TOM SMITH GMC
TOWN OF MIDLAND
STORM WATER MANAGEMENT REPORT

Prepared by:

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APPENDICES

1.0 INTRODUCTION

1.1 General

The owner of the property is proposing to construct a new building at the existing Tom Smith GMC development located at 824 King Street in the Town of Midland. The property is approximately 2.4 hectares in size and is legally described as Part of Lot 102, Concession 1, in the Geographic Township of Tay, County of Simcoe. The property is bounded by King Street to the east, residential development to the west, and commercial development to the north and south. The site location is further illustrated on Figure 1.

The proposed development on the property includes an approximately 3420 sq.m. building and associated asphalt parking. The existing GMC building, Tim Hortons and other buildings are to be demolished and removed. Access to the property will continue to be provided from King Street.

Pinestone Engineering Ltd (PEL) has been retained by the property owner to prepare a Stormwater Management Brief in support of planning approvals. The report generally describes the proposed stormwater quality and quantity control strategy for the site.

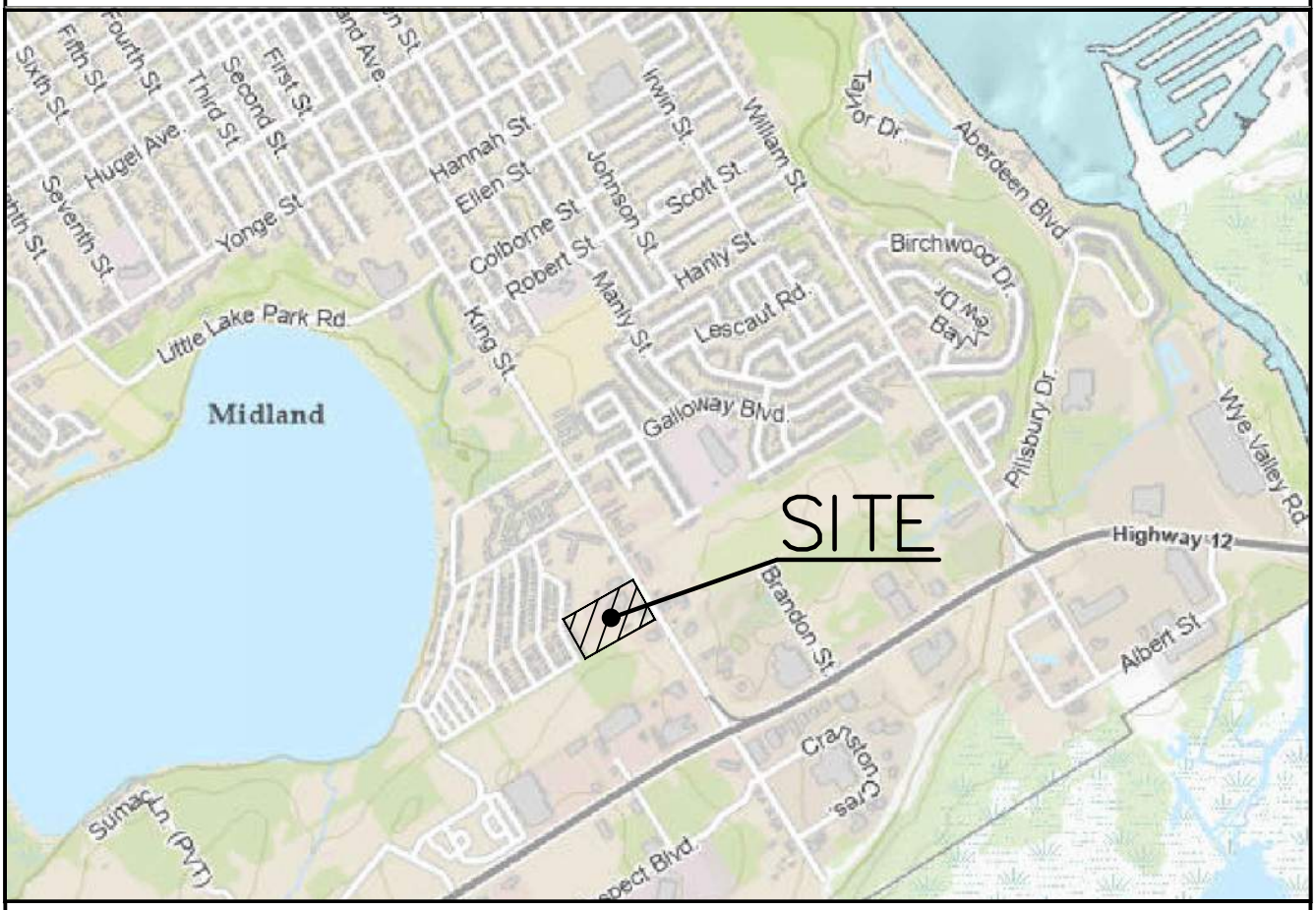
1.2 Purpose and Scope

This report has been prepared in order to outline the storm water management requirements of the proposed development and provide the design details of the required quantity and quality control facilities necessary to address the SWM criteria.

This report has been prepared to satisfy the requirements of the Town of Midland, and the Ministry of the Environment, Conservation and Parks (MECP).

The following objectives have been identified in the preparation of this report:

- Determine the appropriate storm water management criteria for the subject property.
- Determine if a reduction of peak runoff flows through structural controls are required to control potential flooding downstream from the development.
- Outline an appropriate set of quality control techniques that can be implemented to meet current MECP standards for this type of development.
- Provide design details of the proposed storm water management and conveyance facilities.
- Identify methods to control sedimentation and erosion during construction and in the long term.



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TOM SMITH GMC MIDLAND

LOCATION PLAN

DATE:	SCALE:	PROJECT No.	FIGURE No.
FEB. 2023	N.T.S.	22-11692-M	FIGURE 1

1.3 Reference Reports

The following reports and studies have been used for reference in the preparation of this Storm Water Management Plan:

i) *Ministry of the Environment and Energy's Storm Water Management Planning and Design Manual, March 2003.*
ii) *Town of Midland – Engineering Development Design Standards, December 2012*
iii) *Sediment Control Planning Central Region Group, prepared by the Ministry of Natural Resources.*
iv) *Drainage Management Manual, prepared by the Ministry of Transportation, 1997.*

2.0 EXISTING SITE CONDITIONS

2.1 General

The subject property is approximately 2.4 hectares in size and is currently a Tom Smith GMC commercial development. The property is generally comprised of asphalt and gravel parking areas surrounding the GMC building. There is also an existing Tim Horton's and two 1-storey buildings located on the property.

2.2 Topography and Drainage Conditions

Topographic information was provided by Eplett Worobec Raikes Surveying Ltd. Based on our review of the mapping, topography across the development area is gentle to moderate, generally sloping from the west to the east towards King Street at an average grade of 1.0%. No onsite flow attenuation controls exist on the site and pre-development flows from the site are conveyed to existing catchbasins and storm sewers, or drain overland in the form of sheet flow, towards the storm sewer system on King Street.

2.3 Site Geology

Based on our review of the Preliminary Servicing Assessment prepared by Azimuth Environmental Consulting Inc. in January 2020, and Quaternary Geology of the Simcoe County area published by the Ministry of Northern Development and Mines, the geology in the area of the development lots is described as sandy loam.

Based on our review of the soil descriptions outlined in the MTO Drainage Manual on Chart 1.08, we have classified the site material as a Type AB under the Soil Conservation Service, hydrologic soil group. Adjustment of the curve numbers for the pervious component of the lands have been carried out in the computer model to represent Type AB soils.

A copy of the soils mapping, and Chart 1.08 from the MTO Drainage Manual is included in Appendix A.

3.0 PROPOSED DEVELOPMENT

The developer is proposing to construct a new building for the Tom Smith GMC development with associated asphalt parking expansion. Site grading will generally match existing conditions with drainage flowing from east to west towards King Street. Existing vegetation will be preserved where feasible and grading permits. The current GMC building and Tim Horton's development are to be demolished and removed.

4.0 HYDROLOGY

A hydrologic model has been prepared for the site. The intent of the model was to provide quantitative estimates of runoff rates under both existing and proposed development conditions. These estimates can then be compared to determine the impact of the proposed development on the study area.

4.1 Model Selection

The rainfall runoff event simulation model MIDUSS (Microcomputer Interactive Design of Urban Storm Water Management Systems) was used to simulate watershed response to design rainfall events.

4.2 Design Storms

The following design storms were modelled as part of our evaluation:

- 5-year design storm
- 10-year design storm
- 25-year design storm
- 100-year design storm

Rainfall intensity - duration frequency (IDF) values, published by the Ministry of Transportation (MTO) for the Town of Midland area, were entered into an equation that expresses the time relationship intensity for specific frequency, in the form of:

$$i = \frac{a}{(t+b)^c}$$

where: i = intensity, mm/hr.

t = Time of concentration, minutes

a,b,c = constants developed to fit published IDF curves

The storm events were applied to the hydrologic model. Derivation of the design storm hyetographs were based on the "Chicago" 3-hour distribution using MTO intensity, duration, frequency (IDF) data for the Town of Midland area.

The design storm parameters utilized in the modelling, are outlined in Table 1, below:

Table 1
Design Storm Parameters
Chicago Rainfall Distribution

Rainfall Event	Parameter			Duration
	A	B	C	(min)
5Yr	1135.4	7.50	0.841	180
10Yr	1387.0	7.97	0.852	180
25Yr	1676.2	8.30	0.858	180
100Yr	2193.1	9.04	0.871	180

4.3 Drainage Catchments

One (1) pre-development and one (1) post-development catchment has been delineated for the site in order to estimate the peak runoff rate exiting the site. The pre-development catchment represents the existing condition of the property. The post-development catchment represents the proposed development and grading concept of the site.

The pre-development and post-development catchment parameters are listed in Table 2. The pre-development and post-development catchment boundaries are illustrated on Figures 2 and 3, respectively.

Table 2
Sub-catchment Parameters

Catchments	Area (ha)	Slope	% Impervious	SCS Curve No.
Pre-Development				
101	2.38	1%	50.0%	80.74
Post-Development				
201	2.38	1%	85.7%	60.00

In the pre-development condition, a curve number of 80.74 represents a composite value of gravel surface and forested lands under Type AB soils. Reference to the CN values used in the SWM modelling are included in Appendix C.

Table 3 below outlines the calculated pre-development and post-development peak runoff rates (without SWM) during the 5 and 100-year storm events.

LEGEND

PRE-DEVELOPMENT CATCHMENT BOUNDARY

101 / 1.0 — PRE-DEVELOPMENT CATCHMENT NUMBER / PRE-DEVELOPMENT CATCHMENT AREA(Ha.)

101 / 2.38

1 STOREY STUCCO AND DECORATIVE BLOCK (MIDLAND TOYOTA)

1 STOREY STUCCO AND METAL SIDED (TOM SMITH MOTORS) #824 KING STREET

BRICK SIDED BUILDING (TIM HORTONS) #830 KING STREET

1 STOREY (VINYL SIDED)

1 STOREY VINYL SIDED DECOR

KING STREET

ASPHALT PARKING AREA

GRAVEL PARKING AREA

ASPHALT

EDGE OF ASPHALT

EDGE OF GRAVEL

EDGE OF PAVEMENT

CONCRETE CURB

CONCRETE SIDEWALK

CONCRETE WALK

CONCRETE STAIRS

CONCRETE RETAINING WALL TOP OF WALL = 215.87

CONCRETE PAD AND TRANSFORMER PAD ELEV.=215.51

CONCRETE CURB & WOODEN GUARD RAIL

STORAGE CONTAINERS

CONCRETE PAD

CHAIN LINK FENCE

WOODEN LATTICE FENCE

CEDAR RAIL FENCE

POST AND WIRE FENCE

WIRE FENCE

TO BE REMOVED

CB/CULVERT TO BE REMOVED

200mmø STM PIPE TO BE REMOVED

EXISTING UTILITY POLES AND OVERHEAD SERVICE TO BE REMOVED AND RELOCATED BY OTHERS

OVERHEAD SERVICE

UTILITY POLE

SIGN

SIGN SPEAKER

FREEZERS

PROPANE TANK

CB 215.95

CB 214.76

CB 215.12

MH 215.21

INV. 215.03

INV. 214.98

CLEANOUT WITH SURFACE ACCESS INV. 212.81

0.46% 43.0m 375mmø SANITARY SEWER

EX. 300mmø CONC. STORM SEWER

EX. 900mmø STORM SEWER

EX. 600mmø STORM SEWER

EX. 200mmø AC SANITARY SEWER

EX. 400mmø AC SANITARY SEWER

300mmø PVC STORM SEWER

EX. SAN MH #840

EX. CB(MH) BY WTE CONSULTANTS

EX. 300mmø WATERMAIN

50mmø WATER SERVICE

150mmø SAN. SEWER SERVICE

EX. HYD.

EX. CB

EX. CURB

CENTERLINE

L.S.

L.S.O

BOL.

PEL

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TOM SMITH GMC MIDLAND

PRE-DEVELOPMENT CATCHMENT PLAN

PROJECT NO. 22-11692-M

SCALE: 1:750 DATE: FEBRUARY 2023

FIGURE 2

DIRECTION OF OVERLAND FLOW

PRE/POST-DEVELOPMENT CATCHMENT BOUNDARY

201
0.36
PRE/POST-DEVELOPMENT CATCHMENT NUMBER
PRE/POST-DEVELOPMENT CATCHMENT AREA(Ha.)

KING STREET

CB 1
T/G 215.90

CB 2
T/G 215.50

CB 3
T/G 215.00

CB 4
T/G 215.00

SIGN
PYLON

GATED
INVENTORY

CHAIN
LINK
FENCE
WITH
SLIDING
DOORS

INVENTORY

202
2.38

CBMH 4
(1200)
T/G 215.00

OGS
INV. 213.85

CUSTOMER
PARKING

CB 5
T/G 215.00

CB 8
T/G 215.90

GARBAGE
ENCLOSURE

ELECTRICAL
TRANSFORMER

CB 7
T/G 215.40

LOADING
ZONE

CB 6
T/G 215.00

CENTERLINE

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TOM SMITH GMC MIDLAND

POST-DEVELOPMENT CATCHMENT PLAN

PROJECT NO. 22-11692-M

SCALE: 1:750

DATE: FEB 2023

FIGURE 3

Table 3
Runoff Rates

	5Yr	100Yr
Total Pre-development Runoff Rate – Catchment 101 (m^3/sec)	**0.317**	**0.573**
Total Post Development Runoff Rate – Catchment 201 (m^3/sec)	**0.539**	**0.959**

Based on the results of the hydrological modelling, an increase in stormwater runoff rates can be expected during the modelled storm events.

MIDUSS input/output calculations are included in Appendix B.

5.0 STORM WATER MANAGEMENT PLAN

5.1 Storm Water Management Criteria

For developments within the Town of Midland and County of Simcoe, both quality and quantity control of post-development storm runoff is required. As well, the Municipality requires development proponents to identify the mitigation measures that will be put in place during construction to address erosion and sediment control.

Based on the guidelines for sensitive receiving outlets outlined in the current MECP SWM Planning and Design Manual (MECP,2003), the design criteria for this site is as follows:

- Peak flow attenuation to pre-development levels for storm events up to and including the 100-year storm event based on MTO IDF data for the Town of Midland area. The grading design of the site should ensure that post-development flows from storm events in excess of the 100-year event are safely conveyed from the site.
- Water quality enhancement in accordance with a ‘enhanced’ receiving outlet (80% removal of total suspended solids) through the use of accepted control techniques such as extended detention storage, enhanced grass swales, level spreaders, oil grit separators, and best management practices.
- Water balance maintenance as the site is within a Well Head Protection area (WHAP-Q1)
- Implementation of erosion and sediment controls to mitigate impact to the natural environment.

5.2 Quantity Control

As noted in the comparison of the pre-development and post development flows, an increase in runoff will occur as a result of the proposed development of the site to construct the new building and associated asphalt surface parking areas.

To satisfy the selected design criteria, peak flow attenuation of post development flows to pre-development levels for storm events up to and including the 100-year storm event will be provided by using parking lot storage.

Peak flow attenuation for catchment 201 draining to King Street will be achieved using surface parking lot ponding. Attenuated drainage will outlet to the existing storm sewer system on King Street. Post development flow rates will be attenuated to match pre-development rates.

Based on the hydrologic models prepared for the post development condition, inclusion of a 2600 sq.m. parking lot storage area controlled with a 300mm dia. pipe outlet, will attenuate peak flows for up to the 100-year event. Run-off from storm events greater than the 100-year event will overflow towards King Street.

The stage-storage-discharge relationship of the proposed parking lot storage facilities is summarized in Table 4.

Table 4
Stage-Storage-Discharge Relationship of Storage Cells

	Description	Control Stage (m)	Elevation (m)	Storage Volume (m3)	Discharge (m3)
Catchment 201: Parking Lot Storage Cell (300mm dia. outlet pipe)	Orifice	0.00	213.90	0	0.0
	Top of Grate	1.10	215.00	1.0	0.0
	Contour	1.15	215.05	7.2	0.01923
	Contour	1.20	215.10	39.1	0.01973
	Contour	1.25	215.15	92.9	0.02021
	Contour	1.30	215.20	168.5	0.02069
	Weir Overflow	1.35	215.25	265.8	0.02115
	Contour	1.40	215.30	384.8	0.6254

The location of the storm water management facilities and details are identified on the engineering plans included in Appendix D.

Table 5 summarizes the effectiveness of the proposed storm water attenuation features based on the hydrologic model results. Post development MIDUSS output files, with storm water management implemented, are included in Appendix B.

Table 5
Model Results - 3hr Chicago Distribution

	5Yr	10Yr	25Yr	100Yr
Total Pre-development Run-off rate to King Street (Catchment 101) (m^3/sec)	**0.317**	**0.379**	**0.457**	**0.573**
Total Post Development Run-off rate to King Street with SWM (Catchment 201) (m^3/sec)	**0.208**	**0.211**	**0.356**	**0.551**
Parking Lot Storage Elevation (m)	215.21	215.25	215.27	215.29
Storage Volume (m3)	190.4	262.7	311.0	368.5

5.2 Quality Control

The Storm Water Management Planning and Design Manual (MECP, 2003) recommends several suitable water quality enhancement techniques such as detention storage, enhanced grass swales, level spreaders, infiltration facilities, and oil/grit removers.

Quality control of post development run-off will be achieved through the implementation of a treatment train of quality control measures including:

- Installation of an Oil/Grit Treatment unit (Stormceptor or approved equivalent) sized to provide minimum 80% TSS removal
- Maintenance of existing lot line vegetation to act as a secondary filter for landscape run-off prior to discharge to adjacent lands.
- Suitable construction mitigation measures to be utilized during the site development.

A Stormceptor oil / grit separator manhole (or approved equivalent) sized for ‘enhanced’ quality control will be installed at the storm water outlet location prior to discharging to the existing storm sewer system on King Street. For catchment 201, an EF08 unit or equivalent will be installed. The unit will provide at least 80% removal of total suspended solids in accordance with an ‘enhanced’ level of protection. Design calculations utilizing the manufacturer’s software have been provided in Appendix C.

5.3 Water Balance

A water budget analysis was conducted in accordance with the NVCA Stormwater Technical Guide. The analysis follows the Thornthwaite and Mather approach, where surplus is estimated based on precipitation minus evapotranspiration (Steenhuis and Van Der Molen, 1986). The infiltration portion of the surplus is estimated by applying infiltration factors from Table 3.1 of the MECP SWMPD Manual. The precipitation, temperature, and evaporation data were obtained from the 1981-2010 climate normal of the Midland Water Pollution Control Plant. In the pre-development condition, land

use consists of gravel, asphalt and building roof top area with a small portion of forested and landscape areas. For the post-development condition, the proposed development was broken down into pavement, rooftop, and landscape land uses. Results of the annual pre-development and post-development water balance are displayed in Table 6, below.

Table 6
Water Balance Summary

Characteristic	Site			
	Pre-Development	Post-Development	Post-Development SWM	Change (Pre to Post SWM)
Inputs (Volumes)				
Precipitation (m^3/yr)	24766	24766	24766	0.0%
Run-on (m^3/yr)	0	0	0	0.0%
Other Inputs (m^3/yr)	0	0	0	0.0%
Total Inputs (m^3/yr)	24766	24766	24766	0.0%
Outputs (Volumes)				
Precipitation Surplus (m^3/yr)	21701	21699	21699	0.0%
Net Surplus (m^3/yr)	21701	21699	21699	0.0%
Evapotranspiration (m^3/yr)	3065	3068	3068	0.1%
Infiltration (m^3/yr)	2069	1819	1819	-12.1%
Rooftop Infiltration (m^3/yr)	0	0	1601	0.0%
Total Infiltration (m^3/yr)	2069	1819	3420	65.3%
Runoff Pervious Areas (m^3/yr)	517	779	779	50.7%
Runoff Impervious Areas (m^3/yr)	19115	19101	17499	-8.5%
Total Runoff (m^3/yr)	19632	19880	18279	-6.9%
Total Outputs (m^3/yr)	24766	24766	24766	0.0%

Based on the results of the water balance analysis, the site yields an infiltration rate of 2069m^3/year in the pre-development condition and 1819m^3/year in the post-development condition, resulting in a water balance deficit of 250 m^3/year. To mitigate this deficit, the proposed Brentwood Stormtank system will provide an 50% volumetric increase in infiltration benefit for runoff generated off the building rooftop in accordance with Table 4.3.2 of the TRCA LID Manual for roof downspout disconnection in an AB type soil. This 50% increase in infiltration benefit has been included in the water balance analysis for the post-development condition as the actual infiltration factor for the rooftop surface.

The implementation of this stormwater management strategy will increase the overall site infiltration volume to 3420m^3/year, eliminating the water balance deficit and meeting pre-development infiltration rates. A copy of the water balance assessment is included in Appendix C.

6.0 EROSION AND SEDIMENT CONTROL

Sedimentation and erosion control measures are required during construction and until such a time that site development has been completed.

The use of various siltation control measures will be implemented to protect the adjacent properties and receiving waterbodies from migrating sediments.

These works include but may not be limited to:

- Installation of siltation fencing along down gradient portion of the development area.
- Installation of filter cloth under catch basin grates to protect the receiving storm sewers from sediment deposition.
- Installation of a mud mat to control vehicle debris tracking onto public roads.

6.1 During Construction

Prior to carrying out site grading the siltation barriers noted above shall be in place. Other temporary installations of silt fence or other appropriate measures may be required during grading to minimize silt migration from the site. The measures will need to be removed, replaced and relocated as required during the construction period until the site works have been completed and vegetation established. During construction all stockpiled material will be placed up-gradient of the siltation controls.

If site works are to continue through the winter and spring the engineer shall be contacted by the owner to review the measures in place with the contractor on a regular basis to ensure that the facilities are adequate and in good working order. All reasonable methods to control erosion and sedimentation are to be taken during construction.

6.2 Monitoring and Maintenance

It is the responsibility of the contractor and owner to maintain the siltation control devices until suitable cover has been established. A regular review of the facilities by the contractor shall be carried out during the construction period to ensure that the facilities are being properly maintained, and if necessary replaced.

The contractor should inspect the siltation devices immediately after each rainfall. Damaged devices should be repaired immediately, and additional devices installed if necessary. Sediment build-up should be removed from the fencing regularly when deposits are noted.

6.3 Contingency Plan

Should the erosion control measures fail, and sediment migrate beyond the limits of the control works, the following tasks are required to be completed:

- The Town of Midland and County of Simcoe should be notified of the event. The area will be assessed and cleaned up to the satisfaction of the agencies.
- The MNR should be notified if sediment reaches any environment protection areas.
- Additional sedimentation facilities be installed in the area of the migration and down gradient to contain the sediment.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are based on the information and analysis presented in this report:

1) The comparison of pre-development and post-development stormwater flowrates indicate that peak flows will increase during the modelled storm events as a result of the proposed development.

2) The use of parking lot storage has been proposed to attenuate post development flows to pre-development levels.

3) Stormwater quality enhancement to the receiving storm sewer system can be achieved using a “treatment train” of quality control techniques including extended detention storage in the parking lot, maintenance of existing lot line vegetation and the installation of an oil grit separator treatment device on the storm sewer outlet.

4) Suitable measures can be implemented during construction to protect the adjacent properties from migrating sediments.

It is recommended that:

1) This report and drawings be submitted to the Town of Midland and the County of Simcoe for review and approval.
2) The storm water management works shall be constructed in accordance with the design details presented in this report.
3) The construction mitigation measures outlined in this report are utilized as a guideline for construction mitigation management on this site.

We trust this is satisfactory and should you have any questions, please call.

All of which is respectfully submitted,

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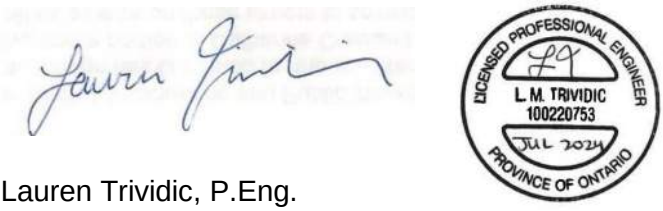

Lauren Trividic, P.Eng.

APPENDIX A

Soils Mapping

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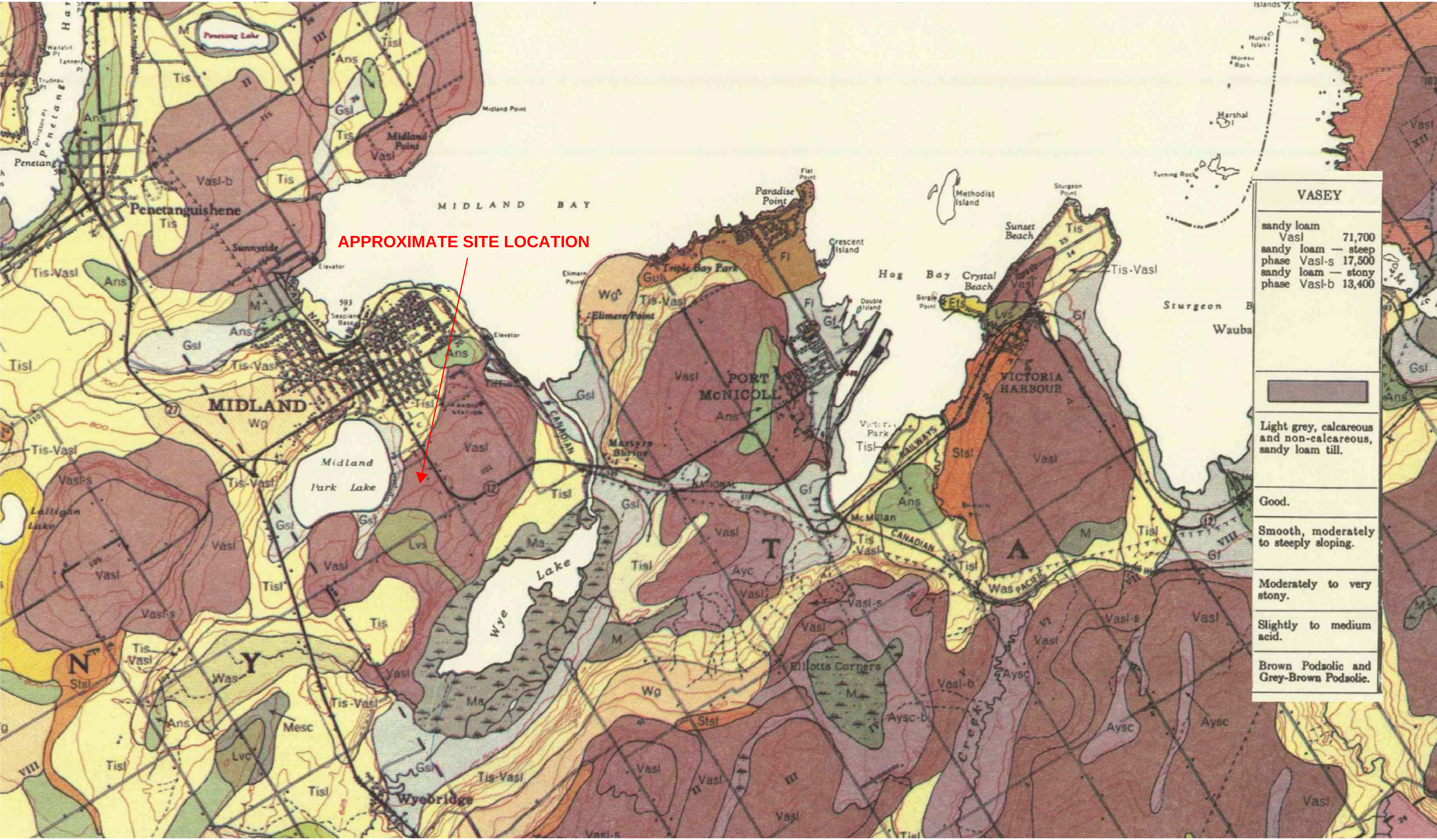

APPROXIMATE SITE LOCATION
MIDLAND BAY
MIDLAND
Midland Park Lake
Wye Lake
PORT McNICOLL
VICTORIA HARBOUR
Penetanguishene
Wyebridge
Hog Bay
Sturgeon Bay
Paradise Point
Midland Point
Sunset Beach
Crystal Beach
Methodist Island
Crescent Island
Ellimere Point
Triple Bay Park
Ellotts Corners
Sunnyside
VASEY
sandy loam Vasl 71,700
sandy loam — steep phase Vasl-s 17,500
sandy loam — stony phase Vasl-b 13,400
Light grey, calcareous and non-calcareous, sandy loam till.
Good.
Smooth, moderately to steeply sloping.
Moderately to very stony.
Slightly to medium acid.
Brown Podzolic and Grey-Brown Podzolic.

Design Chart 1.08: Hydrologic Soil Groups (Continued)

- Based on Soil Texture

Sands, Sandy Loams and Gravels	
- overlying sand, gravel or limestone bedrock, very well drained	A
- ditto, imperfectly drained	AB
- shallow, overlying Precambrian bedrock or clay subsoil	B
Medium to Coarse Loams	
- overlying sand, gravel or limestone, well drained	AB
- shallow, overlying Precambrian bedrock or clay subsoil	B
Medium Textured Loams	
- shallow, overlying limestone bedrock	B
- overlying medium textured subsoil	BC
Silt Loams, Some Loams	
- with good internal drainage	BC
- with slow internal drainage and good external drainage	C
Clays, Clay Loams, Silty Clay Loams	
- with good internal drainage	C
- with imperfect or poor external drainage	C
- with slow internal drainage and good external drainage	D

Source: U.S. Department of Agriculture (1972)

Design Chart 1.09: Soil/Land Use Curve Numbers

Land Use	Treatment or Practice	Hydrologic Condition[4]	Hydrologic Soil Group			
			A	B	C	D
Fallow	Straight row	---	77	86	91	94
Row crops	"	Poor	72	81	88	91
	"	Good	67	78	85	89
	Contoured	Poor	70	79	84	88
	"	Good	65	75	82	86
	" and terraced	Poor	66	74	8	82
	" " "	Good	62	71	78	81
Small grain	Straight row	Poor	65	76	84	88
		Good	63	75	83	87
	Contoured	Poor	63	74	82	85
		Good	61	73	81	84
	" and terraced	Poor	61	72	79	82
		Good	59	70	78	81
Close-seeded	Straight row	Poor	66	77	85	89
legumes[2]	" "	Good	58	72	81	85
or	Contoured	Poor	64	75	83	85
rotation	"	Good	55	69	78	83
meadow	" and terraced	Poor	63	73	80	83
	" and terraced	Good	51	67	76	80
Pasture		Poor	68	79	86	89
or range		Fair	49	69	79	84
	Contoured	Good	39	61	74	80
	"	Poor	47	67	81	88
	"	Fair	25	59	75	83
		Good	6	35	70	79
Meadow		Good	30	58	71	78
Woods		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	25	55	70	77
Farmsteads		---	59	74	82	86
		---	72	82	87	89
		---	74	84	90	92

For average anticedent soil moisture condition (AMC II)

[2] Close-drilled or broadcast.

[4] The hydrologic condition of cropland is good if a good crop rotation practice is used; it is poor if one crop is grown continuously.

Source: U.S. Department of Agriculture (1972)

APPENDIX B

MIDUSS Hydrological Modeling

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```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                                  February 7, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:         Z:\Project Documents\11692M Tom Smith GMC\"
"                                                                SWM Report\MIDUSS"
"                Output filename:                                      5YR_PRE.out"
"                Licensee name:                                      Windows User"
"                Company                                                         "
"                Date & Time last used:                 2023-02-16 at 9:59:16 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1135.400   Coefficient A"
"        7.500   Constant B"
"        0.841   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           135.721    mm/hr"
"             Total depth                  41.752    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   101 - EXISTING SITE CONDITION"
"       50.000   % Impervious"
"        2.380   Total Area"
"      200.000   Flow length"
"        1.000   Overland Slope"
"        1.190   Pervious Area"
"      200.000   Pervious length"
"        1.000   Pervious slope"
"        1.190   Impervious Area"
"      200.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       80.740   Pervious SCS Curve No."
"        0.317   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        6.059   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.874   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.317     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           1.190      1.190      2.380      hectare"
"             Time of concentration  66.534     7.723      23.364     minutes"
"             Time to Centroid       184.792    98.092     121.151    minutes"
"             Rainfall depth         41.752     41.752     41.752     mm"
"             Rainfall volume        496.85     496.85     993.69     c.m"
"             Rainfall losses        28.523     5.243      16.883     mm"
"             Runoff depth           13.229     36.509     24.869     mm"
"             Runoff volume          157.42     434.46     591.88     c.m"
"             Runoff coefficient     0.317      0.874      0.596      "
"             Maximum flow           0.021      0.315      0.317      c.m/sec"
" 38          START/RE-START TOTALS "
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.000    hectare"
"             Total Impervious area                       0.000    hectare"
"             Total % impervious                          0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                                  February 7, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:         Z:\Project Documents\11692M Tom Smith GMC\"
"                                                                SWM Report\MIDUSS"
"                Output filename:                                      5YR_POST.out"
"                Licensee name:                                        Windows User"
"                Company                                                           "
"                Date & Time last used:                2023-02-16 at 10:07:31 AM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1135.400   Coefficient A"
"        7.500   Constant B"
"        0.841   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           135.721    mm/hr"
"             Total depth                  41.752    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            3   Specify values"
"            1   SCS method"
"          201   201 - PROPOSED DEVELOPMENT"
"       85.700   % Impervious"
"        2.380   Total Area"
"      200.000   Flow length"
"        1.000   Overland Slope"
"        0.340   Pervious Area"
"       15.000   Pervious length"
"        1.000   Pervious slope"
"        2.040   Impervious Area"
"      200.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       60.000   Pervious SCS Curve No."
"        0.076   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       16.933   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.874   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.539     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.340      2.040      2.380      hectare"
"             Time of concentration  30.212     7.723      8.044      minutes"
"             Time to Centroid       142.384    98.092     98.725     minutes"
"             Rainfall depth         41.752     41.752     41.752     mm"
"             Rainfall volume        142.10     851.60     993.69     c.m"
"             Rainfall losses        38.581     5.243      10.010     mm"
"             Runoff depth           3.171      36.509     31.742     mm"
"             Runoff volume          10.79      744.66     755.46     c.m"
"             Runoff coefficient     0.076      0.874      0.760      "
"             Maximum flow           0.002      0.539      0.539      c.m/sec"
" 38          START/RE-START TOTALS "
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.000    hectare"
"             Total Impervious area                       0.000    hectare"
"             Total % impervious                          0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                                  February 7, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:         Z:\Project Documents\11692M Tom Smith GMC\"
"                                                                SWM Report\MIDUSS"
"                Output filename:                                      5YR_SWM.out"
"                Licensee name:                                      Windows User"
"                Company                                                         "
"                Date & Time last used:                2023-02-21 at 2:20:27 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1135.400   Coefficient A"
"        7.500   Constant B"
"        0.841   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           135.721    mm/hr"
"             Total depth                  41.752    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            3   Specify values"
"            1   SCS method"
"          201   201 - PROPOSED DEVELOPMENT"
"       85.700   % Impervious"
"        2.380   Total Area"
"      200.000   Flow length"
"        1.000   Overland Slope"
"        0.340   Pervious Area"
"       15.000   Pervious length"
"        1.000   Pervious slope"
"        2.040   Impervious Area"
"      200.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       60.000   Pervious SCS Curve No."
"        0.076   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       16.933   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.874   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.539     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.340      2.040      2.380      hectare"
"             Time of concentration  30.212     7.723      8.044      minutes"
"             Time to Centroid       142.385    98.092     98.725     minutes"
"             Rainfall depth         41.752     41.752     41.752     mm"
"             Rainfall volume        142.10     851.60     993.69     c.m"
"             Rainfall losses        38.581     5.243      10.010     mm"
"             Runoff depth           3.171      36.509     31.742     mm"
"             Runoff volume          10.79      744.66     755.46     c.m"
"             Runoff coefficient     0.076      0.874      0.760      "
"             Maximum flow           0.002      0.539      0.539      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.539     0.539     0.000     0.000"
" 54          POND DESIGN"
"        0.539   Current peak flow    c.m/sec"
"        0.270   Target outflow    c.m/sec"
"        755.5   Hydrograph volume    c.m"
"           7.   Number of stages"
"      215.000   Minimum water level    metre"
"      215.300   Maximum water level    metre"
"      215.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                215.000     0.000     1.000"
"                215.050    0.1923     7.222"
"                215.100    0.1973    39.103"
"                215.150    0.2021    92.905"
"                215.200    0.2069   168.479"
"                215.250    0.2115   265.777"
"                215.300    0.6254   384.780"
"           1.   WEIRS"
"                  Crest      Weir     Crest      Left     Right"
"               elevation coefficie   breadth sideslope sideslope"
"                  215.250     0.900    22.000    50.000    50.000"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
"                213.900     0.630    0.3000     1.000"
"             Peak outflow                  0.208    c.m/sec"
"             Maximum level                215.211    metre"
"             Maximum storage              190.448    c.m"
"             Centroidal lag                 1.766   hours"
"                  0.539     0.539     0.208     0.000 c.m/sec"
" 38          START/RE-START TOTALS 201"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        2.380    hectare"
"             Total Impervious area                       2.040    hectare"
"             Total % impervious                         85.700"
```

```
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                                  February 7, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:         Z:\Project Documents\11692M Tom Smith GMC\"
"                                                                SWM Report\MIDUSS"
"                Output filename:                                      10YR_PRE.out"
"                Licensee name:                                        Windows User"
"                Company                                                           "
"                Date & Time last used:                 2023-02-21 at 4:33:12 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1387.000   Coefficient A"
"        7.970   Constant B"
"        0.852   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           156.261    mm/hr"
"             Total depth                  48.048    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   101 - EXISTING SITE CONDITION"
"       50.000   % Impervious"
"        2.380   Total Area"
"      200.000   Flow length"
"        1.000   Overland Slope"
"        1.190   Pervious Area"
"      200.000   Pervious length"
"        1.000   Pervious slope"
"        1.190   Impervious Area"
"      200.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       80.740   Pervious SCS Curve No."
"        0.358   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        6.059   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.885   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.379     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           1.190      1.190      2.380      hectare"
"             Time of concentration  59.153     7.265      22.205     minutes"
"             Time to Centroid       174.562    96.824     119.207    minutes"
"             Rainfall depth         48.048     48.048     48.048     mm"
"             Rainfall volume        571.77     571.77     1143.54    c.m"
"             Rainfall losses        30.863     5.548      18.206     mm"
"             Runoff depth           17.185     42.500     29.842     mm"
"             Runoff volume          204.50     505.75     710.25     c.m"
"             Runoff coefficient     0.358      0.885      0.621      "
"             Maximum flow           0.031      0.375      0.379      c.m/sec"
" 38          START/RE-START TOTALS "
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.000    hectare"
"             Total Impervious area                       0.000    hectare"
"             Total % impervious                          0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                                  February 7, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:         Z:\Project Documents\11692M Tom Smith GMC\"
"                                                                SWM Report\MIDUSS"
"                Output filename:                                    10YR_POST.out"
"                Licensee name:                                       Windows User"
"                Company                                                         "
"                Date & Time last used:                 2023-02-21 at 4:38:47 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1387.000   Coefficient A"
"        7.970   Constant B"
"        0.852   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           156.261    mm/hr"
"             Total depth                  48.048    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            3   Specify values"
"            1   SCS method"
"          201   201 - PROPOSED DEVELOPMENT"
"       85.700   % Impervious"
"        2.380   Total Area"
"      200.000   Flow length"
"        1.000   Overland Slope"
"        0.340   Pervious Area"
"       15.000   Pervious length"
"        1.000   Pervious slope"
"        2.040   Impervious Area"
"      200.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       60.000   Pervious SCS Curve No."
"        0.100   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       16.933   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.885   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.643     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.340      2.040      2.380      hectare"
"             Time of concentration  24.853     7.265      7.592      minutes"
"             Time to Centroid       133.629    96.824     97.508     minutes"
"             Rainfall depth         48.048     48.048     48.048     mm"
"             Rainfall volume        163.53     980.01     1143.54    c.m"
"             Rainfall losses        43.224     5.548      10.936     mm"
"             Runoff depth           4.824      42.500     37.112     mm"
"             Runoff volume          16.42      866.85     883.27     c.m"
"             Runoff coefficient     0.100      0.885      0.772      "
"             Maximum flow           0.004      0.642      0.643      c.m/sec"
" 38          START/RE-START TOTALS "
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.000    hectare"
"             Total Impervious area                       0.000    hectare"
"             Total % impervious                          0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                                  February 7, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:         Z:\Project Documents\11692M Tom Smith GMC\"
"                                                                SWM Report\MIDUSS"
"                Output filename:                                      10YR_SWM.out"
"                Licensee name:                                        Windows User"
"                Company                                                           "
"                Date & Time last used:                 2023-02-21 at 4:41:01 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1387.000   Coefficient A"
"        7.970   Constant B"
"        0.852   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           156.261    mm/hr"
"             Total depth                  48.048    mm"
"            6   010hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            3   Specify values"
"            1   SCS method"
"          201   201 - PROPOSED DEVELOPMENT"
"       85.700   % Impervious"
"        2.380   Total Area"
"      200.000   Flow length"
"        1.000   Overland Slope"
"        0.340   Pervious Area"
"       15.000   Pervious length"
"        1.000   Pervious slope"
"        2.040   Impervious Area"
"      200.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       60.000   Pervious SCS Curve No."
"        0.100   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       16.933   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.885   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.643     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.340      2.040      2.380      hectare"
"             Time of concentration  24.853     7.265      7.592      minutes"
"             Time to Centroid       133.629    96.824     97.508     minutes"
"             Rainfall depth         48.048     48.048     48.048     mm"
"             Rainfall volume        163.53     980.01     1143.54    c.m"
"             Rainfall losses        43.224     5.548      10.936     mm"
"             Runoff depth           4.824      42.500     37.112     mm"
"             Runoff volume          16.42      866.85     883.27     c.m"
"             Runoff coefficient     0.100      0.885      0.772      "
"             Maximum flow           0.004      0.642      0.643      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.643     0.643     0.000     0.000"
" 54          POND DESIGN"
"        0.643   Current peak flow    c.m/sec"
"        0.270   Target outflow    c.m/sec"
"        883.3   Hydrograph volume    c.m"
"           7.   Number of stages"
"      215.000   Minimum water level    metre"
"      215.300   Maximum water level    metre"
"      215.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                215.000     0.000     1.000"
"                215.050    0.1923     7.222"
"                215.100    0.1973    39.103"
"                215.150    0.2021    92.905"
"                215.200    0.2069   168.479"
"                215.250    0.2115   265.777"
"                215.300    0.6254   384.780"
"           1.   WEIRS"
"                  Crest      Weir     Crest      Left     Right"
"              elevation coefficie   breadth sideslope sideslope"
"                215.250     0.900    22.000    50.000    50.000"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
"                213.900     0.630    0.3000     1.000"
"             Peak outflow                  0.211    c.m/sec"
"             Maximum level                215.248    metre"
"             Maximum storage              262.729    c.m"
"             Centroidal lag                 1.794   hours"
"                  0.643     0.643     0.211     0.000 c.m/sec"
" 38          START/RE-START TOTALS 201"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                       2.380    hectare"
"             Total Impervious area                      2.040    hectare"
"             Total % impervious                        85.700"
```

```
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                                  February 7, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:         Z:\Project Documents\11692M Tom Smith GMC\"
"                                                                SWM Report\MIDUSS"
"                Output filename:                                      25YR_PRE.out"
"                Licensee name:                                        Windows User"
"                Company                                                           "
"                Date & Time last used:                 2023-02-21 at 4:34:15 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1676.200   Coefficient A"
"        8.300   Constant B"
"        0.858   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           181.996    mm/hr"
"             Total depth                  56.186    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   101 - EXISTING SITE CONDITION"
"       50.000   % Impervious"
"        2.380   Total Area"
"      200.000   Flow length"
"        1.000   Overland Slope"
"        1.190   Pervious Area"
"      200.000   Pervious length"
"        1.000   Pervious slope"
"        1.190   Impervious Area"
"      200.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       80.740   Pervious SCS Curve No."
"        0.404   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        6.059   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.895   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.457     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           1.190      1.190      2.380      hectare"
"             Time of concentration  52.407     6.806      20.982     minutes"
"             Time to Centroid       165.157    95.700     117.292    minutes"
"             Rainfall depth         56.186     56.186     56.186     mm"
"             Rainfall volume        668.61     668.61     1337.22    c.m"
"             Rainfall losses        33.494     5.885      19.689     mm"
"             Runoff depth           22.691     50.301     36.496     mm"
"             Runoff volume          270.03     598.58     868.61     c.m"
"             Runoff coefficient     0.404      0.895      0.650      "
"             Maximum flow           0.045      0.450      0.457      c.m/sec"
" 38          START/RE-START TOTALS "
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.000    hectare"
"             Total Impervious area                       0.000    hectare"
"             Total % impervious                          0.000"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                            Version 2.25  rev. 473"
"                MIDUSS created                                  February 7, 2010"
"           10   Units used:                                              ie METRIC"
"                Job folder:         Z:\Project Documents\11692M Tom Smith GMC\"
"                                                                SWM Report\MIDUSS"
"                Output filename:                                    25YR_POST.out"
"                Licensee name:                                       Windows User"
"                Company                                                         "
"                Date & Time last used:                2023-02-21 at 4:39:45 PM"
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"        5.000   Time Step"
"      180.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     1676.200   Coefficient A"
"        8.300   Constant B"
"        0.858   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           181.996    mm/hr"
"             Total depth                  56.186    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            3   Specify values"
"            1   SCS method"
"          201   201 - PROPOSED DEVELOPMENT"
"       85.700   % Impervious"
"        2.380   Total Area"
"      200.000   Flow length"
"        1.000   Overland Slope"
"        0.340   Pervious Area"
"       15.000   Pervious length"
"        1.000   Pervious slope"
"        2.040   Impervious Area"
"      200.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       60.000   Pervious SCS Curve No."
"        0.131   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       16.933   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.895   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.773     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.340      2.040      2.380      hectare"
"             Time of concentration  20.731     6.806      7.139      minutes"
"             Time to Centroid       126.421    95.700     96.435     minutes"
"             Rainfall depth         56.186     56.186     56.186     mm"
"             Rainfall volume        191.22     1146.00    1337.22    c.m"
"             Rainfall losses        48.803     5.885      12.022     mm"
"             Runoff depth           7.383      50.301     44.164     mm"
"             Runoff volume          25.13      1025.97    1051.10    c.m"
"             Runoff coefficient     0.131      0.895      0.786      "
"             Maximum flow           0.008      0.771      0.773      c.m/sec"
" 38          START/RE-START TOTALS "
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.000    hectare"
"             Total Impervious area                       0.000    hectare"
"             Total % impervious                          0.000"
" 19          EXIT"
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"     1500.000   Max. Hydrograph"
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"            1   Chicago storm"
"     1676.200   Coefficient A"
"        8.300   Constant B"
"        0.858   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           181.996    mm/hr"
"             Total depth                  56.186    mm"
"            6   025hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            3   Specify values"
"            1   SCS method"
"          201   201 - PROPOSED DEVELOPMENT"
"       85.700   % Impervious"
"        2.380   Total Area"
"      200.000   Flow length"
"        1.000   Overland Slope"
"        0.340   Pervious Area"
"       15.000   Pervious length"
"        1.000   Pervious slope"
"        2.040   Impervious Area"
"      200.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       60.000   Pervious SCS Curve No."
"        0.131   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       16.933   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.895   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.773     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.340      2.040      2.380      hectare"
"             Time of concentration  20.731     6.806      7.139      minutes"
"             Time to Centroid       126.421    95.700     96.435     minutes"
"             Rainfall depth         56.186     56.186     56.186     mm"
"             Rainfall volume        191.22     1146.00    1337.22    c.m"
"             Rainfall losses        48.803     5.885      12.022     mm"
"             Runoff depth           7.383      50.301     44.164     mm"
"             Runoff volume          25.13      1025.97    1051.10    c.m"
"             Runoff coefficient     0.131      0.895      0.786      "
"             Maximum flow           0.008      0.771      0.773      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.773     0.773     0.000     0.000"
" 54          POND DESIGN"
"        0.773   Current peak flow    c.m/sec"
"        0.270   Target outflow    c.m/sec"
"       1051.1   Hydrograph volume    c.m"
"           7.   Number of stages"
"      215.000   Minimum water level    metre"
"      215.300   Maximum water level    metre"
"      215.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                215.000     0.000     1.000"
"                215.050    0.1923     7.222"
"                215.100    0.1973    39.103"
"                215.150    0.2021    92.905"
"                215.200    0.2069   168.479"
"                215.250    0.2115   265.777"
"                215.300    0.6254   384.780"
"           1.   WEIRS"
"                  Crest      Weir     Crest      Left     Right"
"              elevation coefficie   breadth sideslope sideslope"
"                215.250     0.900    22.000    50.000    50.000"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
"                213.900     0.630    0.3000     1.000"
"             Peak outflow                  0.356    c.m/sec"
"             Maximum level                215.269    metre"
"             Maximum storage              311.048    c.m"
"             Centroidal lag                 1.782   hours"
"                  0.773     0.773     0.356     0.000 c.m/sec"
" 38          START/RE-START TOTALS 201"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        2.380    hectare"
"             Total Impervious area                       2.040    hectare"
"             Total % impervious                         85.700"
```

```
" 19          EXIT"
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"                                                                SWM Report\MIDUSS"
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"     2193.100   Coefficient A"
"        9.040   Constant B"
"        0.871   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           219.635    mm/hr"
"             Total depth                  68.439    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          101   101 - EXISTING SITE CONDITION"
"       50.000   % Impervious"
"        2.380   Total Area"
"      200.000   Flow length"
"        1.000   Overland Slope"
"        1.190   Pervious Area"
"      200.000   Pervious length"
"        1.000   Pervious slope"
"        1.190   Impervious Area"
"      200.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       80.740   Pervious SCS Curve No."
"        0.462   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        6.059   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.915   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.573     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           1.190      1.190      2.380      hectare"
"             Time of concentration  45.524     6.287      19.457     minutes"
"             Time to Centroid       154.983    94.241     114.630    minutes"
"             Rainfall depth         68.439     68.439     68.439     mm"
"             Rainfall volume        814.42     814.42     1628.84    c.m"
"             Rainfall losses        36.800     5.818      21.309     mm"
"             Runoff depth           31.639     62.620     47.129     mm"
"             Runoff volume          376.50     745.18     1121.68    c.m"
"             Runoff coefficient     0.462      0.915      0.689      "
"             Maximum flow           0.072      0.560      0.573      c.m/sec"
" 38          START/RE-START TOTALS "
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.000    hectare"
"             Total Impervious area                       0.000    hectare"
"             Total % impervious                          0.000"
" 19          EXIT"
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"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     2193.100   Coefficient A"
"        9.040   Constant B"
"        0.871   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           219.635    mm/hr"
"             Total depth                  68.439    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            3   Specify values"
"            1   SCS method"
"          201   201 - PROPOSED DEVELOPMENT"
"       85.700   % Impervious"
"        2.380   Total Area"
"      200.000   Flow length"
"        1.000   Overland Slope"
"        0.340   Pervious Area"
"       15.000   Pervious length"
"        1.000   Pervious slope"
"        2.040   Impervious Area"
"      200.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       60.000   Pervious SCS Curve No."
"        0.175   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       16.933   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.915   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.965     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.340      2.040      2.380      hectare"
"             Time of concentration  16.172     6.287      6.593      minutes"
"             Time to Centroid       119.523    94.241     95.023     minutes"
"             Rainfall depth         68.439     68.439     68.439     mm"
"             Rainfall volume        232.92     1395.92    1628.84    c.m"
"             Rainfall losses        56.460     5.818      13.060     mm"
"             Runoff depth           11.979     62.620     55.378     mm"
"             Runoff volume          40.77      1277.24    1318.01    c.m"
"             Runoff coefficient     0.175      0.915      0.809      "
"             Maximum flow           0.015      0.959      0.965      c.m/sec"
" 38          START/RE-START TOTALS "
"            3   Runoff Totals on EXIT"
"             Total Catchment area                        0.000    hectare"
"             Total Impervious area                       0.000    hectare"
"             Total % impervious                          0.000"
" 19          EXIT"
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"                MIDUSS Output ------------------------------------------------>"
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"                MIDUSS created                                  February 7, 2010"
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"                                                                SWM Report\MIDUSS"
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"        5.000   Time Step"
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"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     2193.100   Coefficient A"
"        9.040   Constant B"
"        0.871   Exponent C"
"        0.400   Fraction R"
"      180.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           219.635    mm/hr"
"             Total depth                  68.439    mm"
"            6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            3   Specify values"
"            1   SCS method"
"          201   201 - PROPOSED DEVELOPMENT"
"       85.700   % Impervious"
"        2.380   Total Area"
"      200.000   Flow length"
"        1.000   Overland Slope"
"        0.340   Pervious Area"
"       15.000   Pervious length"
"        1.000   Pervious slope"
"        2.040   Impervious Area"
"      200.000   Impervious length"
"        1.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       60.000   Pervious SCS Curve No."
"        0.175   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       16.933   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.915   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
```

```
"                    0.965     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           0.340      2.040      2.380      hectare"
"             Time of concentration  16.172     6.287      6.593      minutes"
"             Time to Centroid       119.523    94.241     95.023     minutes"
"             Rainfall depth         68.439     68.439     68.439     mm"
"             Rainfall volume        232.92     1395.92    1628.84    c.m"
"             Rainfall losses        56.460     5.818      13.060     mm"
"             Runoff depth           11.979     62.620     55.378     mm"
"             Runoff volume          40.77      1277.24    1318.01    c.m"
"             Runoff coefficient     0.175      0.915      0.809      "
"             Maximum flow           0.015      0.959      0.965      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.965     0.965     0.000     0.000"
" 54          POND DESIGN"
"        0.965   Current peak flow    c.m/sec"
"        0.270   Target outflow    c.m/sec"
"       1318.0   Hydrograph volume    c.m"
"           7.   Number of stages"
"      215.000   Minimum water level    metre"
"      215.300   Maximum water level    metre"
"      215.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"               215.000     0.000     1.000"
"               215.050    0.1923     7.222"
"               215.100    0.1973    39.103"
"               215.150    0.2021    92.905"
"               215.200    0.2069   168.479"
"               215.250    0.2115   265.777"
"               215.300    0.6254   384.780"
"           1.   WEIRS"
"                  Crest      Weir     Crest      Left     Right"
"              elevation coefficie   breadth sideslope sideslope"
"               215.250     0.900    22.000    50.000    50.000"
"           1.   ORIFICES"
"                Orifice   Orifice   Orifice Number of"
"                 invert coefficie  diameter  orifices"
"               213.900     0.630    0.3000     1.000"
"             Peak outflow                  0.551    c.m/sec"
"             Maximum level                215.293    metre"
"             Maximum storage              368.527    c.m"
"             Centroidal lag                 1.755   hours"
"                  0.965     0.965     0.551     0.000 c.m/sec"
" 38          START/RE-START TOTALS 201"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                       2.380    hectare"
"             Total Impervious area                      2.040    hectare"
"             Total % impervious                        85.700"
```

```
" 19          EXIT"
```

APPENDIX C

Design Calculations

PINESTONE ENGINEERING LTD.

TOM SMITH GMC

IMPERVIOUS SURFACE CALCULATIONS

Midland, Ontario

Project Number: 22-11692M
Date: February 15, 2023
Design By: LT

CATCHMENT 101	Surface Area (m²)	% Impervious	SCS Curve Number
Building Rooftop	2715	11.41%	(98.00)
Asphalt Parking	9180	38.57%	(98.00)
Gravel Parking	8515	0.00%	89.00
Woods / Landscape area	3390	0.00%	60.00
TOTAL	**23800**	**49.98%**	**80.74**

CATCHMENT 201	Surface Area (m²)	% Impervious	SCS Curve Number
Building Rooftop	3420	14.37%	(98.00)
Asphalt Parking	16975	71.32%	(98.00)
Woods / Landscape area	3405	0.00%	60.00
TOTAL	**23800**	**85.69%**	**60.00**

TOM SMITH GMC

CLIMATIC WATER BUDGET: CLIMATE NORMALS 1981-2010 (Midland): Potential Evapotranspiration

Midland, Ontario

Project Number: 22-11692M

Date: February 16, 2023

Design By: LT

Calculations Based on Thornthwaite-Mather Approach (1957)														
Month	**Mean Temperature (^{o}C)**	**Heat Index "i"**	**"α"**	**PET - Potential Evapo-transpiration non corrected (mm)**	**Daylight Correction Factor (L/12)**	**Number of Days per Month (N)**	**PTE - Potential Evapo-transpiration corrected (mm)**	**Total Precipitation (mm)**	**P-PE (mm)**	**APWL (mm)**	**ST (mm)**	**ΔST (mm)**	**AE (mm)**	**SURPLUS (mm)**
January	-8.5	0.00	0.49	0.0	0.78	31	0.0	109.8	109.8	0.0	150.0	0.0	0.0	109.8
February	-6.4	0.00	0.49	0.0	0.88	28	0.0	69.9	69.9	0.0	150.0	0.0	0.0	69.9
March	-1.9	0.00	0.49	0.0	0.99	31	0.0	65.7	65.7	0.0	150.0	0.0	0.0	65.7
April	5.8	1.25	0.51	25.6	1.12	30	28.7	65.1	36.4	0.0	150.0	0.0	28.7	36.4
May	12.2	3.86	0.56	57.9	1.22	31	72.9	92.8	19.9	0.0	150.0	0.0	72.9	19.9
June	18.1	7.01	0.61	89.1	1.28	30	114.0	89.5	-24.5	-24.5	176.7	26.7	62.8	26.7
July	20.8	8.66	0.64	103.7	1.25	31	134.0	72.7	-61.3	-85.9	265.9	89.2	-16.5	89.2
August	19.9	8.10	0.63	98.8	1.15	31	117.5	77.9	-39.6	-125.4	346.1	80.2	-2.3	80.2
September	15.9	5.76	0.59	77.3	1.04	30	80.4	99.1	18.7	0.0	150.0	-196.1	80.4	18.7
October	9.3	2.56	0.54	43.0	0.92	31	40.9	90.1	49.2	0.0	150.0	0.0	40.9	49.2
November	3.2	0.51	0.50	13.4	0.80	30	10.7	103.6	92.9	0.0	150.0	0.0	10.7	92.9
December	-3.1	0.00	0.49	0.0	0.76	31	0.0	104.4	104.4	0.0	150.0	0.0	0.0	104.4
Totals		**37.7**	**1.09**				**599.1**	**1040.6**	**441.5**				**277.6**	**763.0**

Annual Heat Index I = 37.7

Notes:

1) Water budget adjusted for latitude and daylight
2) (^{o}C) Represents calculated mean of daily temperatures for the month
3) Precipitation and Temperature data from the Midland Water Pollution Control Plant station at lattitude 44^{o} 45' 28.056" N, longitude 79^{o} 52' 31.014" W, elevation 180.00m ASL.
4) Total water surplus is calculated as total precipitation minus potential evapotranspiration
5) Water Holding Capacity of Native Soil is 150mm in accordance with Table 3.1 of the MOE SWM Manual 2003
6) Soil Moisture Retention Values Obtained from Table 26 of the Instructions and Tables For Computing Potential Evapotranspiration and The Water Balance (Thornthwaite and Mathers, 1957)
7) APWL, accumulated potential water loss; ST, soil retention storage; ΔST, change in soil moisture retention; AE, actual evapotranspiration

TOM SMITH GMC

WATER BUDGET PRE-DEVELOPMENT

Midland, Ontario

Project Number: 22-11692M

Date: February 16, 2023

Design By: LT

Catchment Designation	Pre-Development Condition				
	Woodlands	**Lawn**	**Gravel**	**Impervious**	**Totals**
Area(m2)	3390	0	8515	11895	23800
Pervious Area (m2)	0	0	0	0	0
Impervious Area (m2)	0	0	8515	11895	20410
Infiltration Factors					
Topography Infiltration Factor	0.2	0.2	0	0	
Soil Infiltration Factor	0.4	0.4	0	0	
Land Cover Infiltration Factor	0.2	0.2	0	0	
MOE Infiltration Factor (Sum)	***0.8***	***0.8***	***0***	***0***	
Actual Infiltration Factor	0.8	0.8	0	0	
Run-off Coefficient	0.2	0.1	0	0	
Run-off from impervious surfaces*	0	0	0.9	0.9	
Inputs (per Unit Area)					
Precipitation (mm/yr)	1041	1041	1041	1041	1041
Run-on (mm/yr)	0	0	0	0	0
Other inputs (mm/yr)	0	0	0	0	0
Total inputs (mm/yr)	**1041**	**1041**	**1041**	**1041**	**1041**
Outputs (per Unit Area)					
Precipitation Surplus (mm/yr)	763	763	937	937	912
Net Surplus (mm/yr)	763	763	937	937	912
Evapotranspiration (mm/yr)	278	278	104	104	129
Infiltration (mm/yr)	610	610	0	0	87
Rooftop Infiltration (mm/yr)	0	0	0	0	0
Total Infiltration (mm/yr)	610	610	0	0	87
Runoff Pervious Areas (mm/yr)	153	153	0	0	22
Runoff Impervious Areas (mm/yr)	0	0	937	937	803
Total Runoff (mm/yr)	153	153	937	937	825
Total Outputs (mm/yr)	**1041**	**1041**	**1041**	**1041**	**1041**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**
Inputs (Volumes)					
Precipitation (m3/yr)	3528	0	8861	12378	24766
Run-on (m3/yr)	0	0	0	0	0
Other inputs (m3/yr)	0	0	0	0	0
Total Inputs (m3/yr)	**3528**	**0**	**8861**	**12378**	**24766**
Outputs (Volumes)					
Precipitation Surplus (m3/yr)	2586	0	7975	11140	21701
Net Surplus (m3/yr)	2586	0	7975	11140	21701
Evapotranspiration (m3/yr)	941	0	886	1238	3065
Infiltration (m3/yr)	2069	0	0	0	2069
Rooftop Infiltration (m3/yr)	0	0	0	0	0
Total Infiltration (m3/yr)	2069	0	0	0	2069
Runoff Pervious Areas (m3/yr)	517	0	0	0	517
Runoff Impervious Areas (m3/yr)	0	0	7975	11140	19115
Total Runoff (m3/yr)	517	0	7975	11140	19632
Total Outputs (m3/yr)	**3528**	**0**	**8861**	**12378**	**24766**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**

* Evaporation from impervious areas was assumed to be 10% of precipitation value

TOM SMITH GMC

WATER BUDGET POST DEVELOPMENT <u>WITHOUT MITIGATION</u>

Midland, Ontario

Project Number: 22-11692M

Date: February 16, 2023

Design By: LT

Catchment Designation	Post Development Condition				
	Woodlands	**Lawn**	**Impervious**	**Building**	**Totals**
Area(m2)	0	3405	16975	3420	23800
Pervious Area (m2)	0	3405	0	0	3405
Impervious Area (m2)	0	0	16975	3420	20395
Infiltration Factors					
Topography Infiltration Factor	0.2	0.2	0	0	
Soil Infiltration Factor	0.4	0.4	0	0	
Land Cover Infiltration Factor	0.2	0.1	0	0	
MOE Infiltration Factor (Sum)	***0.8***	***0.7***	***0***	***0***	
Actual Infiltration Factor	0.8	0.7	0	0	
Run-off Coefficient	0.2	0.1	0	0	
Run-off from impervious surfaces*	0	0	0.9	0.9	
Inputs (per Unit Area)					
Precipitation (mm/yr)	1041	1041	1041	1041	1041
Run-on (mm/yr)	0	0	0	0	0
Other inputs (mm/yr)	0	0	0	0	0
Total inputs (mm/yr)	**1041**	**1041**	**1041**	**1041**	**1041**
Outputs (per Unit Area)					
Precipitation Surplus (mm/yr)	763	763	937	937	912
Net Surplus (mm/yr)	763	763	937	937	912
Evapotranspiration (mm/yr)	278	278	104	104	129
Infiltration (mm/yr)	610	534	0	0	76
Rooftop Infiltration (mm/yr)	0	0	0	0	0
Total Infiltration (mm/yr)	610	534	0	0	76
Runoff Pervious Areas (mm/yr)	153	229	0	0	33
Runoff Impervious Areas (mm/yr)	0	0	937	937	803
Total Runoff (mm/yr)	153	229	937	937	835
Total Outputs (mm/yr)	**1041**	**1041**	**1041**	**1041**	**1041**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**
Inputs (Volumes)					
Precipitation (m3/yr)	0	3543	17664	3559	24766
Run-on (m3/yr)	0	0	0	0	0
Other inputs (m3/yr)	0	0	0	0	0
Total Inputs (m3/yr)	**0**	**3543**	**17664**	**3559**	**24766**
Outputs (Volumes)					
Precipitation Surplus (m3/yr)	0	2598	15898	3203	21699
Net Surplus (m3/yr)	0	2598	15898	3203	21699
Evapotranspiration (m3/yr)	0	945	1766	356	3068
Infiltration (m3/yr)	0	1819	0	0	1819
Rooftop Infiltration (m3/yr)	0	0	0	0	0
Total Infiltration (m3/yr)	0	1819	0	0	1819
Runoff Pervious Areas (m3/yr)	0	779	0	0	779
Runoff Impervious Areas (m3/yr)	0	0	15898	3203	19101
Total Runoff (m3/yr)	0	779	15898	3203	19880
Total Outputs (m3/yr)	**0**	**3543**	**17664**	**3559**	**24766**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**

* Evaporation from impervious areas was assumed to be 10% of precipitation value

TOM SMITH GMC

WATER BUDGET POST DEVELOPMENT WITH MITIGATION

Midland, Ontario

Project Number: 22-11692M

Date: February 16, 2023

Design By: LT

Catchment Designation	Post Development Condition with Mitigation				
	Woodlands	**Lawn**	**Impervious**	**Building**	**Totals**
Area(m2)	0	3405	16975	3420	23800
Pervious Area (m2)	0	3405	0	0	3405
Impervious Area (m2)	0	0	16975	3420	20395
Infiltration Factors					
Topography Infiltration Factor	0.2	0.2	0	0	
Soil Infiltration Factor	0.4	0.4	0	0	
Land Cover Infiltration Factor	0.2	0.1	0	0	
MOE Infiltration Factor (Sum)	***0.8***	***0.7***	***0***	***0***	
Actual Infiltration Factor*	0.8	0.7	0	0.5	
Run-off Coefficient	0.2	0.1	0	0	
Run-off from impervious surfaces**	0	0	0.9	0.9	
Inputs (per Unit Area)					
Precipitation (mm/yr)	1041	1041	1041	1041	1041
Run-on (mm/yr)	0	0	0	0	0
Other inputs (mm/yr)	0	0	0	0	0
Total inputs (mm/yr)	**1041**	**1041**	**1041**	**1041**	**1041**
Outputs (per Unit Area)					
Precipitation Surplus (mm/yr)	763	763	937	937	912
Net Surplus (mm/yr)	763	763	937	937	912
Evapotranspiration (mm/yr)	278	278	104	104	129
Infiltration (mm/yr)	610	534	0	0	76
Rooftop Infiltration (mm/yr)	0	0	0	468	67
Total Infiltration (mm/yr)	610	534	0	468	144
Runoff Pervious Areas (mm/yr)	153	229	0	0	33
Runoff Impervious Areas (mm/yr)	0	0	937	468	735
Total Runoff (mm/yr)	153	229	937	468	768
Total Outputs (mm/yr)	**1041**	**1041**	**1041**	**1041**	**1041**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**
Inputs (Volumes)					
Precipitation (m3/yr)	0	3543	17664	3559	24766
Run-on (m3/yr)	0	0	0	0	0
Other inputs (m3/yr)	0	0	0	0	0
Total Inputs (m3/yr)	**0**	**3543**	**17664**	**3559**	**24766**
Outputs (Volumes)					
Precipitation Surplus (m3/yr)	0	2598	15898	3203	21699
Net Surplus (m3/yr)	0	2598	15898	3203	21699
Evapotranspiration (m3/yr)	0	945	1766	356	3068
Infiltration (m3/yr)	0	1819	0	0	1819
Rooftop Infiltration (m3/yr)	0	0	0	1601	1601
Total Infiltration (m3/yr)	0	1819	0	1601	3420
Runoff Pervious Areas (m3/yr)	0	779	0	0	779
Runoff Impervious Areas (m3/yr)	0	0	15898	1601	17499
Total Runoff (m3/yr)	0	779	15898	1601	18279
Total Outputs (m3/yr)	**0**	**3543**	**17664**	**3559**	**24766**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**

* Rooftop downspout disconnections to Brentwood Tanks will provide 50% infiltration potential for the buidling rooftop

** Evaporation from impervious areas was assumed to be 10% of precipitation value.

TOM SMITH GMC

WATER BUDGET SUMMARY

Midland, Ontario

Project Number: 22-11692M

Date: February 16, 2023

Design By: LT

Characteristic	Site				
	Pre-Development	Post Development	Change (Pre to Post)	Post Devlopment with Mitigation	Change (Pre to Post with Mitigation)
Inputs (Volumes)					
Precipitation (m3/yr)	24766	24766	0.0%	24766	0.0%
Run-on (m3/yr)	0	0	0.0%	0	0.0%
Other Inputs (m3/yr)	0	0	0.0%	0	0.0%
Total Inputs (m3/yr)	24766	24766	**0.0%**	24766	**0.0%**
Output (volumes)					
Precipitation Surplus (m3/yr)	21701	21699	0.0%	21699	0.0%
Net Surplus (m3/yr)	21701	21699	0.0%	21699	0.0%
Evapotranspiration (m3/yr)	3065	3068	0.1%	3068	0.1%
Infiltration (m3/yr)	2069	1819	-12.1%	1819	-12.1%
Rooftop Infiltration (m3/yr)	0	0	0.0%	1601	0.0%
Total Infiltration (m3/yr)	2069	1819	-12.1%	3420	65.3%
Runoff Pervious Areas (m3/yr)	517	779	50.7%	779	50.7%
Runoff Impervious Areas (m3/yr)	19115	19101	-0.1%	17499	-8.5%
Total Runoff (m3/yr)	19632	19880	1.3%	18279	-6.9%
Total Outputs (m3/yr)	24766	24766	**0.0%**	24766	0.0%

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

Brentwood Stormtank System Design Calculations

The following is a list of parameters and design criteria for the Brentwood Stormtank system to capture and treat runoff generated from the building rooftop.

- The capacity to treat runoff from a 3420m^2 rooftop area.
- A rainfall depth of 20mm - According to the MECP Stormwater Management Planning and Design Manual (2003), the target storage volume should be 20mm over the surface area since 90% of all daily rainfall depths are less than this amount.
- An overall runoff coefficient of 0.95 for the rooftop surface.
- A maximum infiltration rate of 12mm/hr for native silty sandy clay (Table C1, TRCA LID Manual).
- A recommended drawdown time of 24-48 hours per the LID Manual.
- A void ratio of 0.97 for the ST-36 unit.
- A design infiltration rate 10mm/hr for sandy loam type soils

$$Runoff\ Volume = C * i * A$$

where: *C* = *surface runoff coefficient*
i = *intensity, mm/hr.*
A = *runoff catchment area, m^2*

$$Runoff\ Volume = (0.95)(0.02m)(3420m^2) = 64.98m^3$$

Storage Depth – A deep stone reservoir on a highly permeable soil can cause soil compaction and loss of permeability from the mass of overlying stone and stored water. Therefore, an additional calculation should be conducted to determine the maximum allowable stone reservoir depth while maintaining a target water drawdown time of 24-48 hours. As per the Low Impact Development Stormwater Management Planning and Design Guide (2010):

$$d_{s\,max} = \frac{i * t_s}{V_r}$$

where: $d_{s\,max}$ = *maximum stone reservoir depth, mm*
i = *design infiltration rate of native soil, mm/hr.*
t_s = *drawdown time, hr*
V_r = *void space ratio for reservoir*

$$d_{s\,max} = \frac{10.0 * 48}{0.40} = 1200mm = 1.20m\ (48\ hours)$$
$$d_{s\,min} = \frac{10.0 * 24}{0.40} = 600mm = 0.600m\ (24\ hours)$$

The proposed Brentwood Stormtanks (ST-36) will have a reservoir depth of 0.914m which exceeds the minimum depth requirement of 0.600m to achieve a drawdown time of 24 hours.

To calculate the required number of Brentwood storage tank (ST-24) units:

Required Volume = 64.98 cu.m.
Storage provided by 1 unit = 0.45 cu.m.
Number of units = 64.98/0.45 = 145units
Unit dimensions = 18”x36”
Total footprint area = 60.62 sq.m.

MODULE 25 SERIES
DESIGN GUIDE

STORMTANK®
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CONTENT

GENERAL NOTES

1. Brentwood recommends that the installing contractor contact either Brentwood or the local distributor prior to installation of the system to schedule a pre-construction meeting. This meeting will ensure that the installing contractor has a firm understanding of the installation instructions.
2. All systems must be designed and installed to meet or exceed Brentwood's minimum requirements. Although Brentwood offers support during the design, review, and construction phases of the Module system, it is the ultimate responsibility of the Engineer of Record to design the system in full compliance with all applicable engineering practices, laws, and regulations.
3. Brentwood requires a minimum cover of 24" (610 mm) and/or a maximum Module invert of 11' (3.35 m). Additionally, a minimum 6" (152 mm) leveling bed, 12" (305 mm) side backfill, and 12" (305 mm) top backfill are required on every system.
4. Brentwood recommends a minimum bearing capacity and subgrade compaction for all installations. If site conditions are found not to meet any design requirements during installation, the Engineer of Record must be contacted immediately.
5. All installations require a minimum two layers of geotextile fabric. One layer is to be installed around the Modules, and another layer is to be installed between the stone/soil interfaces.
6. Stone backfilling is to follow all requirements of the most current installation instructions.
7. The installing contractor must apply all protective measures to prevent sediment from entering the system during and after installation per local, state, and federal regulations.
8. The StormTank® Module carries a Limited Warranty, which can be accessed at *www.stormtank.com*.

1.0 INTRODUCTION

About Brentwood

Brentwood is a global manufacturer of custom and proprietary products and systems for the construction, consumer, medical, power, transportation, and water industries. A focus on plastics innovation, coupled with diverse production capabilities and engineering expertise, has allowed Brentwood to build a strong reputation for thermoplastic molding and solutions development.

Brentwood's product and service offerings continue to grow with an ever-increasing manufacturing presence. By emphasizing customer service and working closely with clients throughout the design, engineering, and manufacturing phases of each project, Brentwood develops forward-thinking strategies to create targeted, tailored solutions.

StormTank® Module

The StormTank Module is a strong, yet lightweight, alternative to other subsurface systems and offers the largest void space (up to 97%) of any subsurface stormwater storage unit on the market. The Modules are simple to assemble on site, limiting shipping costs, installation time, and labor. Their structural PVC columns pressure fit into the polypropylene top/bottom platens, with side panels inserted around the perimeter of the system. This open design and lack of internal walls make the Module system easy to clean compared to other subsurface box structures. When properly designed, applied, installed, and maintained, the Module system has been engineered to achieve a 50-year lifespan.

Technical Support

Brentwood's knowledgeable distributor network and in-house associates emphasize customer service and support by partnering with customers to extend the process beyond physical material supply. These trained specialists are available to assist in the review of proposed systems, conversions of alternatively designed systems, or to resolve any potential concerns before, during, and after the design process. To provide the best assistance, it is recommended that associates be provided with a site plan and cross-sections that include grading, drainage structures, dimensions, etc.

2.0 PRODUCT INFORMATION

Applications

The Module system can be utilized for detention, infiltration, capture and reuse, and specialty applications across a wide range of industries, including the commercial, residential, and recreational segments. The product's modular design allows the system to be configured in almost any shape (even around utilities) and to be located under almost any pervious or impervious surface.

Module Selection

Brentwood manufactures the Module in six different heights (Table 1) that can be stacked uniformly up to two Modules high. This allows for numerous height configurations up to 6' (1.83 m) tall. The Modules can be buried up to a maximum invert of 11' (3.35 m) and require a minimum cover of 24" (610 mm) for load rating. When selecting the proper Module, it is important to consider the minimum required cover, any groundwater or limiting zone restrictions, footprint requirements, and all local, state, and federal regulations.

Table 1: Nominal StormTank® Module Specifications

MODEL SPEC	ST-12	ST-18	ST-24	ST-30	ST-33	ST-36
Height	12" (305 mm)	18" (457 mm)	24" (610 mm)	30" (762 mm)	33" (838 mm)	36" (914 mm)
Void Space	93.70%	95.5%	96.0%	96.5%	96.9%	97.0%
Storage Capacity	4.21 ft^3 (0.12 m^3)	6.54 ft^3 (0.18 m^3)	8.64 ft^3 (0.24 m^3)	10.86 ft^3 (0.31 m^3)	11.99 ft^3 (0.34 m^3)	13.10 ft^3 (0.37 m^3)
Min. Installed Capacity*	6.91 ft^3 (0.20 m^3)	9.15 ft^3 (0.26 m^3)	11.34 ft^3 (0.32 m^3)	13.56 ft^3 (0.38 m^3)	14.69 ft^3 (0.42 m^3)	15.80 ft^3 (0.45 m^3)
Weight	17.56 lb (7.97 kg)	22.70 lb (10.30 kg)	26.30 lb (11.93 kg)	29.50 lb (13.38 kg)	31.30 lb (14.20 kg)	33.10 lb (15.01 kg)

(*) Minimum Installed Capacity includes the leveling bed, Module, and top backfill storage capacity for one Module. Stone storage capacity is based on 40% void space. Side backfill storage is not included.

3.0 MANUFACTURING STANDARDS

Brentwood selects material based on long-term performance needs. To ensure long-term performance and limit component deflection over time (creep), Brentwood selected polyvinyl chloride (PVC) for the Module's structural columns and a virgin polypropylene (PP) blend for the top/bottom and side panels. PVC provides the largest creep resistance of commonly available plastics, and therefore, provides the best performance under loading conditions. Materials like polyethylene (HDPE) and recycled PP have lower creep resistance and are not recommended for load-bearing products and applications.

Materials:

Brentwood's proprietary PVC and PP copolymer resins have been chosen specifically for utilization in the StormTank® Module. The PVC is blended in house by experts and is a 100% blend of post-manufacturing/pre-consumer recycled material. Both materials exhibit structural resilience and naturally resist the chemicals typically found in stormwater runoff.

Methods:

Injection Molding

The Module's top/bottom platens and side panels are injection molded, using proprietary molds and materials. This allows Brentwood to manufacture a product that meets structural requirements while maintaining dimensional control, molded-in traceability, and quality control.

Extrusion

Brentwood's expertise in PVC extrusion allows the structural columns to be manufactured in house. The column extrusion includes the internal structural ribs required for lateral support.

Quality Control

Brentwood maintains strict quality control in order to ensure that materials and the final product meet design requirements. This quality assurance program includes full material property testing in accordance with American Society for Testing and Materials (ASTM) standards, full-part testing, and process testing in order to quantify product performance during manufacturing. Additionally, Brentwood conducts secondary finished-part testing to verify that design requirements continue to be met post-manufacturing.

All Module parts are marked with traceability information that allows for tracking of manufacturing. Brentwood maintains equipment at all manufacturing locations, as well as at its corporate testing lab, to ensure all materials and products meet all requirements.

4.0 STRUCTURAL RESPONSE

Structural Design

The Module has been designed to resist loads calculated in accordance with the American Association of State Highway and Transportation Official's (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design manual. This fully factored load includes a multiple presence factor, dynamic load allowance, and live load factor to account for real-world situations. This loading was considered when Brentwood developed both the product and installation requirements. The developed minimum cover ensures the system maintains an adequate resistance factor for the design truck (HS-20) and HS-25 loads.

Full-Scale Product Testing

Engineers at Brentwood's in-house testing facility have completed full-scale vertical and lateral tests on the Module to evaluate product response. To date, Brentwood continues in-house testing in order to evaluate long-term creep effects.

Fully Installed System Testing

Brentwood's dedication to providing a premier product extends to fully installed testing. Through a partnership with Queen's University's GeoEngineering Centre in Kingston, Ontario, Brentwood has conducted full-scale installation tests of single- and double-stacked Module systems to analyze short- and long-term performance. Testing includes short-term ultimate limit state testing under fully factored AASHTO loads and minimum installation cover, lateral load testing, long-term performance and lifecycle testing utilizing time-temperature superposition, and load resistance development. Side backfill material tests were also performed to compare the usage of sand, compacted stone, and uncompacted stone.

5.0 FOUNDATION

The foundation (subgrade) of the subsurface storage structure may be the most important part of the Module system installation as this is the location where the system applies the load generated at the surface. If the subgrade lacks adequate support or encounters potential settlement, the entire system could be adversely affected. Therefore, when implementing an underground storage solution, it is imperative that a geotechnical investigation be performed to ensure a strong foundation.

Considerations & Requirements:

Bearing Capacity

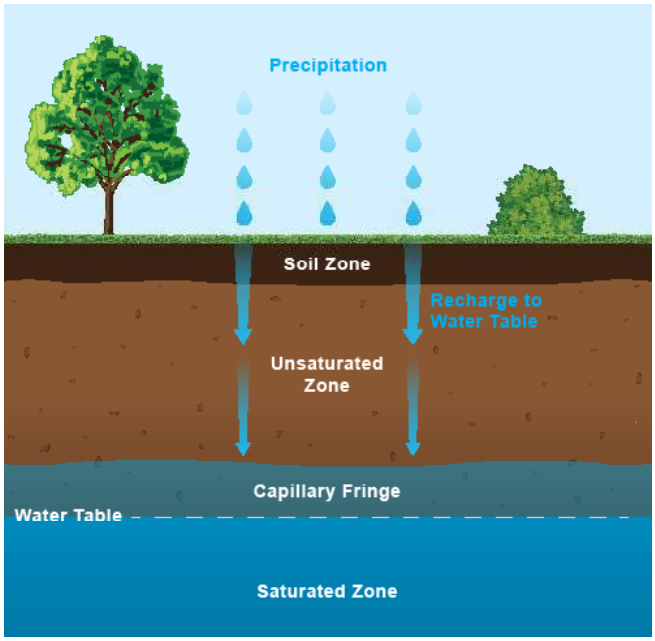
The bearing capacity is the ability of the soil to resist settlement. In other words, it is the amount of weight the soil can support. This is important versus the native condition because the system is replacing earth, and even though the system weighs less than the earth, the additional load displacement of the earth is not offset by the difference in weight.

Using the Loading and Resistance Factor Design (LRFD) calculation for bearing capacity, Brentwood has developed a conservative minimum bearing capacity table (see Appendix). The Engineer of Record shall reference this table to assess actual cover versus the soil bearing required for each unit system.

Soil Profile

Limiting Zones

Limiting zones are conditions in the underlying soils that can affect the maximum available depth for installation and can reduce the strength and stability of the underlying subgrade. The three main forms of limiting zones are water tables, bedrock, and karst topography. It is recommended that a system be offset a minimum of 12" (305 mm) from any limiting zones.



Water Table Zones

Compaction

Soil compaction occurs as the soil particles are pressed together and pore space is eliminated. By compacting the soils to 95% (as recommended by Brentwood), the subgrade strength will increase, in turn limiting both the potential for the soil to move once installed and for differential settlement to occur throughout the system. If designing the specific compaction requirement, settlement should be limited to less than 1" (25 mm) through the entire subgrade and should not exceed a 1/2" (13 mm) of differential settlement between any two adjacent units within the system over time.

Mitigation

If a minimum subgrade bearing capacity cannot be achieved because of weak soil, a suitable design will need to be completed by a Geotechnical Engineer. This design may include the over-excavation of the subgrade and an engineered fill or slurry being placed. Additional material such as geogrid or other products may also be required. Please contact a Geotechnical Engineer prior to selecting products or designing the subgrade.

6.0 SYSTEM MATERIALS

Geotextile Fabric

The 6-ounce geotextile fabric is recommended to be installed between the soil and stone interfaces around the Modules to prevent soil migration.

Leveling Bed

The leveling bed is constructed of 6"-thick (152 mm) angular stone (Table 2). The bed has not been designed as a structural element but is utilized to provide a level surface for the installation of the system and provide an even distribution of load to the subgrade.

Stone Backfill

The stone backfill is designed to limit the strain on the product through displacement of load and ensure the product's longevity. Therefore, a minimum of 12"-wide (305 mm) angular stone must be placed around all sides of the system. In addition, a minimum layer of 12" (305 mm) angular stone is required on top of the system. All material is to be placed evenly in 12" (305 mm) lifts around and on top of the system and aligned with a vibratory plate compactor.

Table 2: Approved Backfill Material

Material Location	Description	AASHTO M43 Designation	ASTM D2321 Class	Compaction/Density
Finished Surface	Topsoil, hardscape, stone, concrete, or asphalt per Engineer of Record	N/A	N/A	Prepare per engineered plans
Suitable Compactable Fill	Well-graded granular soil/aggregate, typically road base or earthen fill (maximum 4" particle size)	56, 57, 6, 67, 68	I & II III (Earth Only)	Place in maximum 12" lifts to a minimum 90% standard proctor density
Top Backfill	Crushed angular stone placed between Modules and road base or earthen fill	56, 57, 6, 67, 68	I & II	Plate vibrate to provide evenly distributed layers
Side Backfill	Crushed angular stone placed between earthen wall and Modules	56, 57, 6, 67, 68	I & II	Place and plate vibrate in uniform 12" lifts around the system
Leveling Bed	Crushed angular stone placed to provide level surface for installation of Modules	56, 57, 6, 67, 68	I & II	Plate vibrate to achieve level surface

Impermeable Liner

In designs that prevent runoff from infiltrating into the surrounding soil (detention or reuse applications) or groundwater from entering the system, an impermeable liner is required. When incorporating a liner as part of the system, Brentwood recommends using a manufactured product such as a PVC liner. This can be installed around the Modules themselves or installed around the excavation (to gain the benefit of the void space in the stone) and should include an underdrain system to ensure the basin fully drains. This liner is installed with a layer of geotextile fabric on both sides to prevent puncture, in accordance with manufacturer recommendations.

7.0 CONNECTIONS

Stormwater runoff must be able to move readily in and out of the StormTank® Module system. Brentwood has developed numerous means of connecting to the system, including inlet/outlet ports and direct abutment to a catch basin or endwall. All methods of connection should be evaluated as each one may offer a different solution. Brentwood has developed drawings to assist with specific installation methods, and these are available at *www.stormtank.com*.

Inlet/Outlet and Pipe Connections

To facilitate easy connection to the system, Brentwood manufactures two inlet/outlet ports. They are 12" (305 mm) and 14" (356 mm), respectfully, and utilize a flexible coupling connection to the adjoining pipe.

Another common installation method is to directly connect the pipe to the system. In order to do this, an opening is cut into the side panels, the pipe is inserted, and then the system is wrapped in geotextile fabric. When utilizing this connection method, the pipe must be located a minimum of 3" (76 mm) from the bottom of the system. This provides adequate clearance for the bottom platen and the required strength in the remaining side panel. To maintain the required clearances or reduce pipe size, it may be necessary to connect utilizing a manifold system.

Direct Abutment

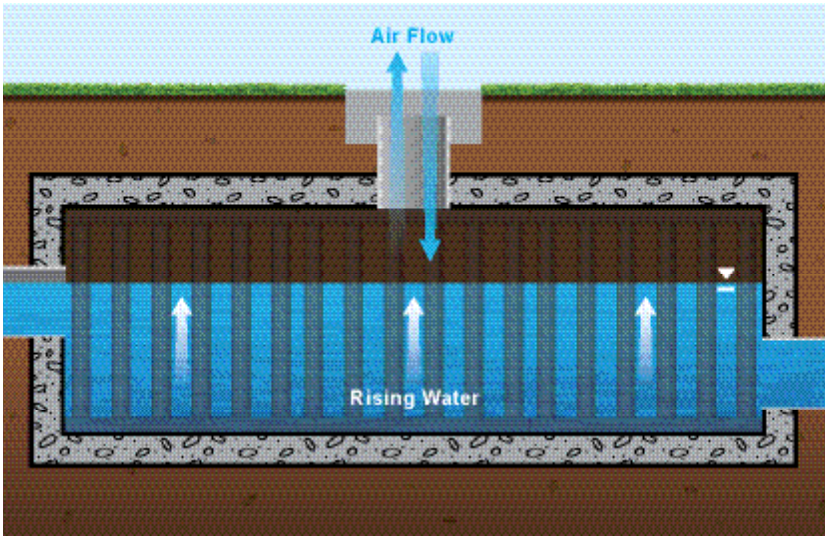
The system can also be connected by directly abutting Modules to a concrete catch basin or endwall. This allows for a seamless connection of structures in close proximity to the system and eliminates the need for numerous pipe connections. When directly abutting one of these structures, remove any side panels that fully abut the structure, and make sure it is flush with the system to prevent material migration into the structure.

Underdrain

Underdrains are typically utilized in detention applications to ensure the system fully drains since infiltration is limited or prohibited. The incorporation of an underdrain in a detention application will require an impermeable liner between the stone-soil interface.

Cleanout Ports

Brentwood understands the necessity to inspect and clean a subsurface system and has designed the Module without any walls to allow full access. Brentwood offers three different cleanout/observation ports for utilization with the system. The ports are made from PVC, provide an easy means of connection, and are available in 6" (152 mm), 8" (203 mm) and 10" (254 mm) diameters. The 10" (254 mm) port is sized to allow access to the system by a vacuum truck suction hose for easy debris removal. It is recommended that ports be located a maximum of 30' (9.14 m) on center to provide adequate access, ensure proper airflow, and allow the system to completely fill.



Ventilation and Air Flow

8.0 PRETREATMENT

Removing pollutants from stormwater runoff is an important component of any stormwater management plan. Pretreatment works to prevent water quality deterioration and also plays an integral part in allowing the system to maintain performance over time and increase longevity. Treatment products vary in complexity, design, and effectiveness, and therefore, should be selected based on specific project requirements.

Typical Stormwater System

Catch Basin → Inlet Piping → Pretreatment → Storage Basin → Outlet Structure

Pretreatment: STORMTANK SHIELD

Storage Basin: STORMTANK SHIELD & MODULE

StormTank® Shield

Brentwood's StormTank Shield provides a low-cost solution for stormwater pretreatment. Designed to improve sumped inlet treatment, the Shield reduces pollutant discharge through gross sediment removal and oil/water separation. For more information, please visit www.stormtank.com.

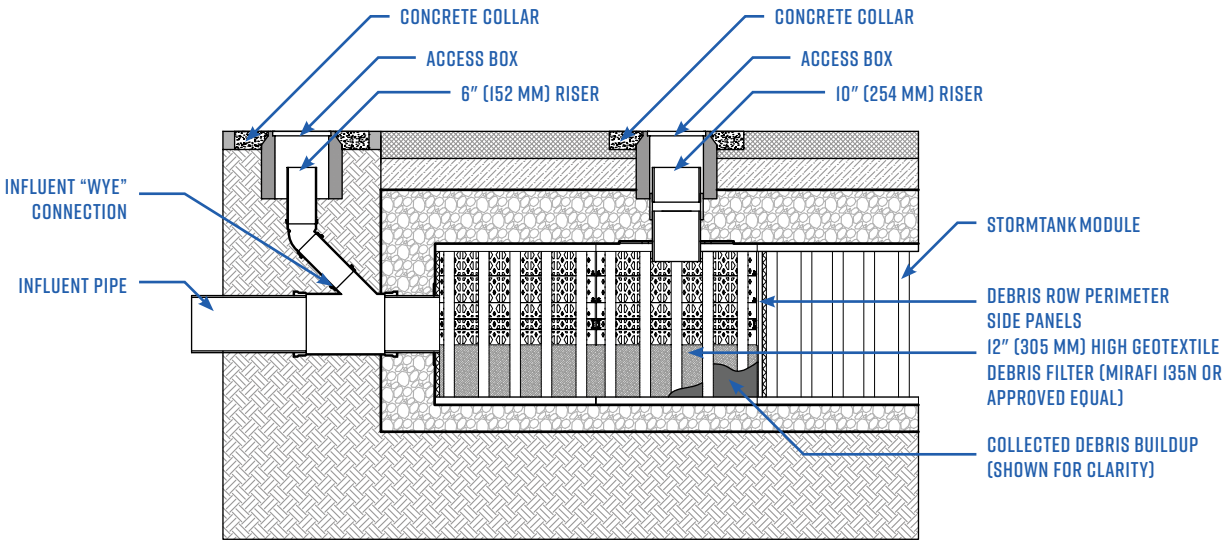
Debris Row (Easy Cleanout)

An essential step of designing, installing, and maintaining a subsurface system is preventing debris from entering the storage. This can be done by incorporating debris rows (or bays) at the inlets of the system to prevent debris from entering the rest of the system.

The debris row is built into the system utilizing side panels with a 12" (305 mm) segment of geotextile fabric. This allows for the full basin capacity to be utilized while storing any debris in an easy-to-remove location. To calculate the number of side panels required to prevent backing up, the opening area of the side panels on the area above the geotextile fabric has been calculated and compared to the inflow pipe diameter.

Debris row cleanout is made easy by including 10" (254 mm) suction ports, based on the length of the row, and a 6" (152 mm) saddle connection to the inflow pipe. If the system is directly abutting a catch basin, the saddle connection is not required, and the flush hose can be inserted through the catch basin. Debris is then flushed from the inlet toward the suction ports and removed.

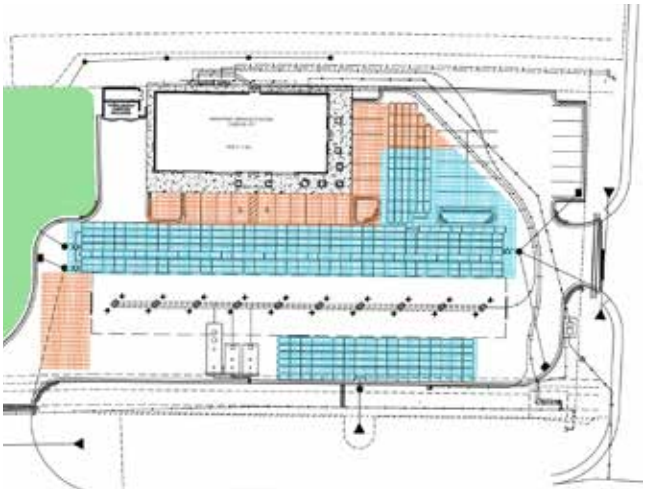
Brentwood has developed drawings and specifications that are available at www.stormtank.com to illustrate the debris row configuration and layouts.



Debris Row Section Detail

9.0 ADDITIONAL CONSIDERATIONS

Many variable factors, such as the examples below, must be taken into consideration when designing a StormTank® Module system. As these considerations require complex calculations and proper planning, please contact Brentwood or your local distributor to discuss project-specific requirements.



Site Plan Module Layout Adaptability
(StormTank Modules shown in blue)

Adaptability

The Modules can be arranged in custom configurations to meet tight site constraints and to provide different horizontal and edge configurations. Modules can also be stacked, to a maximum 2 units tall, to meet capacity needs and can be buried to a maximum invert of 11' (3.35 m) to allow for a stacked system or deeper burial.

Adjacent Structures

The location of adjacent structures, especially the location of footings and foundations, must be taken into consideration as part of system design. The foundation of a building or retaining wall produces a load that is transmitted to a footing and then applied to the surface below. The footing is intended to distribute the line load of the wall over a larger area without increasing the larger wall's thickness. The reason this is important is because the load the footing is applying to the earth is distributed through the earth and could potentially affect a subsurface system as either a vertical load to the top of the Module or a lateral load to the side of the Module.

Based on this increased loading, it is recommended that the subsurface system either maintain a distance away from the foundation, footing equal to the height between the Module invert and structure invert of the system, or the foundation or footing extend at a minimum to the invert of the subsurface system. By locating the foundation away from the system or equal to the invert, the loading generated by the structure does not get transferred onto the system. It is recommended that all adjacent structures be completed prior to the installation of the Modules to prevent construction loads from being imparted on the system.

Adjacent Excavation

The subsurface system must be protected before, during, and after the installation. Once a system is installed, it is important to remember that excavation adjacent to the system could potentially cause the system to become unstable. The uniform backfilling will evenly distribute the lateral loads to the system and prohibit the system from becoming unstable and racking from unequal loads. However, it is recommended that any excavation adjacent to a system remain a minimum distance away from the system equal to the invert. This will provide a soil load that is equal to the load applied by the opposite side of the installation. If the excavation is to exceed the invert of the system, additional analysis may be necessary.

Sloped Finished Grade

Much like adjacent excavation, a finished grade with a differential cover could potentially cause a subsurface system to become disproportionately loaded. For example, if one side of the system has 10' (3.05 m) of cover and the adjacent side has 24" (610 mm) of cover, the taller side will generate a higher lateral load, and the opposite side may not have an equal amount of resistance to prevent a racking of the system. Additional evaluation may be required when working on sites where the final grade around a system exceeds 5%.

10.0 INSPECTION & MAINTENANCE

Description

Proper inspection and maintenance of a subsurface stormwater storage system are vital to ensuring proper product functioning and system longevity. It is recommended that during construction the contractor takes the necessary steps to prevent sediment from entering the subsurface system. This may include the installation of a bypass pipe around the system until the site is stabilized. The contractor should install and maintain all site erosion and sediment per Best Management Practices (BMP) and local, state, and federal regulations.

Once the site is stabilized, the contractor should remove and properly dispose of erosion and sediment per BMP and all local, state, and federal regulations. Care should be taken during removal to prevent collected sediment or debris from entering the stormwater system. Once the controls are removed, the system should be flushed to remove any sediment or construction debris by following the maintenance procedure outlined below.

During the first service year, a visual inspection should be completed during and after each major rainfall event, in addition to semi-annual inspections, to establish a pattern of sediment and debris buildup. Each stormwater system is unique, and multiple criteria can affect maintenance frequency. For example, whether or not a system design includes inlet protection or a pretreatment device has a substantial effect on the system's need for maintenance. Other factors include where the runoff is coming from (hardscape, gravel, soil, etc.) and seasonal changes like autumn leaves and winter salt.

During and after the second year of service, an established annual inspection frequency, based on the information collected during the first year, should be followed. At a minimum, an inspection should be performed semi-annually. Additional inspections may be required at the change of seasons for regions that experience adverse conditions (leaves, cinders, salt, sand, etc).

Maintenance Procedures

Inspection:

1. Inspect all observation ports, inflow and outflow connections, and the discharge area.
2. Identify and log any sediment and debris accumulation, system backup, or discharge rate changes.
3. If there is a sufficient need for cleanout, contact a local cleaning company for assistance.

Cleaning:

1. If a pretreatment device is installed, follow manufacturer recommendations.
2. Using a vacuum pump truck, evacuate debris from the inflow and outflow points.
3. Flush the system with clean water, forcing debris from the system.
4. Repeat steps 2 and 3 until no debris is evident.

11.0 SYSTEM SIZING

System Sizing Calculation

This section provides a brief description of the process required to size the StormTank® Module system. If you need additional assistance in determining the required number of Modules or assistance with the proposed configuration, it is recommended that you contact Brentwood or your local distributor. Additionally, Brentwood's volume calculator can help you to estimate the available storage volumes with and without stone storage. This tool is available at *www.stormtank.com*.

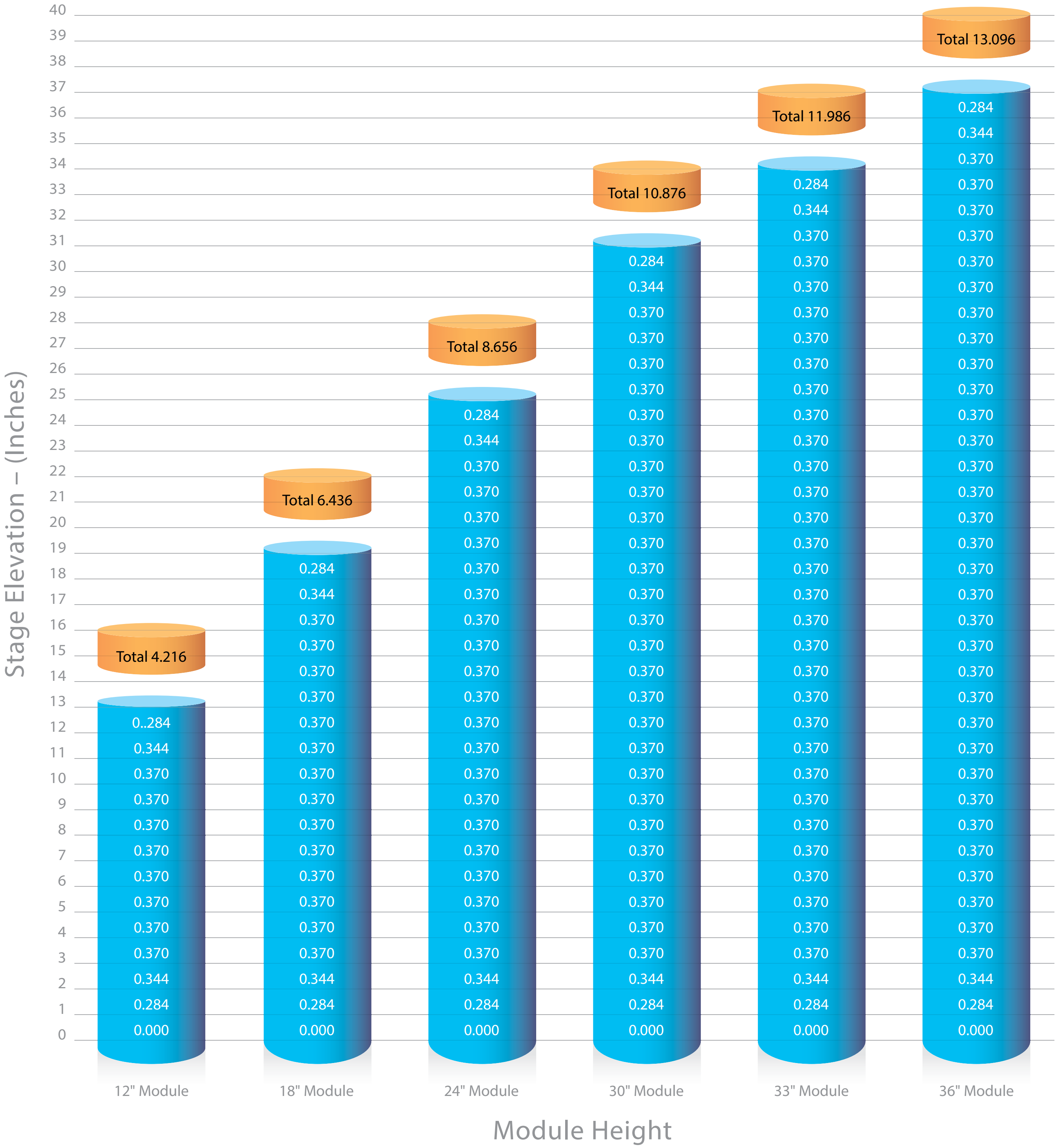
1. Determine the required storage volume (Vs):
It is the sole responsibility of the Engineer of Record to calculate the storage volume in accordance with all local, state, and federal regulations.

2. Determine the required number of Modules (N):
If the storage volume does not include stone storage, take the total volume divided by the selected Module storage volume. If the stone storage is to be included, additional calculations will be required to determine the available stone storage for each configuration.

3. Determine the required volume of stone (Vstone):
The system requires a minimum 6" (152 mm) leveling bed, 12" (305 mm) backfill around the system, and 12" (305 mm) top backfill utilizing 3/4" (19 mm) angular clean stone. Therefore, take the area of the system times the leveling bed and the top backfill. Once that value is determined, add the volume based on the side backfill width times the height from the invert of the Modules to the top of the Modules.

4. Determine the required excavation volume (Vexcv):
Utilizing the area of the system, including the side backfill, multiply by the depth of the system including the leveling bed. It is noted that this calculation should also include any necessary side pitch or benching that is required for local, state, or federal safety standards.

5. Determine the required amount of geotextile (G):
The system utilizes a multiple layer system of geotextile fabric. Therefore, two calculations are required to determine the necessary amount of geotextile. The first layer surrounds the entire system (including all backfill), and the second layer surrounds the Module system only. It is recommended that an additional 20% be included for waste and overlap.


Stage Elevation – (Inches)
40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Total 4.216
0..284 0.344 0.370 0.370 0.370 0.370 0.370 0.370 0.370 0.370 0.344 0.284 0.000
12" Module
Total 6.436
0.284 0.344 0.370 0.370 0.370 0.370 0.370 0.370 0.370 0.370 0.370 0.370 0.370 0.370 0.370 0.370 0.344 0.284 0.000
18" Module
Total 8.656
0.284 0.344 0.370 0.344 0.284 0.000
24" Module
Total 10.876
0.284 0.344 0.370 0.344 0.284 0.000
30" Module
Total 11.986
0.284 0.344 0.370 0.344 0.284 0.000
33" Module
Total 13.096
0.284 0.344 0.370 0.344 0.284 0.000
36" Module
Module Height

11.2 MATERIAL QUANTITY WORKSHEET

Project Name: By:

Location: Date:

System Requirements

Required Storage	ft^3 (m^3)
Number of Modules	Each
Module Storage	ft^3 (m^3)
Stone Storage	ft^3 (m^3)
Module Footprint	ft^2 (m^2) Number of Modules x 4.5 ft^2 (0.42 m^2)
System Footprint w/ Stone	ft^2 (m^2) Module Footprint + 1 ft (0.3048 m) to each edge
Stone	Tons (kg) Leveling Bed + Side Backfill + Top Backfill
Volume of Excavation	yd^3 (m^3) System Footprint w/ Stone x Total Height
Area of Geotextile	yd^2 (m^2) Wrap around Modules + Wrap around Stone/Soil Interface

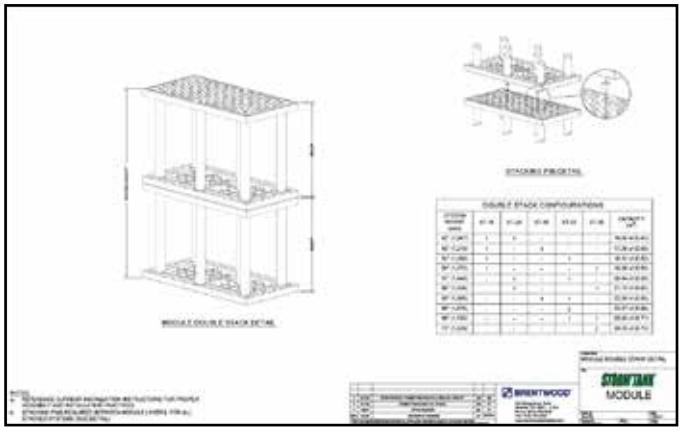
System Cost

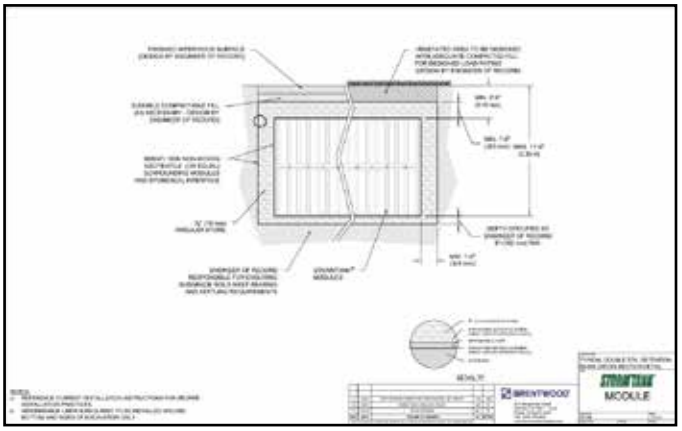
	Quantity		Unit Price		Total
Modules	ft^3 (m^3)	**X**	$	ft^3 (m^3)	**=** $
Stone	Tons (kg)	**X**	$	Tons (kg)	**=** $
Excavation	yd^3 (m^3)	**X**	$	yd^3 (m^3)	**=** $
Geotextile	yd^2 (m^2)	**X**	$	yd^2 (m^2)	**=** $
				Subtotal =	$
				Tons =	$

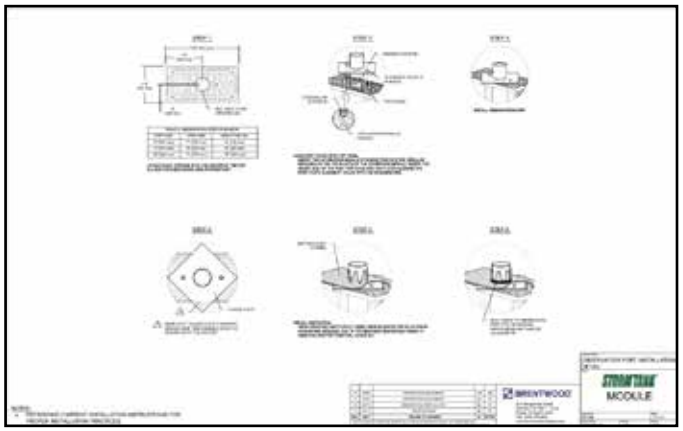
Material costs may not include freight.
Please contact Brentwood or your local distributor for this information.

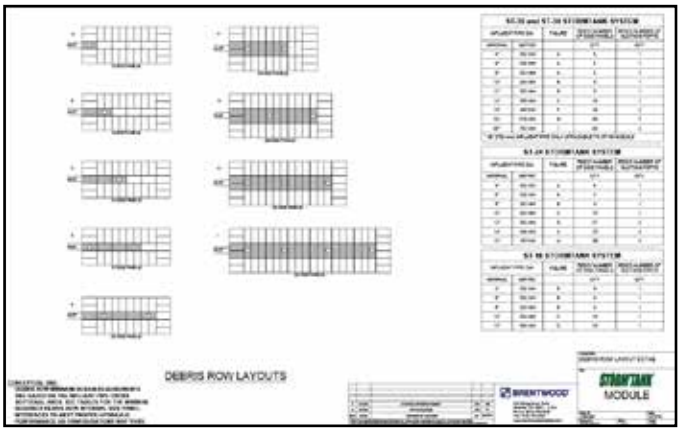
12.0 DETAIL DRAWINGS

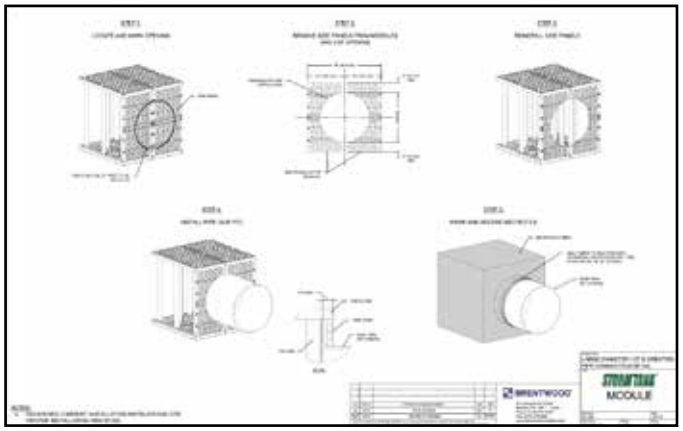
Brentwood has developed numerous drawings for utilization when specifying a StormTank® Module system. Below are some examples of drawings available at www.stormtank.com.

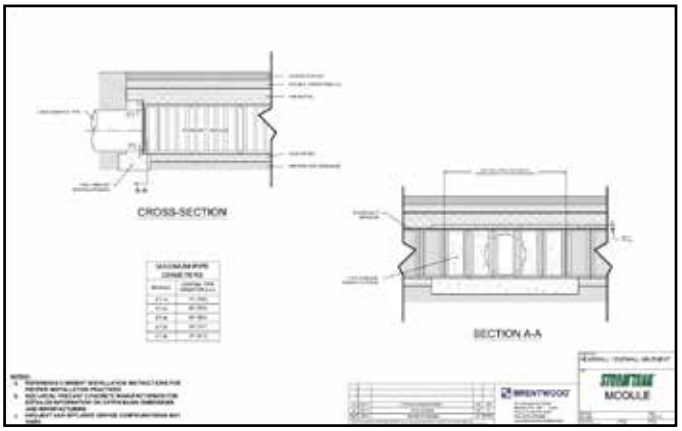












13.0 SPECIFICATIONS

1) General

a) This specification shall govern the implementation, performance, material, and fabrication pertaining to the subsurface stormwater storage system. The subsurface stormwater storage system shall be manufactured by Brentwood Industries, Inc., 500 Spring Ridge Drive, Reading, PA 19610 (610.374.5109), and shall adhere to the following specification at the required storage capacities.

b) All work is to be completed per the design requirements of the Engineer of Record and to meet or exceed the manufacturer's design and installation requirements.

2) Subsurface Stormwater Storage System Modules

a) The subsurface stormwater storage system shall be constructed from virgin polypropylene and 100% recycled PVC to meet the following requirements:

i) High-Impact Polypropylene Copolymer Material

(1) Injection molded, polypropylene, top/bottom platens and side panels formed to a dimension of 36" (914 mm) long by 18" (457 mm) wide [nominal].

ii) 100% Recycled PVC Material

(1) PVC conforming to ASTM D-1784 Cell Classification 12344 b-12454 B.

(2) Extruded, rigid, and 100% recycled PVC columns sized for applicable loads as defined by Section 3 of the AASHTO LRFD Bridge Design Specifications and manufactured to the required length per engineer-approved drawings.

iii) Platens and columns are assembled on site to create Modules, which can be uniformly stacked up to two Modules high, in vertical structures of variable height (custom for each project).

iv) Modular stormwater storage units must have a minimum 95% void space and be continuously open in both length and width, with no internal walls or partitions.

3) Submittals

a) Only systems that are approved by the engineer will be allowed.

b) At least 10 days prior to bid, submit the following to the engineer to be considered for pre-qualification to bid:

i) A list of materials to be provided for work under this article, including the name and address of the materials producer and the location from which the materials are to be obtained.

ii) Three hard copies of the following:

(1) Shop drawings.

(2) Specification sheets.

(3) Installation instructions.

(4) Maintenance guidelines.

c) Subsurface Stormwater Storage System Component Samples for review:

i) Subsurface stormwater storage system Modules provide a single 36" (914 mm) long by 18" (457 mm) wide, height as specified, unit of the product for review.

ii) Sample to be retained by owner.

d) Manufacturers named as acceptable herein are not required to submit samples.

4) Structural Design

a) The structural design, backfill, and installation requirements shall ensure the loads and load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 3 are met.

b) Product shall be tested under minimum installation criteria for short-duration live loads that are calculated to include a 20% increase over the AASHTO Design Truck standard with consideration for impact, multiple vehicle presences, and live load factor.

c) Product shall be tested under maximum burial criteria for long-term dead loads.

d) The engineer may require submission of third-party test data and results in accordance with items 4b and 4c to ensure adequate structural design and performance.

14.0 APPENDIX - BEARING CAPACITY TABLES

Cover		HS-25 (Unfactored)		HS-25 (Factored)	
English (in)	Metric (mm)	English (ksf)	Metric (kPa)	English (ksf)	Metric (kPa)
24	610	1.89	90.45	4.75	227.43
25	635	1.82	86.96	4.53	216.90
26	660	1.75	83.78	4.34	207.80
27	686	1.69	80.88	4.16	199.18
28	711	1.63	78.24	3.99	191.04
29	737	1.58	75.82	3.84	183.86
30	762	1.54	73.62	3.70	177.16
31	787	1.50	71.60	3.57	170.93
32	813	1.46	69.75	3.45	165.19
33	838	1.42	68.06	3.34	159.92
34	864	1.39	66.51	3.24	155.13
35	889	1.36	65.10	3.14	150.34
36	914	1.33	63.80	3.05	146.03
37	940	1.31	62.62	2.97	142.20
38	965	1.29	61.54	2.90	138.85
39	991	1.26	60.55	2.83	135.50
40	1,016	1.25	59.65	2.76	132.15
41	1,041	1.23	58.54	2.70	129.28
42	1,067	1.21	58.09	2.67	127.84
43	1,092	1.20	57.42	2.60	124.49
44	1,118	1.19	56.81	2.55	122.09
45	1,143	1.18	56.26	2.50	119.70
46	1,168	1.16	55.77	2.46	117.79
47	1,194	1.16	55.33	2.42	115.87
48	1,219	1.15	54.94	2.39	114.43
49	1,245	1.14	54.59	2.36	113.00
50	1,270	1.13	54.29	2.33	111.56
51	1,295	1.13	54.03	2.30	110.12
52	1,321	1.12	53.80	2.27	108.69
53	1,346	1.12	53.62	2.25	107.73
54	1,372	1.12	53.46	2.23	106.77
55	1,397	1.11	53.34	2.21	105.82
56	1,422	1.11	53.24	2.19	104.86
57	1,448	1.11	53.18	2.17	103.90
58	1,473	1.11	53.14	2.16	103.42
59	1,499	1.11	53.12	2.14	102.46
60	1,524	1.11	53.13	2.13	101.98
61	1,549	1.11	53.16	2.12	101.51
62	1,575	1.11	53.21	2.11	101.03
63	1,600	1.11	53.28	2.10	100.55
64	1,626	1.11	53.37	2.09	100.07
65	1,651	1.12	53.48	2.08	99.59
66	1,676	1.12	53.61	2.08	99.59
67	1,702	1.12	53.75	2.07	99.11
68	1,727	1.13	53.91	2.07	99.11
69	1,753	1.13	54.08	2.06	98.63

Cover		HS-25 (Unfactored)		HS-25 (Factored)	
English (in)	Metric (mm)	English (ksf)	Metric (kPa)	English (ksf)	Metric (kPa)
70	1,778	1.13	54.26	2.06	98.63
71	1,803	1.14	54.46	2.06	98.63
72	1,829	1.14	54.67	2.06	98.63
73	1,854	1.15	54.90	2.06	98.63
74	1,880	1.15	55.13	2.06	98.63
75	1,905	1.16	55.38	2.06	98.63
76	1,930	1.16	55.64	2.06	98.63
77	1,956	1.17	55.90	2.06	98.63
78	1,981	1.17	56.18	2.06	98.63
79	2,007	1.18	56.46	2.07	99.11
80	2,032	1.19	56.76	2.07	99.11
81	2,057	1.19	57.06	2.07	99.11
82	2,083	1.20	57.37	2.08	99.59
83	2,108	1.20	57.69	2.08	99.59
84	2,134	1.21	58.02	2.09	100.07
85	2,159	1.22	58.35	2.09	100.07
86	2,184	1.23	58.69	2.10	100.55
87	2,210	1.23	59.04	2.11	101.03
88	2,235	1.24	59.39	2.11	101.03
89	2,261	1.25	59.75	2.12	101.51
90	2,286	1.26	60.11	2.13	101.98
91	2,311	1.26	60.48	2.13	101.98
92	2,337	1.27	60.86	2.14	102.46
93	2,362	1.28	61.24	2.15	102.94
94	2,388	1.29	61.62	2.16	103.42
95	2,413	1.30	62.01	2.17	103.90
96	2,438	1.30	62.41	2.18	104.38
97	2,464	1.31	62.81	2.19	104.86
98	2,489	1.32	63.21	2.20	105.34
99	2,515	1.33	63.62	2.21	105.82
100	2,540	1.34	64.03	2.22	106.29
101	2,565	1.35	64.45	2.23	106.77
102	2,591	1.35	64.87	2.24	107.25
103	2,616	1.36	65.29	2.25	107.73
104	2,642	1.37	65.72	2.27	108.69
105	2,667	1.38	66.15	2.28	109.17
106	2,692	1.39	66.58	2.29	109.65
107	2,718	1.40	67.02	2.30	110.12
108	2,743	1.41	67.45	2.31	110.60
109	2,769	1.42	67.90	2.33	111.56
110	2,794	1.43	68.34	2.34	112.04
111	2,819	1.44	68.79	2.35	112.52
112	2,845	1.45	69.24	2.36	113.00
113	2,870	1.46	69.69	2.38	113.96
114	2,896	1.47	70.15	2.39	114.43

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SM021-1_08-18_EN

Stormceptor

FORTERRA

Stormceptor® EF Sizing Report

STORMCEPTOR®
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

02/23/2023

Province:	Ontario
City:	Midland
Nearest Rainfall Station:	BARRIE-ORO
Climate Station Id:	6117700
Years of Rainfall Data:	14

Site Name:	

Drainage Area (ha):	2.38
% Imperviousness:	85.70

Runoff Coefficient 'c': 0.81

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

Project Name:	Tom Smith GMC
Project Number:	11692
Designer Name:	Joe Voisin
Designer Company:	PEL
Designer Email:	jvoisin@pel.ca
Designer Phone:	705-645-8853
EOR Name:	
EOR Company:	
EOR Email:	
EOR Phone:	

Required Water Quality Runoff Volume Capture (%):	90.00
Estimated Water Quality Flow Rate (L/s):	63.15
Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	Yes
Upstream Orifice Control Flow Rate to Stormceptor (L/s):	220.00
Peak Conveyance (maximum) Flow Rate (L/s):	
Site Sediment Transport Rate (kg/ha/yr):	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	59
EFO6	74
EFO8	83
EFO10	88
EFO12	93

Recommended Stormceptor EFO Model: EFO8

Estimated Net Annual Sediment (TSS) Load Reduction (%): 83

Water Quality Runoff Volume Capture (%): > 90

imbrium

THIRD-PARTY TESTING AND VERIFICATION

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

PERFORMANCE

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

PARTICLE SIZE DISTRIBUTION (PSD)

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

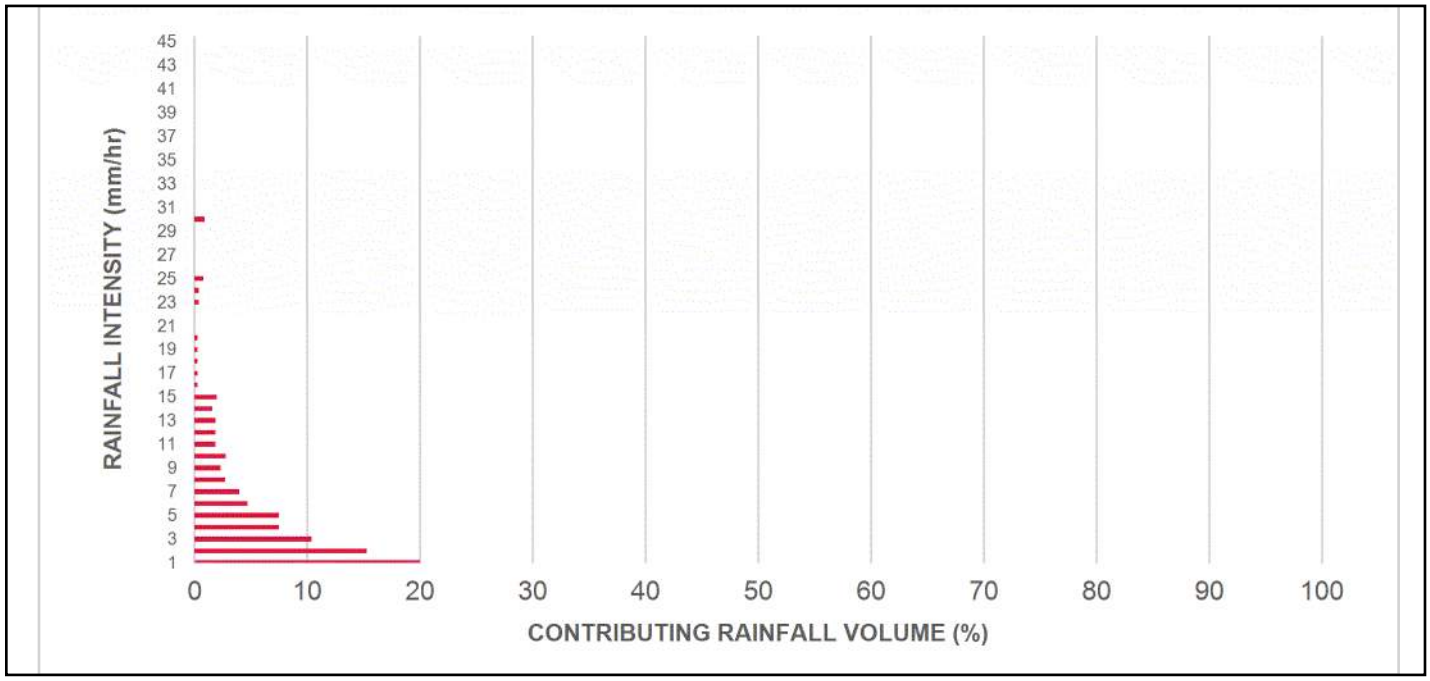
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Upstream Flow Controlled Results

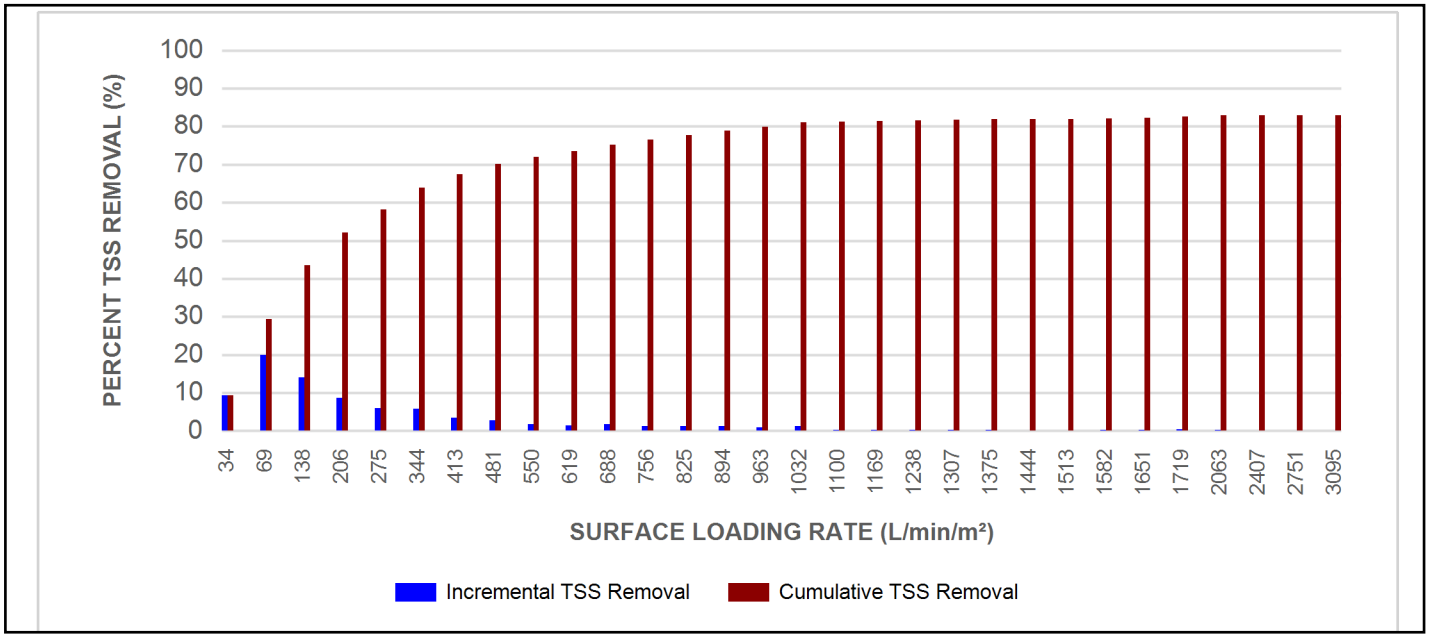
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.5	9.4	9.4	2.69	162.0	34.0	100	9.4	9.4
1	20.0	29.4	5.39	323.0	69.0	100	20.0	29.4
2	15.3	44.7	10.77	646.0	138.0	92	14.1	43.5
3	10.4	55.1	16.16	970.0	206.0	83	8.6	52.1
4	7.5	62.6	21.55	1293.0	275.0	80	6.0	58.1
5	7.5	70.1	26.94	1616.0	344.0	77	5.7	63.9
6	4.7	74.9	32.32	1939.0	413.0	73	3.5	67.4
7	4.0	78.8	37.71	2263.0	481.0	70	2.8	70.2
8	2.7	81.6	43.10	2586.0	550.0	67	1.8	72.0
9	2.3	83.9	48.48	2909.0	619.0	65	1.5	73.5
10	2.8	86.6	53.87	3232.0	688.0	64	1.8	75.2
11	1.9	88.6	59.26	3555.0	756.0	63	1.2	76.5
12	1.9	90.5	64.64	3879.0	825.0	63	1.2	77.7
13	1.9	92.4	70.03	4202.0	894.0	62	1.2	78.9
14	1.6	94.0	75.42	4525.0	963.0	62	1.0	79.9
15	2.0	96.0	80.81	4848.0	1032.0	61	1.2	81.1
16	0.3	96.3	86.19	5172.0	1100.0	59	0.2	81.2
17	0.3	96.6	91.58	5495.0	1169.0	58	0.2	81.4
18	0.3	96.9	96.97	5818.0	1238.0	56	0.2	81.6
19	0.3	97.2	102.35	6141.0	1307.0	55	0.2	81.7
20	0.3	97.5	107.74	6464.0	1375.0	53	0.2	81.9
21	2.5	100.0	113.13	6788.0	1444.0	51	1.3	83.2
22	0.0	100.0	118.52	7111.0	1513.0	48	0.0	83.2
23	0.4	100.4	123.90	7434.0	1582.0	46	0.2	83.4
24	0.4	100.8	129.29	7757.0	1651.0	44	0.2	83.5
25	0.8	101.6	134.68	8081.0	1719.0	43	0.4	83.9
30	0.9	102.5	161.61	9697.0	2063.0	36	0.3	84.2
35	-2.5	100.0	188.55	11313.0	2407.0	31	N/A	83.4
40	0.0	100.0	215.48	12929.0	2751.0	27	0.0	83.4
45	0.0	100.0	220.00	13200.0	2809.0	26	0.0	83.4
Estimated Net Annual Sediment (TSS) Load Reduction =								**83 %**

Climate Station ID: 6117700 *Years of Rainfall Data*: 14

RAINFALL DATA FROM BARRIE-ORO RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

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

SCOUR PREVENTION AND ONLINE CONFIGURATION

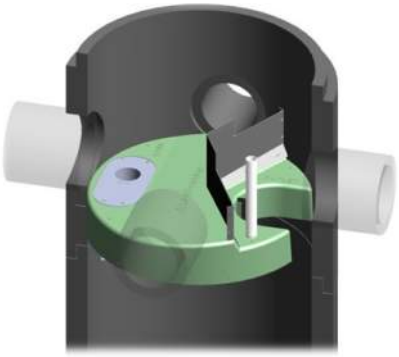
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test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

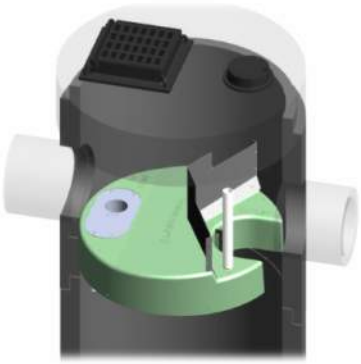
DESIGN FLEXIBILITY

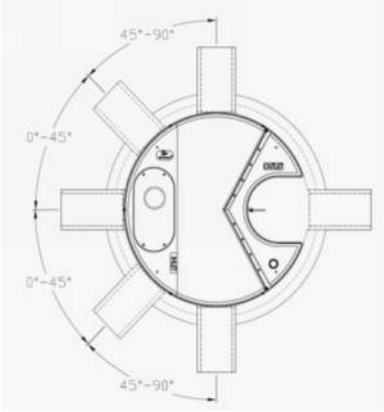
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend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

OIL CAPTURE AND RETENTION

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







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

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

Pollutant Capacity

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

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

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

STANDARD STORMCEPTOR EF/EFO DRAWINGS

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

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

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

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

PART 1 – GENERAL

1.1 WORK INCLUDED

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

1.2 REFERENCE STANDARDS & PROCEDURES

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

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

1.3 SUBMITTALS

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

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

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

PART 2 – PRODUCTS

2.1 OGS POLLUTANT STORAGE

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

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

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

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

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

3.2 SIZING METHODOLOGY

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

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

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

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

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

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

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

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

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

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

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

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

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

APPENDIX D

Drawings

PINESTONE ENGINEERING LTD.

TOM SMITH GMC
824 KING STREET
MIDLAND, ONTARIO

Dwg.No.	Description
	TITLE PAGE
EX–1	EXISTING CONDITIONS PLAN
SERV–1	SITE SERVICING PLAN
GP–1	GRADING AND EROSION CONTROL PLAN
DET–1	GENERAL NOTES AND DETAILS

SITE LOCATION

PUBLIC WORKS DEPARTMENT

MIDLAND PUBLIC WORKS AND ROADS
575 DOMINION AVENUE
MIDLAND, ONTARIO
L4R 1R2

OWNER

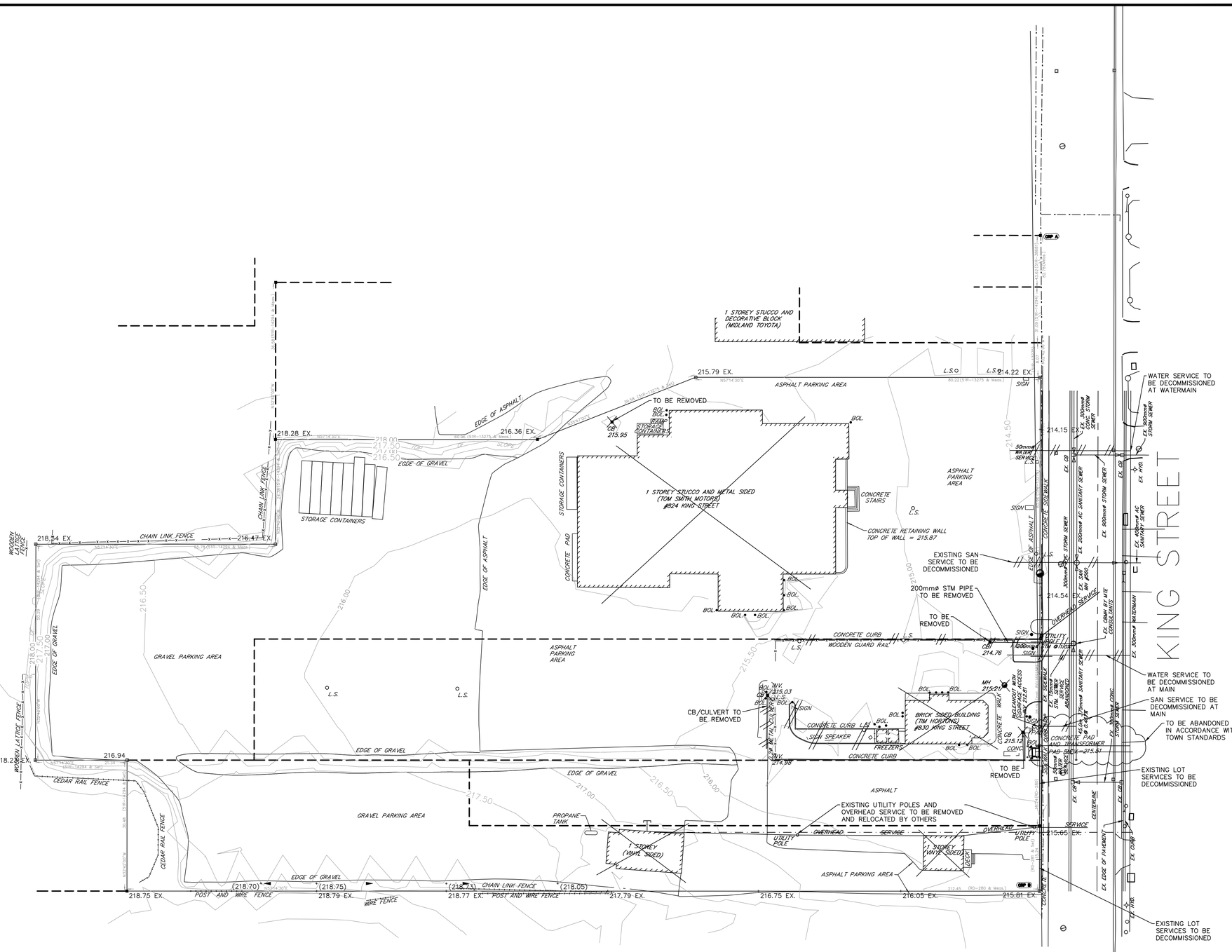
TOM SMITH GMC
824 KING ST.
MIDLAND ON
L4R 4K8

DEVELOPER'S ENGINEER

PINESTONE ENGINEERING LTD.
20 BELL FARM ROAD, UNIT 1
BARRIE, ONTARIO
L4M 6E4

PEL
PINESTONE ENGINEERING LIMITED |
www.pel.ca

Date: JUNE 2024
PEL Project No. 22-11692-M



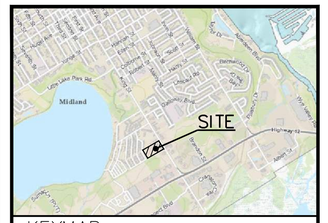
PEL

PINESTONE ENGINEERING LIMITED | www.pel.ca

The position of existing above ground and underground utilities and facilities are not necessarily shown on the drawings, and where shown, the accuracy of the position of such utilities and facilities is not guaranteed. Before starting work, the contractor shall confirm the exact location of all existing utilities and facilities, and shall assume all liability for damage to them.

Drawings shall not be used for construction unless sealed and signed. All work to be performed in accordance with the Occupational Health & Safety Act 1990.

Any errors and/or omissions shall be reported to Pinestone Engineering Ltd. without delay.



KEYMAP

NOTES

1. TOPOGRAPHIC INFORMATION PROVIDED BY EPLETT WOROBEC RAIKES SURVERYING LTD. OLS.
2. PAVEMENT STRUCTURE TO BE
   300mm GRANULAR B
   150mm GRANULAR A
   50mm HL4
   OR AS SPECIFIED BY THE GEOTECHNICAL ENGINEER

LEGEND

- EXISTING HYDRO POLE
- 200.00 EXISTING CONTOUR
- EXISTING CATCHBASIN
- EXISTING STORM MANHOLE
- EXISTING CATCHBASIN MANHOLE
- EXISTING SANITARY MANHOLE
- + 250.00 EX. EXISTING ELEVATION
- S —— S SILT FENCE
- REMOVALS/DECOMMISSIONS

NO.	YY.MM.DD	REVISION	BY
2	24.06.11	REVISED SITEPLAN	M.B.
1	24.03.05	TOWN COMMENTS	M.B.

SEAL

PROFESSIONAL ENGINEER — TIM HARVEY — June 2, 2023 — PROVINCE OF ONTARIO

NORTH ARROW

PROFESSIONAL ENGINEER — L.M. TRIVIDIC — 10020753 — June 2, 2023 — PROVINCE OF ONTARIO

DESIGN BY:	L.T.
DRAWN BY:	M.B.
CHECKED	T.H.
DATE:	FEB 2023
SCALE:	1:500

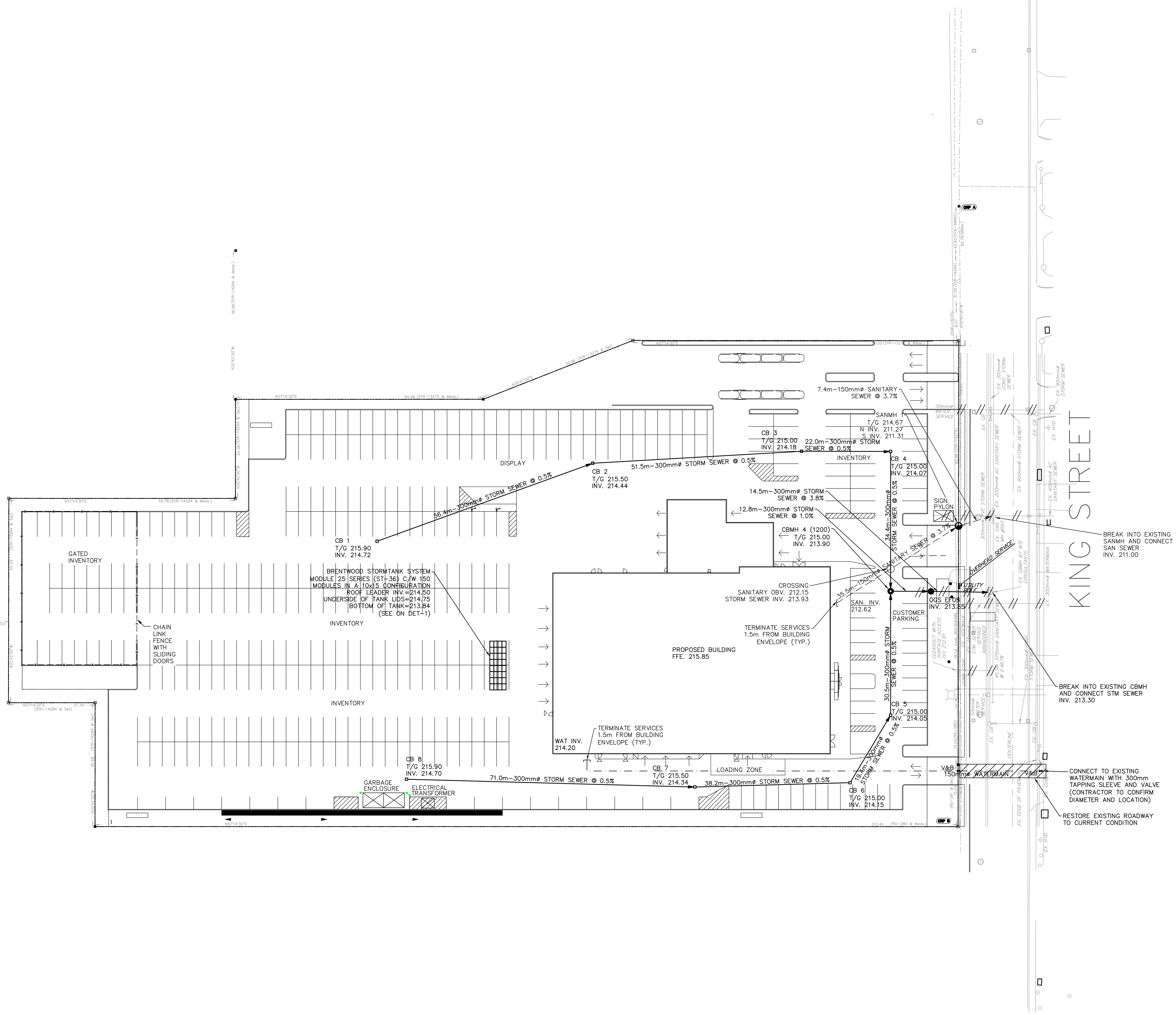
CLIENT/PROJECT

TOM SMITH GMC MIDLAND

DRAWING TITLE

EXISTING CONDITIONS AND REMOVALS PLAN

PROJECT NO.	DRAWING NO.	REVISION
22-11692-M	EX-1	2



PEL
PINESTONE ENGINEERING LIMITED | www.pel.ca

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   300mm GRANULAR B
   150mm GRANULAR A
   50mm HL4
   OR AS SPECIFIED BY THE GEOTECHNICAL ENGINEER

LEGEND

- PROPOSED STORM SEWER
- PROPOSED CATCHBASIN
- PROPOSED STORM CATCH BASIN MAHNHOLE
- PROPOSED STORM SEWER SERVICE C/W CLEANOUT
- 50mm THICK STORM PIPE INSULATION (2.4m WIDE)
- PROPOSED SANITARY MANHOLE
- PROPOSED SANITARY SEWER
- PROPOSED SANITARY SERVICE C/W CLEANOUT
- PROPOSED WATERMAIN
- CURB STOP VALVE
- PROPOSED HYDRANT
- PROPOSED WATER SERVICE C/W CSV
- EX. SANITARY MANHOLE
- EX. CATCH BASIN
- EXISTING HYDRANT
- REMOVALS/DECOMMISSIONS

NO.	YY.MM.DD	REVISION	BY
2	24.06.11	REVISED SITEPLAN	M.B.
1	24.03.05	TOWN COMMENTS	M.B.

SEAL: PROFESSIONAL ENGINEER, T.N. HARVEY, LICENSED, PROVINCE OF ONTARIO, June 2024

NORTH ARROW

PROFESSIONAL ENGINEER, L.M. TRIVIDIC, 10020753, LICENSED, PROVINCE OF ONTARIO, June 2024

DESIGN BY:	L.T.
DRAWN BY:	M.B.
CHECKED	T.H.
DATE:	FEB 2023
SCALE:	1:500

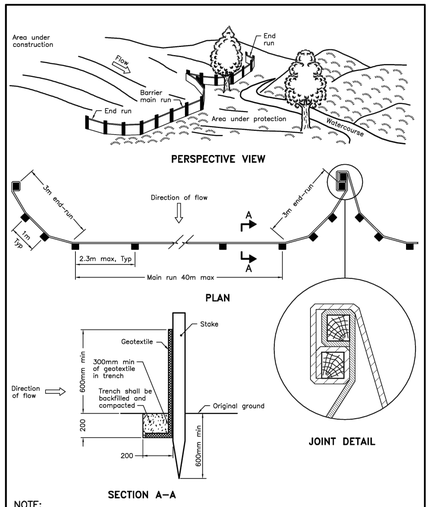
CLIENT/PROJECT

TOM SMITH GMC MIDLAND

DRAWING TITLE

SITE SERVICING PLAN

PROJECT NO.	DRAWING NO.	REVISION
22-11692-M	SERV-1	2

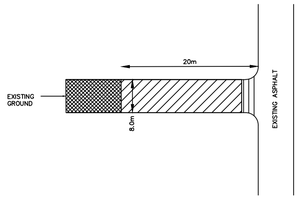


NOTE:
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2015	Rev 2
LIGHT–DUTY SILT FENCE BARRIER		OPSD 219.110

EROSION CONTROL NOTES:

1. All silt fencing to be installed prior to any grading or excavation.
2. Erosion control fencing to be installed around the base of all stockpiles.
3. Additional erosion control measures may be required as site development progresses. Contractor to provide all additional erosion control structures as directed by the engineer.
4. Pinestone Engineering Ltd. to monitor erosion control structures to ensure fencing is installed and maintenance is performed to municipal requirements.
5. Erosion control structures to be monitored regularly and after every rainfall. Any damage repaired immediately. Sediments to be removed when accumulations reach a maximum of 1/2 the height of the fence.
6. All erosion control structures to remain in place until all disturbed ground have been re–stabilized either by paving or restoration of vegetative ground cover.
7. No alternate methods of erosion protection shall be permitted unless approved Pinestone Engineering Ltd. and the Town of Midland.
8. Install mud mat prior to any grading works onsite.
9. Contractor is responsible for municipal roadway to be cleared of all sediments from vehicular tracking etc. at the end of each day.



STONE SIZE
- THE STONE PAD SHALL BE A MIN. 150mm THICK. USE 50mmø STONE OR RECLAIMED CONCRETE EQUIVALENT FOR FIRST 10m FROM ADJACENT ROAD AND 150mmø STONE FOR REMAINDER OF STONE PAD.

LENGTH
- AS REQUIRED BUT NOT LESS THAN 20m

WIDTH
- 8m WIDTH

GEOTEXTILE FABRIC
- GEOTEXTILE FABRIC (TERRAFIX 270R OR EQUIVALENT) WILL BE PLACED OVER THE ENTIRE AREA PRIOR TO PLACING STONE

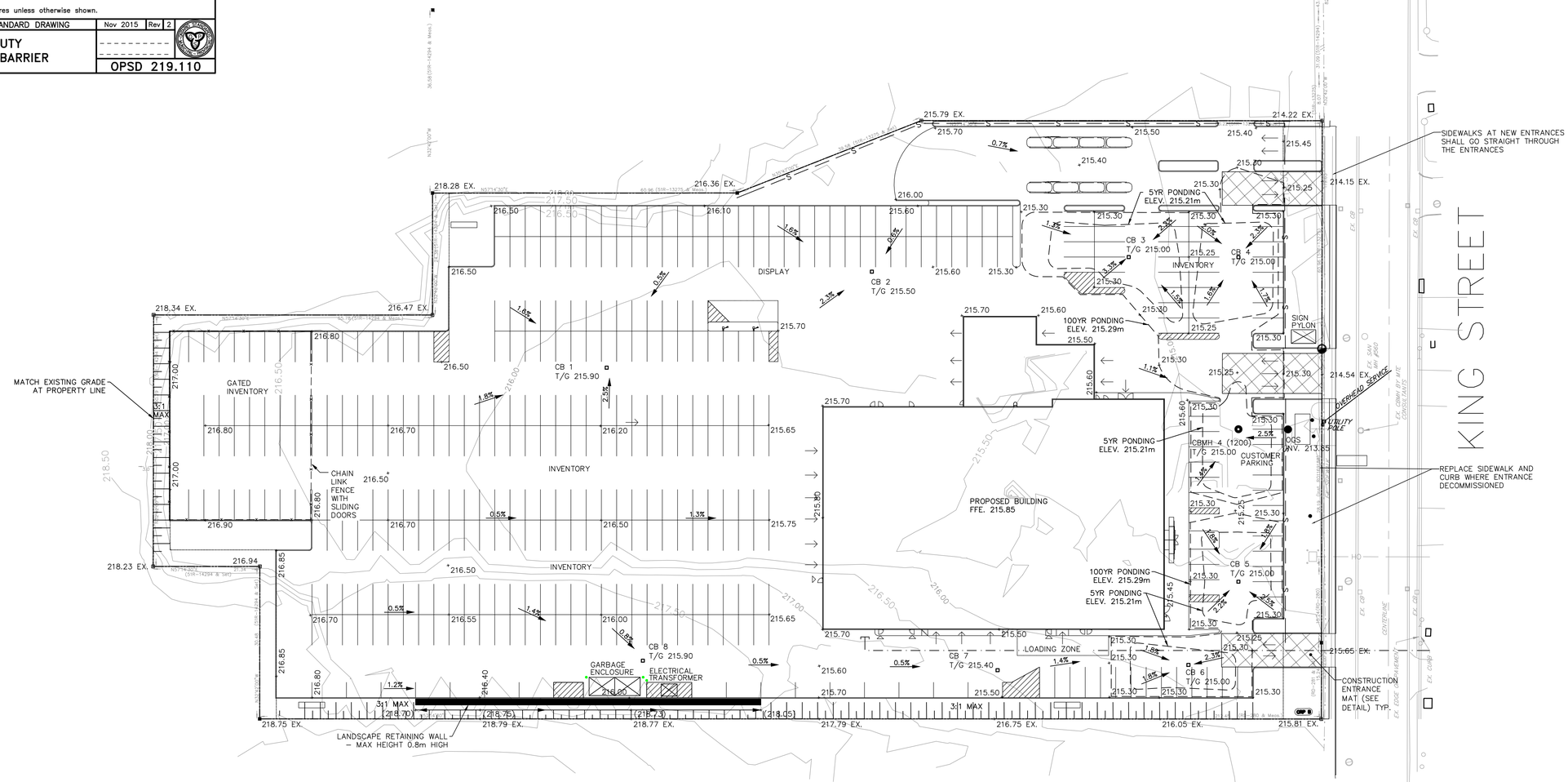
SURFACE WATER
- ALL SURFACE WATER FLOWING OR DIRECTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED ACROSS THE ENTRANCE. IF PIPING IS IMPRACTICAL A MOUNTABLE BERM WITH 5:1 SLOPES WILL BE PERMITTED.

MAINTENANCE
- THE CONTRACTOR SHALL MAINTAIN THE ENTRANCE IN A CONDITION WHICH WILL PREVENT TRACKING OF FLOWING OF SEDIMENT ONTO PUBLIC RIGHT–OF–WAY. THIS MAY REQUIRE PERIODIC DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHT OF WAY MUST BE REMOVED IMMEDIATELY BY THE CONTRACTOR. UPON OBSERVATION OF CONTINUOUS MUD TRACKING ONTO ADJACENT STREETS, THE MAT IS TO BE FULLY REPLACED.

WASHING
- WHEELS SHALL BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTRANCE ONTO PUBLIC RIGHT OF WAY. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH STONE AND WHICH DRAINS INTO AND APPROVED SEDIMENT TRAPPING DEVICE
- INSPECTION AND REQUIRED MAINTENANCE AFTER EACH RAIN SHALL BE PROVIDED BY THE CONTRACTOR.

20m x 8m STONE MUDMAT DETAIL

N.T.S.



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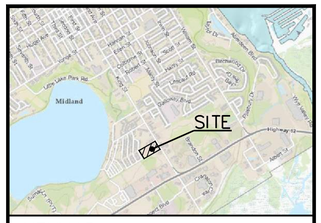
The position of existing above ground and underground utilities and facilities are not necessarily shown on the drawings, and where shown, the accuracy of the position of such utilities and facilities is not guaranteed. Before starting work, the contractor shall confirm the exact location of all existing utilities and facilities, and shall assume all liability for damage to them.

Drawings shall not be used for construction unless sealed and signed. All work to be performed in accordance with the Occupational Health & Safety Act 1990.

Any errors and/or omissions shall be reported to Pinestone Engineering Ltd. without delay.



KEYMAP NOTES

1. TOPOGRAPHIC INFORMATION PROVIDED BY EPLETT WOROBEC RAIKES SURVERYING LTD. OLS.
2. PAVEMENT STRUCTURE TO BE
   300mm GRANULAR B
   150mm GRANULAR A
   50mm HL4
   OR AS SPECIFIED BY THE GEOTECHNICAL ENGINEER

LEGEND

220.00	PROPOSED ELEVATION
220.00T/C	PROPOSED TOP OF CURB
220.00EX.	EXISTING ELEVATION
3.0%	PROPOSED GRADE
■	PROPOSED CATCHBASIN
⊕	PROPOSE WATER VALVE AND BOX
	PROPERTY LINE
▲	PROPOSED ENTRANCE
OH	EXISTING OVERHEAD HYDRO
○	EXISTING HYDRO POLE
◪	EXISTING SANITARY MANHOLE
◎	EXISTING LIGHT POST
⊠	EXISTING CATCHBASIN
◇	EXISTING BELL PEDESTAL
⊕	EXISTING FIRE HYDRANT
⊕	EXISTING CURB STOP
S S	SILT FENCE
	CONSTRUCTION ENTRANCE MAT

NO.	YY.MM.DD	REVISION	BY
2	24.06.11	REVISED SITEPLAN	M.B.
1	24.03.05	TOWN COMMENTS	M.B.

SEAL

PROFESSIONAL ENGINEER LICENSED PROVINCE OF ONTARIO T.N. HARVEY June 2023

NORTH ARMOR

PROFESSIONAL ENGINEER LICENSED L.M. TRIVIDIC 10020753 June 23 PROVINCE OF ONTARIO

DESIGN BY:	L.T.
DRAWN BY:	M.B.
CHECKED	T.H.
DATE:	FEB 2023
SCALE:	1:500

CLIENT/PROJECT

TOM SMITH GMC MIDLAND

DRAWING TITLE

GRADING AND EROSION CONTROL PLAN

PROJECT NO.	DRAWING NO.	REVISION
22-11692-M	GP-1	2

GENERAL NOTES

1. All standards in accordance with current Ontario Provincial Standard Drawings (OPSD) and Ontario Provincial Standard Specifications (OPSS) unless otherwise noted.
2. All works shall conform to The Town of Midland Engineering Design Criteria and Standards Manual.
3. All dimensions are in metres. Pipe sizes in millimetres unless otherwise noted.
4. Notify Bell Canada, Union Gas, Water and Sewer, Hydro and Cable Departments (where applicable) 72 hours prior to commencement for locates.
5. The Contractor shall coordinate the works with the Engineer who shall oversee the project on behalf of the owner.
6. All construction to be completed to the satisfaction of the Engineer.
7. All services and utilities to be supported as per OPSD-1007.01.
8. All trenching to be in accordance with the Occupational Health and Safety Act.
9. All traffic control and signage to be in accordance with M.T.O. Book 7 requirements.
10. Town of Midland and Engineer to be notified at least 72 hours prior to construction.
11. Wherever pipes are passing through uncompacted fill areas, the bedding trench shall be excavated to the undisturbed ground level and backfilled with Granular 'A' compacted to 95% standard proctor density or as otherwise shown on the drawings.
12. Maintain a minimum cover of 1.8m for watermains or as otherwise shown on the drawings with insulation.
13. Perform all blasting in accordance with the specification. Undertake pre-blast survey and provide copy to Engineer prior to commencement of blasting operations.
14. The location of underground and above ground utilities and structures shown on drawings is approximate only and may not be complete. The exact location of all utilities and structures shall be determined by consulting the Town authorities and Utilities companies concerned. The contractor shall prove the exact location of all utilities and structures before construction and shall be responsible for adequately protecting them against damage, assuming all liabilities for damage of such.
15. The Contractor must check and verify dimensions, obtain all utility locates, and obtain all required permits and licenses and verify existing service elevations before proceeding with any work.
16. Latest approved drawings to be used for construction and all discrepancies reported to the Engineer.
17. Drawings are not to be scaled.
18. All materials to be used on this project shall be lead free.
19. Pipe length as labeled is measured horizontally along pipe centre line and may differ from baseline chainage where baseline is not parallel to pipe.
20. Utilize erosion and siltation controls as necessary during construction to control sediment/silt runoff from the site.
21. Ensure accessibility to existing residential driveways at all times.
22. Ensure adequate protection to all culverts.
23. Building storm outlets are not to connect to the sanitary lateral and are to discharge to grade.

RESTORATION NOTES

1) Reinstate roads to previous condition or better, where disturbed by construction activity.
2) Contractor to restore driveways and ditch work in areas disturbed by construction to equal or better conditions.
3) Minimum gravel driveway restoration to be 150mm, Granular 'A'. Asphalt Driveway restoration to be 50mm of HL3. existing gravel subgrade.
4) All grassed areas disturbed during construction shall be restored with 100mm topsoil and sod or hydro mulched as per OPSS 507. Maintain until established.
5) All restoration work to be completed to the satisfaction of the Engineer.

WATERMAIN NOTES

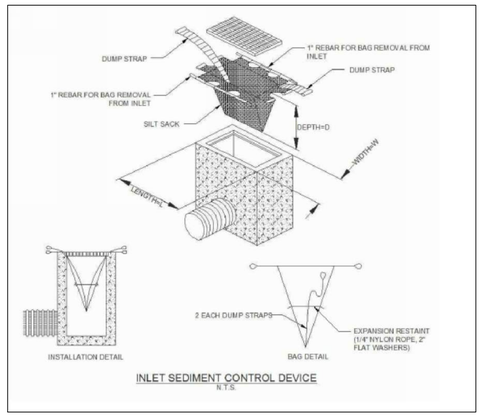
1. Work shall conform to OPSS. 441.
2. Install coated No. 12 TWU stranded copper tracer wire on all watermains as per Town Standards.
3. All watermains to have 1.8m minimum cover as shown on the drawings.
4. Unless noted otherwise, all watermains to be Class 235(DR 18) PVC material in accordance with AWWA C-900 Standard. Exterior of all uncoated D.I. fittings, valves, mechanical joint restraints & associated connections shall have denso petrolatum mastic corrosion protection.
5. All dimensions are in metres. Pipe sizes are in millimetres unless otherwise noted.
6. Exact horizontal and vertical alignment of existing watermain at point of connection to be determined in the field.
7. Valve and Valve boxes to be installed accordance with OPSS. 441
8. Vertical bend distances are not indicated on drawings and are to be installed as required. All watermain fittings tee's, bends, end caps etc, must comply with approved products list for the Town of Midland. Watermains located in fill shall have mechanically restrained joints and be bedded on compacted Granular 'A' founded on native ground. Granular 'A' to be compacted to 95% SPD.
9. Pressure testing of all new water systems will be completed by the Town's Representative and shall be undertaken in accordance with OPSS 701.07.22.01. Watermains must be pressure tested (1035 kPa), chlorinated, and pigged with foam swabs as directed by the Engineer. Hydrostatic testing as per AWWA standard C651. Bacteriological testing as per AWWA Standard C651.
10. All gate valves shall be resilient seat type to AWWA C-509 Standards.
11. All water services to be 25mm dia. HDPE series 160 unless otherwise noted. Provide 1.8m cover for water services at ditch crossings. Service saddles shall be all stainless steel double bolt, fully galvanized, Robar 2616 Boss Pad, or Cambridge Brass 8403 PG. Pipe embedment and backfill shall conform to OPSD 802.010 and 802.013. Pipe embedment material to springline shall consist of Granular "A" or 19mm diameter clear stone. Embedment from springline to 300mm above pipe shall consist of sand. Trench backfill to road subgrade elevation shall consist of approved native material compacted to 95% SPD.
12. Watermain bedding shall be Granular 'A' to OPSD-802.010.
13. Vertical and horizontal bends in watermain to be achieved by manufactured bends only.
14. Hydrants shall meet the requirements of AWWA standard C-502.
15. Watermains with gradients 4:1 or greater to be anchored. Shop drawings to be submitted for approval.
16. All curb stops shall be ball type with compression joint inlet and outlet, non draining, no lead or brass construction, with blow out proof stainless steel stems and unfiled Teflon seats, rated for 300psi conforming to ANSI/AWWA C800-05 and NSF/ANSI 61, drinking water system components-Health Effects. Connections of newly constructed watermains to existing watermains in accordance with AWWA standard C651.
17. All watermain fittings shall have cathodic protection which includes zinc caps and anodes on each fitting.

SANITARY SEWERS

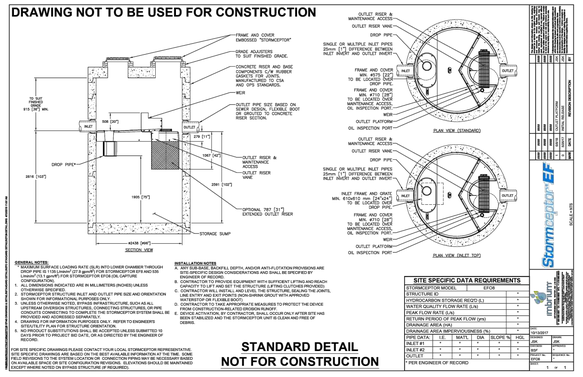
1. Work shall conform to OPSS.410 and the Ontario Building Code. Pipe embedment and backfill shall conform to OPSD 802.010 and 802.013. Pipe embedment material to springline shall consist of Granular "A" or 19mm diameter clear stone. Embedment from springline to 300mm above pipe shall consist of sand. Backfill to be approved native material or select material.
2. Sanitary sewer to be PVC SDR 35 200mmø. Trench backfill to road subgrade elevation shall consist of approved native material compacted to 95% SPD.
3. Sanitary sewer services to be PVC SDR 28 125mmø.
4. All manholes to be minimum 1200mm dia. precast with aluminum rungs at 300mm centers per OPSD.701.010
5. Provide water tight boot pipe-to-manholes connectors in sanitary manholes.
6. All manholes to be benched per OPSD 701.021
7. Manhole at property line shall have waterproofing membrane (mel-rol or approved equivalent) at a minimum of 300mmø at each section of the manhole.
8. Sanitary sewers to be tested in accordance with OPSS 409 & 411. Pipes to be cleaned and flushed prior to the video inspection.
9. All frames/lids for manhole in roadways shall be 3 piece adjustable units such as Bibby(Autostable) C-50M-ONT, Meuller adjustable AJ633 or approved equivalent.
10. Sanitary sewers to be video inspected providing dvd recording copy in triplicate (3) and report of inspection to the Engineer. Sewers are to be inspected once at initial acceptance and once at final assumption without defect.
11. Frost straps to be installed as per OPSD 701.100.
12. The complete sewer system including service connection to the property line and manholes shall be tested in accordance with OPS. Approximately one year prior to the expiration of the maintenance period the complete system shall be inspected by an approved video camera testing company and the Director of Public Works shall be provided with a copy of the appropirte data prior to final approval.

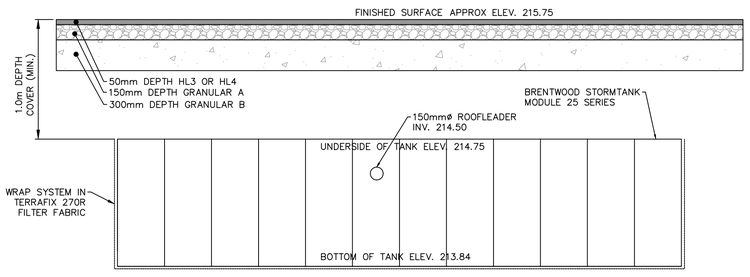
STORM SEWERS, CULVERTS, AND SUBDRAINS

1. Storm sewers shall be smooth wall 320KPa HDPE per BOSS 2000 with bell & spigot joint or PVC Ultra Rib. Pipe embedment and backfill shall conform to OPSD 802.010 and 802.013. Pipe embedment material to springline shall consist of Granular "A" or 19mm diameter clear stone. Embedment from springline to 300mm above pipe shall consist of sand. Trench backfill to road subgrade elevation shall consist of approved native material compacted to 95% SPD.
2. All catch basin manholes to be precast with aluminum rungs at 300mm centers per OPSD.701.010 AND 701.011.
3. Frost tapers at culverts to be per OPSD 803.030.
4. Pipe subdrain shall be 150mmø corrugated HDPE pipe, 210 kpa pipe stiffness, c/w filter sock and shall be connected to storm structures.
5. Storm sewers to be video inspected providing dvd Sewers are to be inspected once at initial acceptance and once at final assumption without defect.
6. Frost straps to be installed as per OPSD 701.100.
7. 30 days prior to both initial and final inspection, a video inspection and report shall be completed and presented to town staff.
8. Catchbasin and Catchbasin Manholes frame and grate to be per OPSD 400.100.

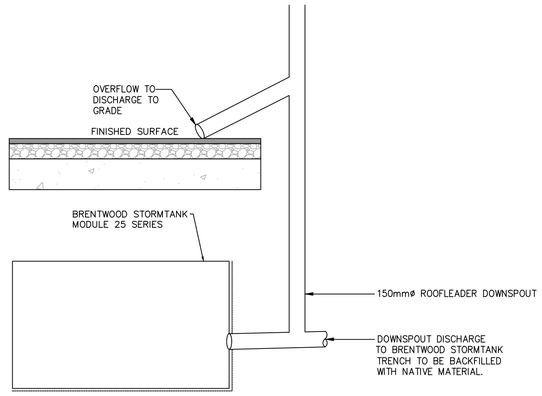


INLET SEDIMENT CONTROL DEVICE
N.T.S.





BRENTWOOD STORMTANK DETAIL
N.T.S.



ROOF DOWNSPOUT DETAIL
N.T.S.

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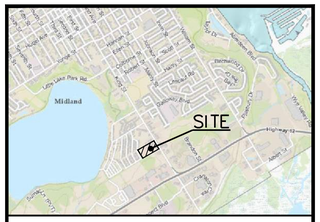

KEYMAP

NO.	YY.MM.DD	REVISION	BY
2	24.06.11	REVISED SITEPLAN	M.B.
1	24.03.05	TOWN COMMENTS	M.B.

SEAL

PROFESSIONAL ENGINEER LICENSED PROVINCE OF ONTARIO T.N. HARVEY June 2023

NORTH ARROW

PROFESSIONAL ENGINEER LICENSED PROVINCE OF ONTARIO L.M. TRIVIDIC 10020753 June 23

DESIGN BY:	L.T.
DRAWN BY:	M.B.
CHECKED	T.H.
DATE:	FEB 2023
SCALE:	

CLIENT/PROJECT

TOM SMITH GMC MIDLAND

DRAWING TITLE

GENERAL NOTES AND DETAILS

PROJECT NO.	DRAWING NO.	REVISION
22-11692-B	DET-1	2