45	3.29	119%
	MH7	MH2	55.0	0.45	0.76	0.34	0.34	10.00	0.53	110.69	0.11	1.60	300	0.12	1.73	86%
	MH2	MH3	86.5	0.45	0.62	0.28	6.80	12.17	0.50	99.69	1.88	1.15	825	1.54	2.88	122%

PEARSON ENGINEERING LTD.

Q= 0.0028*C*I*A (cms)
C=RUNOFF COEFFICIENT
I-RAINFALL INTENSITY= A/(Time+B)^C
A=AREA (ha)

Veteran's Lane
Storm Sewer Design
Pre Development

DATE: 7-Oct-19
FILE: 18079
CONTRACT/PROJECT: VETERAN'S LANE

Areas	MANHOLE FROM	MANHOLE TO	LENGTH (m)	INCREMENT C	INCREMENT A	INCREMENT CA	TOTAL CA	FLOW TIME (min) TO	FLOW TIME (min) IN	I (mm/h)	TOTAL Q (cms)	S (%)	D (mm)	Q FULL (cms)	V FULL (m/s)	% FULL (%)
	MH11	MH8	19.5	0.54	0.81	0.44	0.44	10.00	0.20	110.69	0.13	1.08	375	0.18	1.65	74%
	MH8	MH3	66.7	0.54	0.44	0.24	0.68	10.20	0.51	109.58	0.21	1.50	450	0.35	2.20	59%
	CBMH10	MH3	43.5	0.54	0.20	0.11	0.11	10.00	0.75	110.69	0.03	0.50	300	0.07	0.97	49%
	MH3	MH4	88.8	0.54	0.46	0.25	7.83	12.67	0.52	97.50	2.12	1.00	900	1.81	2.85	117%
	MH4	MH5	82.0	0.57	1.15	0.66	8.49	13.19	0.45	95.34	2.25	1.15	900	1.94	3.05	116%
	CBMH9	MH5	45.0	0.50	0.67	0.34	0.34	10.00	0.22	110.69	0.10	6.00	300	0.24	3.35	43%
	MH5	MH6	125.5	0.50	0.16	0.08	8.90	13.19	0.89	95.34	2.36	0.56	1050	2.04	2.36	115%
	MH6	OUTFALL	140.0	0.00	0.00	0.00	8.90	13.64	0.84	93.56	2.31	0.78	1050	2.41	2.79	96%

Notes:
1. Storm sewer design sheet created by using the Storm Drainage Area Plan for the Beacon Road Subdivion, completed by R.G. Robinson and Associates, as well as the Storm Drainage Area Plan for the Essa/Ferndale Development by R.G. Robinson and Associates.
2. The recreated storm sewer design sheet was completed to show the current capacity of the existing storm sewer.

PEARSON
ENGINEERING LTD.

Q= 0.0028*C*I*A (cms)
C=RUNOFF COEFFICIENT
I-RAINFALL INTENSITY= A/(Time+B)^C
A=AREA (ha)

Veteran's Lane
Storm Sewer Design
Post Development

DATE: 7-Oct-19
FILE: 18079
CONTRACT/PROJECT VETERAN'S LANE

Areas	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	S	D	Q FULL	V FULL	% FULL
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)	(%)
2	DICB1	MH1	40.0	0.90	1.40	1.26	1.26	10.00	0.37	101.72	0.36	1.00	450	0.29	1.79	125%
4	DICB2	MH1	40.0	0.90	0.37	0.33	0.33	10.00	0.69	101.72	0.09	0.50	300	0.07	0.97	138%
3	MH1	MH1	15.4	0.90	0.17	0.15	1.75	10.69	0.10	101.72	0.49	2.20	450	0.42	2.66	117%
1	CBMH1	MH1	29.0	0.90	0.97	0.87	0.87	10.00	0.21	101.72	0.25	1.10	600	0.64	2.28	38%
	FUTURE CBMH	MH1										0.50	450	0.20	1.27	
5, 6	MH1	MH2	85.5	0.88	0.94	0.83	3.45	10.79	0.59	101.72	0.97	1.06	675	0.87	2.42	113%
7, 11	MH5	MH2	17.8	0.85	1.40	1.19	1.19	10.00	0.21	101.72	0.34	0.51	525	0.31	1.42	110%
8	MH2	MH3	61.0	0.65	0.13	0.08	4.72	11.37	0.35	103.42	1.36	1.30	750	1.27	2.87	107%
9	MH3	MH4	33.6	0.90	1.12	1.01	5.73	11.73	0.19	101.72	1.62	1.37	750	1.30	2.95	124%
PROJECT SITE	MH1	DICB6	11.7								0.07	1.00	300	0.10	1.37	72%
10	DICB6	MH4/MH1	15.0	0.60	0.58	0.35	0.35	10.00	0.07	110.69	0.18	8.00	250	0.17	3.43	105%
	MH1	MH2	49.8	0.0	0.0	0.00	6.08	11.92	0.25	100.84	1.77	1.70	750	1.45	3.29	122%
	MH7	MH2	55.0	0.45	0.76	0.34	0.34	10.00	0.53	110.69	0.11	1.60	300	0.12	1.73	86%
	MH2	MH3	86.5	0.45	0.62	0.28	6.70	12.17	0.50	99.69	1.92	1.15	825	1.54	2.88	125%

PEARSON
ENGINEERING LTD.

Q= 0.0028*C*I*A (cms)

C=RUNOFF COEFFICIENT

I-RAINFALL INTENSITY= A/(Time+B)^C

A=AREA (ha)

Veteran's Lane
Storm Sewer Design
Post Development

DATE: 7-Oct-19

FILE: 18079

CONTRACT/PROJECT: VETERAN'S LANE

Areas	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	S	D	Q FULL	V FULL	% FULL
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)	(%)
	MH11	MH8	19.5	0.54	0.81	0.44	0.44	10.00	0.20	110.69	0.13	1.08	375	0.18	1.65	74%
	MH8	MH3	66.7	0.54	0.44	0.24	0.68	10.20	0.51	109.58	0.21	1.50	450	0.35	2.20	59%
	CBMH10	MH3	43.5	0.54	0.20	0.11	0.11	10.00	0.75	110.69	0.03	0.50	300	0.07	0.97	49%
	MH3	MH4	88.8	0.54	0.46	0.25	7.73	12.67	0.52	97.50	2.16	1.00	900	1.81	2.85	119%
	MH4	MH5	82.0	0.57	1.15	0.66	8.38	13.19	0.45	95.34	2.29	1.15	900	1.94	3.05	118%
	CBMH9	MH5	45.0	0.50	0.67	0.34	0.34	10.00	0.22	110.69	0.10	6.00	300	0.24	3.35	43%
	MH5	MH6	125.5	0.50	0.16	0.08	8.80	13.19	0.89	95.34	2.40	0.56	1050	2.04	2.36	117%
	MH6	OUTFALL	140.0	0.00	0.00	0.00	8.80	13.64	0.84	93.56	2.36	0.78	1050	2.41	2.79	98%

Notes:
1. Storm sewer design sheet created by using the Storm Drainage Area Plan for the Beacon Road Subdivion, completed by R.G. Robinson and Associates, as well as the Storm Drainage Area Plan for the Essa/Ferndale Development by R.G. Robinson and Associates.
2. The recreated storm sewer design sheet was modified to add the peak flow from the proposed development upstream of DICB6.

Appendix C

Water Balance Calculations

Table 3.1: Hydrologic Cycle Component Values

	Water Holding Capacity mm	Hydrologic Soil Group	Precipitation mm	Evapo-transpiration mm	Runoff mm	Infiltration* mm
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)						
Fine Sand	50	A	940	515	149	276
Fine Sandy Loam	75	B	940	525	187	228
Silt Loam	125	C	940	536	222	182
Clay Loam	100	CD	940	531	245	164
Clay	75	D	940	525	270	145
Moderately Rooted Crops (corn and cereal grains)						
Fine Sand	75	A	940	525	125	291
Fine Sandy Loam	150	B	940	539	160	241
Silt Loam	200	C	940	543	199	199
Clay Loam	200	CD	940	543	218	179
Clay	150	D	940	539	241	160
Pasture and Shrubs						
Fine Sand	100	A	940	531	102	307
Fine Sandy Loam	150	B	940	539	140	261
Silt Loam	250	C	940	546	177	217
Clay Loam	250	CD	940	546	197	197
Clay	200	D	940	543	218	179
Mature Forests						
Fine Sand	250	A	940	546	79	315
Fine Sandy Loam	300	B	940	548	118	274
Silt Loam	400	C	940	550	156	234
Clay Loam	400	CD	940	550	176	215
Clay	350	D	940	549	196	196

Notes: Hydrologic Soil Group A represents soils with low runoff potential and Soil Group D represents soils with high runoff potential. The evapotranspiration values are for mature vegetation. Streamflow is composed of baseflow and runoff.

* *This is the total infiltration of which some discharges back to the stream as base flow. The infiltration factor is determined by summing a factor for topography, soils and cover.*

Topography	Flat Land, average slope < 0.6 m/km	0.3
	Rolling Land, average slope 2.8 m to 3.8 m/km	0.2
	Hilly Land, average slope 28 m to 47 m/km	0.1
Soils	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
Cover	Cultivated Land	0.1
	Woodland	0.2

Figure C.1 Annual Precipitation Event Distribution

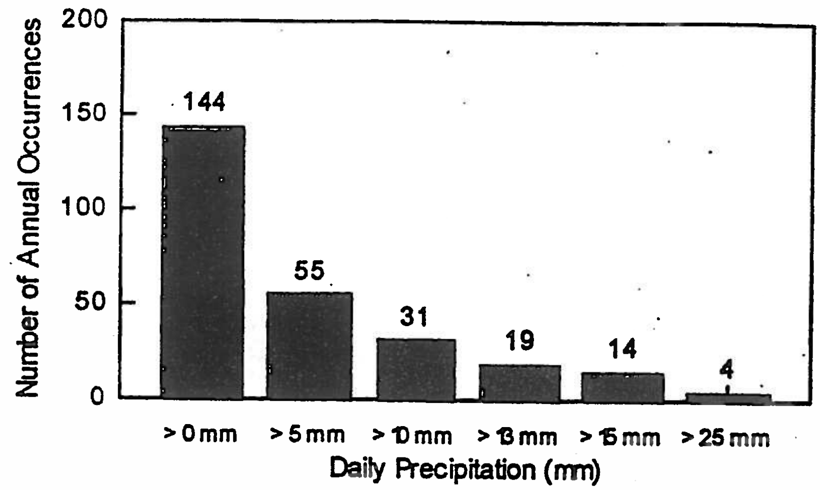
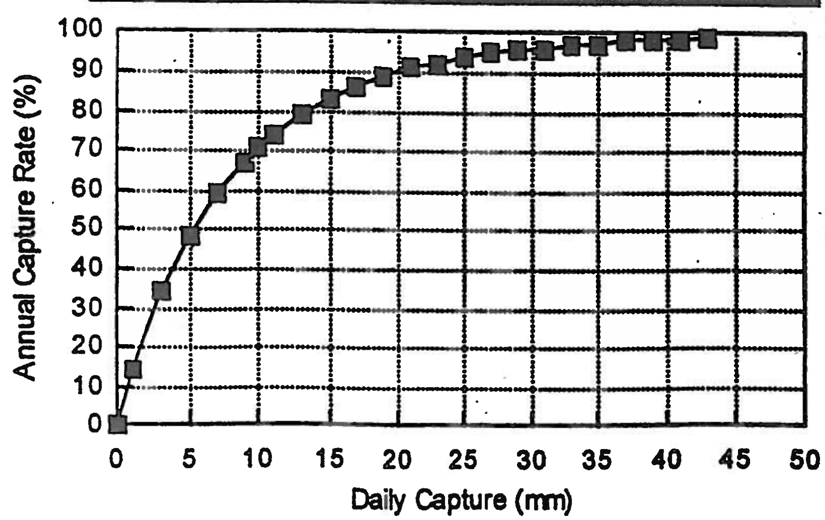


Figure C.2 Annual Capture Rate for Daily Capture Amounts



Source: MOE 1994 "Stormwater Management Practices Planning and Design Manual"

PEARSON ENGINEERING

Sean Homes - Veteran's Lane
Water Balance Calculations

Pre Development Recharge

Precipitation data taken from Environment Canada information for the City of Barrie.

Yearly Precipitation	=	932.9	mm				

Using Table 3.1 of the MOE's SWM Planning & Design Manual, the infiltration amount is approximately 28.0% of the precipitation value for Pasture and Shrubs for Fine Sandy Loam. Using site specific rainfall data, the infiltration can be calculated.

Pasture and Shrubs	=	0.77	ha				
Annual Site Area Recharge Volume	=	0.77		x	0.28	x	932.9
	=	2003	m^3				

Therefore, 2087 m^3 per year of recharge volume is required for the proposed project

Post Development Recharge

Using Table 3.1 of the MOE's SWM Planning & Design Manual, the infiltration amount for Urban Lawns is approximately 24%

Grassed Area	=	0.31	ha				
Annual Site Area Recharge Volume	=	0.31		x	0.24	x	932.9
	=	693	m^3				

Therefore, post development infiltration deficit is as follows

Deficit Volume	=	Pre Development - Post Development		
	=	2003	-	693
	=	1310	m^3	

Recharge Basin

Find the depth of annual rainfall required to infiltrate 1180 m^3 from the area into the ground.

Drainage Area Contributing to Infiltration Locations	=	1123	m^2
Infiltration Deficit	=	1310	m^3

Due to the high groundwater elevation, a surface infiltration gallery has been designed for the 25 mm storm as follows.

Rainfall Target	=	25	mm

As the 25 mm storm accounts for 95% of all storms, the annual precipitation infiltrated is calculated.

Annual Rainfall Depth (mm)	=	932.9	mm	x	95.0	%
	=	886.3	mm			

The runoff coefficient for the contributing area is 0.47, therefore the following yearly precipitation depth is infiltrated.

Precipitation Depth	=	886.3	mm	x	0.47	
	=	416.5	mm			
Annual Volume	=	416.5	mm	x	1123	m^2
	=	468	m^3			

Therefore, City of Barrie guidelines governs over water balance/infiltration requirements. An infiltration gallery will be sized to provide a minimum of 46 m^3 of storage at detailed design to satisfy water balance criteria.

PEARSON ENGINEERING

Infiltration Volume Calculations
Sean Homes - Veteran's Lane

Infiltration volumes from MOE Stormwater Management Planning and Design Manual
Table 3.2 Water Quality Storage Requirements are as follows:

Design Area Total	=	0.88	ha	
Total Imperviousness	=	65%		
Storage Volume	=	33.6	m^3/ha	(Enhanced 80% long-term S.S. removal
Storage Volume Required	=	0.88	x	33.6
	=	29.7	m^3	

Using 25 mm over impervious areas, infiltration storage volumes are as follows:

Storage Volume (V)	=	0.025	x	Impervious Area
	=	0.025	x	5731
	=	143.3	m^3	

Therefore, the site will have a combined storage volume of a minimum of 150 m^3 for infiltration/filtration to satisfy LSRCA Volume Control Criteria.

Appendix D

Phosphorus Calculations

Table 2. Land-Use Specific Phosphorus Export Coefficients (kg/ha/yr) for Lake Simcoe Subwatersheds

Subwatershed	Phosphorus Export (kg/ha/yr)											
	Cropland	Hay-Pasture	Sod Farm/Golf Course	High Intensity Development		Low Intensity Development	Quarry	Unpaved Road	Forest	Transition	Wetland	Open Water
				Commercial /Industrial	Residential							
Monitored Subwatersheds												
Beaver River	0.22	0.04	0.01	1.82	1.32	0.19	0.06	0.83	0.02	0.04	0.02	0.26
Black River	0.23	0.08	0.02	1.82	1.32	0.17	0.15	0.83	0.05	0.06	0.04	0.26
East Holland River	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26
Hawkestone Creek	0.19	0.10	0.06	1.82	1.32	0.09	0.10	0.83	0.03	0.04	0.03	0.26
Lovers Creek	0.16	0.07	0.17	1.82	1.32	0.07	0.06	0.83	0.06	0.06	0.05	0.26
Pefferlaw/Uxbridge Brook	0.11	0.06	0.02	1.82	1.32	0.13	0.04	0.83	0.03	0.04	0.04	0.26
Whites Creek	0.23	0.10	0.42	1.82	1.32	0.15	0.08	0.83	0.10	0.11	0.09	0.26
Unmonitored Subwatersheds												
Barrie Creeks	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
GeorginaCreeks	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26
Hewitts Creek	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Innisfil Creeks	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Maskinonge River	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Oro Creeks North	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26
Oro Creeks South	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Ramara Creeks	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Talbot/Upper Talbot River	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
West Holland River	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26

3.2.2 Methods - Calculating Pre-development Conditions

The pre-development or “existing conditions” phosphorus load is calculated through the following steps, by the user:

1. The user will rely on the information documented and detailed in the EIS for the development that will be used to support the planning application to the Municipality.
2. The user will choose the subwatershed or geographic area of the Lake Simcoe watershed in which the development is proposed from a drop down list provided by the database. If the development area spans two or more subwatersheds, the areas within each subwatershed should be modelled separately.
3. Specific land use classifications will be delineated and their boundaries overlain on an orthographic aerial photograph that shall be included in their submission.

that class of BMP. In two cases, (sorbtive media interceptors and soakways/infiltration trenches), although there are no Ontario phosphorus removal efficiencies reported in the review materials, the techniques are not limited by geography. The reported ranges in efficiency for these BMP classes are narrow so the median efficiency is chosen as a representative phosphorus removal efficiency. In all other cases, there are unacceptable regional differences and wide ranges in efficiencies that would not support the derivation of single representative phosphorus removal efficiencies. In the case of dry swales, the non-Ontario removal efficiencies may be usable, but the range of reported values is large such that it will be necessary to identify design criteria that will limit the range in efficiencies for this class of BMPs before a value can be chosen.

Table 3. Phosphorus Removal Efficiencies for Major Classes of BMPs Using the Decision Tree (Figure 5)

BMP Class	Reference IDs[1]	Reported Phosphorus Removal Efficiency (%)		Relevant to Ontario?	Range <40%?	Are Non-Ontario values acceptable?	Possible design criteria?	Median % Removal Efficiency
		Min	Max					
Post-development BMPs								
Bioretention Systems	8-10, 12,13, 34-38, 40	-1552	80	no	no	no	No	none
Constructed Wetlands	104, 106, 109	72	87	yes	yes			77
Dry Detention Ponds	104, 109	0	20	no	yes	yes		10
Dry Swales	24, 26-32	-216	94	no	no	no	possible	none
Enhanced Grass/Water Quality Swales	21, 104	34	55	no	yes	no	No	none
Flow Balancing Systems	106	77		no	?	yes	Min data	77
Green Roofs	2	-248		no	no	no	No	none
Hydrodynamic Devices	109	-8		no	?	yes		none
Perforated Pipe Infiltration/Exfiltration Systems	7, 4	81	93	yes	yes			87
Sand or Media Filters	104, 109	30	59	no	yes	yes		45
Soakaways - Infiltration Trenches	6, 104	50	70	no	yes	yes		60
Sorbtive Media Interceptors	111	78	80	no	yes	yes		79
Underground Storage	106	25		no	?	yes	Min data	25
Vegetated Filter Strips/Stream Buffers	6, 42, 104	60	70	no	yes	yes	Yes	65
Wet Detention Ponds	104-106, 109	42	85	yes	yes			63

Notes: [1]References associated with IDs are provided in Appendix 7.

Sean Homes - Veteran's Lane
Phosphorus Budget

Barrie Creeks	Low Intensity Development	Hay Pasture	High Intensity - Residential	Forest
Phosphorus Export (kg/ha/year)	0.13	0.08	1.32	0.05

Pre-Development Condition

	Low Intensity Development	Hay Pasture	High Intensity - Residential	Forest
Area (ha)	0.52	0.00	0.00	0.00
Total P (kg)	0.07	0.00	0.00	0.00
Total Pre-Development P (kg)		**0.07**		

Post Development Condition (Without Treatment)

	Low Intensity Development	Hay Pasture	High Intensity - Residential	Forest
Area (ha):	0.00	0.00	0.52	0.00
Total P (kg) :	0.00	0.00	0.69	0.00
Total Post Development (kg):		**0.69**		

Post Development Condition (With Treatment)

Uncontrolled Area	Low Intensity Development	Hay Pasture	High Intensity - Residential	Forest
Area (ha):	0.00	0.00	0.01	0.00
Total P (kg) :	0.00	0.00	0.02	0.00

Area Draining to Permeable Pavers/Rain Gardens	Low Intensity Development	Hay Pasture	High Intensity - Residential	Forest
Area (ha):	0.00	0.00	0.40	0.00
Total P (kg):	0.00	0.00	0.53	0.00

Permeable Pavers/Rain Garden Treatment		
Removal Efficiency (%):		45
P Removed (kg):		0.24
P Remaining (kg):		0.29

Area Draining to Permeable Pavers & Enhanced Swale	Low Intensity Development	Hay Pasture	High Intensity - Residential	Forest
Area (ha):	0.00	0.00	0.11	0.00
Total P (kg):	0.00	0.00	0.15	0.00

Permeable Pavers & Enhanced Swale Treatment

Removal Efficiency (%):	75
P Removed (kg):	0.11
P Remaining (kg):	0.04

Area Draining to Underground Storage	Low Intensity Development	Hay Pasture	High Intensity - Residential	Forest
Area (ha):	0.00	0.00	0.00	0.00
Total P (kg):	0.00	0.00	0.00	0.00

Underground Storage Treatment

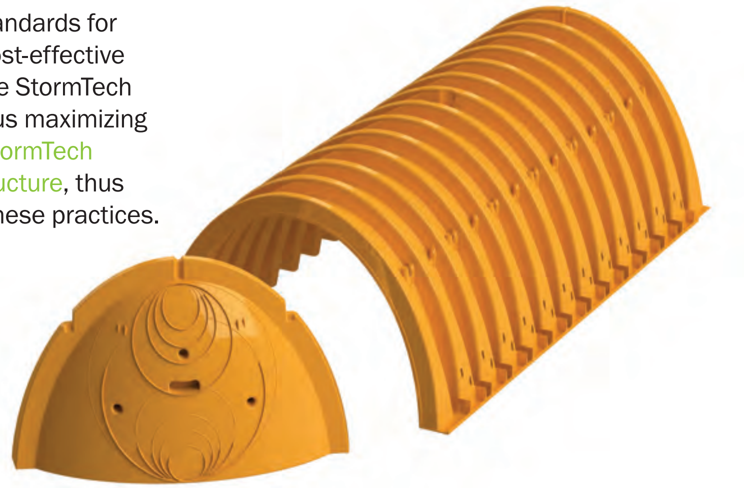
P remaining (kg):	0.33
Removal Efficiency (%):	25
P Removed (kg):	0.08
P Remaining (kg):	0.25
Total Site P (kg) :	**0.26**

Appendix E

StormTech Chamber Information

STORMTECH SC-740 CHAMBER

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots, thus maximizing land usage for private (commercial) and public applications. StormTech chambers can also be used in conjunction with Green Infrastructure, thus enhancing the performance and extending the service life of these practices.



STORMTECH SC-740 CHAMBER
(not to scale)

Nominal Chamber Specifications

Size (L x W x H)
85.4” x 51” x 30”
2,170 mm x 1,295 mm x 762 mm

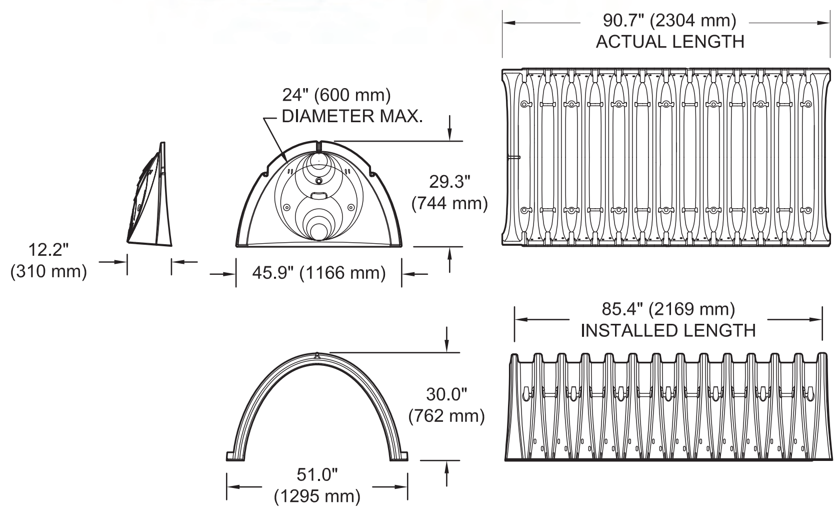
Chamber Storage
45.9 ft^3 (1.30 m^3)

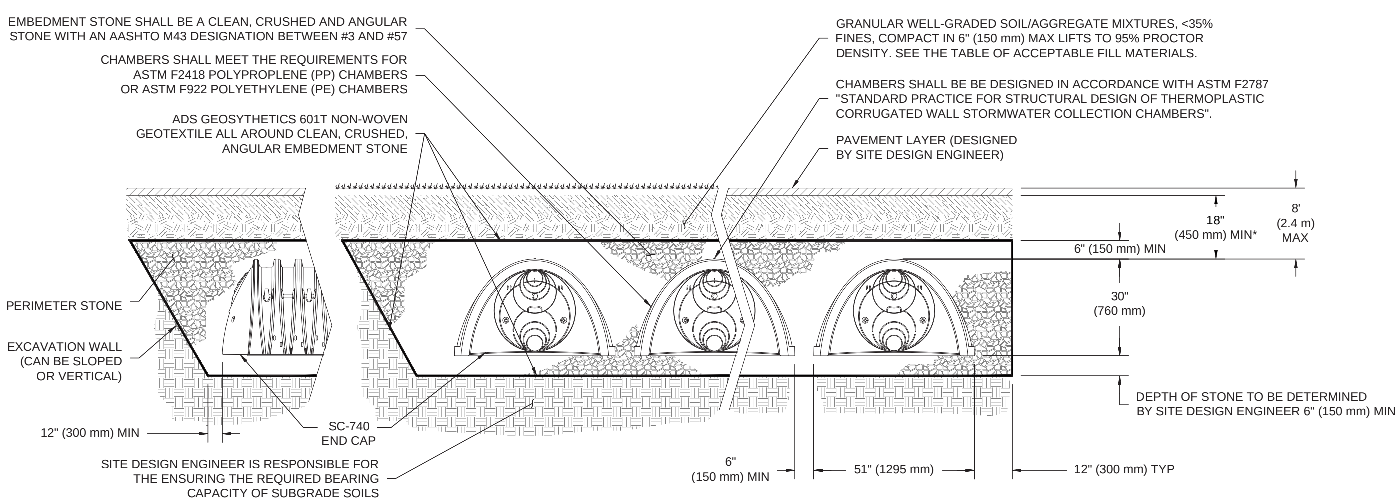
Min. Installed Storage*
74.9 ft^3 (2.12 m^3)

Weight
74.0 lbs (33.6 kg)

Shipping
30 chambers/pallet
60 end caps/pallet
12 pallets/truck

*Assumes 6” (150 mm) stone above, below and between chambers and 40% stone porosity.





*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 24" (600 mm).

StormTech®

ADS®

SC-740 CUMULATIVE STORAGE VOLUMES PER CHAMBER

Assumes 40% Stone Porosity. Calculations are Based Upon a 6” (150 mm) Stone Base Under Chambers.

Depth of Water in System Inches (mm)		Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
42 (1067)	↑	45.90 (1.300)	74.90 (2.121)
41 (1041)		45.90 (1.300)	73.77 (2.089)
40 (1016)	Stone	45.90 (1.300)	72.64 (2.057)
39 (991)	Cover	45.90 (1.300)	71.52 (2.025)
38 (965)		45.90 (1.300)	70.39 (1.993)
37 (940)	↓	45.90 (1.300)	69.26 (1.961)
36 (914)		45.90 (1.300)	68.14 (1.929)
35 (889)		45.85 (1.298)	66.98 (1.897)
34 (864)		45.69 (1.294)	65.75 (1.862)
33 (838)		45.41 (1.286)	64.46 (1.825)
32 (813)		44.81 (1.269)	62.97 (1.783)
31 (787)		44.01 (1.246)	61.36 (1.737)
30 (762)		43.06 (1.219)	59.66 (1.689)
29 (737)		41.98 (1.189)	57.89 (1.639)
28 (711)		40.80 (1.155)	56.05 (1.587)
27 (686)		39.54 (1.120)	54.17 (1.534)
26 (660)		38.18 (1.081)	52.23 (1.479)
25 (635)		36.74 (1.040)	50.23 (1.422)
24 (610)		35.22 (0.977)	48.19 (1.365)
23 (584)		33.64 (0.953)	46.11 (1.306)
22 (559)		31.99 (0.906)	44.00 (1.246)
21 (533)		30.29 (0.858)	1.85 (1.185)
20 (508)		28.54 (0.808)	39.67 (1.123)
19 (483)		26.74 (0.757)	37.47 (1.061)
18 (457)		24.89 (0.705)	35.23 (0.997)
17 (432)		23.00 (0.651)	32.96 (0.939)
16 (406)		21.06 (0.596)	30.68 (0.869)
15 (381)		19.09 (0.541)	28.36 (0.803)
14 (356)		17.08 (0.484)	26.03 (0.737)
13 (330)		15.04 (0.426)	23.68 (0.670)
12 (305)		12.97 (0.367)	21.31 (0.608)
11 (279)		10.87 (0.309)	18.92 (0.535)
10 (254)		8.74 (0.247)	16.51 (0.468)
9 (229)		6.58 (0.186)	14.09 (0.399)
8 (203)		4.41 (0.125)	11.66 (0.330)
7 (178)		2.21 (0.063)	9.21 (0.264)
6 (152)	↑	0 (0)	6.76 (0.191)
5 (127)		0 (0)	5.63 (0.160)
4 (102)	Stone	0 (0)	4.51 (0.128)
3 (76)	Foundation	0 (0)	3.38 (0.096)
2 (51)		0 (0)	2.25 (0.064)
1 (25)	↓	0 (0)	1.13 (0.032)

Note: Add 1.13 ft³ (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

STORAGE VOLUME PER CHAMBER FT³ (M³)

	Bare Chamber Storage ft³ (m³)	Chamber and Stone Foundation Depth in. (mm)		
		6 (150)	12 (300)	18 (450)
SC-740 Chamber	45.9 (1.3)	74.9 (2.1)	81.7 (2.3)	88.4 (2.5)

Note: Assumes 6” (150 mm) stone above chambers, 6” (150 mm) row spacing and 40% stone porosity.

AMOUNT OF STONE PER CHAMBER

ENGLISH TONS (yds³)	Stone Foundation Depth		
	6”	12”	16”
SC-740	3.8 (2.8)	4.6 (3.3)	5.5 (3.9)
METRIC KILOGRAMS (m³)	150 mm	300 mm	450 mm
SC-740	3,450 (2.1)	4,170 (2.5)	4,490 (3.0)

Note: Assumes 6” (150 mm) of stone above and between chambers.

VOLUME EXCAVATION PER CHAMBER YD³ (M³)

	Stone Foundation Depth		
	6 (150)	12 (300)	18 (450)
SC-740	5.5 (4.2)	6.2 (4.7)	6.8 (5.2)

Note: Assumes 6” (150 mm) of row separation and 18” (450 mm) of cover. The volume of excavation will vary as depth of cover increases.

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Isolator® Row O&M Manual

StormTech® Chamber System for Stormwater Management

1.0 The Isolator® Row

1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patented technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

1.2 THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC-310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

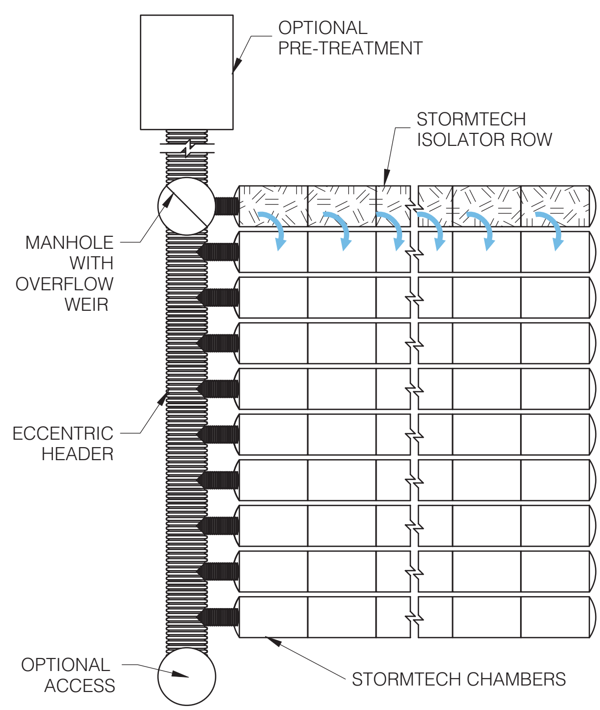
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.0 Isolator Row Inspection/Maintenance

2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

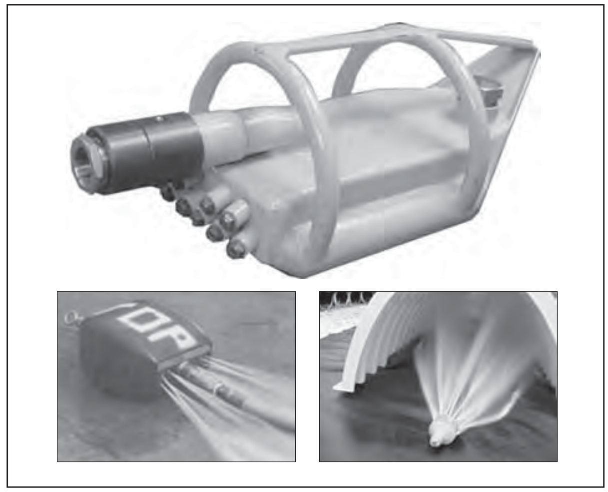
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

2.2 MAINTENANCE

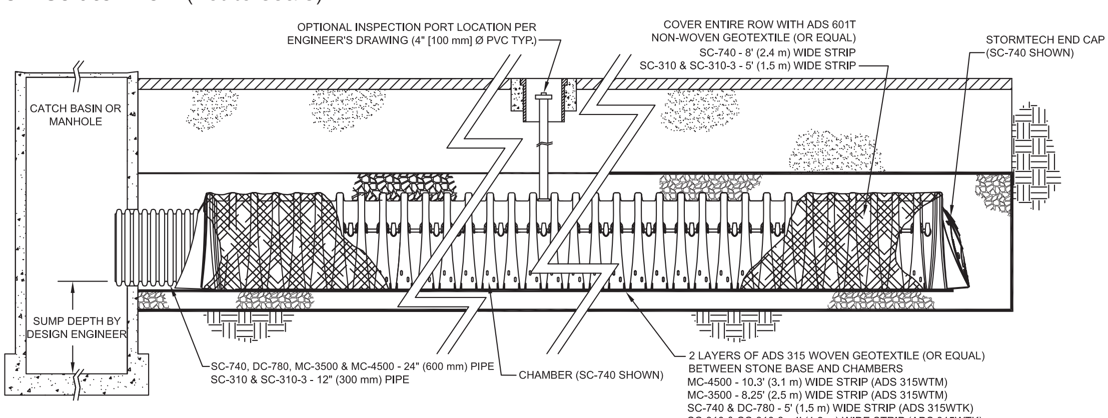
The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

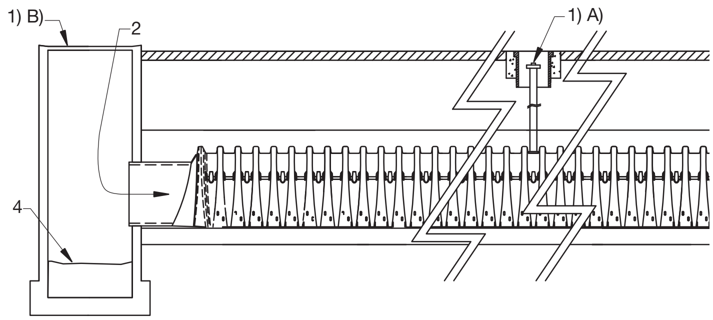
StormTech Isolator Row (not to scale)



NOTE: NON-WOVEN FABRIC IS ONLY REQUIRED OVER THE INLET PIPE CONNECTION INTO THE END CAP FOR DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

3.0 Isolator Row Step By Step Maintenance Procedures

StormTech Isolator Row (not to scale)



Step 1) Inspect Isolator Row for sediment
- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

Step 2) Clean out Isolator Row using the JetVac process
- A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1) - (2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in Isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

StormTech®

Detention • Retention • Water Quality

A division of ADS

70 Inwood Road, Suite 3 | Rocky Hill | Connecticut | 06067

860.529.8188 | 888.892.2694 | fax 866.328.8401 | www.stormtech.com

Appendix F

Oil/Grit Separator Information

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD
BASED ON ETV PARTICLE SIZE DISTRIBUTION

CONTECH ENGINEERED SOLUTIONS

Project: 341 Veteran's Lane
Location: Barrie, ON
OGS ID: OGS

Engineer: **Pearson Engineering**
Contact: T. Arkell, P.Eng.
Report Date: 26-Apr-21

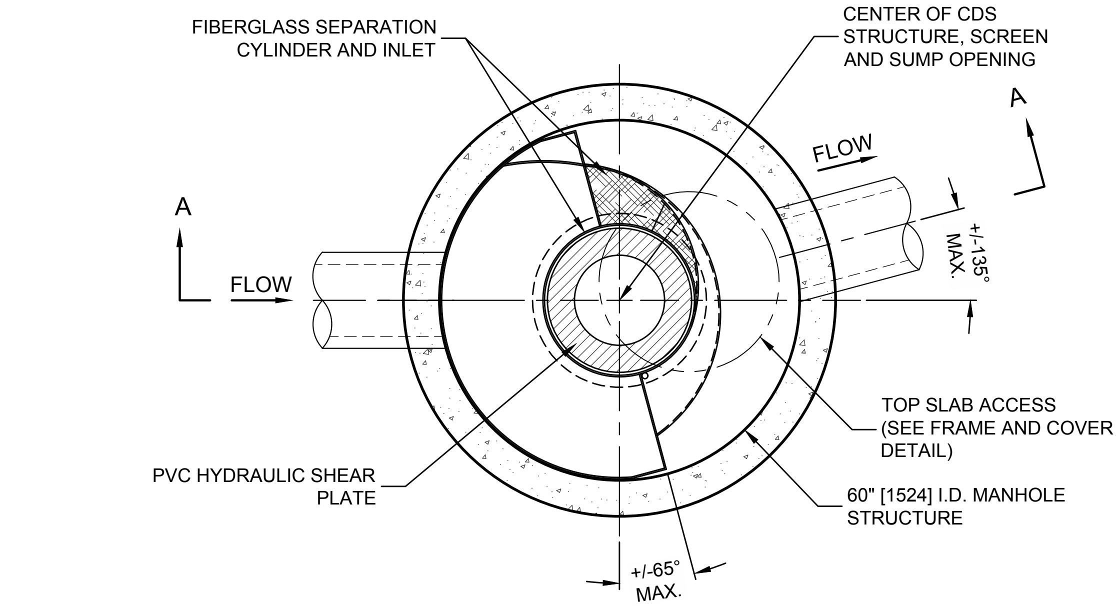
Area: 0.69 ha
Impevious: 74 %
CDS Model: 5

Treatment Capacity: 42.5 l/s
Particle Size distribution: ETV

Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
0.5	8.7%	8.7%	0.7	0.7	1.7	75.4	6.6
1.0	10.8%	19.6%	1.4	1.4	3.3	73.4	7.9
1.5	9.5%	29.0%	2.1	2.1	5.0	71.4	6.8
2.0	8.4%	37.4%	2.8	2.8	6.7	69.5	5.9
2.5	6.8%	44.2%	3.5	3.5	8.4	67.8	4.6
3.0	5.6%	49.8%	4.3	4.3	10.0	66.1	3.7
3.5	5.1%	54.9%	5.0	5.0	11.7	64.5	3.3
4.0	4.9%	59.8%	5.7	5.7	13.4	62.9	3.1
4.5	4.1%	63.9%	6.4	6.4	15.0	61.5	2.5
5.0	3.5%	67.4%	7.1	7.1	16.7	60.1	2.1
6.0	4.9%	72.3%	8.5	8.5	20.1	57.6	2.8
7.0	4.0%	76.3%	9.9	9.9	23.4	55.3	2.2
8.0	3.2%	79.5%	11.4	11.4	26.7	53.3	1.7
9.0	2.2%	81.7%	12.8	12.8	30.1	51.5	1.1
10.0	2.0%	83.7%	14.2	14.2	33.4	49.9	1.0
15.0	8.2%	91.9%	21.3	21.3	50.1	44.6	3.6
20.0	3.4%	95.2%	28.4	28.4	66.9	41.5	1.4
25.0	2.5%	97.7%	35.5	35.5	83.6	38.3	1.0
30.0	1.4%	99.1%	42.6	42.5	100.0	32.6	0.5
35.0	0.3%	99.4%	49.7	42.5	100.0	0.0	0.0
40.0	0.6%	100.0%	56.8	42.5	100.0	0.0	0.0
							61.7

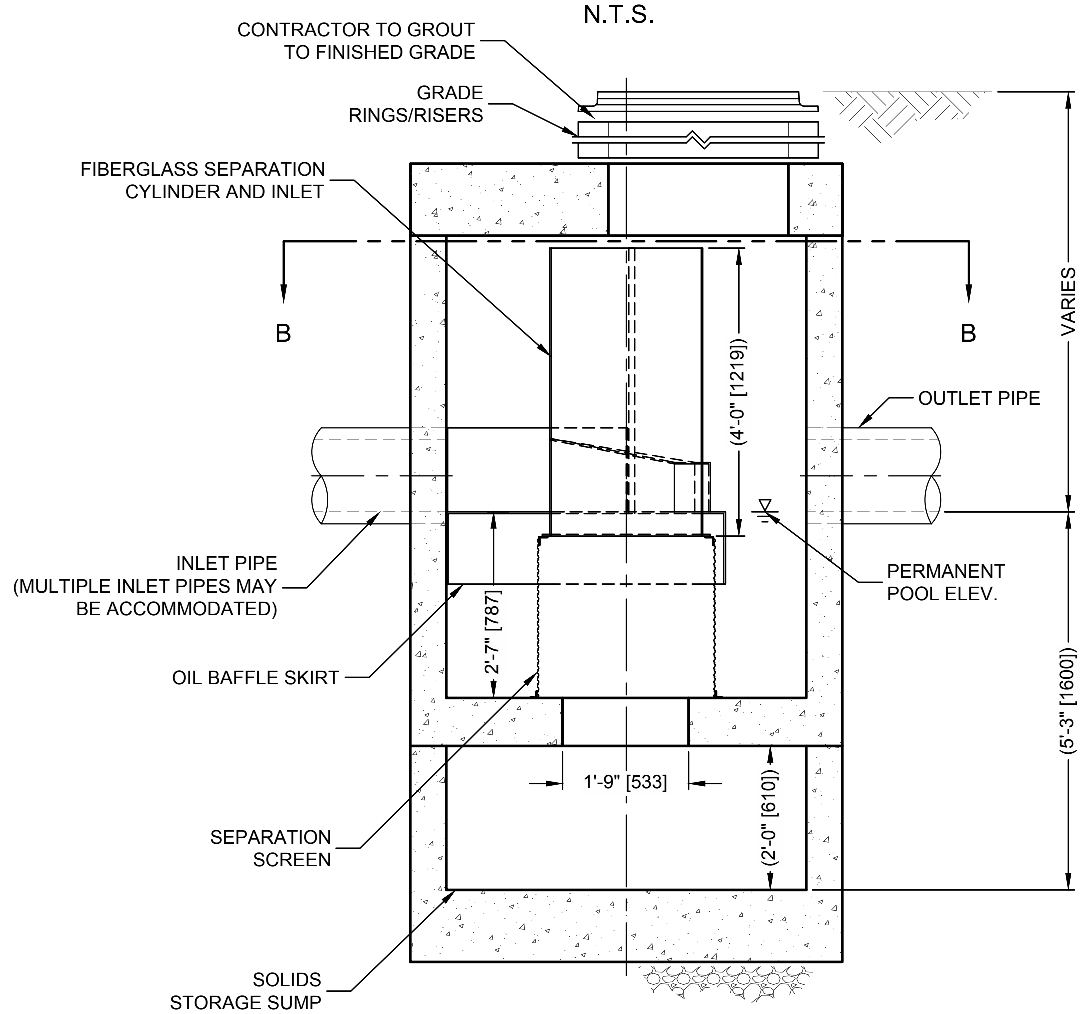
Predicted Net Annual Load Removal Efficiency = 61.7%
Predicted % Annual Rainfall Treated = 99.8%

1 - Based on 27 years of hourly rainfall data from Canadian Station 6110557, Barrie ON
2 - TSS Removal Rate Based on ETV Testing



PLAN VIEW B-B

N.T.S.



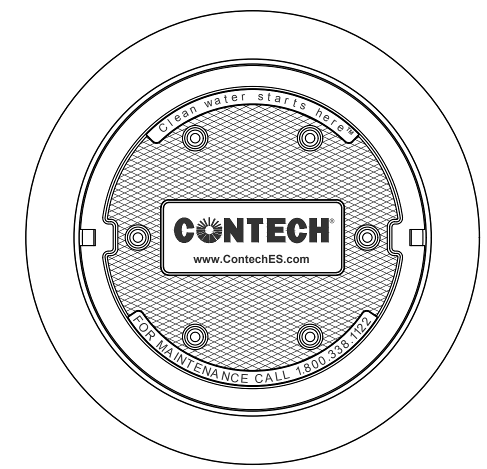
ELEVATION A-A

N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CDS-5-C DESIGN NOTES

THE STANDARD CDS-5-C CONFIGURATION IS SHOWN.



FRAME AND COVER

(DIAMETER VARIES)

N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			
* PER ENGINEER OF RECORD			

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 ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET HS20 (AASHTO M 306) AND BE CAST WITH THE CONTECH LOGO.
6. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

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 CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

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

CDS-5-C
ONLINE CDS
STANDARD DETAIL

I:\STORMWATER\COMMOPS\22 CDS\40 STANDARD DRAWINGS\NJDEP SIZING\CDS-C (ONLINE)\DWG\DWG WITHOUT FLOWS\CDS-5-C DTL.DWG 2/12/2018 10:31 AM

SECTION **[_____]**

STORM WATER TREATMENT DEVICE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope

The Contractor shall furnish all labor, equipment and materials necessary to install the storm water treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.

B. Related Sections – **if applicable**

Section ****: Dewatering
Section ****: Excavation Support and Protection
Section ****: Excavation and Fill
Section ****: Soil Stabilization

1.2 QUALITY ASSURANCES

A. Inspection

All components shall be subject to inspection by the engineer at the place of manufacture and/or installation. All components are subject to being rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair where final acceptance of the component is contingent on the discretion of the Engineer.

B. Warranty

The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period.

C. Manufacturer's Installation Certificate

The SWTD manufacturer shall submit a "Manufacturer's Installation Certificate" certifying that each SWTD has been installed in accordance with manufacturer's installation instructions.

1.3 SUBMITTALS

A. Shop Drawings

The contractor shall prepare and submit shop drawings in accordance with Section **[_____]** of the contract documents.

B. Manufacturer's Performance Certificate

The SWTD manufacturer shall submit to the Engineer of Record a "Manufacturer's Performance Certification" certifying that each SWTD is capable of achieving the specified removal efficiencies listed in this specification section. The certification shall be supported by independent third-party research.

C. Hydraulic Performance

The SWTD manufacturer shall submit a hydraulic report that verifies the system weir is sized correctly for the design treatment flowrate and in addition, indicates the effect the SWTD has on the hydraulic grade line during both treatment flow conditions and peak flow conditions. The hydraulic report shall be sealed by a Professional Engineer licensed in the Province of Ontario.

PART 2.0 – PRODUCTS

2.1 MATERIALS AND DESIGN

A. Precast concrete components shall conform to applicable sections of CSA standards, CAN/CSA A257.0, A257.2, A257.3, A257.4, ASTM C507M and OPSS 1351.

B. Internal Components and appurtenances shall conform to the following:

1. Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
2. Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
3. Fiberglass components shall conform to the National Bureau of Standards PS-15 and coated with an isophalic polyester gelcoat.

2.2 PERFORMANCE

A. REMOVAL EFFICIENCIES

1. The SWTD must have completed testing following The Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014) prepared by the Toronto and Region Conservation Authority (TRCA) for Environment Canada's Environmental Technology Verification (ETV) program requirements. Furthermore, the SWTD must have an active technology fact sheet listed on etvcanada.com.

2. The SWTD shall be sized to achieve a 60 percent average annual reduction in the total suspended solid load with the Canada ETV particle size distribution (listed in Table 1.)

Table 1: Canada ETV Particle Size Distribution

Particle Size (µm)	**Percent Less Than**	**Particle Size Fraction (µm)**	**Percent**
1000	100	500-1000	5
500	97	250-500	5
250	94	150-250	15
150	90	100-150	15
100	86	75-100	10
75	82	50-75	5
50	76	20-50	10
20	69	8-20	15
8	59	5-8	10
5	50	2-5	5
2	30	<2	5

3. The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to 2.4 mm regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated treatment capacity. The SWTD shall be designed to retain all previously captured pollutants addressed by this subsection under all flow conditions.
4. The SWTD shall retain no less than 99% of light liquids (hydrocarbons) when operating at 2600 L/min/m2. Testing shall be verified following the Environmental Technology Verification program requirements as stated in 2.2.A.1 above.

B. HYDRAULIC CAPACITY

1. The SWTD shall be equipped with an internal high flow bypass that is capable of conveying the maximum design flowrate from the treated drainage area with no flow going through the treatment portion of the unit.
2. The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer licensed in the Province of Ontario. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

C. STORAGE CAPACITY AND SYSTEM ACCESS

1. The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 2. The sump chamber shall be physically separated from the treatment section of the SWTD such that accumulated grit does not reduce the treatment chamber volume of the unit. SWTD that use the same chamber for treatment and grit storage are not acceptable. The minimum dimension providing access from the ground surface to the sump chamber shall be 406mm in diameter.

2. The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 2 of the required unit. The SWTD shall be capable of utilizing sorbent media to enhance removal and retention of petroleum based pollutants.

TABLE 2
Storage Water Treatment Device
Storage Capacities

CDS Model	Minimum Sump Storage Capacity (m^3)	Minimum Oil Storage Capacity (L)
CDS4	0.8	232
CDS5	1.6	376
CDS6	2.4	895
CDS8	4.2	1,970
CDS10	6.7	3,652
CDS12	9.6	6,918

2.3 MANUFACTURER

1. The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a Contech CDS® device as supplied by:

Echelon Environmental
505 Hood Road
Markham, ON
L3R 5B6
Tel: 905-948-0000

2. No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor shall be responsible for all updating applicable regulatory approvals.

PART 3 – EXECUTION

3.1 INSTALLATION

1. The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense.
2. The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces.

END OF SECTION

CONTECH® STORMWATER SOLUTIONS INC.

CDS® System

Maintenance

Procedures For
General Inspection and Cleaning

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant deposition and transport may vary from year to year and regular inspections will help insure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall), however; more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Additionally, installations where excessive amounts of trash are expected should be inspected more frequently.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions to inlet and/or separation screen. The inspection should also identify evidence of vector infestation and accumulations of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If sorbent material is used for enhanced removal of hydrocarbons then the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of a permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (center cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained behind the screen. For units possessing a sizable depth below grade (depth to pipe), a single manhole access point would allow both sump cleanout and access behind the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump and/or when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded; however, it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine if the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of the CDS systems should be done during dry weather conditions when no flow is entering the system. Cleanout of the CDS with a vacuum truck is generally the most effective and convenient method of excavating pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump through the center cylinder. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should be pumped out also if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use adsorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash can be netted out if you wish to separate it from the other pollutants. If the screen requires cleaning, it can be washed from the surface or from the CDS inlet structure through the center cylinder.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure proper safety precautions. Confined Space Entry procedures need to be followed.

Disposal of all material removed from the CDS system should be done is accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

SAMPLE INSPECTION & MAINTENANCE LOG

DATE/ INSPECTOR	FUNCTIONALITY/ COMPONENTS	FLOATABLES LAYER THICKNESS (IN)	DEPTH TO SEDIMENT (A) (FT)	SEDIMENT CAPACITY USED ((B-A)/D*100) %	SORBENT DISCOLORATION	MAINTENANCE PERFORMED
11/1/06/TPG	**OK**	**.5**	**14**	**33**	**SLIGHT**	**NONE**
5/1/07	**OK**	**1**	**13**	**67**	**MODERATE**	**NONE**
10/1/07	**OK**	**2**	**12.5**	**83**	**HIGH**	**CLEANING SCHEDULED**
11/1/07	**OK**	**0**	**15**	**0**	**NONE**	**SYSTEM CLEANED**

(B) DEPTH FROM GROUND SURFACE TO BOTTOM OF SUMP: 15 (FT)

(C) DEPTH FROM GROUND SURFACE TO TOP SUMP: 12 (FT)

(D) HEIGHT OF SUMP = B - C = 3 (FT)

OBSERVATIONS OF FUNCTION: ____

____

____

CDS SYSTEM INSPECTION AND MAINTENANCE LOG

DATE/ INSPECTOR	FUNCTIONALITY/ COMPONENTS	FLOATABLES LAYER THICKNESS (IN)	DEPTH TO SEDIMENT (A) (FT)	SEDIMENT CAPACITY USED ((B-A)/D*100) %	SORBENT DISCOLORATION	MAINTENANCE PERFORMED

(B) DEPTH FROM GOUND SURFACE TO BOTTOM OF SUMP: _______________ (FT)

(C) DEPTH FROM GROUND SURFACE TO TOP SUMP: ______________ (FT)

(D) HEIGHT OF SUMP = B - C = _____________ (FT)

OBSERVATIONS OF FUNCTION: ____

____

____

CANADIAN ENVIRONMENTAL TECHNOLOGY VERIFICATION

Enhancing the Credibility of Environmental Technologies

TECHNOLOGY VERIFIED: CDS Hydrodynamic Separator®

Performance Claim

Capture test[a]:

During the sediment capture test, the Contech CDS OGS device with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removed 74, 70, 63, 53, 45, 42, 32 and 23 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, 1400 and 1893 L/min/m², respectively.

Scour test[a]:

During the scour test, the Contech CDS OGS device with preloaded test sediment reaching 50% of the manufacturer's recommended maximum sediment storage depth, generated corrected effluent concentrations of 1.8, 6.5, 8.2, 11.2, and 309.3 mg/L during a test run[1] with approximately 5 minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m², respectively.

Light liquid re-entrainment test[a]:

During the light liquid re-entrainment test, the Contech CDS OGS device with surrogate low-density polyethylene beads preloaded within the oil collection skirt area, representing floating liquid to a volume equal to a depth of 50.8 mm over the sedimentation area, retained 100, 99.9, 98.6, 99.5, and 99.7 percent of loaded beads by volume during a test run[b] with 5 minutes duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m², respectively.

[a] *The claim can be applied to other units smaller or larger than the tested unit as long as the untested units meet the scaling rule specified in the Procedure for Laboratory of Testing of Oil Grit Separators (Version 3.0, June 2014)*
[b] *See variance #1 in "Variances from testing procedure" section*

VERIFIED* PERFORMANCE:
MARCH 2017

License Number: ETV 2017-02

Issued to: CONTECH Engineered Solutions LLC

Expiration Date: March 31, 2020

John D. Wiebe, PhD
Executive Chairman

GLOBE PERFORMANCE SOLUTIONS

Canada

* This verification conforms to the Canadian ETV Program's General Verification Protocol and the ISO 14034:2016. Please refer to Technology Fact Sheet for additional information on the verification of this performance claim.

CANADIAN ETV VERIFIED

CDS Hydrodynamic Separator®

Technology Fact Sheet for CONTECH Engineered Solutions LLC

Technology description and application

The CDS® is a Stormwater treatment device designed to remove pollutants, including sediment, trash and hydrocarbons from Stormwater runoff. The CDS is typically comprised of a manhole that houses flow and screening controls that use a combination of swirl concentration and continuous deflective separation.

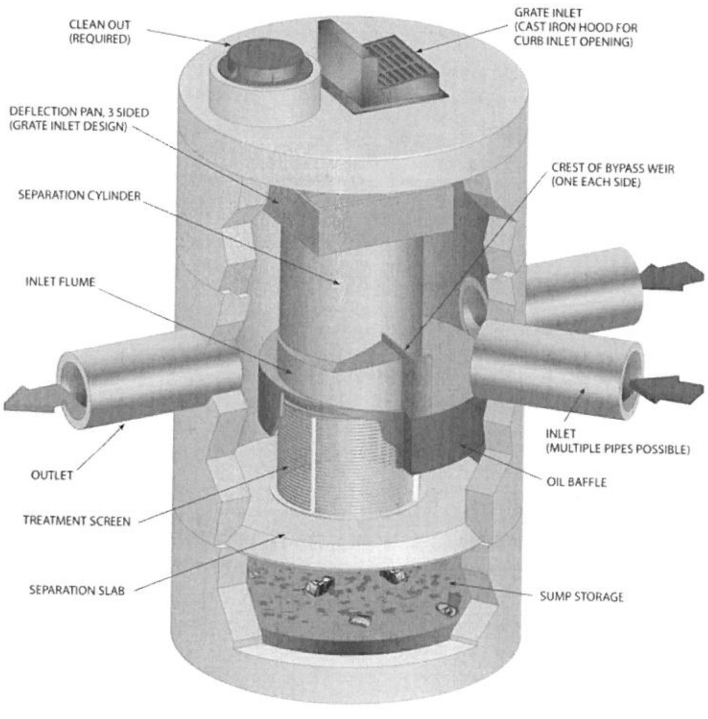


Figure 1. Graphic of typical inline CDS unit and core components.

When stormwater runoff enters the CDS unit's diversion chamber, the diversion pan guides the flow into the unit's separation chamber. The water and associated gross pollutants contained within the separation cylinder are kept in continuous circular motion by the energy generated from the incoming flow. This has the effect of a continuous deflective separation of the pollutants and their eventual deposition into the sump storage below. A perforated screen plate allows the filtered water to pass through to a volute return system and thence to the outlet pipe. The oil and other light liquids are retained within the oil baffle. Figure 1 shows a schematic representation of a typical CDS unit including critical components.

Performance conditions

The data and results published in this Technology Fact Sheet were obtained from the testing program conducted on the Contech CDS-4 OGS device, in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014). The Procedure was prepared by the Toronto and Region Conservation Authority (TRCA) for Environment Canada's Environmental Technology Verification (ETV) Program requirements. A copy of the Procedure may be accessed on the Canadian ETV website at www.etvcanada.ca.

Performance claim(s)

Capture test[a]:

During the sediment capture test, the Contech CDS OGS device with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removed 74, 70, 63, 53, 45, 42, 32 and 23 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, 1400 and 1893 L/min/m^2, respectively.

Scour test[a]:

During the scour test, the Contech CDS OGS device with preloaded test sediment reaching 50% of the manufacturer's recommended maximum sediment storage depth, generated corrected effluent concentrations of 1.8, 6.5, 8.2, 11.2, and 309.3 mg/L during a test run[b] with approximately 5 minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Light liquid re-entrainment test[a]:

During the light liquid re-entrainment test, the Contech CDS OGS device with surrogate low-density polyethylene beads preloaded within the oil collection skirt area, representing floating liquid to a volume equal to a depth of 50.8 mm over the sedimentation area, retained 100, 99.9, 98.6, 99.5, and 99.7 percent of loaded beads by volume during a test run[b] with 5 minutes duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Performance results

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

---

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

[b] See variance #1 in "Variances from testing procedure" section below.

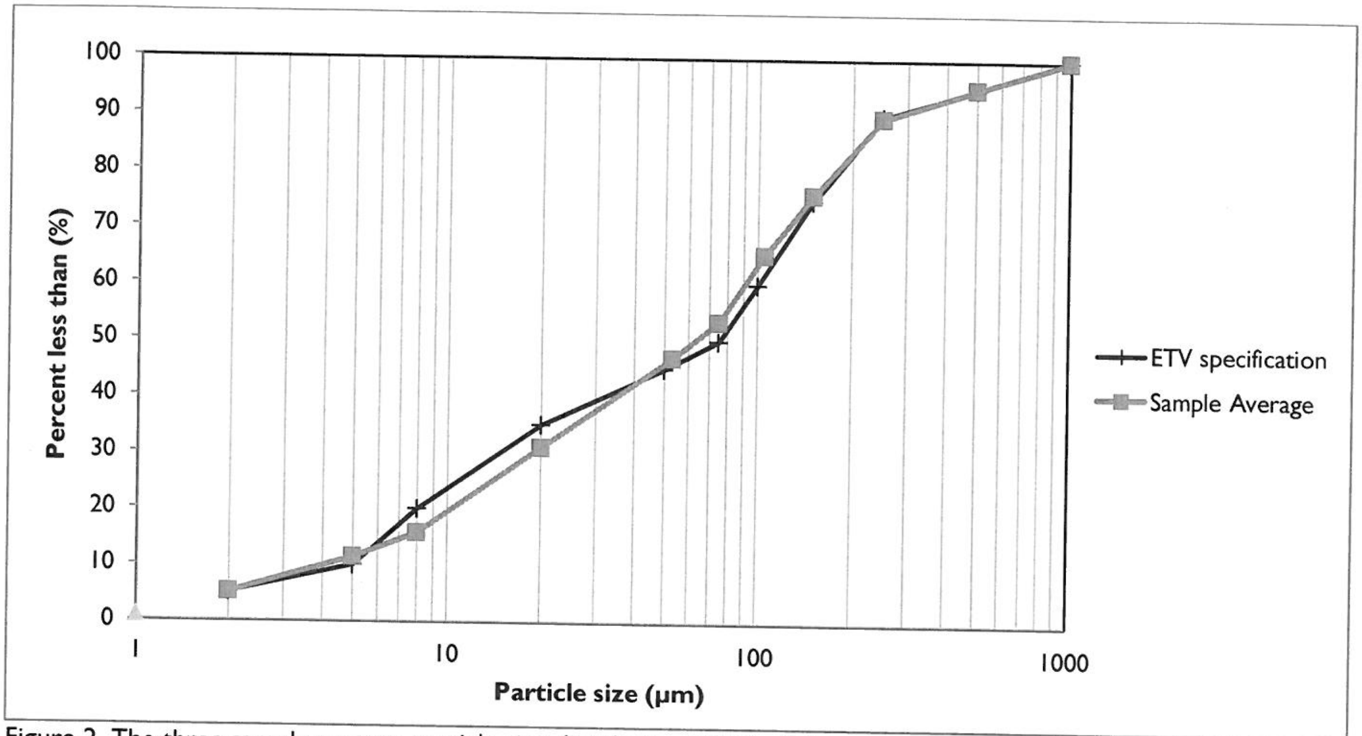


Figure 2. The three sample average particle size distribution (PSD) of the test sediment used for the capture and scour test compared to the specified PSD.

The capacity of the device to retain sediment was determined at eight surface loading rates using the modified mass balance method. This method involved measuring the mass and particle size distribution of the injected and retained sediment for each test run. Performance was evaluated with a false floor simulating the technology filled to 50% of the manufacturer's recommended maximum sediment storage depth. The test was carried out with clean water that maintained a sediment concentration below 20 mg/L. Based on these conditions, removal efficiencies for individual particle size classes and for the test sediment as a whole were determined for each of the tested surface loading rates (Table 1).

In some instances, the calculated removal efficiencies were above 100% for certain particle size fractions (marked with asterisks in Table 1). These discrepancies are not entirely avoidable and may be attributed to errors relating to the blending of sediment, collection of representative samples, and laboratory analysis of PSD. Due to these errors, caution should be exercised in applying the removal efficiencies by particle size fraction for the purposes of sizing the tested device (see Bulletin # CETV 2016-11-0001). The results for "all particle sizes by mass balance" in Table 1 are based on measurements of the total injected and retained sediment mass, and are therefore not subject to sampling or PSD analysis errors.

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

Particle size fraction (µm)	Surface loading rate (L/min/m²)							
	40	80	200	400	600	1000	1400	1893
>500	100	100*	66	79	97	100*	84	77
250 - 500	100*	100*	85	95	100*	91	100*	75
150 - 250	99	100*	100*	97	100	75	68	37
105 - 150	100	100*	100*	74	47	45	30	27
75 - 105	90	91	100*	61	33	36	26	18
53 - 75	71	27	54	100	42	44	15	16
20 - 53	65	51	20	8	10	8	5	4
8 - 20	28	22	9	7	1	1	2	1
5 – 8	30	9	0	8	2	0	1	0
<5	11	8	16	2	6	5	2	2
All particle sizes by mass balance	**73.5**	**70.3**	**63.4**	**52.6**	**45.1**	**41.5**	**32.4**	**23.0**

* Removal efficiencies were calculated to be above 100%. Calculated values typically ranged between 101 and 175% (average 126%). Higher values were observed for the >500 µm and 150-250 µm size fractions during the 80 L/min/m² test run. See text and Bulletin # CETV 2016-11-0001 for more information.

Figure 3 compares the particle size distribution (PSD) of the three sample average of the test sediment to the PSD of the retained sediment at each of the tested surface loading rates. As expected, the capture efficiency for fine particles was generally found to decrease as surface loading rates increased.

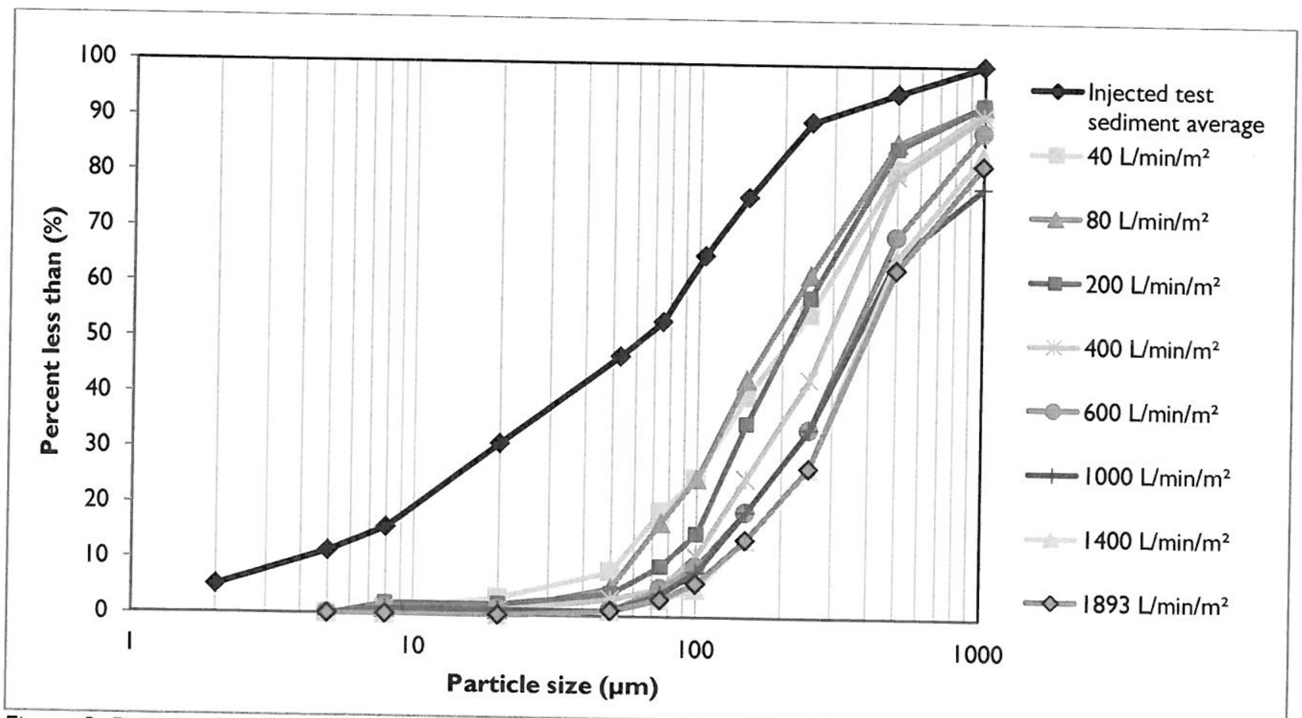


Figure 3. Particle size distribution of retained sediment in relation to the injected test sediment average.

Table 2 shows the results of the sediment scour and re-suspension test. This test involved preloading 10.2 cm of fresh test sediment into the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth. Sediment was also pre-loaded to the same depth on the separation slab (see Figure 1) since sediment was observed to have been deposited in this area during the sediment capture test. Clean water was run through the device at five surface loading rates over a 36 minute period. The test was stopped and started after the second flow rate in order to change flow meters. Each flow rate was maintained for 5 minutes with a one minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC) and PSD by recognized methods. The effluent samples were subsequently adjusted based on the background concentration of the influent water and the smallest 5% of particles captured during the 40 L/min/m² sediment capture test, as per the method described in Bulletin # CETV 2016-09-0001.

Table 2. Scour test adjusted effluent sediment concentration.

Run	Surface loading rate (L/min/m²)	Run time (min)	Background sample concentration (mg/L)	Adjusted effluent suspended sediment concentration (mg/L)†	Average (mg/L)
1	200	1.03	0.5	1.0	1.8
		2.03		1.6	
		3.03		1.8	
		4.03		1.8	
		5.03		2.6	
2	800	6.23	2.0	5.0	6.5
		7.23		6.7	
		8.23		9.4	
		9.23		5.4	
		10.23		5.9	
3	1400	11.43‡	2.0	3.1	8.2
		12.43		11.0	
		13.43		14.6	
		14.43		7.1	
		15.43		5.2	
4	2000	17.20	3.2	7.3	11.2
		18.20		22.8	
		19.20		6.9	
		20.20		6.8	
		21.20		12.1	
5	2600	22.40	8.5	248.5	309.3
		23.40		83.0	
		24.40		438.9	
		25.40		338.7	
		26.40		437.5	

† The adjusted effluent suspended sediment concentration represents the actual measured effluent concentration minus the smallest 5% of sediment particles (i.e. d5) removed during the 40 L/min/m² capture test, minus the background concentration. For more information see Bulletin # CETV 2016-09-0001.
‡ See variance #1 in "Variances from testing procedure" section below.

The results of the light liquid re-entrainment test used to evaluate the unit's capacity to prevent re-entrainment of light liquids are reported in Table 3. The test involved preloading 58.3 L (corresponding to a 5 cm depth over the collection sump area of 1.17m²) of surrogate low-density polyethylene beads within the oil collection skirt and running clean water through the device at five surface loading rates (200, 800, 1400, 2000, and 2600 L/min/m²) over a 38 minute period. As with the sediment scour test, flow was stopped and started after the second flow rate to change flow meters. Each flow rate was maintained for 5 minutes with approximately 1 minute transition time between flow rates. The effluent flow was screened to capture all re-entrained pellets throughout the test.

Table 3. Light liquid re-entrainment test results.

Target Flow (L/min/m²)	Time Stamp	Collected Volume (L)	Collected Mass (g)	Percent re-entrained by volume	Percent retained by volume
200	10:48:42	27 pellets	0.8	0.01	99.99
800	10:55:09	0.07	41	0.12	99.88
1400	11:06:59	0.8	439	1.37	98.63
2000	11:13:00	0.31	177	0.53	99.47
2600	11:19:00	0.18	98	0.31	99.69
Interim Collection Net		0.025	14.2	0.04	99.96
Total Loaded		58.3	33398	--	--
Total Re-entrained		1.385	770	--	--
Percent Re-entrained and retained		--	--	2.38	97.62

Variances from testing Procedure

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

1. It was necessary to change flow meters during the scour and light liquid re-entrainment test, as the required flows exceeded the minimum and/or maximum range of any single meter. After the loading rate of 800 L/min/m², the flow was gradually shut down and re-initiated through the larger meter immediately after closing the valve controlling flows to the small meter. The transition time of 1-minute for each target flow was followed, resulting in an elapsed time of 3 minutes to reach the next target flow of 1400 L/min/m². This procedure was approved by CETV prior to testing, in recognition that most particles susceptible to scour at low flows would not be in the sump at higher flows. Similarly, re-entrainment of the oil beads was not expected to be significantly affected by the flow meter change.

2. As part of the capture test, evaluation of the 40 L/min/m² surface loading rate was split into 3 parts due to the long duration needed to feed the required minimum of 11.3 kg of test sediment into the unit. At the end of the first and second parts of the test, the flow rates were gradually shutdown to prevent capture of particles that would have been washed out under normal circumstances. The amended procedure was reviewed and approved by the verifier prior to testing.

3. Inflow concentrations during the 40 L/min/m² surface loading rate varied from 162 mg/L to 246 mg/L, which is wider than specified ±25 mg/L range in the Procedure.

Verification

The verification was completed by Toronto and Region Conservation Authority, using the Canadian ETV Program's General Verification Protocol (March, 2000) and taking into account ISO 14034:2016. Data and information provided by Contech Engineered Solutions to support the performance claim included the following: Performance test report prepared by Alden Research Laboratory, Inc, and dated February 2015; the report is based on testing completed in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014).

What is Canadian ETV?

Canadian Environmental Technology Verification (ETV) is delivered by GLOBE Performance Solutions under a license agreement from Environment Canada. Canadian ETV is designed to support Canada's environment industry by providing credible and independent verification of technology performance claims.

For more information on the CDS Stormwater Treatment System ® please contact:

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Tel: 207-885-9830
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www.conteches.com

Canadian ETV Contact Information:

c/o GLOBE Performance Solutions
404 – 999 Canada Place
Vancouver, BC
V6C 3E2 Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com
www.etvcanada.ca

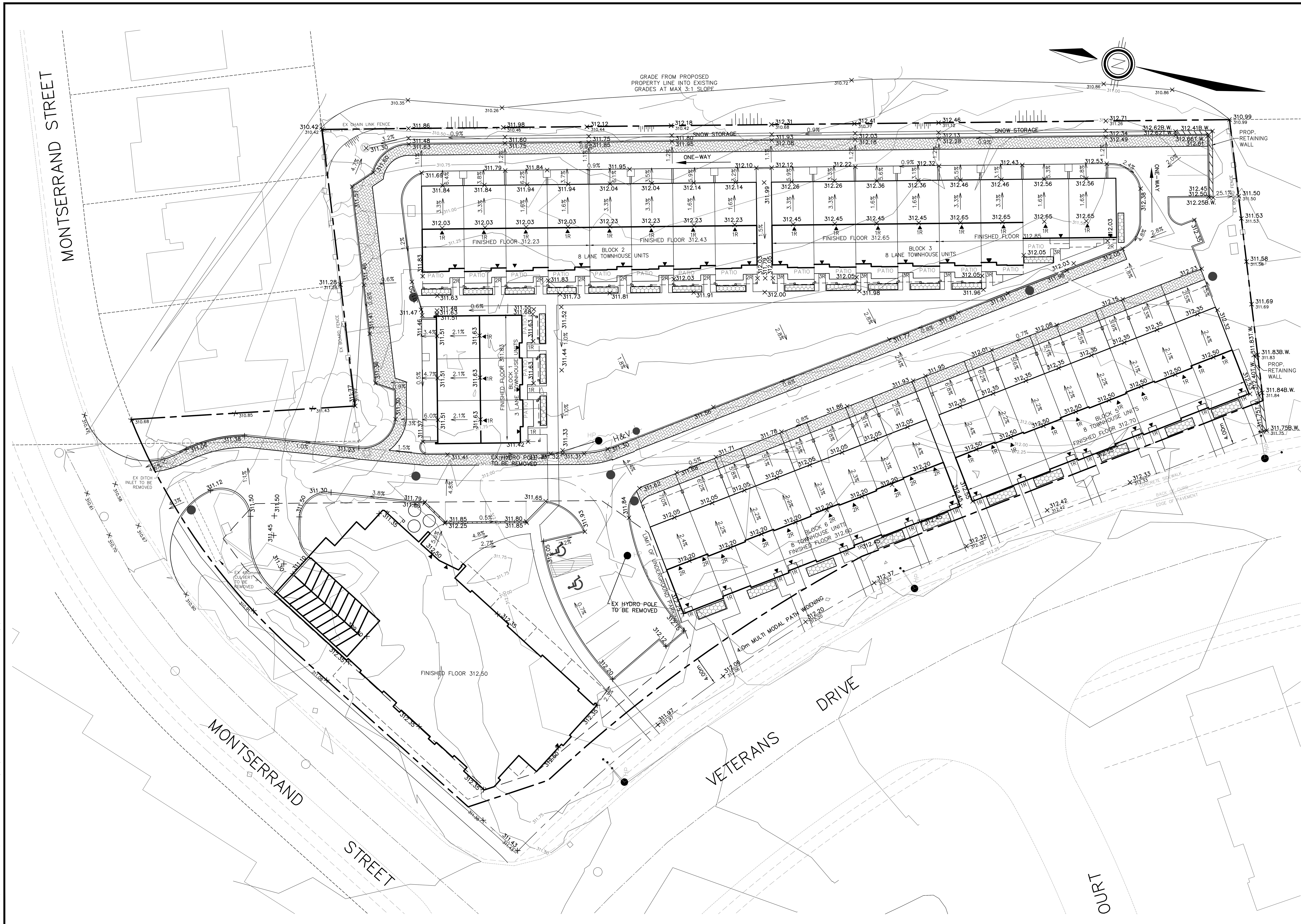
Limitation of verification

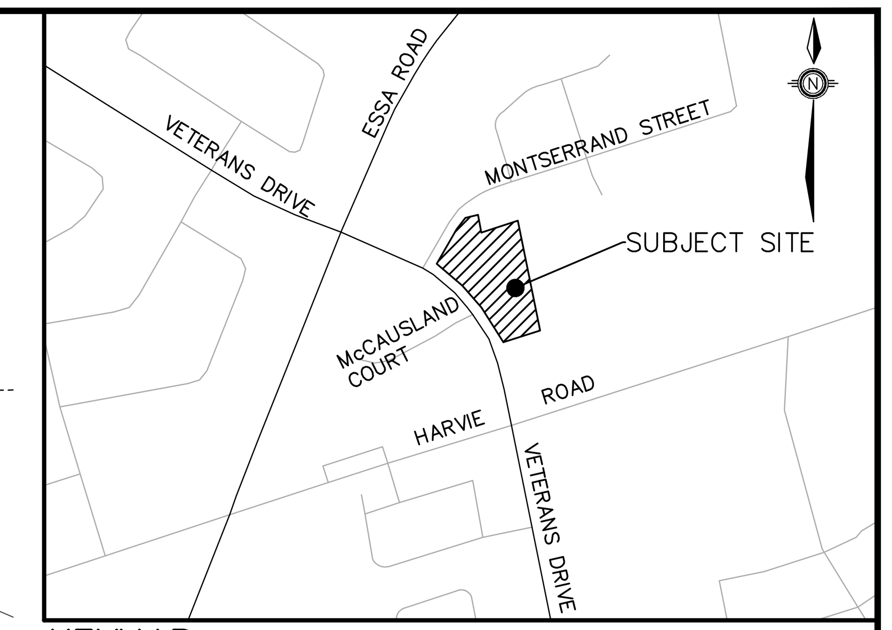
Environment Canada, Canadian ETV and the Verification Expert provide the verification services solely on the basis of the information supplied by the applicant or vendor and assume no liability thereafter. The responsibility for the information supplied remains solely with the applicant or vendor and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

Printed: March 20, 2017 Expires: March 31, 2020

Appendix G

Engineering Drawings





KEYMAP

LEGEND

- CB — CATCH BASIN
- DCB — DOUBLE CATCH BASIN
- CBMH — CATCH BASIN
- MH — STORM MANHOLE
- MH — SANITARY MANHOLE
- SERVICE CAP
- HYD. — FIRE HYDRANT
- VB — WATER VALVE
- CS — CURB STOP W/ SERVICE
- 254.63 / 254.09 — PROPOSED ELEVATION / EXISTING ELEVATION
- 2.0% — PROPOSED DIRECTION AND GRADE
- BACK OF CURB
- EDGE OF PAVEMENT
- CURB CUT LOCATION
- HIGH POINT
- LIMITS OF UNDERGROUND PARKING
- ABOVE GRADE BALCONY
- BH/MW101 — BOREHOLE/MONITORING WELL
- PROP. RAIN GARDENS ($3.2m^2$ TYP.)
- PROP. RAIN GARDENS ($4.8m^2$ TYP.)
- PERMEABLE PAVERS

WELL ID	SEASONAL HIGH GROUNDWATER DEPTH	GROUNDWATER ELEVATION
BM/MW 101	1.30 m	310.79
BM/MW 102	1.44 m	310.03
BM/MW 103	1.31 m	310.65

ELEVATIONS FROM SEASONAL GROUNDWATER LEVEL MONITORING LETTER BY SOIL ENGINEERS LTD. SEPTEMBER 15, 2020

NO.	REVISION NOTE	DATE	BY
1.	AS PER PRE-CONSULTATION REVIEW	04/22/21	JPE

HORIZONTAL
MNRF MONUMENT 03120040021 MONUMENT IS LOCATED AT THE BACK OF THE SIDEWALK ON THE SOUTHWEST CORNER OF ESSA ROAD AND FERNDALE DRIVE SOUTH. NOTE: A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENT CAP.
MNRF MONUMENT 03120040024 MONUMENT IS LOCATED ON THE SOUTH CURB LINE OF FERNDALE DRIVE SOUTH, APPROXIMATELY 150M NORTHWEST OF STROUD PLACE AND OPPOSITE FROM A "MAXIMUM 50KM" SIGN. NOTE: A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENT CAP.

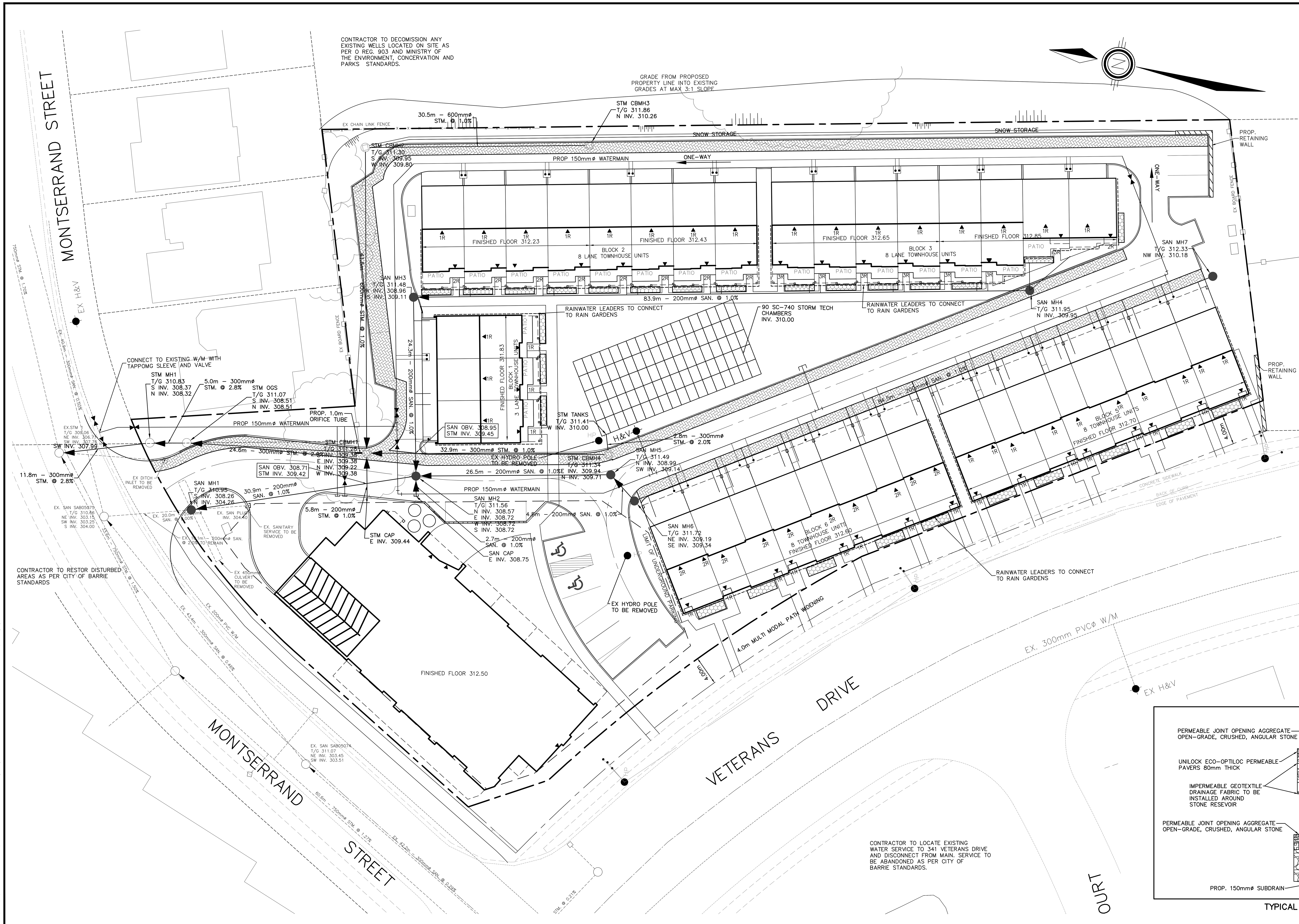
VERTICAL
MNRF MONUMENT 03120030023 MONUMENT IS LOCATED AT WATER RESEVIOR ON HARVIE RD 0.5KM EAST OF VETERANS DRIVE. MONUMENT IS SET FLUSH IN THE SOUTH END OF THE EAST WING ALL TO ENTER THE RESERVOIR. THE TABLET IS CENTERED IN THE WALL AND 90CM BELOW THE TOP OF WALL.
ELEV: 303.862
MNRF MONUMENT 03120080048 LOCATED APPROXIMATELY 11M EAST OF THE CENTERLINE OF THRUSHWOOD DRIVE BETWEEN CRANBERRY AND BLUEBERRY LANES. NOTE, A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENT CAP.
ELEV: 302.524

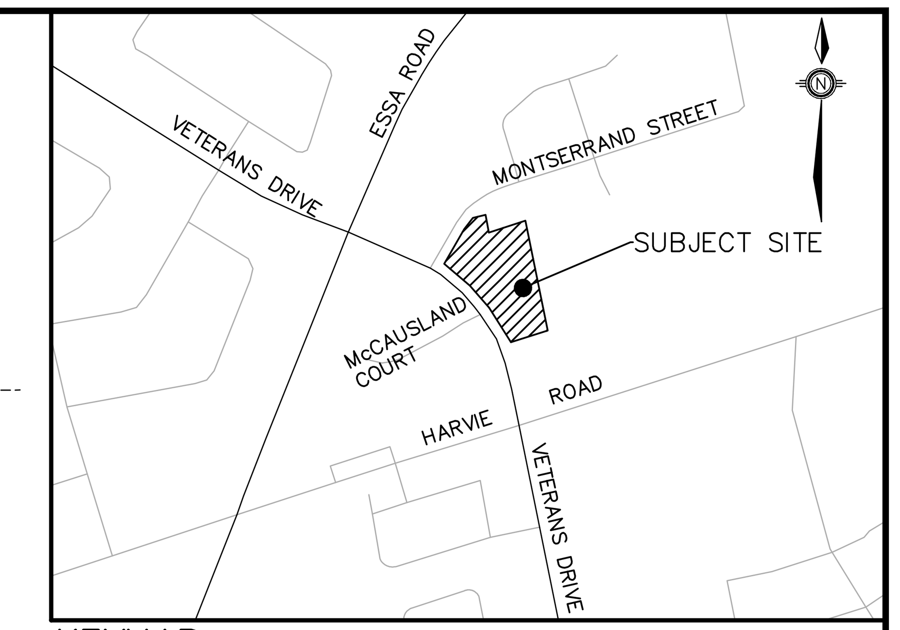
SEAN HOMES
341 VETERANS LANE
BARRIE, ON

SITE GRADING PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	MWD	HORIZ SCALE	1 : 250	PROJECT #	18079
DRAWN BY	JPE	VERT SCALE	N/A	DRAWING #	SG-1
CHECKED BY	GMP	DATE	OCTOBER 2020	REVISION #	1





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- LIMITS OF UNDERGROUND PARKING
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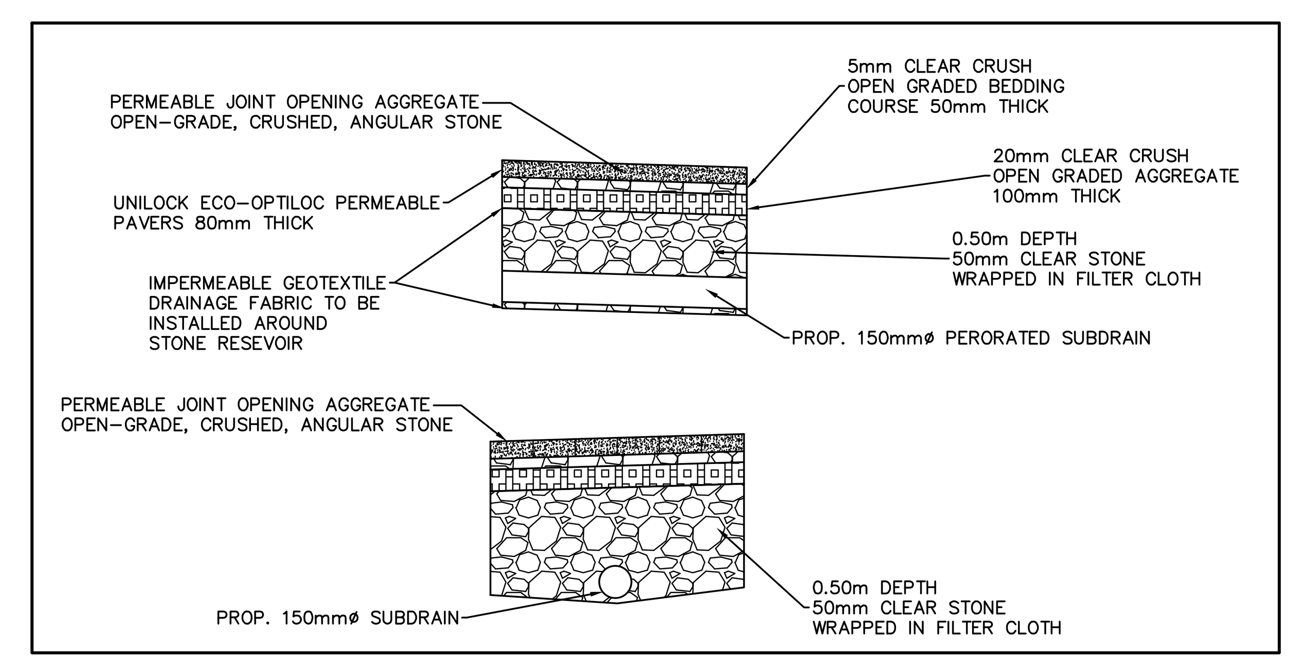
- RAIN GARDEN
- RAIN WATER LEADER



TYPICAL PERMEABLE PAVERS DETAIL
NTS

NO.	REVISION NOTE	DATE	BY
1.	AS PER PRE-CONSULTATION REVIEW	04/22/21	JPE

HORIZONTAL
MNRF MONUMENT 03120040021 MONUMENT IS LOCATED AT THE BACK OF THE SIDEWALK ON THE SOUTHWEST CORNER OF ESSA ROAD AND FERNDALE DRIVE SOUTH. NOTE: A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENT CAP.
MNRF MONUMENT 03120040024 MONUMENT IS LOCATED ON THE SOUTH CURB LINE OF FERNDALE DRIVE SOUTH, APPROXIMATELY 150M NORTHWEST OF STROUD PLACE AND OPPOSITE FROM A "MAXIMUM 50KM" SIGN. NOTE: A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENT CAP.

VERTICAL
MNRF MONUMENT 03120030023 MONUMENT IS LOCATED AT WATER RESEVIOR ON HARVIE RD 0.5KM EAST OF VETERANS DRIVE. MONUMENT IS SET FLUSH IN THE SOUTH END OF THE EAST WING ALL TO ENTER THE RESERVOIR. THE TABLET IS CENTERED IN THE WALL AND 90CM BELOW THE TOP OF WALL.
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SEAN HOMES
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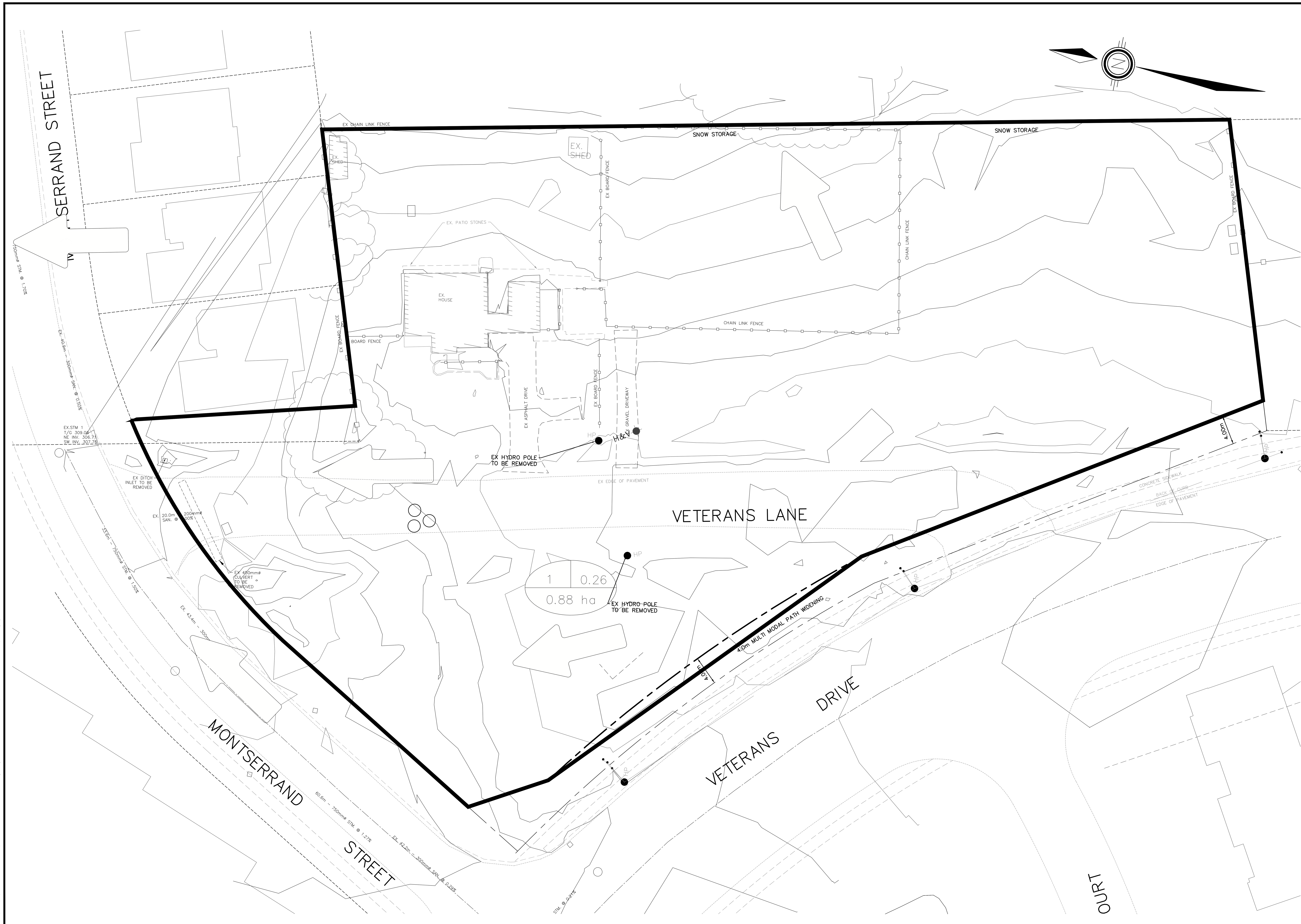
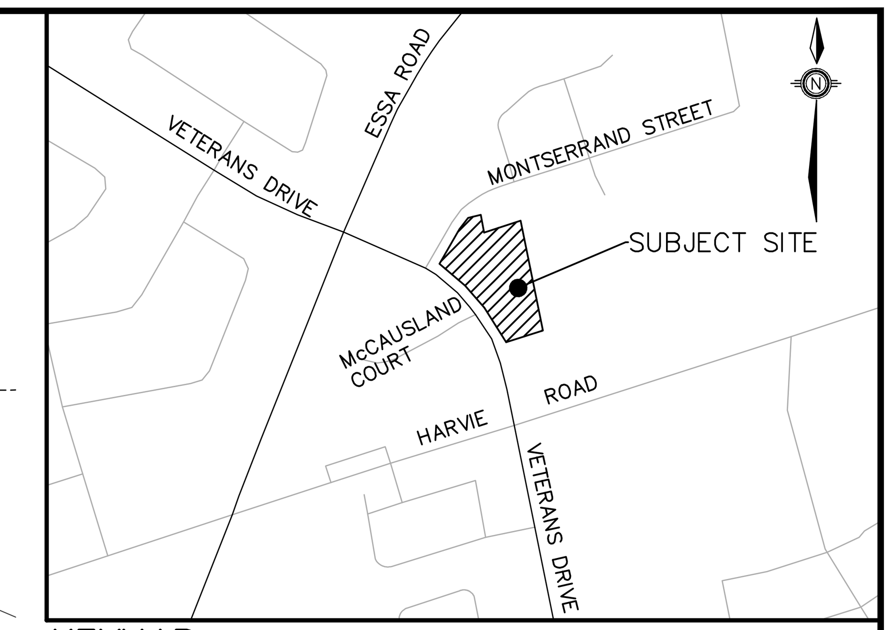
SITE SERVICING PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	MWD	HORIZ SCALE	1 : 250	PROJECT #	18079
DRAWN BY	JPE	VERT SCALE	N/A	DRAWING #	SS-1
CHECKED BY	GMP	DATE	OCTOBER 2020	REVISION #	1





KEYMAP

LEGEND

- CB CATCH BASIN
- DCB DOUBLE CATCH BASIN
- CBMH CATCH BASIN
- MH STORM MANHOLE
- OVERLAND FLOW DIRECTION
- CATCHMENT AREA (1 | 0.75 / 1.00 ha) RUNOFF COEFFICIENT, AREA IN HECTARES
- CATCHMENT BOUNDARY

NO.	REVISION NOTE	DATE	BY
1.	AS PER PRE-CONSULTATION REVIEW	04/22/21	JPE

HORIZONTAL
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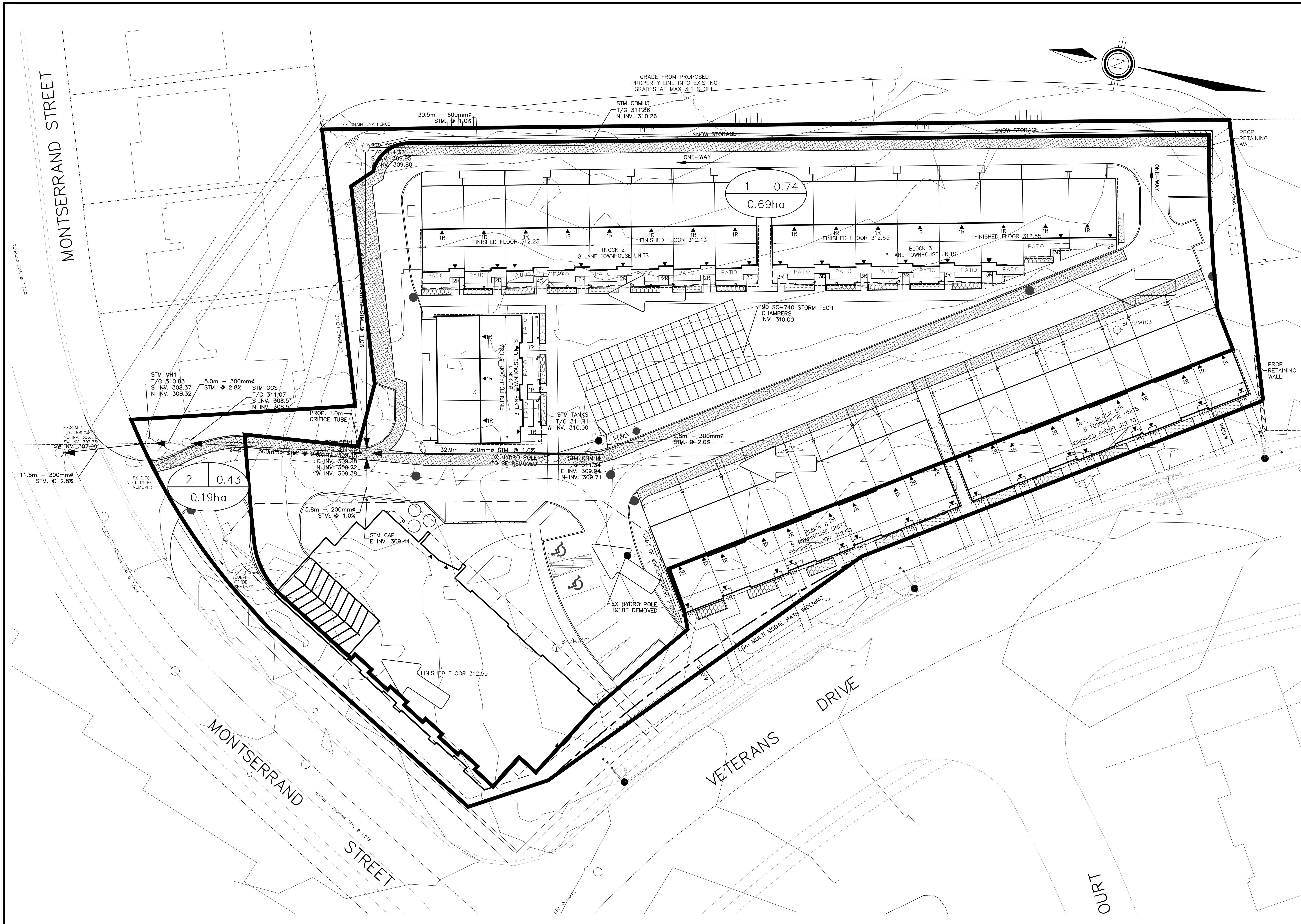
ELEV: 302.524

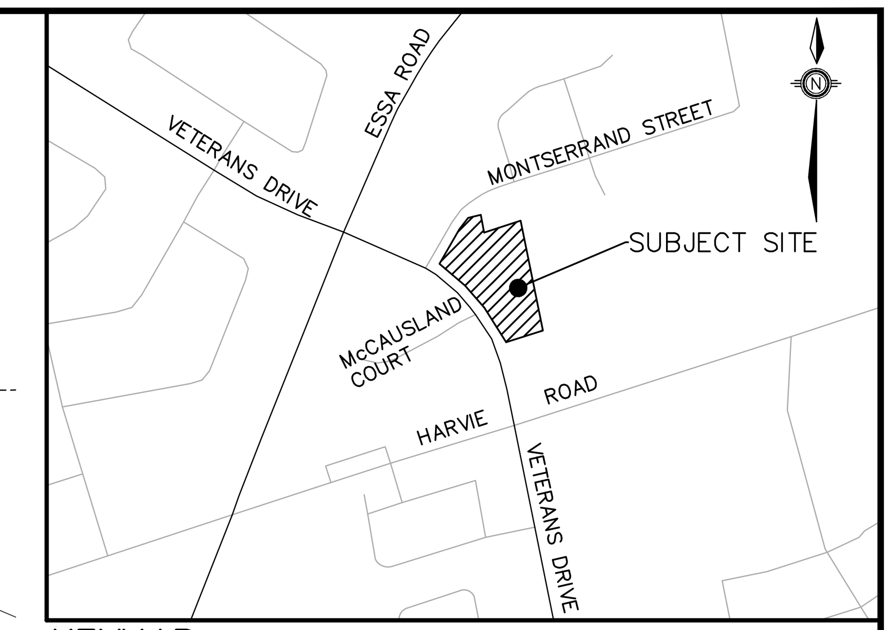
SEAN HOMES
341 VETERANS LANE
BARRIE, ON

PRE-DEVELOPMENT STORM CATCHMENT PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	MWD	HORIZ SCALE	1 : 250	PROJECT #	18079
DRAWN BY	JPE	VERT SCALE	N/A	DRAWING #	STM-1
CHECKED BY	GMP	DATE	OCTOBER 2020	REVISION #	1





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- CATCHMENT BOUNDARY

WELL ID	SEASONAL HIGH GROUNDWATER DEPTH	GROUNDWATER ELEVATION
BM/MW 101	1.30 m	310.79
BM/MW 102	1.44 m	310.03
BM/MW 103	1.31 m	310.65

ELEVATIONS FROM SEASONAL GROUNDWATER LEVEL MONITORING LETTER BY SOIL ENGINEERS LTD. SEPTEMBER 15, 2020

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MNRF MONUMENT 03120040024 MONUMENT IS LOCATED ON THE SOUTH CURB LINE OF FERNDALE DRIVE SOUTH, APPROXIMATELY 150M NORTHWEST OF STROUD PLACE AND OPPOSITE FROM A "MAXIMUM 50KM" SIGN. NOTE: A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENT CAP.

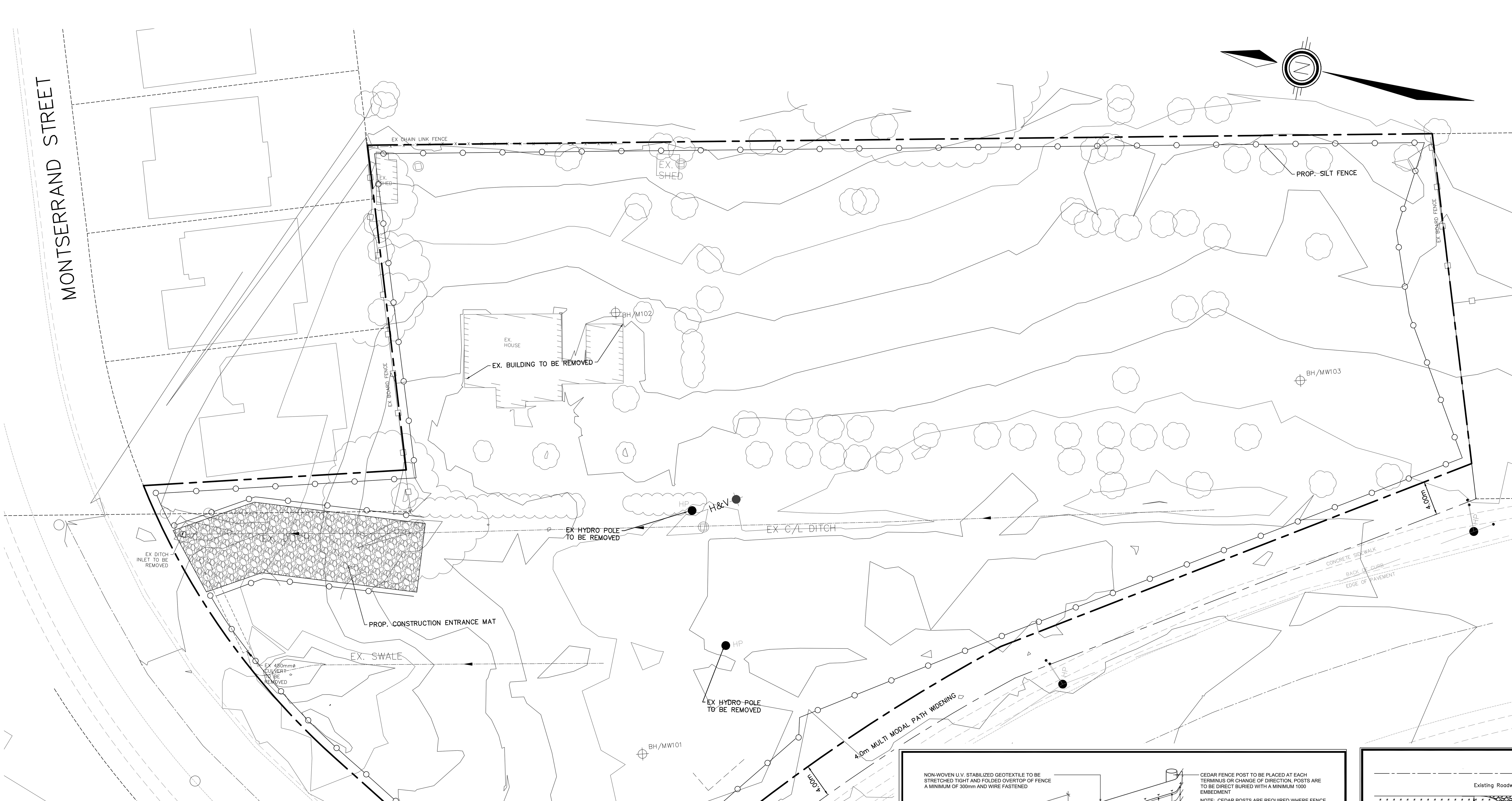
VERTICAL
MNRF MONUMENT 03120030023 MONUMENT IS LOCATED AT WATER RESEVIOR ON HARVIE RD 0.5KM EAST OF VETERANS DRIVE. MONUMENT IS SET FLUSH IN THE SOUTH END OF THE EAST WING ALL TO ENTER THE RESERVOIR. THE TABLET IS CENTERED IN THE WALL AND 90CM BELOW THE TOP OF WALL.
ELEV: 303.862
MNRF MONUMENT 03120080048 LOCATED APPROXIMATELY 11M EAST OF THE CENTERLINE OF THRUSHWOOD DRIVE BETWEEN CRANBERRY AND BLUEBERRY LANES. NOTE, A PROTECTIVE WATER VALVE COVER HAS BEEN PLACED OVER MONUMENT CAP.
ELEV: 302.524

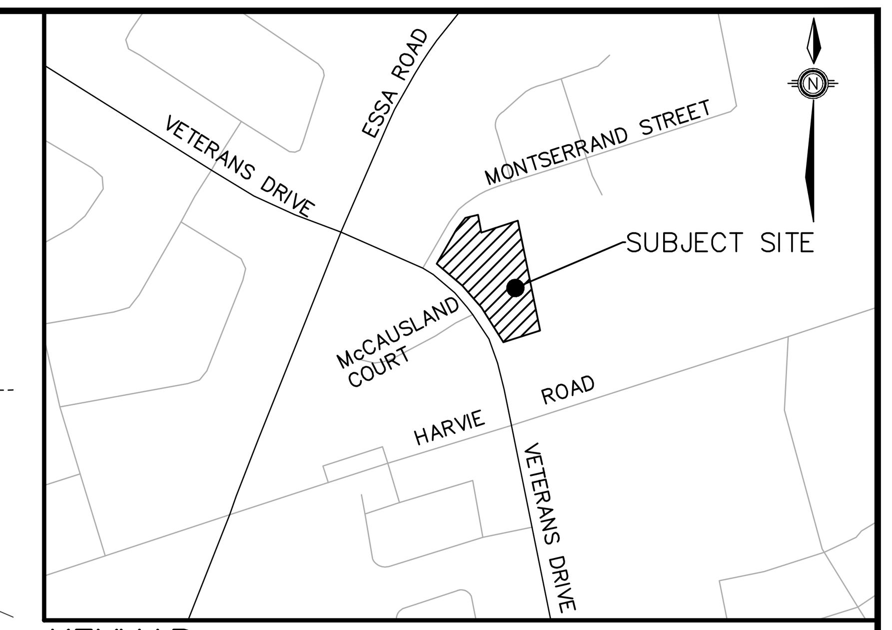
SEAN HOMES
341 VETERANS LANE
BARRIE, ON

POST-DEVELOPMENT STORM CATCHMENT PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	MWD	HORIZ SCALE	1 : 250	PROJECT #	18079
DRAWN BY	JPE	VERT SCALE	N/A	DRAWING #	STM-2
CHECKED BY	GMP	DATE	OCTOBER 2020	REVISION #	1





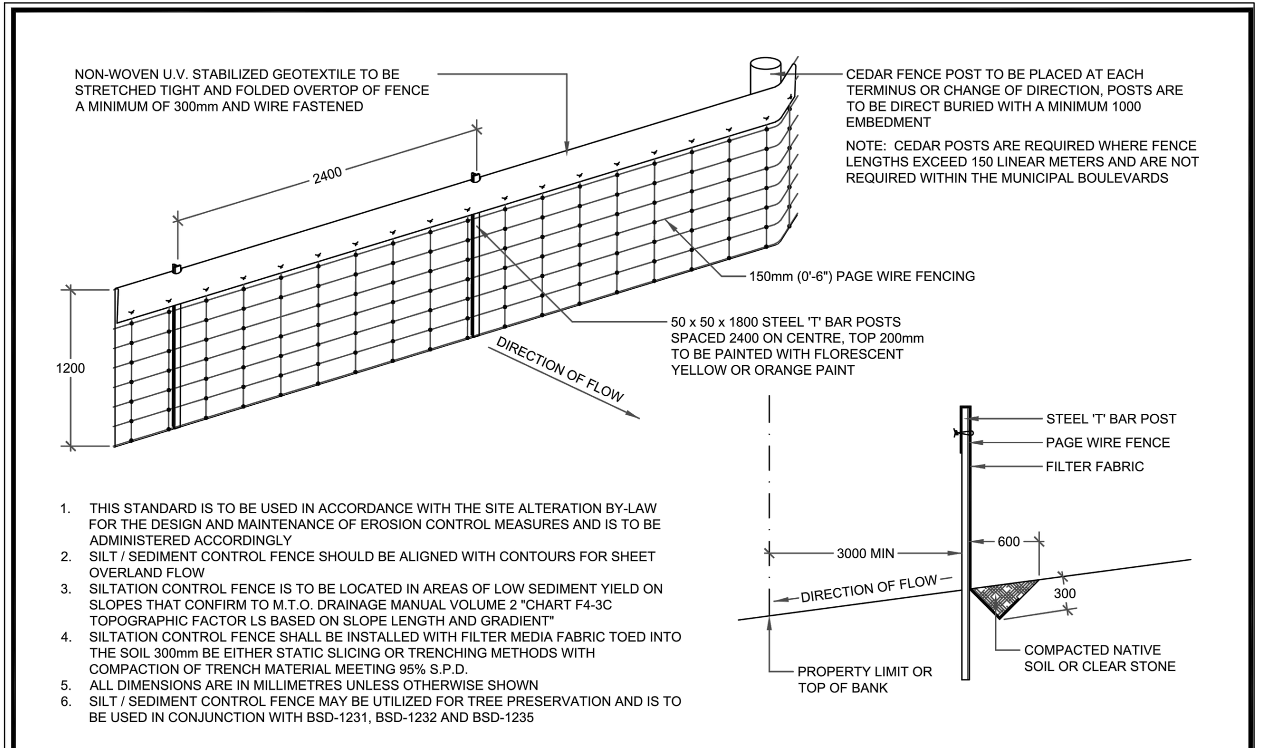
KEYMAP

LEGEND

CB	CATCH BASIN
DCB	DOUBLE CATCH BASIN
CBMH	CATCH BASIN
MH	STORM MANHOLE
MH	SANITARY MANHOLE
BH/MW101	BOREHOLE/MONITORING WELL

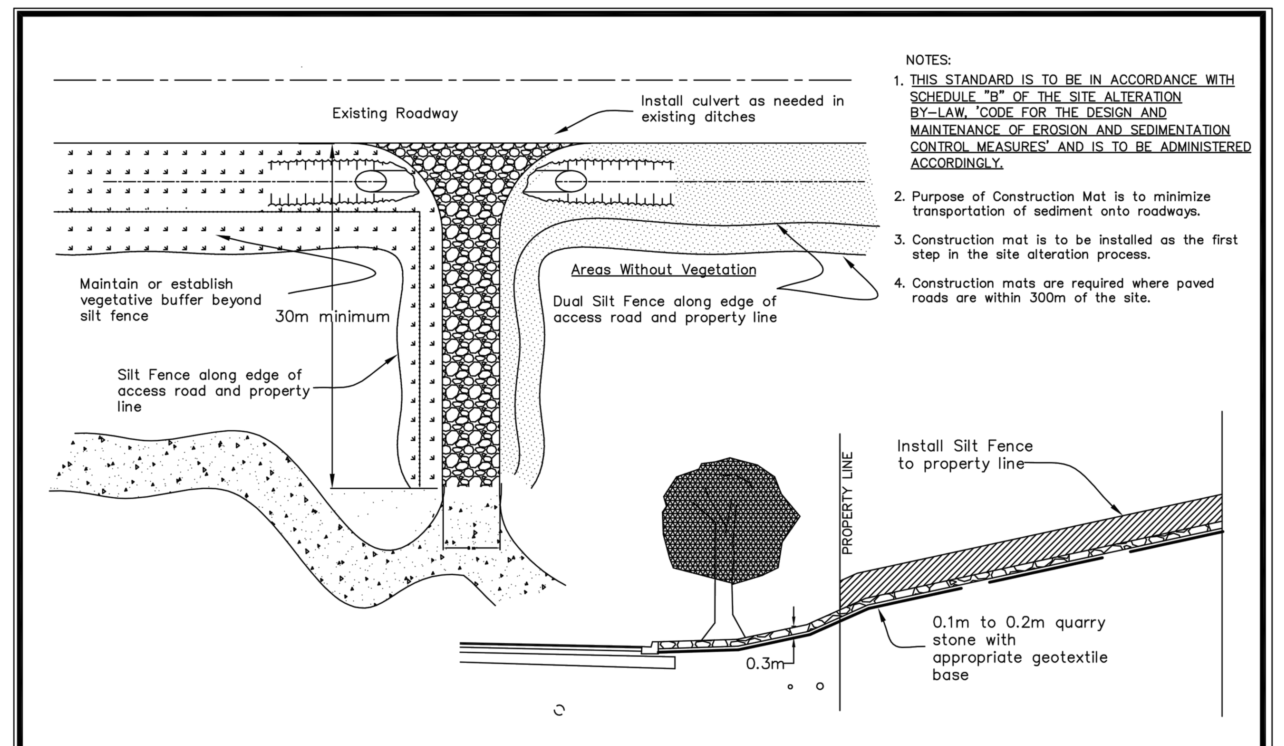
NOTES FOR SEDIMENT & EROSION CONTROL

1. DISTURBED AREAS THAT HAVE FAILED TO HAVE STABLE GROUND COVER ESTABLISHED BY OCTOBER 30TH SHALL BE PROTECTED WITH A SILTATION CONTROL FENCE OR STRAW MULCH ETC. AND MAINTAINED BY THE CONTRACTOR UNTIL VEGETATION BECOMES ESTABLISHED IN THE SUBSEQUENT GROWING SEASON.
2. ANY DEWATERING WASTE SHALL BE DISCHARGED TO A VEGETATED AREA AT LEAST 30m FROM ANY WATERCOURSE AND FILTERED. FILTERING METHODS MUST BE APPROVED BY THE SITE ADMINISTRATOR. DISCHARGE TO MUNICIPAL SERVICES MUST BE APPROVED BY THE CITY OF BARRIE PRIOR TO STARTING WORK AND ADHERE TO CITY OF BARRIE STANDARDS
3. SILT FENCE SHALL BE PUT IN PLACE PRIOR TO AND MAINTAINED DURING ALL GRADING. SILT FENCE TO BE INSPECTED PRIOR TO COMMENCEMENT OF EARTH GRADING ACTIVITIES. SILT FENCE TO BE INSPECTED AND REPAIRED OR REPLACED IF DAMAGED AS DIRECTED BY THE SITE ADMINISTRATOR. SILT CONTROLS TO BE INSPECTED ON A REGULAR BASIS AND AFTER EVERY RAIN EVENT. INSTALLATION SHALL BE TO THE MANUFACTURER'S SUGGESTED SPECIFICATIONS.
4. THE CONTRACTOR SHALL BE PREPARED FOR UNEXPECTED CONDITIONS AND ACCORDINGLY HAVE STOCKPILED MATERIALS ON SITE FOR NECESSARY REPAIRS AS A RESULT OF FAILED OR INADEQUATE CONTROL MEASURES. ALL SEDIMENT AND EROSION CONTROL MEASURES SHALL BE INSPECTED AT LEAST ONCE A WEEK, AND AFTER EVERY RAINFALL EVENT.
5. CONTRACTOR SHALL OBTAIN A CURRENT COPY AND BECOME FAMILIAR WITH OPSS 577, CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES AS WELL AS ALL APPLICABLE MUNICIPAL STANDARDS.
6. THE CONTRACTOR MAY CONSIDER ALTERNATIVE SEDIMENT AND EROSION CONTROL MEASURES. SUCH MEASURES SHOULD BE PRESENTED IN WRITING FOR APPROVAL OF THE SITE ADMINISTRATOR AND MUST BE APPROVED IN WRITING BY THE MUNICIPALITY AND CONSERVATION AUTHORITY.
7. THE TOPS OF ALL FILTER FABRIC MUST BE A MINIMUM OF 1.0 METRES ABOVE THE GROUND LEVEL AND ATTACHED TO THE FENCE WITH A CONTINUOUS STEEL WIRE. ALTERNATIVELY, THE FILTER FABRIC MUST BE FOLDED OVER THE TOP OF THE FENCE AND ATTACHED TO THE FENCE WITH WIRE LOOPED THROUGH THE FABRIC ON BOTH SIDES OF THE FENCE. FILTER FABRIC IS TO BE TERRAFIX 270R OR EQUIVALENT.
8. ALL DISTURBED GROUND LEFT INACTIVE SHALL BE STABILIZED BY SEEDING, SODDING, MULCHING, OR COVERING OR OTHER EQUIVALENT CONTROL MEASURES. THIS PERIOD OF INACTIVITY SHALL BE AT THE DISCRETION OF THE CITY OF BARRIE MANAGER OF ENGINEERING BUT SHALL NOT EXCEED THIRTY DAYS.
9. CONTRACTOR SHALL INSTALL AND MAINTAIN CATCHBASIN SEDIMENT BARRIERS THROUGHOUT THE SITE DURING ALL CONSTRUCTION ACTIVITIES IN ORDER TO TRAP SEDIMENT. REFER TO DETAIL



1. THIS STANDARD IS TO BE USED IN ACCORDANCE WITH THE SITE ALTERATION BY-LAW FOR THE DESIGN AND MAINTENANCE OF EROSION CONTROL MEASURES AND IS TO BE ADMINISTERED ACCORDINGLY
2. SILT / SEDIMENT CONTROL FENCE SHOULD BE ALIGNED WITH CONTOURS FOR SHEET OVERLAND FLOW
3. SILTATION CONTROL FENCE IS TO BE LOCATED IN AREAS OF LOW SEDIMENT YIELD ON SLOPES THAT CONFIRM TO M.T.O. DRAINAGE MANUAL VOLUME 2 "CHART F4-3C TOPOGRAPHIC FACTOR LS BASED ON SLOPE LENGTH AND GRADIENT"
4. SILTATION CONTROL FENCE SHALL BE INSTALLED WITH FILTER MEDIA FABRIC TOED INTO THE SOIL 300mm BE EITHER STATIC SLICING OR TRENCHING METHODS WITH COMPACTION OF TRENCH MATERIAL MEETING 95% S.P.D.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN
6. SILT / SEDIMENT CONTROL FENCE MAY BE UTILIZED FOR TREE PRESERVATION AND IS TO BE USED IN CONJUNCTION WITH BSD-1231, BSD-1232 AND BSD-1235

Barrie STANDARD DETAIL	SILTATION CONTROL FENCING	REV No. 2	DATE: OCT 2017 / SCALE: N.T.S.	APPROVED
		BSD-1233 FORMERLY BSD-23A		DATE Oct 10/17 Original Signed By DIRECTOR OF ENGINEERING



NOTES:

1. THIS STANDARD IS TO BE IN ACCORDANCE WITH SCHEDULE "B" OF THE SITE ALTERATION BY-LAW, 'CODE FOR THE DESIGN AND MAINTENANCE OF EROSION AND SEDIMENTATION CONTROL MEASURES' AND IS TO BE ADMINISTERED ACCORDINGLY.
2. Purpose of Construction Mat is to minimize transportation of sediment onto roadways.
3. Construction mat is to be installed as the first step in the site alteration process.
4. Construction mats are required where paved roads are within 300m of the site.

CITY OF BARRIE STANDARD	NO.	REVISION	APR'D	DATE	
CONSTRUCTION ENTRANCE MAT	1.	Standardized Dimension Text	J.S.	05.10.28	APR'D: R.G.N. DATE: 04.03.16 DRAWN: A.S.C SCALE: N.T.S BSD-23D

SEQUENCE OF CONSTRUCTION

1. ENGINEER TO BE NOTIFIED PRIOR TO INITIATION OF ANY ON SITE WORKS.
2. SILT FENCE AND MUD MAT CONSTRUCTION ENTRANCE IS TO BE INSTALLED PRIOR TO THE COMMENCEMENT OF ANY WORKS ONSITE.
3. VEGETATION REMOVAL MAY COMMENCE AFTER ALL SILT FENCE IS INSTALLED AND APPROVED BY THE ENGINEER.
4. EROSION CONTROL MEASURES TO BE MAINTAINED AS DIRECTED BY THE ENGINEER DURING THE CONSTRUCTION PERIOD. ADDITIONAL CONTROL MEASURES MAY BE REQUIRED AT THE DISCRETION OF THE ENGINEER.
5. ALL DISTURBED GROUND LEFT INACTIVE FOR MORE THAN 30 DAYS SHALL BE STABILIZED WITH SEED, SOD, MULCH OR OTHER ADEQUATE COVERING, AS INSTRUCTED BY THE ENGINEER.

NO.	REVISION NOTE	DATE	BY
1.	AS PER PRE-CONSULTATION REVIEW	04/22/21	JPE

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341 VETERANS LANE
BARRIE, ON

ENVIRONMENTAL PROTECTION AND REMOVALS PLAN

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DESIGNED BY	MWD	HORIZ SCALE	1 : 250	PROJECT #	18079
DRAWN BY	JPE	VERT SCALE	N/A	DRAWING #	EPR–1
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