TOWNHOUSE DEVELOPMENT
FUNCTIONAL SERVICING & STORM WATER MANAGEMENT REPORT
435 BIG BAY POINT ROAD
CITY OF BARRIE

Prepared by:

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17-11291B – rev. 0

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APPENDICES

1.0 INTRODUCTION

1.1 General

The subject property is located at 435 Big Bay Point Road within the City of Barrie approximately 480m west of the Big Bay Point Road and Yonge Street intersection. The site is currently zoned as R1(Residential Single Detached) and is situated within a Lake Simcoe Region Conservation Authority (LSRCA) regulated area and is adjacent to an MNR evaluated wetland.

The subject site is approximately 0.70 hectares (1.73 acres) in size and is currently occupied by single family residential home. Existing access to the site is provided directly from Big Bay Point Road from an asphalt driveway located at the north-west corner of the property. The site is bounded by Big Bay Point Road to the north, existing residential to the west and south, and Lovers Creek to the east.

The location of the subject site is illustrated on Figure 1.

The proposed development consists of a 19-unit townhouse development with access provided from Big Bay Point Road. The proposed development concept is further illustrated on the enclosed engineering plans included in Appendix E.

1.2 Purpose and Scope

Pinestone Engineering Ltd. (PEL) has been retained by the property owner to provide professional engineering services related to the preparation of a Functional Servicing and preliminary Storm Water Management Report. This report has been prepared in support a Rezoning Application for the subject lands.

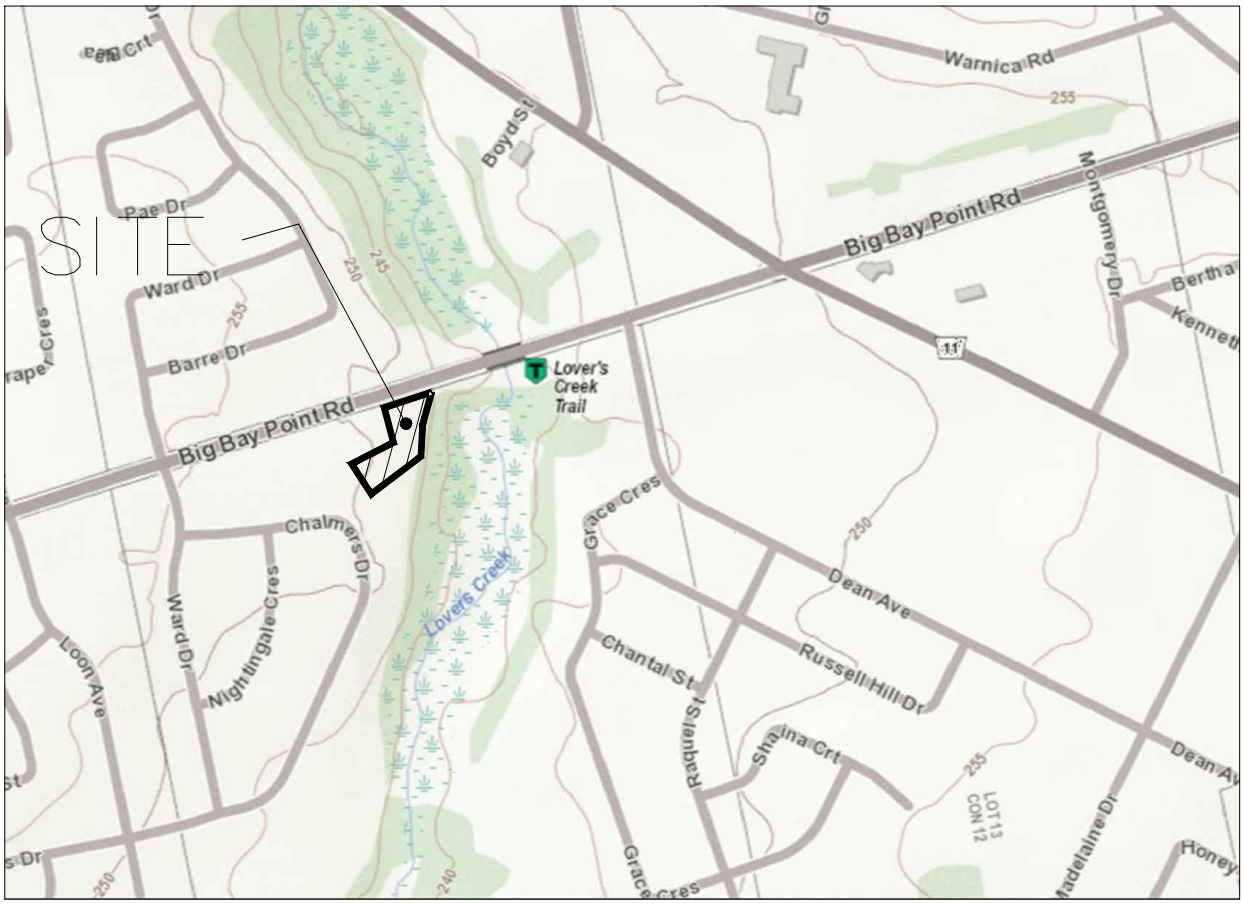
The purpose of this report is to describe the existing servicing infrastructure in the vicinity of the site, and provide recommendations for the provision of sanitary drainage, water distribution, and storm water management in accordance with City of Barrie and LSRCA criteria.

1.3 Reference Reports

The following reports and studies have been used for reference in the preparation of this Functional Servicing Report:

i) *City of Barrie Storm Drainage and Storm Water Management Policies and Design Guidelines, prepared by Valdor Engineering Inc., November 2009*

ii) *LSCRA Technical Guidelines for Storm Water Management Submissions, Effective Date: September 1, 2016*



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435 BIG BAY POINT ROAD

KEY PLAN

DATE:	SCALE:	PROJECT No.	FIGURE No.
JAN 2018	N.T.S.	17-11291B	FIGURE 1

iii) *City of Barrie Urban Design Manual, April 2007*

iv) *Lake Simcoe Protection Plan, June 2009*

v) *City of Barrie Sanitary Sewage Collection System Polices and Design Guideline, October 2017*

vi) *City of Barrie Water Transmission and Distribution Polices and Design Guidelines, May 2015.*

vii) *Ministry of the Environment Storm Water Management Planning and Design Manual, March 2003.*

viii) *Low Impact Development Manual prepared by Credit Valley Conservation and Toronto and Region Conservation, 2010*

ix) *City of Barrie Secondary Plan, Background Studies & Infrastructure Master Plans prepare by amec, October 2013*

2.0 EXISTING CONDITIONS

2.1 General

The subject site is approximately 0.70 hectares (1.73 acres) and is currently occupied by a single-family residential dwelling. Deciduous tree stands exist primarily along the eastern and southern property lines. The remaining site area is vegetated with manicured lawn. The property generally slopes towards the east. There is a steep heavily wooded embankment located at the east property line that descends to the Lovers Creek ravine. Municipal sanitary, water, and storm servicing exist along the property frontage on Big Bay Point Road.

2.2 Topography

Based on a review of the topographic survey provided by Dino Astri (December 2016), the property gently slopes from the west to the east towards the Lovers Creek ravine located at the west limit of the site. Elevations across the site range between 250.80m ASL at the northwest corner of the site to 239.41m ASL at the southeast corner within the ravine.

2.3 Site Geology

A geotechnical investigation and evaluation of the slope stability and erosion hazard limit of Lover's Creek ravine was conducted by Peto MacCallum Ltd. (June 2017). Four (4) boreholes were drilled. Based on our review of their report, the overburden geology consists of a 180-220mm layer of sandy topsoil underlain by a 1.4-15.7m layer of silty sand till. Groundwater was encountered however it is believed excavation will be above the groundwater level and sump pumping will handle seepage where encountered. The slope along the eastern side of the property descending to Lover's Creek comprises predominately of glacial till.

Based on our review of the soil information provided by Peto MacCallum Ltd. we have

classified the site material as a Type C under the Soil Conservation Service, hydrologic soil group as outlined in the *MTO Drainage Manual Volume 3, Design Chart 1.08*. Reference to this design chart is included in Appendix C.

A copy of the geotechnical investigation prepared by Peto MacCallum Ltd. is included in Appendix A.

2.4 Drainage Conditions

Drainage within the site boundary drains in the form of sheet flow from west to east towards the slope along the eastern boarder of the site and discharges into Lover's Creek Ravine. External drainage enters the site from the adjacent residential lot to the west.

The site is located within the Lover's Creek watershed and is within a Lake Simcoe Regional Conservation Authority (LSRCA) regulated area. Approval from the LSRCA is required for development within regulated areas.

3.0 SANITARY SERVICING

3.1 Existing Sanitary Servicing

There is an existing 250mm diameter sewer along the property frontage on Big Bay Point Road. Sewage from the Big Bay Point Road sewer flows easterly and outlets to the Painswick trunk flowing north.

The subject site is located within the Painswick Catchment area and based on our review of the City of Barrie's Infrastructure Master Plan prepared by amec dated October 2013, no downstream surcharging of the existing infrastructure was noted in 2011. A copy of the sanitary mapping prepared by amec is included in Appendix B for further information.

Existing sizes and locations of sanitary sewer infrastructure in the area of the subject site were determined using available City data including GIS information and record plan and profile drawings.

3.2 Proposed Sanitary Servicing

Contributing sanitary flows from the proposed development were calculated using the following City of Barrie design criteria. For medium density encompassing cluster and/or block townhouses the minimum design values are as follows:

- A residential average sewage flow of 225 litres/capita/day
- A residential population density of 2.34 persons/unit
- A extraneous flow rate of 0.1 litres/sec/ha
- A peaking factor based on Harmon's equation

The proposed development concept includes 19 townhouse units with a population of 44

persons based on the above distribution. Incorporating extraneous flows, the peak sewage flow generated by the proposed development is calculated to be approximately 0.51 l/sec. Detailed sanitary calculations are included in Appendix B.

The immediate downstream reach of 250mm diameter sanitary sewer installed at 5.0% has a conveyance capacity of approximately 132.9 l/sec. The proposed peak flow from the development represents approximately 0.38% of the capacity of the immediate downstream reach of sewer and on this basis, it is anticipated that available capacity exists within the existing infrastructure to support the development.

The proposed development would be serviced via a new 200mm diameter PVC single service connection to the existing 250mm diameter main located along Big Bay Point Road. Servicing details will conform to City of Barrie standards and the exact size and location of the service lateral will be determined during detailed design to the support the Site Plan Application.

A conceptual servicing layout is provided on the attached drawings included in Appendix E.

4.0 WATER SERVICING

4.1 Existing Water Servicing

A 900mm diameter transmission water main and 500mm diameter ductile iron water main currently exists on Big Bay Point Road. For the purpose of the zoning change, onsite pressures and flows were confirmed to ensure they are sufficient for domestic and firefighting conditions.

We have utilized the information obtained from the municipal hydrants in the vicinity of the subject site connected to the existing 500mm diameter watermain on Big Bay Point Road. Table 1 illustrates the flow results completed by Vipond and City water operations staff:

Table 1: Results of Hydrant Flow Tests

Test #	Outlet Inside Dia. (in.)	Number of Outlets	Pitot Reading (PSI)	Flow@ Residual (gal/min)
1	n/a	n/a	51 (static)	n/a
2	2.5	1	58	1278
3	2.5	2	58 & 33	2312

The flow test data is included in Appendix B for further information.

4.2 Proposed Water Demands

Based on the City of Barrie's Water Transmission and Distribution Policies and Design Guidelines dated May 2015 and the MOECC Design Guidelines for water distribution systems, the following conditions apply:

- Max day factor of 1.50 and peak hour factor of 2.25 based on MOECC Guidelines Table 3-1 in the Design Guidelines for Drinking Water Systems, 2008.
- Minimum operating pressure of 345 kPa (50 psi).
- Maximum operating pressure of 620 kPa (90 psi).
- Minimum operating pressure of 140 kPa (20 psi) during fire flow and max day.
- Residential water demand of 225 L/cap/day.
- It is understood that the City of Barrie is currently in the process of updating their minimum fire flow requirements to reflect dense residential infill developments. For this project we have used industrial / commercial subdivision development fire flow rate provided in the City of Barrie's Water Transmission and Distribution Policies and Design Guidelines of 142 l/sec to represent the proposed density

Based on the above conditions, Table 2 illustrates the proposed domestic demands for the development.

Table 2: Residential Water Demands

Population	**Per Capita Flow (L/day)**	**Peaking Factors (based on MOECC Guidelines)**		**Flows (L/sec)**	
		Peak Hour	Maximum Day	Peak Hour	Maximum Day
44	225	2.25	1.5	0.26	0.17

Using the information provided from the flow test completed by Vipond, the following flow volume can be supplied from the Big Bay Point Road watermain while maintaining a residual pressure of 140 kPa (20 psi) in the distribution system. The calculation is based on information provided within the City of Barrie's Water Transmission and Distribution Policies and Design Guidelines.

$$QA = QT * (ha/ht)^{0.5}$$

Where, QA = Flow at 20 psi
QT = Flow at test
Ha = pressure drop available
Ht = pressure drop at test

Therefore, the following supply is available:

$$QA = 2312 * ((52-20)/(51-51))^{0.5}$$
$$QA = 13{,}078 \text{ gpm } (825 \text{ L/sec})$$

Based on the hydrant flow test information, adequate domestic and fire flows are available from the proposed 500mm diameter watermain connection point to service the development.

4.3 Proposed Water Servicing

The proposed development will be serviced via a new service connection from the existing 500mm diameter watermain located on the north side of Big Bay Point Road. Requirements for an onsite hydrants and separate domestic and fire lines will be assessed at the detailed design stage. Servicing details will conform to City of Barrie standards and the exact size and location of the service lateral will be determined during detailed design to the support the Site Plan Application.

A conceptual servicing layout is provided on the drawings included in Appendix E. Specific water servicing details will be provided at the detailed design stage to support the Site Plan Application.

5.0 STORM DRAINAGE

5.1 General

A 525mm diameter storm sewer exists along the frontage of the subject site on Big Bay Point Road and conveys drainage easterly towards Lovers Creek. Drainage from the storm sewer system then flows north and outlets to the Lovers Creek storm water management facility (City Pond LV-11). Existing sizes and locations of storm sewer infrastructure in the area of the subject site were determined using available City data including GIS information and record plan and profile drawings.

Based on a review of the topographic survey provided by Dino Astri, the property generally slopes from the west to the east towards Lovers Creek along the western side of the subject site. Elevations across the site range between 250.80m ASL at the northwest corner of the site to 239.41m ASL at the southeast corner within the ravine. External drainage enters the property from the existing residential development to the west.

5.2 Design Criteria

Based on a review of the City of Barrie's and LSRCA's Storm Water Management (SWM) Guidelines, the following criteria applies:

Quantity Control:

- Peak flow attenuation for the 2-year through 100-year storm events to pre-development rates based on the Rational Method using the City of Barrie's IDF parameters. Peak flow attenuation is also required to secure the Ministry of Transportation land use permit.

- Maintain existing drainage patterns, ensuring adjacent properties are not adversely affected.

Quality Control:

- Water quality enhancement to an "enhanced" level of protection or 80% total suspended solids removal (TSS).

- Preparation of detailed erosion, sediment control and construction mitigation plan to be implemented as part of the construction program.

Volume Control & Water Balance:

- Nonlinear redevelopment projects on sites without restrictions that create 0.5 or more hectares of new and/or fully reconstructed impervious surfaces shall capture and retain / treat on site the runoff from a 25 mm rainfall event from the new and/or fully reconstructed impervious surfaces. The proposed development does not create 0.5 or more hectares of impervious surfaces; therefore, volume control is not required.

- As per City policy 4.1.3 of the Storm Water Policy and Design Guidelines, sites less than 5 ha shall minimize any anticipated changes in the water balance between pre-development and post development conditions and shall provide a minimum infiltration equivalent to the first 5mm of rainfall.

Phosphorus Mitigation:

- Evaluation of anticipated changes in phosphorus loadings between pre-development and post-development. Phosphorus offsetting requirements per LSRCA policy is required for this development.

5.3 Pre-Development and Post Development Flow Rates

We have selected the 2-yr through 100-yr design storms as part of our evaluation. Peak flows have been calculated using the Rational Method as recommended in the City of Barrie's SWM Guidelines.

In order to determine the peak flows generated from the site, one (1) pre-development and five (5) post-development catchments were delineated using the catchment parameters listed in Table 3.

Table 3: Sub-catchment Parameters

Catchments	Area (m^2)	Slope (%)	Composite Runoff Coefficient "C"
Pre-Development			
101	6027	4.0	0.30
Post-Development			
201	3667	2.0	0.70
202	928	3.0	0.33
203	452	2.0	0.16
204	690	2.0	0.16
205	290	3.0	0.20

Pre-development and post development catchment areas are illustrated on Figures 2 and 3 respectively. The results from the 2 through 100-year peak storm events are listed in Table 4 below.

Table 4: Rational Method – Peak Flows

	2Yr	5Yr	10Yr	25Yr	50Yr	100Yr
Pre-Development (m^3/sec)						
Catchment 101	0.042	0.054	0.063	0.081	0.099	0.113
Total Pre Development	**0.042**	**0.054**	**0.063**	**0.081**	**0.099**	**0.113**
Post Development (m^3/sec)						
Catchment 201	0.059	0.077	0.090	0.116	0.140	0.160
Catchment 202	0.007	0.009	0.011	0.014	0.017	0.019
Catchment 203	0.002	0.002	0.003	0.003	0.004	0.005
Catchment 204	0.003	0.003	0.004	0.005	0.006	0.007
Catchment 205	0.001	0.002	0.002	0.003	0.003	0.004
Total Post Development	**0.072**	**0.094**	**0.109**	**0.141**	**0.170**	**0.194**

Based on the calculated results using the Rational Method, it is expected that post development flows will increase as a result of the proposed development and construction and increased site imperviousness. Rational Method design calculations are included in Appendix C.

BIG BAY POINT ROAD

LEGEND

- DIRECTION OF OVERLAND FLOW
- PRE-DEVELOPMENT CATCHMENT BOUNDARY
- 101 — PRE-DEVELOPMENT CATCHMENT NUMBER
- 6027 | 0.30 — RUN-OFF COEEFICIENT
- PRE-DEVELOPMENT CATCHMENT AREA(m^2)

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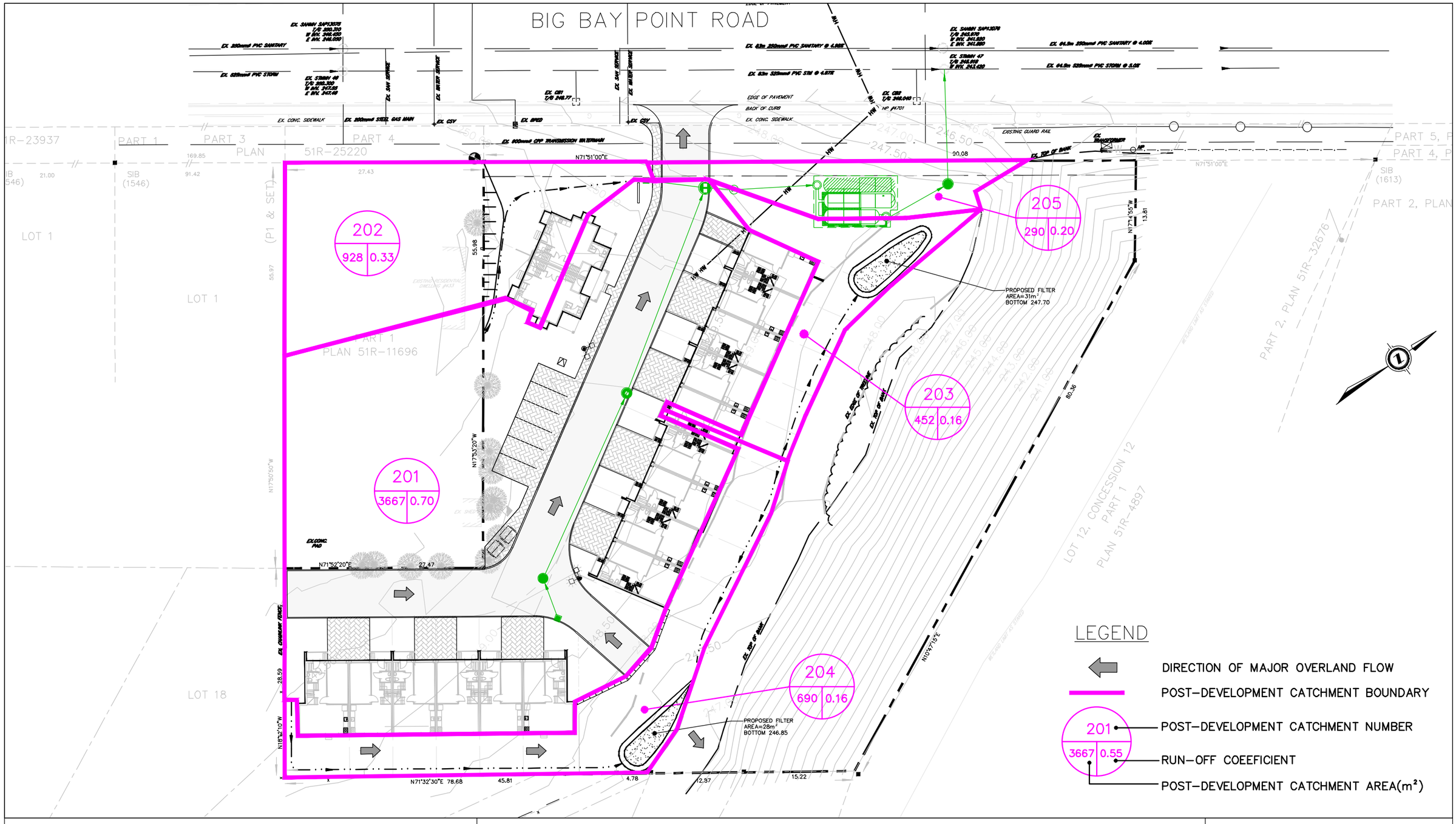
PRE DEVELOPMENT CATCHMENT PLAN

PROJECT NO. 17-11291B

SCALE: 1:500 | DATE: JAN 2018

FIGURE 2



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435 BIG BAY POINT ROAD

POST DEVELOPMENT CATCHMENT PLAN

PROJECT NO. 17-11291B

SCALE: 1:500 | DATE: JAN 2018

FIGURE 3

5.4 Quantity Control

To provide attenuation of post development flows, approximately 80m^3 of storage is required for the 100-year event. The required storage volume will be provided by utilizing StormTech inground chambers. The conceptual servicing plan incorporates StormTech chambers located in the north east property corner. Preliminary storage calculations are included in Appendix C.

Catchment 201 includes the majority of the site impervious areas including driveways, and rooftops, will be controlled with an orifice restriction installed at STMMH#2 located downstream of the underground StormTech chambers. STMMH#2 will outlet to the existing 525mm diameter storm sewer located on Big Bay Point Road ultimately discharging to Lovers Creek.

Catchment 202 includes a portion of the external catchment area and the western portion of the site will be directed to CB#1 located west of the proposed entrance. An enhanced swale complete with a perforated underdrain will be used to collect and convey runoff to the proposed storm sewer system.

Catchment 203 and 204 consists of rear yard landscape areas. Grassed swales will be used to collect and convey runoff to proposed sand filters to be constructed along the western development limit. Due to the condition of the underlying soils, both sand filters will require underdrains. The underdrain servicing the filter located in the southeast corner of the property will discharge directly to the Lovers Creek ravine. The underdrain for the filter located in the northeast corner of the property will discharge into proposed STMMH#2. Catchment 205 includes landscape areas that will flow offsite uncontrolled. Post development drainage patterns will generally match pre-development conditions.

5.5 Quality Control

In order to provide water quality enhancement to an “enhanced” level of protection (80% TSS removal) for this development, we have incorporated a “treatment train” approach consisting of the following elements:

- Provision of “soft” landscaping where feasible.
- Downspout disconnection.
- Yard grading using minimal surface slopes where possible to promote infiltration.
- Construction of an enhanced swale along the west property boundary complete with an underdrain.
- The installation of Imbrium JellyFish ETV tested to remove 89% TSS and 59% Phosphorus.
- Construction of an underground detention system. The underground storage chambers can be constructed with an underdrain below / sand filter if required.

Existing grades permit the construction of an underdrain below the inground storage system. This will be further examined at the site plan approval stage.

- Construction of LID sand filters to provide attenuation and volume control of runoff generated in the rear yard grassed areas.

- Suitable construction mitigation measures to be utilized during the site development.

The potential treatment alternatives have been evaluated with respect to their applicability for this development and implemented in a manner to achieve the best total suspended solids (TSS) removal possible. Table 5 summarizes the proposed measures that in conglomeration will provide an overall TSS removal of greater than or equal to 80% which meets or exceeds the criteria outlined.

Table 5: Proposed Approach for Water Quality Treatment

Surface	Method	TSS Removal Rate	Area (m2)	% Area of Site	Overall TSS Removal %
Asphalt Parking Area and building area (Catchment 201 & 202)	Jelly Fish	89%	4595	76%	67.6
Landscape / Sand Filter & Grass Swales (Catchment 203 &204)	Filtration / Evapotranspiration	80%	1142	19%	15.5
Landscape & Driveway (Catchment 205) Uncontrolled	Filtration / Evapotranspiration	50%	290	5%	2.5
Total			**6027**	**100**	**85.6**

Detailed calculations for quality control devices will be provided through the site plan approval process. The ETV verification statement and manual for the proposed JellyFish unit is included in Appendix C.

5.6 Water Balance & Volume Control

As per City policy 4.1.3 of the Storm Water Policy and Design Guidelines, sites less than 5 ha shall minimize any anticipated changes in the water balance between pre-development and post development conditions and shall provide a minimum infiltration equivalent to the first 5mm of rainfall. Based on a total development area of 4500m^2, the first 5mm of rainfall to be retained on the site for infiltration equates to 22.5m^3. Initial abstraction values provided in the City's SWM guidelines on Table 7.5 are as follows:

Table 6: Initial Abstraction Values

Cover	Initial Abstraction / Depression Storage (mm)
Woods	10
Meadows	8
Cultivated	7
Lawns	5
Impervious areas	3

Adapted from UNESCO, Manual on Drainage in Urbanized Areas, 1987

Using the values provided in the Table 6 above, approximately 17.4m^3 of rainfall will be retained on the site through initial abstraction. To make up the deficiency to retain the first 5mm of rainfall on the site, a 5m^3 concrete tank can be installed adjacent to the proposed underground storage system. Water in this tank can be reused for irrigation purposes on the property. This will be further examined at the site plan approval stage.

As per section 2.2.2.1 of the LSRCA's Storm Water Management Guidelines, nonlinear redevelopment projects on sites without restrictions that create 0.5 or more hectares of new and/or fully reconstructed impervious surfaces shall capture and retain / treat on site the runoff from a 25 mm rainfall event from the new and/or fully reconstructed impervious surfaces. The total impervious area proposed on the site is approximately 2,550m^2 and includes rooftop and hard surface (pavement and concrete) areas. Therefore, volume control requirements outlined in the LSRCA SWM Guidelines are not applicable to this development because the impervious area generated is less than 5000m2.

5.7 Phosphorus Off-Setting

As part of the Lake Simcoe Protection Plan, all new developments must be accompanied with an evaluation of anticipated changes in phosphorus loadings between pre-development and post-development.

The MOE's P-Tool was utilized to determine pre and post development phosphorus loadings. The existing ravine was excluded from the P-Tool model because it remains the same in both the pre and post development conditions. Low intensity land use was used in modelling the phosphorus loadings from the site for the pre-development condition. For the post development condition, high intensity residential development was used to estimate phosphorus loadings. Based on a comparison of pre-development and post development loads, an increase of 1785.71% is expected as a result of the proposed development. Phosphorus budget calculations and phosphorus catchment figures are included in Appendix C.

LSPOP (Lake Simcoe Phosphorus Off-Setting Policy) requires that all new development must control 100% of the phosphorus from leaving their property. This is referred to as the Zero Export Target, a key component of the LSPOP that ensures new development or redevelopment activities do not continue to contribute to phosphorus loading to Lake Simcoe.

The proposed approach to mitigate the impacts of phosphorus include:

- Installation of a JellyFish treatment unit capable of removing 59% P.
- Construction of various LID practices including enhanced swales and sand filters capable of removing 45% P.
- Construction of inground storage system capable of removing 25% P.

Using the proposed approach to mitigate phosphorus impacts, it is anticipated that 80% removal can be achieved onsite with the implementation of LIDS and best efforts. If 100% mitigation cannot be achieved, the developer will be required to pay cash in lieu to the LSRCA in accordance with the LSPOP. Phosphorus removal efficiencies noted above were taken from the LSRCA Storm Water Guidelines. Technical details related to the proposed phosphorus mitigation facilities will be provided at the site plan approval stage.

5.8 LID Assessment

Various LID techniques, including enhanced grass swales, sand filters and underground detention storage have been incorporated into the proposed SWM design concept. Given the existing soils throughout the site, application of infiltration-based LID measures is limited. Further geotechnical testing will be required at the site plan approval stage to provide percolation rates of underlying soils in the areas where the LID measures are proposed. Detailed design of the sand filter and enhanced swales will be conducted at the site plan approval stage once the site plan details have been finalized.

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 and the driveway and parking area has been resurfaced.

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 perimeter of the development area.
- Filter cloth / silt sack placement over drains.
- Installation of vehicle tracking mud mats at the entrance to the site.

Prior to carrying out site grading the siltation barriers and mud mats shall be in place. Any onsite storm sewer works will not be permitted to outlet to the municipal sewers until the site has been stabilized.

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.

Sediment and erosion controls devices will be detailed at the site plan stage once the site plan has been finalized.

7.0 UTILITIES

Correspondence was received from both Enbridge Gas and Alectra Utilities confirming the proposed development can be serviced from existing infrastructure on Big Bay Point Road.

Correspondence with the utility agencies is included in Appendix E.

8.0 SUMMARY AND CONCLUSIONS

Based on the above findings, the proposed development can be serviced utilizing the existing surrounding infrastructure on Big Bay Point Road. The proposed servicing for the development can be achieved without any adverse impact to the existing municipal services in the surrounding areas.

All of which is respectfully submitted by,

PINESTONE ENGINEERING LTD.

Joe Voisin, P.Eng., C.E.T.
Project Manager

APPENDIX A

Geotechnical Investigation

PINESTONE ENGINEERING LTD.

Peto MacCallum Ltd.
CONSULTING ENGINEERS

GEOTECHNICAL INVESTIGATION
SLOPE STABILITY AND EROSION HAZARD LIMIT
PROPOSED 22 UNIT TOWNHOUSE DEVELOPMENT
435 BIG BAY POINT ROAD
BARRIE, ONTARIO
FOR
ADA HOMES LTD.

PETO MacCALLUM LTD.
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Distribution:
2 cc: Client (+email)
1 cc: PML Barrie

PML Ref.: 17BF012
Report: 1
June 2017

Peto MacCallum Ltd.
CONSULTING ENGINEERS

June 13, 2017

PML Ref.: 17BF012
Report: 1

Mr. Andrew Adamek
ADA Homes Ltd.
1 Channen Court
Barrie, Ontario
L4M 6T4

Dear Mr. Adamek

Geotechnical Investigation
Slope Stability and Erosion Hazard Limit
Proposed 22 Unit Townhouse Development
435 Big Bay Point Road
Barrie, Ontario

Peto MacCallum Ltd. (PML) is pleased to present the results of the geotechnical investigation recently completed at the above noted project site. Authorization for this work was provided by Mr. A. Adamak, in the signed Engineering Services Agreement, PML Ref.: 17BF012, dated March 30, 2017.

A 22 unit townhouse development is planned on the parcel of land at 435 Big Bay Point Road in Barrie. Full depth basements, site servicing and paved access are proposed. The east part of the property comprises Lover's Creek ravine which is about 10 m deep. The proposed site layout is shown on Drawing 1, appended.

The purpose of this investigation was to determine the subsurface conditions at the site, and based on this information provide comments and geotechnical engineering recommendations for the building foundations. An assessment of the slope stability of the Lover's Creek ravine and Erosion Hazard Limit was carried out.

Geo-environmental services (observations, recording, testing or assessment of the environmental conditions of the soil and ground water) were not within the terms of reference for this assignment, and no work has been carried out in this regard. If excess soils requiring off-site disposal are generated, a program of sampling and testing will be needed to determine the chemical properties of the soil to evaluate receiving site options, in accordance with the MOECC document; Management of Excess Soil – A Guide for Best Management Practices, January 2014.

The comments and recommendations provided in this report are based on the site conditions at the time of the investigation, and are applicable only to the proposed works as addressed in the report. Any changes in the proposed plans will require review by PML to assess the validity of the report, and may require modified recommendations, additional investigation and/or analysis.

INVESTIGATION PROCEDURES

The field work for this investigation was carried out on April 20 and 21, 2017 and consisted of Boreholes 1 and 2 advanced to 15.7 and 15.4 m, respectively, near the edge of the ravine slope, and Boreholes 3 and 4, advanced to 6.5 m depth set away from the slope. The borehole locations are shown on Drawing 1, appended.

Co-ordination of clearances of underground utilities was provided by PML with the aid of a sub-contracted private utility locating company.

The boreholes were advanced using continuous flight solid stem augers, powered by a rubber tire mounted CME-75 drill rig, equipped with an automatic hammer, supplied and operated by a specialist drilling contractor working under the full time supervision of a member of PML's engineering staff.

Representative samples of the overburden in the boreholes were recovered at frequent depth intervals for identification purposes using a conventional split spoon sampler. Standard penetration tests were carried out simultaneously with the sampling operations to assess the strength characteristics of the substrata. The ground water conditions in the boreholes were assessed during drilling by visual examination of the soil samples, the sampler and drill rods as the samples were retrieved, and measurement of the water level in the open boreholes, if any. Piezometers comprising 19 mm PVC pipe were installed in two of the boreholes to permit monitoring of the ground water table.

Boreholes without piezometers were backfilled in accordance with O.Reg. 903. As per O.Reg. 903 the piezometers become the property of the Owner and will have to be decommissioned when no longer required. PML would be pleased to assist in this regard.

The location of the boreholes were established in the field by PML, utilizing a plan provided by the Client, and cognizant of underground utilities. Surface elevations of the boreholes were referenced to the following Temporary Bench Mark (TBM), as shown on Drawing 1, attached, and described as follows:

TBM: Top of SIB at Northwest Corner of Property

Elevation 250.50 (metric, geodetic)

All recovered soil samples were returned to our laboratory for moisture content determinations and detailed examination to confirm field classification. Two soil samples were submitted for grain size analysis and accompanying Atterberg limits testing. The results are presented on Figures 1 and 2, appended.

SITE DESCRIPTION AND SUMMARIZED SUBSURFACE CONDITIONS

The lot at 435 Big Bay Point Road is currently occupied by a single detached residence at the northwest corner on the site, with a side yard clearing at the northeast corner of the site. The south portion of the site is lightly wooded, bordered be residences to the south and west, with the east part of the site comprising the approximate 10 m deep Lover's Creek ravine. Based on the topographic plan provided, the tableland is relatively flat with relief of about 2 m from west to east.

Reference is made to the appended Log of Borehole sheets for details of the subsurface conditions, including soil classifications, inferred stratigraphy, Standard Penetration test N values, standpipe installation details, ground water observations and the results of laboratory moisture content determinations.

Due to the soil sampling procedures and limited sample size, the depth demarcations on the borehole logs must be viewed as "transitional" zones between layers, and cannot be construed as exact geologic boundaries between layers. PML should be retained to assist in determining geologic boundaries in the field during construction, if required.

The stratigraphy encountered in the boreholes consisted of topsoil, locally over sand, underlain by a major silty sand till deposit.

Topsoil

A 180 to 220 mm layer of sand topsoil was encountered at the surface of all boreholes.

Sand

Below the topsoil in Boreholes 2 and 3, a sand unit was encountered down to 1.4 m depth (elevation 247.2 to 249.1). The layer contained trace silt and gravel and was very loose to compact. The sand was moist or very moist, with moisture contents of 5 to 18%.

Within the till deposit in Borehole 2, a lower sand deposit was encountered between 10 and 13 m depth (elevation 235.6 to 238.6). The layer was very dense and was moist to wet with a water content of 9%.

Silty Sand Till

A major till deposit was encountered below the topsoil of sand in all boreholes, extending to the 6.5 to 15.7 m depth of exploration. The till unit comprised silty sand, with cobbles and boulders noted. Samples of the till (less aggregates greater than 20 mm size) from Boreholes 1 and 2 were submitted for grain size analyses and the results are presented on Figures 1 and 2. Associated Atterberg limits testing showed both samples were non-plastic. The till was compact to very dense, locally very loose in the upper 1.0 m. The unit was typically moist with water contents typically less than 12%. Wet sand seams were noted locally.

Ground Water

The first water strike and the ground water levels measured upon completion of augering, are provided in the table below, on a borehole by borehole basis. The water levels were also measured in the piezometers about two weeks after installation and are also tabulated below:

BOREHOLE	FIRST WATER STRIKE IN BOREHOLE AT TIME OF DRILLING (APRIL 20 & 21, 2017) DEPTH (m)	WATER / WET CAVE LEVEL UPON COMPLETION OF AUGERING (APRIL 20 & 21, 2017) DEPTH (m) / ELEVATION	MEASURED WATER LEVEL IN PIEZOMETERS (MAY 5, 2017) DEPTH (m) / ELEVATION
1	7.6	Wet Cave at 7.0 / 242.4	4.9 / 244.5
2	9.1	Water at 6.7 / 241.9	2.0 / 246.6
3	3.2	Water at 5.5 / 245.0	--
4	3.1	Water at 3.4 / 246.9	--

Ground water levels are subject to seasonal fluctuations, and in response to variations in precipitation.

GEOTECHNICAL ENGINEERING CONSIDERATIONS

General

A 22 unit townhouse development is planned on the parcel of land at 435 Big Bay Point Road in Barrie. Full depth basements, site servicing and paved access are proposed. The east side of the property comprises the approximate 10 m deep Lover's Creek ravine. The proposed site layout is shown on Drawing 1, appended.

The stratigraphy encountered in the boreholes consisted of topsoil, locally over sand, underlain by a major silty sand till deposit. The stabilized ground water table in the Borehole 1 and 2 piezometers was measured to be 2.0 and 4.9 m below grade, elevation 244.5 and 246.6, respectively.

Foundations

The proposed townhouses can be supported on strip and spread footings. Design elevations have yet to be established. However, with only minor grading anticipated, it is anticipated that basement footings will be founded in the native silty sand till deposit.

A geotechnical bearing resistance at Serviceability Limit State (SLS) of 150 kPa and a factored bearing resistance at Ultimate Limit State (ULS) of 225 kPa can be adopted for design of footings supported on the native till.

Footings subject to frost action should be provided with a minimum 1.2 m of earth cover or equivalent.

Settlement based on the geotechnical bearing resistance at SLS should be less than 25 mm with a differential settlement of 75% of the value. The factored bearing resistance at ULS assumes a minimum footing width of 600 mm with minimum footing embedment of 600 mm.

Prior to placement of structural concrete, all founding surfaces must be inspected by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions.

Seismic Design

Site Classification D is applicable for Seismic Site Response as set out in Table 4.1.8.4.A of the Ontario Building Code (2012). Based on the soil profile revealed in the boreholes there is a low potential for liquefaction.

Basement Walls and Floor Slab

Basement walls must be designed to resist the unbalanced lateral pressure due to the weight of the retained soil. The lateral earth pressure, p, may be computed using the following equation and assuming a triangular pressure distribution:

$$p = K(\gamma h + q)$$

Where

K = lateral earth pressure coefficient
= 0.5, assuming level backfill

γ = unit weight of retained soil
= 20.0 kN/m^3

h = depth at which pressure is computed

q = surcharge adjacent to the wall (kPa)

It is recommended that the exterior of basement walls be damp proofed and the backfill behind the wall comprise free draining material such as OPSS Granular B, in conjunction with perimeter weeping tile system to prevent the buildup of hydrostatic pressure behind the wall. The weeping tile should be surrounded by a minimum 150 mm thick layer of clear crushed stone (20 mm nominal size) or pea gravel, fully wrapped with synthetic filter fabric to prevent migration of fines which may otherwise clog the system. The weeping tile should be positively sloped to a frost free sump or outlet.

Alternatively, in lieu of imported OPSS Granular B, a proprietary drainage board product could be provided in conjunction with reuse of site excavated soil as wall backfill.

Backfill should be placed in maximum 200 mm thick lifts and compacted to 95% Standard Proctor maximum dry density. Over compaction close to the wall should be avoided as this could generate excessive pressure on the wall. Suitable bracing and/or precautions should be taken to ensure the wall is not damaged during backfill/compaction activities.

Basement floor slab construction is considered feasible on the native till material.

A minimum 200 mm thick base layer of crushed stone (nominal 20 mm size) is recommended directly beneath the floor slab. Where a vapour sensitive floor finish is to be used then the use of polyethylene sheeting or similar means should be incorporated as a vapour barrier.

Exterior grades should be established to promote surface drainage away from the building.

Site Servicing

It is understood that only minor grading is required to achieve proposed site grades. Invert elevations were not provided by the Client, however are generally anticipated to be 2.0 and 3.5 m below proposed grade.

Trench Excavation and Ground Water Control

Trench excavation and ground water control are described later in the report under Excavation and Ground Water Control.

Pipe Bedding

Native soils are suitable for supporting utilities. Locally, existing fill may exist at proposed invert levels for shallow services. Where existing fill or other deleterious material is encountered at the design invert level, such material should be sub-excavated and replaced with an increased thickness of bedding.

Standard Granular A bedding, in accordance with OPSS, compacted to 95% Standard Proctor maximum dry density should be satisfactory. For flexible pipes, bedding and cover material should comprise OPSS Granular A. For rigid pipes, the bedding material should comprise OPSS Granular A and cover material may comprise select native soil free of oversized material.

Trench Backfill

Backfill in trenches should be placed in maximum 200 mm thick loose lifts compacted to at least 95% Standard Proctor maximum dry density to minimize post construction settlement in the backfill. Backfill for at least the upper 1 m of trench should be close to the optimum moisture content to prevent subgrade instability issues.

Backfill for service trenches should comprise inorganic soil, free of boulders, frozen or otherwise deleterious material, at a moisture content suitable for compaction. The excavated inorganic site soil is generally considered suitable for reuse, subject to exclusions of deleterious content, and subject to geotechnical field review and approval during construction.

Earthworks operations should be inspected by PML to verify subgrade preparation, backfill materials, placement and compaction efforts and ensure the specified degree of compaction is achieved throughout.

Excavation and Ground Water Control

Excavation for proposed services is expected to extend to about 2.0 to 4.0 m depth below existing grade. Excavations for basements are anticipated to extend to about 3.0 m below existing grade.

Excavation utilizing open cut methods is considered feasible and based on the boreholes will encounter fill and the major till deposit. Harder digging and the presence of cobbles and boulders should be expected in the till soil.

The site soils should be considered as Type 3 soil requiring excavation sidewalls to be constructed at no steeper than one horizontal to one vertical (1H:1V) from the base of the excavation in accordance with the Occupational Health and Safety Act.

The stabilized ground water level noted in the piezometers in Boreholes 1 and 2 was at 2.0 to 4.9 m depth (elevation 244.5 to 246.6), although the ground water level encountered during drilling was significantly lower. It is believed that excavation will typically be above the ground water level and it is anticipated that conventional sump pumping techniques should be adequate to handle ground water seepage quantities, where encountered.

Water taking in Ontario is governed by the Ontario Water Resources Act (OWRA) and the Water Taking and Transfer Regulation O.Reg. 387/040, Section 34 of the OWRA requires any one taking more than 50,000 L/d to obtain a PTTW from the Ministry of Environment and Climate Change (MOECC). This requirement applies to all withdrawals, whether for consumption, temporary construction dewatering or permanent drainage improvements. In April of 2016 the MOECC made some changes to the PTTW requirements. Projects assessed to be taking more than 50,000 L/d but less than 400,000 L/d of ground water can obtain a permit/permission online via the Environmental Activity and Sector Registry (EASR) system. Where water taking is assessed to be more than 400,000 L/d then a Category 3 PTTW will be required.

Neither a PTTW nor registry on the EASR is anticipated for the excavation as described above.

It is recommended that a test dig be undertaken to allow prospective contractors an opportunity to observe and evaluate the conditions likely to be encountered and assess preferred means of excavation and ground water control measures based on their own experience.

Pavement Design and Construction

The site soils comprise variable low frost susceptible sand to highly frost susceptible silty sand till. The following typical pavement thicknesses are provided:

MATERIAL	LIGHT DUTY (PARKING)	HEAVY DUTY (SITE ACCESS / FIRE ROUTE)
Asphalt (mm)	70	110
Granular A Base Course (mm)	150	150
Granular B Subbase Course (mm)	300	300
Total Thickness (mm)	520	560

Following rough grading, subgrade preparation should include proofrolling and compacting the exposed subgrade with a heavy compactor. Any unstable zones identified during this process should be sub-excavated and replaced with compacted select material.

Imported material for the granular base and subbase should conform to OPSS gradation specifications for Granular A and Granular B, and should be compacted to 100% Standard Proctor maximum dry density. Asphalt should be compacted in accordance with OPSS 310.

The pavement design considers that construction will be carried out during the drier time of the year and that the subgrade is stable, as determined by proofrolling operations. Where wet and/or unstable subgrade is identified, remediation may include increasing the depth of subbase, the use of Granular B Type II and/or use of geogrid reinforcement, subject to geotechnical review during construction.

For the pavement to function properly, it is essential that provisions be made for water to drain and not collect in the base material. The incorporation of subdrains is recommended in conjunction with crowning of the final surface to promote drainage away from the structure. Subdrains should be installed at least 300 mm below the subgrade level. For details regarding pipe, filter cloth or pipe sock, bedding and cover material, refer to OPSD 216 Series. Subdrains should lead to a frost free outlet and/or be connected to storm sewer system. Maintenance holes/catch basins should be backfilled using free draining material with frost tapers and stub drains extending out from the structures. The above measures will help drain the pavement structure as well as minimize frost movement between maintenance hole/catch basins and pavement.

Geotechnical Review and Construction Inspection and Testing

It is recommended that the final design drawings be submitted to PML to review the compatibility with site conditions and recommendations of this report.

Earthworks operations should be carried out under the supervision of PML to approve subgrade preparation, backfill materials, placement and compaction procedures, and verify that the specified compaction standards are achieved throughout fill materials.

Prior to placement of structural concrete, all founding surfaces must be inspected by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions.

The comments and recommendations provided in the report are based on the information revealed in the boreholes. Conditions away from and between boreholes may vary, considering previous activity at the site. Geotechnical review during construction should be on going to confirm the subsurface conditions are substantially similar to those encountered in the boreholes, which may otherwise require modification to the original recommendations.

Slope Stability Assessment

The east part of the site comprises the approximate 10 m deep Lover's Creek ravine. PML attended the site on April 26, 2017, to review the existing condition of the slope. The existing slope was rated using the Slope Stability Rating Chart, from the MNR Technical Guide, appended as Enclosure 1. Observations are tabulated on the Chart and described below.

1. The slope was 2H:1V or flatter, however a local area at the north end adjacent to Big Bay Point Road was steeper at about 1H:1V slope (Photograph 1).
2. Based on the boreholes the slope comprises predominantly glacial till.
3. No seepage was observed on the slope.
4. The slope is up to 10 m high.
5. The slope is occupied by mature trees with sparse surface vegetation (Photographs 2 and 3).
6. It appears that there may be minor drainage from the tableland over the slope, but there was no active erosion.
7. Lover's Creek was more than 15 m from the toe of the slope.
8. There is no visual evidence of slope instability.

Based on the observations and Slope Stability Rating, there is a low potential for slope instability.

We conducted a Slope Stability Analysis utilizing the software SLOPE from RocScience. The soil/slope model and results are shown on Enclosure 2. The computed minimum Factor of Safety was 1.8 which is satisfactory against an overall slope failure.

As noted earlier, there is a local area adjacent to Big Bay Point Road where the ravine slope is steeper at about 1H:1V. It appeared that this may have been a result of regrading/fill placement. This local slope area should be flattened to match the remainder of the slope and vegetated.

Erosion Hazard Limit

In order to determine the development set back from the top of slope, it is necessary to define the Erosion Hazard Limit at the site which includes assessment of the stability of the slope. In this regard, reference is made to the Technical Guide – River and Stream Systems: Erosion Hazard Limit, Ontario Ministry of Natural Resources, 2002, (Technical Guide). The Erosion Hazard Limit is determined by:

- Toe Erosion Allowance
- Stable Slope Allowance
- Flooding Hazard Limit or Meander Belt Allowance
- Erosion Access Allowance

The Toe Erosion Allowance is a set back to accommodate potential erosion due to current action from a creek within 15 m of the toe of valley slope that may weaken and/or undermine the toe. Where the creek is greater than 15 m from the toe of the valley slope the Toe Erosion Allowance component is removed from the assessment. In this regard, Lover's Creek is more than 15 m from the toe of the valley slope, and therefore there is no requirement for Toe Erosion Allowance.

The Stable Slope Allowance is a setback to ensure safety if slumping or failure of the existing slope should occur. In accordance with Table 4.3 of the Technical Guide, a design minimum factor of safety of 1.3 to 1.5 is recommended for active land use (habitable structures). As discussed earlier, a Slope Stability Analyses was carried out which determined a minimum Factor of Safety of 1.8 for the subject slope which is within the guideline. Thus, the existing slope is safe and a Stable Slope Allowance is not required.

The Lover's Creek system at the location of the site is a Confined System (a valley surrounds the creek). Therefore, there is no requirement for a Flood Hazard Limit.

The Erosion Access Allowance is intended to facilitate access to maintain the slope, if required. This requirement should be confirmed by regulatory authorities.

In summary, no set back is required, except an allowance to facilitate access to maintain the ravine slope, if required. This requirement should be confirmed by regulatory authorities.

CLOSURE

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to call our office.

Sincerely

Peto MacCallum Ltd.

Turney Lee-Bun, P.Eng.
Vice-President

TLB:jlb

Enclosure(s):
Figures 1 and 2 – Particle Size Distribution Charts
List of Abbreviations
Log of Borehole Nos. 1 to 4
Drawing No. 1 - Borehole Location Plan
Photograph No.'s 1 to 4
Enclosure 1 – Slope Stability Rating Chart
Enclosure 2 – Slope Stability Analysis

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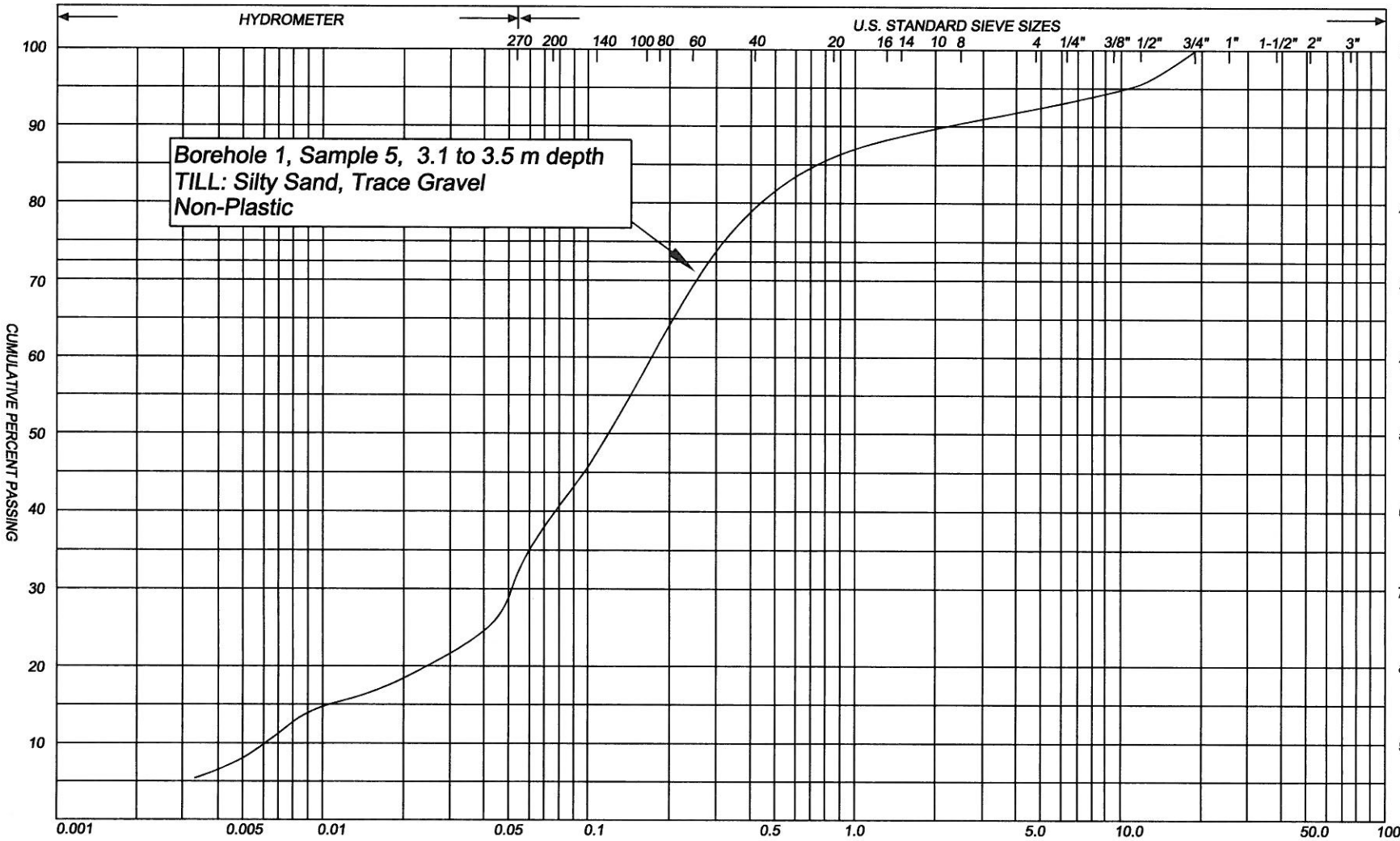
PARTICLE SIZE DISTRIBUTION CHART

PML Ref.: 17BF012

Figure No.: 1



SILT & CLAY				FINE	MEDIUM	COARSE	GRAVEL		COB BLES	UNIFIED
				SAND						
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL		COBBLES	M.I.T.
	SILT			SAND						
CLAY	SILT			V. FINE	FINE	MED	COARSE	GRAVEL		U.S. BUREAU
				SAND						

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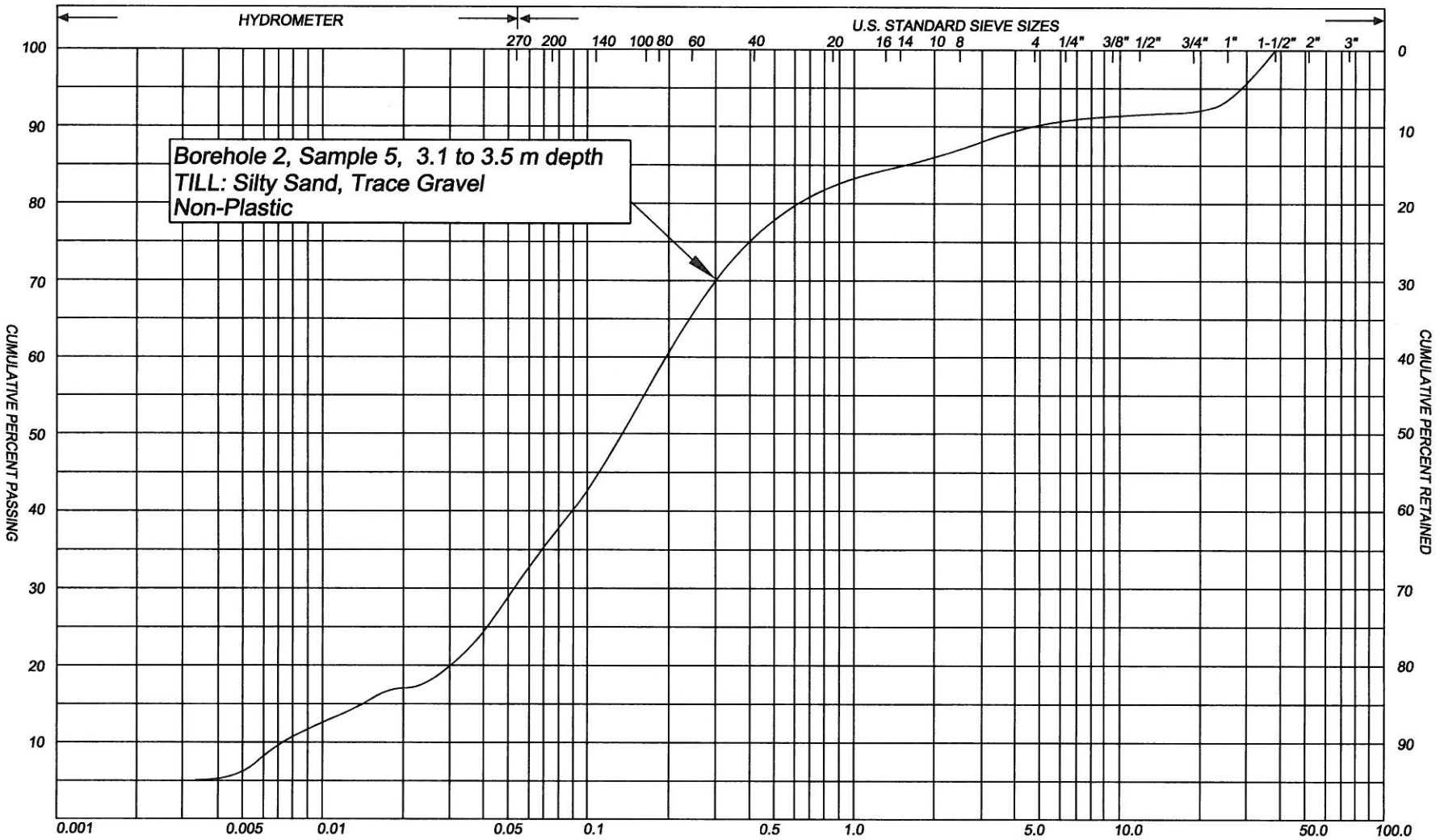
PARTICLE SIZE DISTRIBUTION CHART

PML Ref.: 17BF012
Figure No.: 2



SILT & CLAY			FINE	MEDIUM	COARSE	GRAVEL	COBBLES	UNIFIED
			SAND					
CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	GRAVEL	COBBLES	M.I.T.
	SILT			SAND					
CLAY	SILT		V. FINE	FINE	MED	COARSE	GRAVEL		U.S. BUREAU
			SAND						

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: - The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described in the following terms:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 - 2	0 - 12	Very Loose	0 - 4
Soft	2 - 4	12 - 25	Loose	4 - 10
Firm	4 - 8	25 - 50	Compact	10 - 30
Stiff	8 - 15	50 - 100	Dense	30 - 50
Very Stiff	15 - 30	100 - 200	Very Dense	> 50
Hard	> 30	> 200		

WTPL	Wetter Than Plastic Limit
APL	About Plastic Limit
DTPL	Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon	ST	Slotted Tube Sample
WS	Washed Sample	TW	Thinwall Open
SB	Scraper Bucket Sample	TP	Thinwall Piston
AS	Auger Sample	OS	Oesterberg Sample
CS	Chunk Sample	FS	Foil Sample
GS	Grab Sample	RC	Rock Core

PH	Sample Advanced Hydraulically
PM	Sample Advanced Manually

SOIL TESTS

Qu	Unconfined Compression	LV	Laboratory Vane
Q	Undrained Triaxial	FV	Field Vane
Qcu	Consolidated Undrained Triaxial	C	Consolidation
Qd	Drained Triaxial		

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LOG OF BOREHOLE NO. 1

17T 607301E 4912191N

PROJECT Proposed 22 Unit Townhouse Development
PML REF. 17BF012
LOCATION 435 Big Bay Point Road, Barrie, Ontario
BORING DATE April 21, 2017
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 249.40			
0.0	249.22	TOPSOIL: Dark brown, sand, trace silt, trace gravel, very moist	1	SS	2
0.18		SILTY SAND TILL: Very loose to dense, brown, silty sand, trace gravel, cobbles and boulders, moist	2	SS	31
1.0			3	SS	9
2.1	247.3	Becoming dense to very dense	4	SS	31
2.0			5	SS	69
3.0			6	SS	52
4.0			7	SS	48
5.0			8	SS	42
6.0			9	SS	73
7.0			10	SS	80/290 mm
8.0			11	SS	66/290 mm
9.0			12	SS	59
10.0					
11.0					
12.0					
13.0					
14.0					
15.0		CONTINUED			

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 249, 248, 247, 246, 245, 244, 243, 242, 241, 240, 239, 238, 237, 236, 235

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Stick-up pipe
Concrete
Bentonite seal
19 mm slotted pipe
Filter sand
First water strike at 7.6 m

NOTES

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LOG OF BOREHOLE NO. 1

17T 607301E 4912191N

PROJECT Proposed 22 Unit Townhouse Development
PML REF. 17BF012
LOCATION 435 Big Bay Point Road, Barrie, Ontario
BORING DATE April 21, 2017
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER O Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS; GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
15.0	CONTINUED FROM PREVIOUS PAGE						50 100 150 200	10 20 30 40		
	SILTY SAND TILL: Very dense, grey, silty sand, trace gravel, cobbles and boulders, moist, local wet seams		13	SS	47	234	20 40 60 80	○		
15.7 / 233.7	BOREHOLE TERMINATED AT 15.7 m									Upon completion of augering Wet cave at 7.0 m Water Level Readings: Date Depth Elev. 2017-05-05 4.9 244.5

16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0

NOTES

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LOG OF BOREHOLE NO. 2

17T 607305E 4912192N

PROJECT Proposed 22 Unit Townhouse Development — **PML REF.** 17BF012
LOCATION 435 Big Bay Point Road, Barrie, Ontario — **BORING DATE** April 21, 2017 — **ENGINEER** GW
BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 248.60				
0.0	248.42	TOPSOIL: Dark brown, sand, trace silt, trace gravel, very moist		1	SS	3
0.18		SAND: Very loose to compact, brown, sand, trace silt, trace gravel, moist		2	SS	20
1.0						
1.4	247.2	SILTY SAND TILL: Dense to compact, brown, silty sand, trace gravel, cobbles and boulders, moist		3	SS	32
2.0				4	SS	28
2.9	245.7	Becoming very dense		5	SS	66
3.0						
4.0				6	SS	90/270 mm
5.0						
6.0				7	SS	50/140 mm
7.0						
8.0				8	SS	50/140 mm
9.0				9	SS	72/270 mm
10.0	238.6	SAND: Very dense, brown, sand, trace silt, trace gravel, moist to wet		10	SS	86/270 mm
11.0						
12.0				11	SS	50/140 mm
13.0	235.6	SILTY SAND TILL: Very dense, grey, silty sand, trace gravel, cobbles and boulders, moist		12	SS	50/100 mm
14.0						
15.0		CONTINUED				

ELEVATION SCALE: 248, 247, 246, 245, 244, 243, 242, 241, 240, 239, 238, 237, 236, 235, 234

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Stick-up pipe
Concrete
Bentonite seal
19 mm slotted pipe
Filter sand
First water strike at 9.1 m

NOTES

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LOG OF BOREHOLE NO. 2

17T 607305E 4912192N

PROJECT Proposed 22 Unit Townhouse Development
PML REF. 17BF012
LOCATION 435 Big Bay Point Road, Barrie, Ontario
BORING DATE April 21, 2017
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT kN/m³	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
15.0	CONTINUED FROM PREVIOUS PAGE									
15.4	SILTY SAND TILL: Very dense, grey, silty sand, trace gravel, cobbles and boulders, moist		13	SS	50/120 mm		>>			
233.2	BOREHOLE TERMINATED AT 15.4 m									Upon completion of augering Water at 6.7 m Cave at 10.7 m Water Level Readings: Date Depth Elev. 2017-05-05 2.0 246.6

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L; WATER CONTENT (%): 10 20 30 40

16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0

NOTES

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LOG OF BOREHOLE NO. 3

17T 607295E 4912217N

PROJECT Proposed 22 Unit Townhouse Development
PML REF. 17BF012
LOCATION 435 Big Bay Point Road, Barrie, Ontario
BORING DATE April 20, 2017
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 250.45				
0.0	250.25	TOPSOIL: Dark brown, sand, trace silt, trace gravel, very moist		1	SS	3
1.0		SAND: Very loose to compact, brown, sand, trace silt, trace gravel, very moist		2	SS	22
1.4	249.1	SILTY SAND TILL: Compact to dense, brown, silty sand, trace gravel, cobbles and boulders, moist to very moist		3	SS	15
2.0				4	SS	26
3.0				5	SS	42
4.0	246.5	Becoming very dense		6	SS	77/290 mm
5.0						
6.0				7	SS	72/270 mm
6.5	244.0	BOREHOLE TERMINATED AT 6.5 m				
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

ELEVATION SCALE: 250, 249, 248, 247, 246, 245, 244

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

UNIT WEIGHT kN/m³

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

First water strike at 3.2 m

Upon completion of augering
Water at 5.5 m
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 4

17T 607283E 4912174N

PROJECT Proposed 22 Unit Townhouse Development
PML REF. 17BF012
LOCATION 435 Big Bay Point Road, Barrie, Ontario
BORING DATE April 20, 2017
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
	SURFACE ELEVATION 250.25				
0.22 / 250.03	TOPSOIL: Dark brown, sand, trace silt, trace gravel, very moist		1	SS	3
	SILTY SAND TILL: Very loose to compact, brown, silty sand, trace gravel, cobbles and boulders, very moist		2	SS	10
			3	SS	16
2.1 / 248.2	Becoming dense to very dense		4	SS	43
	Sand seam, wet		5	SS	61
			6	SS	50/290 mm
6.5 / 243.8	BOREHOLE TERMINATED AT 6.5 m		7	SS	83/270 mm

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 250, 249, 248, 247, 246, 245, 244

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

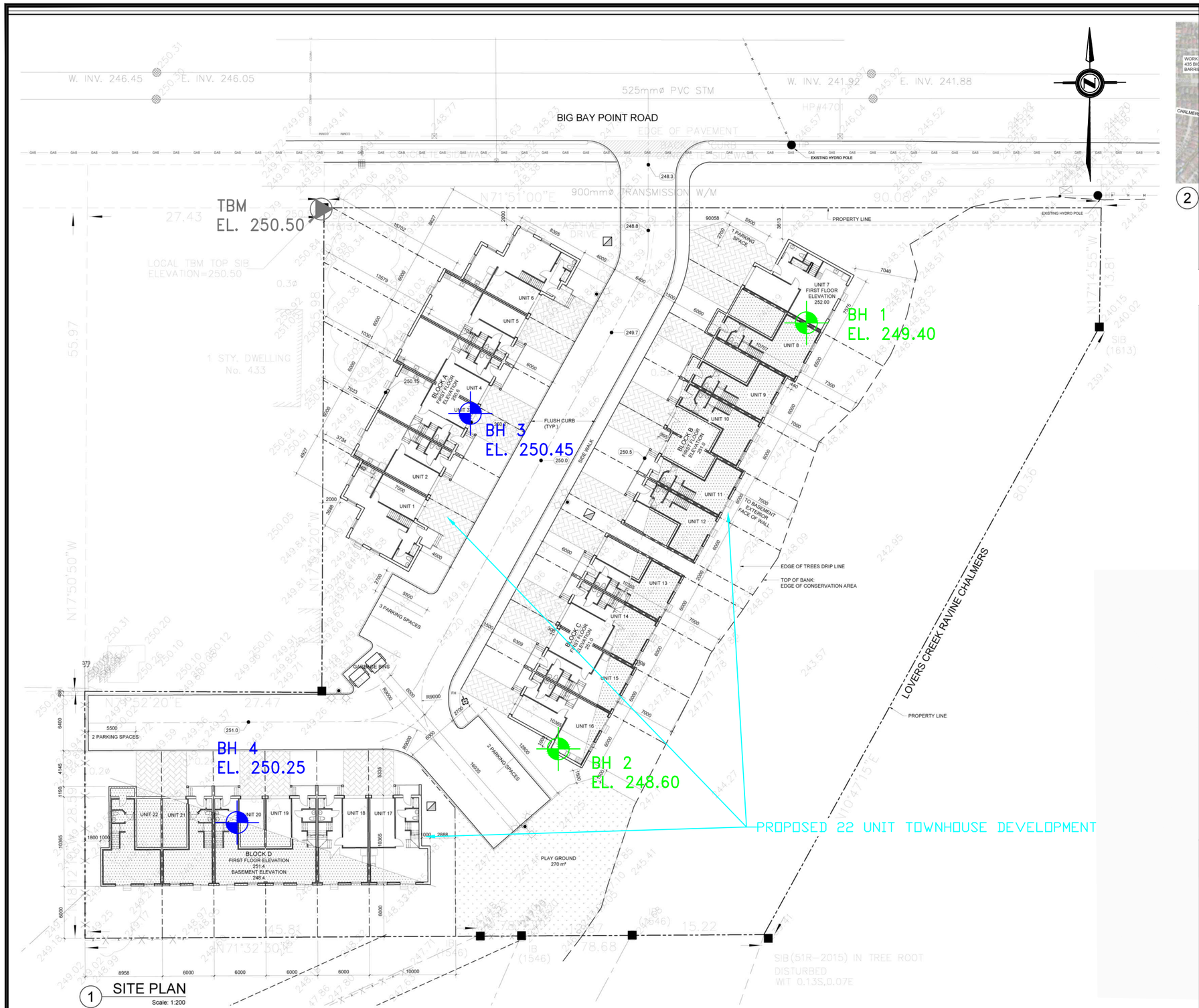
UNIT WEIGHT kN/m³

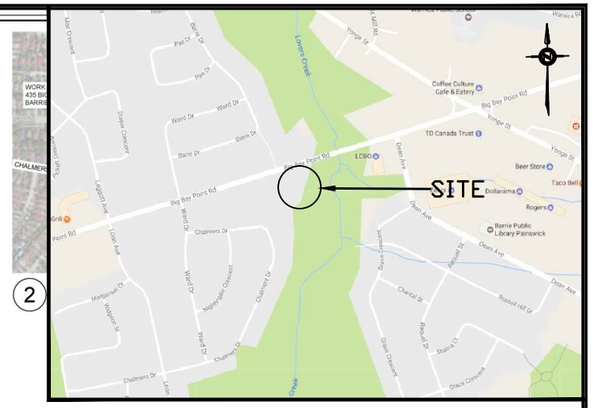
GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

First water strike at 3.1 m

Upon completion of augering
Water at 3.4 m
Cave at 4.1 m

NOTES





KEY PLAN
BARRIE, ONTARIO

LEGEND:

BH 1 EL. 249.40	BOREHOLE 1 (WITH STANDPIPE) SURFACE ELEVATION
BH 3 EL. 250.45	BOREHOLE 3 SURFACE ELEVATION
TBM EL. 250.50	TEMPORARY BENCH MARK TOP OF S.I.B. AT NORTHWEST CORNER OF PROPERTY ELEVATION 250.50 (METRIC, GEODETIC)

REFERENCE:

BASE PLAN PROVIDED BY CLIENT.

0m 8 16 24 32 40

SCALE

BOREHOLE LOCATION PLAN

PROPOSED 22 UNIT TOWNHOUSE DEVELOPMENT
435 BIG BAY POINT ROAD
BARRIE, ONTARIO

Peto MacCallum Ltd.
CONSULTING ENGINEERS

DRAWN	RB	DATE	SCALE	PML REF.	DRAWING NO.
CHECKED	GW	JUNE 2017	AS SHOWN	17BF012	1
APPROVED	GW				

Photograph 1: Steepest portion of slope (about 1H to 1V) adjacent Big Bay Point Road.

Photograph 2: Looking south, well vegetated with mature trees, however no surface vegetation.

Photograph 3: Looking north, at south end of site, slightly more surface vegetation.

Photograph 4: At toe of slope, looking east, Lover's Creek in distance, over 15 m away.

SLOPE STABILITY RATING CHART [(1)]

Site Location: 435 Big Bay Point Road, Barrie, Ontario **PML Ref:** 17BF012

Property Owner: ADA Homes Ltd. **Inspection Date:** April 26, 2017

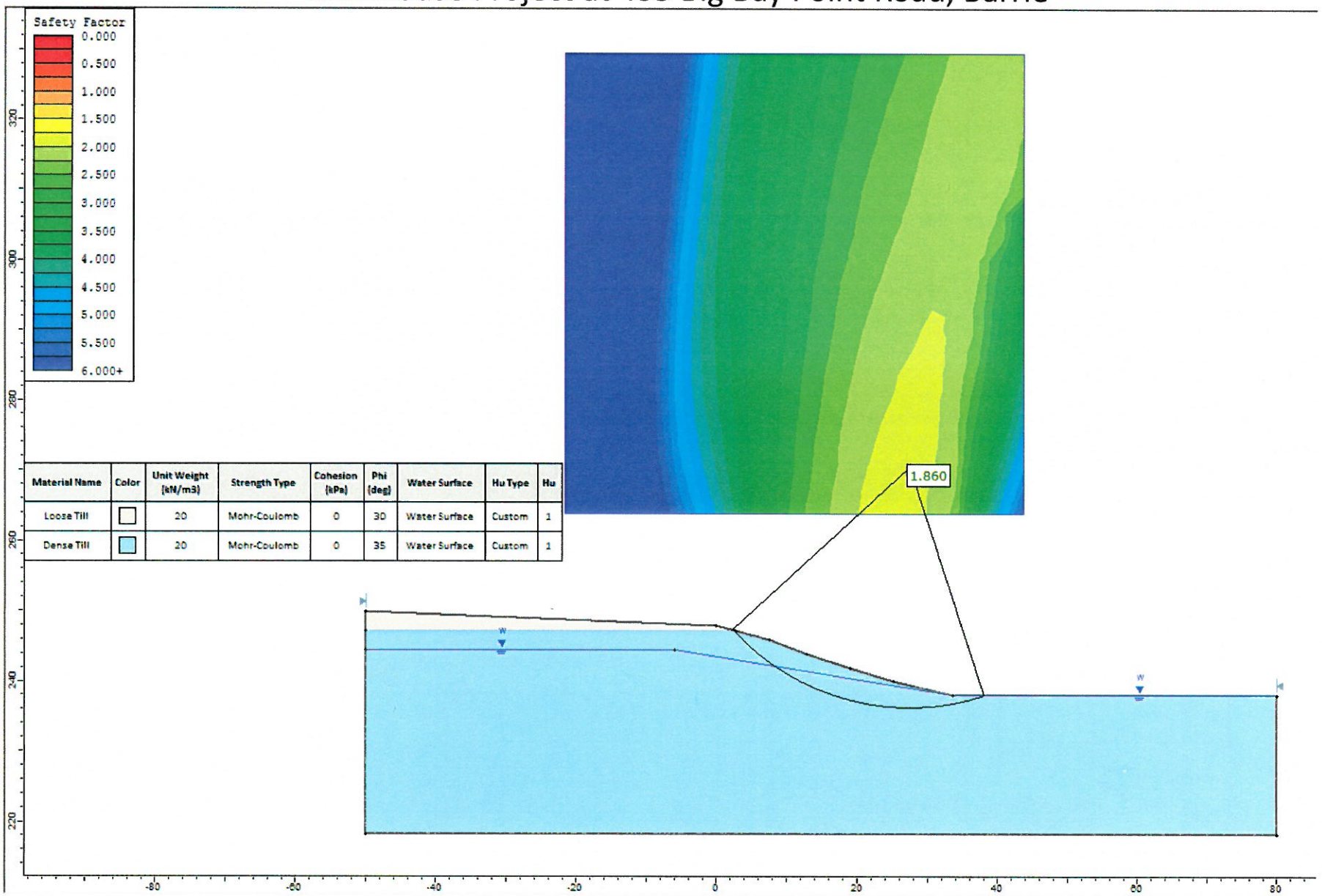
Inspected By: Geoffrey White, P.Eng. / Richard Blair, P.Eng**.** **Weather**: Cloudy, 13 C

1.	**OVERALL SLOPE INCLINATION**		
	Degrees	**horiz : vert.**	
	a) 18 or less	3 : 1 or flatter	0
	b) 18 – 26	2 : 1 to more than 3 : 1	**6**
	c) more than 26	steeper than 2 : 1	16
2.	**SOIL STRATIGRAPHY**		
	a) Shale, Limestone, Granite (Bedrock)		0
	b) Sand, Gravel		6
	c) Glacial Till		**9**
	d) Clay, Silt		12
	e) Fill		16
	f) Leda Clay		24
3.	**SEEPAGE FROM SLOPE FACE**		
	a) None or Near bottom only		**0**
	b) Near mid-slope only		6
	c) Near crest only, or From several levels		12
4.	**SLOPE HEIGHT**		
	a) 2 m or less		0
	b) 2.1 to 5 m		2
	c) 5.1 to 10 m		**4**
	d) more than 10 m		8
5.	**VEGETATION COVER ON SLOPE FACE**		
	a) Well vegetated; heavy shrubs or forested with mature trees		**0**
	b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
	c) No vegetation, bare		8
6.	**TABLE LAND DRAINAGE**		
	a) Table land flat, no apparent drainage over slope		0
	b) Minor drainage over slope, no active erosion		**2**
	c) Drainage over slope, active erosion, gullies		4
7.	**PROXIMITY OF WATERCOURSE TO SLOPE TOE**		
	a) 15 metres or more from slope toe		**0**
	b) Less than 15 meters from slope toe		6
8.	**PREVIOUS LANDSLIDE ACTIVITY**		
	a) No		**0**
	b) Yes		6

SLOPE INSTABILITY RATING	RATING VALUES TOTAL	INVESTIGATION REQUIREMENTS	TOTAL **21**
1. Low potential	**< 24**	**Site inspection only, confirmation, report letter. ☑**	
2. Slight potential	25-35	Site inspection and surveying, preliminary study, detailed report.	
3. Moderate potential	> 35	Boreholes, piezometers, lab tests, surveying, detailed report.	

PML Ref. 17BF012
Enclosure: 2

Slope Stability Analysis using SLIDE program from RocScience
Lover's Creek Ravine
Townhouse Project at 435 Big Bay Point Road, Barrie

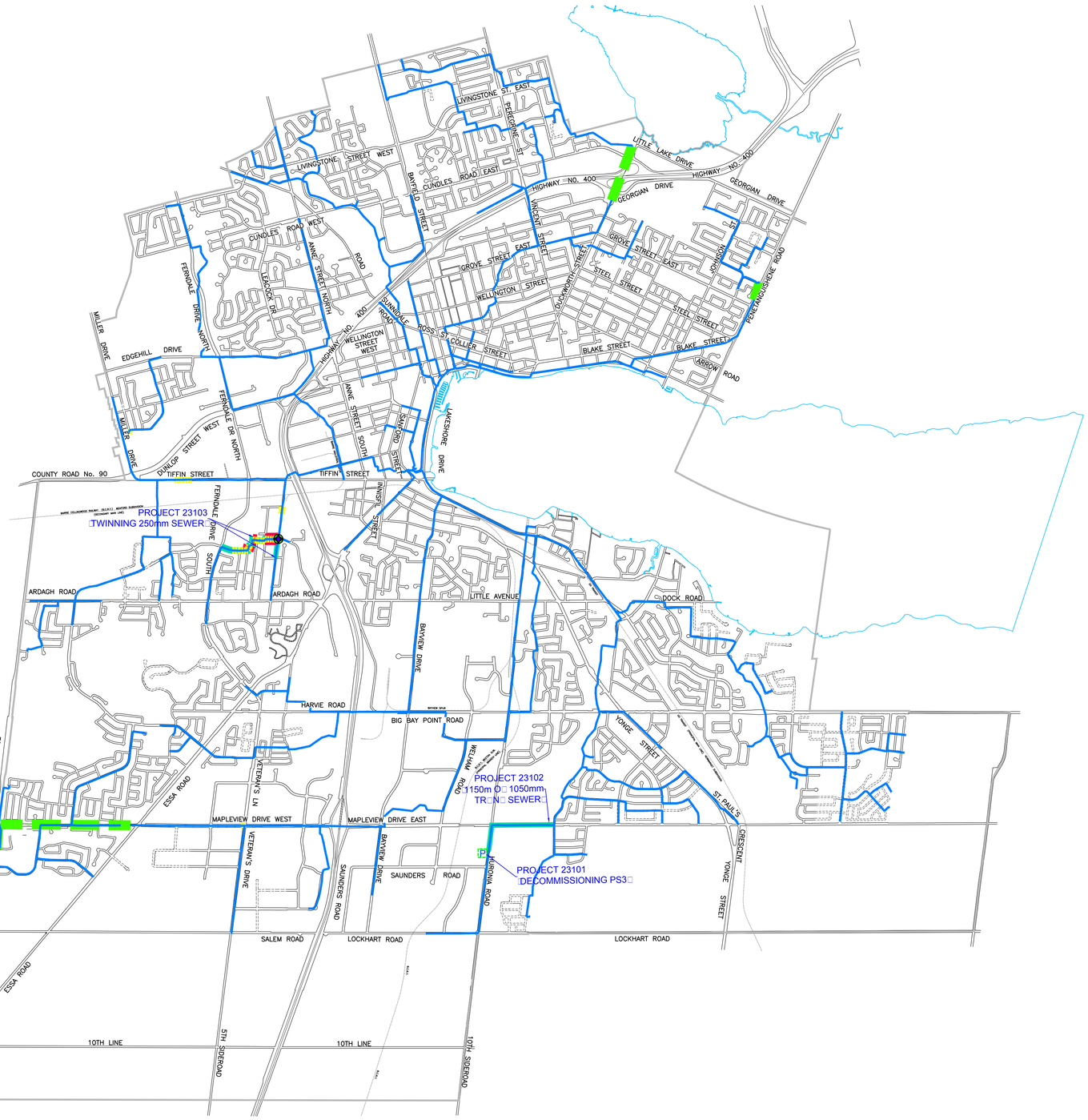


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Loose Till		20	Mohr-Coulomb	0	30	Water Surface	Custom	1
Dense Till		20	Mohr-Coulomb	0	35	Water Surface	Custom	1

APPENDIX B

Water & Sanitary Design Calculations

PINESTONE ENGINEERING LTD.



LEGEND:

- SURCHARGING CONDUITS (GREATER THAN 100% CAPACITY)
- SURCHARGING CONDUITS (GREATER THAN 85% CAPACITY)
- PROPOSED WORKS SEWER
- EXISTING SANITARY SEWER
- FORCEMAIN
- PROPOSED FLOW MONITORING STATION

No.	DATE	BY	REVISIONS	MAN	CAD

APPROVALS

Municipal

Engineer

Date

Design	D.H.S.	Checked	P.D.S.
Drawn	P.D.	Checked	D.H.S.
Scale	N.T.S.		
Date	OCTOBER 2013		

WASTEWATER COLLECTION SYSTEM
DRAFT FINAL
YEAR 2011 EXISTING CONDITION

The City of BARRIE

amec

Contract No.	2011-29
Consultant File No.	110135
Drawing No.	SHEET 4 OF 8

P:\Work\110135\Hwy\dwg\Contract\Sanitary\Third_Submission\October Submission\Existing City\04-2011 Surcharge.dwg

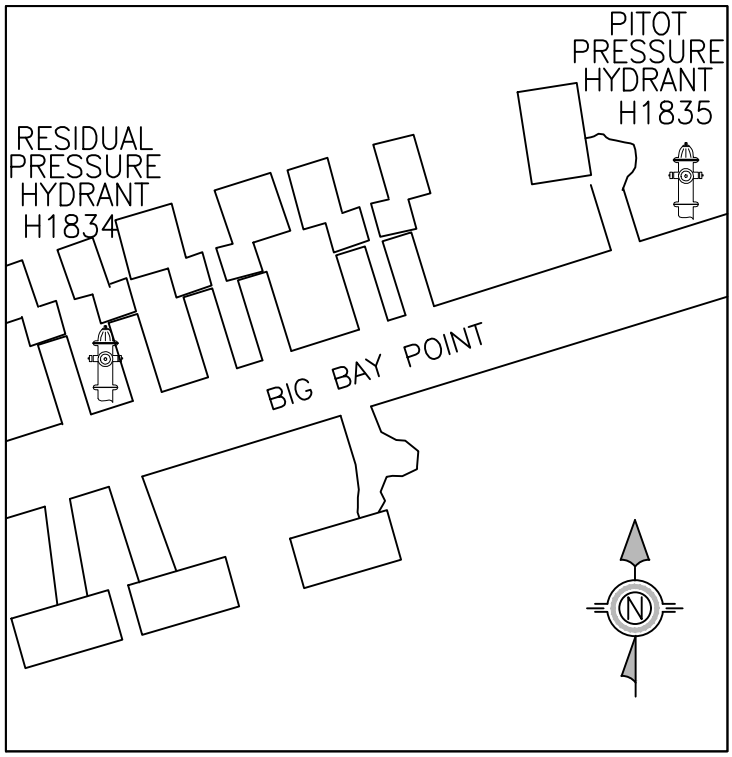
FLOW TEST RESULTS

FIRST FOR FIRE, LIFE SAFETY & SECURITY
VIPOND INC
est. 1945

DATE : MAY 26, 2017 TIME : 9:00 AM

LOCATION : 435 BIG BAY POINT
BARRIE
ONTARIO

TEST BY : Z. DUBROS AND LOCAL PUC



STATIC PRESSURE : 51 PSI

TEST NO.	NO. OF NOZZLES	NOZZLE DIAMETER (INCHES)	DISCHARGE CO-EFFICIENT	RESIDUAL PRESSURE (PSI)	PITOT PRESSURE (PSI)	DISCHARGE (U.S. GPM)	
1	1	2-1/2"	0.9	51	58	1278	
2	2	2-1/2"	0.9	51	58 / 38	2312	

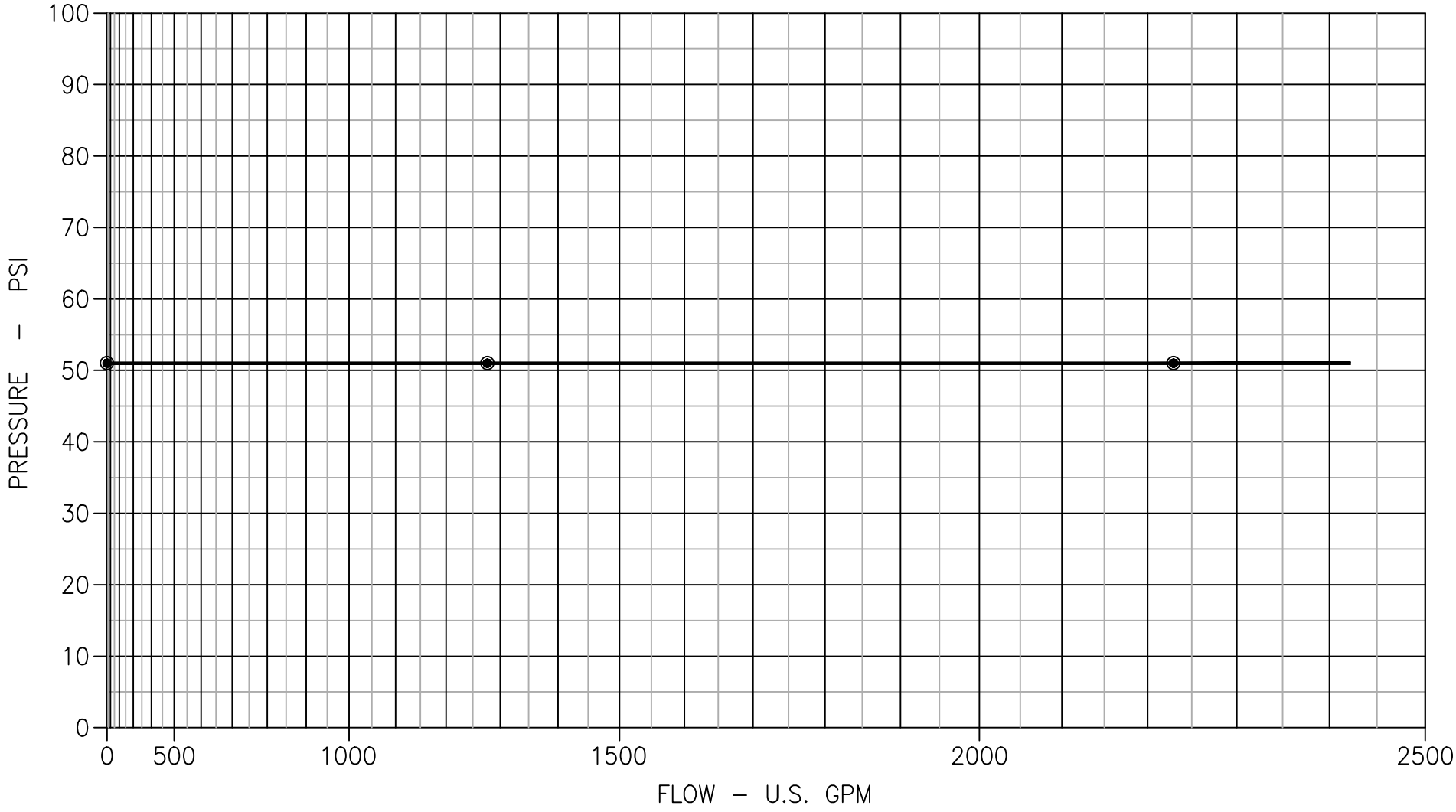
FIRST FOR FIRE, LIFE SAFETY & SECURITY

VIPOND INC

est. 1945

435 BIG BAY POINT	BY : ZACHARY DUBROS
BARRIE	OFFICE : BARRIE
ONTARIO	TEST BY : Z. DUBROS & P.U.C.
	DATE : MAY 26, 2017

STATIC:		RESIDUAL:		FLOW:
51 PSI	TEST#1	51 PSI	@	1278 GPM
	TEST#2	RESIDUAL: 51 PSI	@	FLOW: 2312 GPM



435 Big Bay Point Road

City of Barrie

SANITARY SEWER DESIGN SHEET

ENGINEERING AND PUBLIC WORKS

Project Number: 17-11291
Date: September 1, 2017
Design By: LPB
Checked By: LPB
File: \\pinestoneserver\company\Project Documents\11291B 435 BBPR Townhomes\FSR\Sanitary Sewer Design Sheet_Sept 2017.xls

Drainage Area Plan No: N/A

Design Parameters

Average Daily Flow
Residential 0.0026 L/s/c
Commercial 0.326 L/s/ha (peak x4)

Mannings "*n*" 0.0130
Min. Velocity 0.75 m/sec
Max. Velocity 3.0 m/sec
Residential Harmon Peaking Factor (F)
Infiltration 0.10 L/s/ha

PINESTONE ENGINEERING LTD.

LOCATION				RESIDENTIAL AREAS and POPULATION						SCHOOL, INSTITUTIONAL			COMMERCIAL			INDUSTRIAL				INFILTRATION			DESIGN						
										HECTARES AND FLOW OF EACH ZONING																		
										0.00 *L/s/ha*			0.326 *L/s/ha*			0.00 *L/s/ha*												
STREET	AREA NO.	MANHOLE LOCATION FROM MH	MANHOLE LOCATION TO MH	AREA	UNITS	POPUL.	CUMUL POPUL.	PEAK FACTOR "F"	PEAK RES. FLOW	AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW	AREA	CUMUL AREA	PEAK FLOW	TOTALS-C-I FLOW	AREA	CUMUL AREA	INFIL FLOW	TOTAL VOLUME FLOW	LENGTH	SLOPE	PIPE SIZE	CAPACITY	FULL FLOW VELOCITY	ACTUAL VELOCITY
				ha		*1000s*	*1000s*		*L/sec*	*ha*	*ha*	*L/sec*	*ha*	*ha*	*L/sec*	*ha*	*ha*	*L/sec*	*L/sec*	*ha*	*ha*	*L/sec*	*L/sec*	*m*	*%*	*mm*	*L/sec.*	*m/s*	*m/s*
Proposed Development (19 Townhouse units)				0.70	19.00	0.044	0.042	4	0.4375											0.70	0.70	0.0700	0.5075	60.0	2.00	250	84.0571	1.713	0.465
																								26.0	5.00	250	132.9059	2.709	

Capacity of Immediate Downstream Reach of 250mm dia. Sanitary Sewer =

APPENDIX C

Storm Water Management Calculations

PINESTONE ENGINEERING LTD.

The storm duration is set to the time of concentration (i.e. the sewer inlet time plus the time of travel in the pipe or channel) for the total cumulative drainage area to the node of interest. The maximum inlet time for the first pipe of a storm sewer system is 10 minutes.

The runoff coefficient shall be calculated in accordance with the following table:

Table 3.2: Runoff Coefficients (Rational *C*) (5-yr to 10-yr) Based on Hydrologic Soil Group

Land Use	Runoff Coefficient "C"		
	A-AB	B-BC	C-D
Cultivated Land, 0 - 5% grade	0.22	0.35	0.55
Cultivated Land, 5 - 10% grade	0.30	0.45	0.60
Cultivated Land, 10 - 30% grade	0.40	0.65	0.70
Pasture Land, 0 - 5% grade	0.10	0.28	0.40
Pasture Land, 5 - 10% grade	0.15	0.35	0.45
Pasture Land, 10 - 30% grade	0.22	0.40	0.55
Woodlot or Cutover, 0 – 5% grade	0.08	0.25	0.35
Woodlot or Cutover, 5 - 10% grade	0.12	0.30	0.42
Woodlot or Cutover, 10 - 30% grade	0.18	0.35	0.52
Lakes and Wetlands	0.05	0.05	0.05
Impervious Area (i.e., buildings, roads, parking lots, etc.)	0.95	0.95	0.95
Gravel (not to be used for proposed parking or storage areas)	0.40	0.50	0.60
Residential – Single Family	0.30	0.40	0.50
Residential – Multiple (i.e., semi, townhouse, apartment)	0.50	0.60	0.70
Industrial – light	0.55	0.65	0.75
Industrial – heavy	0.65	0.75	0.85
Commercial	0.60	0.70	0.80
Unimproved Areas	0.10	0.20	0.30
Lawn, < 2% grade	0.05	0.11	0.17
Lawn, 2 - 7% grade	0.10	0.16	0.22
Lawn, > 7% grade	0.15	0.25	0.35

Adapted from Design Chart 1.07, Ontario Ministry of Transportation, "MTO Drainage Management Manual," MTO. (1997)

An approximation of the runoff coefficient can be calculated based on the following relationship with:

$$c=(0.7)(TIMP)+0.2$$

where,

c = the runoff coefficient

TIMP = total impervious fraction (dimensionless)

The runoff coefficient shall be adjusted for return period events greater than the 10-yr storm per the following table:

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)

435 BIG BAY POINT ROAD

MODIFIED RATIONAL METHOD: PRE-DEVELOPMENT CATCHMENT 101

City of Barrie

Project Number: 17-11291B
Date: Septemnber 2018
Design By: JHV
File: \\PINESTONESERVER\Shared Folders\Company\Project Documents\11291B 435 BBPR Townhomes\FSR\MRM Calculations.xls

IDF Curve Parameters				Intensity
Storm Event	A	B	C	(mm/hr)
2 year	678.085	4.699	0.7810	83.11
5 year	853.608	4.699	0.7660	108.92
10 year	975.865	4.699	0.7600	126.55
25 year	1146.275	4.922	0.7570	148.15
50 year	1236.152	4.699	0.7510	164.22
100 year	1426.408	5.273	0.7590	180.15

Tc = 10.0 minutes

$$i = \frac{A}{(t_c + B)^c}$$

i = average rainfall intensity (mm/hr)
A,B,C, = the IDF equation coefficients (dimensionless)
T_c = time of concentration (min)
(see time of concentration calculations for values)

Runoff Coefficients	
Land Use	"C"
Cultivated Land	0.35
Unimproved Area	0.20
Woodlot	0.30
Ponds / Swamps	0.05
Impervious Area	0.95
Building Area	0.95
Gravel	0.50
Lawn	0.16
X	0.00
Y	0.00
Z	0.00

Catchment Parameters			
Catchment ID	=	101	
Catchment Area	=	0.060	ha
Flow Length	=	60	m
Slope	=	0.04	m/m
Weighted Runoff Coefficient	=	0.30	

Pre-Development Runoff Coefficients:

Catchment	Total Area (m^2)	Cultivated Area (m^2)	Unimproved Area (m^2)	Woodlot Area (m^2)	Ponds/Swamps Area (m^2)	Impervious Area (m^2)	Building Area (m^2)	Gravel Area (m^2)	Lawn Area (m^2)	X Area (m^2)	Y Area (m^2)	Z Area (m^2)	Weighted C
101	6,027			3,305		135	337		2,250				0.30

Runoff Coefficient Adjustment for 25-100 yr Storm Events:

Catchment	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
101	0.30	0.30	0.30	0.33	0.36	0.37

Pre-Development Peak Flow Rates:

Catchment	2-Year (m^3/s)	5-Year (m^3/s)	10-Year (m^3/s)	25-Year (m^3/s)	50-Year (m^3/s)	100-Year (m^3/s)
101	0.042	0.054	0.063	0.081	0.099	0.113

Notes:
1) Runoff coefficients from City of Barrie SWM Guidelines
2) Runoff coefficients for events greater than the 10 year storm have been adjusted per MTO Drainage Manual

435 BIG BAY POINT ROAD

MODIFIED RATIONAL METHOD: POST-DEVELOPMENT CATCHMENT 201

City of Barrie

Project Number: 17-11291B
Date: September 26, 2018
Design By: JHV
File: \\PINESTONESERVER\Shared Folders\Company\Project Documents\11291B 435 BBPR Townhomes\FSR\MRM Calculations.xls

IDF Curve Parameters				Intensity
Storm Event	A	B	C	(mm/hr)
2 year	678.085	4.699	0.7810	83.11
5 year	853.608	4.699	0.7660	108.92
10 year	975.865	4.699	0.7600	126.55
25 year	1146.275	4.922	0.7570	148.15
50 year	1236.152	4.699	0.7510	164.22
100 year	1426.408	5.273	0.7590	180.15

Tc = 10.0 minutes

$$i = \frac{A}{(t_c + B)^C}$$

I = average rainfall intensity (mm/hr)
A,B,C, = the IDF equation coefficients (dimensionless)
T_c = time of concentration (min)
(see time of concentration calculations for values)

Runoff Coefficients	
Land Use	"C"
Cultivated Land	0.35
Unimproved Area	0.20
Woodlot	0.30
Ponds / Swamps	0.05
Impervious Area	0.95
Building Area	0.95
Gravel	0.50
Lawn	0.16
X	0.00
Y	0.00
Z	0.00

Catchment Parameters			
Catchment ID	=	201	
Catchment Area	=	0.367	ha
Flow Length	=	60	m
Slope	=	0.02	m/m
Weighted Runoff Coefficient	=	0.70	

Post-Development Runoff Coefficients:

Catchment	Total Area (m^2)	Cultivated Area (m^2)	Unimproved Area (m^2)	Woodlot Area (m^2)	Ponds/Swamps Area (m^2)	Impervious Area (m^2)	Building Area (m^2)	Gravel Area (m^2)	Lawn Area (m^2)	X Area (m^2)	Y Area (m^2)	Z Area (m^2)	Weighted C
201	3,667			810		2,350			507				0.70

Runoff Coefficient Adjustment for 25-100 yr Storm Events:

Catchment	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
201	0.70	0.70	0.70	0.77	0.84	0.87

Post-Development Peak Flow Rates:

Catchment	2-Year (m^3/s)	5-Year (m^3/s)	10-Year (m^3/s)	25-Year (m^3/s)	50-Year (m^3/s)	100-Year (m^3/s)
201	0.059	0.077	0.090	0.116	0.140	0.160

Notes:
1) Runoff coefficients from LSRCA SWM Guidelines Section 21.0 and Section 22.0
2) Runoff coefficients for events greater than the 10 year storm have been adjusted per MTO Drainage Manual

435 BIG BAY POINT ROAD

MODIFIED RATIONAL METHOD: POST-DEVELOPMENT CATCHMENT 202

City of Barrie

Project Number: 17-11291B
Date: September 26, 2018
Design By: JHV
File: \\PINESTONESERVER\Shared Folders\Company\Project Documents\11291B 435 BBPR Townhomes\FSR\MRM Calculations.xls

IDF Curve Parameters				Intensity
Storm Event	A	B	C	(mm/hr)
2 year	678.085	4.699	0.7810	83.11
5 year	853.608	4.699	0.7660	108.92
10 year	975.865	4.699	0.7600	126.55
25 year	1146.275	4.922	0.7570	148.15
50 year	1236.152	4.699	0.7510	164.22
100 year	1426.408	5.273	0.7590	180.15

Tc = 10.0 minutes

$$i = \frac{A}{(t_c + B)^c}$$

I = average rainfall intensity (mm/hr)
A,B,C, = the IDF equation coefficients (dimensionless)
T_c = time of concentration (min)
(see time of concentration calculations for values)

Runoff Coefficients	
Land Use	"C"
Cultivated Land	0.35
Unimproved Area	0.20
Woodlot	0.30
Ponds / Swamps	0.05
Impervious Area	0.95
Building Area	0.95
Gravel	0.50
Lawn	0.16
X	0.00
Y	0.00
Z	0.00

Catchment Parameters			
Catchment ID	=	202	
Catchment Area	=	0.093	ha
Flow Length	=	30	m
Slope	=	0.03	m/m
Weighted Runoff Coefficient	=	0.33	

Post-Development Runoff Coefficients:

Catchment	Total Area (m^2)	Cultivated Area (m^2)	Unimproved Area (m^2)	Woodlot Area (m^2)	Ponds/Swamps Area (m^2)	Impervious Area (m^2)	Building Area (m^2)	Gravel Area (m^2)	Lawn Area (m^2)	X Area (m^2)	Y Area (m^2)	Z Area (m^2)	Weighted C
202	928					200			728				0.33

Runoff Coefficient Adjustment for 25-100 yr Storm Events:

Catchment	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
202	0.33	0.33	0.33	0.36	0.40	0.41

Post-Development Peak Flow Rates:

Catchment	2-Year (m^3/s)	5-Year (m^3/s)	10-Year (m^3/s)	25-Year (m^3/s)	50-Year (m^3/s)	100-Year (m^3/s)
202	0.007	0.009	0.011	0.014	0.017	0.019

Notes:

1) Runoff coefficients from LSRCA SWM Guidelines Section 21.0 and Section 22.0
2) Runoff coefficients for events greater than the 10 year storm have been adjusted per MTO Drainage Manual

435 BIG BAY POINT ROAD

MODIFIED RATIONAL METHOD: POST-DEVELOPMENT CATCHMENT 203

City of Barrie

Project Number: 17-11291B
Date: September 26, 2018
Design By: JHV
File: \\PINESTONESERVER\Shared Folders\Company\Project Documents\11291B 435 BBPR Townhomes\FSR\MRM Calculations.xls

IDF Curve Parameters				Intensity
Storm Event	A	B	C	(mm/hr)
2 year	678.085	4.699	0.7810	83.11
5 year	853.608	4.699	0.7660	108.92
10 year	975.865	4.699	0.7600	126.55
25 year	1146.275	4.922	0.7570	148.15
50 year	1236.152	4.699	0.7510	164.22
100 year	1426.408	5.273	0.7590	180.15

Tc = 10.0 minutes

$$i = \frac{A}{(t_c + B)^c}$$

I = average rainfall intensity (mm/hr)
A,B,C, = the IDF equation coefficients (dimensionless)
T_c = time of concentration (min)
(see time of concentration calculations for values)

Runoff Coefficients	
Land Use	"C"
Cultivated Land	0.35
Unimproved Area	0.20
Woodlot	0.30
Ponds / Swamps	0.05
Impervious Area	0.95
Building Area	0.95
Gravel	0.50
Lawn	0.16
X	0.00
Y	0.00
Z	0.00

Catchment Parameters			
Catchment ID	=	203	
Catchment Area	=	0.045	ha
Flow Length	=	15	m
Slope	=	0.02	m/m
Weighted Runoff Coefficient	=	0.16	

Post-Development Runoff Coefficients:

Catchment	Total Area (m^2)	Cultivated Area (m^2)	Unimproved Area (m^2)	Woodlot Area (m^2)	Ponds/Swamps Area (m^2)	Impervious Area (m^2)	Building Area (m^2)	Gravel Area (m^2)	Lawn Area (m^2)	X Area (m^2)	Y Area (m^2)	Z Area (m^2)	Weighted C
203	452								452				0.16

Runoff Coefficient Adjustment for 25-100 yr Storm Events:

Catchment	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
203	0.16	0.16	0.16	0.18	0.19	0.20

Post-Development Peak Flow Rates:

Catchment	2-Year (m^3/s)	5-Year (m^3/s)	10-Year (m^3/s)	25-Year (m^3/s)	50-Year (m^3/s)	100-Year (m^3/s)
203	0.002	0.002	0.003	0.003	0.004	0.005

Notes:

1) Runoff coefficients from LSRCA SWM Guidelines Section 21.0 and Section 22.0
2) Runoff coefficients for events greater than the 10 year storm have been adjusted per MTO Drainage Manual

435 BIG BAY POINT ROAD

MODIFIED RATIONAL METHOD: POST-DEVELOPMENT CATCHMENT 204

City of Barrie

Project Number: 17-11291B
Date: September 26, 2018
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IDF Curve Parameters				Intensity
Storm Event	A	B	C	(mm/hr)
2 year	678.085	4.699	0.7810	83.11
5 year	853.608	4.699	0.7660	108.92
10 year	975.865	4.699	0.7600	126.55
25 year	1146.275	4.922	0.7570	148.15
50 year	1236.152	4.699	0.7510	164.22
100 year	1426.408	5.273	0.7590	180.15

Tc = 10.0 minutes

$$i = \frac{A}{(t_c + B)^c}$$

I = average rainfall intensity (mm/hr)
A,B,C, = the IDF equation coefficients (dimensionless)
T_c = time of concentration (min)
(see time of concentration calculations for values)

Runoff Coefficients	
Land Use	"C"
Cultivated Land	0.35
Unimproved Area	0.20
Woodlot	0.30
Ponds / Swamps	0.05
Impervious Area	0.95
Building Area	0.95
Gravel	0.50
Lawn	0.16
X	0.00
Y	0.00
Z	0.00

Catchment Parameters			
Catchment ID	=	204	
Catchment Area	=	0.069	ha
Flow Length	=	15	m
Slope	=	0.02	m/m
Weighted Runoff Coefficient	=	0.16	

Post-Development Runoff Coefficients:

Catchment	Total Area (m^2)	Cultivated Area (m^2)	Unimproved Area (m^2)	Woodlot Area (m^2)	Ponds/Swamps Area (m^2)	Impervious Area (m^2)	Building Area (m^2)	Gravel Area (m^2)	Lawn Area (m^2)	X Area (m^2)	Y Area (m^2)	Z Area (m^2)	Weighted C
204	690								690				0.16

Runoff Coefficient Adjustment for 25-100 yr Storm Events:

Catchment	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
204	0.16	0.16	0.16	0.18	0.19	0.20

Post-Development Peak Flow Rates:

Catchment	2-Year (m^3/s)	5-Year (m^3/s)	10-Year (m^3/s)	25-Year (m^3/s)	50-Year (m^3/s)	100-Year (m^3/s)
204	0.003	0.003	0.004	0.005	0.006	0.007

Notes:

1) Runoff coefficients from LSRCA SWM Guidelines Section 21.0 and Section 22.0
2) Runoff coefficients for events greater than the 10 year storm have been adjusted per MTO Drainage Manual

435 BIG BAY POINT ROAD

MODIFIED RATIONAL METHOD: POST-DEVELOPMENT CATCHMENT 204

City of Barrie

Project Number: 17-11291B
Date: September 26, 2018
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File: \\PINESTONESERVER\Shared Folders\Company\Project Documents\11291B 435 BBPR Townhomes\FSR\MRM Calculations.xls

IDF Curve Parameters				Intensity
Storm Event	A	B	C	(mm/hr)
2 year	678.085	4.699	0.7810	83.11
5 year	853.608	4.699	0.7660	108.92
10 year	975.865	4.699	0.7600	126.55
25 year	1146.275	4.922	0.7570	148.15
50 year	1236.152	4.699	0.7510	164.22
100 year	1426.408	5.273	0.7590	180.15

Tc = 10.0 minutes

$$i = \frac{A}{(t_c + B)^C}$$

I = average rainfall intensity (mm/hr)
A,B,C, = the IDF equation coefficients (dimensionless)
T_c = time of concentration (min)
(see time of concentration calculations for values)

Runoff Coefficients	
Land Use	"C"
Cultivated Land	0.35
Unimproved Area	0.20
Woodlot	0.30
Ponds / Swamps	0.05
Impervious Area	0.95
Building Area	0.95
Gravel	0.50
Lawn	0.16
X	0.00
Y	0.00
Z	0.00

Catchment Parameters			
Catchment ID	=	205	
Catchment Area	=	0.029	ha
Flow Length	=	10	m
Slope	=	0.03	m/m
Weighted Runoff Coefficient	=	0.20	

Post-Development Runoff Coefficients:

Catchment	Total Area (m^2)	Cultivated Area (m^2)	Unimproved Area (m^2)	Woodlot Area (m^2)	Ponds/Swamps Area (m^2)	Impervious Area (m^2)	Building Area (m^2)	Gravel Area (m^2)	Lawn Area (m^2)	X Area (m^2)	Y Area (m^2)	Z Area (m^2)	Weighted C
205	290					15			275				0.20

Runoff Coefficient Adjustment for 25-100 yr Storm Events:

Catchment	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
205	0.20	0.20	0.20	0.22	0.24	0.25

Post-Development Peak Flow Rates:

Catchment	2-Year (m^3/s)	5-Year (m^3/s)	10-Year (m^3/s)	25-Year (m^3/s)	50-Year (m^3/s)	100-Year (m^3/s)
205	0.001	0.002	0.002	0.003	0.003	0.004

Notes:

1) Runoff coefficients from LSRCA SWM Guidelines Section 21.0 and Section 22.0
2) Runoff coefficients for events greater than the 10 year storm have been adjusted per MTO Drainage Manual

435 BIG BAY POINT ROAD

MODIFIED RATIONAL METHOD - PRE TO POST DEVELOPMENT FLOW SUMMARY

City of Barrie

PINESTONE ENGINEERING LTD.

Project Number: 17-11291B
Date: September 26, 2018
Design By: JHV
File: \\PINESTONESERVER\Shared Folders\Company\Project Documents\11291B 435 BBPR Townhomes\FSR\MRM Calculations.xls

Storm Event	2 Year (m^3/s)	5 Year (m^3/s)	10 Year (m^3/s)	25 Year (m^3/s)	50 Year (m^3/s)	100 Year (m^3/s)
Pre-Development Catchment 101	0.042	0.054	0.063	0.081	0.099	0.113
Total Pre-Development Flow	**0.042**	**0.054**	**0.063**	**0.081**	**0.099**	**0.113**
Post Development Catchment 201	0.059	0.077	0.090	0.116	0.140	0.160
Post Development Catchment 202	0.007	0.009	0.011	0.014	0.017	0.019
Post Development Catchment 203	0.002	0.002	0.003	0.003	0.004	0.005
Post Development Catchment 204	0.003	0.003	0.004	0.005	0.006	0.007
Post Development Catchment 205	0.001	0.002	0.002	0.003	0.003	0.004
Total Post Development Flow	**0.072**	**0.094**	**0.109**	**0.141**	**0.170**	**0.194**
Total Difference from Post to Pre	**0.030**	**0.039**	**0.046**	**0.059**	**0.071**	**0.082**
Allowable Post Development flow from Catchment 201	***0.040***	***0.053***	***0.061***	***0.079***	***0.096***	***0.109***

435 BIG BAY POINT ROAD

Quantity Control Storage Calculations - Catchment 201

City of Barrie

PINESTONE ENGINEERING LTD.

Project Number: 17-11291B
Date: September 26, 2018
Design By: JHV
File: \\PINESTONESERVER\Shared Folders\Company\Project Documents\11291B 435 BBPR Townhomes\FSR\MRM Calculations.xls

2 Year Storm Event

Total Area 0.5047 ha.
Runoff Coefficient 0.59
Release Rate 25.0 l/sec <= allowable of 0.040
Tc 10.0

Time (mins.)	Intensity (mm/hr)	Peak Inflow (m^3/sec)	Release Rate (m^3/sec)	Required Storage Volume (m^3)
10.0	81.8	0.068	0.025	25.92645377
11	77.5	0.065	0.025	26.14868385
12	73.7	0.061	0.025	26.23027859
13	70.3	0.059	0.025	26.19197107
14	67.2	0.056	0.025	26.05035308
15	64.4	0.054	0.025	25.81888801
16	61.9	0.052	0.025	25.50863598
17	59.5	0.050	0.025	25.12878316
18	57.4	0.048	0.025	24.68703484
19	55.4	0.046	0.025	24.18991193
20	53.6	0.045	0.025	23.64297769
21	51.9	0.043	0.025	23.05101342
22	50.4	0.042	0.025	22.41815604
23	48.9	0.041	0.025	21.74800714
24	47.5	0.040	0.025	21.04372011
25	46.2	0.039	0.025	20.30807045
26	45.0	0.038	0.025	19.543513
27	43.9	0.037	0.025	18.75222882
28	42.8	0.036	0.025	17.93616393
29	41.8	0.035	0.025	17.09706143
30	40.8	0.034	0.025	16.23648851
31	39.9	0.033	0.025	15.35585898
32	39.0	0.033	0.025	14.4564525
33	38.2	0.032	0.025	13.53943083
34	37.4	0.031	0.025	12.60585172
35	36.6	0.031	0.025	11.65668085
36	35.9	0.030	0.025	10.69280213
37	35.2	0.029	0.025	9.71502657
38	34.6	0.029	0.025	8.724100051
39	33.9	0.028	0.025	7.720710028
40	33.3	0.028	0.025	6.705491443
41	32.8	0.027	0.025	5.679031905
42	32.2	0.027	0.025	4.641876244
43	31.7	0.026	0.025	3.594530543
44	31.1	0.026	0.025	2.537465699
45	30.6	0.026	0.025	1.471120599
46	30.2	0.025	0.025	0.395904939
47	29.7	0.025	0.025	-0.687798258
48	29.2	0.024	0.025	-1.779630383
49	28.8	0.024	0.025	-2.879255218
50	28.4	0.024	0.025	-3.986357121
51	28.0	0.023	0.025	-5.100639381

5 Year Storm Event

Total Area	0.5047	ha.
Runoff Coefficient	0.59	
Release Rate	30.0	l/sec <= allowable of 0.053
Tc	10.0	

Time (mins.)	Intensity (mm/hr)	Peak Inflow (m^3/sec)	Release Rate (m^3/sec)	Required Storage Volume (m^3)
10.0	113.2	0.094	0.030	38.62053485
11	107.1	0.089	0.030	39.14622539
12	101.7	0.085	0.030	39.47699195
13	96.9	0.081	0.030	39.64189409
14	92.6	0.077	0.030	39.66414779
15	88.7	0.074	0.030	39.56256136
16	85.1	0.071	0.030	39.35256193
17	81.9	0.068	0.030	39.04694386
18	78.9	0.066	0.030	38.65642375
19	76.2	0.064	0.030	38.19005853
20	73.6	0.061	0.030	37.65556491
21	71.3	0.059	0.030	37.05956648
22	69.1	0.058	0.030	36.40778718
23	67.0	0.056	0.030	35.70520429
24	65.1	0.054	0.030	34.95617068
25	63.3	0.053	0.030	34.16451334
26	61.6	0.051	0.030	33.33361343
27	60.0	0.050	0.030	32.46647189
28	58.5	0.049	0.030	31.56576349
29	57.1	0.048	0.030	30.63388178
30	55.8	0.046	0.030	29.67297659
31	54.5	0.045	0.030	28.6849856
32	53.3	0.044	0.030	27.671661
33	52.1	0.043	0.030	26.6345921
34	51.0	0.043	0.030	25.57522469
35	50.0	0.042	0.030	24.49487759
36	49.0	0.041	0.030	23.39475693
37	48.0	0.040	0.030	22.2759685
38	47.1	0.039	0.030	21.13952844
39	46.2	0.039	0.030	19.98637259
40	45.4	0.038	0.030	18.81736467
41	44.6	0.037	0.030	17.63330339
42	43.8	0.037	0.030	16.4349288
43	43.1	0.036	0.030	15.2229278
44	42.3	0.035	0.030	13.99793914
45	41.6	0.035	0.030	12.76055769
46	41.0	0.034	0.030	11.51133842
47	40.3	0.034	0.030	10.25079981
48	39.7	0.033	0.030	8.979427013
49	39.1	0.033	0.030	7.697674565
50	38.5	0.032	0.030	6.405968946
51	38.0	0.032	0.030	5.104710808

10 Year Storm Event

Total Area	0.5047	ha.
Runoff Coefficient	0.59	
Release Rate	40.0	l/sec <= allowable of 0.061
Tc	10.0	

Time (mins.)	Intensity (mm/hr)	Peak Inflow (m^3/sec)	Release Rate (m^3/sec)	Required Storage Volume (m^3)
10.0	135.6	0.113	0.040	43.84954224
11	127.9	0.107	0.040	44.00609564
12	121.2	0.101	0.040	43.94744844
13	115.2	0.096	0.040	43.70680373
14	109.8	0.092	0.040	43.31040083
15	105.0	0.088	0.040	42.77930366
16	100.6	0.084	0.040	42.13065638
17	96.6	0.081	0.040	41.37858423
18	93.0	0.078	0.040	40.53485263
19	89.6	0.075	0.040	39.60935764
20	86.6	0.072	0.040	38.61049664
21	83.7	0.070	0.040	37.54545248
22	81.1	0.068	0.040	36.42041401
23	78.6	0.066	0.040	35.2407492
24	76.3	0.064	0.040	34.01114253
25	74.2	0.062	0.040	32.73570506
26	72.1	0.060	0.040	31.41806337
27	70.2	0.059	0.040	30.06143212
28	68.4	0.057	0.040	28.66867355
29	66.8	0.056	0.040	27.24234678
30	65.2	0.054	0.040	25.78474875
31	63.6	0.053	0.040	24.29794864
32	62.2	0.052	0.040	22.78381678
33	60.8	0.051	0.040	21.24404917
34	59.5	0.050	0.040	19.68018836
35	58.3	0.049	0.040	18.09364136
36	57.1	0.048	0.040	16.48569491
37	56.0	0.047	0.040	14.85752881
38	54.9	0.046	0.040	13.21022738
39	53.9	0.045	0.040	11.54478945
40	52.9	0.044	0.040	9.86213707
41	52.0	0.043	0.040	8.163123201
42	51.0	0.043	0.040	6.448538396
43	50.2	0.042	0.040	4.719116746
44	49.3	0.041	0.040	2.97554112
45	48.5	0.040	0.040	1.218447812
46	47.7	0.040	0.040	-0.551569315
47	47.0	0.039	0.040	-2.333955151
48	46.3	0.039	0.040	-4.128190028
49	45.6	0.038	0.040	-5.933786778
50	44.9	0.037	0.040	-7.750288066
51	44.2	0.037	0.040	-9.57726401

25 Year Storm Event

Total Area	0.5047	ha
Runoff Coefficient	0.65	
Release Rate	55.0	l/sec <= allowable of 0.079
Tc	10.0	

Time (mins.)	Intensity (mm/hr)	Peak Inflow (m^3/sec)	Release Rate (m^3/sec)	Required Storage Volume (m^3)
10.0	159.9	0.147	0.055	55.14627851
11	150.3	0.138	0.055	54.82158639
12	141.9	0.130	0.055	54.25005222
13	134.5	0.124	0.055	53.47073328
14	127.9	0.118	0.055	52.51418344
15	122.1	0.112	0.055	51.40472992
16	116.8	0.107	0.055	50.16204195
17	112.0	0.103	0.055	48.80223841
18	107.6	0.099	0.055	47.33868713
19	103.6	0.095	0.055	45.78259279
20	99.9	0.092	0.055	44.1434368
21	96.5	0.089	0.055	42.42931142
22	93.4	0.086	0.055	40.64717718
23	90.5	0.083	0.055	38.80306358
24	87.8	0.081	0.055	36.90222747
25	85.2	0.078	0.055	34.94927924
26	82.9	0.076	0.055	32.94828439
27	80.6	0.074	0.055	30.90284603
28	78.6	0.072	0.055	28.81617229
29	76.6	0.070	0.055	26.69113204
30	74.7	0.069	0.055	24.53030105
31	73.0	0.067	0.055	22.33600063
32	71.3	0.065	0.055	20.11033015
33	69.7	0.064	0.055	17.85519442
34	68.2	0.063	0.055	15.57232713
35	66.8	0.061	0.055	13.26331076
36	65.4	0.060	0.055	10.92959374
37	64.1	0.059	0.055	8.572505193
38	62.8	0.058	0.055	6.193267769
39	61.6	0.057	0.055	3.793008745
40	60.5	0.056	0.055	1.372769746
41	59.4	0.055	0.055	-1.066484751
42	58.4	0.054	0.055	-3.523859947
43	57.3	0.053	0.055	-5.998524124
44	56.4	0.052	0.055	-8.489702822
45	55.4	0.051	0.055	-10.99667367
46	54.5	0.050	0.055	-13.51876177
47	53.7	0.049	0.055	-16.05533564
48	52.8	0.049	0.055	-18.60580348
49	52.0	0.048	0.055	-21.16960996
50	51.3	0.047	0.055	-23.7462332
51	50.5	0.046	0.055	-26.33518215

50 Year Storm Event

Total Area	0.5047	ha.
Runoff Coefficient	0.71	
Release Rate	65.0	l/sec <= allowable of 0.096
Tc	10.0	

Time (mins.)	Intensity (mm/hr)	Peak Inflow (m^3/sec)	Release Rate (m^3/sec)	Required Storage Volume (m^3)
10.0	184.6	0.185	0.065	72.14066349
11.0	174.0	0.175	0.065	72.29174825
12.0	164.6	0.165	0.065	72.09113198
13.0	156.3	0.157	0.065	71.59381784
14.0	148.8	0.149	0.065	70.84317825
15.0	142.2	0.143	0.065	69.87395889
16.0	136.1	0.137	0.065	68.71438377
17.0	130.6	0.131	0.065	67.38766314
18.0	125.6	0.126	0.065	65.91309475
19.0	121.0	0.121	0.065	64.30688207
20.0	116.8	0.117	0.065	62.58275191
21.0	112.8	0.113	0.065	60.75242694
22.0	109.2	0.110	0.065	58.82599202
23.0	105.8	0.106	0.065	56.81218143
24.0	102.7	0.103	0.065	54.71860638
25.0	99.7	0.100	0.065	52.55193717
26.0	96.9	0.097	0.065	50.31805018
27.0	94.3	0.095	0.065	48.02214754
28.0	91.9	0.092	0.065	45.66885527
29.0	89.6	0.090	0.065	43.26230443
30.0	87.4	0.088	0.065	40.80619853
31.0	85.3	0.086	0.065	38.30386997
32.0	83.3	0.084	0.065	35.75832757
33.0	81.5	0.082	0.065	33.17229675
34.0	79.7	0.080	0.065	30.54825373
35.0	78.0	0.078	0.065	27.88845482
36.0	76.4	0.077	0.065	25.19496144
37.0	74.9	0.075	0.065	22.46966181
38.0	73.4	0.074	0.065	19.71428971
39.0	72.0	0.072	0.065	16.93044074
40.0	70.6	0.071	0.065	14.11958654
41.0	69.4	0.070	0.065	11.28308726
42.0	68.1	0.068	0.065	8.422202452
43.0	66.9	0.067	0.065	5.538100737
44.0	65.8	0.066	0.065	2.631868295
45.0	64.7	0.065	0.065	-0.295483585
46.0	63.6	0.064	0.065	-3.243011797
47.0	62.6	0.063	0.065	-6.209835445
48.0	61.6	0.062	0.065	-9.195130508
49.0	60.6	0.061	0.065	-12.19812505
50.0	59.7	0.060	0.065	-15.21809495
51.0	58.8	0.059	0.065	-18.25436002

100 Year Storm Event

Total Area	0.5047	ha.
Runoff Coefficient	0.74	
Release Rate	80.0	l/sec <= allowable of 0.109
Tc	10.0	

Time (mins.)	Intensity (mm/hr)	Peak Inflow (m^3/sec)	Release Rate (m^3/sec)	Required Storage Volume (m^3)
10.0	203.3	0.213	0.080	79.56237112
11	192.1	0.201	0.080	79.80058049
12	182.2	0.191	0.080	79.5988379
13	173.4	0.181	0.080	79.02389995
14	165.4	0.173	0.080	78.12895611
15	158.3	0.166	0.080	76.9569869
16	151.7	0.159	0.080	75.54315965
17	145.8	0.152	0.080	73.91657113
18	140.3	0.147	0.080	72.10153752
19	135.3	0.142	0.080	70.1185642
20	130.7	0.137	0.080	67.98508527
21	126.4	0.132	0.080	65.71603464
22	122.4	0.128	0.080	63.32429226
23	118.6	0.124	0.080	60.82103658
24	115.2	0.120	0.080	58.21602554
25	111.9	0.117	0.080	55.51782274
26	108.8	0.114	0.080	52.73398096
27	105.9	0.111	0.080	49.8711922
28	103.2	0.108	0.080	46.93541129
29	100.6	0.105	0.080	43.9319584
30	98.2	0.103	0.080	40.86560452
31	95.9	0.100	0.080	37.74064325
32	93.7	0.098	0.080	34.56095136
33	91.6	0.096	0.080	31.33004018
34	89.7	0.094	0.080	28.0510994
35	87.8	0.092	0.080	24.72703459
36	86.0	0.090	0.080	21.36049943
37	84.2	0.088	0.080	17.95392362
38	82.6	0.086	0.080	14.50953702
39	81.0	0.085	0.080	11.02939067
40	79.5	0.083	0.080	7.515375168
41	78.0	0.082	0.080	3.969236753
42	76.6	0.080	0.080	0.392591449
43	75.3	0.079	0.080	-3.213062464
44	74.0	0.077	0.080	-6.846333411
45	72.8	0.076	0.080	-10.50592675
46	71.6	0.075	0.080	-14.19063607
47	70.4	0.074	0.080	-17.89933545
48	69.3	0.072	0.080	-21.63097251
49	68.2	0.071	0.080	-25.38456222
50	67.2	0.070	0.080	-29.15918134
51	66.2	0.069	0.080	-32.95396339

STORMTECH MC-3500 CHAMBER

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

STORMTECH MC-3500 CHAMBER
(not to scale)

Nominal Chamber Specifications

Size (L x W x H)
90" x 77" x 45"
2,286 mm x 1,956 mm x 1,143 mm

Chamber Storage
109.9 ft³ (3.11 m³)

Min. Installed Storage*
178.9 ft³ (5.06 m³)

Weight
134 lbs (60.8 kg)

Shipping
15 chambers/pallet
7 end caps/pallet
7 pallets/truck

*Assumes a minimum of 12" (300 mm) of stone above, 9" (230 mm) of stone below chambers, 9" (230 mm) of stone between chambers/end caps and 40% stone porosity.

STORMTECH MC-3500 END CAP
(not to scale)

Nominal End Cap Specifications

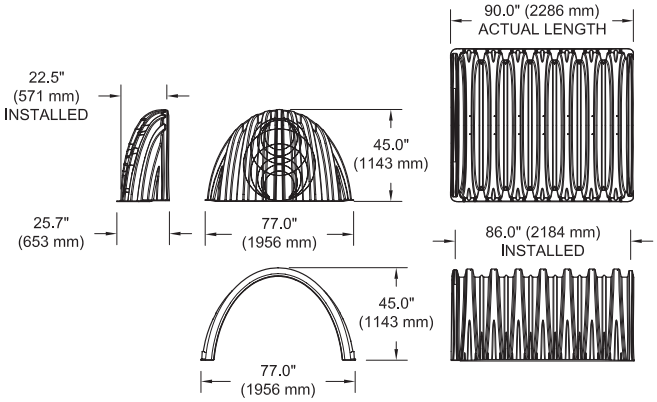
Size (L x W x H)
26.5" x 71" x 45.1"
673 mm x 1,803 mm x 1,145 mm

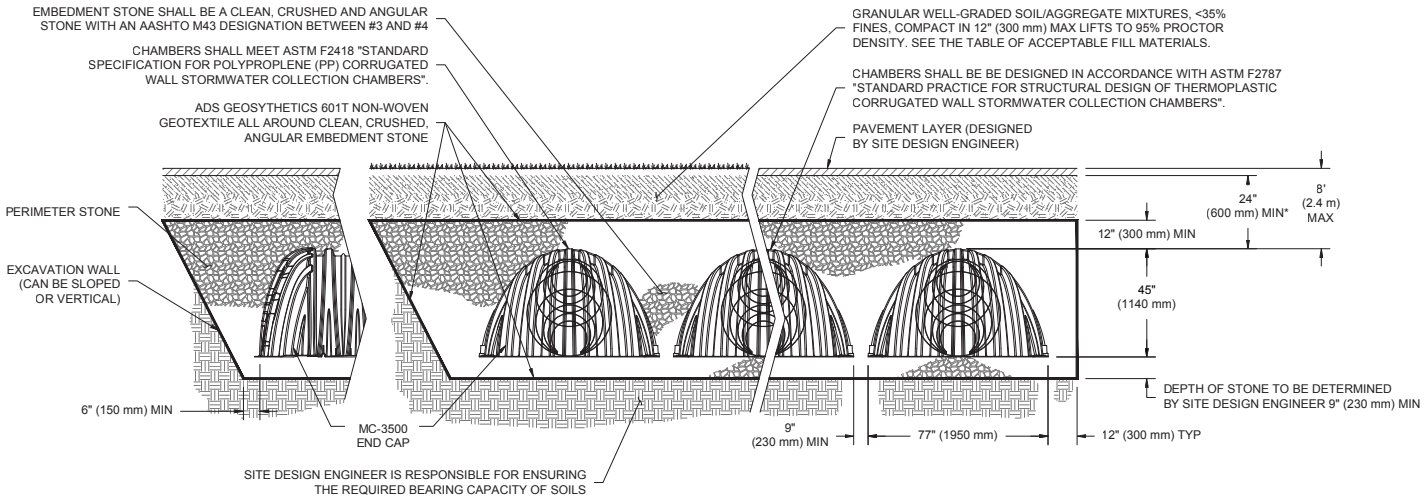
End Cap Storage
14.9 ft³ (1.30 m³)

Min. Installed Storage*
46.0 ft³ (1.30 m³)

Weight
49 lbs (22.2 kg)

*Assumes a minimum of 12" (300 mm) of stone above, 9" (230 mm) of stone below, 6" (150 mm) of stone perimeter, 9" (230 mm) of stone between chambers/end caps and 40% stone porosity.





*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 30" (750 mm).

MC-3500 CHAMBER SPECIFICATION

STORAGE VOLUME PER CHAMBER FT³ (M³)

	Bare Chamber Storage ft³ (m³)	Chamber and Stone Foundation Depth in. (mm)			
		9" (230 mm)	12" (300 mm)	15" (375 mm)	18" (450 mm)
MC-3500 Chamber	109.9 (3.11)	178.9 (5.06)	184.0 (5.21)	189.2 (5.36)	194.3 (5.5)
MC-3500 End Cap	14.9 (.42)	46.0 (1.33)	47.7 (1.35)	49.4 (1.40)	51.1 (1.45)

Note: Assumes 9" (230 mm) row spacing, 40% stone porosity, 12" (300 mm) stone above and includes the bare chamber/end cap volume.

AMOUNT OF STONE PER CHAMBER

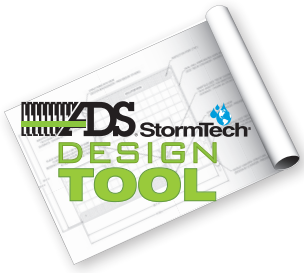
ENGLISH TONS (yds³)	Stone Foundation Depth			
	9"	12"	15"	18"
MC-3500 Chamber	9.1 (6.4)	9.7 (6.9)	10.4 (7.3)	11.1 (7.8)
MC-3500 End Cap	4.1 (2.9)	4.3 (3.0)	4.5 (3.2)	4.5 (3.2)
METRIC KILOGRAMS (m³)	**230 mm**	**300 mm**	**375 mm**	**450 mm**
MC-3500 Chamber	8,220 (4.9)	8,831 (5.3)	9,443 (5.6)	10,054 (6.0)
MC-3500 End Cap	3,699 (2.2)	3,900 (2.3)	4,100 (2.5)	4,301 (2.6)

Note: Assumes 12" (300 mm) of stone above and 9" (230 mm) row spacing and 6" (150 mm) of perimeter stone in front of end caps.

VOLUME EXCAVATION PER CHAMBER YD³ (M³)

	Stone Foundation Depth			
	9" (230 mm)	12" (300 mm)	15" (375mm)	18" (450 mm)
MC-3500 Chamber	12.4 (9.5)	12.8 (9.8)	13.3 (10.2)	13.8 (10.5)
MC-3500 End Cap	4.1 (3.1)	4.2 (3.2)	4.4. (3.3)	4.5 (3.5)

Note: Assumes 9" (230 mm) of separation between chamber rows and 24" (600 mm) of cover. The volume of excavation will vary as depth of cover increases.



Working on a project?
Visit us at www.stormtech.com
and utilize the StormTech Design Tool

For more information on the StormTech MC-3500 Chamber and other ADS products, please contact our Customer Service Representatives at 1-800-821-6710

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ADVANCED DRAINAGE SYSTEMS, INC.

435 Big Bay Point Road

Barrie

STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500 OR APPROVED EQUAL.
2. CHAMBERS SHALL BE MADE FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORT PANELS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
4. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
5. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
6. CHAMBERS SHALL BE DESIGNED AND ALLOWABLE LOADS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
7. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. THE CHAMBER MANUFACTURER SHALL SUBMIT THE FOLLOWING UPON REQUEST TO THE SITE DESIGN ENGINEER FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE:
   a. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY AASHTO FOR THERMOPLASTIC PIPE.
   b. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET. THE 50 YEAR CREEP MODULUS DATA SPECIFIED IN ASTM F2418 MUST BE USED AS PART OF THE AASHTO STRUCTURAL EVALUATION TO VERIFY LONG-TERM PERFORMANCE.
   c. STRUCTURAL CROSS SECTION DETAIL ON WHICH THE STRUCTURAL EVALUATION IS BASED.
8. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS.

   STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 9" (230 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE 3/4-2" (20-50 mm) MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING..
10. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

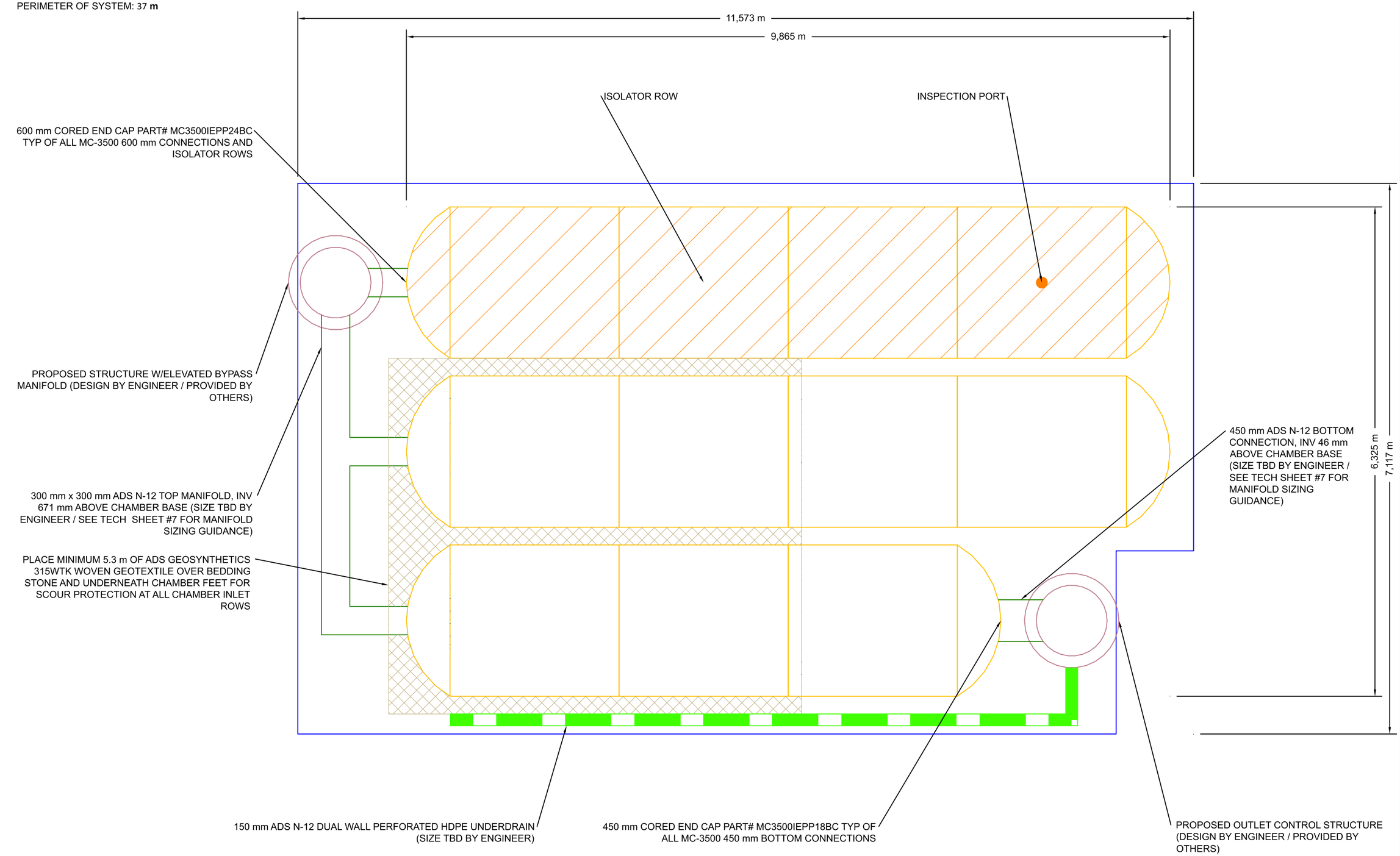
USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

CONCEPTUAL LAYOUT

(11) STORMTECH MC-3500 CHAMBERS
(6) STORMTECH MC-3500 END CAPS
INSTALLED WITH 400 mm COVER STONE, 300 mm BASE STONE, 40% STONE VOID
INSTALLED SYSTEM VOLUME: 81 m³
AREA OF SYSTEM: 80 **m²**
PERIMETER OF SYSTEM: 37 **m**

COMPUTER GENERATED CONCEPTUAL LAYOUT - NOT FOR CONSTRUCTION



435 Big Bay Point Road
Barrie

DATE: 09/24/2018 | DRAWN: JV | CHECKED: ---
PROJECT #: Tool

REV	DRW	CHK	DESCRIPTION

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4640 TRUEMAN BLVD
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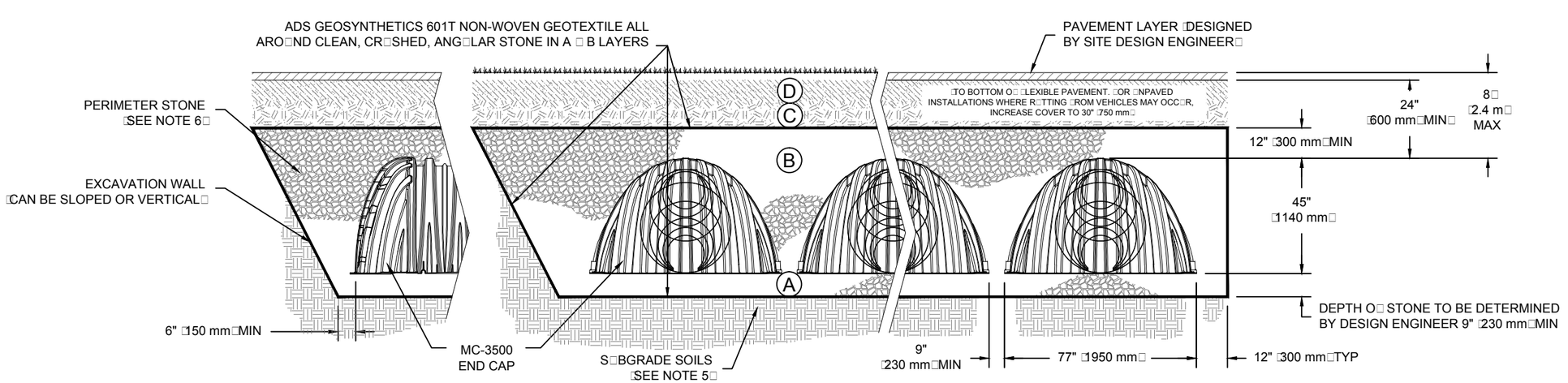
1-800-733-7473

NOT TO SCALE

ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSI□ICATIONS	COMPACTION / DENSITY RE□ □IREMENT
D	**FINAL FILL:** □ILL MATERIAL □OR LAYER ⁄D□ STARTS □ROM THE TOP O□ THE ⁄C□ LAYER TO THE BOTTOM O□ □LEXIBLE PAVEMENT OR □NPAVED □INISHED GRADE ABOVE. NOTE THAT PAVEMENT S□BBASE MAY BE PART O□ THE ⁄D□ LAYER	ANY SOIL/ROC□ MATERIALS, NATIVE SOILS, OR PER ENGINEER□S PLANS. CHEC□ PLANS □OR PAVEMENT S□BGRADE RE□ □IREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER□S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION RE□ □IREMENTS.
C	**INITIAL FILL:** □ILL MATERIAL □OR LAYER ⁄C□ STARTS □ROM THE TOP O□ THE EMBEDMENT STONE ⁄B□ LAYER□ TO 24" ⁄600 mm□ ABOVE THE TOP O□ THE CHAMBER. NOTE THAT PAVEMENT S□BBASE MAY BE A PART O□ THE ⁄C□ LAYER.	GRAN□LAR WELL-GRADED SOIL/AGGREGATE MIXT□RES, □35□ □INES OR PROCESSED AGGREGATE. MOST PAVEMENT S□BBASE MATERIALS CAN BE □SED IN LIE□ O□ THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS A□TER 24" ⁄600 mm□O□ MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" ⁄300 mm□ MAX LI□TS TO A MIN. 95□ PROCTOR DENSITY □OR WELL GRADED MATERIAL AND 95□ RELATIVE DENSITY □OR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** □ILL S□RRO□NDING THE CHAMBERS □ROM THE □O□NDATION STONE □A□ LAYER□ TO THE ⁄C□ LAYER ABOVE.	CLEAN, CR□SHED, ANG□LAR STONE, NOMINAL SI□E DISTRIB□TION BETWEEN 3/4-2 INCH ⁄20-50 mm□	AASHTO M43[1] 3, 4	NO COMPACTION RE□ □IRED.
A	**FOUNDATION STONE:** □ILL BELOW CHAMBERS □ROM THE S□BGRADE □P TO THE □OOT ⁄BOTTOM□ O□ THE CHAMBER.	CLEAN, CR□SHED, ANG□LAR STONE, NOMINAL SI□E DISTRIB□TION BETWEEN 3/4-2 INCH ⁄20-50 mm□	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A □LAT SURFACE. [2 3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE □OR GRADATIONS ONLY. THE STONE M□ST ALSO BE CLEAN, CR□SHED, ANG□LAR. □OR EXAMPLE, A SPECI□ICATION □OR □4 STONE WO□LD STATE: "CLEAN, CR□SHED, ANG□LAR NO. 4 ⁄AASHTO M43□ STONE".
2. STORMTECH COMPACTION RE□ □IREMENTS ARE MET □OR ⁄A□LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" ⁄230 mm□ MAX□LI□TS □SING TWO □□LL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE IN□ILTRATION S□R□ACES MAY BE COMPROMISED BY COMPACTION, □OR STANDARD DESIGN LOAD CONDITIONS, A □LAT S□R□ACE MAY BE ACHIEVED BY RA□ING OR DRAGGING WITHO□T COMPACTION E□□IPMENT. □OR SPECIAL LOAD DESIGNS, CONTACT STORMTECH □OR COMPACTION RE□ □IREMENTS.



NOTES:

1. MC-3500 CHAMBERS SHALL CON□ORM TO THE RE□ □IREMENTS O□ ASTM □2418 "STANDARD SPECI□ICATION □OR POLYPROPYLENE ⁄PP□CORR□GATED WALL STORMWATER COLLECTION CHAMBERS".
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM □2787 "STANDARD PRACTICE □OR STR□CT□RAL DESIGN O□ THERMOPLASTIC CORR□GATED WALL STORMWATER COLLECTION CHAMBERS".
3. "ACCEPTABLE □ILL MATERIALS" TABLE ABOVE PROVIDES MATERIAL LOCATIONS, DESCRIPTIONS, GRADATIONS, AND COMPACTION RE□ □IREMENTS □OR □O□NDATION, EMBEDMENT, AND □ILL MATERIALS.
4. THE "SITE DESIGN ENGINEER" RE□ERS TO THE ENGINEER RESPONSIBLE □OR THE DESIGN AND LAYO□T O□ THE STORMTECH CHAMBERS □OR THIS PROJECT.
5. THE SITE DESIGN ENGINEER IS RESPONSIBLE □OR ASSESSING THE BEARING RESISTANCE ⁄ALLOWABLE BEARING CAPACITY□O□ THE S□BGRADE SOILS AND THE DEPTH O□ □O□NDATION STONE WITH CONSIDERATION □OR THE RANGE O□ EXPECTED SOIL MOIST□RE CONDITIONS.
6. PERIMETER STONE M□ST BE EXTENDED HORI□ONTALLY TO THE EXCAVATION WALL □OR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
7. ONCE LAYER ⁄C□ IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER ⁄D□□P TO THE □INISHED GRADE. MOST PAVEMENT S□BBASE SOILS CAN BE □SED TO REPLACE THE MATERIAL RE□ □IREMENTS O□ LAYER ⁄C□ OR ⁄D□AT THE SITE DESIGN ENGINEER□S DISCRETION.

435 Big Bay Point Road
Barrie

DATE: 09/24/2018 | DRAWN: JV | CHEC□ED: --- | PROJECT □: Tool

REV	DRW	CH□	DESCRIPTION

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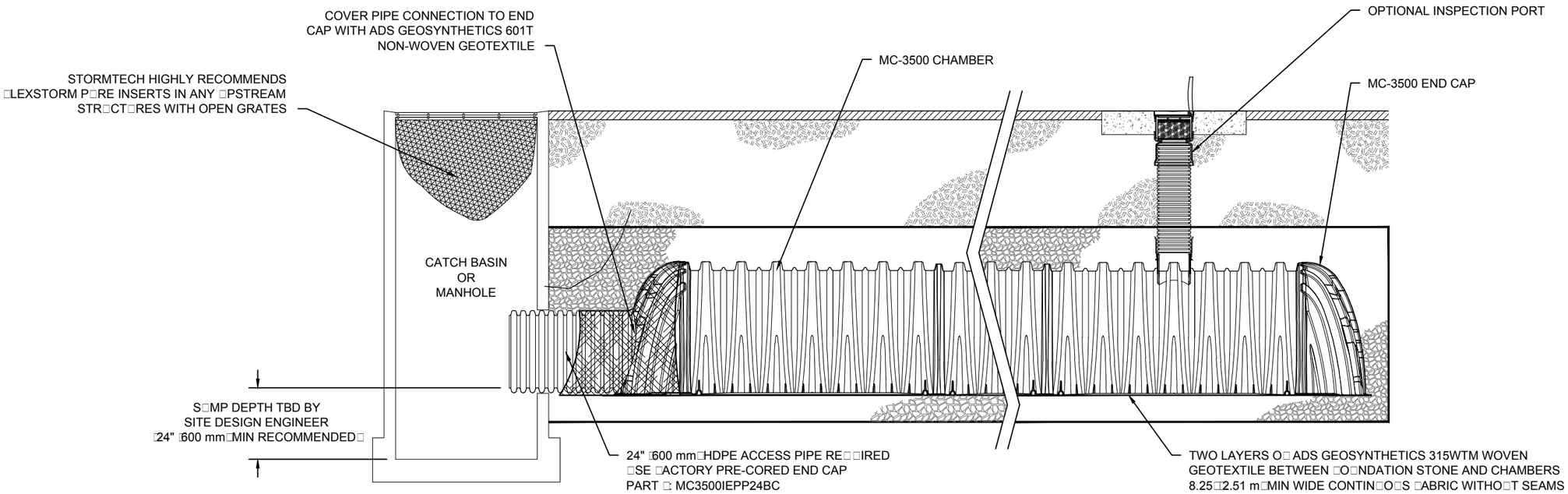


MC-3500 ISOLATOR ROW DETAIL
NTS

INSPECTION & MAINTENANCE

STEP 1□ INSPECT ISOLATOR ROW □OR SEDIMENT
- A. INSPECTION PORTS □I□ PRESENT□
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN □LEXSTORM □ILTER I□ INSTALLED
  - A.3. □SING A □LASHLIGHT AND STADIA ROD, MEAS□RE DEPTH O□ SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW □OR VIS□AL INSPECTION O□ SEDIMENT LEVELS □OPTIONAL□
  - A.5. I□ SEDIMENT IS AT, OR ABOVE, 3" □80 mm□PROCEED TO STEP 2. I□ NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR ROWS
  - B.1. REMOVE COVER □ROM STR□CT□RE AT □PSTREAM END O□ ISOLATOR ROW
  - B.2. □SING A □LASHLIGHT, INSPECT DOWN THE ISOLATOR ROW THRO□GH O□TLET PIPE
    - i□ MIRRORS ON POLES OR CAMERAS MAY BE □SED TO AVOID A CON□INED SPACE ENTRY
    - ii□ □OLLOW OSHA REG□LATIONS □OR CON□INED SPACE ENTRY I□ ENTERING MANHOLE
  - B.3. I□ SEDIMENT IS AT, OR ABOVE, 3" □80 mm□PROCEED TO STEP 2. I□ NOT, PROCEED TO STEP 3.

STEP 2□ CLEAN O□T ISOLATOR ROW □SING THE JETVAC PROCESS
- A. A □IXED C□LVERT CLEANING NO□□LE WITH REAR □ACING SPREAD O□ 45" □1.1 m□OR MORE IS PRE□ERRED
- B. APPLY M□LTIPLE PASSES O□ JETVAC □NTIL BAC□□L□SH WATER IS CLEAN
- C. VAC□□M STR□CT□RE S□MP AS RE□ □IRED

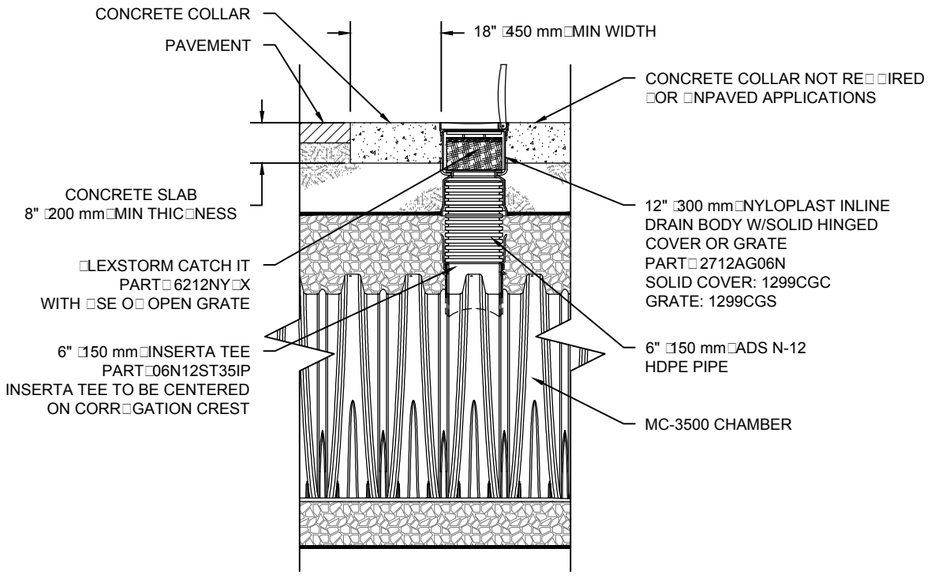
STEP 3□ REPLACE ALL COVERS, GRATES, □ILTERS, AND LIDS□RECORD OBSERVATIONS AND ACTIONS.

STEP 4□ INSPECT AND CLEAN BASINS AND MANHOLES □PSTREAM O□ THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS D□RING THE □IRST YEAR O□ OPERATION. ADJ□ST THE INSPECTION INTERVAL BASED ON PREVIO□S OBSERVATIONS O□ SEDIMENT ACC□M□LATION AND HIGH WATER ELEVATIONS.

2. COND□CT JETTING AND VACTORING ANN□ALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



MC-3500 6" INSPECTION PORT DETAIL
NTS

435 Big Bay Point Road
Barrie

DATE: 09/24/2018 | DRAWN: JV | CHEC□ED: --- | PROJECT □: Tool

REV	DRW	CH□	DESCRIPTION

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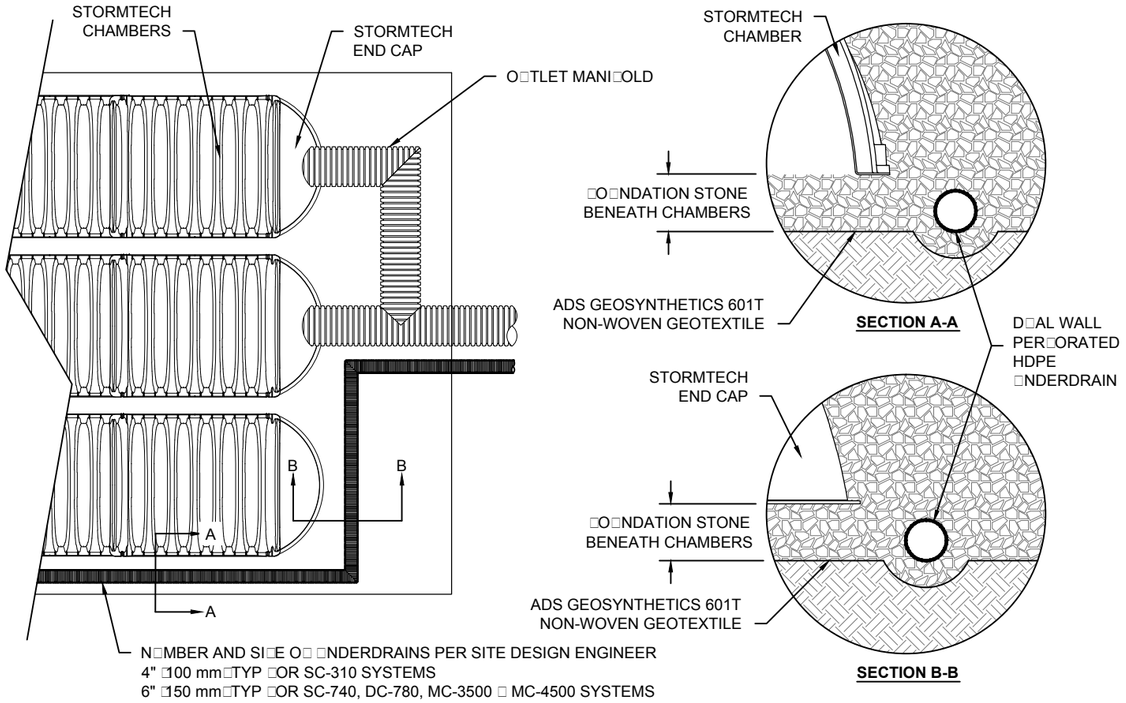
UNDERDRAIN DETAIL

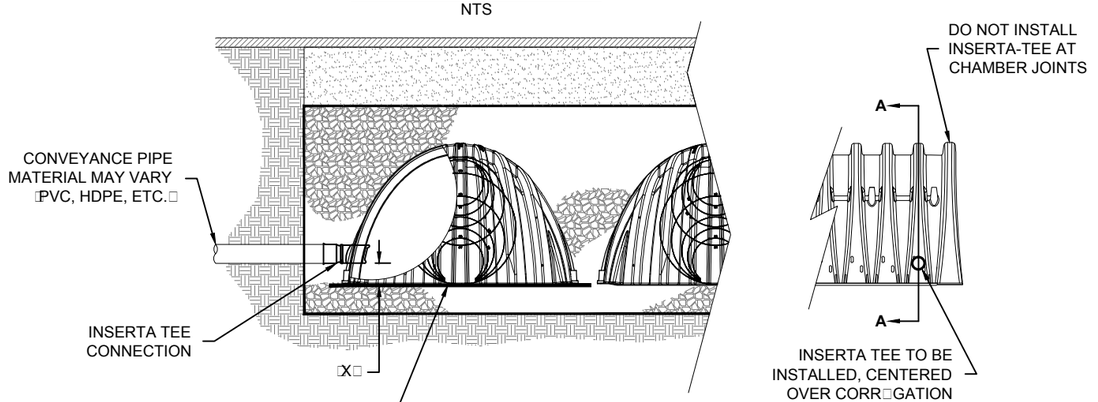
NTS



N□MBER AND SI□E O□ □NDERDRAINS PER SITE DESIGN ENGINEER
4" □100 mm□TYP □OR SC-310 SYSTEMS
6" □150 mm□TYP □OR SC-740, DC-780, MC-3500 □ MC-4500 SYSTEMS

INSERTA TEE DETAIL

NTS

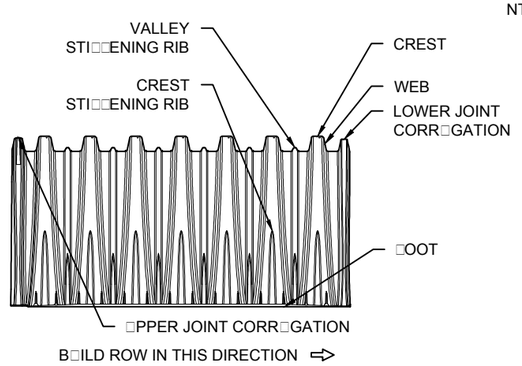


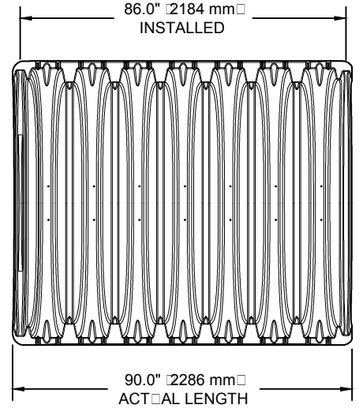
NOTE:
PART N□MBERS WILL VARY BASED ON INLET PIPE MATERIALS.
CONTACT STORMTECH □OR MORE IN□ORMATION.

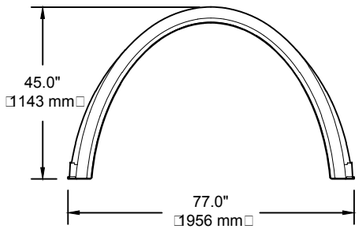
CHAMBER	MAX DIAMETER OF INSERTA TEE	HEIGHT FROM BASE OF CHAMBER (X)
SC-310	6" □150 mm□	4" □100 mm□
SC-740	10" □250 mm□	4" □100 mm□
DC-780	10" □250 mm□	4" □100 mm□
MC-3500	12" □300 mm□	6" □150 mm□
MC-4500	12" □300 mm□	8" □200 mm□
INSERTA TEE □ITTINGS AVAILABLE □OR SDR 26, SDR 35, SCH 40 IPS GAS□ETED □ SOLVENT WELD, N-12, HP STORM, C-900 OR D□CTILE IRON		

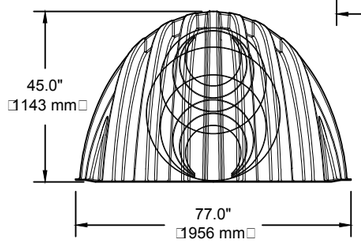
MC-3500 TECHNICAL SPECIFICATION

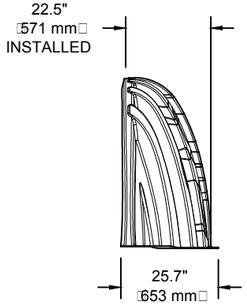
NTS











NOMINAL CHAMBER SPECIFICATIONS

SI□E □W X H X INSTALLED LENGTH□	77.0" X 45.0" X 86.0"	□1956 mm X 1143 mm X 2184 mm□
CHAMBER STORAGE	109.9 C□BIC □EET	(3.11 m³)
MINIM□M INSTALLED STORAGE□	178.9 C□BIC □EET	(5.06 m³)
WEIGHT	135.0 l□□.	□61.2 □g□

NOMINAL END CAP SPECIFICATIONS

SI□E □W X H X INSTALLED LENGTH□	77.0" X 45.0" X 22.5"	□1956 mm X 1143 mm X 571 mm□
END CAP STORAGE	14.9 C□BIC □EET	(0.42 m³)
MINIM□M INSTALLED STORAGE□	46.0 C□BIC □EET	(1.30 m³)
WEIGHT	50.0 l□□.	□22.7 □g□

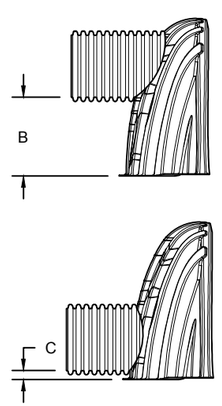
□ASS□MES 12" □305 mm□STONE ABOVE, 9" □229 mm□STONE □O□NDATION AND BETWEEN CHAMBERS,
12" □305 mm□STONE PERIMETER IN □RONT O□ END CAPS AND 40□ STONE POROSITY

ST□BS AT BOTTOM O□ END CAP □OR PART N□MBERS ENDING WITH "B"
ST□BS AT TOP O□ END CAP □OR PART N□MBERS ENDING WITH "T"

PART #	STUB	B	C
MC3500IEPP06T	6" □150 mm□	33.21" □844 mm□	---
MC3500IEPP06B		---	0.66" □17 mm□
MC3500IEPP08T	8" □200 mm□	31.16" □791 mm□	---
MC3500IEPP08B		---	0.81" □21 mm□
MC3500IEPP10T	10" □250 mm□	29.04" □738 mm□	---
MC3500IEPP10B		---	0.93" □24 mm□
MC3500IEPP12T	12" □300 mm□	26.36" □670 mm□	---
MC3500IEPP12B		---	1.35" □34 mm□
MC3500IEPP15T	15" □375 mm□	23.39" □594 mm□	---
MC3500IEPP15B		---	1.50" □38 mm□
MC3500IEPP18TC	18" □450 mm□	20.03" □509 mm□	---
MC3500IEPP18BC		---	1.77" □45 mm□
MC3500IEPP24TC	24" □600 mm□	14.48" □368 mm□	---
MC3500IEPP24BC		---	2.06" □52 mm□
MC3500IEPP30BC	30" □750 mm□	---	

NOTE: ALL DIMENSIONS ARE NOMINAL

C□STOM PRECORED INVERTS ARE AVAILABLE □PON RE□□EST. INVENTORIED MANI□OLDS INCL□DE 12-24" □300-600 mm□SI□E ON SI□E AND 15-48" □375-1200 mm□ECCENTRIC MANI□OLDS.
C□STOM INVERT LOCATIONS ON THE MC-3500 END CAP C□T IN THE □IELD ARE NOT RECOMMENDED □OR PIPE SI□ES GREATER THAN 10" □250 mm□
THE INVERT LOCATION IN COL□MN B□ARE THE HIGHTEST POSSIBLE □OR THE PIPE SI□E.



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REV	DRW	CH□	DESCRIPTION

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MC-SERIES END CAP INSERTION DETAIL

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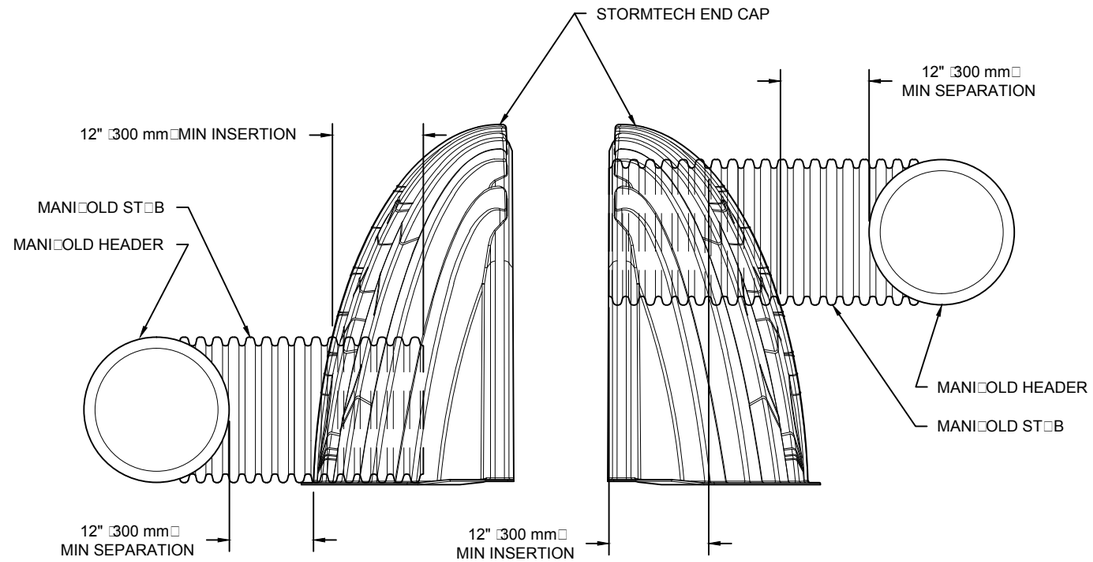

NOTE: MANI□OLD ST□B M□ST BE LAID HORI□ONTAL □OR A PROPER □IT IN END CAP OPENING.

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◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Jellyfish® Filter JF4-2-1

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

In accordance with

ISO 14034:2016

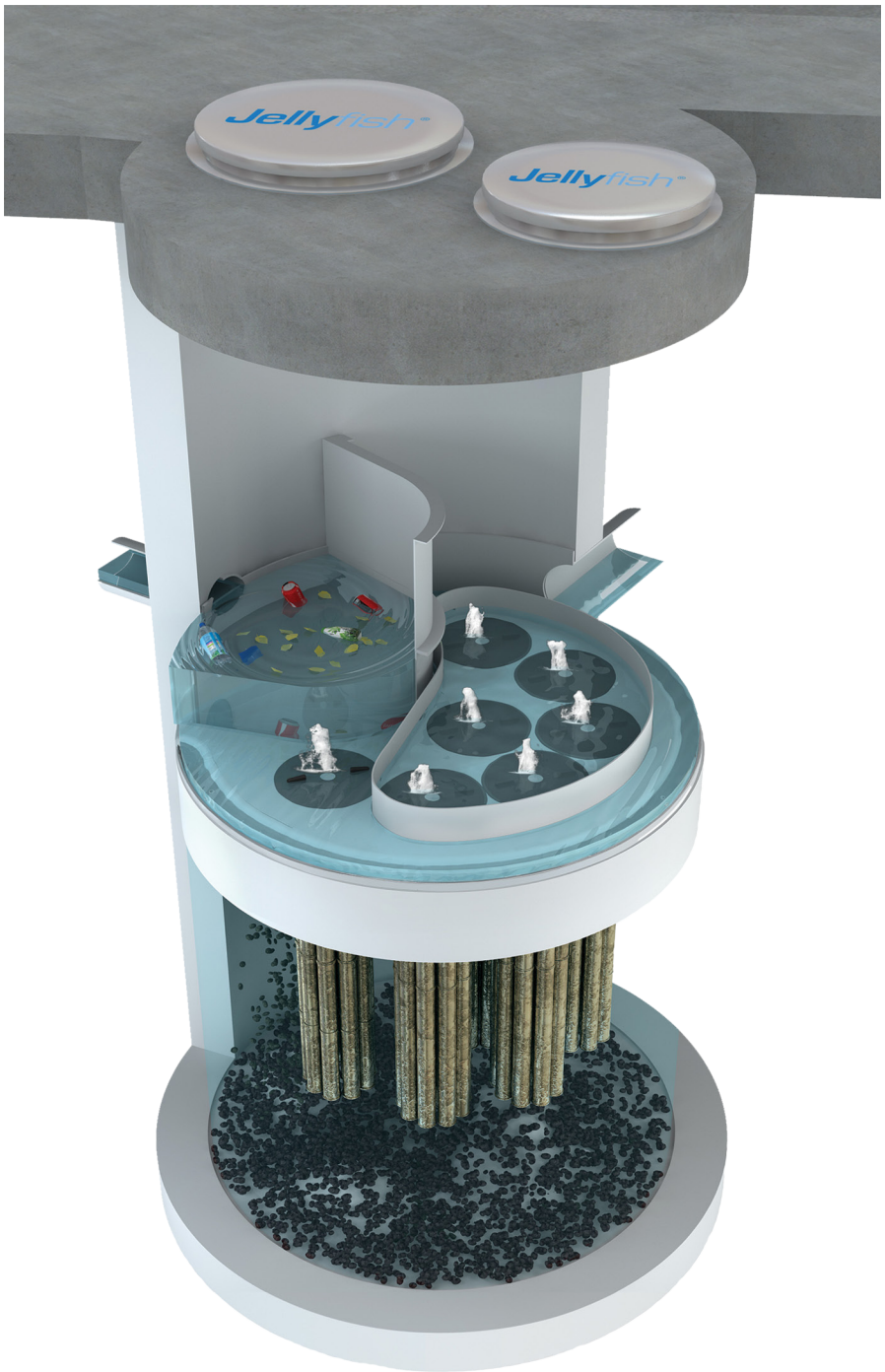
Environmental management —
Environmental technology verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

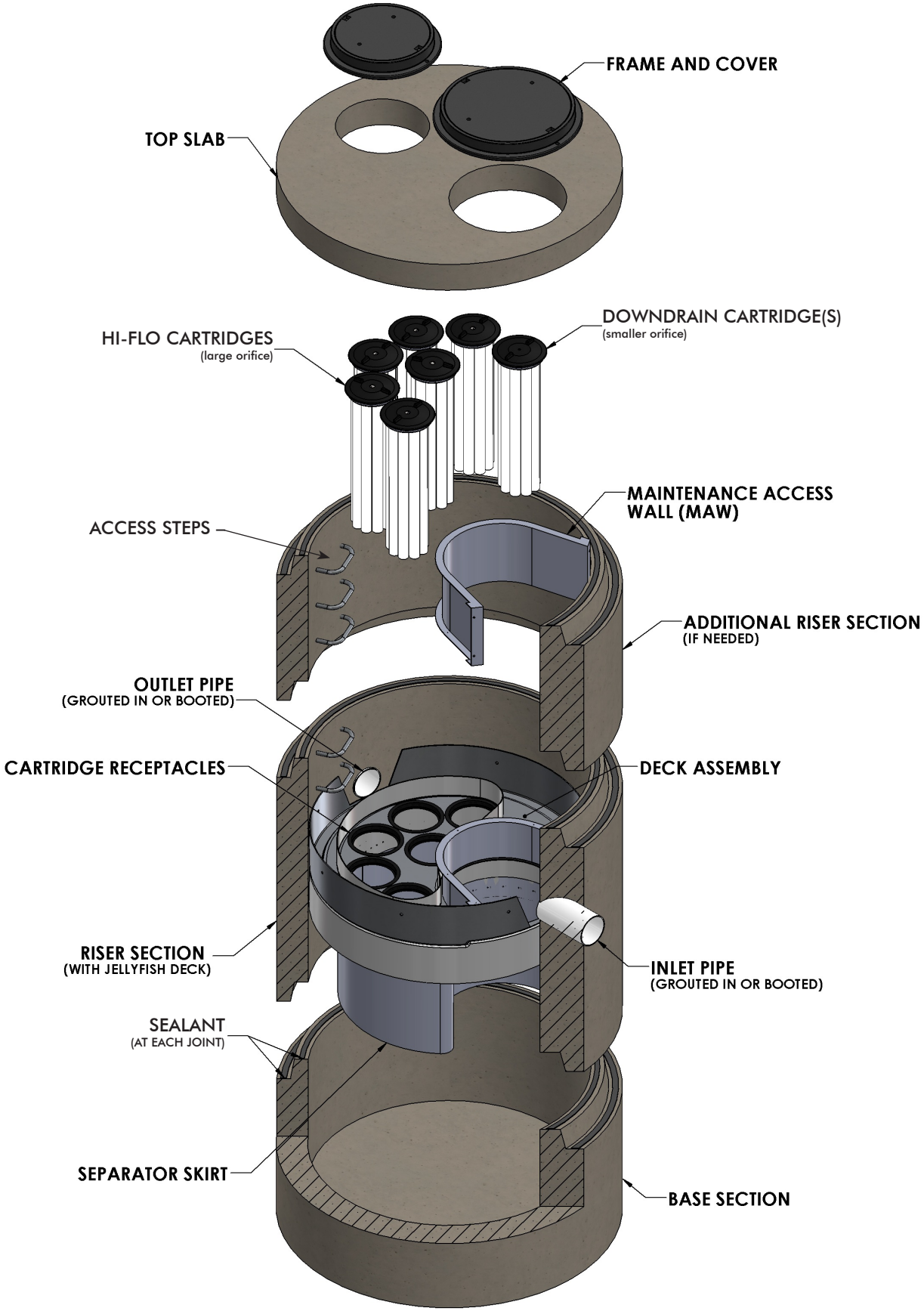
August 3, 2017
Vancouver, BC, Canada

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

Jellyfish® Filter
Owner's Manual



imbrium®


FRAME AND COVER
TOP SLAB
DOWNDRAIN CARTRIDGE(S)
(smaller orifice)
HI-FLO CARTRIDGES
(large orifice)
MAINTENANCE ACCESS
WALL (MAW)
ACCESS STEPS
ADDITIONAL RISER SECTION
(IF NEEDED)
OUTLET PIPE
(GROUTED IN OR BOOTED)
CARTRIDGE RECEPTACLES
DECK ASSEMBLY
RISER SECTION
(WITH JELLYFISH DECK)
INLET PIPE
(GROUTED IN OR BOOTED)
SEALANT
(AT EACH JOINT)
SEPARATOR SKIRT
BASE SECTION

WARNINGS / CAUTION

1. FALL PROTECTION may be required.
2. WATCH YOUR STEP if standing on the Jellyfish Filter Deck at any time; Great care and safety must be taken while walking or maneuvering on the Jellyfish Filter Deck. Attentive care must be taken while standing on the Jellyfish Filter Deck at all times to prevent stepping onto a lid, into or through a cartridge hole or slipping on the deck.
3. The Jellyfish Filter Deck can be SLIPPERY WHEN WET.
4. If the Top Slab, Covers or Hatches have not yet been installed, or are removed for any reason, great care must be taken to NOT DROP ANYTHING ONTO THE JELLYFISH FILTER DECK. The Jellyfish Filter Deck and Cartridge Receptacle Rings can be damaged under high impact loads. *This type of activity voids all warranties. All damaged items to be replaced at owner's expense*.
5. Maximum deck load 2 persons, total weight 250 lbs. per person.

Safety Notice

Jobsite safety is a topic and practice addressed comprehensively by others. The inclusions here are intended to be reminders to whole areas of Safety Practice that are the responsibility of the Owner(s), Manager(s) and Contractor(s). OSHA and Canadian OSH, and Federal, State/Provincial, and Local Jurisdiction Safety Standards apply on any given site or project. The knowledge and applicability of those responsibilities is the Contractor's responsibility and outside the scope of Imbrium® Systems.

Confined Space Entry

Secure all equipment and perform all training to meet applicable local and OSHA regulations regarding confined space entry. It is the Contractor's or entry personnel's responsibility to proceed safely at all times.

Personal Safety Equipment

Contractor is responsible to provide and wear appropriate personal protection equipment as needed including, but not limited to safety boots, hard hat, reflective vest, protective eyewear, gloves and fall protection equipment as necessary. Make sure all equipment is **staffed with trained and/or certified personnel**, and all equipment is checked for proper operation and safety features prior to use.

- Fall protection equipment
- Eye protection
- Safety boots
- Ear protection
- Gloves
- Ventilation and respiratory protection
- Hard hat
- Maintenance and protection of traffic plan

Thank You for purchasing the Jellyfish® Filter!

Imbrium® Systems would like to thank you for selecting the Jellyfish Filter to meet your project's stormwater treatment needs. With proper inspection and maintenance, the Jellyfish Filter is designed to deliver ongoing, high levels of stormwater pollutant removal.

If you have any questions, please feel free to call us or e-mail us at info@imbriumsystems.com.

Imbrium Systems
USA: 301.279.8827 | 888.279.8826
CAD: 416.960.9900 | 800.565.4801
INT'L: +1.416.960.9900

Jellyfish Filter Patents

The Jellyfish Filter is protected by one or more of the following patents:

U.S. Patent No. 8,123,935; U.S. Patent No. 8,287,726; U.S. Patent No. 8,221,618
Australia Patent No. 2008,286,748
Canadian Patent No. 2,696,482
Korean Patent No. 10-1287539
New Zealand Patent No. 583,461; New Zealand Patent No. 604,227
South African Patent No. 2010,01068
**other patents pending*

Table of Contents

Chapter 1

1.0 – Owner Specific Jellyfish Filter Product Information

Below you will find your specific Jellyfish Filter unit information to help you easily inspect, maintain and order parts for your system.

Owner Name:	
Phone Number:	
Site Address:	
Site GPS Coordinates/unit location:	
Unit Location Description:	
Jellyfish Filter Model No.:	
Cartridge Installation Date:	
No. of Hi-Flo Cartridges	
Length of Hi-Flo Cartridges:	
Lid Orifice Diameter on Hi-Flo Cartridge:	
No. of Draindown Cartridges:	
Length of Draindown Cartridges:	
Lid Orifice Diameter on Draindown Cartridge:	
No. of Blank Cartridge Lids:	
Online System (Yes/No):	
Offline System (Yes/No):	

Notes:

Chapter 2

2.0 – Jellyfish Filter System Operations and Functions

The Jellyfish Filter is an engineered stormwater quality treatment technology that removes a high level and wide variety of stormwater pollutants. Each Jellyfish Filter cartridge consists of multiple membrane - encased filter elements ("filtration tentacles") attached to a cartridge head plate. The filtration tentacles provide a large filtration surface area, resulting in high flow and high pollutant removal capacity.

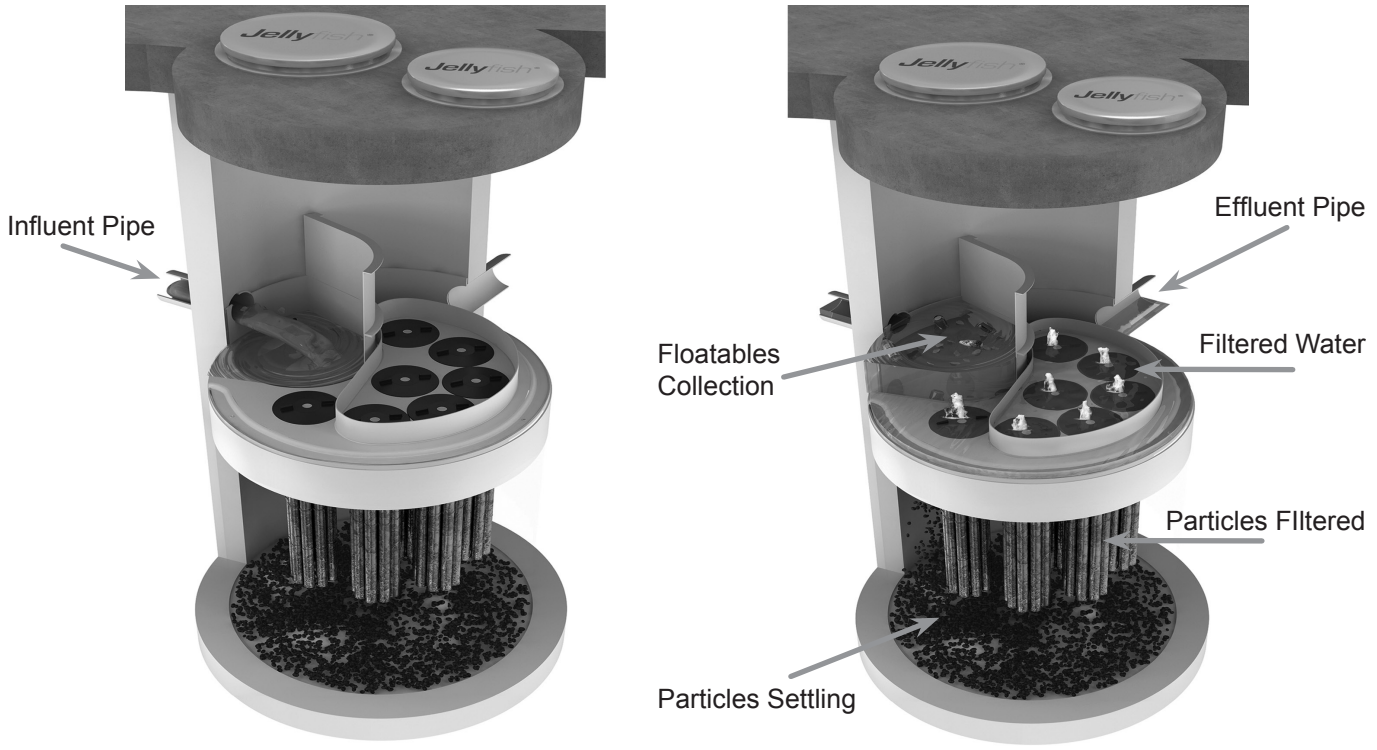
The Jellyfish Filter functions are depicted in **Figure 1** below.

FIGURE 1

Jellyfish Filter Treatment Functions

Membrane Filtration

Section View with Maintenance Access Wall (MAW) Cutaway



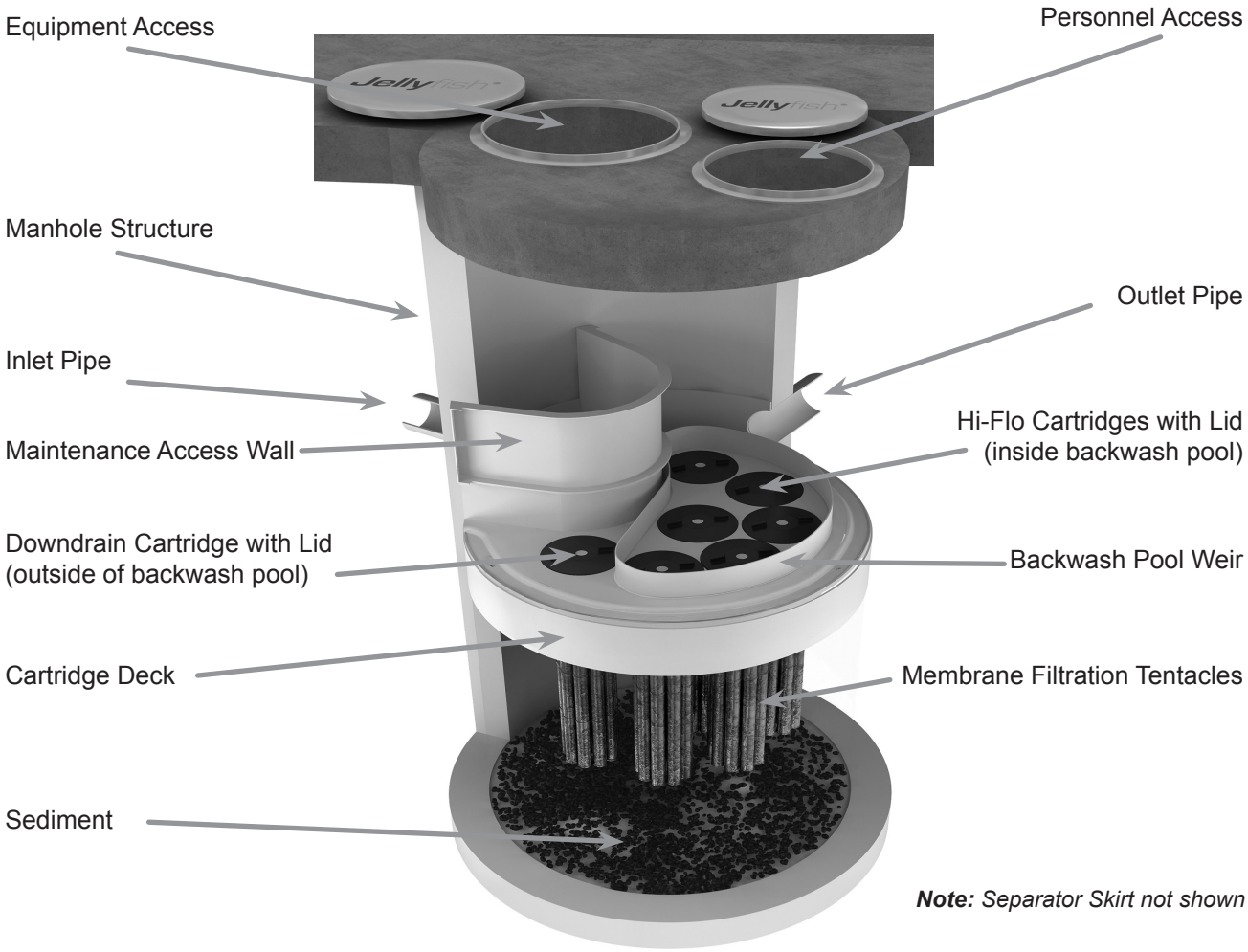
Jellyfish Filter cartridges are backwashed after each peak storm event, which removes accumulated sediment from the membranes. This backwash process extends the service life of the cartridges and increases the time between maintenance events.

For additional details on the operation and pollutant capabilities of the Jellyfish Filter please refer to additional details on our website at www.imbriumsystems.com.

2.1 – Components and Cartridges

The Jellyfish Filter and components are depicted in Figure 2 below.

FIGURE 2 **Jellyfish Filter Components**



Note: *Separator Skirt not shown*

Tentacles are available in various lengths as depicted in Table 1 below.

Table 1 – Cartridge Lengths / Weights and Cartridge Lid Orifice Diameters

Cartridge Lengths	Dry Weight	Hi-Flo Orifice Diameter	Draindown Orifice Diameter
15 inches (381 mm)	10 lbs (4.5 kg)	35 mm	20 mm
27 inches (686 mm)	14.5 lbs (6.6 kg)	45 mm	25 mm
40 inches (1,016 mm)	19.5 lbs (8.9 kg)	55 mm	30 mm
54 inches (1,372 mm)	25 lbs (11.4 kg)	70 mm	35 mm

A Jellyfish membrane filtration cartridge is depicted in Figure 3 below.

FIGURE 3

Jellyfish Membrane Filtration Cartridge

2.2 – Jellyfish Membrane Filtration Cartridge Assembly

The Jellyfish Filter utilizes multiple membrane filtration cartridges. Each cartridge consists of removable cylindrical filtration "tentacles" attached to a cartridge head plate. Each filtration tentacle has a threaded pipe nipple and o-ring. To attach, insert the top pipe nipples with the o-ring through the head plate holes and secure with locking nuts. Locking nuts to be hand tighten and checked with a wrench as shown below.

2.3 – Jellyfish Membrane Filtration Cartridge Installation

- After the upstream catchment and site have stabilized, remove any accumulated sediment and debris from the Jellyfish Filter structure and upstream diversion structure (if applicable). Failure to address this step completely will reduce the time between required maintenance.
- Descend to the cartridge deck (see Safety Notice and page 3).
- Lower the Jellyfish membrane filtration cartridges into the cartridge receptacles within the cartridge deck. A filter cartridge should be placed into each of the draindown cartridge receptacles outside the backwash pool weir. It is possible dependent on the Jellyfish Filter model purchased that not all cartridge receptacles will be filled with a filter cartridge. In that case, a blank headplate and blank cartridge lid (has no orfice) would be installed.

Cartridge Assembly

Avoid snagging the cartridge membranes on the recpticle lip when inserting the Jellyfish membrane filtration cartridges into the cartridge receptacles. Use a gentle twisting or sideways motion to clear any potential snag. Do not force the tentacles down into the cartridge receptacle, as this may damage the membranes. Apply downward pressure on the cartridge head plate to seat the rim gasket (thick circular gasket surrounding the circumference of the head plate) into the cartridge receptacle.

- Examine the cartridge lids to differentiate lids with a small orifice, a large orifice, and no orifice.
  - Lids with a small orifice are to be inserted into the draindown cartridge receptacles, outside of the backwash pool weir.
  - Lids with a large orifice are to be inserted into the hi-flo cartridge receptacles within the backwash pool weir.
  - Lids with no orifice (blank cartridge lids) and a blank headplate are to be inserted into unoccupied cartridge receptacles.
- **To install a cartridge lid, align the cartridge lid male threads with the cartridge receptacle female threads. Firmly twist the cartridge lid clockwise a minimum 110º to seat the filter cartridge snugly in place, with a proper watertight seal.**

Chapter 3

3.0 – Inspection and Maintenance Overview

The primary purpose of the Jellyfish Filter is to capture and remove pollutants from stormwater runoff. As with any filtration system, captured pollutants must be removed to maintain the filter's maximum treatment performance. Regular inspection and maintenance are required to insure proper functioning of the system.

Maintenance frequencies and requirements are site specific and vary depending on pollutant loading. Maintenance activities may be required in the event of an upstream chemical spill or due to excessive sediment loading from site erosion or extreme runoff events. It is a good practice to inspect the system after major storm events.

Inspection activities are typically conducted from surface observations and include:

- Observe if standing water is present
- Observe if there is any physical damage to the deck or cartridge lids
- Observe the amount of debris in the Maintenance Access Wall (MAW)

Maintenance activities typically include:

- Removal of oil, floatable trash and debris
- Removal of collected sediments from manhole sump
- Rinsing and re-installing the filter cartridges
- Replace filter cartridge tentacles, as needed.

It is recommended that Jellyfish Filter inspection and maintenance be performed by professionally trained individuals, with experience in stormwater maintenance and disposal services. Maintenance procedures may require manned entry into the Jellyfish structure. Only professional maintenance service providers trained in confined space entry procedures should enter the vessel. Procedures, safety and damage prevention precautions, and other information, included in these guidelines, should be reviewed and observed prior to all inspection and maintenance activities.

3.1 – Inspection

3.1.1 – Timing

Inspection of the Jellyfish Filter is key in determining the maintenance requirements for, and to develop a history of the site's pollutant loading characteristics. In general, inspections should be performed at the times indicated below; *or per the approved project stormwater quality documents (if applicable), whichever is more frequent.*

- Post-construction inspection is required prior to putting the Jellyfish Filter into service. All construction debris or construction-related sediment within the device must be removed, and any damage to system components repaired.
- A minimum of two inspections during the first year of operation to assess the sediment and floatable pollutant accumulation, and to ensure proper functioning of the system.

- Inspection frequency in subsequent years is based on the inspection and maintenance plan developed in the first year of operation. Minimum frequency should be once per year.
- Inspection is recommended after each major storm event.
- Immediately after an upstream oil, fuel or other chemical spill.

3.1.2 – Inspection Tools and Equipment

The following equipment and tools are typically required when performing a Jellyfish Filter inspection:

- Access cover lifting tool
- Sediment probe (clear hollow tube with check valve)
- Tape measure
- Flashlight
- Camera
- Inspection and maintenance log documentation
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

3.1.3 – Inspection Procedure

The following procedure is recommended when performing inspections:

- Provide traffic control measures as necessary.
- Inspect the MAW for floatable pollutants such as trash, debris, and oil sheen.
- Measure oil and sediment depth by lowering a sediment probe through the MAW opening until contact is made with the floor of the structure. Retrieve the probe, record sediment depth, and presences of any oil layers and repeat in multiple locations within the MAW opening. **Sediment depth of 12 inches or greater indicates maintenance is required**.
- Inspect cartridge lids. Missing or damaged cartridge lids to be replaced.
- Inspect the MAW, cartridge deck, and backwash pool weir for cracks or broken components. If damaged, repair is required.
- **Dry weather inspections:** inspect the cartridge deck for standing water.
  - No standing water under normal operating condition.
  - Standing water **inside** the backwash pool, but not outside the backwash pool, this condition indicates that the filter cartridges need to be rinsed.
  - Standing water **outside** the backwash pool may indicate a backwater condition caused by high water elevation in the receiving water body, or possibly a blockage in downstream infrastructure.
- **Wet weather inspections:** observe the rate and movement of water in the unit. Note the depth of water above deck elevation within the MAW.
  - **Less than 6 inches**, flow should be exiting the cartridge lids of each of the draindown cartridges (i.e. cartridges located outside the backwash pool).
  - **Greater than 6 inches**, flow should be exiting the cartridge lids of each of the draindown cartridges and each of the hi-flo cartridges (i.e. cartridges located inside the backwash pool), and water should be overflowing the backwash pool weir.
  - **18 inches or greater** and relatively little flow is exiting the cartridge lids and outlet pipe, this condition indicates that the filter cartridges are occluded with sediment and need to be rinsed.

The depth of sediment and oil can be measured from the surface by using a sediment probe or dipstick tube equipped with a ball check valve and inserted through the Jellyfish Filter's maintenance access wall opening. The large opening provides convenient access for inspection and vacuum removal of water and pollutants.

3.2 – Maintenance

3.2.1 – Maintenance Requirements

Required maintenance for Jellyfish Filter units is based upon results of the most recent inspection, historical maintenance records, or the site specific water quality management plan; whichever is more frequent. In general, maintenance requires some combination of the following:

- **Sediment removal for depths reaching 12 inches or greater, or within 3 years of the most recent sediment cleaning, whichever occurs sooner.**
- Floatable trash, debris, and oil must be removed.
- Filter cartridges rinsed and re-installed as required by the most recent inspection results, or within 12 months of the most recent filter rinsing, whichever occurs first.
- Replace filter cartridge if rinsing does not remove accumulated sediment from the tentacles, or if tentacles are damaged or missing. It is recommended that tentacles should remain in service no longer than 5 years before replacement.
- Damaged or missing cartridge deck components must be repaired or replaced as indicated by results of the most recent inspection.
- The unit must be cleaned out and filter cartridges inspected immediately after an upstream oil, fuel, or chemical spill. Filter cartridge tentacles should be replaced if damaged by the spill.

3.2.2 – Maintenance Tools and Equipment

The following equipment and tools are typically required when performing Jellyfish Filter maintenance:

- Vacuum truck
- Ladder
- Garden hose and low pressure sprayer
- Rope or cord to lift filter cartridges from the cartridge deck to the surface
- Adjustable pliers for removing filter cartridge tentacles from cartridge head plate
- Plastic tub or garbage can for collecting effluent from rinsed filter cartridge tentacles
- Access cover lifting tool
- Sediment probe (clear hollow tube with check valve)
- Tape measure
- Flashlight
- Camera
- Inspection and maintenance log documentation
- Safety cones and caution tape
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Proper safety equipment for confined space entry
- Replacement filter cartridge tentacles if required

3.2.3 – Maintenance Procedure

The following procedures are recommended when maintaining the Jellyfish Filter:

- Provide traffic control measures as necessary.
- Open all covers and hatches. Use ventilation equipment as required, according to confined space entry procedures.
- **Caution:** Dropping objects onto the cartridge deck may cause damage.
- Perform **Inspection Procedure** prior to maintenance activity.
- To access the cartridge deck for filter cartridge service, descend the ladder and step directly onto the deck. **Caution:** Do not step onto the maintenance access wall (MAW) or backwash pool weir, as damage may result. Note that the cartridge deck may be slippery.

3.2.4 – Filter Cartridge Rinsing Procedure

- Remove a cartridge lid.
- Remove the cartridge from the receptacle using the lifting loops in the cartridge head plate. **Caution:** Should

a snag occur, do not force the cartridge upward as damage to the tentacles may result. Rotate the cartridge with a slight sideways motion to clear the snag and continue removing the cartridge.

- Thread a rope or cord through the lifting loops and lift the filter cartridge from the cartridge deck to the top surface outside the structure.
- **Caution:** Immediately replace and secure the lid on the exposed empty receptacle as a safety precaution. Never expose more than one empty cartridge receptacle.
- Repeat the filter cartridge removal procedure until all of the cartridges are located at the top surface outside the structure.
- Disassemble the tentacles from each filter cartridge by rotating counter-clockwise. Remove the tentacles from the cartridge head plate.
- Position a receptacle in a plastic tub or garbage can such that the rinse water is captured. Using a low-pressure garden hose sprayer, direct a wide-angle water spray at a downward 45° angle onto the tentacle membrane, sweeping from top to bottom along the length of the tentacle. Rinse until all sediment is removed from the membrane. **Caution:** Do not use a high pressure sprayer or focused stream of water on the membrane. Excessive water pressure may damage the membrane. Turn membran upside down and pour out any residual rinsewater to ensure center of tentacle is clear of any sediment.

Rinsing of dirty filter cartridge tentacles with a low-pressure garden hose sprayer, and using a plastic garbage container to capture rinse water.

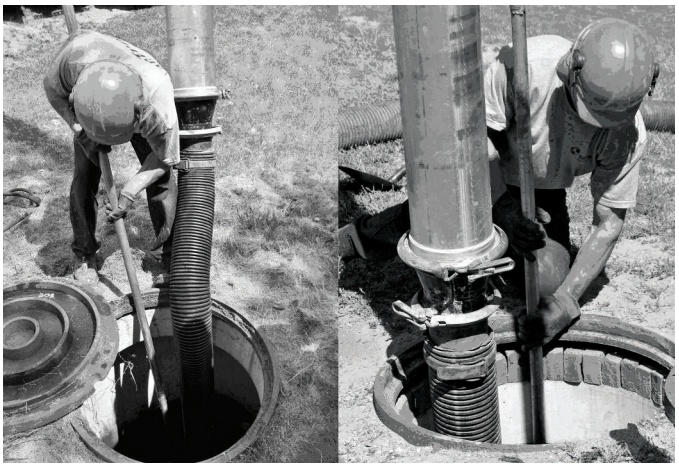
- Remove rinse water from rinse tub or garbage can using a vacuum hose as needed.
- Slip the o-ring over the tentacle nipple and reassemble onto the cartridge head plate; hand-tighten.
- If rinsing is ineffective in removing sediment from the tentacles, or if tentacles are damaged, provisions must be made to replace the spent or damaged tentacles with new tentacles. Contact Imbrium Systems to order replacement tentacles.
- Lower a rinsed filter cartridge to the cartridge deck. Remove the cartridge lid on a receptacle and carefully lower the filter cartridge into the receptacle until the head plate gasket is seated squarely on the lip of the receptacle. **Caution:** Should a snag occur when lowering the cartridge into the receptacle, do not force the cartridge downward; damage may occur. Rotate the cartridge with a slight sideways motion to clear the snag and complete the installation.
- Replace the cartridge lid on the exposed receptacle. Rinse away any accumulated grit from the receptacle threads if needed to get a proper fit. **Align the cartridge lid male threads with the cartridge receptacle female threads. Firmly twist the cartridge lid clockwise a minimum 110º to seat the filter cartridge snugly in place, with a proper watertight seal**.
- Repeat cartridge installation until all cartridges are installed.

3.2.5 – Vacuum Cleaning Procedure

- **Caution:** Perform vacuum cleaning of the Jellyfish Filter only after filter cartridges have been removed from the system. Access the lower chamber for vacuum cleaning **only through the maintenance access wall (MAW) opening**, being careful not to damage the flexible plastic separator skirt that is attached to the underside of the deck. The separator skirt surrounds the filter cartridge zone, and could be torn if contacted by the wand. **Do not lower the vacuum wand through a cartridge receptacle**, as damage to the receptacle will result.
  - To remove floatable trash, debris, and oil, lower the vacuum hose into the MAW opening and vacuum floatable pollutants off the surface of the water. Alternatively, floatable solids may be removed by a net or skimmer.
  - Using a vacuum hose, remove the water from the lower chamber to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank.
  - Remove the sediment from the bottom of the unit through the MAW opening.
  - For larger diameter Jellyfish Filter manholes (8-ft, 10-ft, 12-ft diameter), complete sediment removal may be facilitated by removing a cartridge lid from an empty receptacle and inserting a jetting wand (not a vacuum wand) through the receptacle. Use the sprayer to rinse loosened sediment toward the vacuum hose in the MAW opening, being careful not to damage the receptacle..
  - After the unit is clean, re-fill the lower chamber with water if required by the local jurisdiction, and re-install filter cartridges.
  - Dispose of sediment, floatable trash and debris, oil, spent tentacles, and water according to local regulatory requirements.

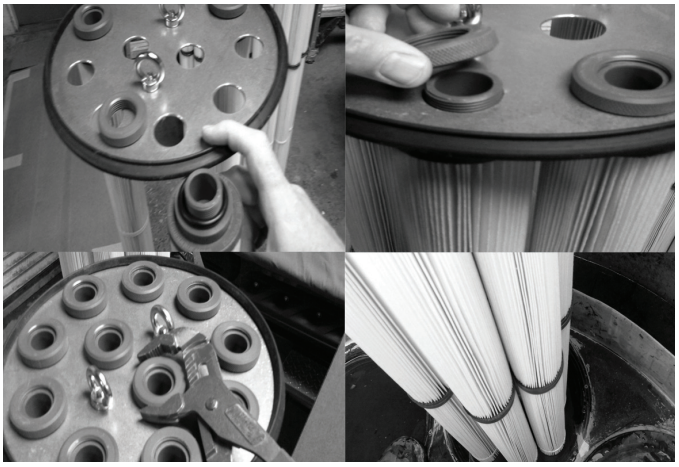
3.2.6 – Chemical Spills

- **Caution**: If a chemical spill has been captured by the Jellyfish Filter, do not attempt maintenance. Immediately contact the local hazard response agency.



A maintenance worker stationed on the surface uses a vacuum hose to evacuate water, sediment, and floatables from the Jellyfish Filter by inserting the vacuum wand through the maintenance access wall opening.

A view of a Jellyfish Filter cartridge deck from the surface showing all the cartridge lids intact and no standing water on the deck (left image), and inspection of the flexible separator skirt from inside the maintenance access wall opening (right image).



Assembly of a Jellyfish Filter cartridge (left) and installation of a filter cartridge into a cartridge receptacle in the deck (right).

3.3 – Disposal Procedures

Disposal requirements for recovered pollutants and spent filtration tentacles may vary depending on local guidelines. In most areas the sediment and spent filtration tentacles, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.

Petroleum-based pollutants captured by the Jellyfish Filter, such as oil and fuels, should be removed and disposed of by a licensed waste management company.

Although the Jellyfish Filter captures virtually all free oil, a sheen may still be present at the MAW. A rainbow or sheen can be visible at oil concentrations of less than 10 mg/L (ppm).

Chapter 4

4.0 – Recommended Safety Procedures

Jobsite safety is a topic and a practice addressed comprehensively by others. The inclusions here are merely reminders to whole areas of Safety Practice that are the responsibility of the Owner(s), Manager(s) and Contractor(s). OSHA and Canadian OSH, and Federal, State/Provincial, and Local Jurisdiction Safety Standards apply.

4.1 – Confined Space/Personal Safety Equipment/Warning and Cautions

Please see reference on Page 3.

Chapter 5

5.0 – Jellyfish Filter Replacement Parts

Jellyfish membrane filtration cartridges, cartridge components, cartridge lids, other replacement parts can be ordered by contacting Imbrium Systems at:

United States: 888-279-8826 or 301-279-8827

Canada/International: 800-565-4801 or +1-416-960-9900

info@imbriumsystems.com

5.1 – Jellyfish Filter Replacement Parts List

Note: Jellyfish Cartridges and/or Filtration tentacles are available in the following lengths:

• 15 Inch (381 mm) • 27 Inch (686 mm) • 40 Inch (1,016 mm) • 54 Inch (1,372 mm)

- Jellyfish Cartridge (specify length). Includes head plate with lifting loops, rim gasket, eleven (11) filtration tentacles, eleven (11) o-rings, and eleven (11) locking nuts
- Standard Head plate
- Blank head plate
- Rim gasket (for head plate)
- Locking nuts (for tentacles)
- O-rings (for tentacles)
- Cartridge lids are available with the following orifice sizes: 70mm, 55mm, 45mm, 35mm, 30mm, 25mm, 30mm, blank lid (no orifice)
- Maintenance Access Wall (MAW) extension (18-inch segment)

** Nothing in this catalog should be construed as an expressed warranty or implied warranties, including the warranties of merchantability and of fitness for any particular purpose.*

Jellyfish Filter Inspection and Maintenance Log

Owner: _____ Jellyfish Model No.:_____

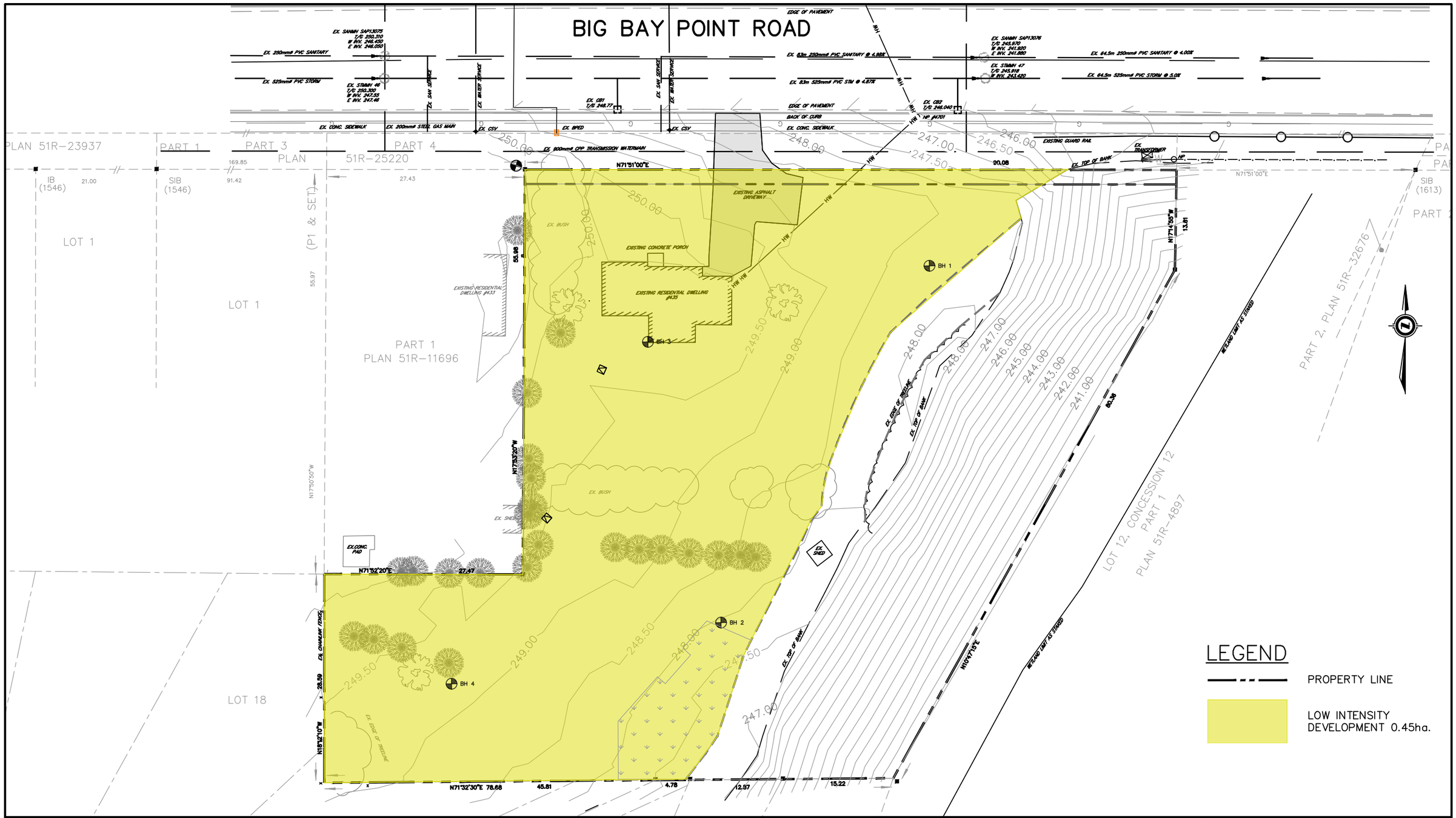
Location: _____ GPS Coordinates: _____

Land Use: Commercial:_____ Industrial: _____ Service Station:_____

Road/Highway:____ Airport: _____ Residential: _____ Parking Lot:_____

Date/Time:						
Inspector:						
Maintenance Contractor:						
Visible Oil Present: (Y/N)						
Oil Quantity Removed						
Floatable Debris Present: (Y/N)						
Floatable Debris removed: (Y/N)						
Water Depth in Backwash Pool						
Draindown Cartridges externally rinsed and re-commissioned: (Y/N)						
New tentacles put on Cartridges: (Y/N)						
Hi-Flo cartridges externally rinsed and recommissioned (Y/N):						
New tentacles put on Hi-Flo Cartridges: (Y/N)						
Sediment Depth Measured: (Y/N)						
Sediment Depth (inches or mm):						
Sediment Removed: (Y/N)						
Cartridge Lids intact: (Y/N)						
Observed Damage:						
Comments:						

BIG BAY POINT ROAD



LEGEND

PROPERTY LINE

LOW INTENSITY DEVELOPMENT 0.45ha.

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435 BIG BAY POINT ROAD

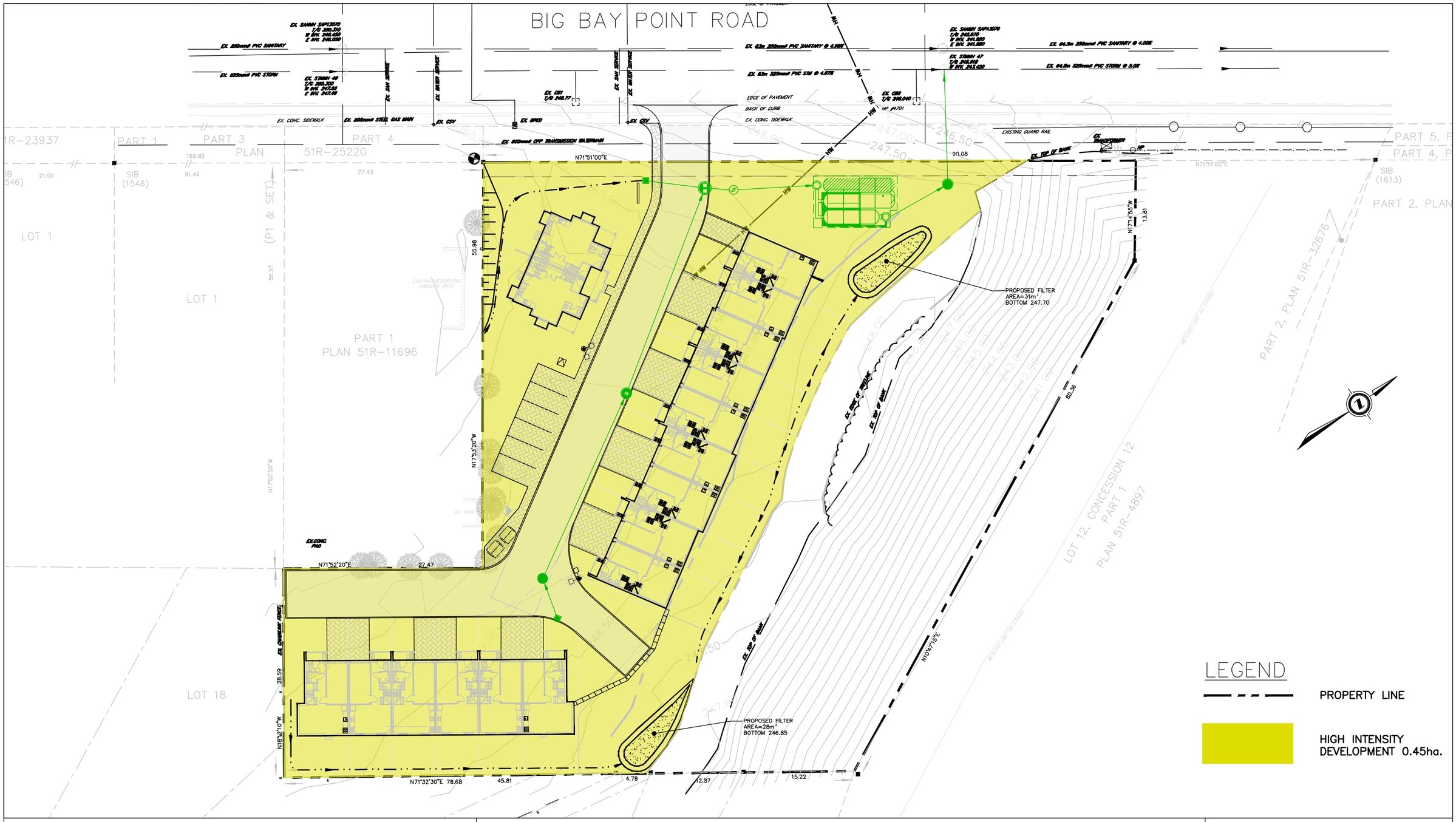
PRE-PHOSPHORUS CATCHMENT AREAS

PROJECT NO. 17-11291B

SCALE: 1:500

DATE: SEPT 2018

FIGURE 4



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435 BIG BAY POINT ROAD

POST-PHOSPHORUS CATCHMENT AREAS

PROJECT NO. 17-11291B

SCALE: 1:500

DATE: SEPT 2018

FIGURE 5

Ontario

MINISTRY OF THE ENVIRONMENT

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

PRE-DEVELOPMENT Phosphorus LOAD

DEVELOPMENT: 435 Big Bay Point Road
Subwatershed: Lovers Creek

Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Low Intensity Development	0.45	0.07	0.03
TOTALS:	**0.45**		**0.03**

Ontario

MINISTRY OF THE ENVIRONMENT

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

POST-DEVELOPMENT Phosphorus LOAD - BMPs applied

Subwatershed: Lovers Creek

Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		BMP P Load (kg/yr)
DEVELOPMENT:	**435 Big Bay Point Road**				
High Intensity - Residential	0.45	1.32	NONE	0%	0.59

Post-Development Area Altered:	**0.45**
Total Pre-Development Area:	**0.45**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**0.03**
Post-Development Load:	**0.59**
Change (Pre- Post):	**-0.56**
1786% Net Increase in Load	
Post-Development (with BMP):	**0.59**
Change (Pre-Post):	**-0.56**
1785.71% Net Increase in Load	

APPENDIX D

Alectra Utilities & Enbridge Gas Correspondence

PEL
PINESTONE ENGINEERING LTD.

Lauren Buss

From: Stephen Cranley <stephen.cranley@alectrautilities.com>
Sent: May 15, 2017 11:03 AM
To: Joe Voisin
Cc: Lauren Buss
Subject: RE: 435 Big Bay Point Road - Functional Servicing Report

Hi Joe,

As requested I am confirming that Alectra Utilities has adequate capacity available along the frontage of 435 Big Bay Point Road (north side of street) to provide hydro servicing for this proposed residential development.

Regards,

alectra utilities
Discover the possibilities

Stephen Cranley, C.E.T.
Supervisor, Subdivisions & New Services
55 Patterson Rd. Barrie, ON L4N 3V9
t 705.722.7244 x31297 | **m** 705.241.7950
alectrautilities.com

From: Joe Voisin [mailto:jvoisin@pel.ca]
Sent: May-08-17 4:33 PM
To: Stephen Cranley; David.Smith@enbridge.com
Cc: Lauren Buss
Subject: 435 Big Bay Point Road - Functional Servicing Report

Hi Stephen and David,

We are working on a Functional Servicing Report for a proposed residential townhouse development located at 435 BBPR. I have appended a drawing showing the proposed development for your reference.

Can you please comment on servicing availability on your end?

Thanks in advance.

Joe Voisin, P.Eng.
Senior Engineer, Partner

PEL
PINESTONE ENGINEERING LTD.

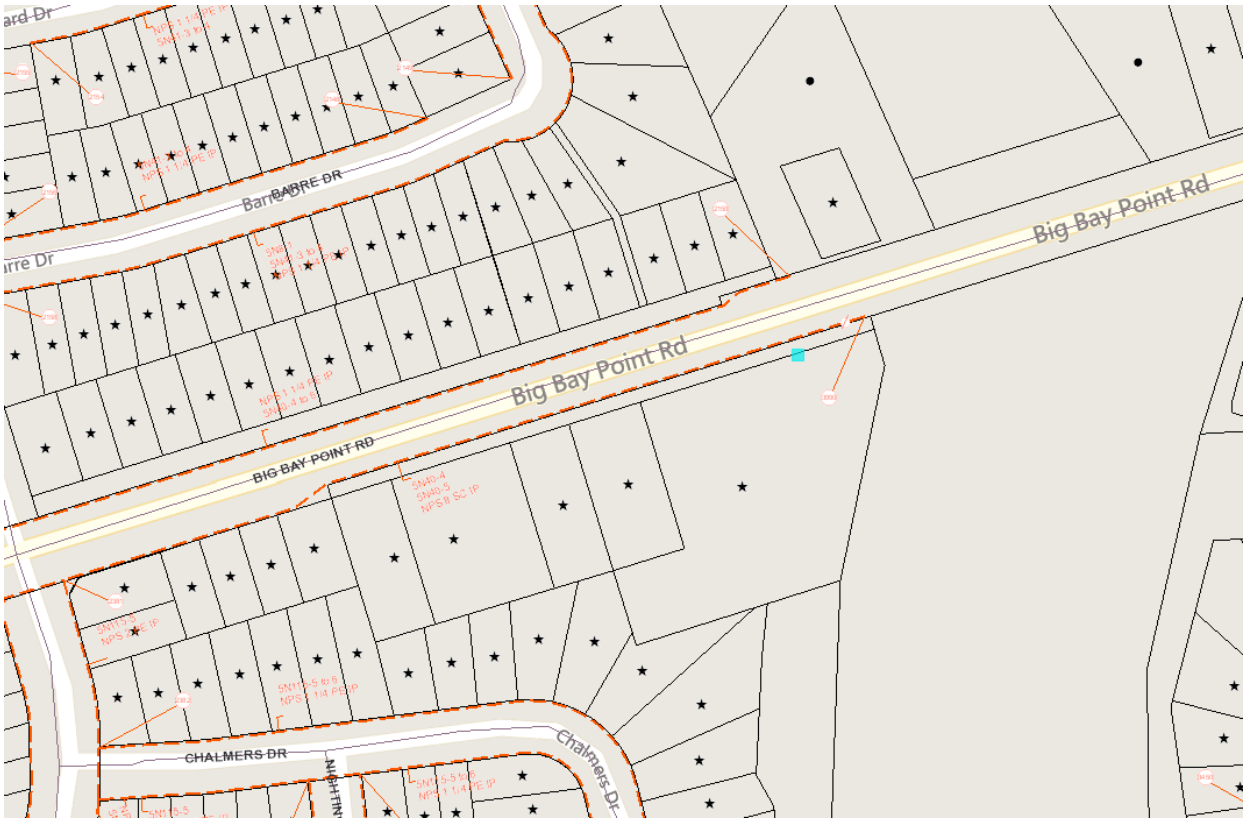
20 Bell Farm Road, Unit 1, Barrie, ON, L4M 6E4
jvoisin@pel.ca | PEL.ca

T: 705-503-1777
F: 705-645-7262
C: 705-641-8301

From: David Smith
To: Joe Voisin
Subject: RE: 435 Big Bay Point Road - Functional Servicing Report
Date: May 9, 2017 9:33:06 AM
Attachments: image002.png

Hi Joe.

We have an 8" Steel main that fronts this property. Gas is available.



Thanks

David K. Smith
Customer Connections Field Representative
—
ENBRIDGE GAS DISTRIBUTION
TEL: 705-739-5254 | FAX: 705-739-5200 | CELL: 705-220-5997
10 Churchill Dr. Barrie, ON L4N 8Z5
David.smith@enbridge.com

enbridgegas.com
Integrity. Safety. Respect.

From: Joe Voisin [mailto:jvoisin@pel.ca]
Sent: Monday, May 08, 2017 4:33 PM
To: Stephen Cranley; David Smith
Cc: Lauren Buss
Subject: 435 Big Bay Point Road - Functional Servicing Report

Hi Stephen and David,

We are working on a Functional Servicing Report for a proposed residential townhouse development located at 435 BBPR. I have appended a drawing showing the proposed development for your reference.

Can you please comment on servicing availability on your end?

Thanks in advance.

Joe Voisin, P.Eng.
Senior Engineer, Partner

PEL PINESTONE ENGINEERING LTD.

20 Bell Farm Road, Unit 1, Barrie, ON, L4M 6E4
jvoisin@pel.ca | PEL.ca

APPENDIX E

Conceptual Drawings

PEL
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BIG BAY POINT ROAD

EX. H&V
EX. 500mmø D.I. WATERMAIN (APPROX.)
BACK OF CURB
EDGE OF PAVEMENT
EX. SANMH SAP13075
T/G 250.310
W INV. 246.450
E INV. 246.050
EX. 250mmø PVC SANITARY
EX. 525mmø PVC STORM
EX. STMMH 46
T/G 250.300
W INV. 247.55
E INV. 247.46
EX. SAN SERVICE
EX. WATER SERVICE
EX. 83m 250mmø PVC SANITARY @ 4.98%
EX. 83m 525mmø PVC STM @ 4.87%
EX. SAN SERVICE
EX. WATER SERVICE
EX. CB1
T/G 248.77
EX. CSV
EX. BPED
EX. CONC. SIDEWALK
EX. 200mmø STEEL GAS MAIN
EX. 900mmø CPP TRANSMISSION WATERMAIN
EX. H&V
EX. SANMH SAP13076
T/G 245.970
W INV. 241.920
E INV. 241.880
EX. STMMH 47
T/G 245.918
W INV. 243.420
EX. 64.5m 250mmø PVC SANITARY @ 4.00%
EX. 64.5m 525mmø PVC STORM @ 5.0%
EX. CB2
T/G 246.040
HP #4701
EDGE OF PAVEMENT
BACK OF CURB
EX. CONC. SIDEWALK
EXISTING GUARD RAIL
EX. TRANSFORMER
HP
EX. TOP OF BANK

PART 3 PLAN 51R-25220
PART 4
PART 1 PLAN 51R-11696
LOT 1
LOT 18
LOT 12, CONCESSION 12 PART 1 PLAN 51R-4897

N71°51'00"E 90.08
N17°14'55"W 13.81
N10°47'15"E 80.36
N17°53'20"W 55.98
N71°52'20"E 27.47
N18°12'10"W 28.59
N71°32'30"E 78.68 45.81 4.78 12.87 15.22
N17°50'50"W

EXISTING ASPHALT DRIVEWAY
EXISTING CONCRETE PORCH
EXISTING RESIDENTIAL DWELLING #435
EXISTING RESIDENTIAL DWELLING #433
EX. SHED
EX. CONC. PAD
EX. CHAINLINK FENCE
EX. BUSH
EX. EDGE OF TREELINE
EX. TOP OF BANK
WETLAND LIMIT AS STAKED

BH 1
BH 2
BH 3
BH 4

HORIZONTAL CONTROL MONUMENTS
U.T.M. (ZONE 17) NAD 83

MONUMENT # 03120040064
THE HORIZONTAL MONUMENT IS LOCATED ON THE SOUTH SIDE OF BIG BAY POINT ROAD ON BRIDGE OVER LOVER'S CREEK AT SOUTH-EAST CORNER OF BRIDGE IN WALKWAY OPPOSITE THE VERTICAL CONTROL MONUMENT #03120030007.
N = 4912309.381 E = 607444.743

MONUMENT # 03120040065
THE HORIZONTAL MONUMENT (03120040065) IS LOCATED IN THE BRIDGE WALKWAY ON THE WEST SIDE OF YONGE STREET, APPROXIMATELY 100M SOUTH OF THE INTERSECTION AT D'AMBROSIO DRIVE. IT IS LOCATED ON THE NORTH END OF THE BRIDGE WHICH CROSSES OVER LOVER'S CREEK..
N = 4913385.898 E = 607173.330

VERTICAL CONTROL MONUMENTS

BENCHMARK:

MONUMENT # 03120030007
ELEVATION: 244.787
BRIDGE ON BIG BAY POINT RD 0.3 KM WEST OF YONGE ST OVER LOVERS CREEK
THE VERTICAL CONTROL MONUMENT IS SET FLUSH IN THE NORTH FACE OF THE CONCRETE ABUTMENT, AT THE SOUTHEAST CORNER OF BRIDGE. THE TABLET IS LOCATED 1.8m WEST OF THE EAST END OF THE BRIDGE AND 50 cm BELOW THE TOP OF THE BRIDGE.

MONUMENT # 03120030305
ELEVATION: 250.827
CULVERT HEADWALL TO DETENTION POND EAST OF EDWARDS DR & NORTH OF BIG BAY POINT RD. THE VERTICAL CONTROL MONUMENT IS SET FLUSH IN THE EAST FACE OF THE CONCRETE CULVERT HEADWALL. THE TABLET IS 140MM BELOW THE TOP OF THE CULVERT HEADWALL AND 160MM SOUTH OF THE NORTH-EAST INSIDE CORNER OF THE HEADWALL.

NOTE:
NOT FOR CONSTRUCTION

LEGEND

- CONTOUR
- EXISTING HYDRO POLE
- EXISTING TREELINE
- EXISTING SANITARY MANHOLE
- EXISTING STORM MANHOLE
- EXISTING STORM CATCHBASIN
- DITCH CENTERLINE
- DIRECTION OF OVERLAND FLOW
- EXISTING BOREHOLE LOCATIONS
- EXISTING DECIDUOUS TREE
- EXISTING CONIFEROUS TREE
- EXISTING CHAINLINK FENCE
- EXISTING ASPHALT
- EXISTING GAS LINE
- EXISTING UNDERGROUND BELL CANADA
- EXISTING BELL CANADA PEDESTAL
- EXISTING CURB STOP VALVE
- EXISTING WATER VALVE
- EXISTING HYDRANT AND VALVE
- EXISTING OVERHEAD HYDRO WIRE

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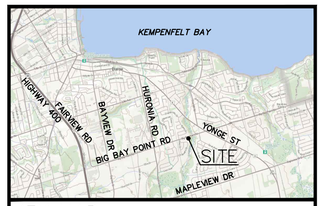
The position of existing above ground and underground utilities and facilities are not necessarily shown on the drawings, and where shown, the accuracy of the position of such utilities and facilities is not guaranteed. Before starting work, the contractor shall confirm the exact location of all existing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



KEY MAP

NOTES

1. TOPOGRAPHIC SURVEY COMPLETED BY DINO ASTRI SURVEYING LTD. O.L.S., DECEMBER 2016.
2. SITE PLAN PROVIDED BY IAN S. MALCOLM ARCHITECTS AUGUST 14, 2017.
3. REFER TO GEOTECHNICAL REPORT PREPARED BY PETO MACCALLUM LTD. FOR BOREHOLE INFORMATION.

BENCHMARK

TBM#1
TOP SIB AT THE NORTH WEST CORNER OF PARCEL HAVING AN ELEVATION OF 250.50

NO.	YY.MM.DD	REVISION	BY

SEAL

NORTH ARROW

DESIGN BY:	J.V.
DRAWN BY:	L.B.
CHECKED	J.V.
DATE:	SEPTEMBER 2018
SCALE:	1: 200

CLIENT/PROJECT

#435 BIG BAY POINT ROAD TOWNHOME DEVELOPMENT ADA HOMES

DRAWING TITLE

EXISTING CONDITIONS PLAN

PROJECT NO.	DRAWING NO.	REVISION
17-11291B	EX-1	0

GP-1

BIG BAY POINT ROAD

EX. H&V

EX. SANMH SAP13075
T/G 250.310
W INV. 246.450
E INV. 246.050

EX. 250mmø PVC SANITARY

EX. 525mmø PVC STORM

EX. STMMH 46
T/G 250.300
W INV. 247.55
E INV. 247.46

EX. SAN SERVICE

EX. WATER SERVICE

EX. CONC. SIDEWALK

EX. 200mmø STEEL GAS MAIN

EX. CSV

EX. BPED

EX. 900mmø CPP TRANSMISSION WATERMAIN

CONNECT TO EX. 500mmø WM WITH TAPPING SLEEVE AND VALVE (TYP.)

EX. 500mmø D.I. WATERMAIN (APPROX.)

BACK OF CURB

EDGE OF PAVEMENT

EXISTING SERVICES TO BE DECOMMISSIONED TO CITY OF BARRIE STANDARDS(TYP.)

150mmø PVC WATERMAIN

SANMH#4A
T/G 247.50
W INV.243.83
E INV.243.71
S INV.243.95

EX. 83m 250mmø PVC SANITARY @ 4.98%

EX. 83m 525mmø PVC STM @ 4.87%

CONNECT PROPOSED SANITARY TO EXISTING SANITARY SEWER WITH PROPOSED SANMH 4A

EX. CB1
T/G 248.77

EX. CB2
T/G 246.040

HP #4701

EX. SANMH SAP13076
T/G 245.970
W INV. 241.920
E INV. 241.880

EX. 64.5m 250mmø PVC SANITARY @ 4.00%

EX. STMMH 47
T/G 245.918
W INV. 243.420

EX. 64.5m 525mmø PVC STORM @ 5.0%

BREAK-IN AND CONNECT TO EX. STMMH 47
S INV. 244.00±

300mmø PVC STM @ 4.0%

EXISTING GUARD RAIL

EX. TOP OF BANK

PART 3
PLAN
51R-25220

PART 4

69.85

42

27.43

N71°5

OB#1
T/G 248.45
INV.246.75

N71°51'00"E

21.8.0m 200mmø SAN @ 4.0%

250mmø CB LEAD @ 2.0%(TYP.)

4.0m 375mmø STM @ 1.0%

V&B

LOT FRONTAGE LINE

PROPERTY LINE / SITE BOUNDARY

90.08

SANMH#3A
T/G 248.33
N INV.244.82
S INV.244.95

H&V
(BSD-507)

JF

INV.245.76

11.0m 375mmø STM @ 5.0%

PROPOSED JELLYFISH TREATMENT UNIT
T/G 248.50
W INV.246.31
E INV.246.16

10.0m 300mmø OUTLET @ 7.0%

CONTRACTOR TO CONFIRM ELEVATIONS OF EXISTING TRAMISSION WATERMAIN AT CROSSING PRIOR TO CONSTRUCTION.

STMMH#2
T/G 248.00
N INV.244.64
W INV.244.80
C/W 100mmø OUTLET ORIFICE CONTROL

PROPOSED STORMTECH UNDERGROUND STORAGE SYSTEM VOLUME PROVIDED 80m³± BOTTOM 245.50±

PROPOSED FILTER AREA=31m² BOTTOM 247.70

DCBMH#1
T/G 248.25
INV.246.35
S INV.246.50
W INV.246.66

UNIT 16 & 17

UNIT 18 & 19

FF 250.50
BFF 247.50

FF 249.10
BFF 246.10

UNIT 1

UNIT 2

FF 249.50
BFF 246.50

UNIT 3

UNIT 4

FF 249.75
BFF 246.75

UNIT 5

UNIT 6

FF 249.90
BFF 246.90

UNIT 7

UNIT 8

FF 250.00
BFF 247.00

UNIT 9

EXISTING RESIDENTIAL DWELLING #433

55.98

N17°14'55"W

13.81

CBMH#3
T/G 249.02
N INV.247.10
S INV.247.22

58.0m 200mmø SAN @ 1.60%

30.0m 300mmø STM @ 2.0%

150mmø PVC WATERMAIN

28.0m 300mmø STM @ 1.0%

FENCE LINE / E.P. SETBACK / NEW PROPOSED LINE

EX. EDGE OF TREELINE

EX. TOP OF BANK

80.36

WETLAND LIMIT AS STAKED

N17°53'20"W

N17°50'50"W

EX. SHED

EX.CONC. PAD

SANMH 1A
T/G 249.79
E INV.246.55

SANMH#2A
T/G 249.18
N INV.245.88
W INV.246.03

N71°52'20"E

27.47

PROVIDE MIN. 0.5m SEPARATION AT CROSSING (TYP.)

26.0m 200mmø SAN @ 2.0%

STMMH#1
T/G 249.15
N INV.247.50
S INV.247.55

CB#2
T/G 249.00
INV.247.65

150mmø PVC WATERMAIN

EX. CHAINLINK FENCE

H&V
(BSD-507)

28.59

N18°12'10"W

FF 250.50
BFF 247.50

FF 250.20
BFF 247.20

FF 249.90
BFF 246.90

UNIT 15

UNIT 14

UNIT 13

UNIT 12

UNIT 11

UNIT 10

PROPOSED FILTER AREA=28m² BOTTOM 246.85

N10°47'15"E

LOT 12, CONCESSION 12
PART 1
PLAN 51R-4897

N71°32'30"E 78.68

45.81

4.78

12.87

15.22

HORIZONTAL CONTROL MONUMENTS
U.T.M. (ZONE 17) NAD 83

MONUMENT # 03120040064
THE HORIZONTAL MONUMENT IS LOCATED ON THE SOUTH SIDE OF BIG BAY POINT ROAD ON BRIDGE OVER LOVER'S CREEK AT SOUTH-EAST CORNER OF BRIDGE IN WALKWAY OPPOSITE THE VERTICAL CONTROL MONUMENT #03120030007.
N = 4912309.381 E = 607444.743

MONUMENT # 03120040065
THE HORIZONTAL MONUMENT (03120040065) IS LOCATED IN THE BRIDGE WALKWAY ON THE WEST SIDE OF YONGE STREET, APPROXIMATELY 100M SOUTH OF THE INTERSECTION AT D'AMBROSIO DRIVE. IT IS LOCATED ON THE NORTH END OF THE BRIDGE WHICH CROSSES OVER LOVER'S CREEK..
N = 4913385.898 E = 607173.330

VERTICAL CONTROL MONUMENTS

BENCHMARK:

MONUMENT # 03120030007
ELEVATION: 244.787
BRIDGE ON BIG BAY POINT RD 0.3 KM WEST OF YONGE ST OVER LOVERS CREEK
THE VERTICAL CONTROL MONUMENT IS SET FLUSH IN THE NORTH FACE OF THE CONCRETE ABUTMENT, AT THE SOUTHEAST CORNER OF BRIDGE. THE TABLET IS LOCATED 1.8m WEST OF THE EAST END OF THE BRIDGE AND 50 cm BELOW THE TOP OF THE BRIDGE.

MONUMENT # 03120030305
ELEVATION: 250.827
CULVERT HEADWALL TO DETENTION POND EAST OF EDWARDS DR & NORTH OF BIG BAY POINT RD. THE VERTICAL CONTROL MONUMENT IS SET FLUSH IN THE EAST FACE OF THE CONCRETE CULVERT HEADWALL. THE TABLET IS 140MM BELOW THE TOP OF THE CULVERT HEADWALL AND 160MM SOUTH OF THE NORTH-EAST INSIDE CORNER OF THE HEADWALL.

PART 1
PLAN 51R-11696

(P1 & SET)

55.97

OT 1

OT 18

NOTE:
ANY WORKS REQUIRED WITHIN THE MUNICIPAL RIGHT OF WAY WILL REQUIRE A RIGHT OF WAY ACTIVITY PERMIT FROM THE CITY OF BARRIE'S OPERATIONS DEPARTMENT AT 165 FERNDALE DRIVE NORTH (CONTACT JOE HAMILTON EX. 4808)

CONTRACTOR TO CONFIRM INVERT ELEVATIONS PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES

NOTE:
NOT FOR CONSTRUCTION

LEGEND

- PROPOSED ASPHALT
- PROPOSED CATCHBASIN
- PROPOSED DOUBLE CATCHBASIN
- PROPOSED STORM MANHOLE
- PROPOSED CATCHBASIN MANHOLE
- PROPOSED SANITARY MANHOLE
- PROPOSED HYDRANT AND VALVE
- PROPOSED VALVE AND BOX
- PROPOSED TEE
- EX. HP
- EX. CATCHBASIN
- EX. HYDRANT
- EX. VALVE AND BOX
- EX. SANITARY MANHOLE
- EX. STORM MANHOLE
- OVERHEAD HYDRO WIRE
- TRANSFORMER LOCATION

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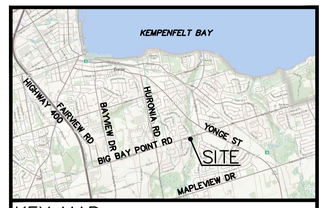
The position of existing above ground and underground utilities and facilities are not necessarily shown on the drawings, and where shown, the accuracy of the position of such utilities and facilities is not guaranteed. Before starting work, the contractor shall confirm the exact location of all existing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



KEY MAP

NOTES

1. TOPOGRAPHIC SURVEY COMPLETED BY DINO ASTRI SURVEYING LTD. O.L.S., DECEMBER 2016.
2. SITE PLAN PROVIDED BY IAN S. MALCOLM ARCHITECTS AUGUST 14, 2017.
3. REFER TO GEOTECHNICAL REPORT PREPARED BY PETO MACCALLUM LTD. FOR BOREHOLE INFORMATION.

BENCHMARK

TBM#1
TOP SIB AT THE NORTH WEST CORNER OF PARCEL HAVING AN ELEVATION OF 250.50

NO.	YY.MM.DD	REVISION	BY
1	19.02.05	SITE PLAN REVISION	A.L.

SEAL

NORTH ARROW

DESIGN BY:	J.V.
DRAWN BY:	J.L.
CHECKED	J.V.
DATE:	FEB. 2019
SCALE:	1:200

CLIENT/PROJECT

#435 BIG BAY POINT ROAD TOWNHOME DEVELOPMENT ADA HOMES

DRAWING TITLE

CONCEPTUAL SERVICING PLAN

PROJECT NO.	DRAWING NO.	REVISION
17-11291B	SERV-1	1

BIG BAY POINT ROAD

BACK OF CURB
EDGE OF PAVEMENT

EX.SANMH
SAP13075
T/G 250.310

EX.STMMH 46
T/G 250.30

SANMH#4A
T/G 247.50

EX.SANMH
SAP13076
T/G 245.970

EX.STMMH 47
T/G 245.918

PART 3
PLAN
(P1 & SET)

PART 4
51R-25220

PLAN 51R-11696

LOT 1

LOT 18

HORIZONTAL CONTROL MONUMENTS
U.T.M. (ZONE 17) NAD 83

MONUMENT # 03120040064
THE HORIZONTAL MONUMENT IS LOCATED ON THE SOUTH SIDE OF BIG BAY POINT ROAD ON BRIDGE OVER LOVER'S CREEK AT SOUTH-EAST CORNER OF BRIDGE IN WALKWAY OPPOSITE THE VERTICAL CONTROL MONUMENT #03120030007.
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N = 4913385.898 E = 607173.330

VERTICAL CONTROL MONUMENTS

BENCHMARK:

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BRIDGE ON BIG BAY POINT RD 0.3 KM WEST OF YONGE ST OVER LOVERS CREEK.
THE VERTICAL CONTROL MONUMENT IS SET FLUSH IN THE NORTH FACE OF THE CONCRETE ABUTMENT, AT THE SOUTHEAST CORNER OF BRIDGE. THE TABLET IS LOCATED 1.8m WEST OF THE EAST END OF THE BRIDGE AND 50 cm BELOW TOP OF THE BRIDGE.

MONUMENT # 03120030305
ELEVATION: 250.827
CULVERT HEADWALL TO DETENTION POND EAST OF EDWARDS DR & NORTH OF BIG BAY POINT RD. THE VERTICAL CONTROL MONUMENT IS SET FLUSH IN THE EAST FACE OF THE CONCRETE CULVERT HEADWALL. THE TABLET IS 140MM BELOW THE TOP OF THE CULVERT HEADWALL AND 160MM SOUTH OF THE NORTH-EAST INSIDE CORNER OF THE HEADWALL.

EX. CONC. SIDEWALK
EX. CSV
EX. BPED
EX. CONC. SIDEWALK
HP #4701
EXISTING GUARD RAIL
EX. TOP OF BANK
PROPERTY LINE / SITE BOUNDARY
LOT FRONTAGE LINE

ENHANCED GRASS SWALE C/W PERFORATED SUBDRAIN BENEATH
CONNECT SUBDRAIN INTO PROP.CB
CB#1 T/G 248.45
ENTRY SIGN
V&B 248.55T/C 248.40 248.30
248.45T/C
SANMH#3A T/G 248.33
JELLYFISH UNIT
DCBMH#1 T/G 248.25
STMH#2 T/G 248.00
H&V
EXISTING RESIDENTIAL DWELLING #433
EX. SHED
EX.CONC. PAD
EX. CHAINLINK FENCE

PROPOSED STORMTECH UNDERGROUND STORAGE SYSTEM VOLUME PROVIDED 80m³± BOTTOM 245.50±

PROPOSED FILTER AREA=31m² BOTTOM 247.70

PROPOSED REDI-ROCK (OR EQUIVALENT) RETAINING WALL C/W PEDESTRIAN GUARD MAX HEIGHT 1.9m T/W 249.50

PROPOSED FILTER AREA=28m² BOTTOM 246.85

FENCE LINE / E.P. SETBACK / NEW PROPOSED LINE
EX. EDGE OF TREELINE
EX. TOP OF BANK
WETLAND LIMIT AS STAKED

UNIT 1 FF 248.10 BFF 245.10
UNIT 2 FF 249.50 BFF 246.50
UNIT 3
UNIT 4 FF 249.75 BFF 246.75
UNIT 5
UNIT 6 FF 249.90 BFF 246.90
UNIT 7
UNIT 8 FF 250.00 BFF 247.00
UNIT 9
UNIT 10 FF 249.90 BFF 246.90
UNIT 11 FF 250.20 BFF 247.20
UNIT 12
UNIT 13
UNIT 14
UNIT 15 FF 250.50 BFF 247.50
UNIT 16 & 17 FF 250.50 BFF 247.50
UNIT 18 & 19

STMMH#1 T/G 249.15
CBMH#3 T/G 249.02
SANMH 1A T/G 249.79
SANMH#2A T/G 249.18
CB#2 T/G 249.00

MATERIAL	LIGHT DUTY - PARKING	HEAVY DUTY - SITE ACCESS/ FIRE ROUTE
ASPHALT (mm)	70	110
GRANULAR A BASE	150	150
GRANULAR B SUBBASE	300	300
TOTAL THICKNESS	520	560

NOTE:
NOT FOR CONSTRUCTION

LEGEND

- 220.00 — PROPOSED ELEVATION
- (220.00) — PROPOSED SWALE ELEVATION
- 220.00T/C — PROPOSED TOP OF CURB
- 220.00EX. — EXISTING ELEVATION
- DIRECTION OF OVERLAND FLOW
- 3.0% — PROPOSED GRADE
- S — S — SILT FENCE
- DITCH CENTERLINE
- PROPOSED ASPHALT
- PROPOSED CATCHBASIN MANHOLE
- PROPOSED DOUBLE CATCHBASIN
- PROPOSED CATCHBASIN
- PROPOSED STORM MANHOLE
- PROPOSED SANITARY MANHOLE
- PROPOSED HYDRANT AND VALVE
- EX. HP/LS
- EX. CATCHBASIN
- EX. VALVE AND BOX
- EX. SANITARY MANHOLE
- EX. STORM MANHOLE
- 246.00 — CONTOUR
- HW — HW — OVERHEAD HYDRO WIRE
- TRANSFORMER LOCATION

PEL
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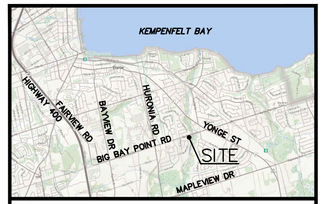

KEY MAP

NOTES

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NO.	YY.MM.DD	REVISION	BY
1	19.02.05	SITE PLAN REVISION	A.L.

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NORTH ARROW

DESIGN BY:	J.V.
DRAWN BY:	L.B.
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SCALE:	1:200

CLIENT/PROJECT

#435 BIG BAY POINT ROAD TOWNHOME DEVELOPMENT ADA HOMES

DRAWING TITLE

CONCEPTUAL GRADING PLAN

PROJECT NO.	DRAWING NO.	REVISION
17-11291B	GP-1	1